REPUBLIC OF AZERBAIJAN

On the rights of the manuscript

ABSTRACT

of the dissertation for the degree of Doctor of Philosophy

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

Specialty:	1203.01 – Computer sciences
Field of science:	Technical sciences
Applicant:	**Mohammad Ali Mofleh AL Qudah**

BAKU - 2024

The work was performed at the Graduate School of Science, Art, and Technology of Khazar University.

Scientific supervisor: Doctor of Philosophy in technical sciences,
Associate Professor
Leyla Gazanfar Muradkhanli

Official opponents: Doctor of technical sciences,
Professor
Naila Fuad Musayeva

Doctor of Philosophy in technical sciences,
Associate Professor
Shahla Surkhay Huseynzade

Doctor of Philosophy in technical sciences
Khanmurad Khanbala Abdullayev

Dissertation council ED 1.20 of Supreme Attestation Commission under the President of the Republic of Azerbaijan operating at Institute of Control Systems of the Ministry of Science and Education of the Republic of Azerbaijan.

Chairman of the
Dissertation council: academician of ANAS
doctor of technical sciences, professor
Ali Mahammad Abbasov

Scientific secretary of the
Dissertation council: Doctor of Philosophy in technical sciences, associate professor
Tahir Ali Alizada

Chairman of the scientific seminar: doctor of technical sciences, professor
Allahverdi Biyakir Hasanov

GENERAL CHARACTERISTICS OF THE WORK

Relevance of the problem. 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 artificial intelligence (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.

Aims and objectives of the dissertation. The research 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 research objective:

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

- 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.

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

Research methods. To achieve this goal, the theoretical and methodological basis of the thesis, which is AI using deep learning and use of the convolutional neural network (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 AI.

Provisions to be defended. The author defends the following provisions.

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

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

3. CNN 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 e-applications and improve the characteristics of smart systems that rely on AI were discussed and developed so that citizens can use them better and improve the quality of service.

Scientific novelty in the research. The following results are introduced in the defense presentation.

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.

The theoretical and practical significance of the research. The theoretical significance of the work lies in proposing models using AI to 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 of research outcomes. The main scientific-theoretical and practical results were presented and discussed at the

1. International Ankara conference on scientific research (October 2021-Turkey);
2. Baku Eurasian University (October 2021-Azerbaijan);
3. 1st International Conference on Contemporary Academic Research (May 2023, Turkey);
4. 1st International Conference on Modern and Advanced Research ICMAR – June-2023, Turkey);
5. IEEE, 17th International Conference on Application of Information and Communication Technologies (AICT), (Baku, Azerbaijan-October -2023).

Publications. 21 works on the topic of the dissertation were published. 14 articles in full, 2 of them without co-authors, including 3 articles in scientific journals and 7 papers in conference proceedings.

The name of the institution where the research work was carried out. The dissertation work was performed at the Graduate School of Science, Art, and Technology of Khazar University.

Structure and scope of work. The dissertation consists of 222 pages of text, 53 figures, 3 tables, 3 equations, and a list of 127 references. The title page of the dissertation consists of 511, a table of contents – 1562, an introduction – 14.214 the first chapter – 174.114, the second chapter – 60.365, the third chapter -40.190, conclusion – 8.168 characters and a list of abbreviations 43 titles. The total volume of the dissertation is 329.717 characters.

The content of the research

The introduction explains the relevance of the research, formulates the goals and objectives of the dissertation work, lists the main and new scientific results, indicates the theoretical and practical significance of the work.

The first chapter contains a literature review. The literature review outlines the primary characteristics of service systems that incorporate AI. Despite the advanced state of research on AI in various theoretical forms, there are still a few topics related to AI in the context of e-government. This chapter focuses on AI, discussing its theoretical role in e-government, its implementation, the benefits and interests of using AI in e-government, and the role of CNN and deep learning in developing AI applications. The discussion also covered the future of e-government utilizing AI and obstacles to the application of AI in government. This chapter extensively discusses the use of iris 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.

The second chapter presents the technical and methodology aspects of the process. The high recognition rate of iris recognition makes it one of the most accurate biometric modalities. Biometric technology, which uses the iris of the eye to register users of e-applications, is one of the most important smart technologies, prompting the government to incorporate it into its technology portfolio and develop it for use across various sectors to enhance service quality. 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.

In addition, the recognition technology, which is based on AI and deep learning, 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. 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 recognition system, which is a leading electronic tool for identifying people, allowing access to e-government applications, and benefiting from its services provided by citizens by taking a picture of the iris. The iris recognition 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. 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's 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. 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.

