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APPLICATION OF ARTIFICIAL INTELLIGENCE TECHNOLOGIES FOR CITIZEN SERVICES IN E-GOVERNMENT

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INTRODUCTION

Relevance of the topic and the distinctness

The main goal of establishing e-government, which is one of the basic elements of the information society, is to raise the level of services provided by government agencies to citizens. Hence, it is possible to simplify access to government information sources and ensure effective participation of all segments of society in public administration through e-government. Understanding this environment is crucial for making informed decisions and guaranteeing the efficient use of e-government applications.

The relationship between the government and citizens is the primary goal of the complex social and technological environment known as e-government. There are problems in various sectors of the e-government environment. However, the main issues covered by this thesis are how to adopt artificial intelligence in e-government applications. The use of artificial intelligence (AI) in e-applications helps to reach applications without resorting to traditional methods. It can help government agencies improve the quality of services and increase citizen satisfaction. To increase the availability and effectiveness of e-government services, there is a need to conduct regular user-oriented evaluations.

The research showed that traditional applications of service delivery systems are not good enough to accurately predict how to deal with the use of e-government applications when compared with the use of AI . The fact that classical applications in e-government often do not consider the significant differences in how services are provided to citizens and recipients of electronic services, such as the system, explains the difference between classical applications and processing requests in complex service systems. On the other hand, there are differences in the quality of service requirements for different types of requests. The different aspects are not taken into account in the classic applications that are used in e-government. An analysis of the available literature shows that there are currently no applications, methodologies, and methods that are effective enough to solve the problems of adopting AI to a sufficient

extent and the mechanism for applying it and linking it with e-government applications in Jordan.

Furthermore, there are still obstacles to integrating traditional applications with AI. This thesis develops and studies a way to combine AI with e-government applications that use the classic system. Iris recognition was chosen as an example of AI, and the study also looks at how important the iris is for e-government applications in Jordan. This is important because it shows how important it is to recognize people. Token-based identification uses something you have, like a passport, ID card, driver's license, credit card, or keys. Examples of knowledge-based identification use something you can realize. Lost, stolen, forgotten, or misplaced tokens, and guessing or forgetting passwords or PINs, have drawbacks. Biometrics verify a person's identity more securely than traditional methods. The iris is the most reliable and trustworthy biometric available. This research access to the e-government applications without going back to entering the national number or name, just entering the user's iris aims to focus on how the Ministry of Interior Jordan Visas and Residency System Applications uses iris biometrics to authenticate users accessing e-government systems through the iris recognition.

Overall, studying the use of AI technologies for citizen services in e-government is important because it investigates the possible advantages, difficulties, and dangers that come with implementing AI in the government sector. By comprehending these characteristics, governments can make well-informed judgments and build strategies to efficiently utilize AI for enhanced citizen services and involvement.

Goals and objectives of the dissertation

E-government has revolutionized communication and public services, allowing governments to provide services electronically and save time, effort, and cost. This thesis aims to understand the demands for e-government services in Jordan, focusing on the MOI and Jordan Visas and Residency System. Numerous government organizations are adopting AI and deep learning (DL), and the Jordanian government intends to start new AI initiatives by the end of 2024.

E-government uses technology to improve citizen services, and traditional methods of identifying citizens are inefficient. Iris biometrics, such as iris scans, facial scans, fingerprints, signatures, and voiceprints, are used to authenticate users and simplify e-government system management.

The thesis introduces several DL models to computerize e-government services, highlighting the importance of iris recognition and AI-based public service delivery in user satisfaction.

The thesis focuses on three main objectives and aims to develop and study how e-government can adopt an iris recognition system for citizen service recipients as part of AI applications. The following problems are solved, keeping in mind the thesis's objective:

1.The development and analysis of the method of automating and simplifying the management of the e-government system through the use of artificial intelligence.

2. Developing deep learning models to computerize e-government services and adopting iris recognition in e-government services in Jordan to facilitate access to e-government applications without referring to traditional methods.

3. Obtaining new frameworks and new methods for adopting e-government and proposing the use of artificial intelligence in e-government applications as a new model for electronic applications in e-government to provide better services to citizens.

Object and subject of the thesis

The application of artificial intelligence technology to enhance and improve citizen services in the context of e-government is the research topic being studied. By employing artificial intelligence methods and developing a new model capable of supporting electronic governance applications, as well as by employing deep learning to build a neural network model. Additionally, in this thesis, we explore the difficulties that arise as a result of the impact of AI on citizens' use of e-government, as well as how AI can be successfully applied to e-government in Jordan. The purpose of this thesis is to examine the use of iris biometrics in the context of artificial intelligence applications. These applications are the most reliable methods.

Thesis methods

In this thesis, convolutional neural networks (CNN). Were used to build the proposed iris recognition model. In the study, we describe how the iris works and how it contributes to the AI system in citizen services, where smart actions and access to applications and services replace old, inefficient services. To speed up delivery and improve accuracy, e-government services have increasingly relied on artificial intelligence as a key component of their infrastructure. Research efforts in image segmentation and recognition are an attractive and challenging field. Attractive because of the many applications that an image recognition and segmentation system can perform. The reason the area remains challenging is related to the need to develop higher resolution recognition and better segmentation. Our work proposed a new model that can be integrated for use in whole iris segmentation and recognition technology. A CNN is a type of artificial intelligence designed to process or learn from large data sets. Convolutional neural network is a newly coined term that specifically describes this type of network, or AI technology in general.

CNN are powerful AI-powered image recognition tools that use deep learning to perform not only generative tasks but also descriptive tasks. Examples of generative tasks include automatic cropping, writing captions, shooting videos, memos, and image overlays. CNN contains so-called convolutional layers. Each neuron in these layers processes information from only a small part of the visual field. The inputs of each neuron are arranged in a checksum-like manner to create a feature map. In this thesis, we followed four steps to build a model supported by AI and deep learning.

1. We collected data from the Multimedia University (MMU) database, which is a public collection including iris pictures.
2. Pre-processing images: This includes removing noise from images, standardizing image size, normalizing image pixels, and converting images from RGB to grayscale.
3. Image Segmentation: I have determined the iris of the eye and know the iris coordinates for each eye.

4. Feature Extraction and Recognition: I extracted the feature of the iris and also reduced the dimensions of the feature via CNN and inserted it into a fully connected layer to train.

The main provisions of the defense

The provisions that this thesis defends are as follows:

1. E-government applications without using technologies such as artificial intelligence and the role of artificial intelligence in developing e-government applications to provide citizens' applications with high quality.

2. Methodology for adopting e-government applications for artificial intelligence, the most important challenges of adopting artificial intelligence in Jordan, and how to prove artificial intelligence.

3. Convolutional neural network and its role in developing smart applications. In this study, neural networks were studied and their impact on the development of e-government applications such as the iris recognition system was determined.

4. Algorithms that can be relied upon to solve problems in electronic applications and improve the characteristics of smart systems that rely on artificial intelligence were discussed and developed so that citizens can use them better and improve the quality of service.

The scientific novelty of the thesis

In this thesis, the following main results are introduced:

1. Enhancing the efficiency of e-government programs by implementing iris recognition will eliminate the limitations of the current system for accessing e-government applications and contribute to the understanding of how AI can be effectively utilized to improve the delivery of e-government services to citizens. The study aims to explore the potential applications, challenges, impacts, and implications of AI technologies in the context of e-government and citizen services.
2. The AI model investigates the use of various AI technologies, such as machine learning (ML), rule-based systems, CNN, and iris recognition, in the e-government domain. It explores how these technologies can enhance citizen services by

automating cognitive tasks, improving services to access the applications, and providing predictive capabilities. Additionally, the research examines the organizational factors and adoption challenges associated with implementing AI in e-government.

3. New models in Jordan show the impact of deep learning and CNN in developing e-government applications and their ease of use for citizens, as well as benefiting from iris segmentation to determine the extent to which e-government applications are increased in accuracy and ease of use for citizens.
4. This research is one of the few studies that study the adoption of AI and its use with e-government applications and its impact on citizens in Jordan and is therefore considered a valuable addition to the literature related to the impact of the use of AI on developing countries.
5. The study resulted in the development and creation of a proposed framework for the use of AI in e-government The research adopted the creation of a comprehensive theoretical framework, such as an iris recognition system, to determine the efficiency of AI model for adoption in e-government applications.

Theoretical and practical significance of the thesis

The theoretical significance of the work lies in proposing models using AI to automate and implement AI in e-government and knowing the extent of the impact of AI on e-government applications. The thesis advances the theoretical comprehension of applying AI technologies in e-government to improve citizen services. It explores the potential benefits, challenges, and implications of using AI in government, and this thesis aims to develop a conceptual framework that can guide the application of AI technologies in e-government. This framework can provide a theoretical basis for future studies and practical implementations in the field.

The application of AI technologies in e-government can lead to improved citizen services by automating routine tasks, enhancing efficiency, and providing personalized experiences. AI can assist in areas such as citizen engagement, service delivery, data analysis, and decision-making AI-powered citizen services can be available 24/7,

providing citizens with convenient access to information, services, and support. This can enhance the overall user experience and satisfaction with government services.

This study focused on recognizing people through the iris, and an AI-powered framework, model, and method were created. The methodological basis of the thesis is AI using deep learning and the use of CNN. The method was used to integrate this methodology into e-government services to improve citizens' access to services and identify the importance of iris recognition for e-government applications as part of AI. We use a modified linear activation function, max pooling, and flattened matrix to build deep learning models.

The application of AI technologies in e-government opens the way for opportunities for innovation and the development of new services and solutions.

Approbation and application of the thesis

The main scientific-theoretical and practical results were presented and discussed at the following conferences:

1. “Artificial Intelligence and Expert System Role in Knowledge Management in Government Institutions." International Ankara conference on scientific research (October 2021-Turkey);
2. “Artificial intelligence using a neural network system to support human resources in the workplace” Baku Eurasian University (October 2021-Azerbaijan);
3. "Artificial intelligence techniques in improving the Quality of services provided by e-government to citizens"—1st International Conference on Contemporary Academic Research (May 2023, Turkey);
4. “E-government applications on innovation and development utilizing” 1st International Conference on Modern and Advanced Research ICMAR – June-2023, Turkey);
5. "Using Artificial Intelligence Applications For E-Government Services As Iris Recognition"—IEEE, 17th International Conference on Application of Information and Communication Technologies (AICT), (Baku, Azerbaijan-October -2023).

Name of the organization where the dissertation work is carried out

Graduate School of Science, Art and Technology of Khazar University.

The dissertation's structure and total volume

The dissertation consists of 192 pages of text, 53 figures, 3 tables, 3 equations, and a list of 127 references. The title page of the dissertation consists of 369, a table of contents – 1.282, an introduction – 13.201 the first chapter – 133.350, the second chapter – 51.123, the third chapter – 41.463, conclusion – 6.295 characters and a list of abbreviations 43 titles. The total volume of the dissertation is 270.949 characters with Figure and table and code.

CHAPTER I. LITERATURE REVIEW

1.1. Chapter overview

The thesis of the literature review introduces the main specific features of service systems with AI. Despite the advanced state of thesis on AI in various theoretical forms, there are still a few topics related to AI in the context of e-government. Chapter One contains literature reviews. This chapter focuses on AI, and the role of AI in e-government was discussed theoretically, as well as the implementation of e-government using AI, the advantages and interests of using AI in e-government, and the role of CNN and DL in developing AI applications. We also discussed the development of AI applications. The discussion also covered the future of e-government utilizing AI. Obstacles to the application of AI in government. more so, the impact of AI in the public sector and the use of biometric systems in e-government systems and e-government services in Jordan, such as iris recognition. This chapter extensively discusses the use of their recognition as a proposed AI model for e-government applications. The importance of the iris in developing e-services and its valuable features for adoption as an AI model has been well established, as this thesis focuses on several theoretical aspects. These aspects are discussed in sub-chapters. Some of the results were explained in scientific papers.

1.2. Overview of artificial intelligence

AI and automation have been at the centre of recent discussions about technological progress. Machines with AI are capable of mimicking human cognition and behaviour An intelligent machine can learn and find solutions on its own.

AI should be able to rationalize and take actions that will best achieve a goal. Machine learning (ML), is a branch of AI that allows computers to teach themselves new skills and adapt to their environment [6 , p. 65–82].DL absorbs massive amounts of unstructured data like text, images, and video to enable automatic learning. We only recently realized that AI's potential impact on societies and democracies worldwide is undefined.

Most academics, however, agree that it entails the faculties of will, learning, intelligent planning, communication, and decision-making [7, p. 9–20], [8, p. 1–10]. AI attempts to simulate human intellect by performing cognitive tasks such as problem-solving and reasoning. Currently, two types of AI are in use "weak AI" (AI that focuses on one particular task, supporting humans) and "strong AI" (AI that matches or exceeds human intelligence) [9, p. 344-351], [10, p. 2230–2882].

It's also an umbrella term for machine-learning techniques that mimic human cognition. Today, scholars study ML, which allows for an evolving system that gets better with time. To extract features and patterns, DL in ML mines enormous datasets [11,p. 1-16], [12, p. 1–7]. It can interpret speech, detect malignant moles, and operate motor vehicles. ML and DL are the AI subfields most relevant to this study. Because of their sophistication, these technologies have the potential to have the greatest impact on our societies [13, p. 1–16]. Since the 1950s, AI has existed, but large data sets and the internet have made it possible to use it. Faster computers, more data from social media, and Google may have helped AI rise. AI can now solve problems, plan, learn, speak, develop vision, and process actions [14, p. 1–16],[13, p. 3–10].

AI collects data from Facebook, Google, and other apps to gain knowledge. These platforms' companies use their data to tailor advertisements and recommendations to their preferences [15, p. 65–74],[16, p. 130–157]. AI usage in detecting diseases, translating languages, and assisting self-driving cars has increased due to faster computers and the availability of more data. AI requires "big data." Algorithms, which computers follow to process data, calculate, and perform other mathematical operations, are essential to AI. Most people associate AI with robots. Big-budget movies and novels feature human-like machines that wreck the Earth. False.

The fundamental premise of AI is that a computer can learn to think and reason like a human being. AI attempts to simulate human intelligence. Researcher s and developers have made unexpected strides in simulating learning, thinking, and perception to the extent that these abilities can be described. There seems to be no end to the potential applications of AI. The technique has several potential applications in

both government and industry. The government is putting AI through its paces. AI devices include self-driving automobiles and chess-playing computers. These machines must consider the potential outcomes of their actions.

1.3. Artificial intelligence in E-government

According to the researcher Alqudah [11, p. 1–10], AI is programming or training a computer to do human-like tasks like recommending movies or answering technical questions. AI will soon influence government interactions. In both the United States and Japan, AI is helping local governments enhance services for their citizens. Reducing administrative hassles, assisting with resource allocation challenges, and handling complex jobs are some of the most obvious and instantly helpful use cases of AI in government. Common use cases for AI in citizen service include answering inquiries, document completion and searching, request routing and translation, and document creation.

As a result of using these applications, government workers may have more time to engage with the public. AI has the potential to enhance public participation, service delivery, and e-government satisfaction. AI has the potential to improve service delivery, privacy, and ethics, but if done improperly, it might have the opposite effect.

Organizations interested in using AI may learn from both government modernization efforts and private industry AI adoption. Implement these six AI strategies in government organizations to make AI a part of a goal-based, citizen-centric program; to solicit feedback; to capitalize on existing assets; to be data-ready and cautious with privacy; to limit ethical concerns and prevent AI decision-making; and to augment, rather than replace, existing personnel. This thesis examines how AI can be applied in government-citizen services in response to queries and demands from real people. It advises policymakers on the optimal use of AI.

According to Alqudah [17, p. 57–72]. Contemporary public services Citizens employ modern 21st-century technology to renew driver's licenses and access health and human services, while their government relies on outdated 20th-century systems. When it comes to acquiring products and services and engaging with the government,

citizens often encounter subpar experiences. People respond less favourably to public services than to private ones. The general populace demands a government that has undergone complete digitization. Even though 92% of citizens claimed "better digital services would positively impact their perception of the state. only 27% of citizens reported being satisfied with state digital offerings, per Accenture. The private sector is stepping in to fill the voids left by government organizations' technology preparation for the future. Government organizations can incorporate AI into their plans for modernizing outdated systems. While AI has been around for decades, it has only lately begun to permeate our everyday lives in both real and virtual ways. Accenture projects that by 2035 artificial intelligence will have doubled economic growth in the big data era. AI is the process of teaching machines to think and act like humans.

This requires sensory input processing, inference and prediction, language and social skills, and the capacity to interact with humans and machines and to grow and develop over time. Big data and analytics can automate some processes, but AI cannot. Al's strength comes from ML, a technique whereby a computer learns to enhance its responses through supervised training and inputs.

ML has the potential to improve translation, facial recognition, and internet advertising. When there is a large amount of data but not enough personnel to handle it or expertise to evaluate it, ML may be effective in Government. Automating repetitive tasks that get easier with time is another good example. Table (1.3.1) explains Government Issues Well Suited to AI Applications, demonstrating how AI may ease administrative burdens, address resource allocation problems, and manage difficult activities.

Table 1.3.1.Government issue using AI applications

Types of government problems suitable for the uses of artificial intelligence	
Resource allocation	Inadequate administrative assistance slows down response times to inquiries, which slows down work completion.
Large dataset	Employees will not be able to effectively work with such a vast dataset. Combining internal and external datasets can improve results and understanding. There is a lot of history and organization in the data.
Expert storage	The time spent on answering simple inquiries may be put to better use. Knowledge of specialized topics can aid researcher s.
Predictable Scenario	The situation may be predicted using past data, which will aid in making timely decisions.
Procedural	The nature of the task is repetitious. The answers to inputs and outputs are binary.
Diverse Data	Information can be both aural and visual in nature. Qualitative and quantitative data should be summarized periodically.

According to the researcher Abduljabbar [19, p. 1–15], savings could be realized through the use of AI in citizen services. Deloitte predicts that the federal government could save between $3.3 billion and $41.1 billion annually by automating processes that take between 96.7 million and 1.2 billion hours of employee time. The use of AI in e-government is not novel. Its primary applications have been defence, intelligence, and time-saving. Machine vision automatically sorted mail containing handwriting on envelopes in the late 1990s.

The US Postal Service now saves hundreds of millions of dollars annually thanks to this once-revolutionary way of sorting more than 25 billion letters. 9 The

administration commissioned two in-depth investigations on AI and held a Senate hearing on its potential uses, economic effects, and competitiveness. AI is the answer to all of our issues.

The use of AI enhances the provision of services to citizens [6, p. 65–82]. Government bodies around the world are testing AI. Citizen service inquiries and information requests were the primary use cases. Examples include situations where individuals must endure lengthy waits on hold, physically visit a location, or rely on online resources and external entities to find solutions to their problems. Individuals can use AI to perform routine tasks like filling out forms and receiving immediate responses. Examples of AI applications in citizenship include responding to inquiries, completing and searching papers, directing requests, interpreting, and creating drafts.

The government's usage of AI lags behind that of the business sector, yet the two have parallel applications. In many of these cases, learning AI is effective. The most revolutionary uses of AI will be in the realm of learning and improvement, rather than in the replacement of existing applications in customer service or the automation of routine computer activities. Instead of just replacing humans with machines, AI will be most useful if it can ease administrative costs and improve the human experience. Carefully using AI can enhance public service delivery while simultaneously decreasing costs and increasing citizen happiness and participation [21, p. 665-686]. Below are the listed use cases of AI in citizen inquiries and information initiatives. These use cases are pilots and early AI applications, but they show how AI is reshaping this type of work.

The Researcher Krafft according [22, p.72-78],exemplified Alan Turing's first using government AI to decrypt the Enigma system and intercept communications during World War II. When Barth considered how AI is changing Government, he uncovered problems with discretion, responsiveness, judgment, and responsibility on the part of administrators. When it comes to the United States military's use of AI, Sloane argued that the novelty of having users—rather than the Navy's thesis and development bureaucracy—and the technology itself were either incorrect or perceived

to be inappropriate by operational professionals. Unstructured big data has applications in public health, economics, and economic forecasting.

This area is of great interest to me. He wrote about automating application management. Business success depends on efficient application portfolio management, according to [23, p. 2320–2882]. Despite its importance, efficient application portfolio management is not considered trendy in the IT industry. This application portfolio is associated with high costs, human error, manual processes, and inefficient resource allocation in IT.

Automating it is ideal. Further, automated application management, supported by AI and machine learning, can save an organization more than 40% in 3–5 years by reducing IT labour costs and improving efficiency and productivity. demonstrates how automation is changing IT services. Additionally, provides a comprehensive analysis of AI automation. Their article shows how AI automation will change work. To benefit from AI automation, people and organizations must adapt as machines replace human labour in the workplace, according to [24, P. 1-10].

They also claim that automation and AI are transforming businesses and will boost the economy. These two technologies will do this by increasing productivity.

According to Manyika and Sneader (2018) [12, P. 1–7]. AI automation will help solve societal issues like health and climate change. These scholars also believe AI automation will change work and the workplace. AI automation will allow machines to perform many human tasks. With AI in organization, machines will likely outperform humans for a long time.

The authors listed ten ways AI automation will change work. First, AI automation in the workplace will create new opportunities for businesses, the economy, and society. They believe AI automation technologies are adding value to various products and services. For this reason, several firms in various sectors are already using them to personalize product recommendations, find production anomalies, and identify fraudulent transactions. AI automation will also reduce some occupations and jobs. Automation also creates new jobs. Automation will alter some jobs. Machines will replace more jobs, according to studies.

According to Manyika and Sneader (2018) [12, p. 1–7] provide seven ways to reduce the dangers posed by AI in the workplace. Maintain healthy rates of economic expansion and productivity gains, encourage innovative corporate practices, adapt teaching and learning to an ever-evolving workplace, and invest in human capital. Enhancing labour-market dynamism, redesigning work, rethinking incomes, investing in job-demand drivers, and safely adopting AI and automation are other steps. (van Assen, Banerjee, and De Cecco [13, p. 3–10]) are also very interested in AI automation. He wrote about AI automation in 2020. AI is the business community's motto. He claims that AI automation reduces human effort and eliminates the need for intervention in various tasks. AI in automation aids many tasks. Drones and self-driving cars He lists five ways AI automation can benefit businesses. AI automation helps businesses prevent fraud. AI automation can link thefts to faces. AI automation could attach a camera to the POS system to record all transactions and link them to the image and system details. This technology identifies counterfeiters and credit card fraudsters.

Thomas Davenport and Kokina discuss this. They discuss automation and AI. [20, pp.94] AI automation can revolutionize customer service. They say chatbots are vital to customer service. Siri started it. Chatbots have become crucial for brands, especially online ones, in recent years. Chatbots accept user input and answer questions. They automate sales, marketing, and customer service. As with apps, the download process for bots on popular platforms like Facebook Messenger creates friction. These bots are game-changers because they often feel human. Thus, they can cut reception and other customer service costs[26, p. 1–14]. believes AI automation will aid software testing and development. He believes software testing automation is growing.

With the abundance of software and application testing options, automation of software testing is becoming increasingly feasible. ReTest, SauceLabs, and Applitools are popular intelligent software testing tools. These tools allow software developers to focus on the main code and let intelligent systems fix bugs. Although software development automation has not been achieved, there are tools available to assist software developers with menial tasks. Amazon Glue illustrates these tools. Amazon

Glue manages the tedious task of typing scripts. [27, p. 49-59] also wrote about how AI automation can help HR management.

According to Abduljabbar et al. (2019) [19, p. 1-15], recruiters frequently struggle to sort through a large number of applications in order to best candidate. They struggle with managing old data too. AI automation can alter this. According to Abduljabbar et al. (2019), recruiters' work can be automated at scale. Most resumes sent to HR and recruitment managers now go through an e-tracking system. After users apply for jobs, such solutions upload their work application constituents to their database. HR and recruiting professionals receive information in packets, which they can organize and manage. This simplifies application sorting[28, p. 94–98]. wrote about AI automation's effects on various fields.

They have focused on how AI automation will streamline healthcare. They also noted the benefits of AI automation in healthcare. They've also highlighted why any company should use intelligent automation. They cite lower costs. According to Davenport and Kalakos (2019) [20, p. 94],routine task training costs repeat. Employee turnover, skill development time, and vocational costs will burden the employer. Machines differ. Unlike humans, trained machines only get better. Retraining machines is completely free [29, p. 108–116].

1.4. Utilizing artificial intelligence for the development of e-government

Data utilized in governmental decision-making AI systems possess a distinct framework for representing knowledge, which encompasses facts and their interconnections, unlike statistics programs. Relationship standards of behaviour are established [30, p. 8–14]. Rules and cognitive structures form the knowledge base. AI software is often characterized by the lack of a known algorithmic solution to the problems it tackles. Therefore, it is vital to rely on diligence, which refers to the selection of solution approaches that appear suitable while ensuring a high level of accuracy. This regulation and the accompanying Knowledge Base article provide a comprehensive amount of background information on the subject at hand. Persistence

is key. If initial attempts prove unsuccessful, remember that alternative possibilities exist. Only a small number of individuals would meet the criteria of exhibiting intelligent behaviour by learning from mistakes, hence enhancing their performance through the utilization of previous errors. Only a small number of individuals possess high intelligence, and the process of acquiring knowledge from errors is contingent upon an individual's capacity to make generalizations.

Contemporary organizations, including e-government entities, have acknowledged the significance of knowledge as a distinguishing factor. These organizations have recognized the value of implementing knowledge management principles to effectively utilize their knowledge assets. This involves engaging in processes related to the generation, structuring, and dissemination of knowledge, to enhance service provision within these institutions. The utilization of the IoT in conjunction with the advancements in information and communication technologies has facilitated its application in the domain of knowledge management. This is primarily due to the IoT's ability to establish connections between tangible entities and facilitate interaction with human users. The point of this study is to better understand how IoT applications can help with information management in e-government, which will ultimately lead to better service delivery. To achieve this objective, the present study utilizes a descriptive methodology to examine and analyses scholarly works produced in various nations. The aim is to identify and extrapolate the domains about the intersection of the IoT and knowledge management practices within the context of e-government. The findings of the thesis demonstrate that the implementation of the IoT has yielded advantageous outcomes for e-government initiatives. Specifically, IoT has facilitated the tracking of both tangible and intangible assets within these institutions, enabling the identification of their whereabouts in case of misplacement or loss. Moreover, IoT has enabled the monitoring of visitor numbers, the identification of peak hours, and the determination of the most frequently utilized resources. Consequently, these institutions have achieved enhanced operational capabilities. By offering prompt and engaging services that cater to the desires and goals of the recipients. This study suggests that diverse information institutions should proactively

leverage the IOT technologies to address the evolving and renewable requirements of their beneficiaries.

According to the researcher (Efremov et al., 2020)[31, p. 2049–2053],escalation of the criminal scenario in Latin America has prompted the exploration of novel technical remedies to address the security challenges faced by both nations and individuals.

According to researcher (Zhang et al., 2021)[32, p. 1646–1650], the emergence of "e-government services" made it necessary to create government applications to provide services to people. At the same time, this endeavor is of great importance in identifying shortcomings and improving service quality. The utilization of eye tracking equipment has been progressively increasing in the domain of usability thesis. Hence, this study aims to ascertain the scope of recent advancements in the use of AI for eye tracking applications, particularly in the domain of assessing the user-friendliness of e-government apps.

According to the researcher (Yahia & Miran, 2022)[33, p. 594–601], the exponential advancement of technology has significantly influenced cognitive processes, social interactions, and commercial practices, prompting governments worldwide to modify their modes of engagement with their respective populations. The proliferation of information and communication technology has heightened individuals' need for governments that are more transparent, with less bureaucracy and streamlined procedures. Furthermore, it is imperative that the government prioritize the inclusion of individuals in the decision-making process that directly impacts their lives. These initiatives aim to streamline administrative processes, minimize bureaucracy, and combat corruption. Despite being in its early stages, this quantitative essay seeks to evaluate the progress of e-government in the Kurdistan regional administration.

According the researcher (AlRousan & Intrigila, 2020)[34, p. 217–224]. increasing utilization of tablets and cell phones has a notable influence on e-government services. These devices constituted 59 percent of the overall IP traffic in 2018. Username and password authentication remains the prevailing method for verifying user identity in the delivery of e-government services. However, a password

is a vulnerable authentication mechanism since it may be readily compromised via an unprotected network connection. Hence, an effective security solution to prevent information from being sent is becoming more and more essential.

According the researcher (Yusuf et al., 2020)[35,p.1-6]. For a project to be successful, all key stakeholders must participate effectively. Nowadays, a wide range of technologies, including biometrics, the IoT & Big-Data are being used to enable eligible individuals to participate. E-participation is progressively being used to enhance individuals' participation in political, economic, governmental, and cultural endeavors. Furthermore, biometrics has been used as a means of identification. In contrast to behavioral characteristics, the system relies on biometrics such as iris, facial, finger, and voice recognition.

An increasing number of people are becoming interested in biometrics, and personal identity verification procedures are becoming increasingly common. Academics have shown a great deal of interest in iris recognition methods, and these methods are usually a prominent topic because they are used in verification practices. The widespread adoption of iris recognition technology has led to the development and raising of the efficiency of e-applications, which has led to increased effectiveness for the end user.

1.5. Advantages and concerns of Artificial intelligence in e-government

Artificial intelligence's benefits

Governments should be the ones to start using AI initially. Numerous government agencies on different continents have started conducting preliminary AI tests. Only a select few have realized genuine AI at scale, while the others can only speculate. The leading AI service providers are heavily investing in this technology to boost revenue and reduce costs. AI can demonstrate its potential in these instances. There is great potential for AI to improve government operations, including decision-making, service delivery, and more.

So, technology can aid governments in providing better services to residents. Some of the better examples demonstrate how AI can enhance service quality,

customer satisfaction, speed, cost, and accuracy of business, despite ongoing government experimentation. Continued Duty Government services are enhanced, and new ones are developed, thanks to AI. Governments can use information about job seekers including their work experience, education level, socioeconomic status, and other pertinent characteristics to determine the best course of action for providing supplementary assistance through employment agencies. A model that optimizes traffic management reduces commute times. Health systems save time and money with the use of artificial intelligence-enhanced customer demand analytics. The primary goals of e-government are service enhancement and cost reduction. The following are some additional advantages of using e-government applications:

1. Transparency: e-government applications and media sources can aid in making government policies and initiatives more transparent by increasing the visibility of news and notifications.
2. Trust: Technology that is both open and simple to use can help rebuild public trust in government.
3. Citizen participation: e-government apps simplify citizen participation in policymaking and polling, yielding more accurate results that better serve the public interest.
4. Environmental support: e-government services reduce the need for paper applications as well as the energy required to run and operate facilities and processing units.

The Concerns Using Artificial Intelligence

Technological improvements to public systems can improve access, efficiency, and, in the current pandemic, health and safety. However, using algorithmic systems to solve institutionalized problems will worsen them.

We must first establish proper public procurement oversight to maximize new technologies' potential. As they become mainstream, AI systems pose new risks to society. Private companies taking over our digital public infrastructure could lead to unprecedented political capture under the guise of "modernizing" public services. We

need proper oversight, review, and citizen empowerment. Humans who build AI algorithms may unintentionally or intentionally introduce bias.

AI algorithms will produce biased results if their training sets or algorithms are biased. Many people expect a net increase in jobs, or at least the same number, to replace those lost due to AI technology, but some jobs will be automated. Business profit-loss statements show the economic benefits of increased efficiencies, but the social and human benefits are less clear. Since technology has made the world smaller, governments will need to agree on new laws and regulations for AI technology to ensure safe and effective global interactions. However, implementing AI in e-government applications still raises concerns.

1. Trust: If individuals trust in their government and if the services themselves are trustworthy, then they are more likely to use them (e.g., there are still a large number of citizens who prefer to handle paper applications rather than web services).
2. Lack of experts: Top-notch web services necessitate a crew of web developers, security analysts, and privacy advocates.
3. Inaccessibility: Internet access is still a major problem in many developing nations. Protection: state-of-the-art security is essential for e-government services and citizen data privacy.

1.6. Neural networks and deep learning in developing Artificial intelligence applications.

Overview of neural networks

Neural networks have facilitated the progress of AI technologies. Essentially, a neural network is a collection of algorithms that can identify patterns, acquire knowledge from input, and provide predictions or judgments. The neural network's design is derived from the cognitive processes of the human brain, whereby linked nodes collaborate to process and scrutinize input.

Neural networks excel at acquiring knowledge from intricate and disorganized material. These applications are used in several domains, including image and audio

recognition, NLP , and predictive analytics. Neural networks have been used in the advancement of autonomous vehicles since they possess the ability to scrutinize vast quantities of sensor data to make real-time judgments.

To get a deeper comprehension of the capabilities of neural networks, let us delve into the fundamental principles and methodologies associated with their design and implementation.

1. Neurons and layers: A neural network is comprised of linked nodes, known as neurons, that are arranged in layers. The input layer of a neural network takes data from external sources, whereas the output layer generates the final output of the network. Interposed therein, there may exist one or several concealed strata that execute computations and alterations on the data as it traverses the network. Every individual neuron receives one or more inputs, performs a mathematical operation on them, and generates an output that is then sent to the subsequent layer.

2. Activation functions: Activation functions are mathematical functions that are applied to the output of each neuron in a neural network. By introducing nonlinearity, the network becomes capable of representing intricate connections between inputs and outputs. Popular activation functions include the Sigmoid function, the Rectified Linear Unit (ReLU) function.

3. Backpropagation is a method used to train neural networks by modifying the weights and biases of neurons in the network. The functioning of the system involves comparing the output of the network with the anticipated output and then modifying the weights and biases in a manner that reduces the discrepancy between the two. This procedure is iterated several times, with the network progressively improving its precision over time.

4. Convolutional Neural Networks: are a specific sort of neural network that excels in the processing of images and videos. The process involves the application of many filters on the input data, with each filter extracting a distinct characteristic from the picture. These characteristics are then sent to the following levels for additional processing and analysis.

5. Recurrent Neural Networks (RNNs) are a specific sort of neural network that is specifically built to handle sequential input, such as time series data or natural language text. It operates by retaining a "memory" of past inputs, enabling it to simulate temporal relationships in the data. RNNs are very advantageous for jobs like voice recognition and language translation.

Neural networks are a potent instrument for propelling AI technology forward and unleashing new opportunities in several domains, including healthcare, finance, and transportation. To fully grasp the transformational potential of this new technology, it is essential to comprehend the fundamental principles and technologies behind its design and execution.

Recent years have seen a considerable increase in the amount of attention paid to neural networks and deep learning due to the potential applications that these technologies have in a variety of disciplines, including e-government. Artificial neural networks are utilized in deep learning, which is a subset of machine learning. Deep learning is used to process and analyze considerable volumes of data. The application of deep learning in the context of e-government has the potential to improve data management, data processing, and cybersecurity. The following is an in-depth summary of neural networks, deep learning, and the uses of these technologies in electronic government:

Neural Networks: Neural networks are computer models that take their inspiration from the structure and operation of the human brain. Their structure is composed of artificial neurons, also known as linked nodes, which are arranged in layers. Each neuron receives input and then processes the data to produce output. Weights are connected with the connections between neurons, and these weights influence the strength of the connection between the neurons. During the training phase, neural networks acquire knowledge by modifying their weights by the data that is fed into them and the output that is sought.

Deep learning is a subject of machine learning that focuses on training deep neural networks with numerous layers. Deep learning is also known as "unsupervised learning." Deep neural networks can develop hierarchical representations of data,

which enables them to extract intricate patterns and features from the data. However, even though they demand a significant quantity of data and computer resources, deep learning algorithms have demonstrated outstanding performance in a variety of fields.

E-Government using Deep Learning and Neural Networks

E-government systems generate enormous amounts of data, which deep learning can analyze and manage. This can be accomplished through the application of deep learning. It can assist in the classification of data, the clustering of data, and the prediction of data, which enables more effective decision-making processes.

Cybersecurity: The use of deep learning algorithms has the potential to improve cybersecurity in applications used by the government. The detection of anomalies, the detection of intrusions, and the identification of patterns of cyber-attacks are all possible applications for them. The application of deep learning models allows for the detection and prevention of potential cyberattacks by analyzing network data and user behavior.

Natural Language Processing: Deep learning algorithms perform exceptionally well in natural language processing tasks, including speech recognition, sentiment analysis, and language translation, among others. Enhanced communication with citizens, improved citizen services, and automated document processing are all possible outcomes that can be achieved with the implementation of e-government technologies.

Utilizing deep learning models, it is possible to extract useful information from photos and videos through the process of image and video analysis. In the realm of electronic governance, technology can be utilized for a variety of activities, including facial recognition for identity verification, object detection for security, and video analytics to monitor public spaces.

Comprehensive understanding of the functioning of neural networks

CNN have significantly propelled the development of AI technologies. They possess the capacity to acquire and adjust to novel information, making them very efficient in diverse applications like image recognition, audio recognition, and NLP . Gaining a comprehensive comprehension of neural networks is essential for the

development and execution of AI systems that can automate processes, enhance productivity, and deliver superior user experiences.

Neural networks may be comprehended as a collection of linked nodes that collaborate to process information. Every node in the system gets input from other nodes, performs information processing, and then communicates the result to the remaining nodes. This process continues until the output layer generates the outcome. Neural networks are specifically designed to acquire knowledge from data, enabling them to enhance their performance gradually, hence increasing the precision of their predictions.

To enhance understanding of neural networks, it is important to consider the following salient factors:

1. CNN emulate the human brain: The design of neural networks is derived from the organization and operation of the human brain. Neural networks can acquire knowledge and adjust their behavior similar to people, making them very efficient in many applications.

2. CNN may undergo training via either supervised or unsupervised learning. In supervised learning, labelled data is sent to the neural network, while unsupervised learning includes the use of unlabeled data. Both techniques provide benefits and drawbacks, depending upon the specific use case.

3. CNN may be structured with numerous levels, including one or more hidden layers. These hidden layers are responsible for processing intermediate representations of the input data. Network performance may be enhanced by modifying the number of layers and nodes in each layer.

4. CNN are used for image recognition. CNNs are specific kinds of neural networks that demonstrate exceptional proficiency in identifying and discerning patterns inside pictures. They operate by implementing filters on the input picture and then merging the outcomes to provide a conclusive output.

5. Recurrent neural networks (RNNs) are used in the field of NLP and RNN are specific kinds of artificial neural networks that excel at handling sequential input, such

as written or spoken language. They operate by transmitting information sequentially, enabling them to comprehend the context and significance of the input.

Gaining a comprehensive comprehension of the functioning principles of neural networks is crucial for the progress of AI technologies. Using neural networks, we can create sophisticated systems capable of automating processes, enhancing user experiences, and optimizing efficiency. The potential of neural networks is boundless as thesis and development progresses.

Categories of neural networks

Neural networks are AI systems that mimic the structure and function of the human brain. The system has linked nodes that collaborate to process and analyze intricate data. Neural networks find use in several domains, including picture and audio recognition, NLP, and predictive analytics. They have become a crucial instrument in the progress of AI technology.

Various categories of neural networks exist, each with distinct characteristics and practical uses. Convolutional neural networks, such as those widely used in tasks involving image and video recognition. The purpose of this system is to identify patterns in visual data by the analysis of tiny segments of the picture simultaneously and processing them in parallel. Conversely, recurrent neural networks are used in tasks related to NLP and voice recognition. Its purpose is to analyze sequential data by systematically examining each element in a sequence about preceding elements.

Below are many widely used neural network architectures in AI applications:

1. Feed-forward Neural Networks the CNN type is the most basic and straight forward kind. Information flows unidirectionally, proceeding from the input to the output, via a sequence of concealed layers, whereby the input undergoes a metamorphosis to provide the output. Feedforward neural networks are used in applications such as image and voice recognition.

2. RNN are used for applications that include sequential data, such as NLP or voice recognition. The network incorporates a feedback loop that allows it to use knowledge from earlier inputs to guide the processing of upcoming inputs.

3. CNN are specifically used in tasks that pertain to pictures and videos, such as object detection or face recognition. Convolutional layers are used to examine picture or video data, detect characteristics like edges and colors, and then utilize pooling layers to diminish the data's dimensions.

4. Lengthy Short-term Memory LSTM Networks are a specific sort of RNN that are used for applications that need processing lengthy sequences of input. They are meant to store and use past inputs to guide the processing of future inputs.

5. Generative Adversarial Networks (GANs) are a kind of neural networks used to synthesize novel data. The system comprises of two networks, namely a generator network and a discriminator network, which collaborate to produce novel data that closely resembles the input data.

Various neural network architectures possess distinct characteristics and find application in diverse AI domains. Gaining a comprehensive comprehension of the advantages and constraints of each category is crucial in the development of efficient AI systems.

