AUTHENTICATION IN ATM/ITM MACHINES USING IRIS RECOGNITION BIOMETRICS

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ABSTRACT

Biometric identification is a method that encompasses many types of authentication systems, including iris features and characteristics. The behaviour of the tiny pixels in a person's iris and pupil can be extracted and uniquely used for authentication in ATM/ITM machines. In this study, achieving higher accuracy and success is the goal. We have found out that the Daugman algorithm can enable the implementation of iris biometrics in a faster and more accurate way compared to other algorithms. This will allow ATM/ITM users can comfortably access their accounts and make transactions without the need for a card or PIN, while authenticating their identity in the machines using their iris biometrics. Such a system can also be used to authenticate national ID entitlement in programmes. Furthermore, such a system can enhance the accessibility of social benefits, subsidies, and other entitlements while minimizing fraudulent activities [1].

KEYWORDS

Iris Recognition, biometric authentication, Daugman algorithm, ATM Authentication by iris biometrics.

1. INTRODUCTION

People using ATM cards, encounter to many security problems in the location that they use their bank cards in order to authenticate their identity information in a secure and convenient manner. Losing the card, forgetting the pin of the card, damaging the card's chips and most unexpected problems likely to take place or these are occurring every day. For those problems, iris bio metrics can be an easy solution ubiquitously—meaning that everyone's eyes are available in front of ATM systems. One's eyes' information including limbic and pupil boundaries along with their patterns are the only necessary parts. They can facilitate aspects of the process of proving their identification that recorded in bank systems meanwhile ATM machines can access to those parameters. The authentication process implemented in our work has two main features: The first one is to recognize the account holder by only iris biometric and the second one is to personalize the iris extraction data in card's chip and process it without needing any kind of pin or password in ATM systems. In this system, after a card's insertion into machine, account holder should stand in front of the ATM, letting the iris camera to capture the iris region and identify the owner of the account. After successful authentication, the account holder can access his account.

1.1. Literature Review

Going through the recent literature, the bank united of Texas developed iris scanner to do transactions without using any kind of card but only iris biometrics, using a face detector along

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with a face recognizer and an eye localizer. The mentioned face recognition system is implemented in two steps, the first step is to capture entire face of the person and compare it with the image which exists in database. The second step is to verify by taking yes, no decision in ATM machines. To elaborate iris recognition part, Bank United of Texas developed iris-based capability in ATM machines to do transactions. In order to facilitate transaction without ATM card, they utilized the biometric of iris by brightening the iris with IR light to capture the iris image at distance of 20 cm to 30 cm [2]. Iris verification is a base to authenticate the actual individual's identity after extracting the iris information and specific parts saved in database and the converted iris data is compared with others for identification purposes [3]. — Computer vision technologies contributed many sectors to do operations easier and more convenient since its beginnings. Biometric authentication is one of them implemented along with deep learning to utilize cloud network for data store and retrieve. For this system Triple DES 64bit algorithm is considered and used thus encrypting data and saving it to cloud because of retrieval in decryption process in a fast way. Briefly the purpose of this model is to use in automatic systems for identifying individuals effectively [4]. In another article, CNN (convolutional neural network) is described as one of the deep learning methodologies utilized to collect, preprocess, and augment datasets in the first step. Extraction features and their classification occurred in the structure of CNN is shown in the article [5].

1.2. Objective of our Work

In our project, the objective is to develop an ATM/ITM identity authentication software that can control access to automated teller machines. The purpose of this software is to reduce the usage of physical cards and secure ATM operations in a convenient way. In other words, situations like losing a card, forgetting the card PIN, or having the card chip damaged while in one's pocket or wallet can happen. If a customer loses their card, they need to inform the bank to block it to prevent someone else from using it in the future.

1.3. Remove the Password or PIN from the Automated Teller Machines

Iris scanning technology is being incorporated into many systems as a secure form of authentication, leading to the eventual demise of passwords, which have been used for many years. This technology is expected to be widely adopted in the future, particularly in many countries. Fujitsu has developed a smartphone that includes a special camera for capturing images of the user's iris [6]. The phone's camera is capable of recognizing the unique pattern of the iris, even if it is partially obscured. This feature sets iris recognition apart from fingerprint recognition, as it remains effective over a long period of time without requiring regular updates. Unlike fingerprints, the iris does not change significantly with age [6].