This research explores the use of AI and deep learning based digital technologies in government-provided e-services for the general public. In the study, we describe how the iris of the eye works and how it contributes to the AI system in citizen services, where smart procedures and access to apps and services have replaced the old, inefficient ones. To speed up delivery and improve accuracy, e-government services have increasingly relied on AI as a key component of their infrastructure.

Research 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. The dissertation work proposed a novel model that may be integrated for use in a complete iris segmentation and recognition technique, Fig. 1. Build Model AI application.

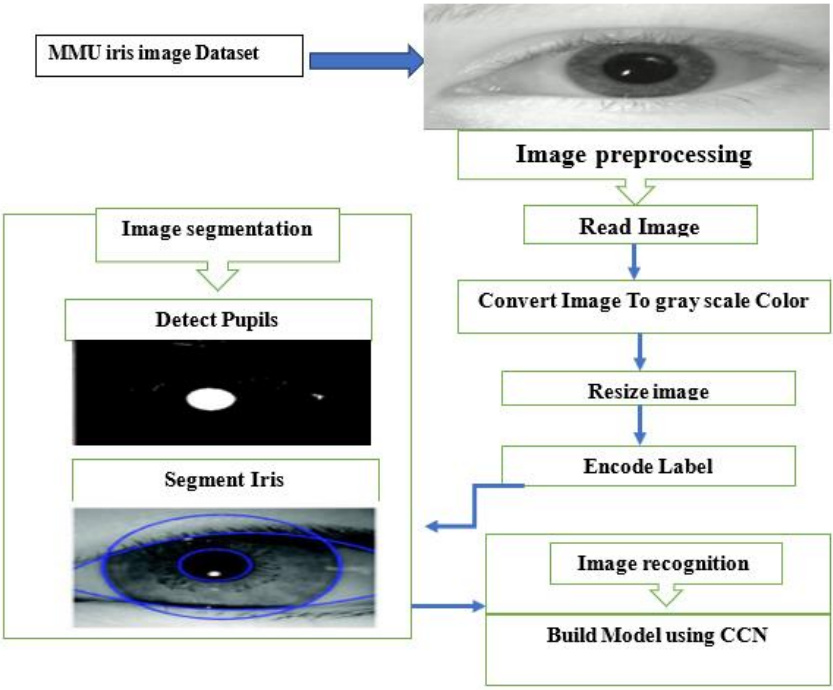

Fig. 1. Build Model artificial intelligence application.

This section first discusses pre-processing techniques. 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. We divided the work into three main parts: data collection, data segmentation, and data augmentation.

1. Data collection to build application

Multimedia University 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. All bitmap images (.bmp) used in this study were changed to jpeg format.

2. Segmentation of the data

Dividing a large image into smaller, more manageable chunks (sets of pixels, sometimes called image objects) is what we mean when we talk about segmenting. Segmentation's goal is to make an image's representation easier to understand and comprehend. One typical use of image segmentation is the detection of objects and their associated boundaries (lines, curves, etc.)

3. Data augmentation

The availability of more data typically results in an improvement in the performance of deep-learning neural networks. The process of using previously collected training data to artificially generate more training data is referred to as data augmentation. To do this, domain-specific approaches are applied to examples taken from the training data, which results in the creation of new and unique training examples.

The creation of altered copies of pictures in the training dataset that still belong to the same class as the original image is the goal of image data augmentation, which is possibly the most well-known sort of data augmentation. The term "transform" encompasses a wide variety of operations in the realm of picture modification, including but not limited to shifts, flips, zooms, and many more.

Deep learning models rely on large volumes of diverse data to develop accurate predictions in various contexts. Data augmentation supplements the creation of data variations that can help a model to improve the accuracy of its predictions. Augmented data is vital in training images. Fig. 2. explains data augmentation.

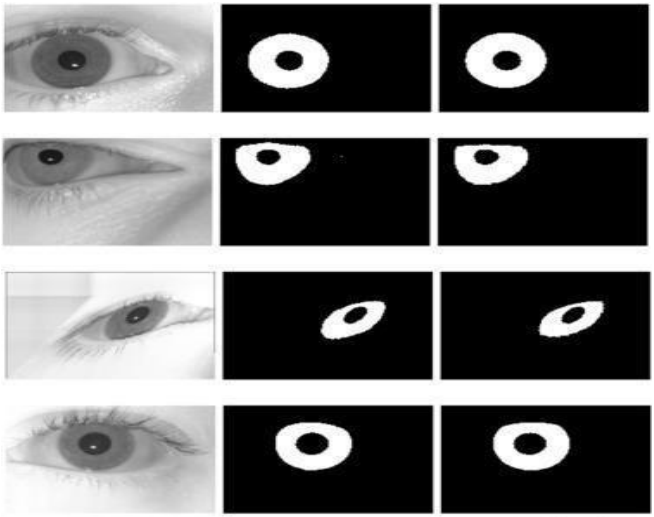

Fig. 2. Data augmentation.

