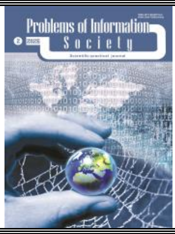

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Implementation of iris recognition to access e-government applications

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ABSTRACT

The research reveals that traditional service delivery systems are inadequate in predicting the use of e-government applications compared to artificial intelligence. Classic applications often fail to consider the differences in service delivery to citizens and recipients of electronic services, leading to a difference between classic applications and processing requests in complex service systems. There are currently no effective applications, methodologies, or methods to solve the problems of adopting artificial intelligence and linking it with e-government applications in Jordan. This paper aims to develop and study a way to combine artificial intelligence with classic e-government applications, using iris recognition as an example. The study focuses on e-government system applications that use iris biometrics to authenticate users accessing e-government systems. The theoretical and methodological basis of the paper is artificial intelligence using deep learning and convolutional neural networks to integrate this methodology into e-government services, improving citizens' access to services and determining the importance of recognizing people through iris for e-government applications as part of artificial intelligence.

1. Introduction

This study investigates the use of iris biometrics to authenticate users using e- government services to eliminate the need of repeatedly enter national identity numbers or names (AL Qudah & Muradkhanli, 2024; Juan & Kim, 2020; Olugbade et al., 2022). The traditional or manual identification approach has problems such as challenges in memory, susceptibility to guessing, and insecurity caused by people storing complex passwords in easily reachable places. (Agarwal et al., 2015) Use key characteristics to identify individuals and make it easier for them to effectively use e-government programmers. This paper investigates how iris recognition technologies can be used for citizen identification and electronic application access (Al Qudah et al., 2023) .The research aims to develop and study how e-government can adopt an iris recognition system for citizen service recipients as part of artificial intelligence (AI) applications. The following problems are solved, keeping in mind the research objective: study and analyze the mechanism of using AI to computerize and simplify the management of the e-government system; development of DL models to computer e-government services and the adoption of iris recognition in e-government services in Jordan (Al Qudah, 2021); obtaining frameworks and methods for e-government adoption, as well as proposing the use of AI in e-government applications. The following results are introduced in the.

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, convolutional neural network (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.

To achieve this objective, one should answer this question using the following provisions:

1. E-government applications without using technologies such as AI.

2. Methodology for adopting e-government applications for AI, as well as the challenges of adopting AI in Jordan.

3. CNN and their role in developing smart applications.

4. Algorithms to solve problems in electronic applications, improving the characteristics of smart systems based on AI mechanisms, and developing them so that citizens can use them.

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 research paepr 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 research 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 research 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.

2. Related work

2.1. Artificial Intelligence

AI and automation have been significant subjects in current discussions over technological progress (Abdillah et al., 2024) AI-powered machines have the potential to imitate human cognitive functions and behaviors (Parisi et al., 2024). An intelligent machine is defined by its capacity to independently collect information and offer solutions. AI ability to make rational decisions and carry out activities that maximize goal achievement is essential. Machine learning (ML), a subset of AI, enables computers to independently acquire new skills and adapt to their environment. DL is a computer method that efficiently processes large amounts of unstructured data, like text, images, and videos, to enable independent learning (Al Qudah et al., 2024).Only recently has the potential impact of this phenomenon on global societies and democracy been acknowledged. There is no commonly accepted definition for the concept of AI. Scholars generally agree that it includes cognitive qualities like as volition, knowledge acquisition, strategic thinking, effective communication, and rational decision-making. AI aims to mimic human intelligence by performing cognitive tasks such as problem-solving and reasoning.

2.2. Biometric Systems in E-Government

Currently, AI involves programming or instructing a computer system to execute tasks like those done by humans, such as giving movie suggestions or addressing technical questions. AI is set to have a substantial influence on government relations soon. AI is being used in the United States and Japan to enhance the services provided by municipal governments to their citizens. AI integration in government has shown effective in reducing administrative tasks, streamlining resource distribution, and handling complex responsibilities (Abdullayeva et al., 2025). AI is commonly used in citizen service for duties including answering inquiries, finishing, and locating papers, directing requests, and aiding in document creation(Aliyev et al., 2026) .Using these apps could result in government officials being more accessible to the public. Neural networks, commonly referred to as AI, can enhance public engagement, improve service delivery, and increase overall satisfaction with e-government. AI can improve service delivery, protect privacy, and maintain ethical guidelines. If implemented poorly, it could result in negative consequences (Al Qudah et al., 2024). Organizations interested in implementing AI might get important insights from government modernization efforts and the utilization of AI by private sectors. (Shikhaliyev, 2026). The scholarly article suggests incorporating six AI techniques in government organizations to efficiently integrate AI into goal-driven, citizen-focused programs (Bharadiya, 2023). The strategies involve incorporating feedback mechanisms, leveraging existing assets, ensuring readiness for data utilization while maintaining privacy precautions, addressing ethical concerns, avoiding AI-based decision-making, and enhancing rather than replacing existing personnel.

