Biometric Cashless Payment System

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Abstract: The major issue in the e-payment system is delivering security to the users in the backing business. Conventional techniques usually suffer from the issues, regarding incapability to identify whether the person who wants to access is authorized or a fraud (who duplicitous the identity of authorized person). Biometric frameworks work on physiological and behavioral parameters, also Biometric installment is utilized for different sorts of frameworks. Rather than the strain of keeping cards and remembering their troublesome security code we can just go for biometrics. This framework is very useful and secure as well as manageable, eliminating the use of watchword or mystery codes to recall. The biometric cashless payment system is a multimodal system in which all the transaction is done by using biometric signatures of the authorized person as a security code or key to access their accounts. The biometrics will be stored in the database and will be provided to the system for identification. The system is based on image processing, it recognizes a person via its face, iris, and fingerprints and allows them to access their account. This multimodal system will be quick, easy and highly secure, also a prominent appropriation of biometric installment framework if developed will drive down the cost of biometric users and in this way making it more reasonable to entrepreneurs.

Introduction

The Cashless payment system is the system in which all the transactions or transfer of amount are done by the means of digital media such as mobile wallets like Paytm, Google Pay, or by using cards (Debit or Credit Card). The key advantage of the cashless payment is that all the transactions are recorded that is we have all the records about our transactions, this limits the growth of the black money and minimize the chance of tax avoidance [1] and many other benefits include a corruption-free environment, people don't have to worry about carrying hard cash with them [2].

The government starts to promote cashless payment after the demonetization when at a sudden all 500 and 1000 notes are banned within a night. All the money was available in the virtual form, therefore the payments in all the sectors such as showrooms, hotels, shopping centers, petrol pumps, etc., done via the digital means and mobile wallets that are the part of the cashless society, but with this cashless payment system some problems like card theft, internet fraud, identity theft, etc., leads to the question concerning the security of this system [3].

The cards or wallets that are used for the transactions are electronically linked with the cardholder accounts [4] [5]. The wallets store the card details and allow card-less transactions by using online transactions [6]. UPI app is the mobile application provided by the banks that gives facility for online transactions and online shopping [7]. All the discussed systems provide PIN/Passwords for doing secure transaction but these can be easily hacked by the fraud person [8].

Therefore, a biometric fingerprint-based system is derived to eliminate the interference of the third person i.e. the fraud person during the transaction, in this system a fingerprint is used instead of PIN/Password to identify the authorized person. The fingerprint is more reliable biometric than other and it is easy to access, therefore anyone can willingly give it but along with that many people which are unable to access via fingerprint due to some disadvantaged can access their account with the help of face and iris recognition which is more secure than the fingerprint, as human have identical face geometries along with dimensions and the iris is the more unique and steady approach, the identical twins have different iris patterns along with that, both of our eyes have different iris patterns. A fingerprint is nothing but the representation of the epidermis of a finger.

The problem with the unimodal biometric system is the one level authentication if it fails because of any biological or physical trait the system will not able to recognize. However, the multimodal biometric authentication system consists of two or three-level authentication which makes it more secure and lowers possibilities of failure.

Literature Review

1.1. Biometric Recognition Techniques

A Review in this paper by Shweta Gaur, V. A. Shah, and Manish Thakkar gives a relative study on different biometric that is used for human recognition such as fingerprint, heart rate, retina, face recognition, etc., according to the physiological characteristics [9].

Sulochana Sonkamble, Dr. Ravindra Thool and Balwant Sonkamble on their survey, had focused on the application of the biometric basically on security access, personal identification, banking, and password [10].

Different biometric fingerprints stored in the UID database helps in providing various government services to true persons as discussed in Aadhaar Enabled Service Delivery published by UIDAI, Government of India dated Feb 2012 [11].

1.2. Aadhaar based Financial Inclusion

In this paper, it is discussed that how Aadhaar is useful for the fingerprint-based transaction, as we know that Aadhaar is linked with our bank account, the banks can use the Aadhaar database to provide secure service [12].