This section discusses model-building and design techniques that have been researched and planned to build a model that supports the characteristics required by the project. Every layer of a CNN is responsible for transforming one volume of activations into another using a differentiable function. A straightforward CNN is composed of a series of layers. Convolution layers, pooling layers, and fully connected layers are the three primary types of layers that we implement while building CNN architectures. These layers are precisely the same as those found in ordinary neural networks.

A convolutional layer is the main building block of a CNN. It contains a set of filters (or kernels), parameters of which are to be learned throughout the training. The size of the filters is usually smaller than the actual image. Each filter convolves with the image and creates an activation map.

Firstly, the CNN layer computes without making any comparisons to the brain or neurons. The parameters of the CNN layer are comprised of a series of filters that may be learned. Every filter takes up a limited amount of physical space (along the width and height), but it affects the

input volume over its entirety. The learned weight refers to the filter that was applied across the entirety of the picture, with the feature map serving as the result. In CNNs, a feature map is the output of a convolutional layer representing specific features in the input image or feature map. During the forward pass of a CNN, the input image is convolved with one or more filters to produce multiple feature maps by the CNN described in Equation 1.

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

Secondly, the fully connected layer has full connections to all activations in the earlier layer, as seen in regular neural networks. As a result, matrix multiplication and bias offset can be used to compute their activations. A fully connected layer, also known as the dense layer, is where the results of the convolutional layers are fed through one or more neural layers to generate the prediction we presented in Fig. 3.

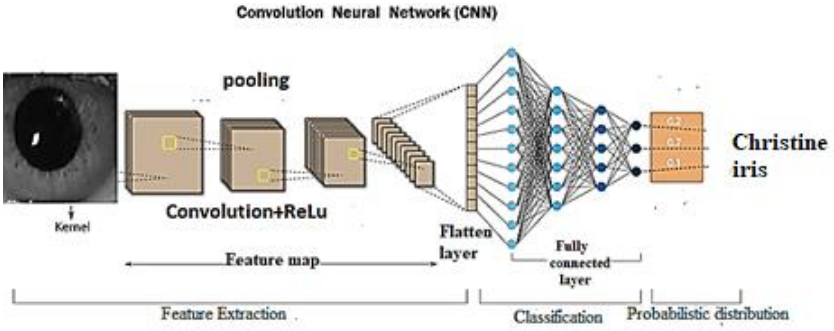

Fig. 3. Neural Networks layers.

Thirdly, the flattened layer is located in the middle of the convolution layer and the linked layer. The process of flattening converts a two-dimensional matrix of information into a vector that may be input into a neural network classifier that is fully linked.

Metric provides you with the ability to list the metrics that should be checked when your model is being trained. Metric values are recorded after each epoch on the training dataset. If a validation dataset is also supplied, the measure that was recorded will additionally be computed for the validation dataset.

The proportion of accurately anticipated data points relative to the total number of data points is called the accuracy. In a sense that is a little bit more formal, it may be defined as the number of true positives and true negatives divided by the number of true positives, true negatives, false positives, and false negatives. The accuracy calculation is shown in Equation 2 .

$$Accuracy = \frac{True\ Negative + True\ Positive}{True\ Positive + False\ Positive + True\ Negative + False\ Negative} \quad (2)$$