1.4. Existing Systems

Iris recognition is an automated biometric identification system that uses mathematical operations to convert the unique pattern of a person's iris into a code for compilation and application to their eye images. According to studies, the iris and pupil have a unique, stable, and complex pattern that can be seen from a distance. Retinal scanning is a different ocular-based biometric technology that uses the unique patterns of a person's retinal blood vessels, which is often confused with iris recognition. Iris recognition uses video camera technology with subtle near-infrared illumination to capture images of the intricate and detail-rich structures of the iris that are visible externally. Mathematical and statistical algorithms then encode digital templates from these patterns, enabling the identification of an individual or someone attempting to impersonate that individual. Matcher engines search databases of enrolled templates at speeds measured in millions of templates per second per single-core CPU with low false match rates. Iris recognition

systems have been widely adopted in several countries for convenience purposes, such as passport-free automated border crossings and some national ID programs, with several hundred million people enrolled in these systems. One of the key advantages of iris recognition, aside from its speed and low false match rates, is the stability of the iris as an internally protected, yet externally visible organ of the eye [7].

Figure 1.1 Real System Implementation [8]

2. COMPARISON OF FOUR WELL KNOWN ALGORITHMS

The recognition of person by his or her iris is computed under 4 well known algorithms that were developed in the scope of four academic articles. These four algorithms belong to Avila [9], Li Ma [10], Tisse [11] and Daugman [12]. They implemented and compared these four algorithms on the CASIA image database. As a result, Daugman ‘s algorithm performed the operation with 99.9 % accuracy. It has the highest accuracy among these algorithms [13] is shown In Table 2.1.

Table 2.1 Success Rate of Comparison of four algorithms

Algorithm References	FAR/FRR	Overall Accuracy
Avila [9]	0.03/2.08	97.89 %
Li Ma [10]	0.02/1.98	98.00 %
Tisse [11]	1.84/8.79	89.37 %
Daugman [12]	0.01 /0.09	99.90 %

The accuracy of an iris recognition system is typically evaluated based on the False Acceptance Rate (FAR) and False Rejection Rate (FRR). These rates are often used to calculate the overall percentage of accuracy based on the implemented algorithms. In their work, the authors approached iris recognition using four steps: 1) locating the iris in the image, 2) performing a Cartesian to polar reference transform, 3) extracting local features, and 4) matching the image to an enrolled template. To locate the iris, the authors used Daugman’s Integro-differential operator equation to identify the inner and outer boundaries of the iris. This operator utilizes the circular geometry of the iris and pupil and detects the circular edge, recognizing that the sclera of the eye

is typically whiter than the iris, which has a darker colour, and that the pupil is the darkest part of the eye.

2.1. Iris-Based Biometric Recognition using Dyadic Wavelet Transform

Systems are being attacked every single day as technology concepts changes in authentication schemes basing on passwords, secret codes, and identification cards or tokens. These kinds of approaches are cracked by password dictionaries or in some system by brutal force attacks. Besides, intruders attack systems basing on identification card or tokens by robbing, copying or simulating them. The potential of the human iris for such problems comes from the anatomy of the eye. Features and properties of human iris shows that they have good suitability for automatic identification such as:

1. Inherent isolation and protection from the external surroundings.
2. It is impossible to modify iris by surgical operation. It damages eyes.
3. It can be detected when any eye has a plastic modification in its physiological response to light.

As a result of this, at the moment only two prototype iris-recognition systems have been developed by Daugman.

2.2. Feature Extraction of Iris Signature

The first step of the feature extraction block is to get a data set from each isolated iris sample which allows a suitable extraction of its features. As a result of analysis which is obtained in biometric recognition is 97.9 % of classification success.

2.3. Log Filtering and Determination of Corner Description

The iris is a thin, circular structure in the eye. Eye is connecting to those controls its diameter and responsible for (the amount of light reaching the retina depending on it). Eye colour is iris's colour. It can be green, blue, or brown. Some may be grey, violet, and even pink. The eye pupil enlarges or narrows. If the eyes's pupil are bigger than more light can come inside the eye [13]. Since diversity in the patterns that bring the iris region of people's eyes to the attention of scientists and engineers, researchers use this difference as a distinguishing feature in identifying people's identities. This working area is called iris recognition. In some countries in various parts of the world, millions of people are registered with iris recognition systems. Technology has brought this application for life-facilitating, and it is working right now as an automatic border crossing without passports. One of the important advantages of iris recognition (as well as resistance to mating speed and false mappings) is the irreversibility of the iris as an internally visible organ [13]. The iris detection process is one of the intermediate steps of 'iris recognition'. The feature information must be coded to be used in the recognition process of the iris. In order to be able to perform this process, the boundaries of the iris region must be correctly determined within the image of the eye of an individual.