Sravya V, Radha Krishna Murthy, Ravindra Babu Kallam and Srujana B. survey about the benefits of the fingerprint as biometric, such as the system is economical, can work at any environment, easily maintained and are more user-friendly [13].

Anil K. Jain, Patrick Flynn and Arun A. Ross, Handbook of Biometric (Springer Science+ Business Media, LLC, 2008), this book relates different features of the fingerprint [14].

Vishal Vishwas Jadhav, Rahul Ratnakar Patil, Rohit Chandrashekar Jadhav, and Adwait Niranjan Magikarp, derived E-payment System based on Biometrics that uses the Aadhaar database for authentication in their paper [15].

W. Zhao, R. Chellappa, PJ Phillips and A. Rosenfeld in his article, "Face Recognition: a statistical survey of the literature", shows that research on the face recognition system is at its peak, and in the last forty years, the research in this field has increased exponentially [16].

M. A. Patil, Dr. Satish R. Kolhe, Dr. Pradeep M. Patil explained the principal component analysis (PSA) for the face recognition method Recognition article with the PCA technique [17].

M. A. Turk and A. P. Pentland describes in their article "Recognizing faces using their faces" on the methodology of their faces for face recognition in the field of artificial vision [18].

U. Gupta, P. and P. Sinha Chharia to the article Reducing overlapping genuine scores and impostors based on variation and inter classical deviation scores on a multimodal biometric system analyzes the advantages of the multimodal biometric authentication system on the unimodal biometric authentication system [19].

Proposed System

Biometric is a unique identity based on our own physiological or behavioral characteristic, this can be used to identify a particular individual [9].

This personal identification is used as a PIN/Password for making the cashless payment more secure as it cannot be hacked by the internet hackers as it is the physical impression of the authorized person [10].

The Unique Identification Authority of India (UIDAI) derives an authentication system that can be accessed by different banks for cashless transactions based on the fingerprint [12]. The fingerprint is reliable than the other biometric because of the ease to access [14].

The fingerprint consists of ridges and valley (ridges are the dark lines and valleys are the bright) as shown in Fig. 1. The minutiae are referring as the termination, bifurcation, crossover, etc., of ridges and valley shown in Fig. 2. The ridges (dark lines) form various patterns distinguish as an arch, loop, and whorl shown in Fig. 3 [14].
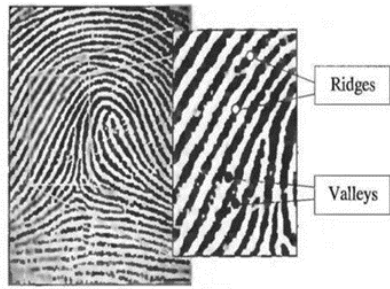
**Figure 1.** Fingerprint: Ridges and Valley

Figure 2. Minutiae

Figure 3. Loop, Whorls, and Arches

Fingerprint Recognition System and Techniques: A Survey is done by Rahul Sharma, Nidhi Mishra, Sanjeev Kumar Yadav gives various techniques to recognize the fingerprint of an individual [16]. Various techniques for fingerprint matching are described as under:

Minutiae Based Matching: Technique is based on Minutiae. In this technique, the fingerprint is recognized by its local features, such as termination and bifurcations. Fig. 4 shows the termination and bifurcation points. Strategies are the unique finger impression by its nearby components, as terminations (edge completion) and bifurcations. The flow chart illustrates the minutiae-based matching technique for fingerprint matching [18].
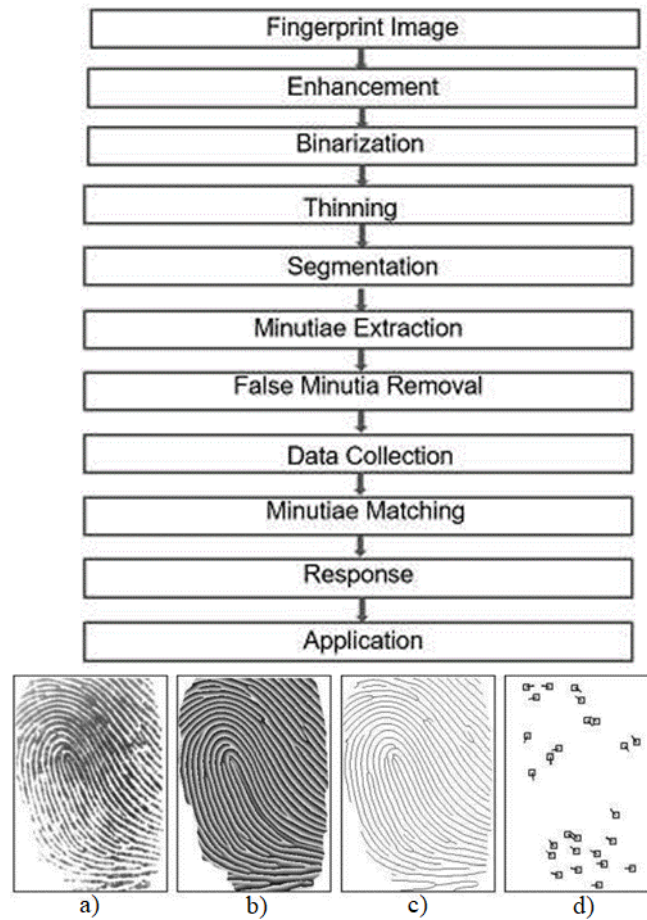
Figure 4. Minutiae Based Matching

Pattern-Based Matching: The algorithm is based on the fingerprint patterns such as arch, whorl, and loop by relating the fingerprint with the template that is already stored in the system. It requires images to be placed in a similar orientation. For this, the techniques define a central point in the fingerprint image and center on that. This technique is also known as Ridge Feature-Based Techniques.

Correlation Based Matching: For several reasons, for example, non-straight twisting, skin condition, and finger weight cause picture to shine, differentiate variety, and the strategy is comparatively highly costly [18].

Image-Based matching: Technique work on the global features of a whole fingerprint image for matching. In this algorithm fingerprint authentication system, the enrolled image itself is used either as a template or reference image and the intensity values at every point of the registered image are compared with the intensity values of the query image under observation [18].
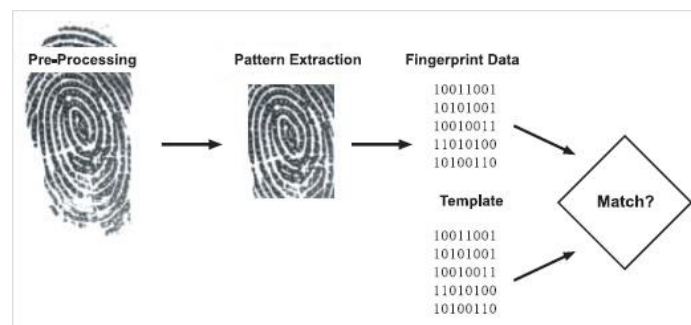

Figure 5. Pattern-Based Matching
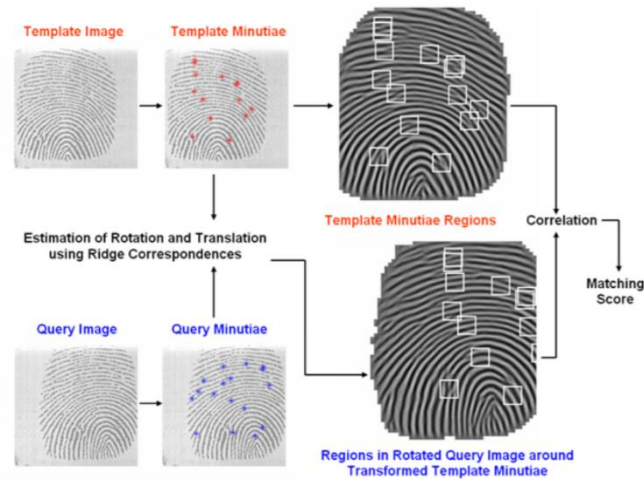
Figure 6. Correlation Based Matching [21]
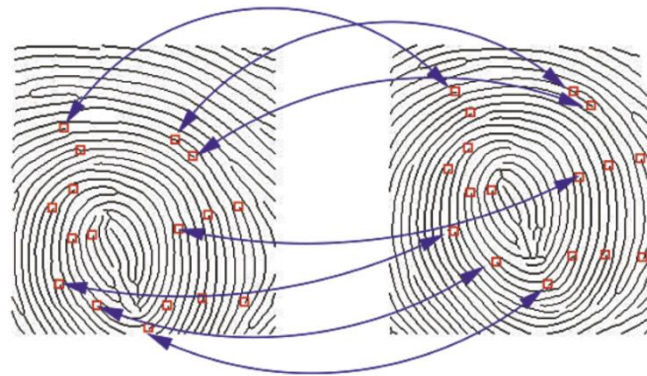
Figure 7. Image-Based Matching