Biometrics is an emerging technology that has not reached its maximum capabilities. Challenges in providing e-government services include the absence of universally accepted biometric data standards, privacy concerns, and security risks (Vagifli, 2026) .Using the Internet and e-commerce helps governments improve the services they provide to their citizens(Dobbin & Simon, 2011; Nkurikiyeyezu et al., 2021). The government's main goal is to strengthen relationships with firms and individuals by offering better and more efficient services. When e-government is implemented correctly, technology can significantly change government operations by increasing efficiency, cutting costs, and enhancing service delivery to residents(Fraihat et al., 2024). Therefore, many governments are focusing on offering e-government services that can be accessed through online platforms. Concerns over the security and reliability of electronic government services are legitimate among the general population. Using biometric IDs can enhance the security, secrecy, and dependability of electronic government systems. Using such identifying techniques compromises the effectiveness of technology, the accuracy of biometric solutions, and financial benefits. Concerns about privacy breaches, resistance to change, skepticism about technology and data usage, and compliance with data protection laws all hinder the widespread adoption of biometric technologies. Despite the highlighted obstacles, utilizing biometric identification for accessing e-government services online may be essential (Al Qudah, 2021; Al Qudah et al., 2023).

3. Materials and methods

3.1. Research methodolody

Data collection to build the 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 research paper, we have a dataset related to the BMP format. All bitmap images (.bmp) used in this study were changed to jpeg format.

This study focused on recognizing people through the iris, and an AI-powered framework, model, and method were created. The methodological basis of the paper is AI using DL 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 DL models (Al Qudah et al., 2023). 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 paper proposed a novel model that may be integrated for use in a complete iris segmentation and recognition technique, fig. 1. Build Model application.

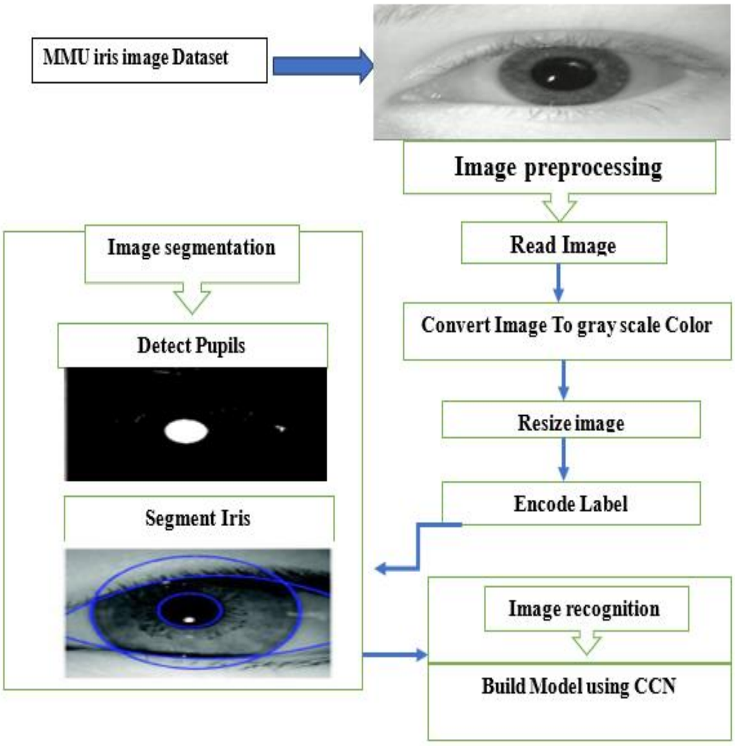

Fig.1. Build Model application.

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. The study and development of model-building and design methods to create a model that meets the project criteria are examined in this part. Transforming one set of activations into another using a differentiable function is the job of each layer of a CNN. Layers are the building blocks of a basic CNN. Three primary types of layers are commonly utilized in CNN architectures: fully connected, pooling, and convolutional (Al Qudah et al., 2023). You won't find these layers in any ordinary neural network. The backbone of any CNN is its convolutional layer.