Neural network training

Training neural networks is a crucial aspect of constructing AI systems. Data ingestion is the process of providing information to the network, enabling it to acquire knowledge and provide forecasts based on the provided data. The training process is characterized by iteration and requires a substantial quantity of data, computer capacity, and time. The objective is to optimize the weights and biases (parameters) of the neural network to get precise predictions on novel input. The training process may be categorized as supervised, unsupervised, or semi-supervised, based on the nature of the issue being addressed. The efficiency of training neural networks has improved with the advancement of DL methodologies and the use of specialized technology, such as graphics processing units.

Below are many fundamental concepts regarding the training of neural networks:

1. Data preprocessing: The caliber and volume of data used for training a neural network are important. Accurate labeling of the data is essential to guarantee that the network acquires the relevant patterns. Data augmentation methods, such as

permutation, rotation, and splitting, may be used to expand the quantity of data accessible for training purposes.

2. Hyper parameter settings: Hyper parameters refer to the configurable parameters that influence the learning process of a neural network. The factors include learning rate, batch size, number of layers, and activation functions. Modifying these excessively high metrics may significantly improve network performance.

3. Regularization: Regularization methods are used to mitigate overfitting, whereby the neural network excessively memorizes the training data instead of acquiring meaningful patterns. To avoid overfitting, one may use techniques such as L1 or L2 regularization, dropout, and early halting.

4. Transfer learning: Transfer learning is a method that enables the use of a neural network that has undergone prior training for a distinct purpose. By using acquired knowledge from one job, the network may be optimized for another task with less data and processing resources.

5. Hardware acceleration: The process of training neural networks may need a significant amount of processing resources, particularly when dealing with extensive data sets and intricate structures. Specialized hardware, such as Graphics Processing Units GPUs, and Tensor Processing Units TPUs, may greatly diminish the time required for training and enhance the efficiency of the process.

Training in neural networks is an essential and crucial process in the development of AI applications. Significant quantities of data, computing resources, and time are necessary. Through meticulous data preparation, fine-tuning hyper parameters, using regularization methods, leveraging transfer learning, and utilizing specialized hardware, we can effectively train neural networks that are both precise and efficient.

Implementations of neural networks in artificial intelligence

AI has had significant growth in computer science in recent years. Neural networks are widely used in the field of AI to address intricate difficulties, making them highly favored. Neural networks are designed to mimic the intricate organization of the human brain, enabling them to acquire knowledge via experience, identify recurring patterns, and make predictions about future events. Neural networks are extensively used in

many domains, such as image identification, NLP , voice recognition, and gaming. This section will examine key uses of neural networks in the field of artificial intelligence.

1. picture Recognition: CNN are widely used for picture recognition CNN are a specific sort of neural network that excels at identifying and discerning patterns within visual data, such as photographs. Facial recognition technology uses CNN to accurately detect and recognize faces in both images and movies. Self-driving automobiles exemplify the use of neural networks to identify traffic signs, pedestrians, and other vehicles on the road.

2. Natural language processing NLP. is a branch of AI that focuses on the analysis and understanding of human language. CNN are applicable in NLP applications such as language translation, sentiment analysis, and voice recognition. A RNN is a neural network specifically designed to handle sequential input, making it particularly well-suited for NLP tasks. An illustrious instance of NLP is Google Translate, which uses neural networks to convert text from one language to another.

3. CNN may be used in robots to augment their functionalities. Deep reinforcement learning DRL is a neural network technique used to teach robots to execute intricate tasks. DRL employs an iterative process of experimentation and evaluation to instruct robots on how to execute a certain job. This is achieved by providing positive reinforcement to the robots when they successfully do the task. Robots have been trained using this technology to acquire skills in game playing, home tasks, and surgical assistance.

4. Games: The gaming industry has also used neural networks to develop more intelligent and demanding games. Neural networks are used by game creators to design non-player characters (NPCs) who possess the ability to acquire knowledge and adjust their actions based on player behavior, hence enhancing the game's level of difficulty and immersion. An illustrious instance is AlphaGo, which used a neural network to vanquish the reigning go world champion.

Neural networks play a crucial role in propelling the area of AI forward. Artificial neural networks find extensive use across several domains like image identification, NLP , robotics, and gaming. With the ongoing expansion of neural network thesis, we

anticipate a proliferation of novel and captivating uses for this technology in the next years.

Neural networks in developing artificial intelligence technologies

The rapid expansion of neural networks in recent years represents a significant advancement in the field of artificial intelligence. Neural networks are fundamentally transforming our approach to intricate issues and expanding the realm of previously unattainable possibilities. Neural networks are gaining significance in many domains such as image identification, NLP , and voice recognition, among others. Neural networks play a crucial role in advancing driverless cars, robotics, and other sophisticated technology.

1. Enhancing precision: Neural networks have shown a notable level of accuracy while executing intricate jobs. For instance, the process of picture identification, formerly reliant on human interaction has now been automated via the use of neural networks. These networks possess the ability to precisely identify and categorize things seen in photographs. This technique has several uses, particularly in the field of medical imaging, where it may facilitate the diagnosis of illnesses and other health concerns.

2. Enhanced processing speed: Neural networks can handle substantial volumes of data at a much accelerated pace compared to conventional computing techniques. The velocity is crucial in time-sensitive applications such as self-driving cars, where prompt judgments are necessary to avoid collisions. Neural networks provide the ability to rapidly analyze many inputs and deliver dependable and secure output.

3. Flexibility: Neural networks can adjust and acquire knowledge from novel circumstances. Proficiency in this skill is crucial for the development of algorithms that can function well in ever-changing contexts. For instance, an autonomous vehicle must possess the capability to adjust to dynamic road circumstances, including traffic congestion, meteorological conditions, and ongoing roadworks. Neural networks provide the capability to analyze and acquire knowledge from vast quantities of data, making them very suitable for the development of these algorithms.

4. Enhance decision-making capabilities: Neural networks can process vast quantities of data and derive choices from it. AI systems can discern patterns and trends that may elude human perception, therefore rendering them very advantageous in decision-making procedures. Neural networks in finance can analyze stock market patterns and create forecasts by examining historical market behavior.

Neural networks have significantly contributed to the progress of artificial intelligence technologies. Their capacity to handle substantial volumes of data, adjust to novel circumstances, and acquire knowledge from past encounters makes them well-suited for the creation of sophisticated technologies efficiently and precisely. Neural networks provide novel opportunities and revolutionize our approach to intricate issues. In the next years, we may anticipate seeing more notable progressions in AI technology as these networks continue to develop.

Deep learning and intelligent applications

DL is an AI technique that trains computers to interpret data using a methodology inspired by the functioning of the human brain. DL models use advanced algorithms to identify intricate patterns in many forms of data, such as photos, text, audio, and more, to provide precise insights and predictions. DL techniques may be used to automate processes that conventionally need human intellect, such as generating descriptions for photographs or converting an audio recording into written language.

The significance of DL lies in its ability to process and analyze vast amounts of complex data, enabling the development of highly accurate and efficient models for various tasks.

AI endeavors to educate computers to emulate human thinking and learning processes. DL technology is the driving force behind several AI applications seen in common daily items, including the following:

1. Virtual personal helpers
2. Television remote controls that can be operated using voice commands.
3. Identification and prevention of fraudulent activities
4. Automated facial and iris identification

5. Additionally, they play a crucial role in cutting-edge technology like autonomous vehicles, virtual reality, and other advancements.

DL models are digital files that data scientists have taught to execute tasks using an algorithm or pre-determined sequence of actions. DL models are used by companies to analyze data and provide predictions across a range of applications.

1.7. Artificial intelligence development the applications

Smartphone apps can streamline and enhance our daily lives and professional activities. Thanks to advancements in mobile technology, we are now able to rely less on electronic devices. Rapid advancements in AI have had an impact on programmers in recent years. Advancements in ML and AI have led to the development of flexible algorithms that enable seamless and intuitive experiences. Smartphones can recognize speech and text and make decisions. AI is the key to this revolution. AI allows computers to think and learn on their own. AI enables mobile apps to evolve. Interactive applications are becoming more and more popular. The ability of AI to adapt and learn allows companies to develop intelligent applications and create personalized experiences for each user. AI is rapidly gaining popularity in the business sector. Many companies have used AI and ML to streamline their operations. Technology is constantly evolving to integrate AI into other areas, such as robotic process automation (RPA) and mobile app development. The increasing use of AI in mobile applications is a boon for enterprise applications.

Artificial intelligence developing mobile applications

AI is a hot topic in the technology industry. This technology can revolutionize mobile app development. Artificial intelligence, a branch of computer science, seeks to endow machines with similar human intelligence. It allowed machines to behave, interact, and act in the same way as humans.

The best companies that make mobile apps use AI-powered tools to give their users a personalized and easy-to-use experience. Few apps can predict user actions and adjust appearances based on mood. This increases user loyalty and engagement. AI

applications are getting more and more important and will greatly influence the future of mobile app development.

Artificial Intelligence and Mobile App Development: How Artificial Intelligence is Changing:

1. The iris of the eye was discovered these applications can present the iris identification feature in various shapes. All security-based, e-commerce, and camera applications should include this feature. It is one example of a security-based application that can recognize its irises and provide distinct channels. It works to facilitate the use of e-applications without referring to a restrictive system to enter these applications, such as a password.
2. Customized and relevant content Most apps fail to get people's attention because they don't have content that is interesting or focused on the user. Apps can analyze data from readers and users and combine it with a learning algorithm to figure out which content is best for the user. AI steps in here. Additionally, AI can organize additional user content based on their preferences. ML is the most important support for artificial intelligence. It can scan and filter a lot of data to find the most valuable one. Leaders can make better decisions by being more informed. Leaders can offer customers more personalized solutions and create a brand identity.
3. For user convenience AI is making great strides in providing the best possible user experience. Let's look at an example to show the point. We no longer have to visit the supermarket to buy things. Now we can order everything online and have it delivered straight to our homes.

Google Assistant and Amazon Alexa can now receive instructions via the agent. It can perform multiple tasks simultaneously, which is impressive. Using iris recognition as an application and linking these e-government applications without referring to traditional databases is an impressive example of performing multiple tasks simultaneously.

Artificial intelligence, one of the most groundbreaking technologies, has exploded in popularity in recent years because of this trend. It finds application in many fields.

There are now examples of this technology becoming a major phenomenon in the real world, thanks to its adoption by people and businesses. AI is increasingly a key component in app creation for both desktop and mobile platforms. It facilitates the development of self-learning programs that, through repeated usage, come to understand the user's preferences and preferences alone. The application of AI also helps boost user engagement and happiness. AI improves voice search functionality. AI is at the forefront of creating a customized user experience, which is crucial for boosting user engagement and keeping existing customers happy. We may anticipate that future AI platforms will run on and even integrate a wide variety of mobile device interactions as web and mobile applications continue to expand into more and more areas of people's lives.

1.8. Challenges Artificial intelligence in e-government

Intelligent machines will change the face of Government. The advent of AI has the potential to enhance government efficiency and effectiveness by reducing the price tag of essential Government operations, enhancing the quality of decisions, and liberating the potential of records of administration.

Organizations that use AI to achieve these gains will face important questions about algorithm and user interface design, the limits of human and machine decision-making, the line between public action and private contracting, the agency's ability to learn using AI over time, and whether AI is allowed. Discussion and thesis in the public sphere are essential. Nevertheless, beyond a few headline-grabbing cases or surface-level explanations, very little is known about how agencies are deploying AI systems. The public and academia are increasingly discussing how to oversee the government's use of artificial intelligence, but the process through which agencies acquire and track such tools has received less attention. Incorporating AI into the public sector Many ML applications have been presented across many economic and day-to-day living sectors as a result of advancements in computer power and algorithms and the explosion in data availability. Big data, machine learning, and DL are all used interchangeably in this updated AI and several brand-new products.

However, researcher s use AI in different ways due to a lack of conceptualization [31, p. 2049–2053]. Some call AI intelligent software; others thesis AI as a technology rather than a tool. Instead of focusing on the creation of new machine-learning models, this article explores the use of AI in the form of information and communication technology systems that mimic human abilities in areas like perception, learning, and understanding[32, p. 1646–1650]. AI technologies can benefit government organizations in many ways, scholars say [33, p. 594–601], [34, p. 217–224]. Empirical evidence for the claims that AI applications may help governments address problems like resource allocation, corruption, and the achievement of social development goals by getting insights from big datasets, a lack of specialists, repetitive procedural activities, and diversified data is limited. Chatbots may improve citizen-government communication, but e-government challenges may prevent this. [35, p. 1-6] Algorithms in public sector organizations may lead to opaque decision-making processes, accountability issues, and distrust in AI-enabled decisions. [36, p.130-145] Thesis also focused on the potential negative effects of privacy risks arising from sensitive, granular, and in-depth data collection. Thesis also focused on bias-related discrimination, another potential negative effect. These perspectives on AI's value and risks may affect the public sector's adoption and society's acceptance of innovation Furthermore he invasion of technology into the workplace has affected every aspect of business as usual. IT's integration into a company's ecosystem can affect its relationships with customers, prospects, and partners, as well as its processes and operations. Over the past few decades, AI has become the most impressive IT application .Theories and techniques used to create machines capable of simulating intelligence" is its definition.

A computer models intelligent behaviour without human intervention in AI. IDC expects 40% of digital transformation initiatives in 2019 to use AI services, and 75% of business applications will use AI by 2025 [37, p. 1–16]. Since the early 2010s, American GAFAM and Chinese BATX, among others, have been racing to develop AI's most promising component, learning systems, to boost productivity and develop

new services such as ML or DL. AI's benefits and possibilities make it the best market for the future.

1.9. Future of E-government and Artificial intelligence

Rising citizen expectations are just one of the many difficulties governments must contend with today. Public services are under increasing demand due to rapid urbanization, an aging population, and complex socioeconomic challenges. Governments need cost-effective and long-term strategies due to stagnant economies and shrinking resources.

To achieve this goal, governments must have a consolidated view of citizen data and share it appropriately across agencies while maintaining confidentiality. Furthermore, governments can utilize data to develop innovative services, proactively address consumer needs, and mitigate potential issues.

There are two key areas in which governments excel in AI compared to the commercial sector. Government agencies organize and analyze their vast citizen data for the greater good. They can measure and mitigate inequalities in outcomes and access. They can also safely collaborate with third parties to develop useful apps and services for the public. Citizens' adoption and utilization of these tools are within their sphere of influence. Governments have a responsibility to set an example for the responsible application of AI technology, to set guidelines for business AI practices, and to educate the public about the risks they face. Governments can use AI to help them deal with these problems. It can either assist humans or take their place. The primary three areas are:

1. Sensing: AI can speed up visual detection. In a second, AI software can analyze footage from traffic cameras. That governments may improve public transportation, lessen environmental impact, and regulate traffic flow.
2. Thinking: Large volumes of data can be analyzed and processed by ML and DL, and NLP far more quickly and accurately than by people. Several governments are implementing these technologies to aid instructors with administrative tasks and individualize instruction for their students.

3. Acting: Artificial intelligence, intelligent automation, and chatbots can aid people in making mundane choices. Frontline staff can prioritize services and enhance the citizen experience. We think that intelligent governments can use AI to better the lives of their citizens. In a series of articles, we'll go over six different approaches. We'll also discuss how governments should regulate AI and implement AI-based systems.

The client plays a crucial role in the use of apps within the government entity. A marketing strategy incorporating AI and information technology tools was implemented to effectively capture and analyze user preferences, perspectives, reactions, and complaints on e-government products and applications. This strategy aims to facilitate customer relationship management by leveraging technological advancements.

1.10. Integrating Artificial Intelligence into government operations.

The AI landscape's uncertainty and complexity make designing and implementing effective AI policies difficult for governments. Governments have a hard time achieving policy goals because AI is unpredictable, difficult, and nonlinear. (Gasser & Almeida, 2017) [38, pp. 58–62]. ML systems' opacity and unpredictability make AI accountability difficult for governments.

This paper provides a concise and comprehensive analysis of the importance of AI and ML in the context of enterprises.AI has emerged as a prominent and transformative technology in contemporary times, presenting a multitude of benefits to enterprises. AI and ML contribute to cost reduction in a firm by effectively reducing the overall expenses associated with various business activities. Furthermore, it facilitates the ability of enterprises to efficiently address operational challenges and enhances their capacity to make informed judgements on their operational procedures. Customers can engage in communication with chatbots that utilize AI technology, regardless of the time of day, hence enabling them to seek clarification or information about various businesses or products. ML presents significant benefits for enterprises by streamlining and automating their operational processes. Furthermore, ML

efficiently facilitates cognitive interaction between staff and consumers, providing answers to various customer challenges, such as password-related problems and others.

First, it's hard to control AI because of the lack of transparency, explain ability, and accountability in complicated ML algorithms. Making algorithms more explainable has been found to diminish their complexity, which in turn reduces their accuracy and performance. Even with the required transparency and explain ability of algorithms, experts can't grasp how some algorithmic outputs are formed from their inputs. This is a serious flaw in the EU's General Data Protection Regulation's ability to combat algorithmic bias.

Due to the complexity of ML algorithms and their vast datasets, it is practically impossible to detect and delete all variables connected with sensitive personal data. ML algorithms and their vast datasets are connected with sensitive personal data, making it practically hard to detect and delete all variables. This practice is lawful under intellectual property rights and is implemented to avoid cyberattacks and safeguard trade secrets. Most consumers are not technically literate or ready to pay for such expertise; therefore, the required explanations under GDPR are not likely to inform or empower them. Second, ML judgments are data-driven and sensitive to initial conditions.

As manufacturers and programmers cannot always foresee the inputs and design rules that might lead to harmful or discriminatory outputs, it is difficult to assign guilt and accountability for software failures in AI systems. AI Government is a hot topic because of the challenges associated with keeping data private and making AI systems accountable for the decisions they make based on that data. Data fragmentation and system incompatibility provide challenges to an organization's control over data flows throughout its life cycle and in shared roles in data sharing clouds. The responsibility and causality of those who facilitate AI-driven decisions and events Existing Government and regulatory frameworks are unprepared to address social challenges relating to AI due to a lack of information and regulatory gaps. While governments have traditionally been in charge of distributing and controlling society's resources, tech giants like Google, Facebook, Microsoft, and Apple now have a considerable edge

thanks to their access to more information and resources as they regulate AI. Tech businesses create information asymmetries that hamper regulators' understanding and application of AI laws [39, p. 137-157].

Rapid technological advancements have left regulators behind, leaving us with regulations that are "too generic" or "vague" and lack the specificity necessary to successfully control the technology. Most notably, programmers might avoid taking personal responsibility and accountability for the social behaviour of the system by discouraging lawmakers from setting precise norms and duties for algorithm programmers.

We show that the four governing resources countries typically use for regulation are insufficient to deal with AI dangers and that governments need to find new ways to acquire information and construct effective laws that can adjust to the rapidly evolving AI landscape. [40, pp. 596–615].

Industry groups and governments have moved to self-regulatory or "soft law" approaches to AI design as a result of the failings of "hard law" regulatory frameworks. Soft law techniques utilize "nonbinding norms and processes" to establish "substantive expectations that are not immediately enforced." Governments have developed many AI ethical guidelines and Government frameworks, while industry organizations have issued several voluntary standards, guidelines, and codes of conduct.

When compared to laws, guidelines can be revised more quickly, so they keep up with technological advances. This method, which was developed in response to prior emergent technologies, is intended to encourage the development of AI that is ethical, fair, and non-discriminatory; however, its effectiveness is debatable. To begin, self-regulatory projects may not always adhere to the principles because they are voluntary and generally lack uniform enforcement criteria. Second, governments will have a hard time applying these principles consistently to build the same AI technology across industries if they are inconsistent and not adequately coordinated with regulations.

Self-regulation may not be adequate or desired for AI Government because it cannot guarantee inclusivity and the representation of varied stakeholders. Concerns that corporate interests drive AI rules arise from the extensive participation of industry

stakeholders in defining ethical standards and regulations for AI; this is a common criticism of self-regulatory initiatives to control emerging technology.

1.11. Artificial intelligence in the public sector

Computer systems that can learn, act, understand, have a holistic vision of the world, and have core competencies on par with human beings are referred to as AI. The public and governmental sectors are enthusiastic about AI. Language obstacles, service delivery lags, wait periods, overwhelming caseloads, and staff turnover are just some of the problems that AI can address in the public sector.The government is investing in AI thesis and development to enhance government operations. AI will revolutionize how governments function [41, p. 2394–3696].

AI can help the public sector, society, and economy in many ways. Fortunately, society, policymakers, and academia do not view AI as a vital technology as it evolves. Thus, public-sector AI definitions are difficult to define. Since the 1950s, some have called AI the science or practice of making intelligent technology [42, p. 739–754].There are a variety of AI methodologies, priorities, and goals in this area. AI-supported industrial processes and robots vastly enhance human digital aid and decision-making in life-or-death, complex scenarios [43,p. 5-10]. Thus, governments have a greater incentive to reap AI's benefits in the public sector. The existence of AI now cannot be delayed.

According to Kokina and Davenport (2017) [44, p. 115–122], the first government agencies to embrace AI were able to argue that the cheaper AI technology got, the better the economy was. Government workers have found numerous applications for AI in the public sector. Drone routes, medical triage, bail hearings, citizen questions, infrastructure plans, fraud detection, and immigration judgment payments are just a few examples of real-world scenarios where AI could be useful. Understanding the risks, opportunities, roadblocks, and motivators of using AI in the public sector is essential.

There could be both positive and negative outcomes from introducing AI into the public sector. Preliminary thesis indicates a wide range of transdisciplinary, as well as

technological, obstacles to public AI applications. AI technology makes previously impossible tasks possible, but it doesn't always carry them out.

The effects of AI vary from setting to field, depending on how technology is utilized and its impact on underlying structures and procedures. So, the effects of AI vary from setting to field. Factors such as demographics, culture, and geography can influence people's reactions. Unforeseen changes in the behavior of government employees when AI systems are released to the public may negatively impact input data, workflows, and AI technology.

The public impact of AI may be more difficult to gauge than suggested by previous studies. As a result, familiarity with the AI system is essential for evaluating its impacts. More short-term influence can be achieved through thorough comparisons of policy or public situations before and after the use of AI. Therefore, it supplements the way we now study policy. [45, pp. 46–60] We will use it as a conceptual framework to attract enough researcher.

From a Government perspective, this diversity of opinion should discourage public administrators from relying on a single stakeholder group's perspective on AI. Government agencies collaborating with private IT corporations should take precautions to prevent becoming locked in to a single vendor. Consequently, governments should build thorough public-sector AI frameworks and regulatory advice to prevent vision lock-in. One possible first step towards this kind of straightforward optimization is creating a map of stakeholder expectations. These kinds of optimizations are not driven by AI technology but by politics.

The researcher proposes [46, pp. 682–693], that AI holds the most promise for altering the ways in which governments interact with the public, formulate policies, and oversee the nation's physical infrastructure. Distributed ledger and smart contract technologies are examples of trusted record-keeping concepts that could form the basis of a decentralized, cheaper, more efficient, and individually tailored public service infrastructure if combined with advanced data and analytics infrastructures.

To incorporate data science into government operations, many nations have launched e-government or digital government programs. The United Kingdom,

Singapore, and Estonia are the frontrunners. Most of these projects, however, use AI in some capacity. The state-of-the-art e-Estonia infrastructure allows online access to most Estonian government services and provides every citizen with a digital identity, signature, and personal record. Estonia's newest initiative, e-Residency, provides users with access to a platform that is open, lawful, and transparent. [47, p. 448–460] E-residents can use public e-services and access EU business environments with their digital identities. Private-sector data science can transform the public sector.

When people talk about AI in public, they often mix up two Government issues: using AI to automate policymaking and how to govern AI. We'll go over government AI applications.

1. Chatbots or virtual assistant is a piece of AI software that lets a user talk to it in natural language through messaging apps, websites, mobile apps, or the phone.

2. Segmenting and classifying documents: Sort incoming and automatically created documents by their content to make the flow of information in your organization more efficient.

3. Anticipating customer anger: Figure out which customers are most likely to get mad and leave for a competitor, and figure out what the best offer is to keep them. Find cheaters by looking at how they've cheated in the past and what signals they've picked up.

4. Detecting a birth defect: finding items or events that don't fit the pattern or other data set items that a human expert wouldn't notice.

5. Demand forecasting: look at sales data and make predictions about demand to cut down on costs for logistics and stock.

6. Text classification: customize tags or categories for text according to its content.

7. Customer categories: Group customers by common traits so companies can effectively and appropriately market each group.

8. Sentiment analysis is a process that uses AI to find positive, negative, and neutral customer opinions about a customer's products and services in social media text.

9. Recommended Engine: Use purchase history, behavior, and other factors to predict customer purchases.

10. Biometric customer identification: Using a picture to create a class name from a group of other classes.

According to the author [48, p. 1–6], although AI has barely been around for 60 years, its useful applications have already had far-reaching effects. AI helps in creating intelligent machines. Computers' low processing power and computing capacity hampered the first wave of AI thesis, and the third, propelled by DL , resulted in increased practical applicability and saw the development of artificial neural networks that emulated the human brain. Lack of resources and reluctance to take chances contribute to the underdevelopment of AI.

1.12. E-government uses biometrics systems

Biometrics has not yet been fully realized as an emerging technology. E-government services may be hampered by issues including a lack of worldwide biometric standards, privacy concerns, and security concerns. Governments can better provide services to their citizens with the use of the Internet and e-commerce. The government's goal is to strengthen ties with companies and residents by delivering better, more efficient services. When properly implemented, e-government has the potential to revolutionize government operations by increasing productivity, lowering costs, and enhancing service to citizens [49,p.10-30].

That is why many governments are prioritizing e-government services that citizens can access online. Citizens have legitimate worries about the safety and reliability of e-government services. Biometric identifiers have the potential to enhance the safety, privacy, and credibility of e-government.

Using such IDs, however, compromises the efficiency of technology, the accuracy of biometric solutions, and the returns on investment. Concerns about privacy breaches, resistance to change, mistrust of technology and data usage, and sensitivity to data protection rules are all factors that slow the widespread adoption of biometrics. Notwithstanding these obstacles, biometric identification may be required to access internet-delivered e-government services.

Some biometric models in e-government

1.Immigration and Entry Systems: Several immigration and border control systems use biometric technologies for identification purposes. International passengers from outside the United States are subject to fingerprinting at U.S. airports. London Heathrow Airport's facial recognition system collects biometric face pictures of all passengers on aircraft bound for the United Kingdom and Ireland.

2.Biometric Passport: The data page of a biometric passport (also known as a digital passport) prints and saves information about the owner's biometric features in the passport chip. Immigration checkpoints use this data to verify the identities of foreign travellers and prevent cases of identity theft. (Morosan, 2013) [50, p. 23–39].

3.Registered Traveler Programs: Airports can offer air travellers convenient biometric services (Morosan, 2013) [50, p. 23–39]. Some major airports in the United States have "Registered Traveller" programs that allow passengers to skip the security line after passing through biometric authentication. Airline authorities in Germany and the United Kingdom have been using this service since 2004 in place of an e-passport.

4.Safe Payments: Non-aviation activities or income streams are one of the primary developments that have contributed to the expansion of the airport-related industry in recent decades.

5.Employees' access to restricted areas. Commercial businesses that sell travel services have increased airport passengers' financial transactions, so biometric technologies for payments and employee access to restricted areas are possible. Biometric of technology ensure airport access to authorized users. Airports restrict employee access to critical areas using biometrics.

6.Time and flow accuracy: The airport uses biometrics to track passenger movement and provide real-time queue and bottleneck information. Gatwick and Bristol airports in the UK use this tool to assess and adjust staffing needs.

Biometric technologies definition and benefits

Biometrics. These systems' main features, applications, and operations are explained below (also related to the government). Definition Biometrics. Human recognition is the basis for biometrics. Humans' capacity to remember a familiar iris,

face, voice, or walking style is the result of an ingeniously simple brain pattern recognition mechanism that records and saves certain qualities about the seen individual and then retrieves them at the proper moment.

Biometrics enhances traditional methods of human recognition by making them more efficient and by introducing novel modalities like the iris. As compared to human recognition, biometrics is faster, more accurate, and more flexible. Computing advancements, neural networks, and expert systems all go into intelligent recognition. Biometrics are invariable characteristics of the human body. There are two types of biometrics that the authors differentiate between:

1. biological biometrics that are uncontrollable by the human owner (for example, fingerprint, iris, voice, or face traits).
2. behaviour biometric that are controllable by the owner of the behaviour (for example, handwriting or signature terms). are listed in Figure 1.12.1. Principal biometric modalities.

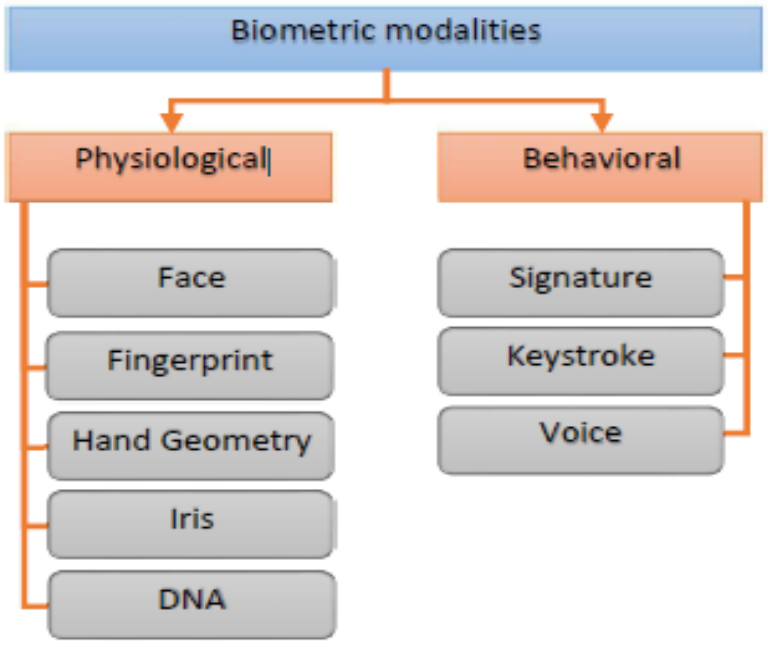


Figure 1.12.1.Biometric modalities

Advances in information and communication technology have led to the increasing use of biometric traits for verification purposes. Recognizing these human biometrics is a

primary goal of biometric identification systems, which seek to improve the reliability of individual identification. Intelligent recognition utilizes expert systems, artificial neural networks, and other forms of high-tech computing. When compared to more conventional approaches, these aid in retention and comprehension.

Although 3D facial recognition is more accurate than fingerprinting, no biometric pattern is optimal for all applications. Fingerprint, facial, iris, vocal, and signature recognition systems are currently the most widely used biometric identifiers. Computerized biometric verification relies on a person's unique physical characteristics.

The best biometric technologies

The best biometric technologies follow a two-stage pattern that entails this stage:

1.Enrollment. First, the sensor module receives the user's biometric image or sound. An algorithm analyzed a user template and stored it in a database [51, p. 80–105].

2.Recognition. Recognition can be verified or verified. After a user has proven his identity, a 1-1 matching audit may commence. The live image is then compared to the stored image in the system's database. If there is a high enough degree of similarity, the user is allowed access. verification. The template picture in the system database with the most comparable features is assigned to the real-time scanned image regardless of whether or not this is the best practice. One-to-many matching describes this method of ID (e.g., 3D facial recognition is more accurate than fingerprinting). The most popular biometric authentication methods are fingerprint, face, iris, voice, and signature scanning. It is important to think about both theorizing and doing [52, p. 661–690].

Theoretical requirements:

1. Universality: Everyone must have some sort of biometric identifier to comply with this rule.

2. Distinctiveness:. indicates that there needs to be enough of a difference between two people's biometrics to tell them apart.

3. Permanence: signifies that a person's biometric characteristics shouldn't evolve as he ages.

4. Collectability:. This necessitates a quantitative evaluation of the chosen biometrics.

Practical requirements:

1. Performance: refers to the accuracy, speed, and hardness of, the recognition system.

2. Acceptability: refers to the range of people's acceptability for any biometrics characteristics to be daily used in their identification.

3. Circumvention: refers to the tolerance in fooling the system by faked techniques.

Benefits of using biometrics

1.Increased security: combating identity theft Passwords can be guessed, duplicated, or forgotten, and tokens can be hacked or stolen, limiting the effectiveness of traditional security measures. In 2014, identity theft impacted 17.6 million U.S. residents. The vast majority of victims had their bank or credit card information stolen (38% and 42%, respectively). Identity theft using biometric data is unusual, though. Biometric information cannot be faked, lost, or stolen in any way. As they are inseparable, only the individual can verify them.

2.Increased convenience: Classical systems require users to write down their passwords or carry tokens. Lost credentials prevent service access. Biometrics don't require memory or storage, unlike classical systems. Services are available 24/7.

3.Increased accountability: transferability issues "Biometrics are great for transferability. Token-based attendance systems allow users to willingly swap identifiers. Attendees are accountable for token possession, not token presentation. This issue may be resolved by using biometrics in accountability applications such as capturing the biometric identities of passengers boarding a flight, signing for equipment, etc.

4.Negative recognition: Classical recognition systems allow users to enroll multiple times with different identities to illegally use the system's features. Users can

submit multiple visa, social welfare, etc. applications. After using the service, users can easily deny their identity. Classical systems cannot detect fraud. Problem statement How can a recognition system confirm that a person is enrolled in the system even if he denies it" negative recognition problem. Biometrics can answer this.

5.Non-repudiation service: The non-repudiation service allows the system to link an action to a user so that they cannot deny it. Tokens and passwords can't verify a user's responsibility for an audited act. The user can claim that someone else used his credentials. A person uses computer resources and denies responsibility. Managers use video surveillance, which makes employees uncomfortable, to consolidate system reports. "therefore any activity conducted that can be related to that biometric is likely to have been undertaken by the legal proprietor of the biometric in question," because biometrics are difficult to forge. This makes it hard to trust any explanations that a biometric was obtained fraudulently by another party.

History of biometrics identification systems

Alphonse Bertillon invented anthropometric measurements to identify criminals in 1870. When fingerprints were discovered in the late 19th century, this idea was expanded. Fingerprints were first used in criminal cases in the UK in 1905. After digital signal processing was invented in the early 1960s, human identification was automated [53, p. 3–18]. Thus, biometric identification is used for security, anti-crime, and justice (involving a growing number of people). In the 1960s, this technology could be used for high-security access control and personal financial transactions.

Face recognition was created by Turk and Pentland in 1991. This system has been upgraded over time thanks to the advent of digital cameras and higher-quality images. With the advent of cheaper and smaller 3D cameras and the ability to record video in real-time, this technology is now usable on tablets, smartphones, and PCs. In the early 1990s, the first iris identification system was created: a camera that could record iris pictures and classify them in compact binary code In 2001, this kind of identification was employed in Dubai for border control, and in 2003, it was deployed in Amsterdam for frequent-traveler immigration checks [54, p. 71–86],[55,p 1148-1161], [56,p 1167-1175] .

Main applications of biometrics identification systems

In recent years, biometrics technologies have become increasingly popular and useful as identifying systems. Location can make a difference when applying:

1.Forensic: Criminals can be tracked or caught with the use of biometric identification technology (based on face recognition biometric features)

2.Government: Digital passports incorporate biometric data, and biometric voter ID and employee identification systems are in use.

3.Commercial: The usage of biometric identification technologies in the financial sector is a rapidly expanding market. Biometric identification technologies provide a safer alternative to traditional payment methods like passwords and PINs.

4.Travel: Travelers can be identified via biometric systems (e.g. for immigration reasons or security reasons).

Concerns about biometric identification systems

Biometric identification systems require people and technology to interact and record biometric features [58, p. 85–39]. As a result, those who design and implement these technologies must understand their identification's social, cultural, and legal context. Failure to follow these social impact considerations may reduce technology effectiveness and have unintended consequences (Pato & Millett, 2010) [58, p. 85–93].

Increased security or reduced financial fraud can bring benefits to some people, companies, and organizations, but it can also have drawbacks for others (Pato & Millett, 2010) [58, p 85-39]. Some people, companies, and organizations benefit from increased security or reduced financial fraud, but others may suffer.

Cultural, social, and legal factors affect biometric identification systems' efficacy and impact, as well as how people use, interact with, and perceive the technology. Technology and purpose determine such systems' effects. These systems also affect different people differently: cultural values, personal beliefs, and behaviour differ.

Acceptance of biometric identification systems

In 2015, SITA surveyed airline passengers to find out what they liked and disliked about their flights (SITA, 2015). Security and border checks were cited as the most frustrating elements of the trip by 36% of respondents. The use of biometric self-

service technologies led to a 97% improvement in overall satisfaction among respondents [58,p 85-93].

According to Jones, Antón, and Earp (2007) [59, p. 91–98], half of their respondents prefer biometric identification systems to passwords or other methods to verify their identity, and many of them have a positive opinion of biometrics. Respondents are most familiar with biometric authentication systems[60, p. 5–7]. Password-based systems are most familiar, but fingerprint scanning is familiar to 51.3%, voice recognition to 43.5%, and iris scanning to 27.8%. 46% of respondents to Heckle, Patrick, and Ozok (2007)' [61, p. 153–154]. Thesis on fingerprint technology's perception and acceptance found it "very comfortable" or "extremely comfortable," depending on the circumstances and nature of the exchange.

Implementation context affects biometric identification system acceptance. Heckle, Patrick, and Ozok (2007) [61, p. 153–154]. suggest that user perceptions of benefits and risks may affect the use of biometric identification services. Benefits increase acceptance and perception. According to Clodfelter (2010) [62, p. 181–188], customers' awareness of biometrics such as fingerprint identification increases when they understand their benefits [62, p. 181–188].

Biometric identifiers provide the most value in the setting in which they are used. Financial transactions (66.1%), building access (47%), and retail outlets (37%), as reported by Jones, Antón, and Earp (2007), are where biometrics prove most beneficial. More than 80% of respondents believe that iris and fingerprint scanning are safe authenticator systems, as stated by Jones, Antón, and Earp (2007) [59, p. 91–98], although respondents appear to be more worried about the goal than they first agreed to. Just 32 percent of respondents are worried about privacy 28 percent for iris scanning and facial recognition.

Instead, privacy was a concern for some Heckle, Patrick, and Ozok (2007) [61, p. 153–154] biometrics study respondents. Ten participants who initially felt comfortable using fingerprint technologies later expressed privacy and risk concerns.

According to the article, respondents' knowledge affects the acceptance of biometric identification systems. Ignorance of technology and unclear risks cause

hesitance (Heckle, Patrick, & Ozok, 2007) [61, p. 153–154]. Biometric system acceptance depends on consumer education and technology awareness (Clodfelter, 2010) [62, p. 181–188]. Unfamiliarity can affect biometric identification system adoption and user perception (Jones, Antón, & Earp, 2007) [59, p. 91–98]. Instead of improper technology use, more familiarity and understanding of technology improve the experience (Pons & Polak, 2008). Better experience and comfort reduce privacy concerns. To conclude, context and awareness affect biometric technology acceptance. Users are concerned about the fate of biometric identification system data (Jones, Antón, & Earp, 2007) [59, p. 91–98].

Technology readiness and customer satisfaction

Lin and Hsieh's article on technology readiness in customer perception and the adoption of self-service technologies [63, p. 1597–1615] examines the relationship between customer satisfaction and technology readiness, taking into account [64, p. 1–15]. They recommend using technological preparedness as a predictor of consumer reactions. Levels of satisfaction among customers were found to be correlated with their levels of optimism and creativity while using technology-based services, while levels of dissatisfaction were correlated with levels of pessimism and cynicism (linked to discomfort and insecurity).

Technology readiness is also linked to customer satisfaction because customers willing to adopt new technology with a positive attitude and the ability to use it are more likely to be satisfied than those who are not (Lin & Hsieh, 2007) [63, p. 1597–1615].

Son and Han (2011) studied how technology readiness affects consumer satisfaction [65, p. 1178–1182]. Son and Han constructed an empirical model that connects tech fluency with user contentment and loyalty. Similar to Lin and Hsieh's work, Son and Han think of consumer optimism and creativity as drivers and customer uncertainty and discomfort as inhibitors. Optimism impacts innovative function and diversity. Innovativeness affects innovative function, usage, and variety. Insecurity lowers technology readiness, and discomfort lowers basic function usage (Son & Han, 2011) [65, p. 1178–1182].

Finally, Son and Han (2011) [65, p. 1178–1182] tested assumptions about how usage patterns improve satisfaction. All of the usage patterns above improve satisfaction. These studies help researcher s understand how technology readiness affects technology adoption and customer satisfaction.

