Enhanced Security for ATMs using Digital Image Processing

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Abstract- *Automated Teller Machine (ATM) use is now one of the standard methods for making financial transactions and is continuously increasing due to its convenience. With the support of ATM, though banking becomes easier, it has also become feeble. There has been countless gear of abuse that have been used in banking transactions like suspects covering their faces with objects like mask, sunglasses or helmet when entering the ATM or unauthorized card transactions. Thus, there is an essential need to provide high security. Considering this we aim to avoid the ATM robberies and wrong person misusing the ATM, so that we can help the ATM users lead their life safely and securely. The proposed system involves an automatic helmet detection to alert when the person is wearing helmet/mask in ATM using Deep Learning Convolutional Neural Network (CNN) architecture and Face Recognition using Multitask Convolutional Neural Network (MTCNN) that localizes the face by creating bounding box around it and FaceNet identifies the face in the bounding box. If face Recognition fails to recognise the user, OTP mechanism using Amazon Simple Notification Service (SNS) is proposed to let the user carry on with the transaction*

Key Words: Helmet Detection, Face Recognition, Deep Learning, CNN, MTCNN, FaceNet, SNS.

1. INTRODUCTION

In the day to day present case, people want an easy and comfortable way of living. For this reason, the use of Automated Teller Machine (ATM) has increased rapidly due to its convenience. It is a machine used to dispense cash to costumers without them having to visit the respective bank each time for cash withdrawal. However, with the increased use of ATMs related crimes have also been increasing and have a major threat in the banking sector. There are risks of ATM pin release, card cloning. There may be ATM robberies even in the presence of CCTV cameras placed in and around the ATM. To overcome the problems associated with the present ATM System, in our project we are using face recognition. The term Biometrics is composed of two words – Bio (Greek word for Life) and Metrics (Measurements). Biometrics technologies are a safe means of authentication as it is a technology that helps to make user data highly secure, distinguishing all the users by their personal physical

characteristics. In Enhanced Security for ATMs using Digital Image Processing, firstly it checks if the user's face is occluded using a helmet, scarf or a mask making use of Convolutional Neural Networks (CNN). CNN are a category of Neural Networks used in areas such as image recognition and classification. Secondly, it carries out face recognition searches for the user's face in the stored database making use of Multi-task Cascade Convolutional Neural Networks and FaceNet. MTCNN is a neural network which detects faces and facial landmarks on images and FaceNet is a system that learns a mapping from face images to a compact Euclidean space where distances directly correspond to a measure of face similarity. And lastly, if the face fails to match with the pin and the image data stored in the database it sends an OTP to the card owner using Amazon Simple Notification Service (SNS). It is a web service that co-ordinates and manages the delivery or sending of messages to the subscribing endpoints or clients.

2. OBJECTIVES

i. The primary objective of this project is to detect if the person is wearing a helmet or a mask to hide his identity. The first level of protection is implemented through denial of service such as denying withdrawal of money for person wearing mask or helmet.

ii. Authentication of the ATM user by the use of facial recognition, as an additional blanket of security, to prevent identity theft. The additional security provided is Face recognition which finds its application in criminal identification, privacy security etc. Face recognition feature allows only authorized person to go ahead with the process of transaction, thus reducing frauds.

iii. Provide an authenticated mechanism via OTP's (One Time Password) to let a non-account holder to continue with the transaction. In case any other person needs to conduct the banking transactions on behalf of the original account holder, the system sends an OTP (One Time Password) to the mobile phone registered to the Account holder. The account holder can then provide the OTP as a means of authorization.
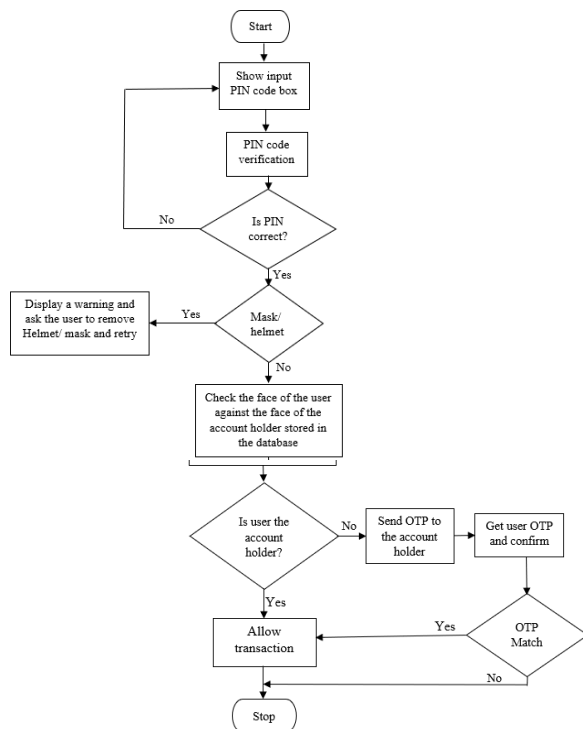
3. PROPOSED SYSTEM