When training begins, the system learns the values for a set of filters, or kernels. Filters typically have a smaller size compared to the original image. Each filter generates an activation map by applying a convolution operation to the image (Ahmadov & Mahmudov, 2026; Al Qudah, 2022; AL Qudah & Muradkhanli, 2024). The CNN layer performs calculations first, apart from the brain and its neurons. A set of trainable filters makes up the CNN layer's parameters. Filters affect the input volume cumulatively, although they only take up a limited amount of space physically. To create the feature map, we use the learned weight across the board, which is equivalent to the convolutional filter. The output of a convolutional layer of a CNN is called a feature map, and it depicts the many features found in the input image or another feature map. Several feature maps are generated during the forward pass of a CNN by convolution in the input picture with one or more filters.

3.2. Problem solution

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.

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.

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

• z^s - the output (activation) of the (s) -th neuron in the current layer.

• f- the activation function (ReLU, Sigmoid, or Tanh) that introduces non-linearity.

• $\Sigma_{t=1}^{q}$ - the summation of all weighted inputs from the previous layer (from (1) to (q)).

• W_i^s - the weight assigned to the connection between the (i) -th input and the (s) -th neuron.

• X^i – the input value from the (i) -th neuron of the preceding layer.

• b_s – the bias term for the (s) -th neuron, which allows the activation function to shift.

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. 2.

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.

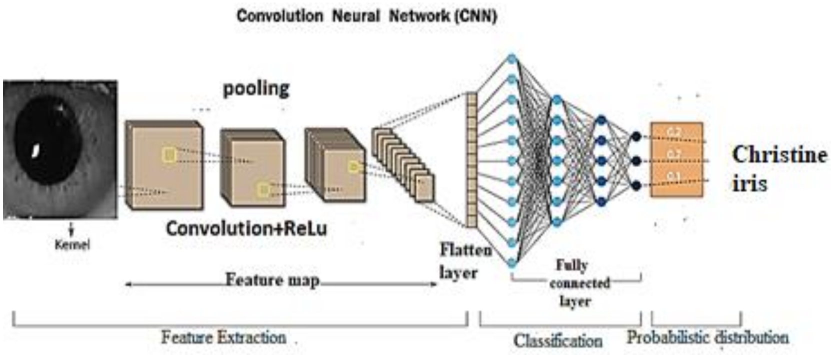

Fig.2. Neural network layers.

3.3. Experimental results

The results are categorized into distinct sections. The initial section focuses on the outcomes of experiments that encompassed segmentation results. The subsequent part examines the outcomes of data augmentation. Thirdly, prediction modeling presents conclusive findings.

3.3.1. Iris Segmentation result image

Segmentation is the process of dividing an image into distinct and uniform segments based on a specific criterion, such as color. Digital image processing specifically refers to the technique of image segmentation as a crucial step. The merging of these distinct regions should result in the emergence of a reconstructed version of the original image. Slicing is a crucial process that allows for the extraction of high- quality data from an image.

Slicing provides a great level of detail, enabling this possibility (Al Qudah et al., 2023; Fataliyev & Verdiyeva, 2026). The graphic depicts a network of nodes connecting each region to its surrounding regions. Each node represents a specific section of the image.

3.3.2. Data augmentation

Data augmentation is the method of creating additional data from existing data, mainly to train new ML models. ML models necessitate extensive and diverse datasets for their initial training. Data augmentation is a technique that artificially expands the dataset by introducing minor modifications to the original data. Data augmentation is a technique that helps mitigate overfitting during the training of ML models. Overfitting is a problematic behavior in ML where a model can properly predict outcomes given the data it was trained on. This study involved augmenting the data to mitigate overfitting. When a model exclusively trains with a limited dataset, it may become overfitted and produce predictions that are only relevant to that sort of data. On the other hand, data augmentation offers a significantly more extensive dataset for training the model. Deep neural networks are unable to learn to operate with specific qualities since it causes training sets to appear distinct. The image augmentation techniques used include random horizontal flips, random rotation within the range of - 15° to +15°, random zooming in and out by 20%, and random crop by 20%. The achieved accuracy rate is the highest observed, at 96.8%. Fig 3 illustrates that we will store the model depending on the accuracy of the information. The accuracy calculation is shown in Equation 2.