Why use iris recognition

Automatic identification techniques that are safe are important in many fields, such as ID cards, border control, control of access, and forensics. Passwords, PINs, and identification cards do not provide sufficient security. Cards can be misplaced or misused, and passwords are easily forgotten or leaked. Physiological and behavioral human identifications are promising alternatives to traditional forms of identity verification.

Biometrics don't require knowledge or tokens, making them more user-friendly. Each person's face, iris, voice, fingerprint, and palm print are unique and constant. Biometric methods are gaining popularity for these reasons. This thesis focuses on iris recognition for human identification. Iris patterns are the most reliable biometric traits for distinguishing people. Large-scale evaluations show remarkable recognition accuracy.

According to Wikipedia, the iris is an "annular structure of elastic connective tissues forming a rich pattern of random texture, visible in the eye." It sits between the pupil and the sclera (bright region). Pupillary and limbic boundaries are the iris/sclera and iris/pupil boundaries. Radial, contraction, and crypt patterns cover the iris surface. iris texture. Figure 1.12.2 shows the human eye anatomy schematically.

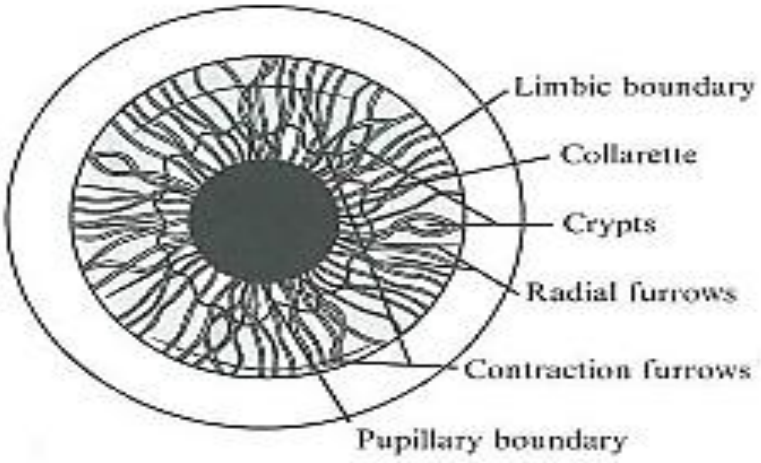


Figure 1.12.2. Frontal view of a schematically human eye

Iris has intriguing qualities[56,p 1167-1175]. Unlike fingerprints and faces, the iris is a protected internal organ that cannot be changed. Biometrically, it is unique. Iris's texture is complex and random. From the third to the eighth month of gestation, the texture is epigenetic (not genetically determined, except for eye color). The iris provides lifelong stability. For these reasons, the iris can distinguish monozygotic twins. A person's right and left eyes have different iris textures.

1.Iris acquisition

Obtaining high-quality iris images is difficult. The 11-mm-diameter iris is a small part of the face. The iris is a reflective internal organ behind the cornea. Most commercial iris acquisition systems use NIR. The illumination source emits 700–900 nm light. Even highly pigmented irises (dark eyes) can be seen at those wavelengths, and light reflection is greatly reduced. Figure 1.12.3 shows a near-infrared iris image. Such wavelengths show iris texture.

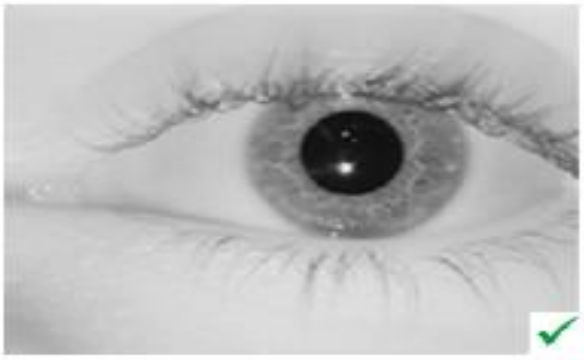


Figure 1.12.3.Iris image acquisition

- **Controlled mode: conventional acquisition**

Researcher s study iris image acquisition conditions and quality. Conventional systems were difficult to acquire. Asked. Open the eye and center it in the image. The specular reflection is inside the pupil, not at the pupillary boundary or iris. Algorithmic image contrast, illumination, and iris resolution measurements The IREX V Standards and Technology Guide established technical guidelines for iris image collection (NIST).

- **Uncontrolled mode: less constrained acquisition,**

In many real-world security applications, like remote and mobile iris recognition, it is not possible to make the user follow these rules. The IOM system uses a portal at a distance of 3 meters to ease the strain of the acquisition process on the customer. Iris detection at 1.5 meters, working range of 1.5-3 meters to 12-30 meters, stand-off system These kinds of systems deal with plausible situations.

However, as the subject's freedom of movement and position increases, the resolution, illumination, and eye pose of the images acquired by such systems increase between different acquisition environments, and their negative impact on the recognition of the same eye significantly decreases when the environment acquisition differs, causing confusion regarding the biometric decision (whether the iris is from the same person or not). The papillary and limbic boundaries are often blurred in the images. Strong occlusions (eyelids, eyelashes, specular reflections) for acquisition mode

2.Iris recognition.

The first to suggest using irises as a sole means of identification. It serves as a model for most modern systems. Typically, they are broken down into the following four stages:

1. iris segmentation :first isolate the iris texture from eyelids, eyelashes, spotlights, and shadows. Artefacts must be handled now. Circles or ellipses usually model the papillary and limbic boundaries. The segmentation module also creates a binary mask to identify iris texture pixels to remove noisy information in later steps.

2. Normalization: The size-invariant normalized iris image maps the iris region. The image's dimensionless coordinate system handles pupil dilation. This transformation uses the segmentation module's iris boundary parameterization. Normalization compares any two iris images' alignment.

3. Feature extraction: This stage extracts iris texture. Any two images are compared by matching their iris texture. Iris-Code, a binary code, represents the template. Iris quantization yields these bits.

4. Template matching: Iris recognition systems decide if two templates are the same iris in the final stage. To compare binary codes, a similarity or dissimilarity score is calculated. Comparing the matching score to a threshold determines acceptance or rejection. To make the right decision, set this threshold correctly. During these four stages, the iris is represented at three levels: pixel-level (segmentation and normalization), feature-level (feature extraction), and bit-matching.

Iris biometric systems have become increasingly popular in a variety of fields, including e-government, since they are very accurate and do not require any physical contact. Here are some important considerations regarding the implementation and utilization of iris biometric technologies in electronic government:

1.Access Control: To improve safety and simplify the process of managing access, government buildings have begun implementing access control systems that are based on iris technology. Not only do these systems provide a high level of accuracy, but they are also difficult to share or reproduce.

In the realm of electronic governance, the technology of iris recognition is also utilized to do time and attendance tracking. Employees can validate their identification in a matter of seconds thanks to the fact that it offers accurate and quick authentication.

2.Iris biometric systems are utilized in healthcare organizations to guarantee the correct identification of customer and visitors, as well as to regulate access to important areas of the facility. Individuals can be identified more quickly with the help of these technologies, which is especially useful in emergencies where customer might not be able to produce documentation.

3.Law enforcement: In their operations, law enforcement agencies use iris-based biometrics for a variety of purposes. For instance, iris readers that are incorporated into computerized asset lockers guarantee that only authorized personnel can access weapons and evidence. To identify individuals in airports and train stations, handheld iris-based devices are utilized. Additionally, self-service kiosks equipped with iris cameras are utilized to facilitate the entry of authorized non-residents into specific countries.

4.Voter Registration: Iris biometrics have been adopted in several nations and territories for voter registration and identification verification during elections. The use of this technology offers a solution that is both dependable and accurate for certifying the identity of citizens.

Even though iris biometric systems provide great accuracy and operate without the need for touch, it is essential to be aware that there may be certain restrictions or factors to take into account. One such limitation is the influence that ocular disorders have on the accuracy of the system..

1.13. E-government in Jordan services

In the third decade of the 20th century, various e-government applications emerged. E-government is a modern concept that uses information and communication technologies to improve government-to-citizen communication and government-to-government dealings. Some believe that building e-government encourages society to enter the digital world and develop modern information and electronic communication systems as the basis for community facilities, including education, health, commercial, economic, and administrative transactions [66, p. 211–230]. Most countries are actively seeking to implement e-government by harnessing information technology and communications during implementation.

E-government, introduced by the World Bank in 2005, is the process of using institutions for information technology (such as Internet networks, broadband information, etc.) to change and transform transparency and more efficient management of institutions to enhance relations with citizens by accessing information, which provides more transparency and more efficient corporate management [68, p. 5–18].

According to the UN, e-government is when government agencies use information and communication technology, like external communication networks, Internet sites, and computer systems, to change how they work with citizens and their businesses.

To complete administrative operations, provide utility services, and communicate with employees in a more democratic manner, modern governments are turning to e-government, which has been characterized as e-services over the Internet and the use of digital information technology." "synonymous with streamlining government procedures and facilitating the bureaucratic system for citizens, by providing services to them swiftly and equitably, within a context of honesty, openness, and government accountability.

According to the advanced definitions, e-government involves using information technology, such as databases, information networks, and modern communication methods like the Internet, to improve citizen services and make them more effective, efficient, transparent, and accountable. One way to enhance government services is by saving time, effort, and money [69, p. 56–66].

E-government goes beyond using technology to serve citizens. Instead, it uses advanced electronic methods to complete all work inside and outside government institutions and represents citizen-government participation.

According to the 2018 UN E-Government Survey, all 193 states had national portals and back-end systems to automate core administrative tasks. Online payment, income tax submission, and new business registration are the most popular online transactional services in 140 nations. Statistics show a significant increase in countries with e-government.

E-government projects aim to increase government transparency and accountability. [70, p. 3–9] E-government services are convenient because they are not limited by distance or hours [71, p. 270–276]. Governments and citizens benefit from 24/7 service. A full-time worker can renew their driving licence without visiting a government office. [72, p. 609–618] stated that government officials must consider cultural factors when making e-government decisions, implying that geographical and cultural changes are needed for successful adoption and implementation. E-government empowers citizens by listening to their demands [73, p. 299–306], [74, p. 189–203].

The use of technology in government has led to more openness, efficiency, and citizen engagement. Although m-government is the wave of the future, poor nations will require solid infrastructure to put money into and enhance e-government. Strategic decision-making is necessary as AI and big data affect e-government operations. [75, p. 99–109].

Contradicting [75, p. 99–109], the statement that decision-makers now listen to citizens and mediate proposed legislation also suggests that decision-makers underestimate users as innovators. stated that social media influence decision-makers [76, p. 1354–1361] and that government support and resources are essential for e-government implementation.

There may be a correlation between citizens' faith in government, their quality of life, their contentment with their local administrative districts, and their usage of government-run social media and e-government platforms. Services evaluation. Citizens' satisfaction with and trust in government will increase as their government increases its use of social media, leading to a positive correlation between citizens' positive evaluations of their administrative district's quality and their government's use of social media[77, p. 351–358], [78, p. 291–304].

Pillars of E-government

1. Consolidating information and interactive and exchange services on the official government website, similar to government department complexes.
2. Maintaining 24/7 public contact year-round to meet all citizen information and service needs.
3. Accelerating linking, coordination, performance, and achievement between and within government departments.
4. Generating lots of spending and commercial government revenue

E-government goals and benefits

E-government primarily aims to improve administrative performance by achieving the best results in activities and services. Benefits include.

1-Enabling information storage and retrieval to foster administrative activity. Improved services boost citizen confidence.

2-Simplifying and speeding up administrative tasks to serve the most customers and avoid long lines at the administration.

3-Reducing administrative costs and operations while improving administration efficiency through interactions with individuals and institutions.

4-The factor of administrative interests exploiting personal relationships is reduced by eliminating or limiting direct transactions between the parties.

5-The electronic archive took the place of the paper archive because it could be changed easily and mistakes could be fixed quickly.

Components of e-government implementation

1. The Ministry of Post and Information Technology and Communication is in charge of setting up a very advanced communications infrastructure.
2. widespread Internet use for all government-to-person transactions, whether legal or not
3. Access to computers is essential for e-government.
4. The need for laws that regulate e-transactions, guarantee documentary security, protect private data, and protect e-signatures.
5. Providing qualified human resources: The director of information systems, the director of data processing systems, the programmer, and the systems analyst are crucial to e-government success.
6. Re-engineering government work procedures: E-government requires rethinking and digitizing government procedures.

E-government interactions

E-government encompasses many entities and processes, but its foundation is four types of interactions, according to the e-government toolkit for developing countries [80, p. 28-45].

Tax services, paperwork, and the usage of licenses and papers are all examples of e-services that demonstrate state sovereignty. Services supplied by the state to the general people to meet their most fundamental requirements are also examples of social infrastructure [81, p. 81–97].

1.E-government transactions with citizens (G2C)

According to[82, p. 137–163], Certificates of registration in the commercial or industrial registry, as well as certificates of conformity to environmental and health conditions, are just a couple examples of the types of public and private documents that can be obtained by citizens through government websites and do not require identity verification. Official government websites may offer certificates like death, marriage, and divorce can also be obtained online. As Education certificates. And Passports and IDs. Since the law has secured the procedures for obtaining documents, their delivery is manual, and obtaining these private data requires verifying the requester [83, p. 651–674].

2.E-government transactions with a business organization (G2B)

The government regulates, collects, and supports the business sector regardless of the service or product offered by private sector institutions, and electronic tax payment is one of the most significant services it provides to company organizations [84 , p. 13–20,].

3.Transactions between governmental organizations (G2G)

It coordinates government agencies to work together at all administrative levels and includes the relationship between central and local agencies, such as the exchange of data and information on regulations and laws, work systems, and business procedures. Government agencies are linked via the Internet. integrating multi-agency government services [85, p. 261–266].

4.Internal services provided to employees of governmental organizations (G2E)

To improve employee performance and clarify business practices, information technology is used in human resources management, including self-services for employees like obtaining licenses, accessing efficiency reports, and e-training, and depends on integrated databases for government employees. Age, qualification, employment, academic degree, and marital status indicate it [83, p. 651–674.].

The difference between traditional government and e-government

Table I compares traditional and computerized government, according to[73, p. 299–306]. The table comparison may provide some benchmarks for E-government project success, where certain standards or measurements can be set to determine how well the E-government changed old procedures to those desired from E-government adoption.

Such standards can enable e-government implementers to identify shortcomings and opportunities for development or construct a process control unit to monitor e-government performance. (e.g., monthly transactions). On government factors, the authors also compared industrialized countries like the United Kingdom to developing countries. as show in Table (1.13.1) explain differences between traditional and e-government.

Table 1. 13.1. Differences between traditional and e-government

Traditional government	E-government
Formalized procedures, a defined chain of command	Customer service and community participation, flattened or hazy organizational structures
Focus on processes	Putting the customer first
Separated data gathering and administrative tasks	Focus on providing resource-based information
Breakdown of barriers between units or functional specialization, prejudice towards certain regions	Integration of government, dissolution of barriers between units
Decisions on uniform rules and awkward reporting approvals	Negotiated agreement with unstated checks and approvals
Independent administrative tasks Fragmented systems of information technology Procedural length	Comprehensive support for resources

E-services in E-government

E-services change Web use. It publishes corporate functions on the Web for universal access. Below, we describe the benefits of this architecture to e-business.

Additionally, "e-service" refers to services provided using information and communication technologies. Various fields utilize e-services. E-business and e-government are e-services' main applications (or non-commerce). E-services are Internet services. [87, p. 192–196] E-services include online order processing, application hosting by ASPs, and any web-based processing capacity. [88, p. 383–392.] . claims that Internet services may be bought and sold, unlike traditional websites, which simply provide descriptive information. E-services are Internet-delivered online services. "An e-service is an activity or set of activities that take place during the contact between a supplier and a client through an e-channel [26, p. 1–14],[89, p. 311–316], [90, p. 960–967] described e-services as intangible, of a process nature, homogeneous, inseparable, non-owned, interactive, self-serving, and non-rival. The European judiciary defines e-services as Internet services or resources that promote communication between citizens, enterprises, and European institutions [91, p. 679–700]

In Council Regulation [92, p. 100–125], "e-services" are those that are "delivered over the Internet (or an e-network that relies on the Internet or a similar network for its provision) and are heavily dependent on information technology for their supply," according to the definition. Such services are "essentially automated, involving minimal human intervention," and "would not be viable without information technology." Website delivery and web hosting are examples of electronically delivered services, while radio and television broadcasting, telecommunications, electronically ordered and processed commodities, etc. are not.

E-services categorization

1. E-services to supplement tangible goods and services (e.g., online reservation of seats in an aircraft).
2. E-substitutes for physical services (e.g., electronic auctions).
3. New online-only e-services (e.g., online search through search engines).

Main features of e-services

1. Provision through ICT mainly the Internet.
2. Direct or indirect use through ICT mainly the Internet.
3. Possibility of charging by provider.
4. Principle of self-service – physical interaction between user and provider is not required.

E-services , by whatever definition or set of features, are services delivered using information and communication technology (ICT). But, it is also important to take into consideration the procedures (inside the service provider's organization) that are designed to deliver the service.

E-service characteristics

We need to define "e-service" before discussing government-provided public e-services. E-services are delivered electronically. [93, p. 10–23] A service. The Latin term "servitude" means "slavery" and has many meanings. Today, it might signify serving, helping, or providing a public need (ibid.). Academic papers have more detailed definitions. Traditionally, service is an activity. Marketing scholars [94, p. 163–172], any act or activity one party can give to another that is fundamentally intangible and does not result in the ownership of something," is how you could define service. A tangible result is not guaranteed. This study concludes that intangibility, inseparability, and heterogeneity are what set services apart from tangible goods. Intangible goods include services, or performances [95, p. 168–178].

To ensure quality, most services are hard to count, measure, test, and verify before sale or use. Many services are produced and used inseparably. The customer's or client's and service provider's interaction determines service quality. Services vary by producer, customer, and time. [96,p.97-105] refers to this as heterogeneity and variability, with the addition of perishability.

Implementation requirements for governmental e-services

The following are some definitions and explanations of e-government or e-services offered by various authors: The term "e-government" refers to a government that runs its operations and provides public services using electronic means, such as the Internet. E-government refers to the provision of government services using information and communication technologies such as computers, smartphones, and tablets [97, p. 1–9].

E-government uses ICTs to improve government efficiency and effectiveness, simplify access to public services and information, and promote openness, good Government, and accountability to the public during service delivery [98, p. 100–105].E-government involves service automation, ICT devices, and innovative technologies to supply public services to citizens and integrate and coordinate government institutions like ministries, authorities, agencies, and departments for seamless operation [80.p 40-65].

E-government is a model for delivering and managing government services that take advantage of digital networking and information sharing [99, p. 254–258].E-government is defined as a full and reliable promise by the government to improve interactions between citizens, the private sector, and the government by using digitalized and computerized systems to reduce the cost of providing public services.

Governmental service in commerce applications

Mobile commerce is an emerging trend observed globally, with young individuals increasingly adopting the platform for its advantageous features such as flexibility, simplicity, and convenience in doing online shopping via mobile devices. The impact of various characteristics of mobile commerce service quality on the perception of service quality and customer satisfaction is examined. The concept of satisfaction refers to the state of contentment or fulfillment that individuals experience when their mobile commerce has been found to positively influence the inclination of customers to revisit a certain platform or website. We developed the study model based on the established framework.

Models like the SERVQUAL model have played a crucial role in the advancement of e-government by incorporating artificial intelligence. The SERVQUAL model,

often used to assess service quality, has been particularly influential. The authors of this work are Parasuraman, Zeithaml, and Perry. It aids firms in quantifying and managing the quality of their services.

The SERVQUAL model examines many dimensions of service quality and its perception by individuals. Through the use of questionnaires, polls, and other qualitative thesis methodologies, firms may get substantial insights into the experiences of their consumers. This tutorial explores every aspect and offers advice on using the SERVQUAL model to enhance the overall quality of service. The SERVQUAL model is a tool that specifically assesses the disparity between individuals' service expectations and their actual perceptions of the service they receive. The SERVQUAL approach facilitates the identification of deficiencies in service delivery and provides insights into areas for improvement.

According to the SERVQUAL model, consumers' impressions of five fundamental dimensions - tangibility, dependability, responsiveness, assurance, and empathy - accurately predict their evaluations of service quality.

SERVQUAL uses a questionnaire, including specific statements for each category, to assess the quality of the service. Customers evaluate their expectations and perceptions of the service using a Likert scale, often ranging from 1 (strongly disagree) to 7 (strongly agree). Evaluation is the gathering of data on customers' expectations and the actual outcomes they get. This enables organizations to assess the two and identify any discrepancies.

The SERVQUAL model calculates the gap score for each metric by subtracting the average expectation score from the average perception score. A good disparity score indicates a discrepancy between consumers' perceptions and their objectives, highlighting areas that need modification.

The SERVQUAL approach enables firms to identify specific areas that need attention to enhance the quality of their services. It provides organizations with a means to quantify and enhance customer happiness, aiding in their comprehension and fulfillment of consumer expectations. SERVQUAL applications Below are some

SERVQUAL applications that enhance the use of e-government applications and that came as a measure to raise the efficiency and clarity of artificial intelligence.

1. Measuring service quality SERVQUAL evaluates the quality of customer service. Helps determine customer expectations versus service impressions. This data can help detect service quality problems and develop solutions.
2. Evaluate customer satisfaction. Understanding customer satisfaction can help retain and recruit customers. SERVQUAL is a measurement tool used to assess customer satisfaction. Companies can evaluate how well their services align with customers' needs by comparing customers' expectations and views across the five dimensions.
3. Service improvement and innovation. Service providers can use SERVQUAL to identify opportunities for improvement. Organizations can focus on improving customer perceptions by assessing the gaps between expectations and perceptions in each category. This aids service innovation and continuous improvement efforts.
4. Competitive benchmarking. SERVQUAL may evaluate service quality across companies in the same industry. Organizations can determine their competitive positioning, strengths, and weaknesses by measuring and comparing customer perceptions and expectations. This data informs competing strategies.
5. Training and Development: SERVQUAL identifies the training and development needs of service personnel. Organizations can discover training needs by examining the dimensions on which service providers score low. This improves employee and customer service skills.
6. Service Recovery SERVQUAL can evaluate the recovery process after a service breakdown. Organizations can evaluate recovery efforts by comparing customer perceptions before and after an outage. This improves service recovery strategies.

SERVQUAL is an effective method for assessing and enhancing the standard of service quality. It offers a systematic approach to determining client preferences and gauging their sentiments in many areas of service excellence.

Through quantifying the extent of disparity between these expectations and views, firms may identify areas for improvement and prioritize their efforts accordingly. Adopting SERVQUAL may result in increased customer satisfaction and loyalty, ultimately leading to improved corporate performance over time.

SERVQUAL is a renowned methodology for evaluating service quality that may assist organization using Question-Pro as their survey platform in gaining valuable insights. Organizations using Question-Pro as their survey platform can readily use the SERVQUAL Dimensions in conjunction with Question-Pro's robust functionalities and tailored survey templates.

Question-Pro enables organizations to efficiently gather and analyze customer expectations and views, identify areas where service is lacking, and make data-driven decisions to enhance service quality. We derive this model to examine and assess the degree to which e-government incorporates artificial intelligence.

Dimensions related to information and system quality derive elements incorporated in the service quality model, known as SERVQUAL. Partial Least Squares (PLS) 3.2 is a non-compensatory analytical approach that involves the use of artificial neural network analysis. As a consequence, the parameters of responsiveness and cognitive control exhibited a substantial relationship. This pertains to the overall service quality in the context of mobile commerce. The degree of usefulness of content pertaining to information quality.

One of the most significant is strategic institutionalization, e-Government, administrative organization, and services. Government transactions gradually include employee education and training, client quality and education, issuing and amending relevant legislation, and ensuring information security and protection in e-administration.

Data [100, p. 91–102] The information network, considered an essential part of e- Government, has continued with rapid development and widespread deployment around the world to become what it is today, used in various fields, including education, and perhaps one of the most important factors that encouraged the rapid spread of the international information network in various areas: abundance The numerous sources

of information and direct and indirect interaction through which people can communicate via email, video conferencing, and other means (Relay-Chat) Information accessibility, exchange, and speed of multidirectional communication are one-to-many [101, p. 889–891]. He claims the international information network will improve communication.

Management and personnel, like typical libraries' information sources, identify and use information that requires certain skills. As it offers employees the newest global advances in their field of expertise through scholarly publications and action plans, its value grows daily. [102,p 1-4] learning, The international information network provides an atmosphere [103, p. 13–21]—a new cooperative where workers may collaborate, discuss, and solve problems. [104,p. 347–366] Managers rely on international information in information systems. Their major information encyclopedia

Specialized databases in their industry allowed staff to deliver extensive information. From their fields, using methods that would have been possible but unlikely without them [105, p. 959–965.]

E-government adoption to use AI

The United Nations found in 2014 that the adoption and use of e-government services were higher in countries with clear national visions and strategies, strong and committed leadership support, well-established legal frameworks (policies), collective Government frameworks, and improved ICT infrastructure.

E- Government can be strengthened by ensuring that all members of the population have access to and are taught to use computers. [106, p. 5–20] asserts that individuals' familiarity with and usage of the internet and computers (technical skills) have an impact on the success of e-government initiatives worldwide. Acceptance and use of e-government depend on a number of factors, including but not limited to users' Internet and computer skills, knowledge, government backing, and readiness. [107, p. 115–130].

Presently, organizations worldwide are experiencing a period of rapid digital transformation, where the intersection of technology and business presents novel

difficulties and prospects. AI is essential in this context, as it serves as a vital instrument for strengthening organizational performance and improving the institutional structure of these organizations. AI is a potent technology that utilizes programming and ML concepts to empower organizations to accomplish optimal outcomes and adapt to the demands of the contemporary day.

Applying AI to enhance organizational structure enables the exploration of novel opportunities that facilitate the development of production processes, optimization of resource management, and enhancement of the customer experience. This article aims to examine the significance of AI in enhancing institutional structure and its possible advantages for contemporary organizations.

1.The importance of artificial intelligence in improving institutional structure

By using AI technology, organizations can efficiently and precisely analyze vast volumes of data, enabling them to identify intricate patterns and trends that would be difficult to discern via human methods. AI can analyze both systematic and unsystematic data, therefore uncovering concealed links and connections among various variables. These profound insights enable organizations to make more precise strategic choices and gain a deeper understanding of market behavior and client requirements.

Using ML and AI has the capability to acquire knowledge from historical data, forecast forthcoming patterns, and discern prospects for advancement and enhancement. AI can examine client behavior, make predictions about future purchases, and construct models that can anticipate sales and inventory levels. This data may further serve as a guide for marketing initiatives, enhance resource planning, and attain a more optimal equilibrium between supply and demand.

AI is more than a mere technological tool it signifies a paradigm shift in how organizations handle information and make choices. It offers the organization excellent skills for data analysis, enhancing decision-making, and strategic guidance, providing them with a significant competitive edge in the commercial market.

Incorporating AI into a business architecture requires a thorough strategy and efficient management of digital transformation. Organizations should allocate

resources towards acquiring suitable technological infrastructure and provide the requisite expertise and training to those responsible for implementing artificial intelligence. organizations should also be cognizant of the ethical dilemmas linked to the utilization of AI, including issues of privacy, prejudice, and openness in data acquisition and utilization.

2.Improving internal processes with artificial intelligence

Enhancing internal processes is a crucial endeavor that organizations encounter in their pursuit of efficiency and competitiveness. AI plays a significant role in delivering inventive solutions to enhance an organization's operations and attain exceptional performance.

Organizations may get deeper and more accurate insights into their internal processes by using AI methods such as big data analysis and ML. Additionally, it has the capability to identify vulnerabilities in operations, propose enhancements, enhance productivity, and minimize expenses. For instance, AI can examine manufacturing procedures, enhance the consistency of workflow, and eradicate any superfluous replication or periods of inactivity in an organization's activities. AI may also be used for the analysis and enhancement of administrative procedures, such as inventory management, production planning, and schedule coordination.

3.Digital transformation and improving institutional architecture.

Organizations rely heavily on digital technology and AI to drive their digital transformation. AI enables organizations to optimize their corporate framework and boost their efficiency and operational efficacy.

Artificial intelligence has the capability to analyze a wide range of data and convert it into useful knowledge, thereby facilitating the process of making well-informed strategic choices. Furthermore, AI can improve the efficiency of internal operations, including inventory management, distribution, and manufacturing. AI can analyze data with more precision and speed compared to humans, resulting in decreased mistakes and enhanced operational efficiency.

Facilitates buyers and users of e-applications by providing product recommendations and ideas. Many ML elucidate the principles on which this thesis is

founded. To accurately forecast future orders, it is necessary to have extensive data on customers' buying patterns for various stock-keeping units (SKUs) at retail outlets. This data should include details on customers' preferences and shopping habits. Companies typically acquire this kind of information by storing data related to orders, products, and customers in databases. Additionally, it is important to consider external variables such as meteorological conditions, public holidays, and scheduled activities. Typically, external sources acquire the data and integrate it into the AI programming for users of e-apps. Data assimilation refers to the systematic transmission of data from several sources to a designated target location. This procedure entails using distinct connections for every data source and intended destination.

Azure Data Factory offers a range of connectors that enable data extraction from many sources, such as databases, file systems, and cloud services. Microsoft and third-party suppliers develop these connectors to effectively interact with various data sources.

Training a machine-learning model is also a viable option. ML is a computational technique that uses an algorithm to identify and comprehend patterns within data. In this scenario, it aims to establish a model capable of properly forecasting a customer's future purchase.

Jordan e-Government

Jordan's MOICT implements the e-Government plan (Jordan e-Government, 2013 [107,p. 115-130]. This strategy encourages government institutions to provide high-quality, performance-driven services to residents, corporations, the government, and employees. This plan also includes e-Government national objectives, strategic initiatives, national projects, and strategic objectives, as indicated in Figure 1.14.1. e-Government national objectives and strategies in Jordan

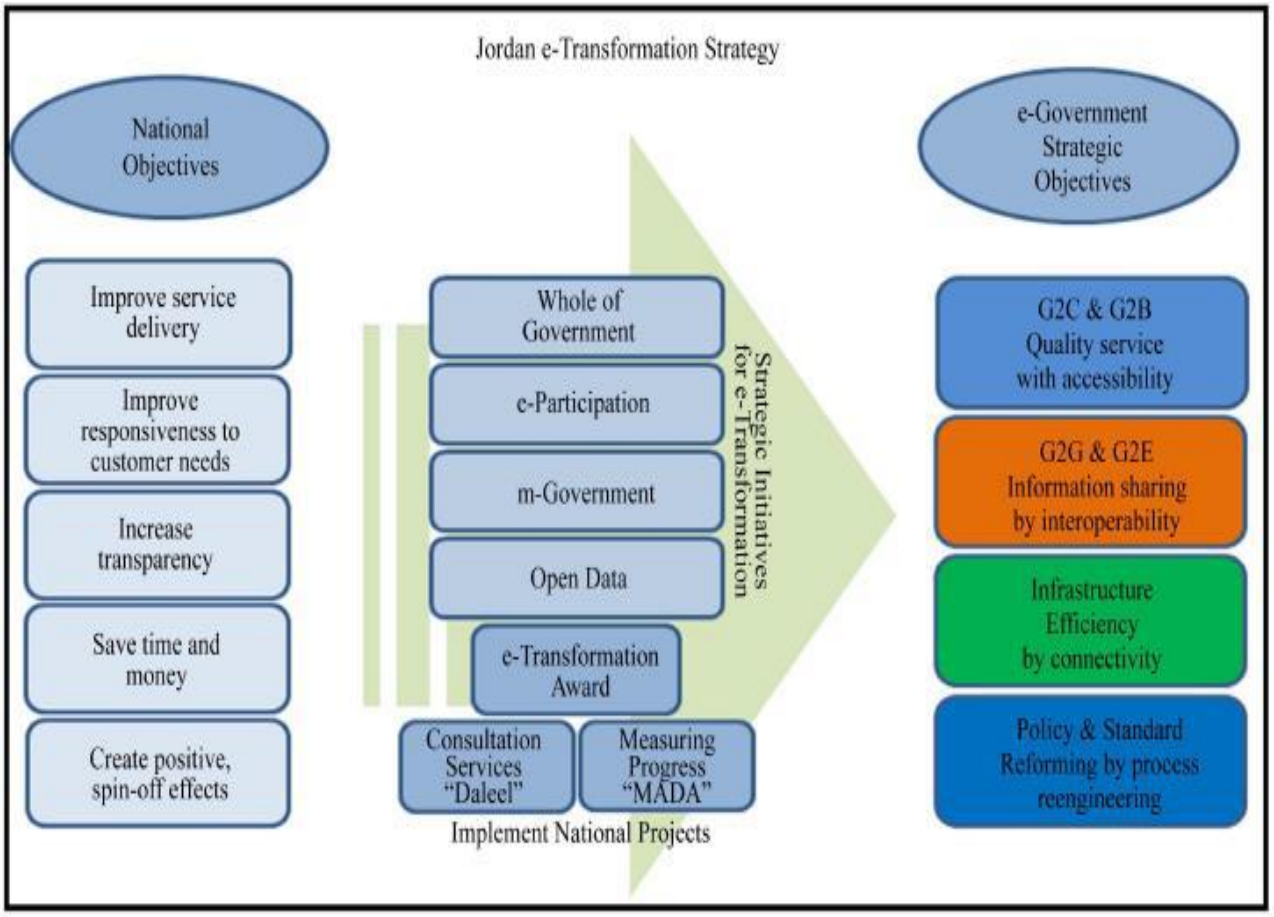


Figure 1.13.1.Jordan e-Government strategic

National objectives and strategic initiatives and implementation of national projects in the Jordanian government

E-government national objectives

Jordan's e-Government program can achieve its objectives by improving services to individuals and businesses Jordan E-site]some Examples.

1. Speeding up government interactions with stakeholders (G2C, G2B, G2G, and G2E) with high-quality service.

2. Improving responsiveness to supply public sector services and information through new accessible channels.

3. Enhancing government transparency by improving service accessibility and information availability.

4. Saving time and money Common technological standards, policies, and financial reform will boost government efficiency.

5. Building up the government and businesses' ICT skills to make Jordan's economy and society more competitive.

Strategic initiatives

E-government can help national development; therefore, the right initiatives will fulfill the key strategic goal these initiatives cover:

1. Whole of Government Approach: Technology optimization enables public service innovation and productivity growth.

2. E-Participation: By enabling citizen participation in government activities This will allow citizens to influence government decisions and improve user happiness.

3. M-Government: Using mobile devices to improve and simplify government services for stakeholders.

4. Open Data: Anyone can share government data. Making this data public increases transparency and citizen participation in decision-making.

National projects implementation

During the strategy period, Jordan e-Government launched three primary projects to focus government entities on e-Transformation .The three projects launched were:

1. The e-Government Award: This competition honors revolutionary e-Government and IT achievements. The initiative raises e-Government awareness and knowledge in order to sustain e-Transformation.

2. MADA: Assessing government entities' Enterprise Architecture Framework-based e-Transformation Progress in Jordan.

3. Daleel: Consulting on business growth and government e-transformation.

E-government strategic objectives

Key Performance Indicators (KPIs) will be applied to all services, information sharing between government entities, measuring the connectivity within and between entities, and reforming the business process reengineering ([108, Jordan e-Government, 2013). To reach these strategic objectives, measurement metrics will be applied to the following areas.

1. G2C & G2B: The quality of government-to-citizen and government-to-business services, as well as their accessibility to individuals and businesses, will be evaluated using KPIs.

2. G2G & G2E: Measurements will be used in government-to-government and government-to-employee services and interactions to assess the degree to which information systems are interoperable and how much data and information are shared among government bodies. G2E analysis considers the extent to which information systems are used by workers and the value they provide.

3. Infrastructure efficiency: Improving connectivity performance by applying standards for connectivity across government organizations and inside these organizations.

4. Policy & Standard: The efficiency and efficacy of e-transformation may be improved by business process reengineering by implementing regulations and standardization inside ICT.

E-government service in Jordan

Many countries are pursuing e-government efforts to improve public services and promote public objectives. The Internet and WWW are used to provide citizens with government information and services [109,p 286-300,], [110, p. 159–179].

The Hashemite Kingdom of Jordan wants to implement e-government transactions and digital transformation to minimize processing costs, improve service delivery, and boost openness and communication with the public. The program is part of the Kingdom's development initiatives and programs to attain sustainable and all-around development [111,p 345-350] Jordan site].

The 2001 National e-Government Initiative had high ownership. This plan aimed to create a competitive knowledge society with dynamic economic conditions. Jordan has developed realistic methods to achieve strategic ambitions and improve society, the economy, and government.

Building the infrastructure required to exchange and supply government services is central to the e-government program's mission to boost the use of e-government by enhancing service quality, reducing response times, and enhancing the user experience.

The government provides 2,460 services, 403 of which are automated, based on their value to citizens and businesses. The applicant can access the automated government service via several methods (such as the Internet, a smartphone, or electronic kiosks). Submitting, following up, and receiving the response online with the possibility to pay fees or financial dues via a range of e-services that serve local and non-local citizens These e-services are also in high demand, which has become a sign of community need and user convenience.

E-government in the public sector

The Jordanian public sector—also known as the state sector—includes public services and institutions. Include government, utilities, and public services.

The public sector offers several community-benefiting services. E-services for all government sectors are government-provided.

An e-site delivers all Jordanian government e-services , including news and application explanations. Jordan’s Internet and e-government portal Jordan began its e-revolution when the Ministry of Digital Economy and Entrepreneurship, a public sector institution, launched the Internet.

Jordan's fixed and mobile Internet providers are the Ministry of Digital Economy and Entrepreneurship and private firms. The Jordanian government began e-government efforts in early 2000 to benefit its citizens. Jordan's e-government portal is www.portal.jordan.gov.jo. E-government service users can find all government services and amenities on this website. E-services in the areas of education, real estate, immigration, construction, leasing, building, employment, and retirement benefits are all available through the e-Jordan site. (www.portal.jordan.gov.jo). e-sections Jordan's are:

1.The most recent updates on forthcoming e-government events may be found in the announcements section.

2.The News area features the latest and most important stories from a variety of government agencies. Information about popular tourist destinations in Jordan, means of transportation to and within the country, restaurants, hotels, shopping areas, essential services, visa procedures, weather news services, etc. can be found in the Tourist

Information section, while the Open Data section provides access to common data sets published by the Jordanian Government and other organizations, such as statistics, reports, and surveys.

3.Jordan The section contains information about the government, statistics, the environment, strategies, and policies. Monopoly, legal involvement, and the specifics of the data needed to access various transactions are all aspects of government public sector e-services. Customer (or 'user') choice is another important differentiator; in private-sector e-commerce, a user can choose from several different companies, but in e-government, there is only one government entity that provides that service. This leads some to argue that to create citizen-centered e-government services, governments must first learn what motivates their constituents to use these services.

In practice and perception, the content, delivery, and user happiness of an e-service are all thought to contribute to its overall quality. perceived usefulness/reuse intentions While content and delivery quality do affect customer happiness, Although citizens are unsatisfied with the government, they are content with government services given online due to other factors, including holistic trust and ICT knowledge. Thus, citizens may view e-government differently from traditional government services.

Azerbaijan's e-government

Azerbaijan implements programmatic governance. A presidential decree in Azerbaijan ratified the "Socio-economic Development Strategy of the Republic of Azerbaijan for 2022-2026" in 2022. This strategy aims to achieve consistent and strong economic growth, strengthen the ability to withstand both internal and external factors, and promote a dynamic, inclusive, and socially equitable society. The strategy additionally seeks to cultivate a skilled workforce, promote cutting-edge advancements, and establish Azerbaijan as a leading nation in sustainable growth during the next ten years. The strategy delineates five primary objectives at the national level, with a significant emphasis on the substantial recovery of the formerly occupied regions, seen as a crucial priority for Azerbaijan's goals by 2030. The Centre has implemented monitoring and accountability portals to oversee the socio-economic

development strategy for the period of 2022–2026, You can access these portals at azerbaijan2030.gov.az.

In 2019, the Republic of Azerbaijan achieved the 64th position in the global artificial intelligence assessment index. The United Nations conducts research every two years to evaluate electronic government applications. In 2020, the e-government index rate stayed unchanged at 70 compared to 2018. The e-participation index experienced a decline of 6 points, resulting in a value of 73. Azerbaijan lags the leading countries in the area and sub-region, namely South Korea and the United Arab Emirates, respectively. Nevertheless, Azerbaijan surpasses the global average benchmarks in terms of delivering electronic services in its region and sub-regions.

The Azerbaijani government is currently in the initial phase of implementing artificial intelligence technologies to address governmental matters. The government actively collaborates with industry experts and individuals from all disciplines to facilitate and establish the groundwork for this kind of transformation.