Fourthly, we conducted 200 epochs of training for our model. More precisely, the ones observed in Fig. 4. 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 and 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
```

Fig. 4. Process of model training.

The third chapter introduces the experiential results sections. 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 the conclusion results.

1. Segmentation result

The act of fragmenting an image into coherent and homogenous parts according to a given criterion, such as color, is referred to as image segmentation. Image segmentation is an essential stage of digital image processing and refers to the technique itself. A reconstruction of the initial image ought to emerge as a consequence of the combination of these different regions. Slicing is an essential step that, once completed, enables the extraction of qualitative data from an image. This is made possible by the fact that slicing provides a high level of detail, as shown in Fig. 5 Segmentation

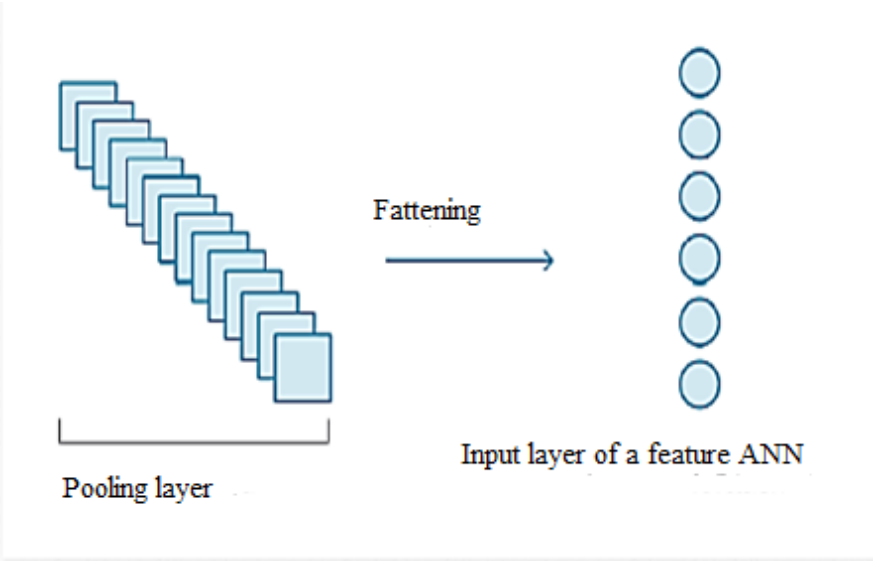

Fig. 5. Segmentation.

Description of the picture, in which each region is connected to its surrounding regions through a network of nodes; each node represents a section of the image. A card that describes the corresponding section is present with each node, which represents a distinct area of the image. It provides information on the region's qualities, such as its dimensions, color, shape, and orientation, among other things. Information about the connection between neighboring regions, such

as whether one area is included in another if it is under or above it, and so on, can be labeled on the nodes that link them. Additionally, the nodes themselves can display this information. The method of network slicing that is applied can have a significant impact on the complexity of the network design.

Because the results of this step were not definitive, no attempt was made to evaluate how well it performed in terms of accurate segmentation. This method relied on minimizing image distortion to detect and segment the iris and pupils from an image. Identifying the pupils required minimizing picture distortion.

The pupil detection process aims to identify the pupils of the image, identify the darkest area in the image, and remove the noise from the image, making it easier for us to know the iris of the eye through techniques that use the contour algorithm. The basic algorithm has many advantages. It is easy to use, uncomplicated and does not require much time.

2. Iris segmentation result

Segmentation is the most important part of the iris recognition process because areas that are wrongly segmented out as iris regions will corrupt biometric templates, resulting in very poor recognition Segmentation is the process of dividing an image into multiple parts or regions that belong to the same class. This task of clustering is based on specific criteria, for example, color or texture. This process also referred to as pixel-level classification, employs a heuristic formula to extract the iris of the eye, which maintains a constant distance from the pupil. This formula extracts all the iris's features and utilizes a mask to extract them. Fig. 6 explains iris segmentation.