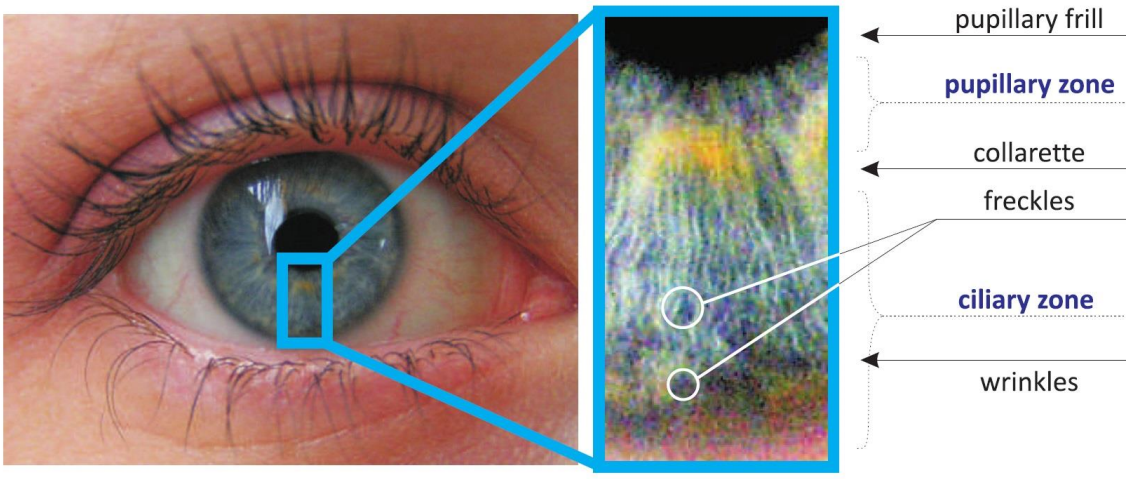

Figure 2.1 Iris properties [13]

2.3.1. Preferred Method

Daugman thought that both pupil and iris which have circular shape. For this, he applied integrodifferential operator.

$$\max = r, x_0, y_0 \left| G_\sigma r * \frac{\partial}{\partial r} \oint_{r,x_0,y_0} \frac{I(x,y)}{2\pi r} ds \right| \qquad (2.1)$$

2.3.2. Computation of Input

An image of the eye (in jpg format) selected from the iris database and the values of Rmin, Rmax to which the iris radius can be input are given as input to the algorithm. The region starting from the rmin distances from the edges is determined as the iris center point search region and the center of the iris circle is assumed to be absent in the coordinates outside this region. It must be at least Rmin from the center edges so that the iris circle can remain in the image. (For the picture on the left, Rmin = 40 is selected and the yellow fields show the center point search area.) Another input information may be the scaling factor which is described in the preliminary section. Law no. 1472 ruled for the closing of special vocational schools in 1971, and engineering schools were affiliated with the Istanbul State Engineering and Architectural Academy [14].