The Azerbaijani government's involvement can aid in providing a framework for standard-setting harmonization while the industry debates its standards for these technologies. Given the government's significant purchasing power in the market, we may leverage it to encourage private-sector acceptance of AI adoption guidelines and facilitate the widespread adoption of AI outside of public-sector firms. Undoubtedly, the extensive integration of technology following the COVID-19 pandemic has greatly aided AI. The convergence of ubiquitous digital adoption, exponential growth in data-driven analytics, and an unmanageable workload has prompted professional services organizations to reassess their traditional approaches. In less than five years, AI has transformed from a gloomy prospect to a useful ally. We have now reached a critical stage in the adoption of AI, where its practicality and effectiveness are surpassing the initial excitement about the technology. By the end of 2024, Deloitte predicts that 60% of global government agencies will adopt AI. Currently, almost 80% of organizations worldwide are in the initial phases of implementation.

Artificial intelligence (AI) is being used in program-based governance. The automation of procedures on the boyukgayidish.gov.az portal faced several obstacles, leading to the exploration of artificial intelligence (AI) as a potential solution. The main goals of incorporating AI into the monitoring and evaluation process and progress report production include the following: examination of organized and unorganized data. Conducting analysis on both organized and unstructured data, namely textual material, and generating concise summaries. Additionally, analyze data from several sources. Examining data obtained from various sources, such as live surveillance cameras, pictures, interactive and themed maps, and assisting in identifying project activity indicators, and consolidating information from official web resources.

The process involves gathering data not only from specific institutions but also from other authorized online sources, which enhances the dataset used for evaluating indicators. Additionally, the compilation of progress reports is automated. Automation of labor in the creation of progress reports, including the identification of accomplishments, recognition of emerging challenges and hazards, and presentation of well-informed suggestions; Improved retrieval of information using customized chatbots. The integration of customized chatbots into the portal enables the rapid retrieval of more comprehensive analysis using existing data within a limited time span. The "Next Generation Professional" survey conducted in 2018 by Devex and DAI shed light on the impact of artificial intelligence on M&E. Devex is a media platform and network center for professionals in the international development sector focused on achieving the SDGs. DAI is an international development consulting company that specializes in project implementation and technical assistance to address development challenges in different countries. According to a poll of more than 2,500 development specialists, almost 25% of respondents believe that artificial intelligence will have a substantial influence on monitoring and evaluation (M&E) in the future, perhaps leading to the transformation of M&E into a worldwide development field. The rapid advancement of artificial intelligence has led to various advancements in techniques for gathering, organizing, verifying, and analyzing data, all with the goal of enhancing monitoring and evaluation processes. Based on the data provided on the site,

it is considered possible to use artificial intelligence for several objectives in the process of monitoring and evaluation. Artificial intelligence possesses the capacity to examine data in diverse fields like education, health, and social welfare. This allows for an evaluation of the effectiveness of government programs and facilitates well-informed decision-making. Moreover, AI could predict forthcoming patterns and results by utilizing incoming data, playing a pivotal role in decision-making procedures, and enhancing resource allocation techniques. Utilizing natural language processing (NLP) for both syntactic and semantic analyses will facilitate the rapid processing, validation, and analysis of textual material input into the portal. Utilizing the capabilities of natural language processing (NLP) enables the processing and analysis of large amounts of textual data. It is highly proficient at extracting organized information from text that lacks structure, skillfully identifying important components, and converting data into a more structured and easily accessible format. This architecture significantly enhances the search functionality of the site, making it more efficient to get relevant information. Furthermore, NLP is crucial in the process of document summarizing, as it allows readers to access the key parts of a text without having to extensively explore its entire content. NLP's dynamic capabilities enable the utilization of personalized chatbots and virtual assistants, facilitating authentic and captivating interactions with users. One notable aspect of NLP is its ability to facilitate language translation, allowing the site to provide material in other languages. Computer vision (CV) enables the automatic analysis of photos and videos, providing the ability to identify and differentiate objects and patterns within visual data. This feature greatly enhances the understanding of the information stored in the portal. CV plays a crucial role in analyzing geographical features, recognizing landmarks, and collecting relevant data in the field of interactive and thematic maps. This augmentation improves the utility of maps by adding extra layers of information through the automatic analysis of visual features. Computer vision algorithms are crucial in automatically categorizing and categorizing photos and videos based on their content. This automated solution enhances user accessibility by simplifying the process of retrieving specified information through visual queries. Moreover, the use of CV's

application also encompasses the detection of potential security risks and the monitoring of infrastructure projects. In addition, CV streamlines essential procedures such as monitoring attendance and tracking the supply chain, providing a versatile solution to improve operational efficiency and boost security measures within the portal. Due to the large number of reports available on the centralized boyukgayidish.gov.az portal, it is difficult to efficiently get comprehensive information. A bespoke chatbot model was created for the specific situation, utilizing sophisticated natural language processing techniques such as GPT. The chatbot's customization is being enhanced through painstaking fine-tuning of specific data. Additionally, the model has undergone fine-tuning to improve its accuracy in delivering relevant responses. Regular monitoring, analysis, and changes to the chatbot's performance guarantee continuous enhancements. Consequently, customers may quickly access concise progress reports in Azerbaijani through the personalized bot on the page. These reports provide information on goal achievement, obstacles, and other relevant aspects.

This research study presents a new artificial intelligence method designed to tackle difficulties faced in program-based governance, namely in the monitoring and evaluation process. Firstly, we present a unique example of program-based governance that has been implemented in Azerbaijan. Our specific focus is on the digitalization of the monitoring and assessment process. This example explores the results and budget-focused monitoring and assessment processes within a centralized database framework. Therefore, we propose integrating artificial intelligence models by utilizing the existing database. This methodology aims to optimize the monitoring and evaluation process by utilizing the database, reducing dependence on human labor, enhancing user experience, improving accuracy, and expanding the portal's capabilities in identifying risks and challenges and performing predictive analysis. Our future involves testing the proposed artificial intelligence models on the site to evaluate various options for improving governance functions.

Azerbaijan's e-government plan for AI utilization is focused on using artificial intelligence technologies to optimize the efficiency and efficacy of public services and

governance. The Azerbaijani government acknowledges the potential of artificial intelligence (AI) in revolutionizing several industries and is actively striving to apply it.

Key elements of Azerbaijan's e-government strategy for utilizing AI encompass: The government engages in active collaboration and partnerships with industry professionals, academic institutes, and international organizations to foster the advancement and use of AI solutions. This collaboration facilitates the utilization of specialized knowledge and resources to stimulate creativity and guarantee the seamless incorporation of AI technologies.

Azerbaijan is now investigating the application of AI in several sectors, such as sports, agriculture, customs, contact centers, and language processing. AI is utilized in sports including football, wrestling, and judo to optimize performance and training. Agricultural drones are employed to monitor and enhance agricultural growth. The electronic government site "ASAN Login" employs facial recognition and AI-based systems for system access and authentication.

CHAPTER II. TECHNIQUES AND METHODOLOGIES

2.1. Chapter Overview

In this chapter of the dissertation, we talk about the relationship between AI and e-government services by designing and building an application that links between e-government services and the application that works on an AI system based on DL and neural networks, which is about a system that recognizes people through biometrics iris .introduces the technical and methodology parts. The biometric technology of the iris of the eye in registering users of government services is one of the most important smart technologies that directed the government to include it among the technologies used and develop it to work in various sectors to benefit from it in upgrading the services of the government and private sectors, as it is a smart tool capable of linking with the government database. The iris recognition system is an integrated system that contributes to enhancing the security system for its users in many transactions in various sectors to identify customers in a smart, fast, and accurate way in a high-tech environment.

2.2. E-government application

This part focuses on the application of AI techniques for citizen services in e-government. We begin with a discussion of the study's sample, which consisted of applications for visas and residence permits issued by the Jordanian Ministry of the Interior(MOI). Where the old system provides many services, the visa renewal system has been selected, which provides eight services Where the systems were traditional is not supported by any technology of artificial intelligence. Where we integrated these systems with iris recognition technology, which is an emerging application in artificial intelligence, as it was developed using powered by DL and troubleshooted the technical problems of the database. The model was developed with the goal of

answering the question, "How can we change these conventional applications into smart ones?" using iris recognition as biometric.

We also studied the possibility of adopting AI in these systems. Where we used a set of hypothetical data through which the extent of the possibility of using artificial intelligence in this application will be known

In these steps, we explain to a bout traditional model of how to use an e-government application in the MOI in Jordan this application is about the Visas and Residency System in Jordan and this system provides the website and mobile application .

- In this steps to show E-government application in website and mobile application

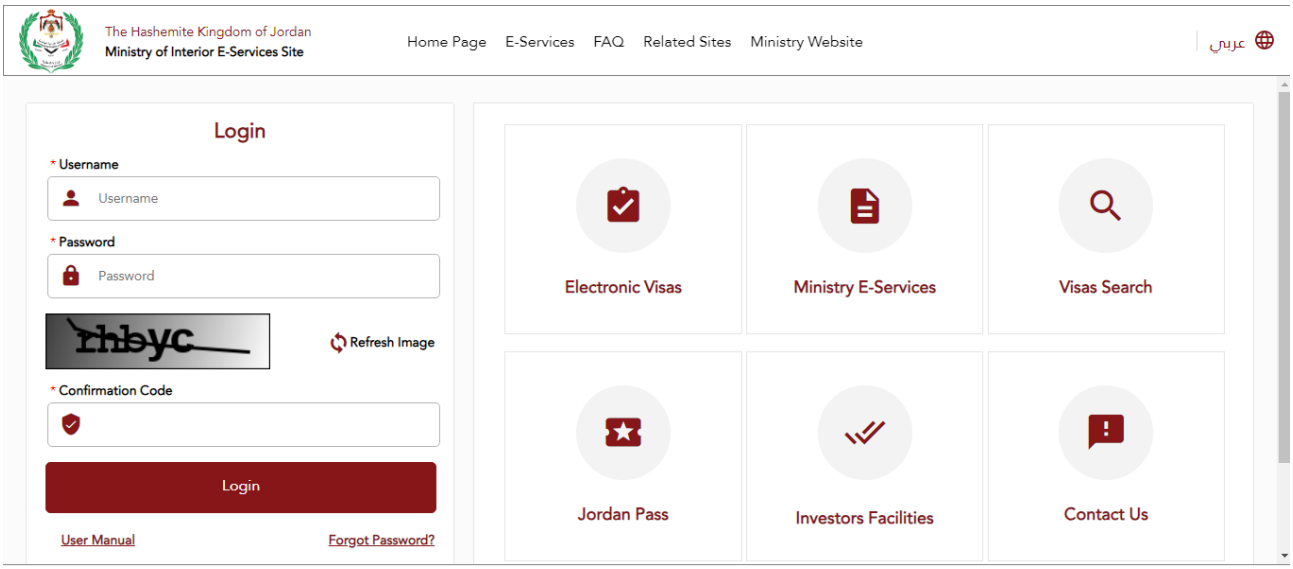


Figure 2.2.1. E-government application in website and mobile application

By clicking on the "Jordan Pass" symbol that is located on the homepage of the E-Services Site, users are able to quickly access the website for the Jordan Pass.

The E-services website may be accessed using a mobile application, which can be located and downloaded from the following locations: the Google Play Store, the Apple App Store, or the Huawei App Gallery.

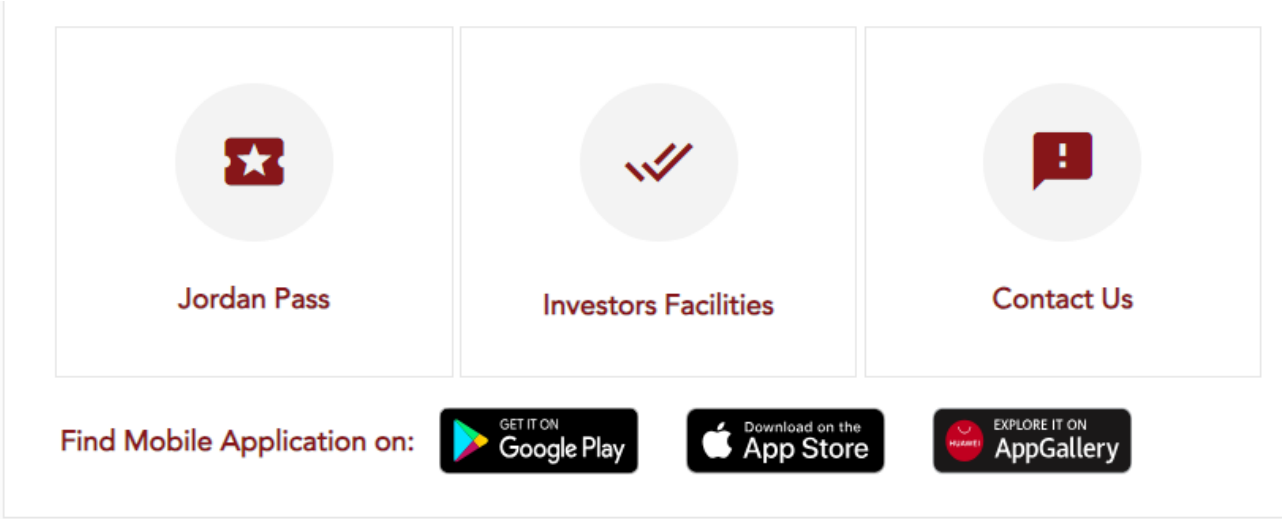


Figure 2.2.2. E-government application in mobile for MOI

- In this steps we start to create and sing into e-services and register using username and password and we start from the Figure 2.2.3 until 2.2.9 as the steps to using the (MOI) traditional application.

1. Create a new account by selecting "create New User" from the drop-down menu in the login box.

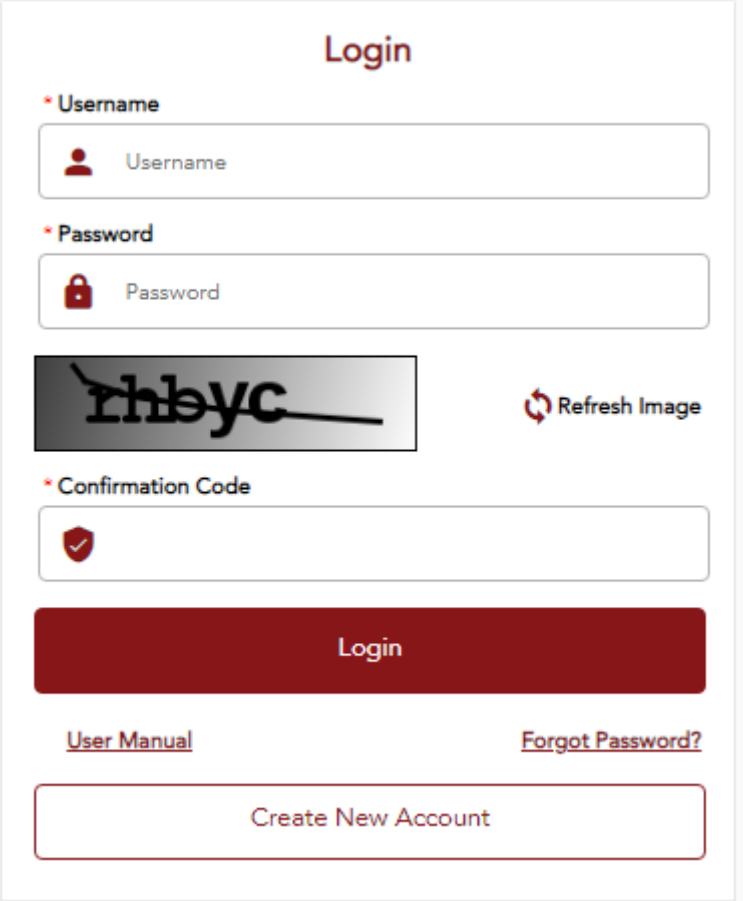


Figure 2.2.3. Sign in to MOI system traditional application

1. A list of the many forms of registration that are currently available will be displayed; select the appropriate type to open the registration form.

Figure 2.2.4 . Sign in to MOI system traditional application

2. The following is an example of an individual registration form; it has many tabs on the side, the first of which is an area for personal information, as seen in the example further down.

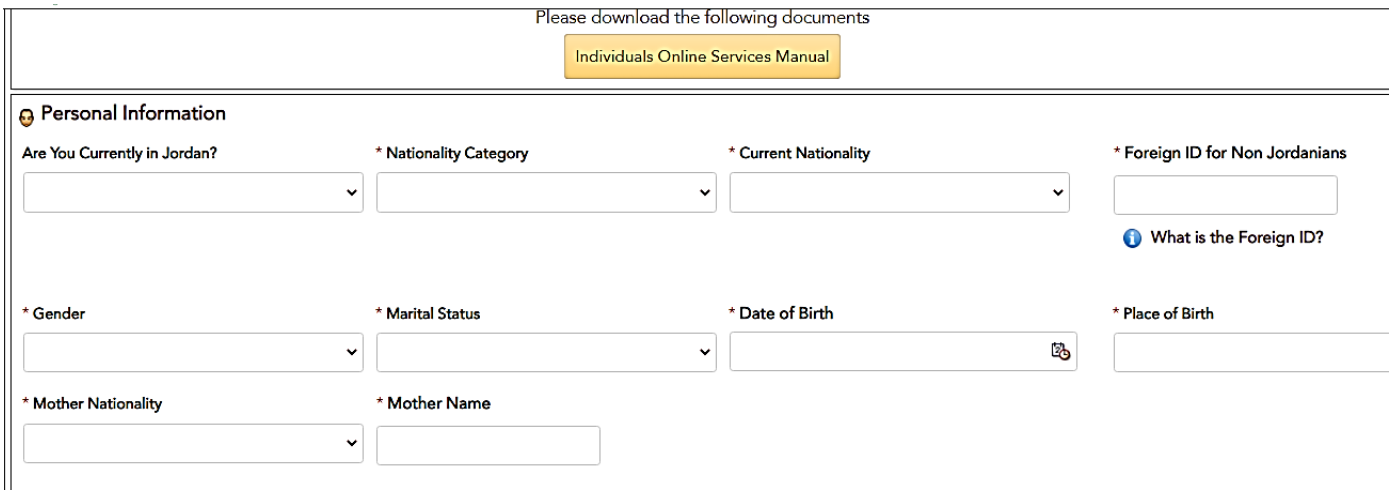


Figure 2.2.5 . Sign in to MOI system traditional application

3. Make sure that at least the required fields are filled out, and then scroll down to continue on to the next tab labeled "Passport and ID Information," as seen below.

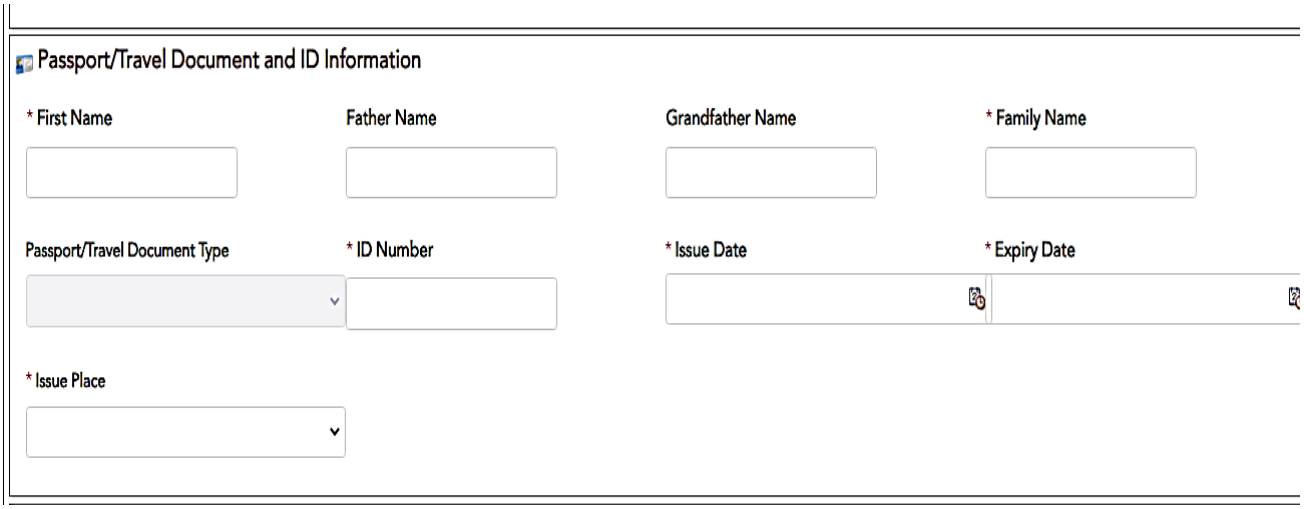


Figure 2.2.6.Sign in to MOI system traditional application

4. scroll down until you reach the box labeled "Contact and Login Information." The email address and cell phone number that you provide in this section will be the ones on which you get notifications, so be sure to use your actual email account and phone number.

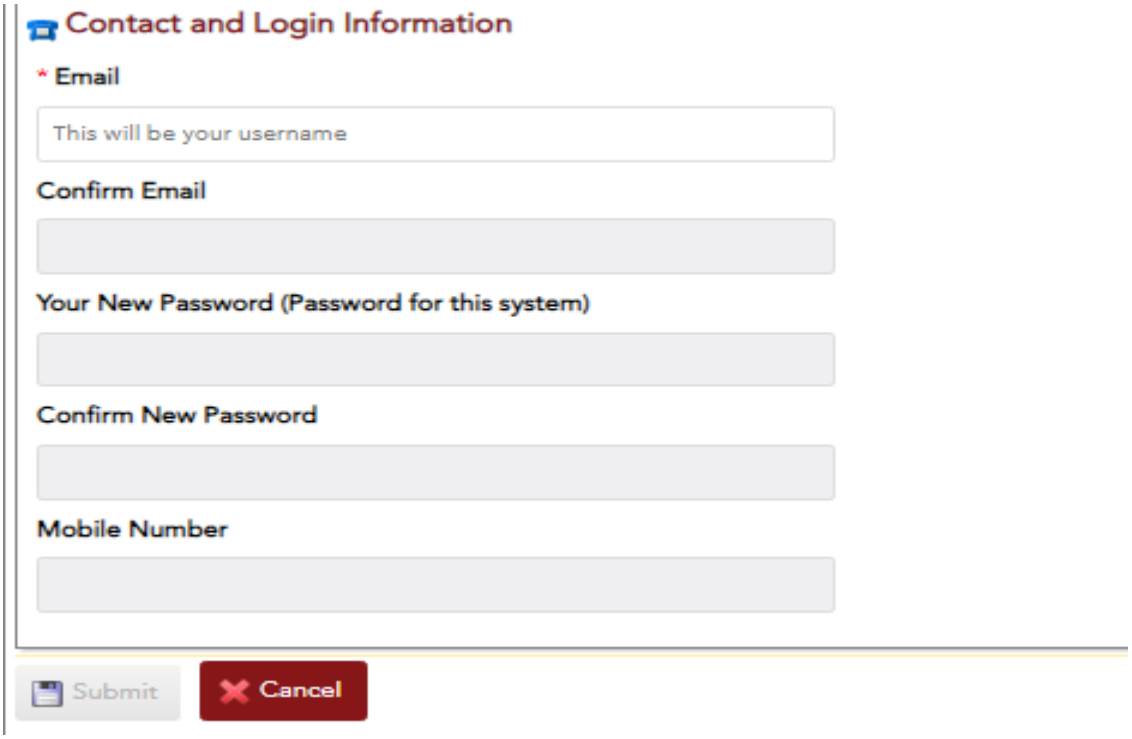


Figure 2.2.7.Sign in to MOI system traditional application

After you have clicked the "Submit" button to send in the form, you will get a series of confirmation codes through email and text message; these numbers must be entered into the Confirmation area before you can click the "Submit" button.

5. A notification will be sent to the user to follow in order to activate the account.

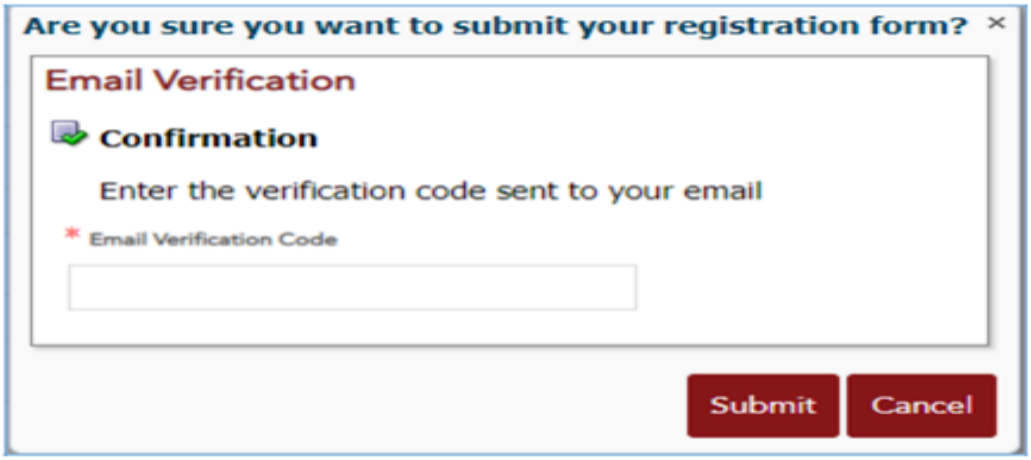


Figure 2.2.8.Sign in to MOI system traditional application

6. The login page, which will display the part mentioned above, will be launched. Complete the areas labeled "Username" and "Password" with the email address and password that you used to register for the service, respectively - In the Confirmation Code area, type the code that you see in the image; then, click the Login button to access the system.

   Notes: You have the ability to alter the confirmation code by clicking on the link that says "Refresh Image."

   If you do not remember your email address, you may generate a new password by clicking the "Forgot Password" link.

Figure 2.2.9.Sign in to MOI system traditional application

2.3. Applications adopted IRIS recognition

The biometric technology of the iris of the eye in registering users of government services is one of the most important smart technologies that directed the government to include it among the technologies used and develop it to work in various sectors to benefit from it in upgrading the services of the government and private sectors, as it is a smart tool capable of linking with the government database. The iris is an integrated system that contributes to enhancing the security system for its users in many transactions in various sectors to identify customers in a smart, fast, and accurate way in a high-tech environment. In addition, the "iris eye" technology, which is based on AI and DL, contributes to enhancing the empowerment of the government sector and protecting the safety of society by applying health requirements, facilitating and speeding up services, and confirming the authenticity of the service applicant's identity[113,p 1646-1656]. This technology would contribute to enhancing the environment. Through innovative technologies, private sector businesses provide an easy, fast, and effective customer journey for obtaining digital government services.

This includes the development of the "iris" system, which is a leading electronic tool for identifying people and allowing access to e-government applications and benefiting from its services provided by citizens, by taking a picture of the iris of the iris.

The iris identification system provides the ability to identify and authenticate with a high degree of accuracy and confidence through "one look," thus achieving superiority over the traditional systems of using personal identification cards and passwords.[113,p 1646-1656] A single glance at the system's camera, located at eye level, will allow the camera to recognize the iris of the eye by comparing it with the data stored in the memory within two seconds, allowing the user to quickly enter the security areas.

The iris identification system has been classified as the most advanced security identification system in the world for controlling access to places that require an entry permit. First, users register with the central server by storing the user's iris pattern in the system memory. When the user looks at the camera, an image of the iris of the eye is taken and compared to the one in the system's memory for login authentication. The system does not allow the user to enter unless the two images coincide. The theory of identification by the iris of the eye is characterized by its simplicity and clarity. The thin, collared membrane of the iris that surrounds the pupil of the eye has unique and highly complex characteristics that differ from one person to another. [114,p 142-146]These characteristics remain constant and do not change with age. The characteristics of the left eye differ from the right eye in the same person.

Experiments have also shown that these characteristics are different even in identical twins. As a result, using the iris identification system to document people is a secure, accurate, and non-forgery method.

The iris recognition system is simply a "one look" system, in which an image of the user's iris is automatically captured and compared to samples in memory. There is no need to stand at a certain level or look from a specific angle. In addition to being an alternative to personal identification cards and password systems, the system provides many other features. The number of potential users is determined by the number of

previously stored iris images. The system also reduces the error rate to less than 1 in 1,200,000, which makes the possibility of error or confusion with another person almost impossible. The system is competitively cost-effective as it saves a lot of time and eliminates the need for traditional identification cards. In addition to being an effective tool for authentication, the iris of the eye included in the system is characterized by the possibility of its integration with the systems of e-government applications

E-government can use the iris system's recognition technology to enhance certain aspects of e-government applications. The utilization of iris recognition technology, which entails the acquisition and examination of the distinct patterns within an individual's iris, presents numerous advantages for e-government services, such as heightened security, improved user experience, and enhanced efficiency. Now, let's delve into these benefits with greater precision:

1.Improved Security: Iris recognition offers a highly reliable approach to confirming and validating one's identity. The particular patterns found in an individual's iris are highly unique and challenging to replicate, which makes it a dependable biometric identification.

By integrating iris recognition technology into e-government systems, governments may guarantee that only authorized individuals can gain access to sensitive information or carry out essential duties, thereby mitigating the potential for identity theft, fraud, and unauthorized entry.

2.Enhanced User Experience: Iris recognition provides a convenient and user-friendly approach to authentication. Users can effortlessly authenticate their identity by directly gazing into a camera or dedicated iris-scanning equipment, thereby obviating the necessity for passwords or physical identification documents.

This efficient authentication procedure reduces the amount of time and energy required by users, hence enhancing the accessibility and user-centeredness of e-government services.

In addition, iris identification is non-contact, which is especially advantageous in instances where hygiene and public health are a priority, such as during a pandemic.

3. Enhanced productivity: Iris recognition technology enhances the overall efficiency of e-government applications by providing high speed and accuracy. Iris recognition systems can rapidly compare an individual's iris pattern with a database of registered users, facilitating prompt and precise identity authentication.

This enhanced efficiency can greatly decrease the amount of time required for various government activities, such as issuing identification documents, processing visa applications, or obtaining government benefits.

In addition, the incorporation of iris recognition technology into other e-government systems, such as databases and workflow management tools, can automate and simplify administrative procedures, leading to enhanced efficiency and decreased instances of human errors.

To summarize, incorporating iris recognition technology into e-government services can bolster security, enhance user experience, and optimize productivity. By utilizing the distinct and dependable biometric attributes of the iris, governments can guarantee secure entry to services, simplify verification procedures, and streamline administrative duties.

2.4. Method build the artificial intelligence application

This thesis focuses on the integration of digital technologies based on AI and DL in e-government services provided to citizens. In this chapter, we explain to him the work of the iris of the eye as part of the thesis and its role in strengthening the AI system in citizen services, in which traditional procedures are replaced by smart procedures and access to applications and services E-government, which plays an important role in enhancing the credibility of government services, came to enhance the role of AI as a major system in e-government services to accelerate delivery and accuracy.

Thesis efforts in image segmentation and recognition are a very attractive and challenging field. Attractive because of the many applications that the image recognition and segmentation system can do. The reason that the area remains challenging is related to the need for the development of higher-accuracy recognition

and better segmentation. Schemes, more carefully selected features, and techniques for image feature extraction. Our work proposes a novel model that may be integrated for use in a complete iris segmentation and recognition technique [120,p 878–887].

This chapter describes an integrated system for eye recognition and segmentation and suggests new techniques to enhance the overall recognition results to be suitable for the iris. The chapter is divided into three main sections, divided into subsections.

The first section describes the pre-processing module in detail. The aforementioned section is divided into four sub-sections to describe each technique. The second section describes the segmentation module; this section is divided into two sub-sections. The first sub-section describes detecting the pupils from an image. The second sub-section describes the segment iris from an image. The third section describes the Recognition module; this section is divided into five subsections, The first sub-section describes Splitting the data to train or validate. The second subsection details normalizing the image's grayscale and reshaping (Feature extraction). The third subsection details the Image Data Generator image.

The fourth subsection details Build Model CNN, and The fifth subsection details Predict Model. As shown in Figure 2.4.1 the various components that compose our entire iris segmentation and recognition technique

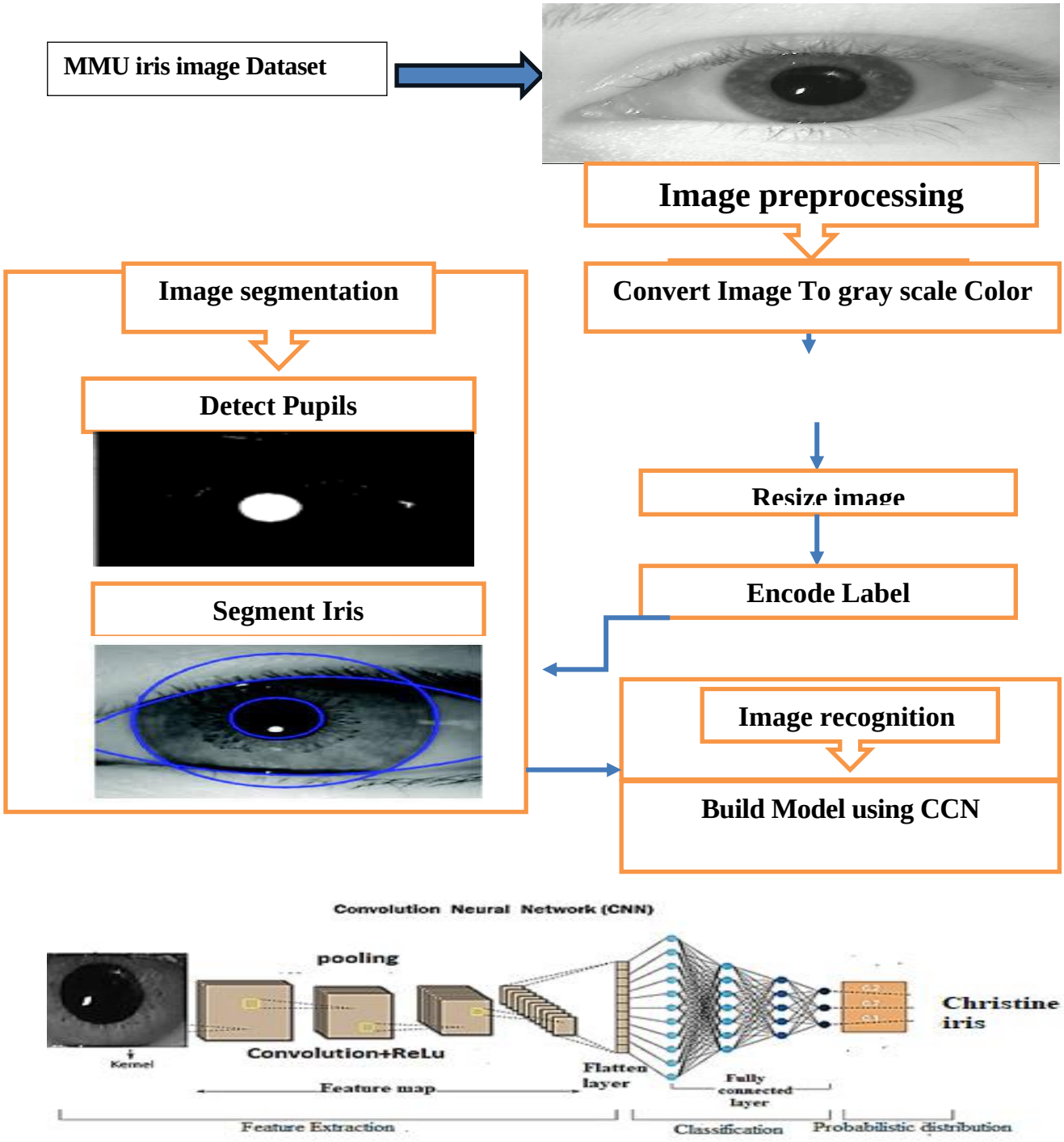


Figure 2.4.1.Build Model.

It may be helpful to lay out the purpose of this section and provide a quick summary before commencing a discussion of the preprocessing approaches addressed in this thesis. This section initially discusses pre-processing techniques that have been thesis

and tested on an in-house database of ophthalmic pictures accompanied with the corresponding customer name. As this study is concerned with an iris-based segmentation system, it was also important to address pre-processing including individual iris identification and iris-owner information. The next three subsections make up the remaining portion of this section: In the first segment, we learn about an online archive of eye photos. In the second part, we get to the noise cancellation and segmentation. In the third paragraph, we learn how to identify the iris's owner.

2.5 Convolution neural network and Architectural Design

Convolutional neural networks, also called CNN, are a kind of model for DL that has received a lot of focus and success in a variety of applications related to computer vision. CNNs have been particularly created. A neural network is a computational model used in the field of AI that aims to enable computers to interpret data by emulating the cognitive processes observed in the human brain. DL is an ML methodology that makes use of linked nodes or neurons arranged in a layered pattern, resembling the neural architecture of the human brain. It facilitates the development of an adaptive framework utilized by computers to acquire knowledge from errors and enhance their performance iteratively. Artificial neural networks endeavor to address intricate tasks, such as document summarization or iris identification, with heightened precision. Convolution operations are crucial since they enable the neural network to effectively interpret the pixel values inside an image as numerical representations. Convolutional layers serve the purpose of transforming a picture into numerical representations that can be comprehended by a neural network, therefore enabling the extraction of pertinent patterns from those representations. The primary function of filters inside a convolutional network is to generate a two-dimensional array of values, which can then be propagated to the following layers of the neural network. These subsequent layers are responsible for acquiring knowledge about the patterns present within the picture. CNN employ many filters to discern and identify patterns within input pictures. The use of various filters results in distinct matrices that produce a more intricate and improved representation of the original picture. Frequently employed

numerical values for CNN filters include 32, 64, 128, and 512. The greater the number of filters employed, the more potential there is for CNN to thoroughly analyze the input data and derive knowledge from it.

A CNN employs the analysis of variations in pixel values to discern and delineate object boundaries. In the context of a grayscale image, a CNN only focuses on discerning variations in shades of black and white, ranging from brighter to darker intensities. In the case of color pictures, the CNN considers not only the variations in brightness but also the three distinct color channels, namely red, green, and blue. In this scenario, the filters possess three channels, mirroring the number of channels present in the picture. In this case, the level of detail in the filter is determined by the number of channels the filter contains, and the number of layers in the filter must match the number of channels in the image to be matched.

Architectural Design of Neural Networks.

The neural network architecture draws influence from the human brain. Neurons, which are the fundamental units of the human brain, establish a sophisticated and intricately interconnected system, facilitating the transmission of electrical impulses among themselves to facilitate the cognitive processing of information in humans. Artificial neural networks, in a similar vein, are comprised of artificial neurons that collaborate to address a given problem. Artificial neurons, referred to as nodes, are software entities, whereas artificial neural networks are software programs or algorithms that employ computational systems to address mathematical computations.

The topic of discussion pertains to the architectural design of neural networks.

1.Fundamental neural networks are comprised of artificial neurons that are linked in three distinct layers.

1.1.The initial layer of a neural network model is sometimes referred to as the "input layer." The input layer of artificial neural networks serves as the point of entry for external information. The input nodes are responsible for processing, analyzing, or classifying the data and subsequently transmitting it to the subsequent layer.

1.2.The concept of a hidden layer refers to an intermediate layer of nodes in a neural network that is not directly connected to the input. Hidden layers receive inputs

from either the input layer or additional hidden layers. Artificial neural networks can incorporate a substantial quantity of concealed layers. Every concealed layer evaluates the output received from the preceding layer, performs further processing on it, and transmits it to the subsequent layer.

1.3.The output layer is a crucial component of neural networks, particularly in the field of ML. It is responsible for producing the final. The output layer is responsible for providing the outcome of all data processing processes conducted by artificial neural networks. The structure may consist of either a single node or numerous nodes. In the case of a binary classification issue, where the objective is to classify instances into two categories (yes or no), the output layer of the neural network will consist of a solitary output node that produces a binary outcome, represented by the values 1 or 0. In the setting of a classification with several class problems, the output layer may have numerous nodes. To view the CCN architecture, just remove one component from Fig 2.5.1.