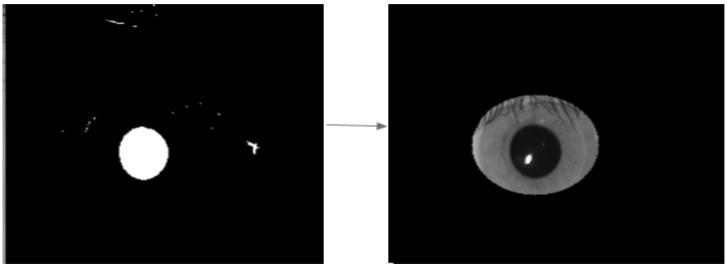

Fig. 6. Iris segmentation.

3. 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 cause of this is the ambiguity that computer-based or human-based recognition faces in the absence of context. For this reason, many image processing systems appeared through many technologies and some models to teach the computer about these images. Therefore, most personality classification experiments were conducted using numerous image processing techniques and were also trained by CNN. The results were divided into four steps, as follows:

Step 1. Feature Extraction

Feature extraction refers to the process of transforming raw data into numerical features that can be processed while preserving the information in the original data set. It yields better results than applying ML directly to the raw data. Features are attributes or characteristics of the data that are relevant, informative, and discriminative for the task at hand. The objective is to collect all of the characteristics of the iris so that the computer can comprehend them; this is necessary since the computer works with picture pixels, so we need specific techniques and can handle these properties, which are to apply the preprocessing function when reading images and use

resizing, which deals with images of equal size, then extract the pixels of the images, specifically those seen in Fig. 7.

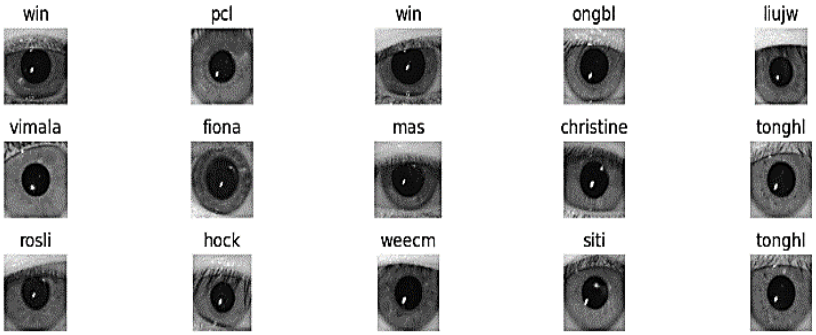

Fig. 7. Feature Extraction.

Step 2. Classes balance

Within this section, we enumerate the classes, operating under the assumption that each output class or target class possesses an equal number of input samples. This methodology analyses the data as a balanced data set. This facilitates the inclusion of a substantial quantity of data points, hence enabling the computer to acquire knowledge from an ample amount of data and generate exceptional outcomes, as in Fig. 8. It displays the names of those who possess images of irises.

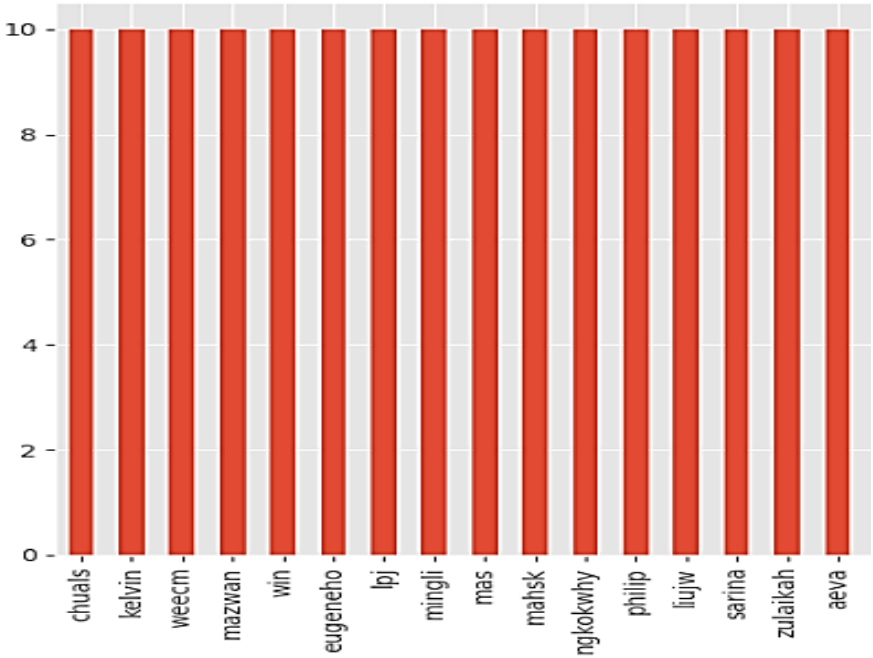

Fig. 8. Classes balance.

Step 3. Data augmentation

Data augmentation is the process of artificially generating new data from existing data, primarily to train new ML models. ML models require large and varied datasets for initial training, but sourcing sufficiently diverse real-world datasets can be challenging because of data silos, regulations, and other limitations. Data augmentation artificially increases the dataset by making small changes to the original data. Data augmentation helps prevent overfitting when you're training ML models. Overfitting is an undesirable ML behavior where a model can accurately provide predictions for training data. In this study, data has been augmented to help reduce overfitting If a model trains only