$$Accuaracy = \frac{T_N + T_P}{T_P + T_N + F_P + F_N}$$

Where
T_N : True Negative
T_P : True Positive
F_P : False Positive
F_N : False Negative

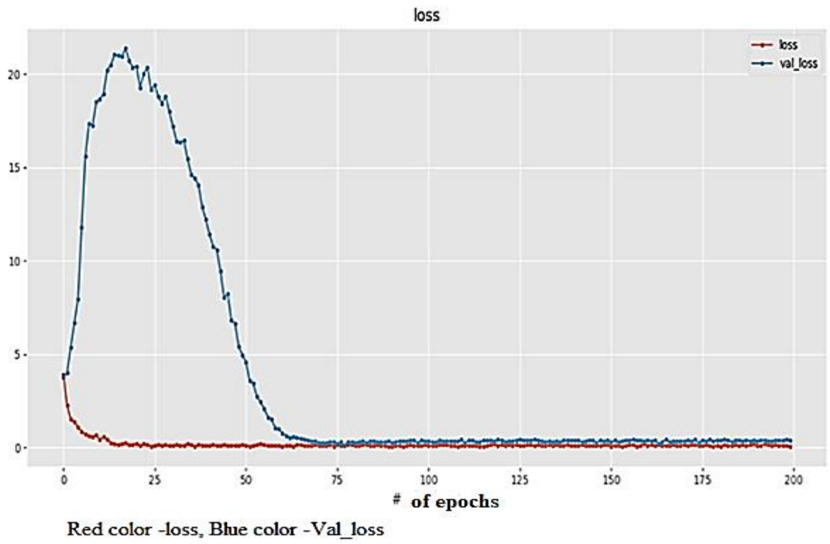

Fig. 3. Loss function method evaluation.

3.3.3. Predict model

To foretell what will happen in the future, predictive modelling uses mathematical and computational methods.

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.

4. Discussion

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.

In a mathematical approach, the phenomena under examination are described using an equation-based model. By manipulating the model's inputs, one can anticipate the outcome of an event later. fig. 4 shows the outcome of the notebook model, while Table 1 shows an example of the accuracy of the prediction model.

Table. 1. Prediction 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%**

By executing the software on a total of 460 distinct photographs, we successfully obtained 96.8% of the intended results. The two sets of photos are entirely interchangeable. To use these tactics, a camera with a good resolution is essential. The results obtained from the computer were satisfactory. The role of this system, which relies on DL and neural networks, is in its ability to increase AI and facilitate the adoption of e-government. It can also help integrate e-services and government apps to stay up with technological breakthroughs and AI.

5. Conclusion

We propose the potential of AI and ML to enhance the effectiveness and efficiency of e-government. 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 consumers. The study investigated the relationship between neural network-based e-government systems and their practical application.

Additionally, it aims to determine the significant contributions that these highly intelligent programs might offer to the functioning of organizations. We developed a new method and algorithm to construct an iris recognition model for e-government applications, utilizing deep learning and a neural network.

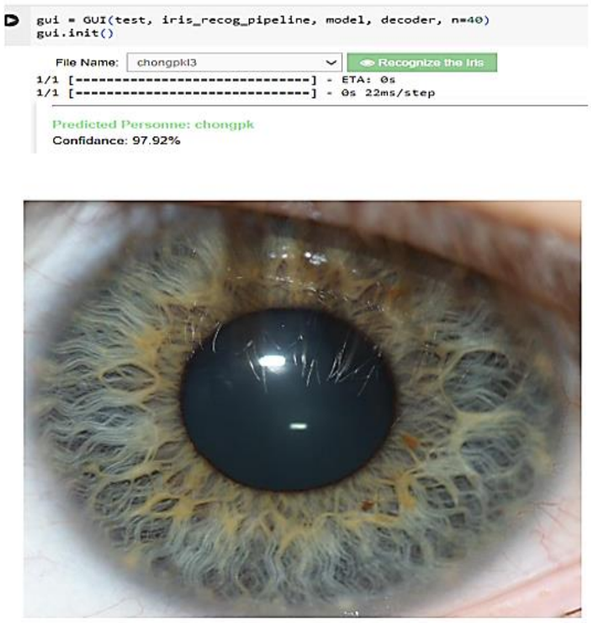

Fig. 4. Result notebook

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. Modeling methods and techniques, such as DL, 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 application and providing predictive capabilities, which enhance the role of DL in improving e-government services.

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