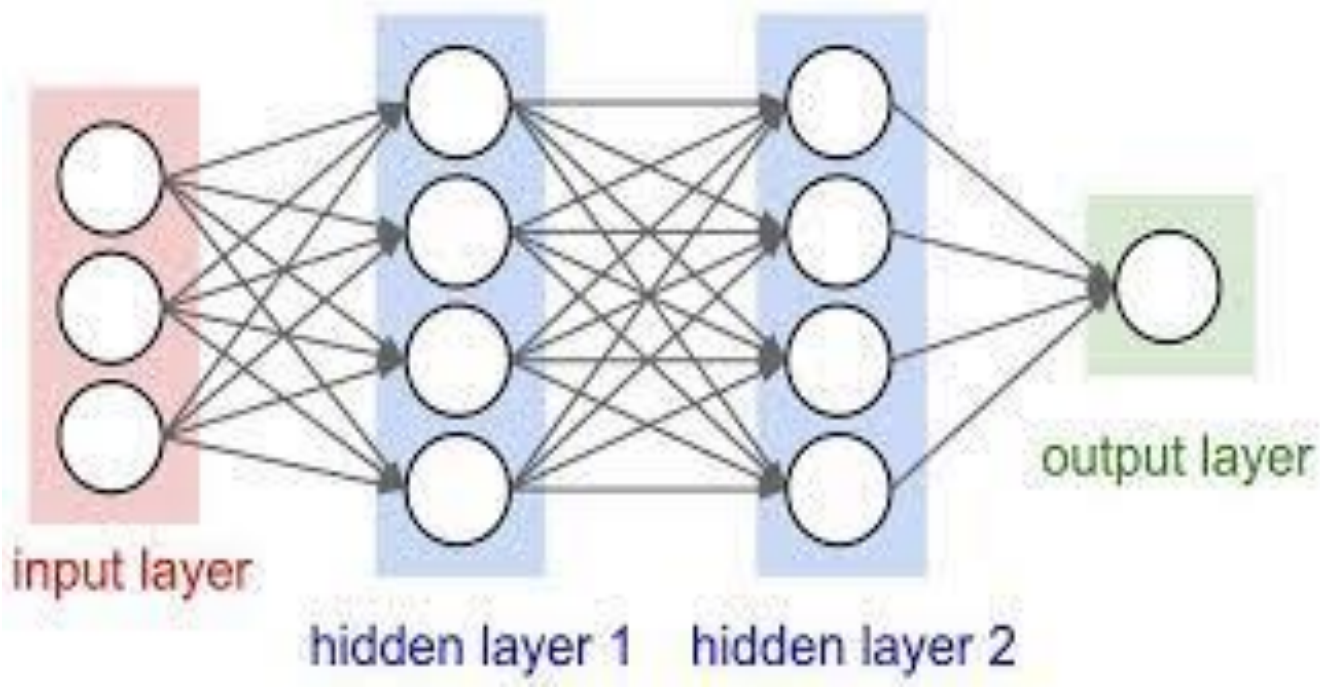


Figure 2.5.1.CCN architecture

2.6. Data collection to build application

Multimedia University (MMU) is the source of the Iris Dataset. The distinctive Iris patterns in each eye may easily identify each person. There are 460 photos, 5 from each of the left and right IRIS of 46 people, plus a few blank files. Individual identification or classification from an IRIS image can be achieved using IRIS segmentation using a pre-existing database. in this thesis, we have a dataset related to the bmp format.

The bmp file format is an image file format that is used to hold bitmap images of digital pictures, primarily in Microsoft Windows and OS/2. The term "bitmap" is also used to refer to this file format. Numerous graphical user interfaces (GUIs) run on the BMP format, which is denoted by the suffixes. bmp or. DIB, depending on the application.

All of the Bitmap images (.bmp) used in this study were changed to JPEG format. Figure 2.6.1 displays a few examples of the types of iris photos included in the database that were chosen for this study.

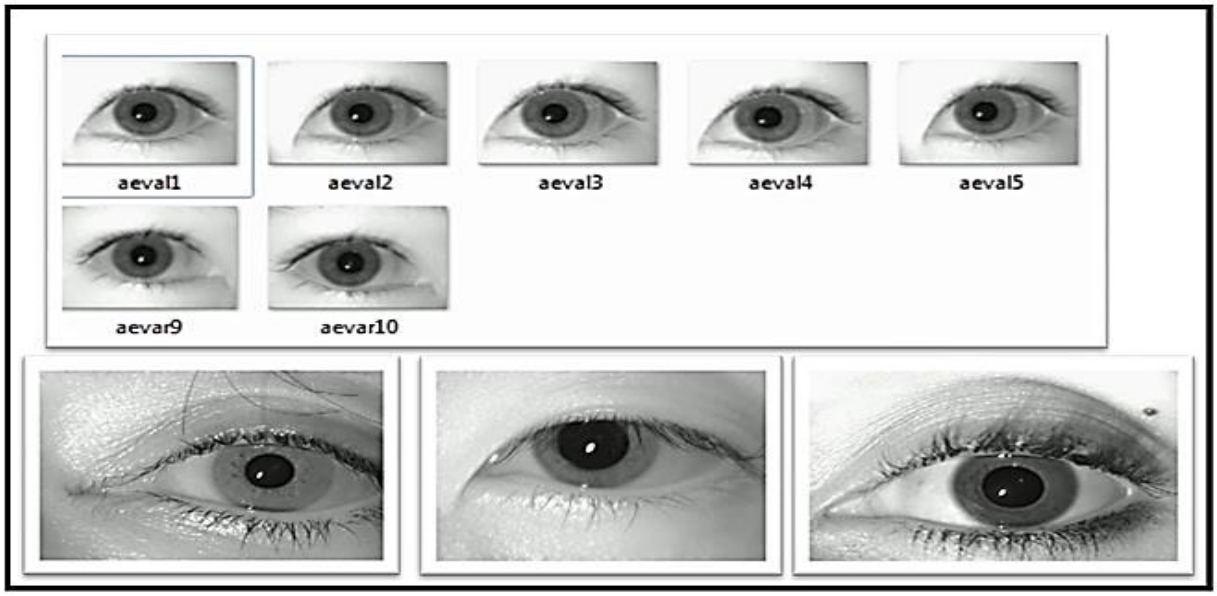


Figure 2.6.1.Samples of iris images Database

An example of an image from the MMU iris database and the areas of each part of the iris is shown in Figure 2.6.2 Morphology of the human iris.

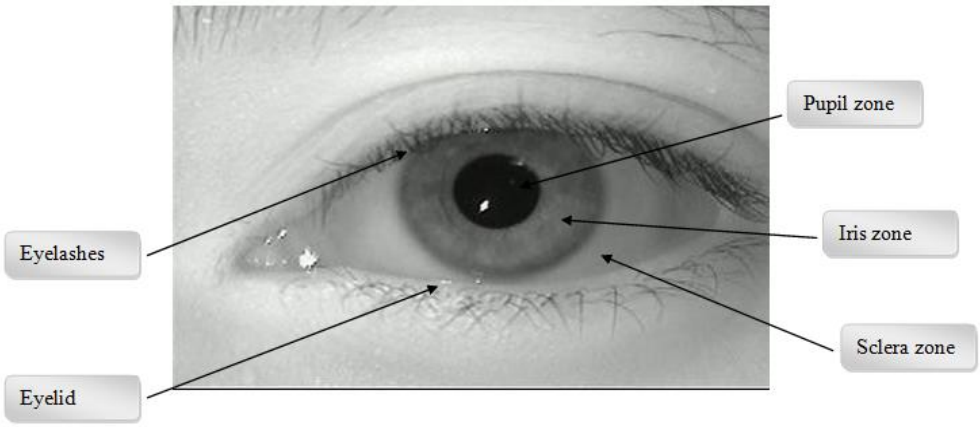


Figure 2.6.2.Morphology of the human iris

Iris recognition is a form of automated biometric identification that relies on the unique, stable, and distantly visible complex patterns in a video picture of one or both of an individual's irises.

All biometric technologies' discriminatory abilities rest on the entropy they are able to encode and apply to the matching process.

Pre-processing aims to produce data that makes it easier for systems to identify and accurately segmentation the parts of the eye specifically iris detect, and to know who the owner of this iris is, despite the difference iris zone from one person to another.

The main objectives of pretreatment are:

1. Read Image.
2. Convert Image To gray scale Color.
3. Resize image.
4. Encode Label.

1. Read Image

This is a database provided by the Multimedia University MMU .The produced image will be in a different format (bmp) but weconverted it to jpg and put the image in gray scale, format the eye as shown in Figure 2.6.3 Sample of MMU iris dataset.

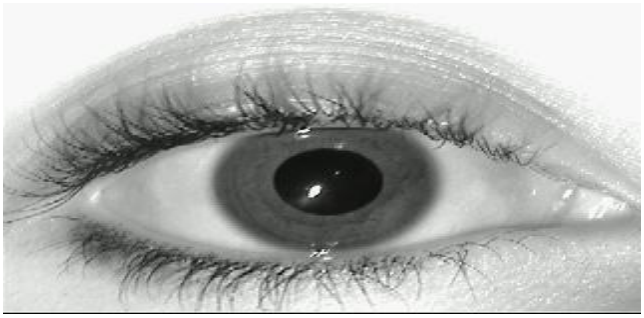


Figure 2.6.3.Sample of MMU iris dataset.

2. Convert Image To gray scale Color

Grayscale images are distinct from one-bit bi-tonal black-and-white images, which, in the context of computer imaging, are images with only two colures: black and white(also called bi-level or binary images), The contrast ranges from black at the weakest intensity to white at the strongest. Why did these pictures turn gray?

Because the dataset images are already grayed out, and I want the computer to read it the same as it really is so that it doesn't affect the training process later and also make it appear in a clear way. As shown in Figure 2.6.4 picture that came from a computer, just like reality.

3.Resize image

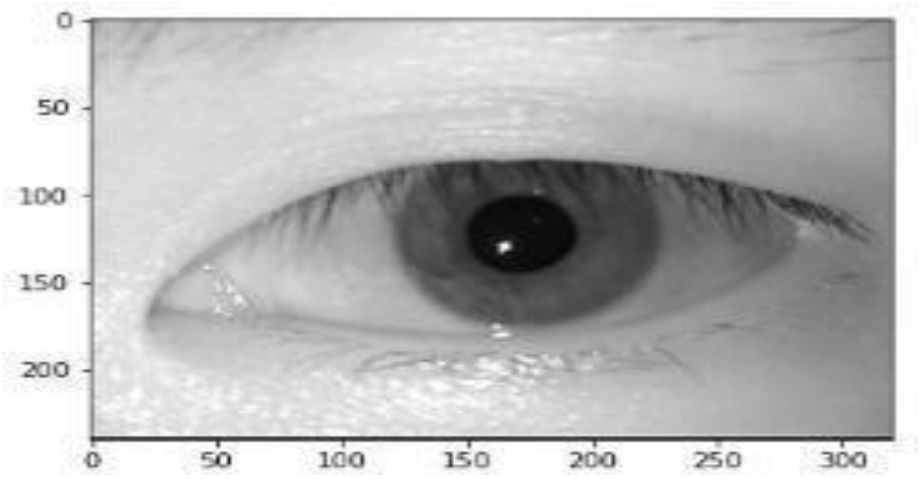


Figure 2.6.4.Picture that came from a computer

Resizing images is a critical preprocessing step in computer vision. Principally, our ML models train faster on smaller images. An input image that is twice as large

requires our network to learn from four times as many pixels — and that time adds up. Moreover, many DL model architectures require that our images are the same size and our raw collected images may vary in size .It also requires that after this process we remove the blur from the image size reduction process and (adjust the size) by interpolation.

4. Encode Label

Label Encoding is a method for transforming category columns into numeric ones, making them compatible with machine-learning models that only accept numerical information for fitting. It's a vital part of any AI effort that comes before the actual learning itself.

Encode target labels with value between 0 and n_classes-1. This transformer shouldbe used to encode target values, *i.e.* y, and not the input X. As shown in Figure 2.6.5 Encode Label.

```
/content/IrisSeg/aeva
0
/content/IrisSeg/bryan
1
/content/IrisSeg/chingyc
2
/content/IrisSeg/chongpk
3
/content/IrisSeg/christine
4
/content/IrisSeg/chuals
5
/content/IrisSeg/eugeneho
6
/content/IrisSeg/fatma
7
/content/IrisSeg/fiona
8
/content/IrisSeg/hock
9
/content/IrisSeg/kelvin
10
```

Figure 2.6.5.Encode Label.

2.7. Segmentation the data

To segment a picture is to divide it into smaller, more manageable pieces (sets of pixels, also known as image objects). The purpose of segmentation is to transform an image's representation into one that is more digestible and informative. Finding objects

and boundaries (lines, curves, etc.) in a picture is a common use of image segmentation. [115,p 1-10]. In the proposed method, segmentation is performed in two levels.

1- Detect Pupils

To augment the iris recognition system's ability to identify the pupil, specific methodologies and procedures can be employed. Here are several methodologies that can be employed:

1.Data Collection: Gather a wide range of photos that encompass various iterations of the pupil patterns. This process may entail obtaining photos of the pupil under diverse lighting conditions, varying angles, and different persons. Greater dataset diversity enhances the system's ability to discern novel patterns.

2. Pre-processing it is crucial to perform pre-processing on the photos in order to improve the clarity of the pupil. This can encompass methods such as improving the quality of images, reducing unwanted noise, and adjusting the contrast to guarantee the visibility and clarity of pupil patterns.

3.Feature extraction is essential for pattern recognition as it involves extracting pertinent information from the pictures of the pupil. Multiple techniques for extracting features can be utilized, including wavelet decomposition, Laplacian mask, Gabor transform, and Fourier transform . These techniques can record several facets of the pupil pattern, enabling more accurate identification.

4.Training and updating the recognition model involves applying machine learning algorithms to train the model after extracting the features. This process entails inputting the derived features into the model and instructing it to learn and identify various pupil patterns. The model can be regularly updated with new patterns to enhance its recognition capabilities.

5.Assessment and Verification: Once the model has been trained, it is crucial to evaluate its performance. One way to accomplish this is by evaluating the model using a distinct dataset that contains both familiar and unfamiliar patterns. The model's accuracy and dependability can be evaluated by its proficiency in accurately identifying and categorizing pupil patterns.

To enhance the iris recognition system's ability to identify the pupil, you can incorporate additional patterns by according to the following instructions. This will improve the system's capacity to precisely recognize and verify individuals by analyzing their distinct iris patterns.

Computer vision technique that allows us to identify and locate objects in an image or video. Detect of the pupil is in stages:

1. Select the darkest region in the image(Threshold).
2. Morphological transformations and Delete noise on the image.
3. Find contours.
4. Bounding Boxes.
5. Delete noise on the image by Dilation and erosion

1. Select the darkest region in the image(Threshold)

In OpenCV, the method known as "threes holding" is used to assign pixel values in proportion to a given threshold. Thresholding involves comparing the value of each pixel to a predetermined limit. The pixel value is set to 0 if it is less than the threshold, and to the maximum value otherwise (generally 255). One common method of segmentation is called "threes holding," and it's used to differentiate between the foreground and background of a scene. A threshold is a dividing line between two possible states, either below or above it. [116,p 2049-2058].

Explanation of the OpenCV library: One of the Python team's aims is to promote Python's status as a dependable and accepted programming language through libraries and software frameworks. The OpenCV library is one of the most well-known and sophisticated libraries in the field of image and video processing, and there are several applications for it, particularly in the medical, industrial, artificial intelligence, and ML industries.

OpenCV is a framework that contains numerous algorithms and software code. This framework's primary goal is to deliver solutions in Computer Vision.

We determined the region that is the most dark in the real image by setting the threshold in it, which is 35, which symbolizes pixel the pupil less than 35 it set to 0 , It is darker in the image and turns it white, which the computer distinguishes to determine

it, while the rest of the pixels outside the range convert them to black As exemplified by in Figure 2.7.1 Select the darkest region .

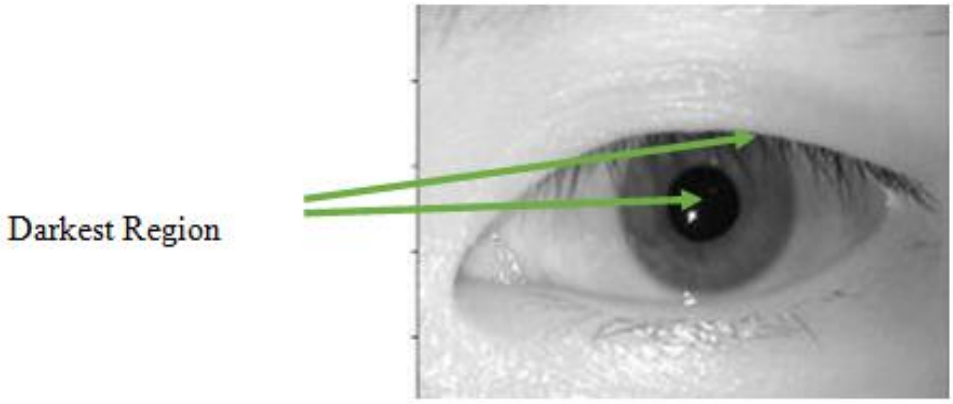


Figure 2.7.1.Select the darkest region

2.Morphological transformation and Delete noise(morphologyEx)

Some basic operations that may be performed on a picture are morphological transformations. Often, this operation is used on binary pictures. The first is the original picture, and the second is a structural element or kernel that determines the type of operation to be performed. Erosion and Dilation are the two fundamental morphological operators. There are then its subtypes, such as Opening, Closing, and Gradient.

Acquire the Theory of Structural Elements Provides a morphological operator with a structuring element of the given size and form. The defining component that can be provided to erode, dilate, or morphology Ex is built and returned by the function. But, you may also utilize a binary mask you make yourself as an organizing principle. [117,p 76-80].

We take the circular geometric shape ellipse in the form of a pupils and form a kernel from it, any image slide with an appropriate size (5,5) and we do a training so that it fits the shape of the pupils by convolution, but the noise generated from the size of the kernel must be removed because the more the size of the kernel all we have done Scanning too many pixels and this leads to image distortion perform a closing operation: erode then dilate(morphologyEx) to delete noise on the image. As shown in Figure 2.7.2 Get Structuring Element and detect darkest Region Add Kernel by Convolution**.**

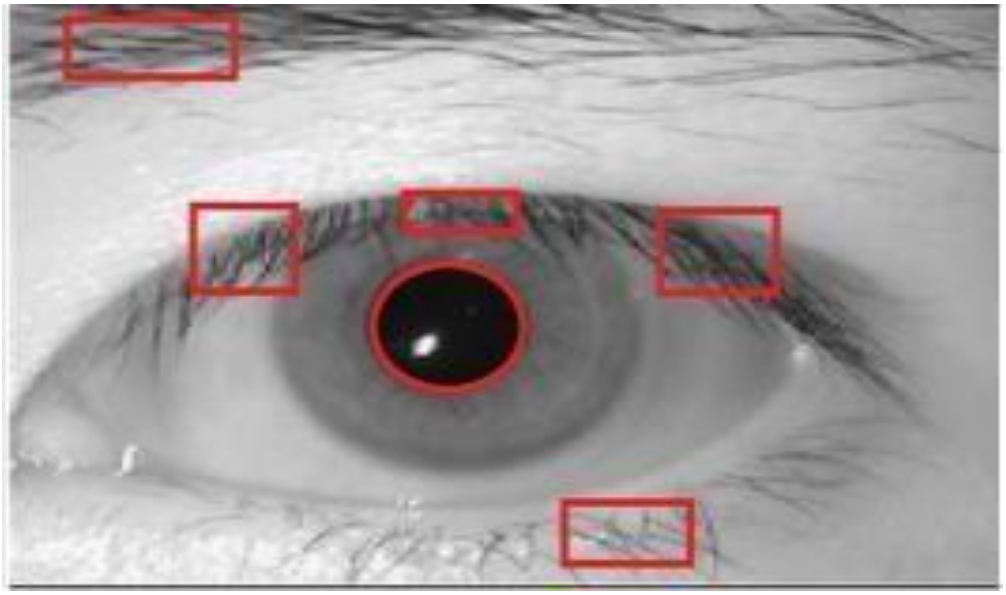


Figure 2.7.2.Structuring Element and detect darkest Region

3.Find Contour

Contours are defined as the line connecting all the spots along an image's boundaries that have the same intensity. Contours are useful in form analysis, determining the size of an object of interest, and detecting objects. The discover contour () function in OpenCV aids in the extraction of contours from images. It works well with binary pictures, thus we should start with thresholding approaches, Sobel edges, and so on.

Contour in image is an outline on the objects present in the image. The significanceof the objects depend on the requirement and threshold you choose. You extract all the shapes in the picture circles and squares and take the largest sizearea in the picture (sort

by area and select the biggest contour), which in our work isa pupils. As shown in Figure 2.7.3 Contour, Figure 2.7.4 Extract Largest area.

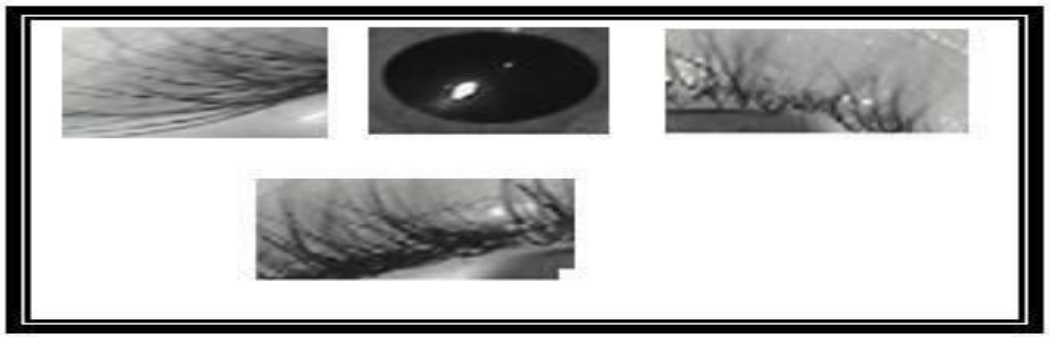


Figure 2.7.3.Contour

Figure 2.7.4.Extract Largest area.

4. Bounding boxes

This means that our Image Treatment will identify rectangles around each pupil in our pictures. Bounding boxes are generally defined by the position of the top left corner(2 coordinates) and a width and height (in several pixels). as exemplified by Figure 2.7.5.

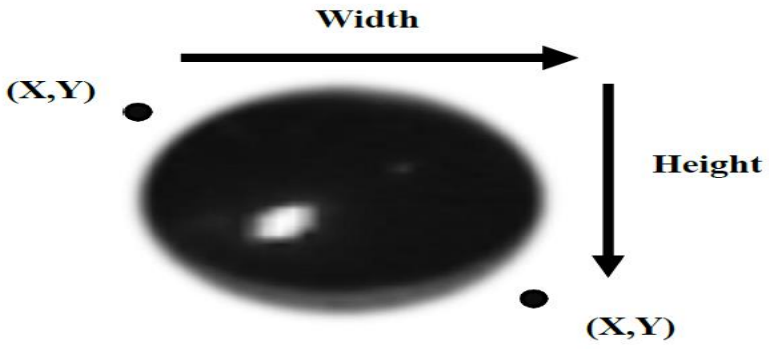


Figure 2.7.5.Bounding boxes

5.Delete noise on the image by Dilation and erosion

Erosion and enlargement are the two most fundamental morphological processes. Several different things may be done with them.

Removing noise

Isolation of individual elements and joining disparate elements in animage .Finding of intensity bumps or holes in an image

While erosion already gets rid of the white noises while simultaneously shrinking our object, image dilation is useful. Hence, we enlarge it. They won't return now that the background noise is gone, but the number of objects we can see will grow. As may be seen in Figure 2.7.6 dilation is an effective method for repairing shattered objects. Remove picture noise and the Figure 2.7.7 Steps Detect Pupils .

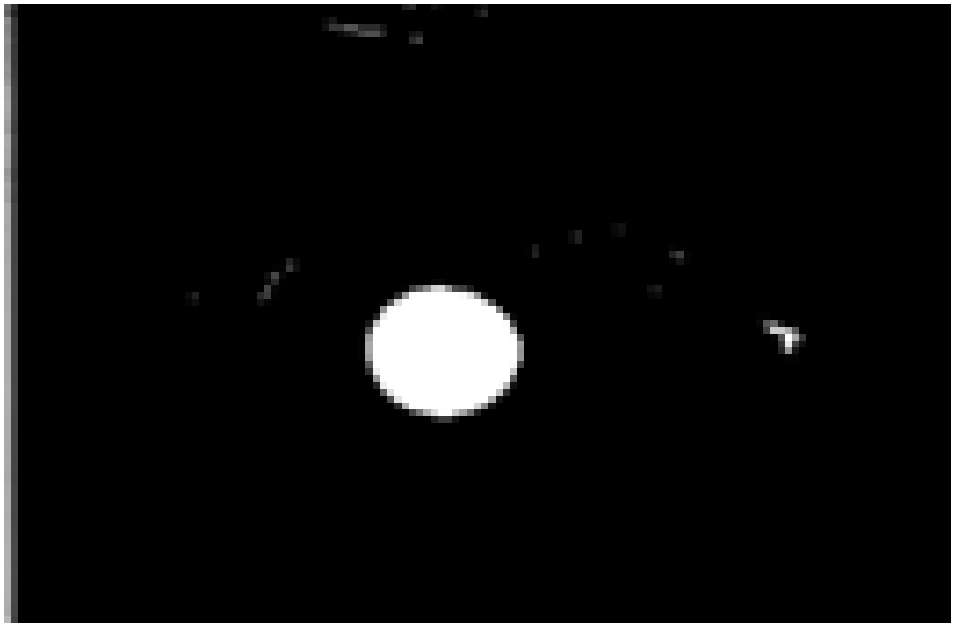


Figure 2.7.6.Removing noise

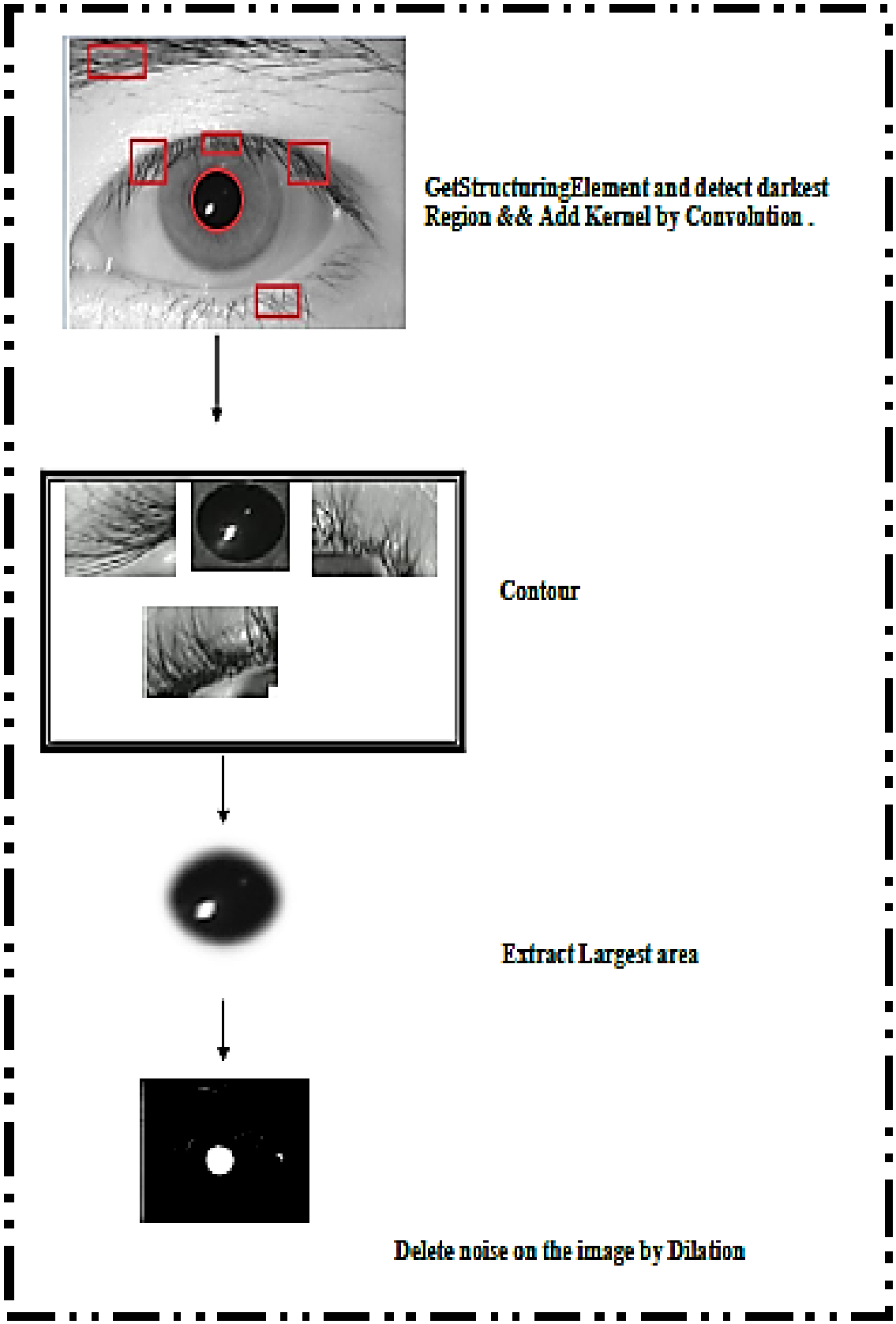


Figure 2.7.7.Steps Detect Pupil

2- Segment Iris

Image Segmentation is the process by which a digital image is partitioned into various subgroups (of pixels) called Image Objects, which can reduce the complexity of the image, and thus analyzing the image becomes simpler

Detect of the Segment is in stages:-

1.Get the box center & radius of the iris.

2.Create a mask to extract the iris.

3. Segment and Save.

1. Get the box and center && radius of the iris

Now we will use the pupils box with the threshold we have chosen and we will shift [stride] into 30px(pixels) or 35px in order to get to the iris area. The box that consistsof [X, Y, W, H] and when we do the stride, I will subtract the X axis with the stride because it's an distance and also I subtract Y with the stride. For the width, I'll add it to the stride and multiply it by 2 because it's both sides, the heights add it to the stride and multiply it by 2 because it's both sides also this code explain about get box and center radius of the iris.

```
def segment_iris(img, no_mask, stride=30, thresh=30):
        """segment the iris from an image"""
        box, __ = IrisSegmentor.detect_pupiles(img, thresh)
        # get the iris box, since it almost in a const distance
from the pupils
        # will use a heuristic formula
        box[:2] -= stride
        box[2:] += stride * 2
        x, y, w, h = box
        if no_mask:
            return img[y:y+h, x:x+w]
        # get the center and radius of the iris
        r = w // 2
        cx, cy = x + r, y + r
        # create a mask to extract the iris
        mask = np.zeros_like(img)
```

```
        cv.circle(mask, (cx, cy), r, (255, 255, 255), -1)
        # extract the iris
        iris = cv.bitwise_and(img, mask)
        return iris
```

And you can see the Figure 2.7.8. explain about Get the box and center && radius of the iris as you see in the code.

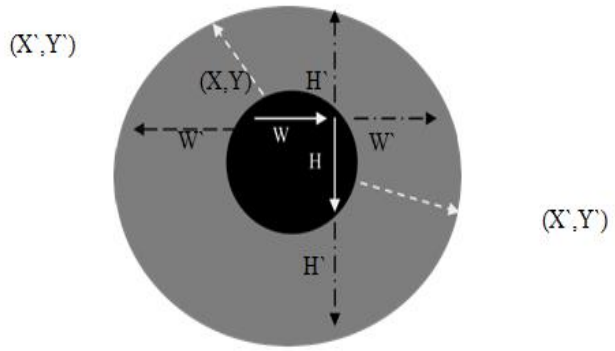


Figure 2.7.8.Get the box and center and radius of the iris

2. Create a mask to extract the iris

Mask allows us to focus only on the portions of the image that interests us For example, as in our project we were building a computer vision system to recognize the iris of the eye. The only part of the image we care about finding and describing are the parts of the image that contain the iris - we simply don't care about the rest of the image content. Provided we can find the iris in the image, we can create a maskto show only the iris that is in the image.

Using a non-rectangular mask(Circular Mask), we could extract only the region of the image that contains the iris eye and ignore the rest. We construct a NumPy array, filled with zeros, with the same width and height as our original image this code presented mask , also shown in Figure 2.7.9 Create a mask.

```
 def segment_and_save(self, save_folder:str, size=None, no_mask=False,
**kws):
        """segment and save the iris in directory, if size specified will
resize the
        images before segmentation"""
        save_folder = Path(save_folder)
        if isinstance(self.path, Path):
            assert save_folder.absolute() != self.path.absolute(), "The
saving directory should not be the same as the images folder"
        for i, path in enumerate(self.images, 1):
            fname = path.name
            cls = path.parent.name
            image = self.read_img(str(path), size)
            iris = self.segment_iris(image, no_mask, **kws)
            new_path = save_folder / cls
            new_path.mkdir(exist_ok=True)
            cv.imwrite(str(new_path / fname), iris)
        print("[INFO]", f"Saved {i} image file in
{str(save_folder.absolute())!r}")
```

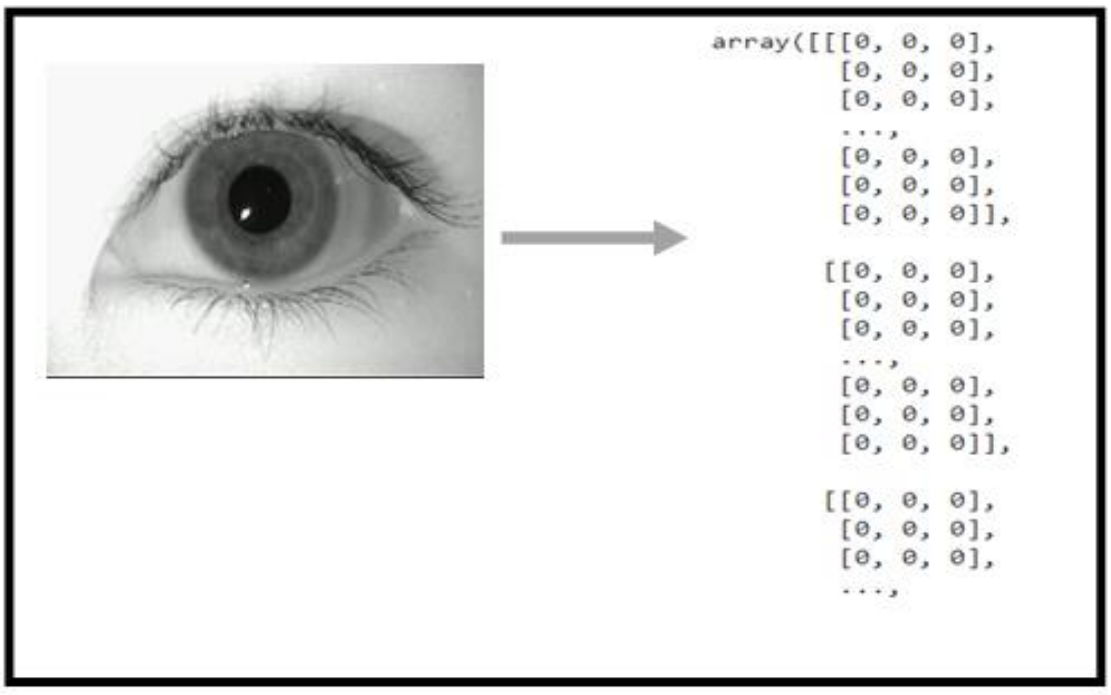


Figure 2.7.9.Create a mask

1. We draw a white circle(256, 256) on our mask image, starting at thecenter of my Pupils with a radius of iris as you see in the code.

```
def show_steps(image_path:str, step:int or str="all"):
    """Displays each step of the algorithm.

    Args:
    -----
        @image_path
        @step: (1, 2, or "all") the step to display"""

    iris = IrisSegmentor
    img = iris.read_img(image_path, (256, 256))
    pupils_img = iris.detect_pupiles(img)[1]
    iris_img = iris.segment_iris(img, False)
    if step == 1:
        to_add = [pupils_img]
    elif step == 2:
        to_add = [iris_img]
    else:
        to_add = [pupils_img, iris_img]
    stack = np.hstack((img, *to_add))
    return stack

from google.colab.patches import cv2_imshow

show_steps(image_path,step="all")

cv2_imshow(show_steps(image_path,step="all"))
```

as shown in Figure 2.7.10 get the center and radius of the iris

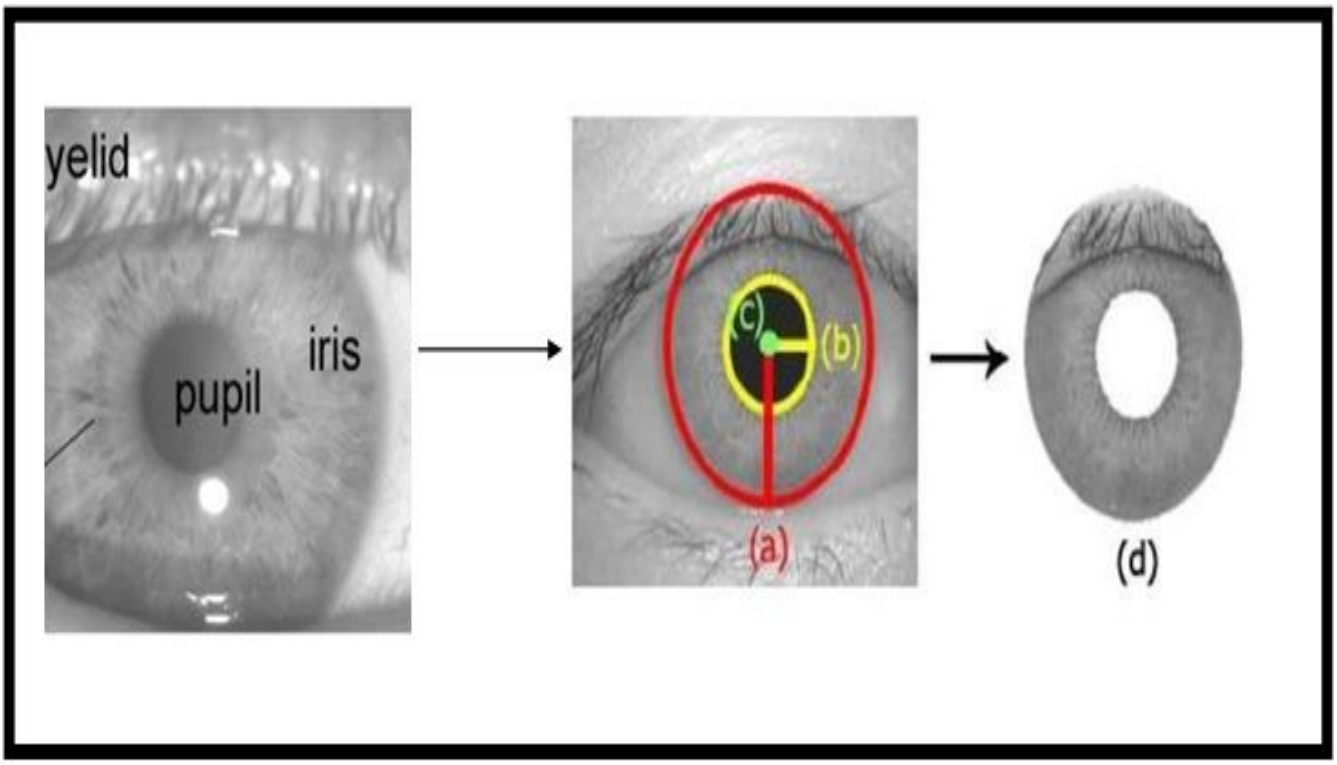


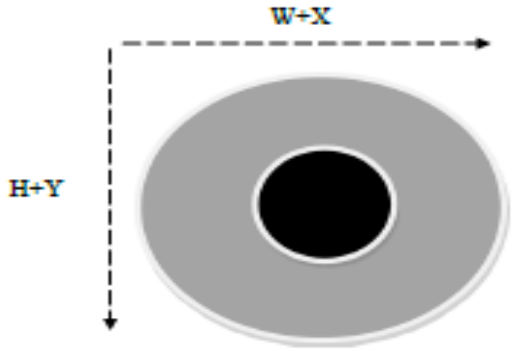
Figure 2.7.10.Get the center and radius of the iris

2. Apply Bitwise operations function:- a binary manner and are represented as grayscale images. A given pixel is turned “off” if it has a value of zero, and it is turned “on” if the pixel has a value greater than zero. It turns out that this function is used extensively when applying masks toimages. The first two parameters are the :-

1. Image itself (i.e., the image where we want to apply the bitwise operation).

2. However, the important part of this function is the mask keyword. When supplied, the bitwise and function is True when the pixel values of the input images are equal, and the mask is non-zero at each (cx, cy)-coordinate (in thiscase, only pixels that are part of the white circular) as see in the figure 2.7.11 .

Note: if no mask:-False_return (img [y:y+h, x:x+w])



Black Color : Pupils .
Gray Color:- iris .