Fig 1-Flow Diagram

Below is the algorithm of the program:

i. User will enter the ATM for withdrawal of money.

ii. The person will insert the card and PIN i.e., entering the user name and password in the log in page.

iii. The camera will detect the face of the person.

iv. If the face is not detected properly, the system will display a warning message to the user for adjusting his face in proper manner. i.e., to uncover his face.

v. After the face is detected, the face recognition takes place.

vi. If the user's face matches the database stored in bank, then he is given the permission to continue with the transaction.

vii. If the user's face is not matched with the database, it indicates that it is someone else and not the owner of that card who is using it.

viii. The OTP will be sent to the contact number registered for that account.

ix. After entering the OTP, the user is allowed to continue his transaction.

4. METHODOLOGY

4.1 CNN classifier

In this project, for helmet, scarf and mask detection, the CNN (Convolutional Neural Networks) is implemented. The system is trained and tested with images of people helmets, scarfs, and masks and is used to detect if a person is covering his face or not.

CNN is a type of Neural Networks widely used for image recognition and image classification. CNN uses supervised learning. CNN consists of filters or neurons that have biases or weights. Every filter takes some inputs and performs convolution on the acquired input. The CNN classifier has four layers; Convolutional, pooling, Rectified Linear Unit (ReLU), and Fully Connected layers.

i. Convolutional layer

This layer extracts the features from the image which is applied as input. The neurons convolve the input image and produce a feature map in the output image and this output image from this layer is fed as an input to the next convolutional layer.

ii. Pooling layer

This layer is used to decrease the dimensions of the feature map still maintaining all the important features. This layer is usually placed between two convolutional layers.

iii. ReLu layer

ReLu is a non-linear operation which replaces all the negative values in the feature map by zero. It is an element wise operation.

iv. Fully Connected layer

FLC means that each filter in the previous layer is connected to each filter in the next layer. This is used to classify the input image based on the training dataset into various classes.

It has four phases:

1. Model construction

2. Model training

3. Model testing

4. Model evaluation

Model construction depends on machine learning algorithms. In this projects case, it was Convolutional Neural Networks.

After model construction it is time for **model training**. Here, the model is trained using training data and expected output for this data.

Once the model has been trained it is possible to carry out **model testing**. During this phase a second set of data is loaded. This data set has never been seen by the model and therefore it's true accuracy will be verified.

After the model training is complete, the saved model can be used in the real world. The name of this phase is **model evaluation.**

4.2 MTCNN

After the detection for helmet, scarf or mask is carried out and the user's face is not covered, face recognition is carried out to verify if the user trying to access the ATM is the card holder or not using MTCNN and FaceNet. MTCNN (Multi-task Cascade Convolutional Neural Networks) is a Neural Networks algorithm which is used to detect faces by creating bounding boxes and marks five facial landmarks on the face. It has three stages and each stage relatively improves the detection result.

The first layer is called **P-Net (Proposal Network)** and is used to create multiple scaled copies of the image and to generate bounding boxes. non-maximum suppression is then applied to merge the copies which are highly overlapping.

The output from the P-Net is fed to the second layer called the **R-Net (Refine Network)**. This layer further performs non-maximum suppression and calibrates the bounding boxes.

Then, **O-Net (Output Network)** again reduces the false copies and marks five facial landmarks on the detected faces.

4.3 FaceNet

The output from the MTCNN is fed to FaceNet system which is a deep convolutional network and performs tasks such as face recognition, verification and clustering. The face is mapped into 128 vectors called 'Embeddings'. The Euclidean norm between the two faces signifies the similarity of the faces.