with a narrow dataset, it can become overfit and give predictions related to only that specific data type. In contrast, data augmentation provides a much larger and more comprehensive dataset for model training. It makes training sets appear unique to deep neural networks, preventing them from learning to work with only specific characteristics. Random horizontal flip, random rotation from -15° to +15°, random zoom in and out by 20%, random crop by 20%—the highest accuracy we've seen is 96.8%. As you can see in Figure 9, we will store the model based on the validity of that information.

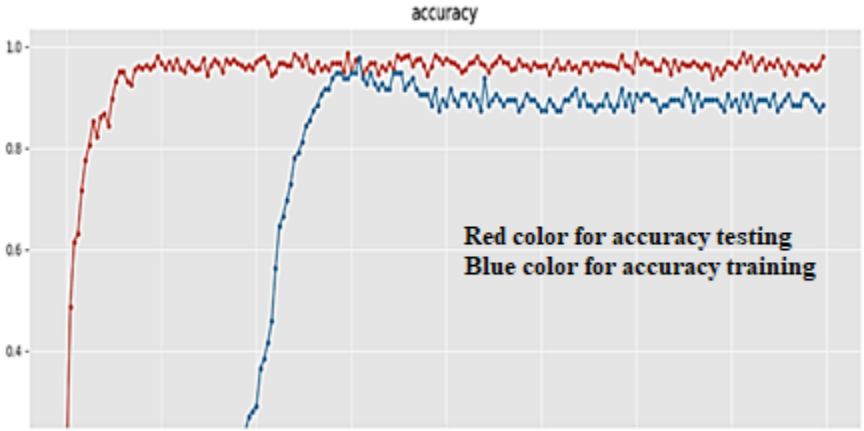

Fig. 9. Data augmentation accuracy.

One technique to determine the accuracy of a particular algorithm in simulating the given data is through function decrease. The loss function will produce a very large number if the forecasts are very far from the actual results. The loss function gradually learns how to minimize the prediction error with the help of some optimization functions. This happens over time. Fig. 10 shows the loss function method evaluation.

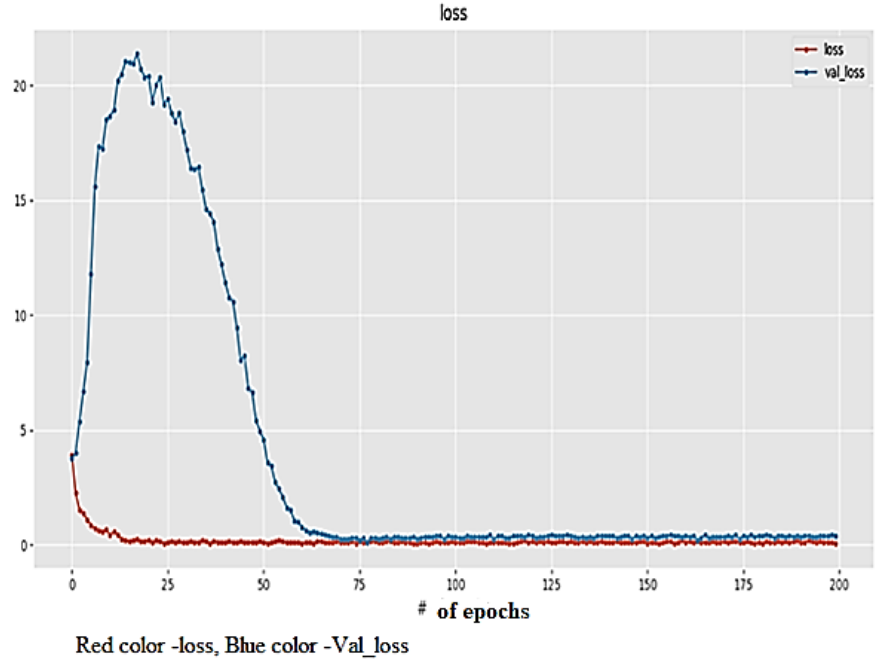

Fig. 10. Loss function method evaluation.

Step 4. Predict Model

Predictive modeling is a process that employs mathematical and computer techniques to make forecasts about future events or outcomes. An equation-based model is used in a mathematical method that describes the phenomena that are being taken into consideration. Based on alterations made to the model's inputs, a prediction can be made about the result of some event at some point in the future. Fig. 11 is a representation of a prediction model. Table 1 presents an illustration of the prediction model's accuracy, and Fig. 12 presents the result of the notebook GUI model.

Fig. 11. Predict Model.

Table. 1. Predict Model 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%***

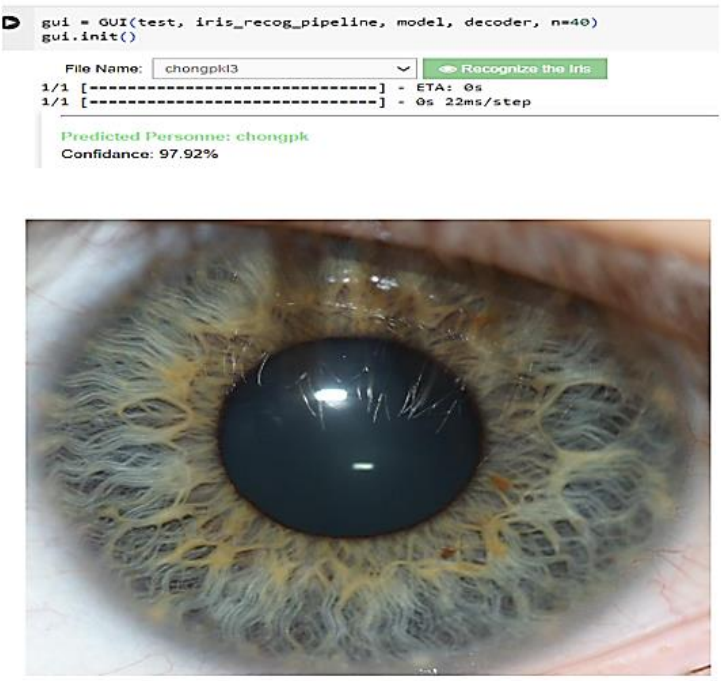

Fig. 12. Result notebook GUI.

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 high resolution is necessary to put these strategies into practice. The outcomes from the computer were satisfying. Where we draw our conclusions from this system, which is based on deep learning 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 to keep pace with technological advancements and AI. As some countries 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 AI. There were some restrictions, such as a limited number of images. However, to link with

the actual databases of these applications, we require photographs of actual people.

Conclusion

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.[3, 2, 11, 18]

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.[12, 19]

3. AI modeling 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.[10, 12, 13]

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.[8, 12, 14]

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.[6, 9, 13, 16]

The main results of the dissertation were published in the following scientific works

1. M. A. Alqudah, L. Muradkhanli. Artificial intelligence in e-government; ethical challenges and governance in Jordan/Electronic Research Journal of Social Sciences and Humanities, 2021 - №3, (1), p. 65–74. https://ssrn.com/abstract=3806600