If Mask :-

Black Color: Background (0 pixels).
White Color: Circular Mask Resulting from

R1= w // 2 R2=h//2
cx , cy = x + R1, y + R2

Figure 2.7.11.Image bitwise operation

.

3. Segment and Save

Segment and save the iris in directory, if size specified will resize the images before segmentation, As shown in Figure 2.7.12 Segment and Save.

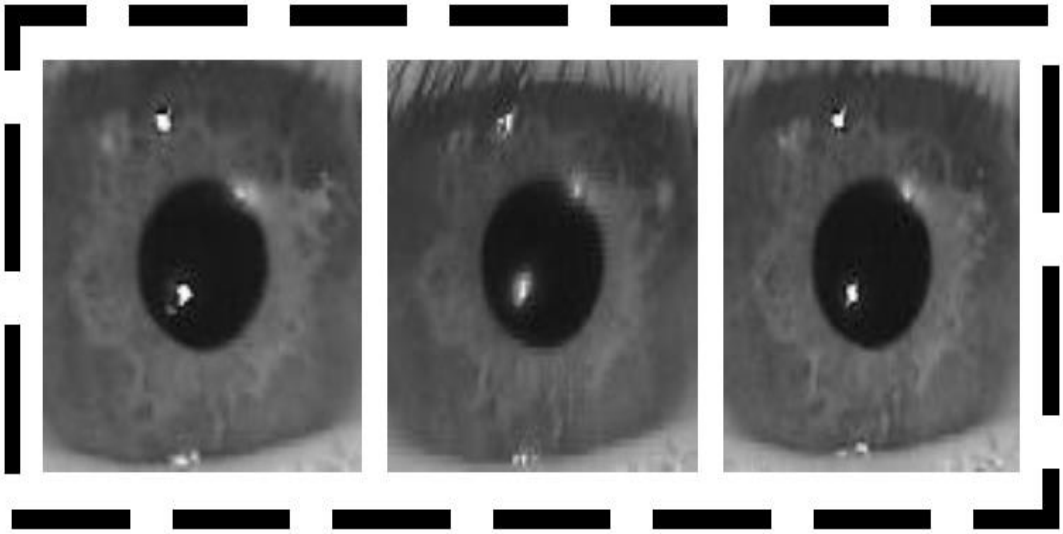


Figure 2.7.12.Segment and Save image

2.8. Classification and recognition model

Image classification involves assigning a label to an entire image or photograph. Some examples of image classification include:

- Labeling an x-ray as cancer or not (binary classification).
- Classifying a handwritten digit (multiclass classification).
- Iris Recognition (multiclass classification).

In our thesis, we want to know who owns the iris that was extracted by segmentation and this is from the Multiclass classification system.

In the proposed method, Classification is performed in steps:

1. After segmentation split the data train/validation set
2. Data augmentation
3. Model Building
4. Model Training & Evaluation
5. Predict Model
6. Build a notebook GUI

1.After segmentation split the data to train/validation set

The train-test split is a technique for evaluating the performance of a ML & DL algorithm. It can be used for classification or regression problems and can be used for any supervised learning algorithm[115, p 1-10].

The procedure involves taking a dataset and dividing it into two subsets. The first subset is used to fit the model and is referred to as the training dataset. The second subset is not used to train the model; instead, the input element of the dataset is provided to the model, then predictions are made and compared to the expected values. This second dataset is referred to as the test dataset[119,p 824-836].

Train Dataset: Used to fit the ML model.

Test Dataset: Used to evaluate the fit ML model.

The objective is to estimate the performance of the ML model on new data: data not used to train the model. This is how we expect to use the model in practice. Namely, to fit it on available datawith known inputs and outputs, then make predictions on new examples in the futurewhere we do not have the expected output or target values. In our dissertation: Splitting the data to train/validation set with 20% and stratify with 'class' tokeep the same number of classes in each set.

2. Data augmentation

The performance of DL neural networks often improves with the amount of data available .Data augmentation is a technique to artificially create new training data from existingtraining data. This is done by applying domain-specific techniques to examples fromthe training data that create new and different training examples.

Image data augmentation is perhaps the most well-known type of data augmentation and involves creating transformed versions of images in the training dataset that belong to the same class as the original image. Transforms include a range of operations from the field of image manipulation, suchas shifts, flips, zooms, and much more. The intent is to expand the training dataset with new, plausible examples. This means,variations of the, training set images that are likely to be seen by the model [115,p 1-10] .

In this thesis performed the some data augmentation to prevent over fitting and increase the samplesize and we will used:

1. Random horizontal flipping.
2. Random Rotation (-15, 15) degree
3. Zoom range 20% in and out
4. Shear range of 20%

As shown in Figure 2.8.1 explained about Data augmentation

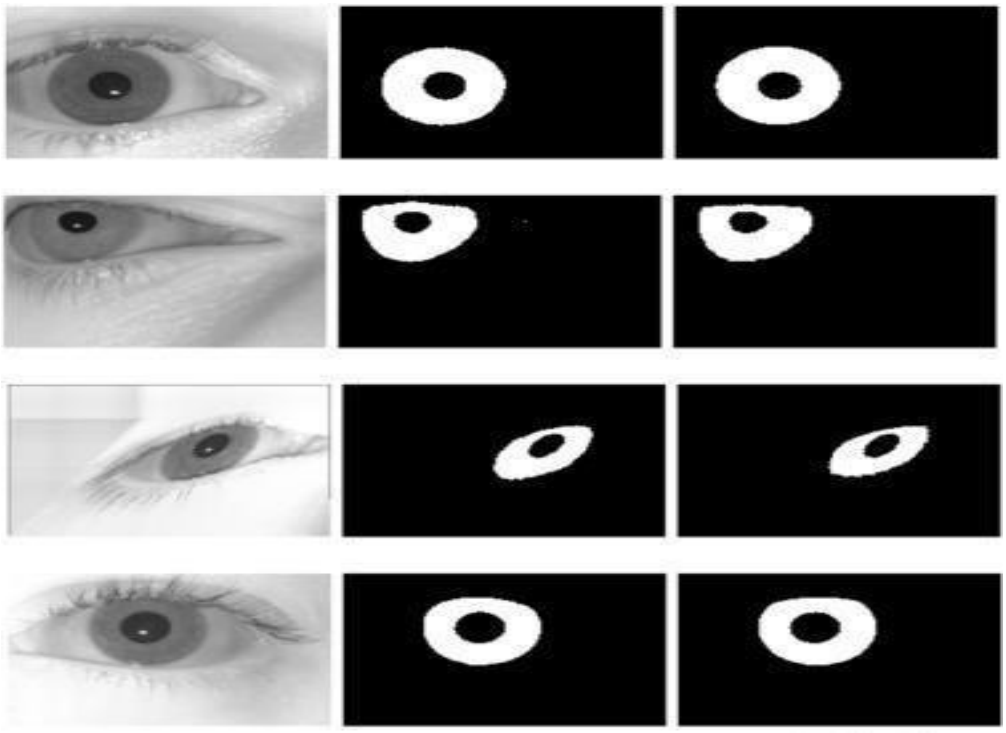


Figure 2.8.1.Data augmentation

*Note before data augmentation .Preprocessing function perform grayscale histogram equalization then rescale thedata to range[0, 1], before feeding it the model. “gray: images pixels array. should be in grayscale. To handle in image data generator dtype ,normalization histogram equalization inimages grayscale and expand dimension even this code show how to make normalization

```
def simple_cnn(in_shape):

    model = tf.keras.Sequential( name="iris_recognition" )
    # input layer
    model.add(L.Input(in_shape))
```

```
    # convulotion layers
    # 32 x (3, 3) -> ReLU -> BatchNorm -> MaxPool
    model.add(L.Conv2D(32, (3, 3), padding="same"))
    model.add(L.Activation("relu"))
    model.add(L.BatchNormalization())
    model.add(L.MaxPooling2D(pool_size=(3, 3)))

    # 64 x (3, 3) -> ReLU -> BatchNorm -> MaxPool
    model.add(L.Conv2D(64, (3, 3), padding="same"))
    model.add(L.Activation("relu"))
    model.add(L.BatchNormalization())
    model.add(L.MaxPooling2D(pool_size=(2, 2)))

    # 128 x (3, 3) -> ReLU -> BatchNorm -> MaxPool
    model.add(L.Conv2D(128, (3, 3), padding="same"))
    model.add(L.Activation("relu"))
    model.add(L.BatchNormalization())
    model.add(L.MaxPooling2D(pool_size=(2, 2)))
    # flatten the features map
    model.add(L.Flatten())

    # fully connected layer
    # connect the extracted features to dense layer for classification
    model.add(L.BatchNormalization())
    model.add(L.Dense(NUM_CLS))
    model.add(L.Activation("softmax")) # output layer softmax for outputing
probabilities
    opt = tf.optimizers.Adam(0.001) # adam optimizer with 0.001 learning
rate
    loss = "categorical_crossentropy" # loss for multiclass classfifcation
    model.compile(optimizer=opt, loss=loss, metrics=['accuracy'])
    return model
```

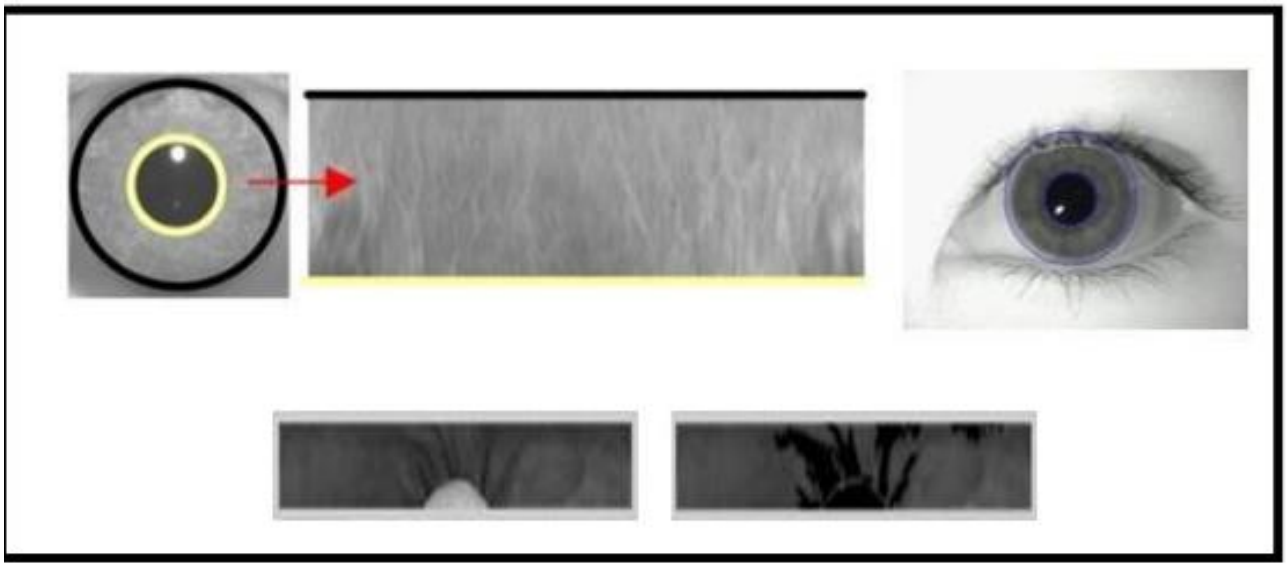


Figure 2.8.2.Normalization

3.Model Building

It is designed to build a model to cut the number of features project, the better, the less number weight in neurons, and better results. A simple CNN is a sequence oflayers, and every layer of a CNN transforms one volume of activations into another through a differentiable function. We use three main types of layers to buildCNN architectures: Convolution Layer, Pooling Layer, and Fully Connected Layer exactly as seen in regular CNN.

For our model architecture we will use a simple superficial model, to avoid overfitting,with 3 Conv2D layers + Max-Pooling to extract features then single dense layer as classifier.

Before we start talking about methods, we should know Dimensional reduction is a method of unsupervised learning. However, it can be used as a data transformation preprocessing step for ML algorithms on predictive regression and classification modelling datasets with supervised learning algorithms. is the transformation of data from a high-dimensional space into a low-dimensional space so that the low-dimensional representation retains some meaningful properties of the original data. We have some important methods as mentioned down.

1 . 2D convolution layer: (e.g. spatial convolution over images), This layer creates a convolution kernel that is convolved with the layer response to produce a tensor of outputs. The CNN layer is the core building block of a Convolutional Network that does most of the computational heavy lifting. Let's first discuss what the CNN layer computes without brain/neuronanalogies. The CNN layer's parameters consist of a set of learnable filters. Every filter is small spatially (along width and height), but extends through the full depth of the input volume. For example, a typical filter on the first layer of a CNN might have a size of 5x5x3 (i.e. 5 pixels width and height, and 3 because images have depth 3, the color channels) that extracts features from a source image. Convolution helps with blurring, sharpening, edgedetection, noise reduction, or other operations that can help the machine to learn specific characteristics of an image [84, p 5455-5460] .

The learned weight is the filter that convolved through the whole image where the result is the feature map. The features map determines the unique features in the original input image. The feature map is computed according to the Equation 2.8.1.to convert the original input image to convolution network.

$$Z^s = f(\sum_{t=1}^{q} W_i^s * X^i + b_s \quad (2.8.1)$$

Equation 2.8.1 to convert the original input image to convolution network . As shown in Figure 2.8.3 Convolution Layer when start to convert original image .

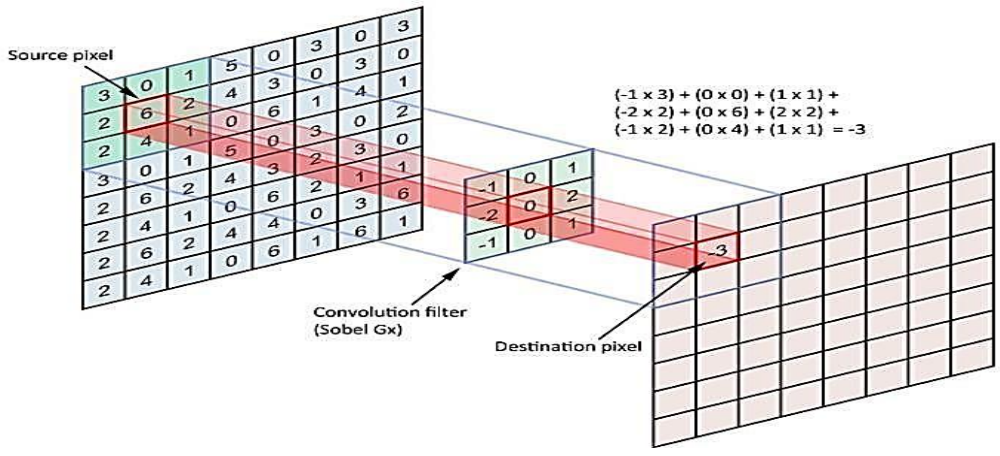


Figure 2.8.3.Convolution Layer

Artificial neural networks exhibit similarities to the functioning of the human brain, enabling computer programs to identify patterns and address prevalent challenges in the domains of artificial intelligence, ML, and DL. Consequently, these artificial networks aim to emulate cognitive processes and activities associated with brain functionality through learning algorithms. The primary objective of this study is to investigate the relationship between human resources and smart organizations using neural network systems and their practices. The neural network system is analogous to the cognitive processes of human beings and is considered a valuable resource within the operational context. Additionally, this study aims to identify the significant contributions that these highly intelligent applications can make to organizational behavior. The data was subjected to analysis. The simulation system is designed to evaluate neural networks using mean clustering tests. It aims to determine the extent of influence of inputs and outputs in achieving the proposed model. Additionally, the system assesses the accuracy and performance of the model, as well as the level of error encountered during neural network training. Furthermore, it examines the strength of the relationship between nodes in different layers, the weights associated with hidden neurons in the hidden layer, and the relative importance of these factors. The dimensions of the input and output of the final model. The findings of the thesis indicate that the implementation of intelligent organizational practices significantly influences many aspects of human resources. The study suggests that decision-making centers should recognize the significance of utilizing simulation systems in neural networks to address administrative issues. This is due to the considerable time, effort, and cost savings, as well as the enhanced accuracy of results. Furthermore, it emphasizes the necessity of promoting and implementing human resources, as they serve as the foundation for attaining a crucial strategic competitive advantage through knowledge acquisition.

- Source pixel in original image
- An image kernel (Convolution Filter)is a small matrix used to apply effects like the ones you might find in Photoshop or Gimp, such as blurring, sharpening, outlining or embossing. They're also used in ML for 'feature extraction', a

technique for determining the most important portions of an image.(size of kernel that match in size pixel image) and use the mathematic dot product pixel of image in match pixel of kernel

example (-1*3)+(0*0)+(1*1)+(-2*2)+(0*6)+(2*2)+(-1*2)+(0*4)+(1*1)=-3

Stride: How much Shift is needed to move the kernel. As shown in Figure 2.8. 4 Stride.

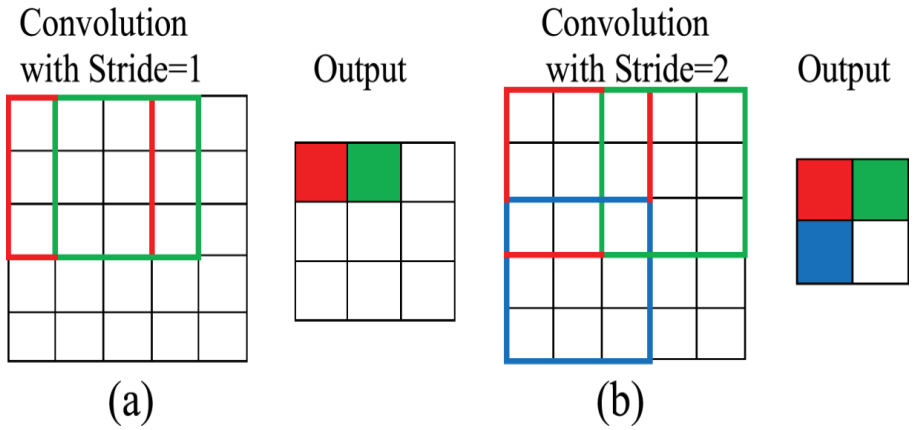


Figure 2.8.4.Stride

2. Activation Function: The activation function is a mathematical “gate” in between the response feeding the current neuron and its output going to the next layer. It can be as simple as a step function that turns the neuron outputon and off, depending on a rule or threshold. Or it can be a transformation that maps the response signals into output signals that are needed for the neural network to act As shown in Figure 2.8.5 Activation Function.

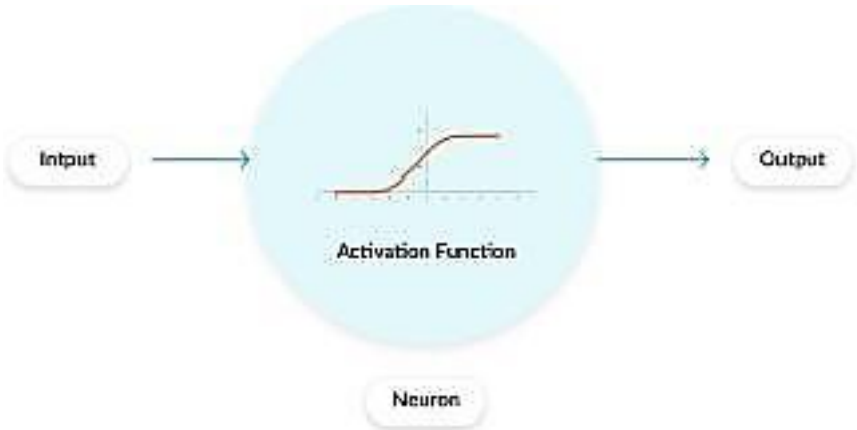


Figure 2.8.5 .Activation Function

Types of activation function:

1. ReLU (Rectified Linear Unit) Advantages:

- Computationally efficient—allows the network to converge very quickly
- Non-linear—although it looks like a linear function, ReLU has a derivative function and allows for back propagation .

As shown in Figure 2.8.6 Activation Function Relu.

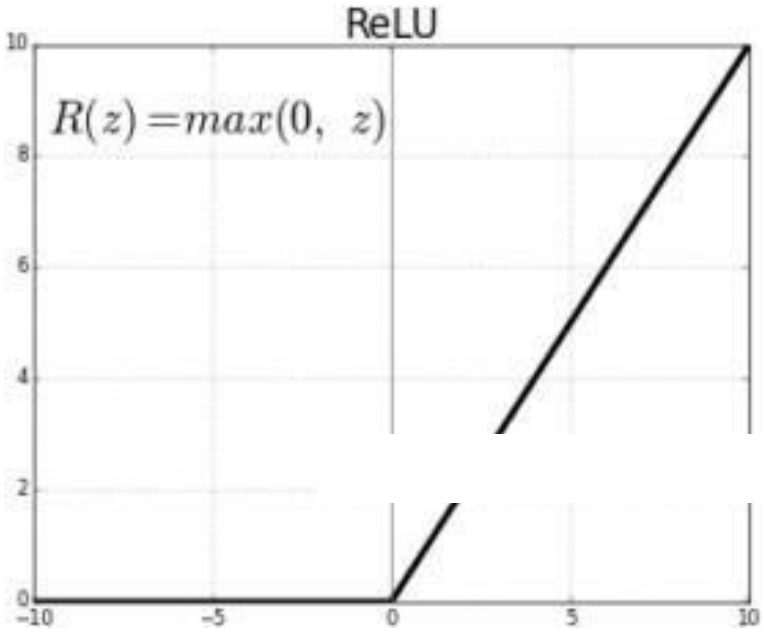


Figure 2.8.6.Activation Function ReLU

2.Soft max Advantages:

- Able to handle multiple classes only one class in other activation functions—normalizes the outputs for each class between 0 and 1, and divides by their sum, giving the probability of the input value being in a specific class.
- Useful for output neurons—typically Soft max is used only for the outputlayer, for neural networks that need to classify inputs into multiple categories.

As shown in Figure 2.8.7 Activation Function SoftMax

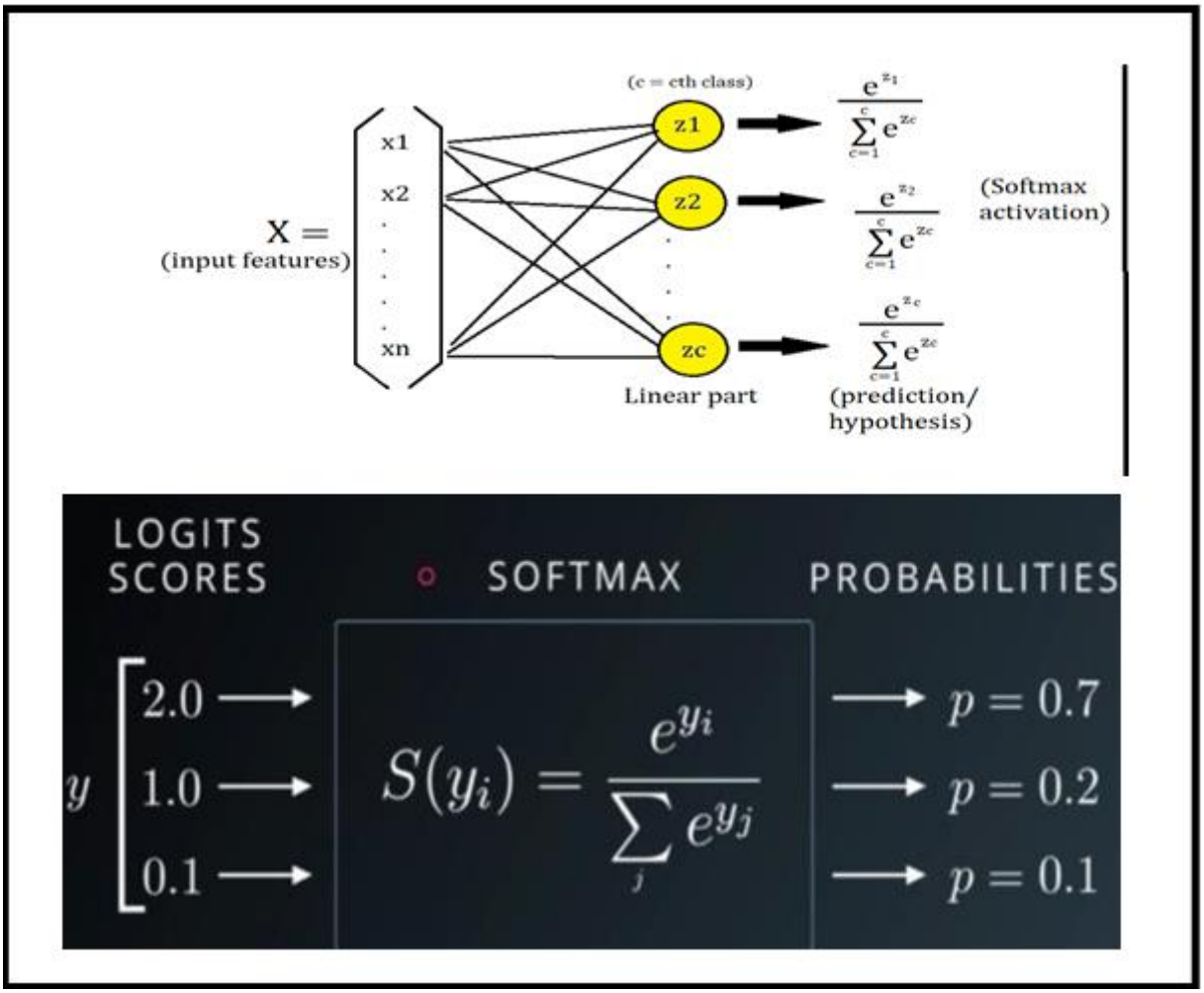
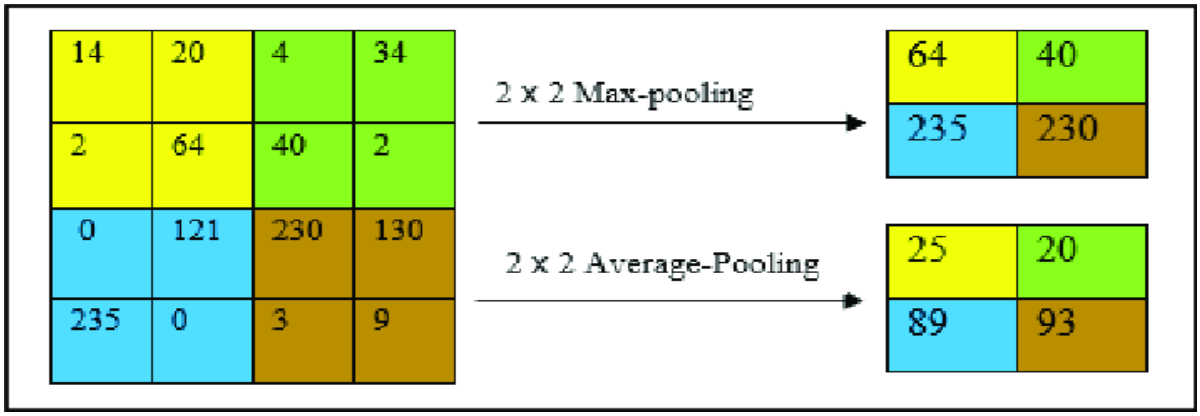


Figure 2.8.7.Activation Function Soft max

3. Pooling Layer: It is common to periodically insert a Pooling layer in-between successive Conv layers in a CNN architecture. Its function is to progressively cut the spatial size of the representation to cut the number of limits and computation in the network, and hence to also control overfishing, A pulling layer that reduces the image dimensionality without losing important features or patterns [122 , p6148-6157].

Types of Pooling layer:

1. Average Pooling: Calculate the average value for each patch on the featuremap in the small dataset.
2. Maximum Pooling (or Max Pooling): Calculate the greatest value for each patch of the feature map in the large and medium datasets.



3. Figure 2.8.8.Average Pooling and Maximum Pooling

As shown in Figure 2.8.8 Average Pooling and Maximum Pooling. The image emerging from the CNN to pooling is done by specifying the pixel image according to the size window pool(pool size), And it is either with max the highest value of the image pixel because it indicates the importance of the part in image and also a complement to the process of reducing thedimensions or through average pooling .

4.Fully connected layer: Neurons in a fully connected layer have full connections to all activations in the earlier layer, as seen in regular Neural Networks. Their activations can hence be computed with a matrix multiplication followed by a bias offset, (A fully connected layer also known asthe dense layer, where the results of the convolutions layers are fed through one or more neural layers to generate a prediction)As shown in Figure 2.8.9 Fully connected layer

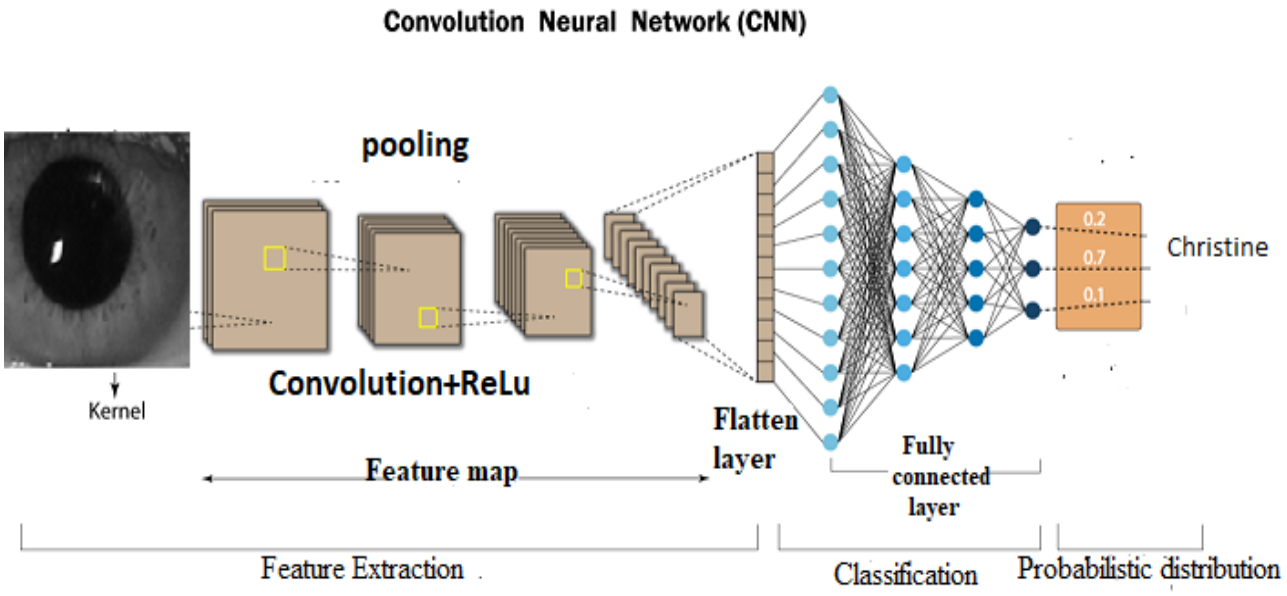


Figure 2.8.9.Fully connected layer

1. Flatten: In between the convolutions layer and the fully connected layer, there is a Flatten layer. Flattening transforms a two-dimensional matrix offeatures into a vector that can be fed into a fully connected neural network classifier, As shown in Figure 2.8.10 Flatten.

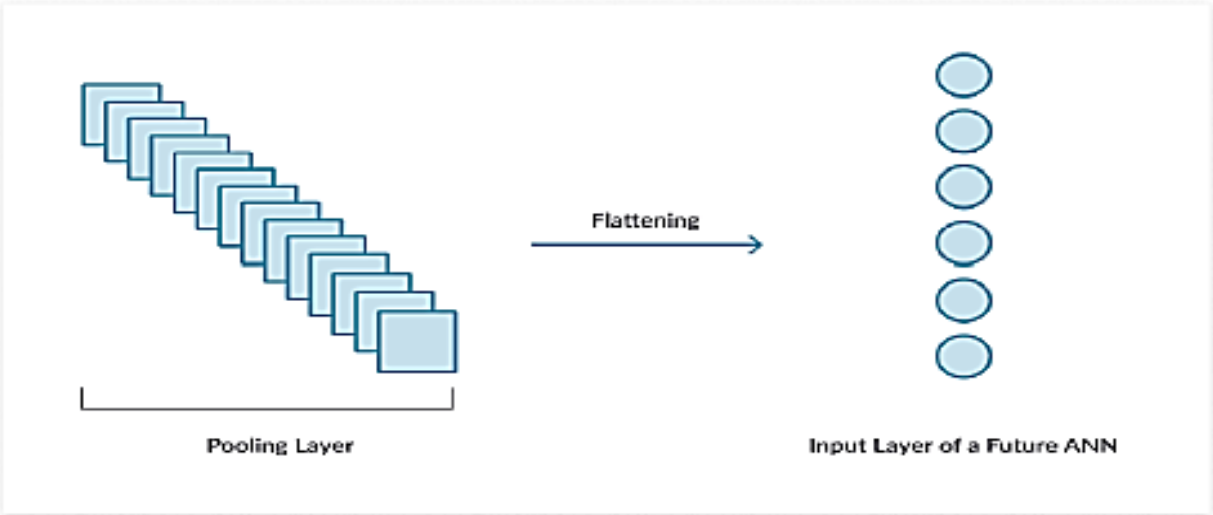


Figure 2.8.10.Flatten

The reason we flatten the multidimensional feature map into a vector is so that we may feed it into a neural network. To rephrase, we will use this vector as the input to the layer of a neural network that will be connected to the convolutional neural network we've been developing up until.

2. Batch Normalization: Batch Normalization is a DL training process acceleration approach. In order to accomplish this, the activation of layers in the neural network must be fine-tuned for each individual data packet. Where the value of the internal covariate shift can be decreased with the use of this method. The endogenous variable shifts as a result of training-induced adjustments to the distribution of network activation. In addition to making network training quicker, this technology also makes networks more stable. Batch normalization is used to improve the efficiency and reliability of neural networks. The input layers are processed by resizing and shifting their centers to achieve this. To put it simply, Batch normalization is a supervised learning technique. It transforms the interlayer's output into a set or process format. This effectively resets the preceding layer's output distribution, allowing the next layer to process it more efficiently.(also known as the batch norm) is a method used to make artificial neural networks faster and more stable through normalization of the response layer by re-centering and re-scaling, less over fitting, As shown in Figure 2.8.11 Batch Normalization.

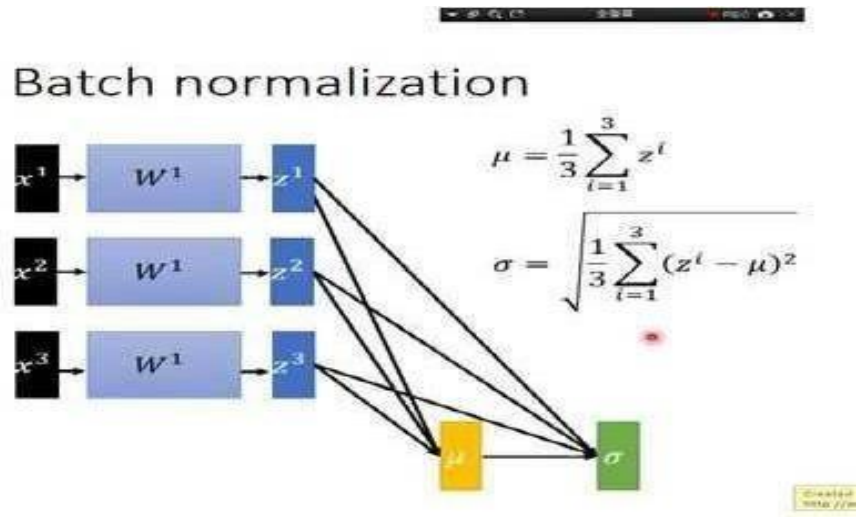


Figure 2.8.11 .Batch Normalization.

Overfitting is an undesirable ML behavior that occurs when a ML model makes accurate predictions for training data but not for new data. When data scientists use ML models to make predictions, they first train the model on a known data set. Then, based on this information, the model attempts to predict outcomes for new data sets. An overfit model can give inaccurate predictions and cannot work well for all types of new data.

Overmatching occur you can only get accurate predictions if the ML model generalizes to all types of data within its domain. Over-matching occurs when the model is unable to generalize but closely fits the training data set. Excessive matching occurs for several reasons, such as:

1. The size of the training data is too small and does not contain enough data samples to accurately represent all possible input data values.
2. Training data contains large amounts of irrelevant information, called noisy data.
3. The model is trained for a very long time on a single sample set of data.
4. The complexity of the model is high, so it learns the noise within the training data.

is a modeling error that occurs when a function is too closely fit toa limited set of data points. Over fitting the model generally takes the form of making an overly complex model. As shown in Figure 2.8.12 . Convolution Neural Network.

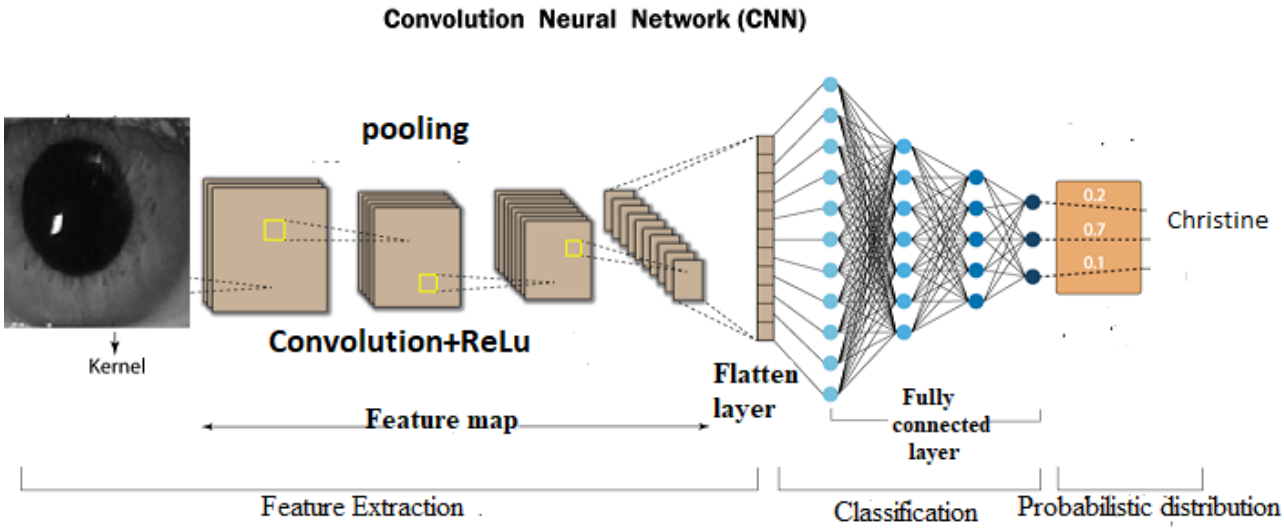


Figure 2.8.12.Convolution Neural Network

3. Compile Model: Before beginning training on a model, the statements inside it must be compiled. It validates the input and specifies the loss function, optimizer, learning rate, and metrics, and checks for formatting issues. Training requires a built model, although prediction may be done without one.

is created, you can config the model with losses and metrics with the model compile and we have the type of model compile .

- Loss Function: It's a method of evaluating how well specific algorithm models the given data. If predictions deviate too much from actual results, loss function would cough up a very large number. Gradually, with the help of some optimization function, the loss function learns to cut the error in prediction [121,p 3001-3012][115,p 1-10]. As shown in Equation 2 In ML, you may measure your model's accuracy using something called a loss function. To rephrase, loss functions quantify how well your model can foretell the target value.

Both the cost function and the loss function have the same application (namely, the backpropagation-based training procedure that seeks to reduce the gap between the observed and expected values). The loss function is computed for each sample output and compared to its true value, while the cost function is computed as the average of all loss function values.

The loss function is intrinsically linked to your model's forecasts. Your model will perform well if the loss function value is small. If you want your model to perform better, you need to find a way to decrease the loss function (or, alternatively, the cost function) you're using to evaluate its worth.

$$\boldsymbol{MSE} = \frac{\sum_{i=1}^{n}(y_i - \widehat{y_i})^2}{n} \tag{2.8.2}$$

Equation 2.8.2 loos function This function is based on the well-known concept in information theory known as Cross Entropy, which is a measure of how similar two different probability distributions are for the same event. In ML, we use this definition and its law to calculate the loss (cost). Where the output of the neural network is a probability distribution of several classes.

The activation method here is either Sigmoid or SoftMax, which are the only activation methods that are compatible with CCE.As advice for better results, always rely on the SoftMax.