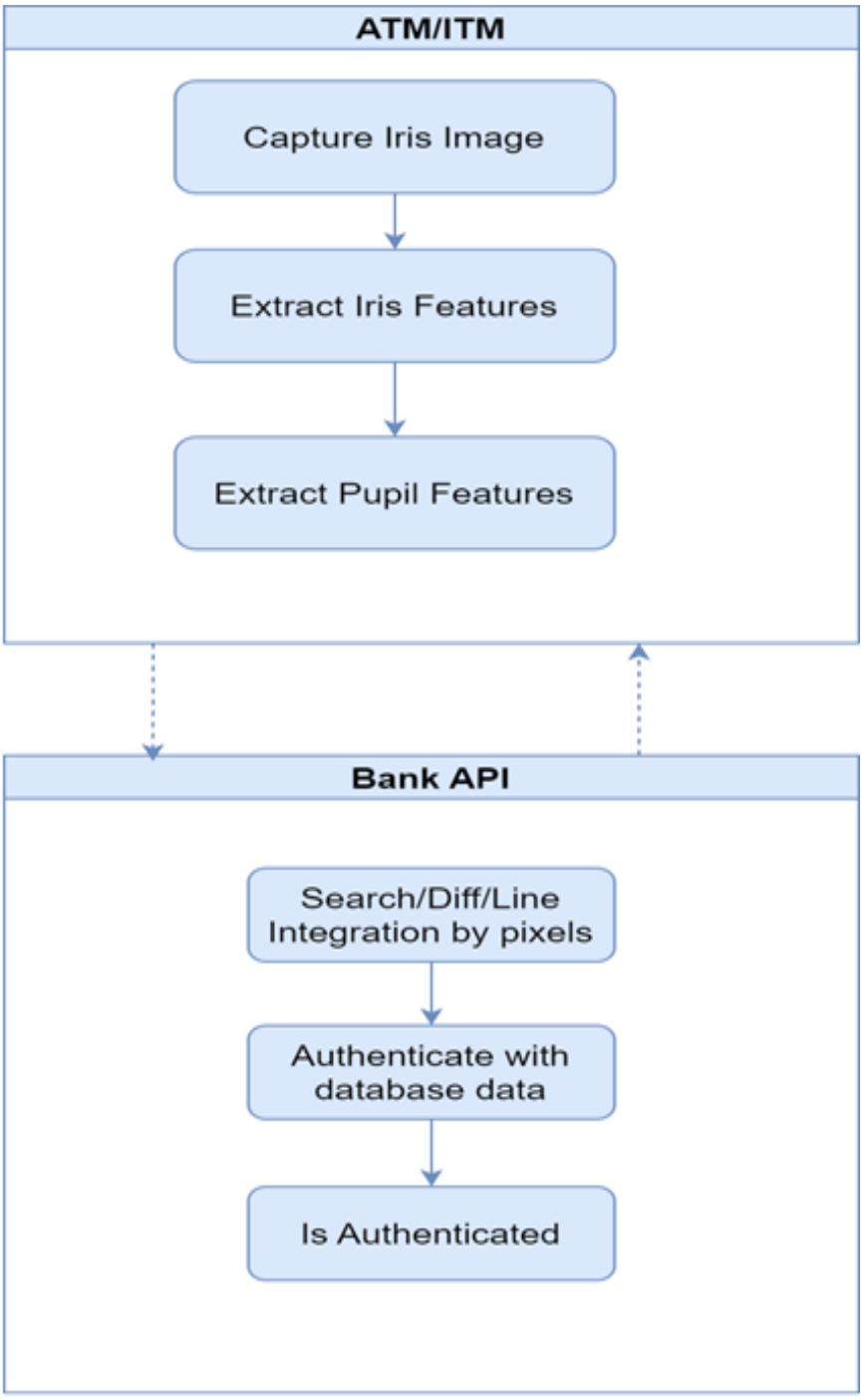

Figure 2.2 System Package [13]

3. RESULTS AND DISCUSSION

Daugman iris recognition algorithm, which is widely used and highly accurate. The author explains the algorithm's key features, including the use of Gabor filters for feature extraction and a normalization process to make the iris images invariant to rotation and scale. The article also discusses the computational efficiency of the algorithm and its potential for real-world applications [15]. In a book name "Handbook of biometrics" provides an overview of iris

recognition technology, including its history, algorithms, and applications. The authors discuss various aspects of iris recognition, such as image acquisition, feature extraction, matching, and template storage. Also covers the performance evaluation of iris recognition systems and the factors that can affect their accuracy, such as image quality, occlusion, and aging [16]. In addition referring to the "Image-based authentication" article published in 2016 by Bowyer, K. W., & Hollingsworth, K. write a comprehensive review of image-based authentication techniques, including iris recognition. The authors discuss the advantages and limitations of iris recognition technology and the challenges associated with its implementation, such as privacy concerns, interoperability, and spoofing attacks. The article also presents several evaluation metrics for assessing the performance of iris recognition systems, such as FRR, FAR, and equal error rate (EER) [17]

3.1. Performance Analysis

The Daugman algorithm is a widely used iris recognition algorithm, and its accuracy rate is considered to be very high. In fact, the Daugman algorithm is known for its high accuracy and is considered one of the most accurate iris recognition algorithms. The accuracy rate of the Daugman algorithm is typically reported in terms of its false acceptance rate (FAR) and false rejection rate (FRR). FAR refers to the rate at which the algorithm incorrectly accepts a non-matching iris as a match, while FRR refers to the rate at which the algorithm incorrectly rejects a matching iris as a non-match. According to the research literature, the Daugman algorithm typically achieves a FAR of less than 0.1% and a FRR of less than 1%, which makes it highly accurate for iris recognition applications. However, the actual accuracy rate of the algorithm can vary depending on factors such as image quality, lighting conditions, and the quality of the iris image being used [15].