Working flow of proposed Online Cashless Payment Systems system is as below:

(1) The user must be registered to the system by giving a unique User ID with an account number. After registration, a user can do the transaction through the system.

(2) For doing transactions customer needs to give registered User ID and business correspondent User ID with the payee's multimodal biometric. The system will send these details to the bank.

(3) The customer's bank sends an authentication request to the UID database.

(4) Database performs authentication by comparing the extracted fingerprint, face and iris with the stored template of a fingerprint and face and iris database. Based on the comparison, the result is produced, either the customer is genuine or an imposter.

(5) The database sends the result of the authentication to the customer's bank.

(6) If the person is authorized then the amount is debited from the customer's bank account and credited to the business correspondent's bank account.

(7) Acknowledgment sends to business correspondent either the transaction is successful or failed by the business correspondent bank. After the completion of the above steps, the system will be closed or it will be used for the next customer's transaction.
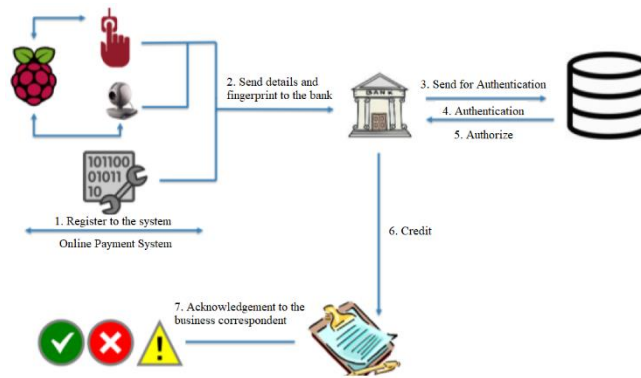
Figure 8. Proposed System

Haar Like Features: Every single human face shares a few likenesses. If you take a gander at a photo demonstrating an individual's face, see, for instance, that the eye locale is darker than the scaffold of the nose [22]. The cheeks are likewise more brilliant than the eye district. We can utilize these properties to enable us to comprehend if a picture contains a human face [23].

A straightforward method to discover which district is light or darker is to include the pixel estimations of the two areas and analyze them. The whole of the pixel esteems in the darkest area will be not exactly the total of the pixels in the lightest district. This can be accomplished by utilizing highlights like Haar.

A comparative Haar includes is spoken to by taking a rectangular piece of a picture and separating the content into a few sections. They are regularly shown as adjoining highly contrasting square shapes.

Fig. 8 shows the fundamental highlights of a square shape like Haar. In this picture, you can see 4 fundamental sorts of highlights like Haar:

(1) Level element with two square shapes.

(2) A vertical element with two square shapes.

(3) A vertical element with three square shapes.

(4) Inclining highlight with four square shapes.

The initial two models are valuable for edge discovery. The third distinguishes the lines and the fourth helps find the inclining highlights. The estimation of the element is determined as a solitary number: the entirety of the pixel esteems operating at a profit territory less than the total of the pixel esteems in the white zone. For uniform zones like a divider, this number would be near zero and won't give you any significant data [23].

To be valuable, an element like Haar must give you a substantial number, which implies that the regions in highly contrasting square shapes are altogether different. There are known capacities that work to identify human faces and irises.