The mean squared error (MSE) loss function measures how far off the actual value is from the projected value. It's the go-to when it comes to loss functions for regression analysis.

- Adam optimization: is an optimization algorithm that can be used instead of the classical stochastic gradient descent procedure to update network weights iterative based on training data, As shown in Figure 2.8.13 Adam optimization.

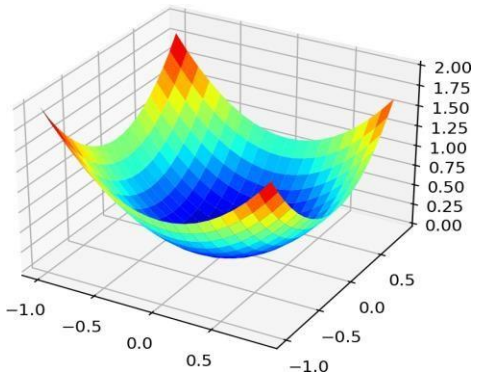


Figure 2.8.13.Adam optimization

Adam optimization: Get to the optimum solution faster(Minimum Loss Functionnear in zero)

- Metric: Kera’s allows you to list the metrics to check during the training of your model, Metric values are recorded at the end of each epoch on the training dataset. If a validation dataset is also provided, then the metric recorded is also calculated for the validation dataset.

Accuracy is the number of correctly predicted data points out of all the data points. More formally, it is defined as the number of true positives and true negatives divided by the number of true positives, true negatives, false positives, and false negatives [115,p 1-10]. As shown in Equation Accuracy.

$$Accuracy = \frac{True\ Negative + True\ Positive}{True\ Positive + False\ Positive + True\ Negative + False\ Negative} \quad (2.8.3)$$

Equation 2.8.3 Accuracy

As shown in Figure 2.8.14 Build Model

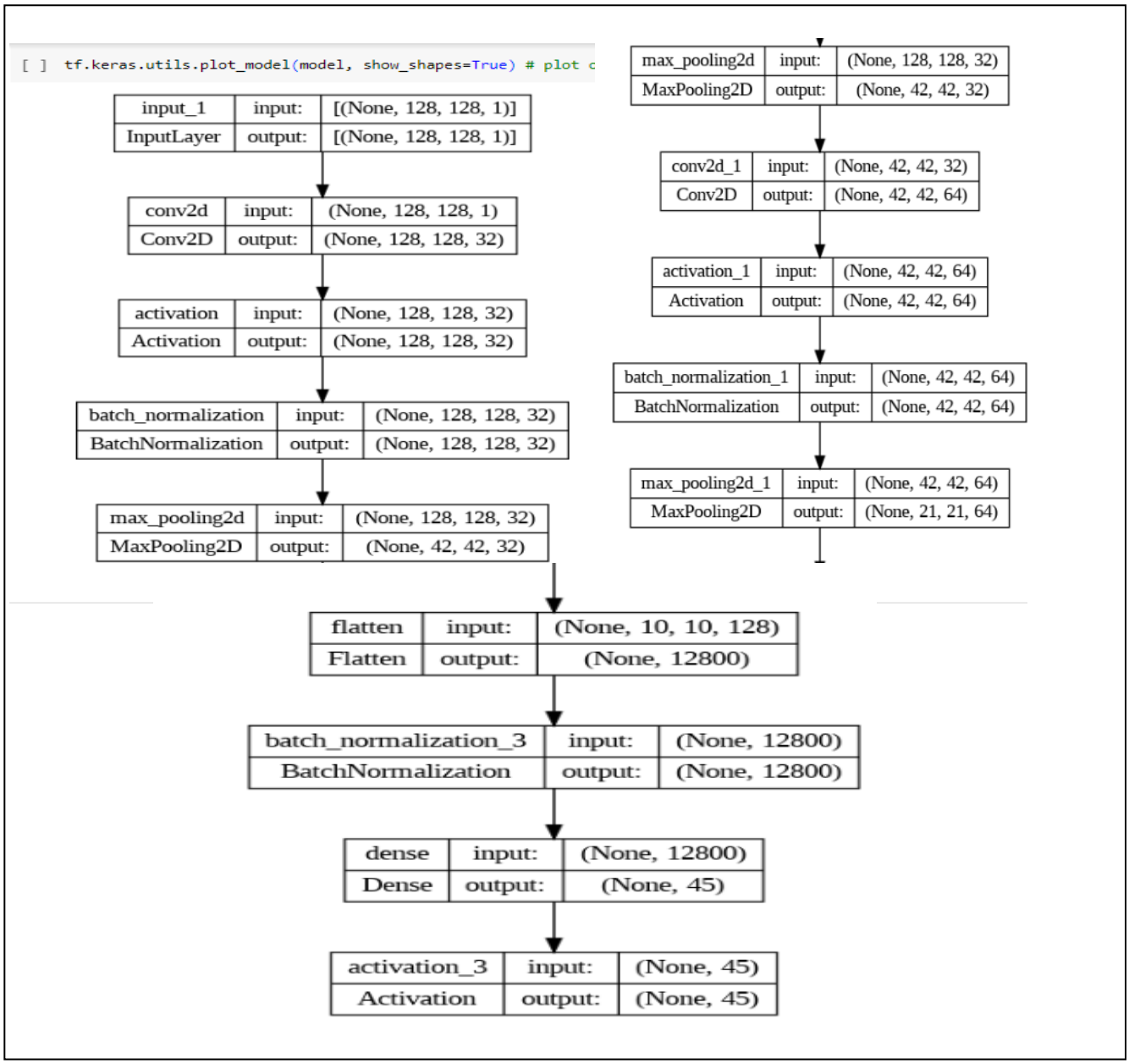


Figure 2.8.14.Build Model

4. Model Training & Evaluation

we conducted 200 epochs of training for our model. More precisely, the ones observed in Fig. 2.8.15. The process of model training involves explaining the typical training process for the first three epochs and the last four epochs using the following steps

1. Fit Model: is a measurement of how well a ML model adapts to data that is similar to the data on which it was trained. The fitting process is generally built into models and is automatic. A well-fit model will accurately approximate the output when given new data, producing more precise results.
2. Epoch: refers to one cycle through the full training dataset. Usually, training a neural network takes more than a few epochs.
3. Batch size: is a term used in ML and refers to the number of training examples used in one iteration.
4. Train steps : The CNN network applies random assignments to the values of each image and subsequently compares them with the class label of the input image.
5. Test steps : deep learning approach that utilizes filters or kernels to extract different picture attributes such as edges, color, gradient, and orientation from an input image.
6. Callbacks: saves the model to add in when the loss is the lowest (accuracy highest).

```
Epoch 1/200
10/10 [==============================] - 8s 670ms/step - loss:
3.9651 - accuracy: 0.1678 - val_loss: 3.7758 - val_accuracy:
0.0312 - lr: 0.0010
Epoch 2/200
10/10 [==============================] - 6s 557ms/step - loss:
2.5705 - accuracy: 0.4211 - val_loss: 4.1856 - val_accuracy:
0.0312 - lr: 0.0010
Epoch 3/200
10/10 [==============================] - 6s 576ms/step - loss:
1.5320 -
Epoch 197/200
10/10 [==============================] - 6s 599ms/step - loss:
0.1555 - accuracy: 0.9375 - val_loss: 0.3910 - val_accuracy:
0.9167 - lr: 1.0000e-18
Epoch 198/200
10/10 [==============================] - 7s 674ms/step - loss:
0.1372 - accuracy: 0.9638 - val_loss: 0.5277 - val_accuracy:
0.9062 - lr: 1.0000e-18
Epoch 199/200
10/10 [==============================] - 7s 668ms/step - loss:
0.1354 - accuracy: 0.9507 - val_loss: 0.5503 - val_accuracy:
0.9062 - lr: 1.0000e-18
Epoch 200/200
10/10 [==============================] - 6s 625ms/step - loss:
0.0646 - accuracy: 0.9844 - val_loss: 0.6016 - val_accuracy:
0.8854 - lr: 1.0000e-18
```

Figure 2.8.15.Process of model training.

5- Predict Model

Predictive modeling is a technique that uses mathematical and computational methods to predict an event or outcome. A mathematical approach uses an equation-based model that describes the phenomenon under consideration. The model is used to forecast an outcome at some future state or time based upon changes to the model inputs, As shown in Figure 2.8.16 Predict Model .

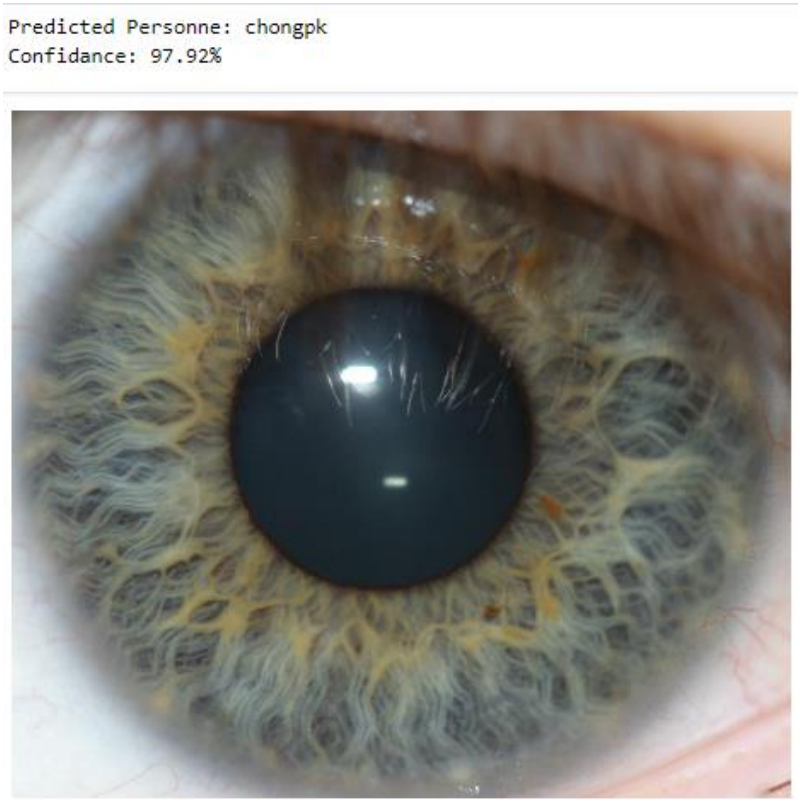


Figure 2.8.16.predict model

6- Build a notebook GUI

Since more complex to build full webpage (with backend), for displaying purposes, in this section we will try to build a notebook graphical userinterface (GUI) to display our results, Using the ipywidgets library[123, p 208-215].

IPyWidgets is a Python library of HTML interactive widgets for Jupyter notebook. Each UI element in the library can respond to events and invokes specified event handler functions. They enhance the interactive feature of Jupyter notebook application As shown in Figure 2.8.17 GUI.

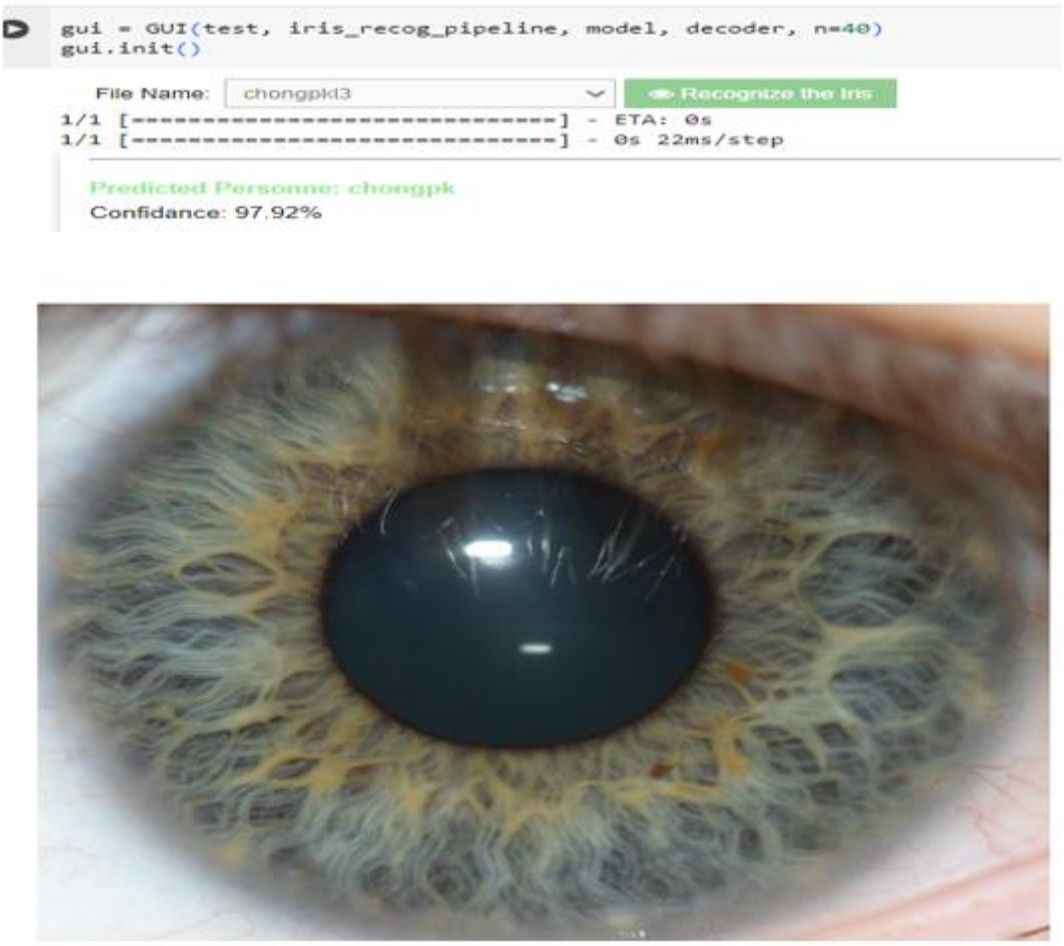


Figure 2.8.17.Graphical user interface (GUI)

CHAPTER III. EXPERIMENTAL RESULTS

3.1. Chapter overview

This chapter outlines all the relevant results that were conducted by using the techniques from Chapter 3. The results are divided into sections based on those presented in Chapter 2. Certain sections are further divided into sub-sections. The first section deals with the results of the experiments that involved the segmentation results. The second section discusses the iris eye image feature extraction results. Finally, The third section discusses the owner of this iris recognition and conclusion results.

3.2. Dataset characteristics

A comparison of iris recognition methods requires similar input data to compare and evaluate their results. Therefore, standard iris dataset are of great importance and become indispensable in the development process. Several databases of iris images are freely available on the Internet. In this section, we describe the main features of public and freely accessible iris image databases for biometric purposes, which will be used in this thesis. In this thesis, dependent databases were used in Multimedia University MMU database is a public database. IRIS patterns for each Eye are unique for every individual and this is helpful in identifying an individual. This Dataset consists of both 5 images each of left and right IRIS of 46 persons, totaling 460 images along with few empty files. IRIS segmentation can be performed for Individual identification/classifying an IRIS image according to saved database, As shown Figure.

3.2.1 Dataset. The dataset was extracted from the Kaggle website:-

https://www.kaggle.com/datasets/naureenmohammad/mmu-iris-dataset

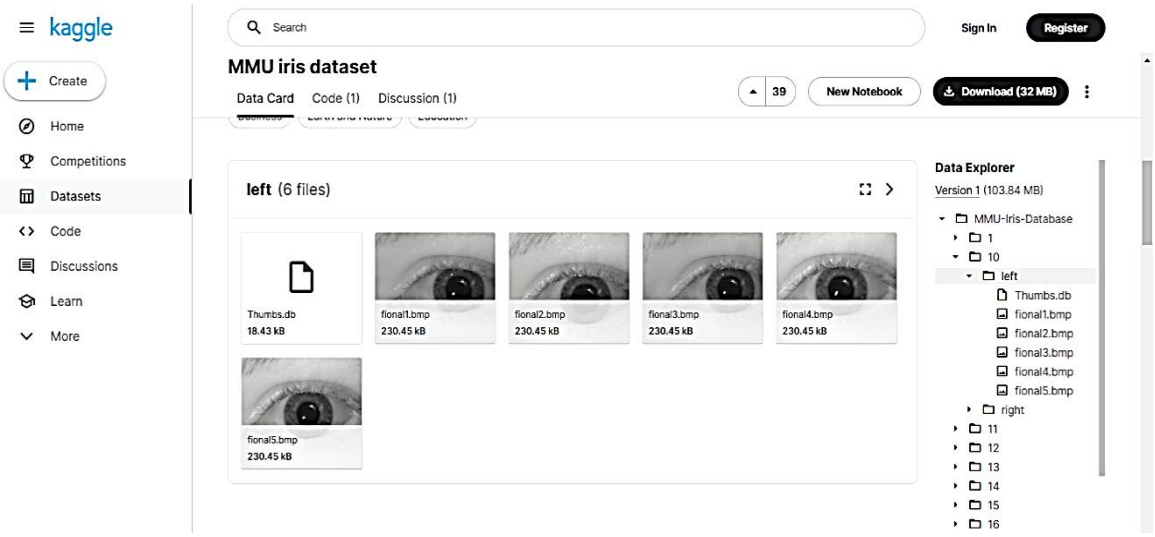


Figure 3.2.1.Dataset was extracted from the Kaggle

3.3. Segmentation result

Image segmentation is an important stage of digital image processing, which is the process of fragmenting the image into coherent and homogeneous regions according to a specific criterion such as color. The union of these regions should result in a reconstruction of the original image.

Slicing is an important stage that allows the extraction of qualitative information about the image, as it provides a high-level description, as each region is linked to its neighboring regions within a network of nodes in which each node represents a region in the image, and this node carries a card that contains qualitative information about the region such as its size, color, shape, and orientation. The nodes that connect the nodes can be labeled with information about the relationship between adjacent areas, such as being, for example, one area contained in another, or being under or above it, and so on. The level of complexity in network configuration varies depending on the slicing technique used.

Because the results of this step were not definitive, there was no attempt made to evaluate how well it performed in terms of accurate segmentation.

This method relied on minimizing image distortion in order to detect and segment the iris and pupils from an image. Identifying the pupils required minimizing picture distortion.

1. Detect Pupils

The aim of this process is to identify the pupils of the image and to identify the darkest area in the image and remove the noise from the image through which it is easier for us to know the iris of the eye through a lot of techniques used for this task in my thesis which uses the contour algorithm described in Chapter 3. The basic algorithm has many of advantages. It is easy to use, uncomplicated and does not require much time. As shown in the code to get the Figure 3.3.1 Detect pupil's result and also the code to get iris segmentation .

```
import numpy as np
import cv2 as cv
import random
from pathlib import Path
image_path="/content/aevar7.bmp"
class IrisSegmentor:
    def __init__(self, images_folder:str or list, images_ext:str="png"):
        self.path = None
        if type(images_folder) is str:
            self.path = Path(images_folder)
            self.images = Path(images_folder).rglob(f"*.{images_ext}")
        else:
            self.images = images_folder
    @staticmethod
    def read_img(path:str, size=None) -> np.ndarray:
        """reads an image and convert it to gray scale"""
        path = str(path)
        img = cv.imread(path)
        img = cv.cvtColor(img, cv.COLOR_BGR2GRAY)
        if size:
            img = cv.resize(img, size, interpolation=cv.INTER_LANCZOS4)
        return img
    @staticmethod
    def show(img:np.ndarray, title:str="Image display"):
        """helper function that display the image"""
```

```
        cv.imshow(title, img)
        cv.waitKey(0)
        cv.destroyAllWindows()

    @staticmethod
    def detect_pupiles(img, thresh=35):
        """detect the pupiles from an image"""
        # select the darkest region in the image
        dark = cv.inRange(img, 0, thresh)
        # perform a closing operation: erode then dilate
        # to delet noise on the image
        k = cv.getStructuringElement(cv.MORPH_ELLIPSE, (5, 5))
        closed = cv.morphologyEx(dark, cv.MORPH_CLOSE, k, iterations=3)
        # find contours
        cnts = cv.findContours(closed, cv.RETR_EXTERNAL,
cv.CHAIN_APPROX_SIMPLE)[0]
        # sort by area and select the biggest contour
        cnts = sorted(cnts, key=cv.contourArea, reverse=True)
        pupile = cnts[0]
        # define the bbox
        box = np.array(cv.boundingRect(pupile))
        return box,closed

    @staticmethod
    def segment_iris(img, no_mask, stride=30, thresh=30):
        """segment the iris from an image"""
        box, __ = IrisSegmentor.detect_pupiles(img, thresh)
        # get the iris bbox, since it almost in a const distance from the
pupile
        # will use a heuristic formula
        box[:2] -= stride
        box[2:] += stride * 2
        x, y, w, h = box
        if no_mask:
            return img[y:y+h, x:x+w]
        # get the center and radius of the iris
        r = w // 2
        cx, cy = x + r, y + r
        # create a mask to extract the iris
        mask = np.zeros_like(img)
```

```
        cv.circle(mask, (cx, cy), r, (255, 255, 255), -1)
        # extract the iris
        iris = cv.bitwise_and(img, mask)
        return iris

    def segment_and_save(self, save_folder:str, size=None, no_mask=False,
**kws):
        """segment and save the iris in directory, if size specified will
resize the
        images before segmentation"""
        save_folder = Path(save_folder)
        if isinstance(self.path, Path):
            assert save_folder.absolute() != self.path.absolute(), "The
saving directory should not be the same as the images folder"
        for i, path in enumerate(self.images, 1):
            fname = path.name
            cls = path.parent.name
            image = self.read_img(str(path), size)
            iris = self.segment_iris(image, no_mask, **kws)
            new_path = save_folder / cls
            new_path.mkdir(exist_ok=True)
            cv.imwrite(str(new_path / fname), iris)
        print("[INFO]", f"Saved {i} image file in
{str(save_folder.absolute())!r}")

def show_steps(image_path:str, step:int or str="all"):
    """Displays each step of the algorithm.

    Args:
    -----
        @image_path
        @step: (1, 2, or "all") the step to display"""

    iris = IrisSegmentor
    img = iris.read_img(image_path, (256, 256))
    pupiles_img = iris.detect_pupiles(img)[1]
    iris_img = iris.segment_iris(img, False)
    if step == 1:
        to_add = [pupiles_img]
    elif step == 2:
```

```
        to_add = [iris_img]
    else:
        to_add = [pupiles_img, iris_img]
    stack = np.hstack((img, *to_add))
    return stack
from google.colab.patches import cv2_imshow
show_steps(image_path,step="all")
cv2_imshow(show_steps(image_path,step="all"))
```

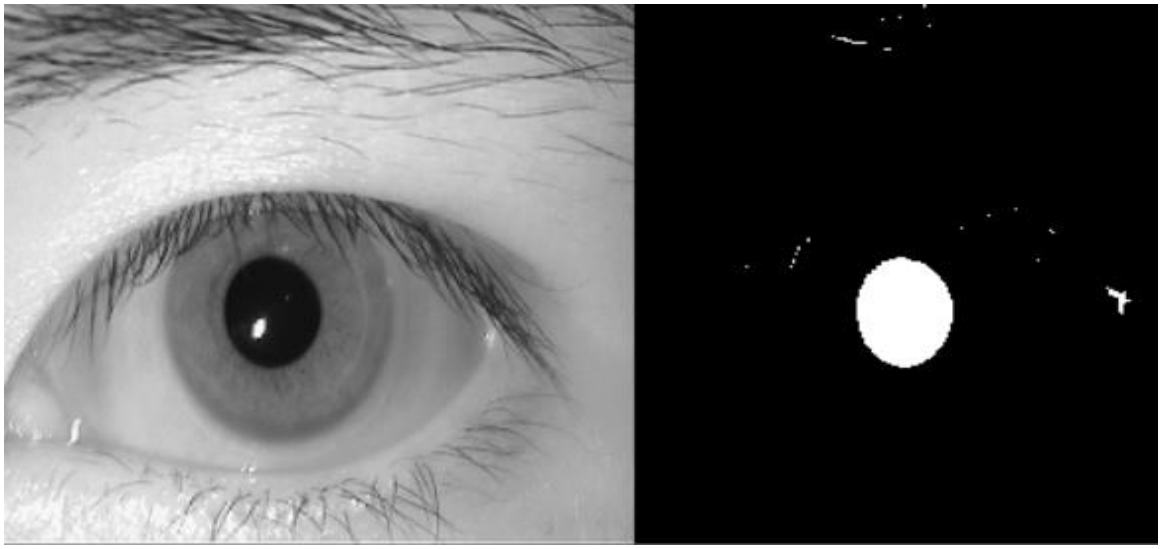


Figure 3.3.1.Detect pupils result

2. Iris segmentation result

The goal of this stage is to reach the iris that surrounds the pupils. To perform this task he will use an heuristic formula, by which the iris of the eye will be obtained, since it is at approximately a constant distance from the pupil which extracts all the features

of the iris and use the mask to extract the iris, as shows Figure 3.3.2 iris segmentation

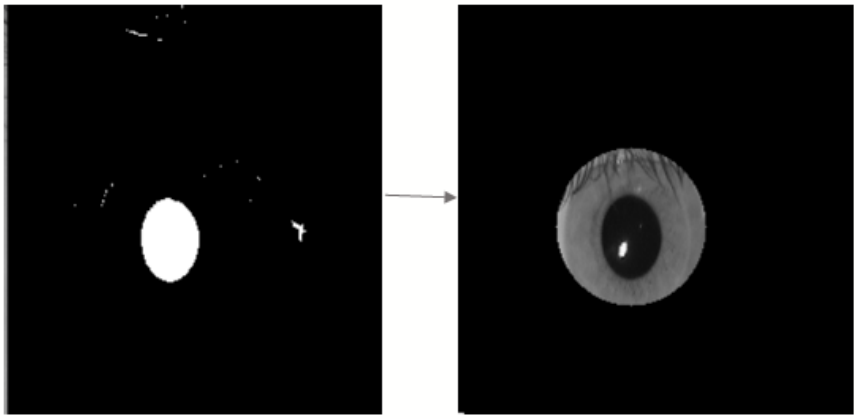


Figure 3.3.2. IRIS segmentation

3.4. Recognition result

The present section is concerned with presenting the results of the identification of the owner of the iris and the task of the iris being unique is a challenging task not only for computers but for humans as well. The main reason for this is the ambiguity faced by computer-based or human-based recognition in the absence of context. For this reason, many image processing systems appeared through many technologies and some models to teach the computer on these images. Therefore, most personality classification experiments were conducted using numerous image processing and also trained by CNN. One of the most important image processing processes: -

1. Feature Extraction Results
2. Classes balance
3. Data augmentation
4. Model building by Convolutional neural network
5. Predict Model

1 . Feature Extraction Results

The goal of this stage is to get all the features of the iris so that the computer can understand it because it deals with image pixels, so we need specific techniques and can handle these properties, which is to apply the preprocessing function when reading images and use resizing, which deals with images with equal size , then extracts the

pixels of the images and then performs the grayscale histogram equation to scale the data back to the range [0, 1], as shows Figure 3.4.1 image resize.

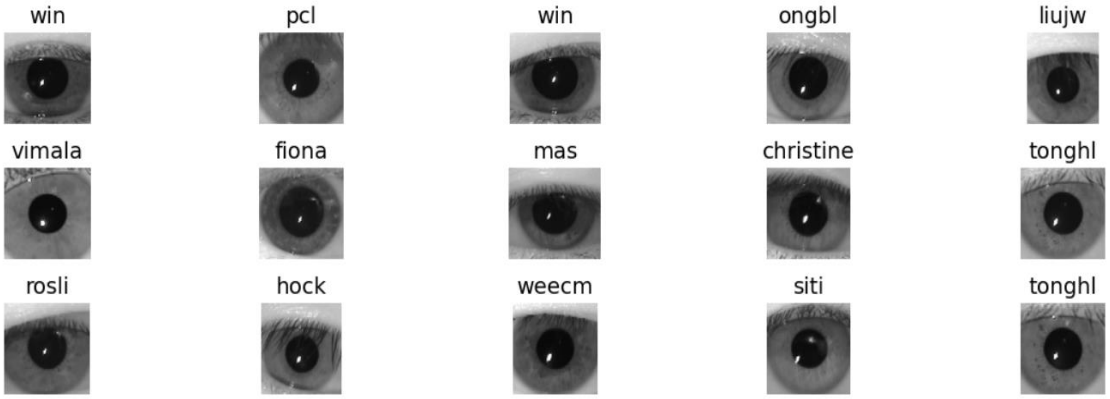


Figure 3.4.1.Image resize

2. Classes balance

This technique examines the data as a balanced data set by the classes count, a data set where each output class (or target class) is represented by the same number of input samples, which allows for a large number of data so that the computer can learn on enough data and gives excellent results. As show Figure 3.4.2 Classes balance and the code to build classes balance.

```
def create_dataframe(root:Path):
    """Create a dataframe from our dataset with 2 columns:
        path: image path
        class: persone name

    Args:
        root (Path): the path the folder dataset.

    Return:
        the dataset dataframe(path:str, class:str)"""
    images, classes = [], []
    for image_path in root.rglob('*.bmp'):
        images.append(str(image_path))
        class_ = image_path.parent.name.split('_')[-1]
        classes.append(class_)
    df = pd.DataFrame({"path":images, "class":classes})
    return df.sample(frac=1).reset_index(drop=True)
```

```
def read_img(path, size=None):
    """read the image from the path

    Args:
        path: image path
        size: tuple if not None will resize the image

    Return:
        image pixels in a numpy array"""
    img = cv.imread(path)
    img = cv.cvtColor(img, cv.COLOR_BGR2GRAY)
    if size:
        img = cv.resize(img, size, interpolation=cv.INTER_LANCZOS4)
    return img

def show_examples(df, n):
    """show random picked examples in the dataset and display the in a grid
figure.

    Args:
        df: dataset dataframe.
        n: number of examples to display (max is 25)."""
    n = min(n, 25)
    fig = plt.figure()
    samples = df.sample(n)
    i = 1
    for _, r in samples.iterrows():
        fig.add_subplot(5, 5, i)
        img = read_img(r['path'])
        plt.imshow(img, cmap="gray")
        plt.axis("off")
        plt.title(r['class'])
        i += 1
    plt.show()
```

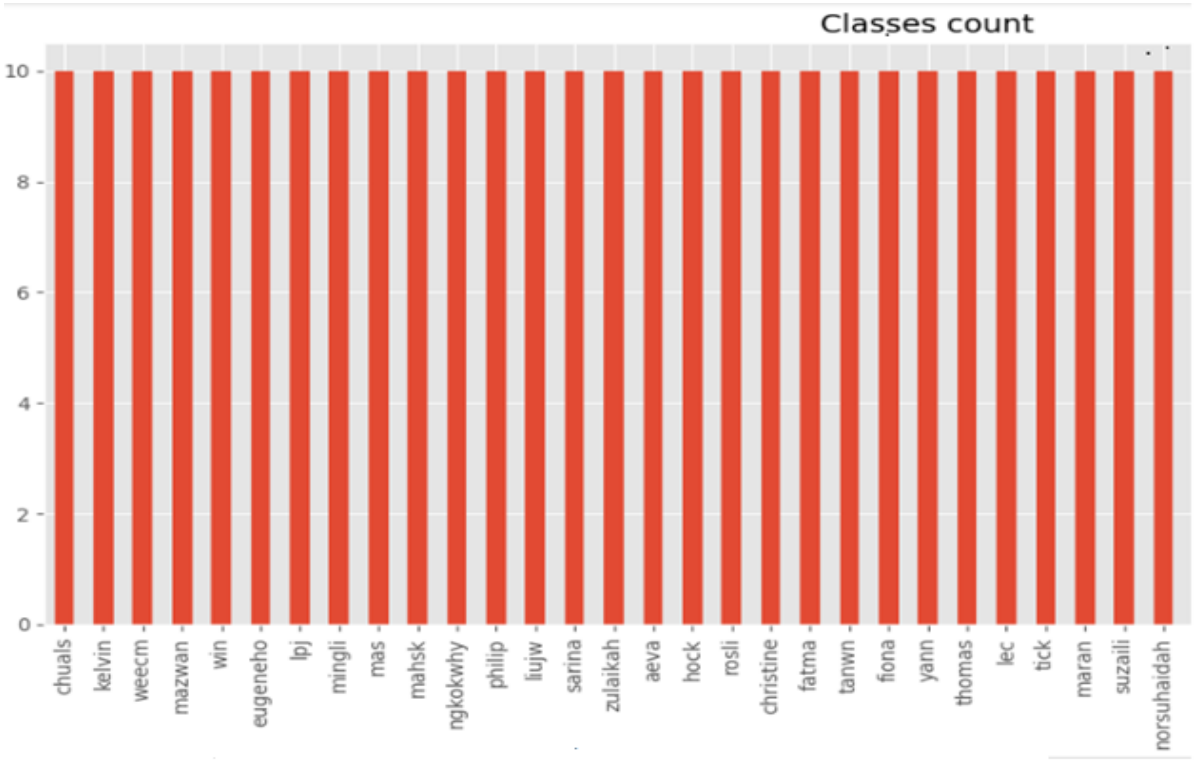


Figure 3.4.2.Classes balance

3. Data augmentation

The techniques Data augmentation used in data analysis are techniques used to augment the amount of images by adding slightly modified versions of existing data or newly created synthetic data from existing data. It acts as an organizer and helps reduce overfitting when training a ML model, we will use: Random horizontal flipping, Random Rotation (-15, 15) degree, Zoom range 20% in and out Shear range of 20% [124 , p 1927-1931].

4. Model building by Convolution neural network

Model building is designed to reduce the number of project features, the better, the fewer the weight of the number of neurons, and the better results. A simple CNN is a series of layers, and each layer of CNN converts one volume of activations into another through a differentiable function. We use three main types of layers to build CNN architectures: the convolution layer, the pooling layer, and the fully connected layer (just as it appears in normal neural networks) [125 ,p 1339-1359].For our model we used a super simple model, to avoid overfitting, with 3 Conv2D + Max-Pooling layers for feature extraction and then dense layer as classifier as show Figure 3.4.3. model architecture the code to Build model CNN.

```
def simple_cnn(in_shape):

    model = tf.keras.Sequential( name="iris_recognition" )
    # input layer
    model.add(L.Input(in_shape))
    # convulotion layers
    # 32 x (3, 3) -> ReLU -> BatchNorm -> MaxPool
    model.add(L.Conv2D(32, (3, 3), padding="same"))
    model.add(L.Activation("relu"))
    model.add(L.BatchNormalization())
    model.add(L.MaxPooling2D(pool_size=(3, 3)))

    # 64 x (3, 3) -> ReLU -> BatchNorm -> MaxPool
    model.add(L.Conv2D(64, (3, 3), padding="same"))
    model.add(L.Activation("relu"))
    model.add(L.BatchNormalization())
    model.add(L.MaxPooling2D(pool_size=(2, 2)))

    # 128 x (3, 3) -> ReLU -> BatchNorm -> MaxPool
    model.add(L.Conv2D(128, (3, 3), padding="same"))
    model.add(L.Activation("relu"))
    model.add(L.BatchNormalization())
    model.add(L.MaxPooling2D(pool_size=(2, 2)))
    # flatten the features map
    model.add(L.Flatten())

    # fully connected layer
    # connect the extracted features to dense layer for classification
    model.add(L.BatchNormalization())
    model.add(L.Dense(NUM_CLS))
    model.add(L.Activation("softmax")) # output layer softmax for outputing
probabilities
    opt = tf.optimizers.Adam(0.001) # adam optimizer with 0.001 learning
rate
    loss = "categorical_crossentropy" # loss for multiclass classfifcation
    model.compile(optimizer=opt, loss=loss, metrics=['accuracy'])
    return model
```

Figure 3.4.3.Model architecture code

And we trained our model for 200 epochs, and saved them in the best epoch. Fit Model: We trained the model using model. Fit model as show Figure 3.4.4 Model Training & Evaluation code.

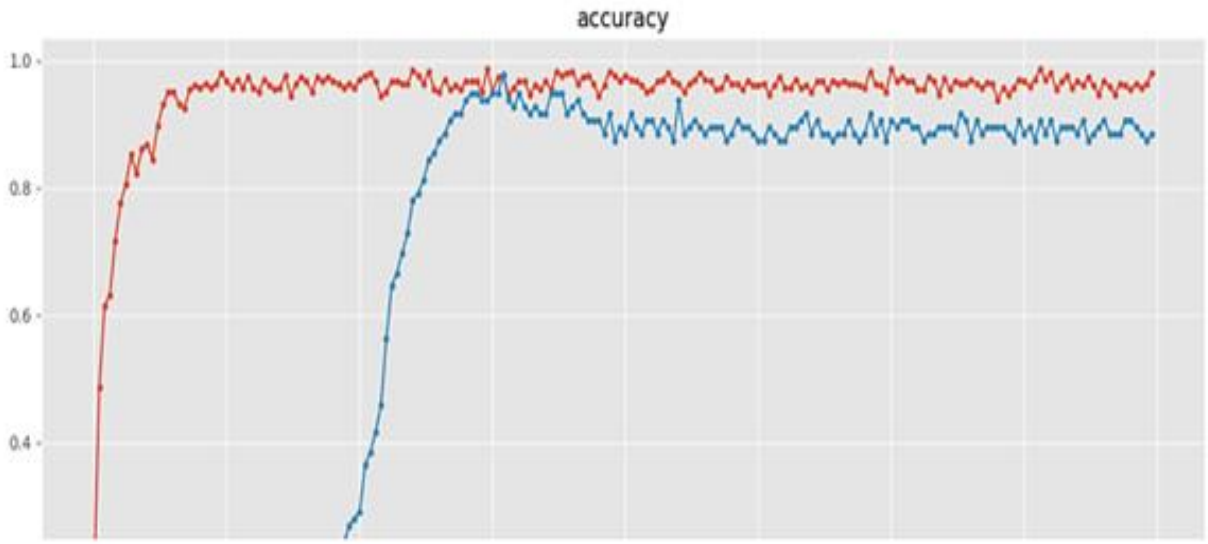
```
train_steps = train_gen.n // BATCH # how many steps to take in batch (train
set)
test_steps = test_gen.n // BATCH # how many steps to take in batch (test
set)

callbacks = [
    tf.keras.callbacks.ModelCheckpoint(MODEL_PATH, save_best_only=True), #
saves the model to hdd in when the loss is the lowest (accuracy highest)
    tf.keras.callbacks.ReduceLROnPlateau() # reduce the learning rate on
plateau
]

EPOCHS = 200
H = model.fit(train_gen, validation_data=test_gen,
steps_per_epoch=train_steps,
              validation_steps=test_steps, callbacks=callbacks,
epochs=EPOCHS)
```

Figure 3.4.4.Model Training & Evaluation code

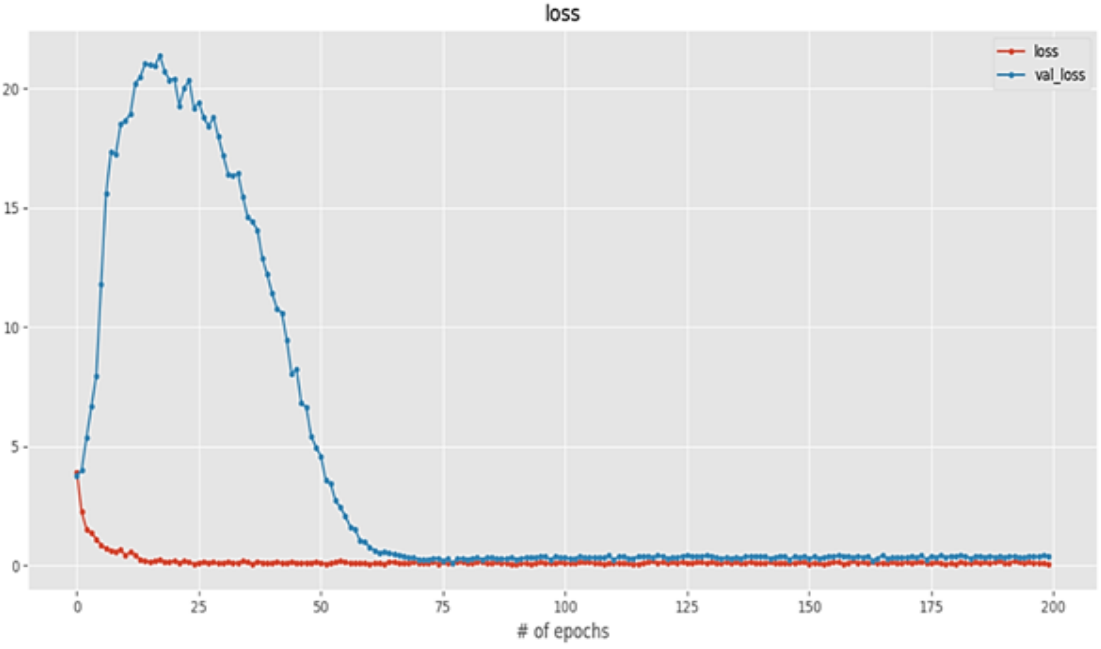
And the best validation accuracy we had is 96.8 %! so the model will be saved on that accuracy. as show Figure 3.4.5 Graph showing accuracy.