In the "Speed Performance Summary" [15] section of the article, Daugman discusses the computational efficiency of his iris recognition algorithm. He notes that the algorithm can process an iris image in about one second on a 1999-era PC, which he considers to be acceptable for most practical applications. He also points out that the algorithm’s computational requirements are mainly due to the use of Gabor filters, which are used to extract iris features, and suggests that faster implementations could be achieved with hardware acceleration or more efficient algorithms for feature extraction. Overall, Daugman concludes that his iris recognition algorithm is computationally feasible for real-world applications, but that further research is needed to optimize its performance.

3.2. Future Work

According to accuracy and reliability, there are still some scenarios in which it does not work properly and consistently, the time if the iris image’s quality decreases or occlusion and any changes in illumination are other challenges to be improved in Daugman iris recognition algorithm. In addition, comparing to existing methods’ performance Daugman algorithm is fast. But, it still need to be researched and it may requires to search the ways of capturing iris image for preventing the negative effects in this stage. Besides, paying attention on the state-of-art while successful development and accurate results have been achieved, ATM/ITM authentication and other systems can be made such as border crossing identity verification another example of that method can guide to bring a solution. Overall, relating to the Daugman method’s success, we will be continuing to involve ongoing research and development, with focus on improving performance and increasing accessibility, and advancing the state-of-the-art.

3.3. Project Result Interfaces

We developed a project in Python and Django framework. User interface of the project is presented by its interface pages as in below figures:

- Registration page is to enrol the person with his/her identity, name, surname, and eye biometrics into database.