It employs Triplet loss function to train the system. It selects an anchor image. Now, it selects another image for training. If it selects an image of the same person as the anchor image, it brings it closer to the anchor image and if it selects an image of a person different from the anchor image, it pushes it away from the anchor image.

Thus, arranges the FaceNet network so that the positive example is closer to the anchor than the negative example and this is repeated until there are no more changes to be made and the faces are compared using the Euclidean formula.

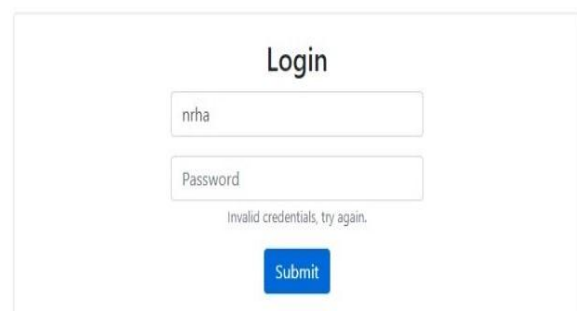### 4.4 OTP Mechanism using Amazon Simple Notification Service

OTP is usually a sequence of numbers that is valid for only one login session or transaction. In this application we use OTP to authenticate the user, an application asks for OTP to proceed which is sent via text message to a registered mobile number. It is easy and secure approach to verifying user identity.

We made use of Amazon SNS to send OTP to the registered mobile number. Amazon Simple Notification Service (SNS) is a Web service that co-ordinates and manages the delivery or sending of messages to the subscribing endpoints or clients.

5. APPLICATIONS

The security system designed for ATMs can also be used at:

1. Airports

2. Unlocking phones

3. Automobile industry

6. ADVANTAGES

The improvement of security level
1. Easy integration process
2. High accuracy rates
3. Full automation
4. Reduction in Fraud rates
5. Contactless and user-friendly
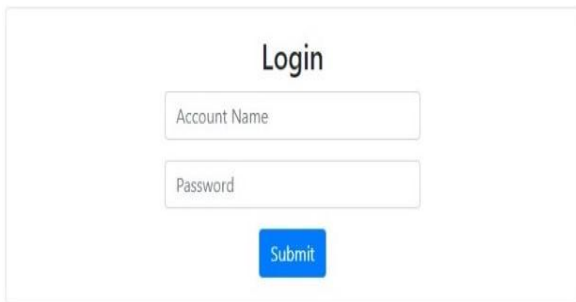
7. RESULT AND ANALYSIS

Fig 2-Login Page

The user can log in using his name and ATM pin as in analogous to card insertion. The Whole idea of entering the name and ATM pin prior is to check wheather the user holds an account or not. The user interface part has the text fields for username and pin. Also, it consists of a submit button. The user is expected to enter his name and ATM pin in the space provided. The username and pin is expected to be the same as the one which is registered in the Bank. Only then, the credentials will be considered.
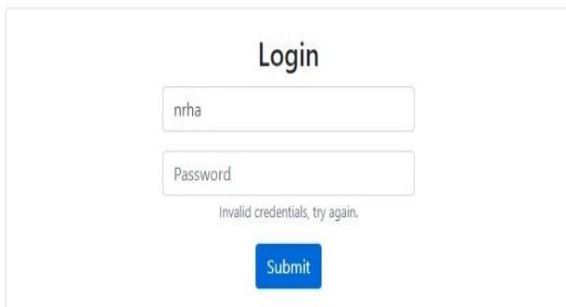
Fig 3-Login Page With invalid username/Password

Enter the user name and password into the text fields provided. The credentials provided will be matched against the bank database. When the user enters the wrong name or the password the credentials will not match with the one which is stored in the Banks Database. Hence the message invalid credentials,try again is displayed.

Fig 4-Login Page with valid username Password

And for the transaction to proceed it is necessary to provide valid information.