The red color for accuracy testing ,The blue color for accuracy training

Figure 3.4.5.Accuracy

And loss Function It's a method of evaluating how well specific algorithm models the given data .If predictions deviate too much from actual results, loss function would cough up a very large number. Gradually, with the help of some optimization function, the loss function learns to cut the error in prediction As shown in Figure 3.4.6 Graph showing Loss Function.



Red color -loss, Blue color -Val_loss

Figure 3.4.6.Loss Function.

5. Predict Model

Predictive modeling is a technique that uses mathematical and computational methods to predict an event or outcome .a mathematical approach uses an equation-based model that describes the phenomenon under consideration. The model is used to forecast an outcome at some future state or time based upon changes to the model inputs, As shown in Figure 3.4.7 predict model. And the code to prepared the prediction also Figure 3.4.8 and the table 3.4.1 show you the Epochs and the Accuracy.

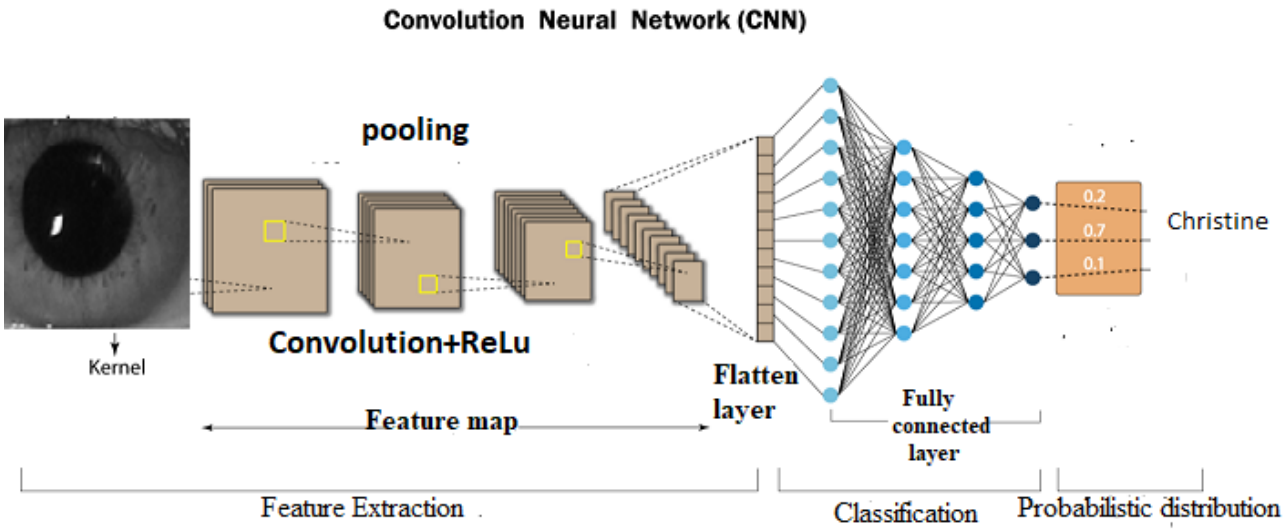


Figure 3.4.7.Process Predict model

```
def process_input(img_path):
    """prepare the image to be feeded to the model"""
    if type(img_path) is str:
        img = read_img(img_path, SIZE)
        img = preprocess(img)
        ins = np.expand_dims(img, 0)
    else:
        images = []
        for img in img_path:
            img = read_img(img, SIZE)
            img = preprocess(img)
            images.append(img)
        ins = np.array(images)
    return ins

def process_output(pred, decoder):
```

```
    """decode the output of the model"""
    proba = pred.max(axis=1)[0]
    pred = pred.argmax(axis=1)[0]
    id = decoder[pred]
    return id, proba

def iris_recog_pipeline(img_path, model, decoder, show=False):
    """a pipeline that takes an image path preprocess it feed it to the
model
    and decode the output then display it.

    Args:
        img_path: the image path
        model: the loaded (trained) model
        decoder: dict that containe each class and it index"""
    ins = process_input(img_path)
    pred = model.predict(ins)
    out, proba = process_output(pred, decoder)
    if show:
        plt.imshow(ins.squeeze(), cmap="gray")
        plt.title(f"Predicted person: {out}")
        plt.grid(None);plt.axis("off")
        plt.show()
        return
    return out, proba
```

```
i = 12# <==== just change this to select a diffrent iris from the validation
set
t_path, t_cls = test.iloc[i, 0], test.iloc[i, 1]
print(INF, f"Testing with image {t_path!r}, that belongs to: {colored(t_cls,
'red', attrs=['bold'])}")
print("="*80)
iris_recog_pipeline(t_path, model, decoder, show=True)
```

```
Predicted Personne: chongpk
Confidance: 97.92%
```

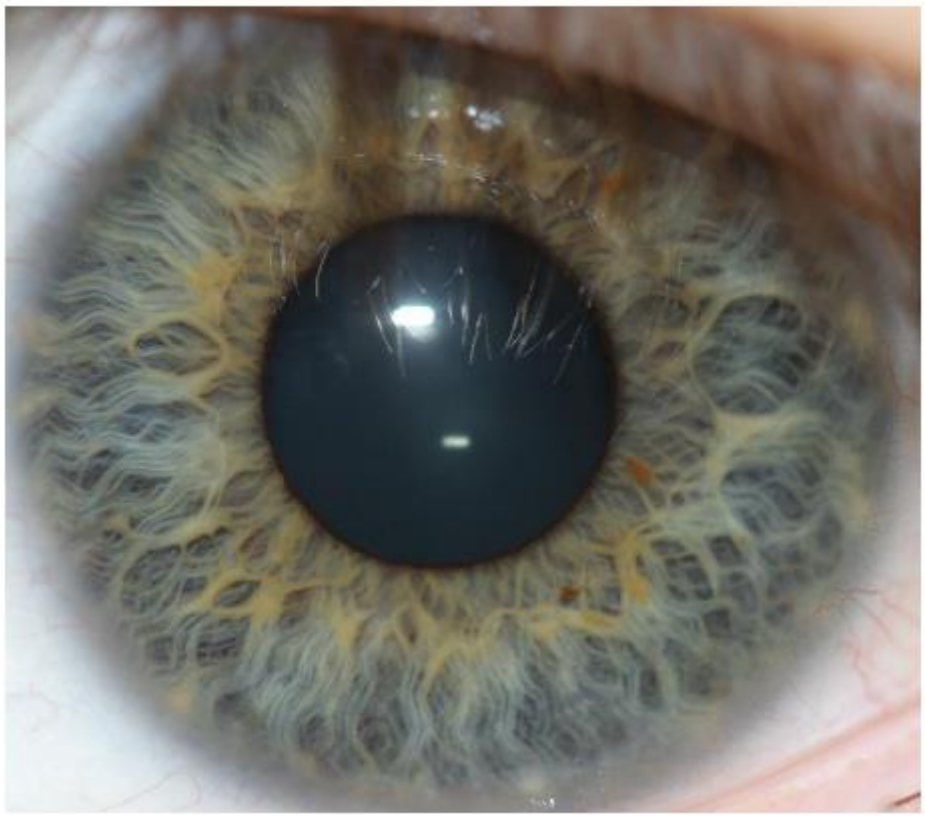


Figure 3.4.8.Predict model

Table 3.4.1 Show you the Epochs and the Accuracy

Number of Epochs	Best Test Accuracy
1	91.6%
2	92.7%
3	90.6%
4	93.7%
5	89.5%
6	88.5%
7	96.8%

3.5. Build a notebook GUI

We built a graphical user interface to display our results, Using the ipywidgets library as show figure 3.5.1 GUI and there the explanation code how to create GUI.

ipywidgets, also known as jupyter-widgets or simply widgets, are interactive HTML widgets for Jupyter notebooks and the Python kernel.

This package contains the python implementation of the core interactive widgets bundled in ipywidgets. The fundamental widgets provided by this library are called core interactive widgets. A demonstration notebook provides an overview of the core interactive widgets, including:

- sliders
- progress bars
- text boxes
- toggle buttons and checkboxes
- display areas

```
class GUI:
    """
    a notebook gui for displaying results of the iris recognition DL
model.

    Author: Iliass Benali.

    Parameters:
    -----
        @df: pandas dataframe that has "path" column containing images
path.
        @prediction_func: pipeline function that takes image path,
process it,
            feed it to the model and process and finaly process the
output.
        @model: tensorflow trained model.
        @out_decoder: dict that maps index to classes names.
        @n: max number of files allowed to display.

    after initialization, use the init() method to display the gui.
    e.g: gui = GUI(...)
```

```
         gui.init()
    """
    def __init__(self, df, prediction_func, model, out_decoder, n=10):
        self.pred_func_args = {"model":model, "decoder":out_decoder}

        self.predict = prediction_func
        self.dropdwn = dropdown = widgets.Dropdown(
                              options= self.get_path_names(df, n),
                              description='File Name:',
                              ensure_option=True,
                              disabled=False)
        self.btn = button = widgets.Button(
                         description='Recognize the Iris',
                         disabled=False,
                         button_style='success',
                         tooltip='Identify the selected iris',
                         icon='eye')
        self.html_header = HTML("""
                <link rel="stylesheet"
href="https://stackpath.bootstrapcdn.com/font-awesome/4.7.0/css/font-
awesome.min.css">
        """)
        self.display_card = """
            <div class="card" style="box-shadow: 0 4px 8px 0
rgba(0,0,0,0.2);transition: 0.3s;">

                <div class="container" style="padding: 2px 16px;">
                    <hr>
                    <h4 style="color:lightgreen"><b>Predicted Personne:
{pred}</b></h4>
                    <p>Confidance: {proba:.2%}</p>
                </div>
            </div>
        """

    def init(self):
        """displays the graphical user interface."""
        gui = widgets.HBox([self.dropdwn, self.btn])
        gui_output = widgets.Output()
        @gui_output.capture(clear_output=True)
```

```
        def display_prediction(e):
            path = self.dropdwn.value
            pred, proba = self.predict(path, **self.pred_func_args)
            html = self.display_card.format(pred=pred, proba=proba)
            img = read_img(path)
            display(HTML(html))
            plt.figure(figsize=(10, 5))
            plt.imshow(img, cmap="gray")
            plt.grid(None);plt.axis("off")
            plt.show()

        self.btn.on_click(display_prediction)
        return display(self.html_header, gui, gui_output)
    @staticmethod
    def get_path_names(df, n):
        """randomly select n number of images path from the dataframe"""
        return [(Path(path).name.split(".")[0], path) for path in
df.path.sample(n).values]
```

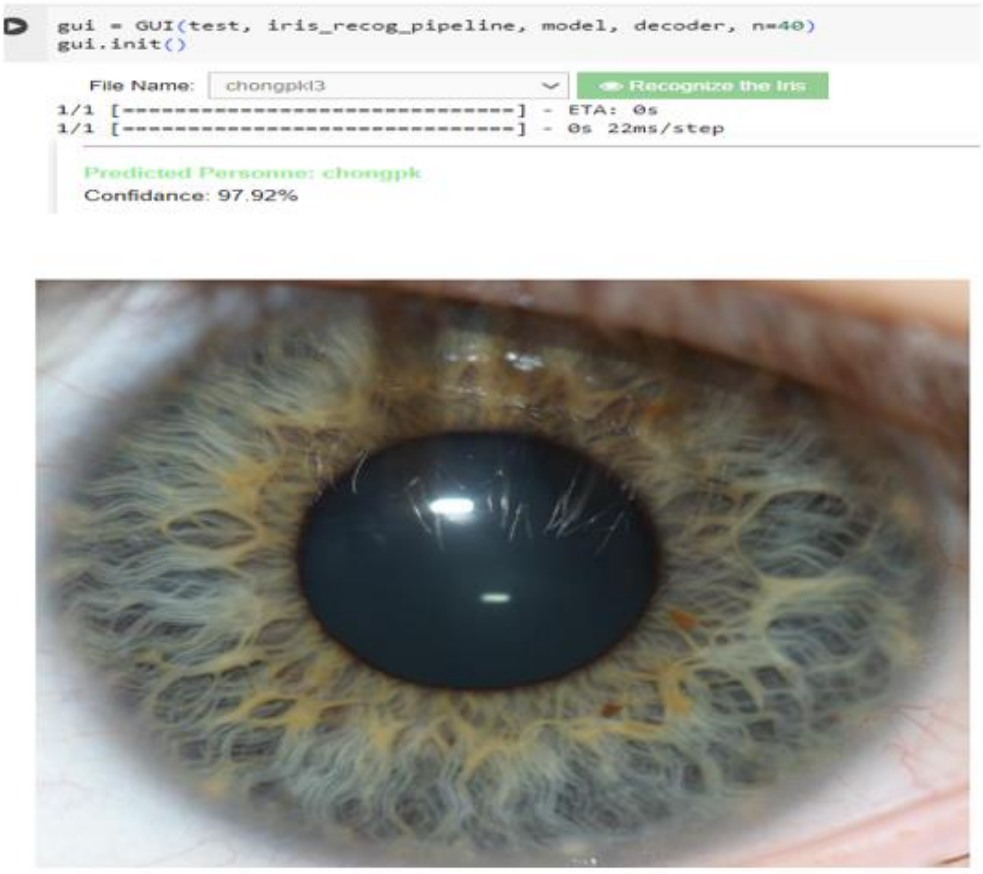


Figure 3.5.1.Notebook GUI

After running the software on 460 different photos, we were able to acquire 96.8 % of the desired outcomes. The two sets of pictures are completely interchangeable with one another. A camera with a high resolution is necessary in order to put these strategies into practice. Together with a camera. The outcomes from the computer were satisfying. Where we draw our conclusions from this system, which is based on DL and neural networks, is the role that it can play in the enhancement of AI to adopt e-government and integrate e-services and government applications in order to keep pace with technological advancements and artificial intelligence.

As there are some countries that make use of these applications, the application that was built was put through its paces during testing and verification, which resulted in positive feedback. On the other hand, we are working to combine it with e-government apps so that we may better assist citizens in benefiting from the ongoing revolution in artificial intelligence. There were some restrictions, such as a limited number of images; however, in order to link with the actual databases of these applications, we require photographs of actual people.

3.6. Result discussions

Ultimately, according to the comparison of the thesis and previous work, we differ in the importance of artificial intelligence, and the goals that there are in making e-government applications effective for use.

To achieve this goal, the theoretical and methodological basis of the thesis, which is AI and DL and use of the CNN method, was used to integrate this methodology into e-government services and improve citizens' access to services and determine the importance of recognizing people through iris for e-government applications as part of artificial intelligence. We use a modified linear activation function, max pooling, and flat matrix. To build DL models.

According the researcher (Zhang et al., 2021)[32,p. 1646–1650] .This study analyzed articles on studies of the use of e-applications, focusing on eye-tracking-based methods. The thesis method was experimental, using special eye-tracking equipment such as scanning path maps. Heat map, comparison of areas of interest, behavioral

observation. The study also included methods for collecting auxiliary data such as testimonies, interviews, and transaction records. The results showed different results for the outputs and types of eye movement measurement. The findings revealed disparate outcomes and variations in the outputs and methodologies of eye movement assessment. The utilization of non-wearable gadgets and the constrained experimental environment impose limits on the effectiveness of eye tracking is it usability assessment for government apps. These devices facilitate analysis of viewing patterns but also influence self-evaluation and operational patterns.

When comparing my study with this study, it reinforced the principle of using biometrics in e-applications. I studied the theoretical aspect of the e-government adoption mechanism for artificial intelligence, avoiding some challenges, and taking iris as part of artificial intelligence. On the practical side, I used iris data techniques and DL methodology. The researcher relied on the operational patterns. The results appeared better when using DL.

According to the findings of the researcher (Efremov et al., 2020)[31, p. 2049–2053], the high crime rate in Latin American countries compels the government to look for innovative technical solutions to any security issues that may arise, including those that pertain to the banking industry. In the year 2014, Latin America (LA) was referred to as the most rapidly expanding market for biometrical technologies (BT) that are utilized for facial identification. The governments of this region are increasingly utilizing these technologies. Because of the high rate of criminal activity in Latin American countries, the authorities have been looking for innovative technical solutions to improve security, beginning with the banking industry. A rising number of people in the region are making use of biometrical technologies, which are based on the unique biological traits of individuals. There are two various kinds of biometrical data systems: static biometrical data, which are characteristics that are unique from birth, and dynamic biometrical data, which are acquired over time or changed due to age or external influence. Static biometrical data are the more common form. Countries such as Peru, Uruguay, and Chile are committed to achieving widespread deployment of these technologies, which is contributing to the growing adoption of these

technologies. The connectivity of these systems is a significant step towards globalization since it enables the rapid flow of information across states and improves both the physical and information security of the world. Technologies for biometric identification are extensively utilized in a variety of contexts, including but not limited to border control, critically needed public services, e-signature systems, and elections.

When referring to the researcher ’s study. The results of the thesis are compared as previously mentioned. The high crime rate in Latin American countries forces the government to search for innovative technical solutions to any security issues that may arise, including those related to the banking industry where biometrics have been encountered. The thesis studied several models in Latin American countries. It has not been determined which biometrics is most appropriate. In my study, the iris was identified as the most suitable for use in e-government applications, as the iris is a biometric feature. Also, the researcher did not use any data or classifications or build an intelligent model using any AI methodologies. It was a study of samples of several countries. But he recommended using biometrics as identification systems on applications.

The researcher that he suggests (McGrath et al., 2018)[126,p.1-8]. This study presentation attack detection PAD attacks that we are familiar with. The purpose of this design is to differentiate between images of the real iris, which may include individuals wearing clear contact lenses, and iris images containing textured contact lenses. The software is developed using the Python & C++ programming languages, and exclusively uses open-source tools, such as OpenCV. This method does not involve segmentation of the iris image, which can be problematic for specimens of unknown authenticity. Instead, it uses informed judgment to determine the approximate position of the iris. Binary statistical image features (BSIF) are used to extract features associated with PAD. The features are subsequently classified using a set of classifiers, which include a support vector machine, a random forest, and a multilayer perceptron. The current version presented with this article shows an accuracy variability of approximately 85% when evaluated against the LivDet-Iris 2017 criteria.

In my work, I used DL and segmentation classification, and the accuracy rate was 96.8%. I used the Python library.

The researcher (Yahia & Miran, 2022)[33, p. 594–601]. Examines the influence of the swift expansion of technology on cognitive processes, interpersonal communication, and corporate administration. Numerous governments worldwide have been compelled to alter their approach in managing their citizens due to the consequences. The spread of information and communications technology has led to increasing demand among individuals for more open and transparent governments, with fewer bureaucratic and administrative hurdles. Since 2007, the Kurdistan Regional Government has announced its intention to create a strong e-government based on technology, thus replacing traditional transactions with e-services . The purpose of this quantitative article is to analyze the progress that has been made in implementing e-government in the KRG, although e-government in the KRG is still in its early stages. By using the Lean and Lee model, a maturity model, for e-government, Kurdistan can assess the level of maturity the process has reached. This thesis will analyze the thoughts and feelings of citizens in both the initial and subsequent evaluation stages by examining the data generated from a questionnaire specifically prepared for this purpose. The evaluation thesis reveals that the process is time-consuming, and most individuals lack familiarity with e-services. Furthermore, they see no forthcoming advancements in this domain.

Comparing the results presented by this thesis, we found that the e-government in Jordan was more developed, as reliance was placed on e-applications from the year 2010, and there was much development in the year 2020. The Jordanian government decided to rely more on modern technology, such as artificial intelligence. Also, the researcher was using maturity models, and this is a traditional model. To increase the efficiency of use and cannot be relied upon to develop e-applications, as we mentioned previously in the thesis, we used the DL methodology. There was an efficiency ratio in examining the iris of the eye, which the study focused on as part of highly efficient smart applications, as we adopted it as a thesis methodology.

According to the researcher (AlRousan & Intrigila, 2020)[34, p. 217–224]. That the growing use of smartphones and tablets is significantly influencing e-government services. The username and password continue to be the dominant form of authentication for delivering e-government services. Nevertheless, a password is a vulnerable form of authentication, as it may be effortlessly compromised via an unsecured network connection. Consequently, there is a growing demand for a robust security solution to protect data while it is being transferred. This study introduces a comprehensive authentication system for e-government services that integrates multi-factor authentication. I employed the OTP technique, which leverages hash functions and pseudorandom number generators to offer robust encryption and render password prediction exceedingly challenging. An alternative method involves employing algorithms specifically designed for time-synchronized systems. It is crucial to acknowledge the limitations of this study and the proposed paradigm. The proposed model is yet to undergo testing and will necessitate future scrutiny to validate the notion, as outlined in forthcoming thesis. Hence, without further investigation, the model stays just theoretical.

Within the thesis, several photographs were examined from a given data collection. The thesis utilized DL, AI, and neural networks approaches, resulting in excellent accuracy and reduced processing time. Comparing this study to the study conducted by the researcher who employed the OTP methodology and algorithms for time-synchronized systems, which had not undergone testing, proved to be exceedingly challenging.

The researcher (Yusuf et al., 2020)[35, p.1-6]. Heavily on the active involvement of all pertinent parties. Presently, the use of knowledge and technology related to computers, such as identity verification, such as IoT & Big-data , is enabling the involvement of relevant stakeholders. Therefore, the objective of this study is to combine the areas of e-participation and biometrics from an academic standpoint. This thesis has specific ramifications. This thesis makes a valuable contribution to the advancement of a new conceptual paradigm in the domains of digital citizenship, e-government, information technology, computing, computer science, the processing of

images, and biometrics. This thesis has sparked numerous inquiries that necessitate further scrutiny and exploration.

The researcher examined the elements of a novel conceptual model. While AI is often not considered a supported theory, its utilization in government IT programmed has a significant influence.

In their study, Chuang and Fan (2021) [127, p. 60–65].Employed experimental process tracing to utilize an efficient deep-learning network based on YOLO. During the initial phases, developers are required to generate visual drawings that are precisely annotated. The database utilized in this investigation was examined with a macroscopic lens. Displays the dataset consisting of eye images captured in visible light, which is utilized for both training and evaluating the YOLO-based model.

The YOLO model, employing DL techniques, has remarkable effectiveness in detecting objects within pictures. To identify objects of varying sizes, a pass-through layer architecture is employed to integrate and apply more precise characteristics. The researcher suggests using it on extra-proficient CNN models to enhance real-time efficiency on edge devices.

The thesis work on CNN involved constructing the model using the same techniques, however with a greater volume of data and a more extensive variety of images. The photographs were subsequently transformed into grayscale. The results had a narrow margin, signifying a notable degree of precision.

After comparing previous studies, we concluded that iris is important and plays a role in automating e-government applications. Through my thesis, I discovered that DL has been included in the field of AI as a methodology and convolutional neural network. This has been a major contributor to enhancing the efficiency of AI in the context of e-government applications. All studies recommend using Iris as an application that supports e-government applications.

E-government today requires the integration of AI, particularly biometric authentication. As a result, governments will be able to establish a person's identity with certainty using simple physiological markers. It will be attractive for governments to expand the use of biometric technology given that a very high percentage of citizens

can utilise AI-related smart apps. Biometrics used in e-government services benefit both citizens and governments, but thorough thesis is necessary before widespread adoption of biometric identifiers can occur. Although there are considerable security dangers in deploying e-government services, many governments are ready to take advantage of the chance to improve internal government procedures and provide a higher-quality public service. This thesis examines the significance of biometric IDs as a foundational technology for digital services. Before biometric technologies can be widely implemented, certain obstacles must still be overcome despite thesis proving the necessity of robust forms of authentication for efficient e-service supply. In addition to being trustworthy and simple to operate, biometric technologies must also be functional. The government's hasty adoption of biometrics across the board may exacerbate the public's concern that their privacy is being invaded without reason. So, the key issue in the context of biometrics in e-government service delivery is the level of verification deemed essential and suitable to get access to a given service.

The most important scientific results published in scientific journals lead us to the following:

1. E-government is the only area where AI is finding widespread use. Yet, there are also several difficulties and ethical concerns that AI brings up. This article charts the development of AI thesis in the business world, emphasising significant publications and influential journals along the way. It highlights numerous major patterns in development and the difficulties that arise from them. The discipline was established on the premise that a machine can be simulated with sufficient accuracy. The debate centres on the nature of human intellect and the feasibility of its simulation. Thesis into AI is a niche field. When it comes to the adoption of e-government, AI is by far the most important ethical concern that arises. Thesis on AI ethics in e-government is sparse, but Jordan aspires to take part in and lead global regulation of AI.

2. More and more business is being done on mobile devices, especially by younger people who like how flexible, easy, and convenient the platform is. Understanding how various aspects of mobile commerce service quality impact customers' opinions and

overall satisfaction levels is crucial. Customer satisfaction in mobile commerce drives consumers' propensity to return. We performed a statistical analysis based on the variance of the data using Smart Partial Least Squares. Artificial neural network analysis, a non-compensatory analytic approach, evaluated the study models. Responsiveness and cognitive control variables highly connect to the total service quality in mobile commerce. There was a strong correlation between the total service quality in mobile commerce and the information quality component of content usefulness and adequacy. There was a strong correlation between the quality of the service as a whole and the quality of the mobile commerce system. The general impression of service quality highly impacts consumer satisfaction and subsequent return intentions in the realm of mobile commerce. Analysed using an artificial neural network with many layers. We drew conclusions on the roles played by three key elements of mobile commerce platforms: website innovativeness, content usefulness, and simplicity of use.

3. The client is the backbone of the government institution's application usage procedure. With the goal of managing the customer relationship using technological advancements, AI sought to embody the tools of information technology to create a marketing strategy that would track customers' shifting wants, needs, and complaints as they related to specific products and services developed by e-governments.

4.The goal of artificial neural networks is to represent human behaviour in accordance with learning algorithms, and these networks aim at cognitive and cognitive activities related to brain function in the same way that the human brain recognises patterns and solves common problems in the fields of artificial intelligence, ML, and DL. The main goal of this study is to find out how human resources relate to smart organization that use neural networks and what level of practice they use, as well as what the most important contribution these very smart programmes can make to how organization work. We examined the information by With the neural networks simulation system, you can test the model's accuracy and performance, as well as the amount of error in training neural networks, the strength of the link between layer nodes, the weights of the effect of hidden neurons (layer hidden), and how important

each of these factors is. The weight of the inputs relative to the model's predictions is an important factor in the simulation system for neural networks.

5. Data Government, which is not a new notion, is the foundation of AI-based Government. Businesses need a specific amount of policy and knowledge to manage the gathered information. Although data-driven organization often require data Government to be a top priority, this area of focus has mostly stayed in the background. In recent years, however, as corporations take their initial steps towards artificial intelligence, data Government has risen to the forefront of conversations across the board in the media and on the boards of numerous organizations. The growing interest of governments in protecting citizens' personal information has also significantly contributed to this shift. The dangers of AI and the need to keep its framework updated in the face of fast ML advancements were his primary concerns. As a result, organization of all stripes are checking to make sure data Government hasn't set up an investigation in a manner that would facilitate trade amid the current era's dramatic sway towards the demanding machine. We also introduce new Government needs associated with AI, which require a robust, openly implemented structure.

6.This study looks at how AI and ML might help organization clearly and thoroughly. AI is a cutting-edge technology of the current day that has many practical applications for companies. The use of AI and ML has resulted in cost savings for the corporation. Moreover, it aids organization in solving business problems and making better process-related decisions. Chatbots powered by AI are available around the clock to respond to customer inquiries regarding any company's offerings. Company activities create opportunities for enterprises, and ML automates the entire process. Furthermore, ML efficiently improves employees' and customers' cognitive involvement and provides answers to consumer problems like forgotten passwords. The report also details the methods and approaches taken to reach its conclusions. Before integrating AI and ML into their workflows, businesses need to learn about augmentation and automation processes.

7.This dissertation examines the most crucial decision-support system applications, tools, and methodologies used by contemporary businesses and e-

governments throughout many generations of AI-related decision-support systems. Expert systems, genetic algorithms, fuzzy logic, and neural network analysis This thesis defines the idea of AI and the relative relevance of each component within it to find and investigate the applications of AI in support of administrative choices. To learn how the most well-known AI problem-solving apps achieve their desired results, one must first analyse their methodology. Articulate the framework for AI programmes (neural network systems and technologies, fuzzy logic systems, genetic algorithms, and expert systems).

8.way to design the quality of iris pictures and how they affect how government services are given. As we saw earlier in the third chapter, e-government apps are traditional apps that use a traditional system, like entering a password and making a personal account. If integrated, these apps will evolve. By using AI, the government of Jordan improves its services, and this study aims to better understand how DL enhances the intelligence of these services. Furthermore, our quality scale can differentiate iris texture to a great degree and can be integrated with government programs.

9. The concept of AI arose as a consequence of the activities, investigations, and studies conducted by a large number of thinkers and researcher s. The purpose of artificial intelligence is to supply all the knowledge and extremely complex programmes that an individual could ever want, therefore enabling them to produce the finest work possible in whatever field they are working in. Expert systems (ES) are a subfield of AI , which refers to applications of AI. 1960 marked the beginning of its very first application. The primary goal was to transfer human knowledge to computers so that they could carry out a variety of functions. Professionals and academics utilized it to facilitate a wide variety of activities in disciplines such as the medical field, industry, and the administration of information. Information specialists initiated a large number of studies and experiments in indexing, abstracting, and classifying data. In the realm of information retrieval, the purpose of this study is to conduct an analysis of the initiatives involving expert systems.

10. In contemporary organization, particularly in the realm of e-government, knowledge has emerged as a critical resource for differentiation. Recognising this

significance, e-government entities have embraced the notion of knowledge management to effectively harness their existing knowledge. This involves engaging in processes that encompass the generation, organisation, and dissemination of knowledge, ultimately enhancing the quality of service provision within these institutions. The utilisation of advanced applications of the IoT concept, coupled with the progress in information and communication technologies, presents opportunities for its application in knowledge management. This is due to the capability of IoT technologies to establish connections between physical entities and facilitate interaction with human users. This study aims to emphasise the significance of IoT applications in facilitating knowledge management operations within the context of e-government, ultimately leading to enhanced service provision. In order to accomplish this objective, the present study employs a descriptive methodology, which involves examining and analysing the intellectual contributions published in various nations. The aim is to identify and extrapolate the domains pertaining to the intersection of the IoT and knowledge management practices within the context of e-government. The findings of the study suggest that the implementation of the IoT has provided significant advantages to e-government systems. Specifically, it has facilitated the tracking of both physical and intangible entities within these institutions, enabling the identification of their locations in case of loss or displacement. Additionally, the IoT has enhanced the monitoring of visitor numbers, peak hours, and the utilisation of various resources. Consequently, these institutions have been able to leverage these benefits to improve their overall operations. By offering efficient and engaging services that effectively address the needs and desires of the recipients. This study suggests that diverse information institutions should proactively leverage IoT technologies in order to address the evolving and renewable requirements of their beneficiaries.

11.This thesis study examines the experiences of a selection of nations that have been recognised as pioneering examples in the field of e-government. The report further compares these countries to Jordan in order to evaluate their respective positions at both the global and continental levels. The measurement and evaluation of e-government development can be approached through a method known as multi-

practice, which involves the integration of various methods and techniques. This approach aims to assess both the tangible and intangible benefits of e-government. By considering multiple aspects of measurement, this method enhances the reliability of evaluating e-government. This paper examines the various methodologies put forth by international organization for the purpose of assessing and evaluating the effectiveness of e-government initiatives. The United Nations conducted the E-Government Survey. The United Nations e-government development index established the e-government maturity index, which was used for the comparison and evaluation. This index encompasses the Telecommunication Infrastructure Index (TII), the Human Capital Index (HCI), and the Online Service Index (OSI) as sub-indicators for e-government services. The analysis was carried out over a period spanning from 2008 to 2020. The purpose of this comparison is to leverage these experiences, address existing deficiencies, and capitalise on the opportunities accessible to Jordan in order to enhance its e-government capabilities. By aligning with the global e-government movement and enhancing its efficiency, Jordan aims to contribute to the objectives of sustainable development. The United Nations E-Government Survey has determined that Jordanian e-government is currently in its first phase, commonly known as the first generation. The e-government index has witnessed significant enhancements in its performance, as indicated by the observed changes in the e-government development index.

12. E-government refers to the efficient and comprehensive use of information and communication technology to streamline the administrative functions of government sectors. The advent of digital communication technology has necessitated that several public sector organization adapt their operations to the realm of e-commerce, hence increasing the demands placed upon them. E-government is the term commonly used to describe this phenomenon. E-government refers to the efficient and comprehensive use of all information and communication technologies. Individuals are identified via the use of their fingerprints, facial features, hand structures, and iris patterns, among other biometric attributes. This study aims to utilise iris recognition for the purpose of identifying individuals based on iris images. It involves

implementing a Python programme that utilises a CNN with DL techniques to compare printed iris images with a database of known individuals. The programme will display the name of the person who owns the matching iris image. This project aims to use the DL approach for the purpose of matching individuals' printed iris photographs. This is a modern system that assists in identifying people and replaces e-government systems with intelligent systems that integrate AI into their operations to provide the most optimal services to inhabitants. The Jordanian government aims to extensively incorporate biometric traits, including the iris of the eye, as a fundamental component of all computerised government services.

CONCLUSIONS

This dissertation concludes the thesis by providing an overview of the work that was done. The most important findings and significant contributions to the field presented in each chapter are summarised, respectively. A variety of potential directions for further thesis are discussed.

1. The potential of AI and ML to enhance the effectiveness and efficiency of e-government are proposed. AI is a state-of-the-art technology that offers numerous practical applications for enterprises in the present era. In addition, ML effectively enhances the cognitive engagement of employees and customers and offers solutions to consumer. The study examined the correlation between e-government systems utilizing neural networks and the extent to which they are used in practice. Additionally, it aims to determine the significant contributions that these highly intelligent programs might offer to the functioning of organizations.

2. New method and algorithm developed to build an iris recognition model for e-government applications using deep learning and a neural network. The study demonstrates the impact of deep learning and CNN in the development of e-government applications, highlighting their ease of use for citizens. Additionally, it highlights the benefits of iris segmentation in enhancing the accuracy and user-friendliness of these applications.

3. AI modelling methods and techniques, such as deep learning, CNN, and iris recognition, have been developed and tested in the field of e-government. The study showed that these technologies can enhance citizen services by automating e-applications in the future, improving services that are accessible to applications, and providing predictive capabilities, which enhance the role of deep learning in improving e-government services.

4. The framework for citizen services to consider the outcomes satisfactory has been developed. The importance of this system, which uses CNN and deep learning, lies in the fact that it can advance AI by facilitating the implementation of e-government and the integration of e-services and apps that the Jordanian government

uses. Since this would make it possible for the government to keep up with the most recent technological advancements and effectively use AI, it would be beneficial.

5. The adoption of AI and its use with e-government applications and its impact on citizens in Jordan have been studied. Therefore the study considered a valuable addition to the literature related to the impact of the use of AI on developing countries.

SUMMARY OF CONTRIBUTIONS

The thesis addresses the thesis problem mentioned earlier by presenting several original contributions. These contributions are as follows:

We have gone over the e-government system as well as the biometric one. In addition, we discuss the benefits that biometric systems can bring to e-government initiatives. The theoretical significance of the work lies in proposing models using AI to automate and implement AI in e-government and knowing the extent of the impact of AI on e-government applications. It involves following technological developments, evaluating work, and adapting to "technical" and employment-based achievement. E-government, defined as the use of technology for communication and information by the government to provide citizens with access to data and government services, is a key aspect of modern ICTs. E-government services are available 24/7 and improve efficiency, cost, and quality. Despite the rise of internet users and improved connectivity, Jordanians still use e-government services less. Governments struggle to encourage the use of online services, often overlooking factors like website quality. E-government uses biometrics, such as fingerprints, faces, hand geometry, and iris fingerprints, to streamline administrative processes. CNNs have gained attention in iris recognition, but they require more samples and computational complexity. DL, a crucial part of AI, is essential for e-government applications. However, the use of DL in e-government applications remains difficult due to challenges such as finding professionals capable of creating effective and trustworthy AI systems, the creational loop, and the need for robust data security and privacy regulations.

We can see from the contributions noted in the thesis how important the iris of the eye played in recognizing people, as this thesis is considered a model for transforming

the traditional framework of government services into an intelligent framework based on AI and DL for enhancing and accelerating government services and providing the best results to citizens, which is the axis of the problem. We can see from the contributions mentioned in the thesis that the iris of the eye plays an important role in recognizing people. In this thesis, the focus is on eliminating the use of secure and helpful technological methods for the success of e-government programs, such as the iris of the eye. The purpose is to end the restrictive system for entering e-government applications. Utilizing the iris reconfiguration and Fit models is stable. in e-government systems. We created new models to look at how DL and CNN affect the creation of smart technologies. These models use the Rectified Linear Activation Function, Max Pooling, and the flattened in the fully connected layer to sort images and use iris segmentation to make AI in e-government applications more accurate and easier for people to use. Utilizing the iris segmentations to increase the effect accuracy of e-government and its usability to citizens. This thesis is one of the few studies that study the adoption of AI, its use with e-government applications, and its impact on citizens in Jordan. it is therefore considered a valuable addition to the literature related to the impact of the use of AI on developing countries. The study led to the creation of a proposed framework for employing artificial intelligence in the e-government sector.

FUTURE WORK AND CHALLENGES

In the future, researchers can pursue many different directions for their theses. The following provides future work on these.

1. Increasing the dataset images while keeping in mind the image quality efficiency of investigation Increasing the number of photos utilized and connecting them to a real database can lead to improved efficiency, and we will use it for future work.
2. A deeper investigation can be used to enhance results, such as using deeper networks like ResNet50 and ResNet101, etc., while overcoming the limitation by using a supercomputer that has more than a single GPU. Which helps reduce the training time.

3. To make it easier for artificial intelligence, deep learning, and iris recognition to work with e-government systems, researchers need to understand how important it is to use computer vision and image recognition techniques.
4. Present more studies The conceptual model of the dissertation lacks an analysis of security system measures. The proposed paradigm remains untested and will necessitate future studies to validate its efficacy, as outlined in forthcoming investigations. Hence, unless further inquiries are conducted, the model remains merely a concept. Researchers can pursue and focus on the security part.
5. A deeper investigation can be used to enhance the results of the use of smartphones as a means of enhancing AI and the role of mobile device security.

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LIST OF ABBREVIATIONS

B2B	BUSINESS TO BUSINESS
B2C	BUSINESS TO CONSUMER
B2G	BUSINESS TO GOVERNMENT
B2G	BUSINESS TO GOVERNMENT
C2B	CONSUMER TO BUSINESS
C2C	CONSUMER TO CONSUMER
E-COMMERCE	ELECTRONIC COMMERCE
ICT	INFORMATION AND COMMUNICATIONS TECHNOLOGY
IS	INFORMATION SYSTEM
ISO	INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
IT	INFORMATION TECHNOLOGY
AI	ARTIFICIAL INTELLIGENCE
DL	DEEP LEARNING
E-GOVERNMENT	E-GOVERNMENT
UN	UNITED NATIONS
CNN	CONVOLUTIONAL NEURAL NETWORKS
PIN	PASSWORD IDENTIFICATION
DB	DATABASES
FP	FINGERPRINT
E-G	ELECTRONIC GOVERNMENT
ML	MACHINE LEARNING
US	UNITED STATE
HR	HUMAN RESOURCES
E-SERVICES	ELECTRONIC SERVICES
MOICT	MINISTRY OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

KPIS	KEY PERFORMANCE INDICATORS
CODI	CENTRE OF DIGITAL INNOVATION
CRM	CUSTOMER RELATIONSHIP MANAGEMENT
JPG	JOINT PHOTOGRAPHIC EXPERT GROUP
OPSI	OBSERVATORY OF PUBLIC SECTOR INNOVATION
PDA	PERSONAL DIGITAL ASSISTANT
RFID	RADIO FREQUENCY IDENTIFICATION
MOI	MINISTRY OF INTERIOR
Daleel	IS AN ARABIC WORD FOR GUIDE
MADA	IS AN ARABIC WORD FOR EXTENT
DI	DEVELOPMENT INDEX
HCI	HUMAN CAPITAL INDEX
OSI	ONLINE SERVICE INDEX
PLS	PARTIAL LEAST SQUARES

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