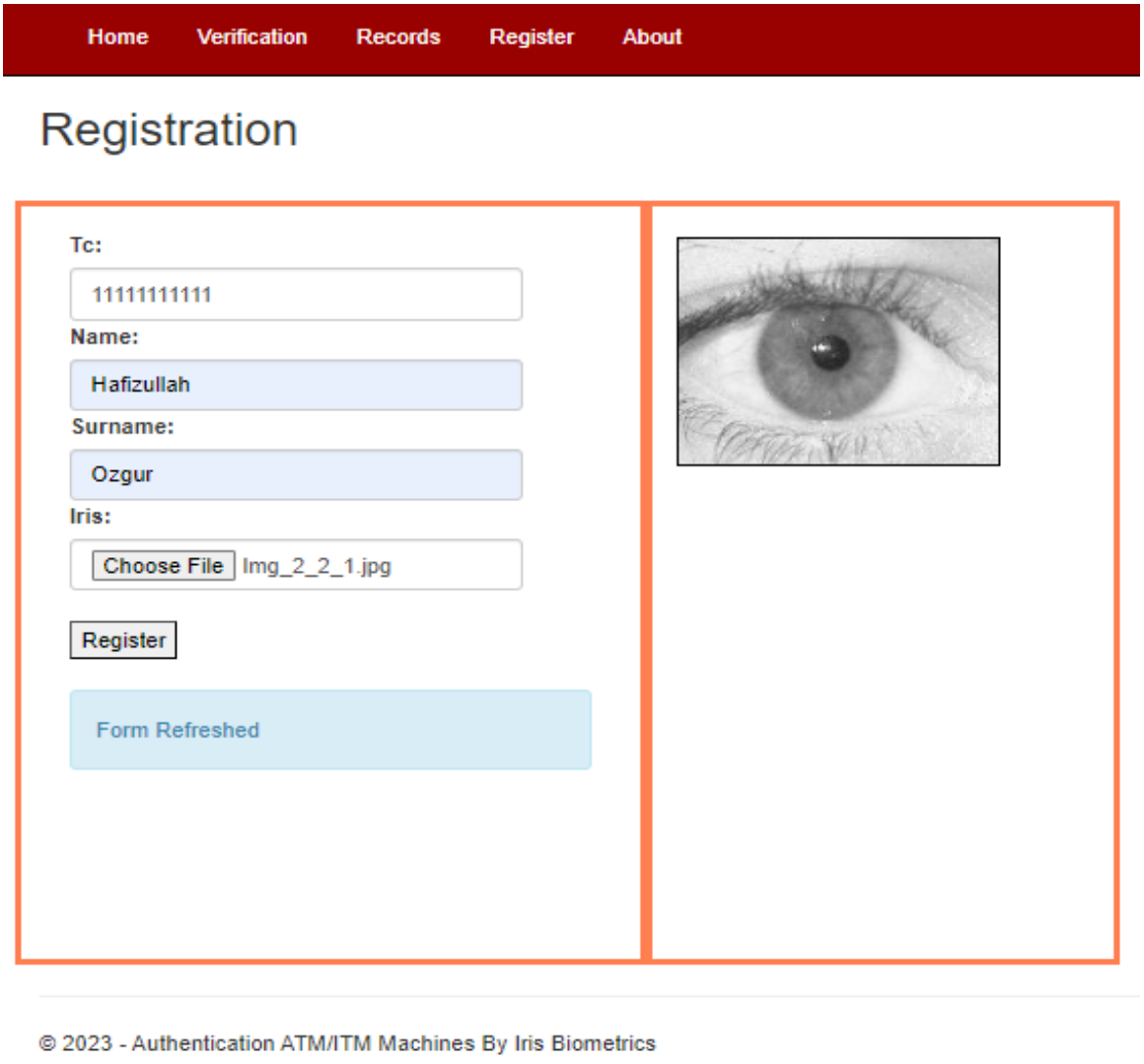

Figure 3.1 User Interface of the Project - Registration [18].

- If the inputs saved successfully then there will be a notification interface showing that the person has been recorded into database.

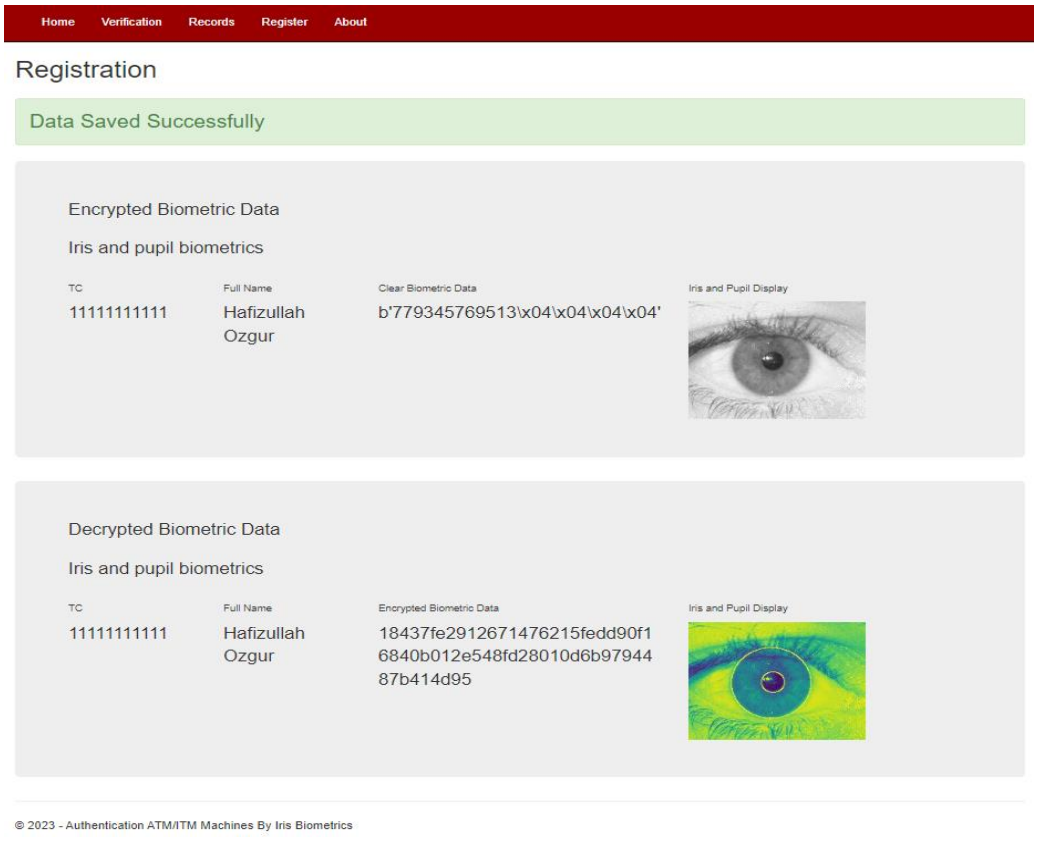

Figure 3.2 User Interface of the Project - Successfully Registered [18].

In this stage, assuming the ATM/ITM capturing the customer's iris image and his/her card into the ATM/ITM Card Bin to carry out an authentication operation.