2. M.A.Alqudah, L.Muradkhanli, M. Al-Awasa. Artificial Intelligence Applications That Support: Business Organizations and E-Government in Administrative Decision/International ınternatıonal Journal on Economics, finance and Sustainable Development, 2021, vol. 3, №3, (3), p. 57–72. http://dx.doi.org/10.2139/ssrn.3866216
3. M. A. Alqudah, L. Muradkhanli. Artificial Intelligence in Managing the Electronic Customer Relationship and Enhancing the Level of Satisfaction with Electronic Services /Internatıonal Journal On Orange Technologıes, 2021, No, (2), p.1-16. http://dx.doi.org/10.2139/ssrn.3858964

4. M. A. Alqudah, L. Muradkhanli. Internet of things in knowledge management in e-government/ International Journal of Engineering and Artificial Intelligence, 2021,Vol 2 , No (2), p. 73–80.
http://dx.doi.org/10.2139/ssrn.3992316
5. M. A. Alqudah , L. Muradkhanli. E-government in Jordan and studying the extent of the e-government development index according to the United Nations report/International Journal of Multidisciplinary: Applied Business and Education Research, 2021, 2(4),p.310-320.
https://doi.org/10.11594/ijmaber.02.04.04
6. M. A. Alqudah. Investment Artificial Intelligence in Decision-making Processes in the Jordanian Ministry of Interior/ International Journal of Innovations in Engineering Research and Technology, 2021, vol. 8, no. 10, p. 40-53. DOI:10.17605/OSF.IO/5D7KZ.
7. M.A.Alqudah, N. E. D. Lemounes. Expert Systems In Information Retrieval Review: Classification, Indexation, And Abstraction /International Journal of Advances in Electronics and Computer Science, 2021, p.2394-2835.
http://dx.doi.org/10.2139/ssrn.4066530.
8. M. A.Alqudah. Towards the governance of government data using artificial intelligence / Journal Of Advanced Research in Engineering& Management (IJAREM), 2021, p.1-10.
http://dx.doi.org/10.2139/ssrn.3992303
9. A. Salamah, S. Hassan, A. Aljaafreh,, W. A. Zabadi., M. A. AlQudah, N. Hayat, A. Al Mamun, T Kanesan. Customer retention through service quality and satisfaction: using hybrid SEM-neural network analysis approach/ Heliyon, 2022, 8(9), e10570 .
DOI:https://doi.org/10.1016/j.heliyon.2022.e10570.

10. M. A.Alqudah. Artificial Intelligence Using a Neural Network System to Support Human Resources in the Workplace/Khazar Journal of Science and Technology, 2022, vol.6(1), p.62-76. DOI: 10.5782/2520-6133.2022.6.1.58
11. N Mohan, K. D. Prasad, V. K. Soujanya, D. C. Dobhal, M.A.Alqudah, M. Tripathi. An Adaptive Service-Oriented Business Management Pattern Based on Machine Learning Rule ML /In 2023 3rd International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE), 2023, p. 1672-1676. IEEE. DOI: 10.1109/ICACITE57410.2023.10183158
12. V.K. Saroha, S. Kanipakam, M.A.Alqudah, C. Singh. O.yebode, M. Sharma.Elevating Corporate Operations In India: Harnessing The Potential Of Artificial Intelligence For Peak Efficiency And Effectiveness In Line With Contemporary Trends/ Business, Management And Economics Engineering, 2023, Volume 21(Issue 02), p. 878–887. https://businessmanagementeconomics.org/article/view-2023/02-878.html.