After the login proces is successful and it is confirmed that the user holds a bank account then the next step will be helmet/scarf detection.
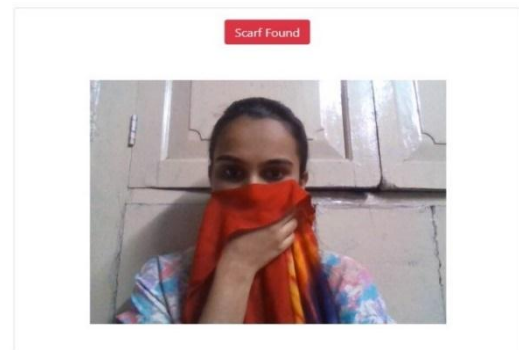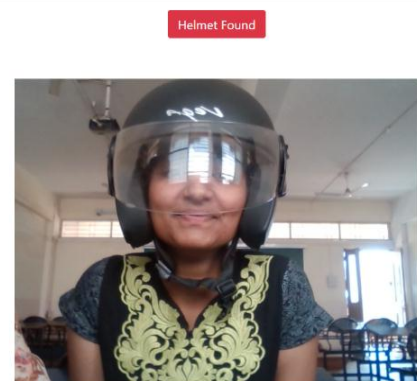

Fig 5-Helmet Detection

Fig 6-Scarf Detection

If the user is found to be wearing a helmet/scarf the transation process will not continue.For the transaction to continue further the user has to remove the helmet or the scarf and verify his identity (Face recognition).

If the entered credentials matches the database of the bank and if the user is not wearing helmet or scarf ,then the face recognition takes place
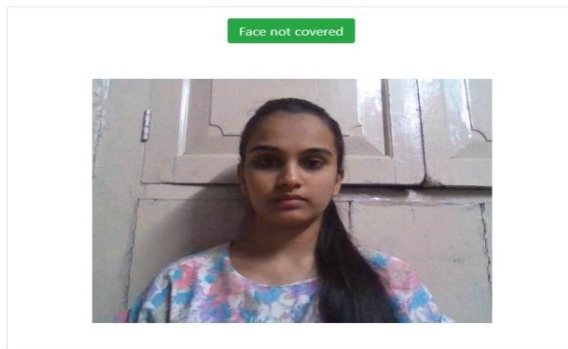
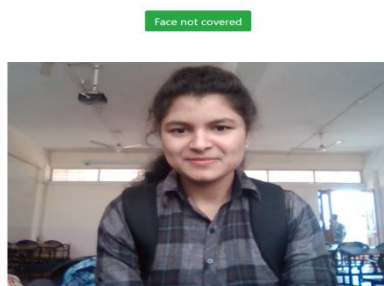Fig 7-Face Recognition Process with user 1

Fig 8 -Face Recognition Process with user 2

After the Face of the user is matched with face stored in the Database the user can withdraw the money from the ATM.

Fig 9-Face Recognition Process Successful

The Face recognition system ensures that an authentic person is handling the atm card, and transaction is secure.

After the face recognition takes place and when it fails to recognize the face of the actual card owner, then to continue the process the system will genearte a 6 digit OTP which will be sent to the registerd mobile number of the authorized person.After entering the 6 digit OTP the transaction can be continued.
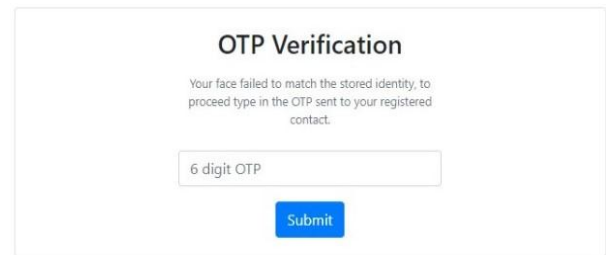

Fig 10-OTP Verification

This OTP solution is also helpful when the user himself is unable to go to the atm for withdrawal.The OTP verification will safeguard the customers against the risk of unauthorized transaction when the user himself is not present at the ATM .

If the OTP entered is wrong in the provided text field, the system takes the user back to the Login page.

8.CONCLUSION

Face recognition technology has come a long way in the last twenty years. Today, machines are able to automatically verify identity information for secure transactions, for surveillance and security tasks, and for access control to buildings. Prototype system for automatic Helmet Detection, face detection and face recognition are successfully implemented and tested. The system is smart in the way that if the person tries to cover his face, it gives warning message for proper detection of face. If face is not recognized, then OTP is sent to authorize person.

9. FUTURE SCOPE

System can be further improved by developing better algorithm for faster face recognition.

3D Models can be used to identify or verify another 3D image from database. The 3Dmodel is more reliable, better, effective and accurate than 2D

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