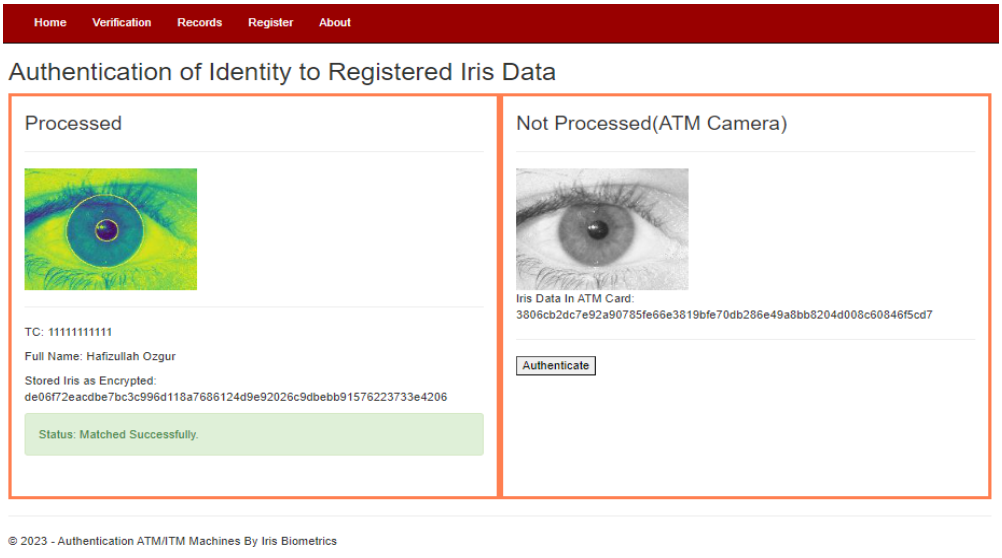

Figure 3.3 User Interface of the Project - Successfully Authenticated [18].

- If the authentication stage is unsuccessful, the result will be failed and will be showed a "Not Matched" warning message.

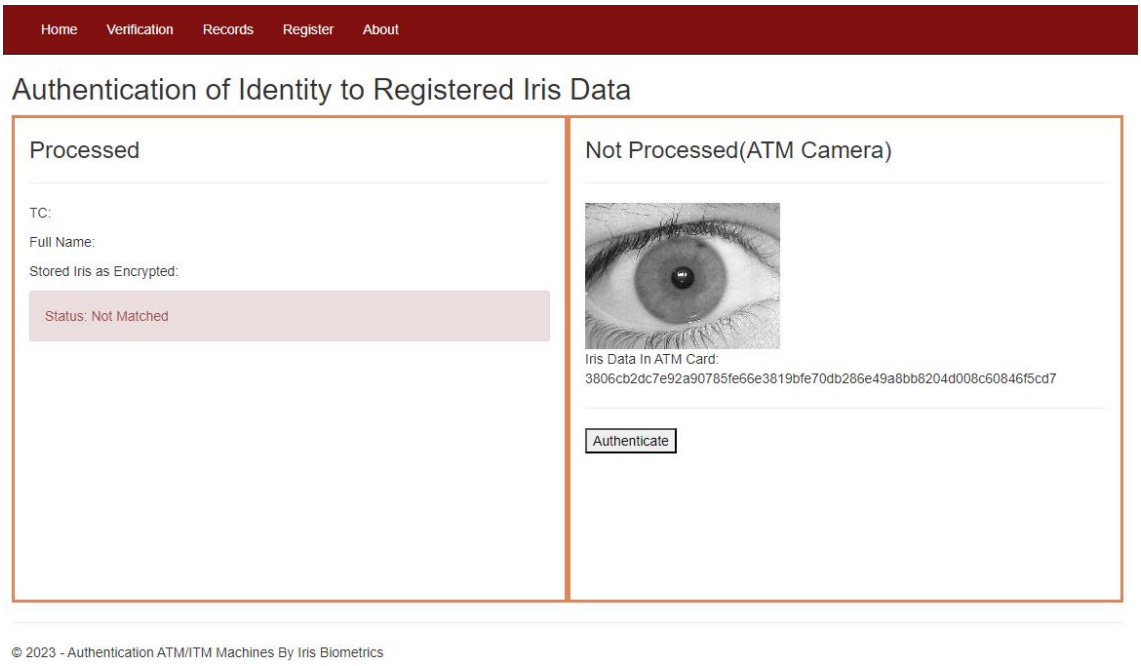

Figure 3.4 User Interface of the Project - Not Matched [18].

4. CONCLUSION

The use of iris biometrics as an authentication method for automated teller machines (ATMs) can provide a convenient and secure solution for many security issues encountered by ATM cardholders, such as losing or damaging their cards or forgetting their card PINs. By recognizing the unique patterns in the limbic and pupil boundaries of an individual's eyes, iris biometrics can facilitate the process of proving one's identification recorded in bank systems. The literature review presented several studies and developments on the use of iris recognition technology in ATM authentication, including the development of iris-based capabilities in ATM machines by Bank United of Texas [2] and the utilization of deep learning and cloud network for data storage and retrieval. The objective of the thesis is to develop an ATM/ITM identity authentication software that controls access to ATM machines without requiring physical cards or PINs. The use of iris recognition technology is expected to replace passwords and be widely adopted in many countries due to its stability and low false match rates. Iris recognition systems have already been adopted in several countries for convenience purposes, such as passport-free automated border crossings and national ID programs, with several hundred million people enrolled in these systems.