13. M. A. Alqudah, L. Muradkhanli. The use of generative artificial intelligence for customer services, /Problems of Information Technology journal(jpit), Baku, Azerbaijan, 2023, pp. 10-17. DOI : http://doi.org/10.25045/jpit.v15.i1.02
14. M. A. AlQudah, L. Muradkhanli, Z. Muradkhanli, A. A. Salameh. 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, 2023, p. 1-7.

DOI: 10.1109/AICT59525.2023.10313183

15. M. A. Alqudah. Artificial intelligence and expert system role in knowledge management in government institutions/International ankara conference on scientific research, October, 2021, Turkey, p. 286.
    ISBN-978-625-7464-30-7.
16. M. A. Alqudah. Artificial intelligence using a neural network system to support human resources in the workplace/ International Baku scientific research congress, Baku eurasian university, October, 2021, Baku, Azerbaijan, p. 91
    ISBN-978-1-955094-16-0
17. M. A. Alqudah, L.Muradkhanli. Artificial intelligence techniques in improving the quality of services provided by e-government to citizens / 1st International Conference on Contemporary Academic Research ICCAR 2023, may, 2023, Turkey, p.72.
    ISBN-978-625-99108-2-6

18. M. A. Alqudah, l. Muradkhanli. Using Artificial Intelligence Applications For E-Government Services As Iris Recognition / 1st International Conference On Recent Academic Studies Icras, May, 2023, Konya, Turkey, P.47
    ISBN: 978-625-99108-0-2
19. M. A . Alqudah, L. Muradkhanli. E-government applications on innovation and development utilizing artificial intelligence/1st International Conference on Modern and Advanced Research ICMAR, July, 2023, Turkey, p.33.
    ISBN-978-625-6530-48-5.
20. M. A. Alqudah, L. Muradkhanli. Adopting big data and artificial intelligence to enable e-government to implement sustainable

development / 2nd International Conference on Information Technologies and Their Applications (ITTA 2024), Baku, 2024, Abstracts, p. 127.
https://doi.org/10.54381/itta2024.abstracts

21. M. A. Alqudah, L. Muradkhanli. Challenges of Artificial Intelligence and Its Applications In E-Government / 2nd International Conference on Information Technologies and Their Applications (ITTA 2024), Baku, 2024, Abstracts, p. 128.
https://doi.org/10.54381/itta2024.abstracts

The defense will be held on **May 3, 2024** at **14^{00}** at the meeting of the Dissertation council ED 1.20 of Supreme Attestation Commission under the President of the Republic of Azerbaijan operating at the Institute of Control Systems of the Ministry of Science and Education of the Republic of Azerbaijan.

Address: Institute of Control Systems, 68 B.Vahabzade Str., AZ1141, Baku, Azerbaijan.

Dissertation is accessible at the library of Institute of Control Systems of the Ministry of Science and Education of the Republic of Azerbaijan.

Electronic versions of dissertation and its abstract are available on the official website of Institute of Control Systems of the Ministry of Science and Education of the Republic of Azerbaijan.

Abstract was sent to the required addresses on **April 1, 2024.**

Signed for print 29.03.2024

Paper format: A5

Volume : 42112

Number of copies: 40