System Design

The system can be achieved by interfacing an R305 fingerprint module with raspberry pi 3 using python code. The R305 fingerprint has its database that can store up to 1000 fingerprints. The system consists of four switches one for updating a new fingerprint, second for deleting the fingerprint and the other two are for increment and decrement [17].

R305 Fingerprint Detection Module: A particular kind of a finger impression connection joins two segments: one of them is a kind finger impression selection and, remarkable fingerprint organizing (planning can be either 1:1 or 1:N). To enroll a new finger the customer needs to enroll the finger two times. At the time of initializing, customer places the finger on the optical sensor and this optical sensor will make a design of the finger which make it more complex entity, finally, it arranges the fingers collected as per finger library For 1:1 organizing, the system also envisions the live finger and specific format allocated in the Module; for 1:N planning, the structure will look the whole finger library for the organizing finger. In the two conditions, the structure will reestablish planning results, accomplishment and disillusionment. Utilizing a serial interface, this Module may talk with MCU of 3.3V or 5V control: TD partners with RXD (tolerating pin of MCU), RD interfaces with TXD (trading stick of MCU).

Figure 9. R305 Module [20]

USB to TTL Serial Connection: TTL-232R-3V3 is a USB to TTL serial converter links fusing FTDIs FT232RQ USB Serial UART interface IC gadget. It takes the serial input and gives a USB output [18].

Pi CAM: The Raspberry Pi Camera Module is a 5MP CMOS camera with a fixed center focal point that is fit for catching still pictures just as top-quality video. Stills are caught at a goal of 2592 x 1944, while a video is upheld at 1080p at 30 FPS, 720p at 60 FPS and 640x480 at 60 or 90 FPS. The camera is upheld in the most recent variant of Raspbian, Raspberry Pi's favored working framework.
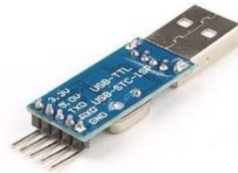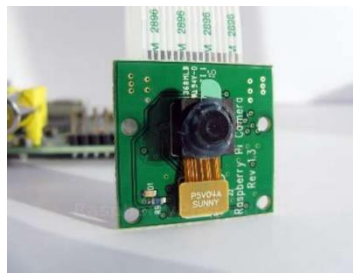

Figure 10. USB to TTL
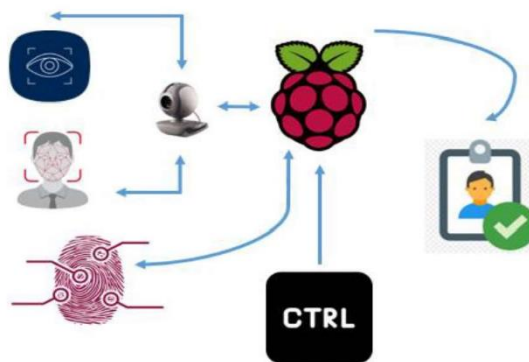

Figure 11. Pi CAM

The flow of the system:

Figure 12. Pi CAM

The heart of the system is the raspberry pi 3 which gets the input instruction from the control key and the fingerprint module for fingerprint scanning and the pi cam for iris and face recognition, which is interfaced via USB to serial converter (UART) and displays the message on the LCD if the payment is successful or not. And whenever there is a transaction the authorized person of the account will get a notification message on the registered number.

Figure 13. Notification received on the Registered Contact Number

Future Scope

With the help of GUI (Graphical user interface), an application can be developed that does the payments via biometric authentication. Also, for making the recognition system more secure we can use the dot projection that can even detect the face and iris in dark along with 3D face recognition makes the system more secure as it only recognizes the 3D face, a touch-less fingerprint sensing can be created with the help of image processing to avoid the finger impression above the sensor. A speaker fitted at the output for notifying the people with low vision.

Conclusion

The biometric-based transaction is a payment system that can use several data formats. A transaction with the biometric system has all the properties of a Database transaction (Atomicity, Consistency, Isolation, and Durability). Hence, a multimodal system has been created which consists of iris, face, and fingerprint as a biometric signature or key that allows the authorized person to access their respective account.

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