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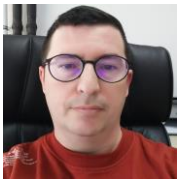

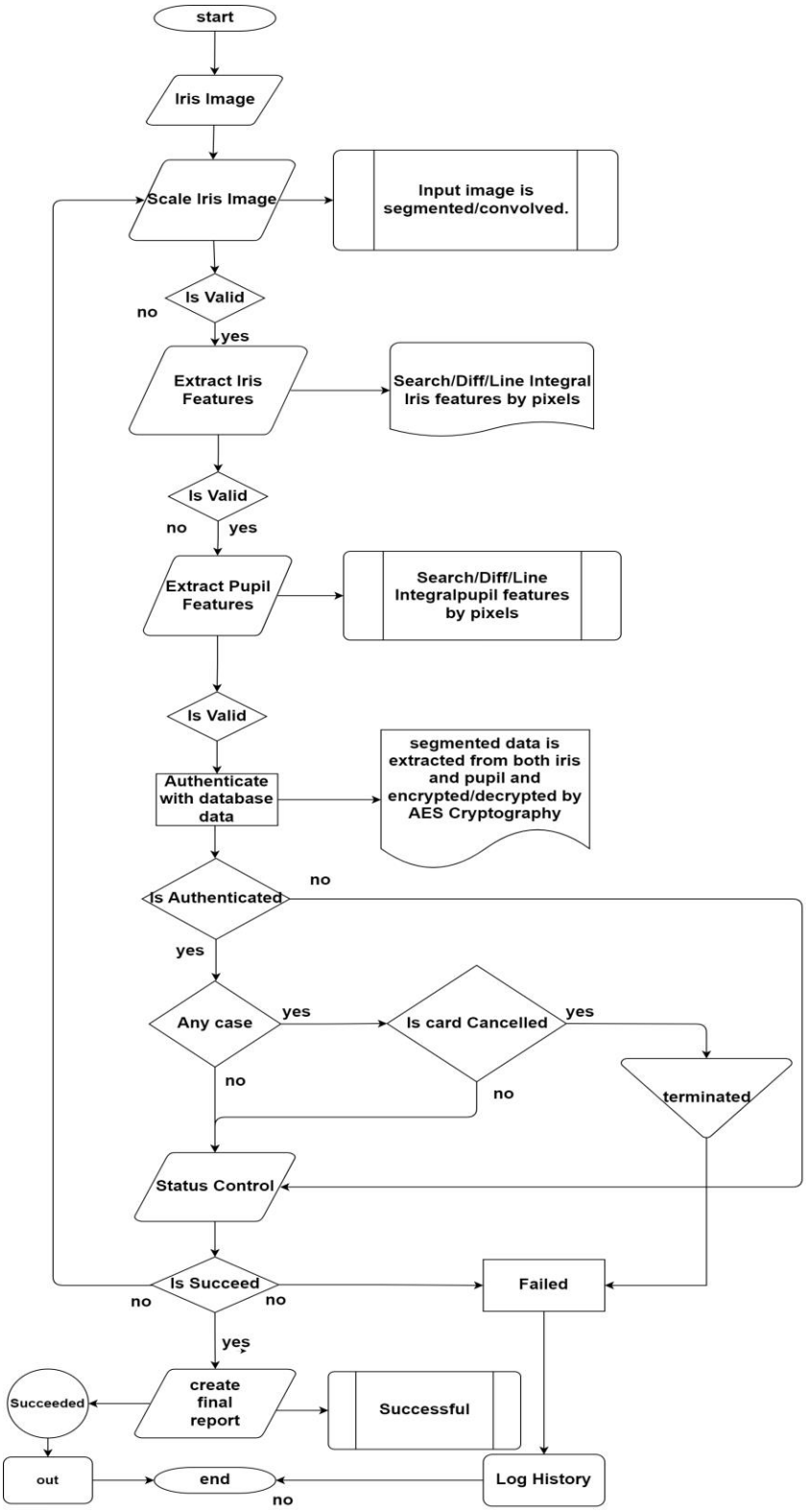

Figure .1 Appendix A - System Activity Flowchart [13]