Cloud Based Point of Sale System with Face Recognition

Ch Madhavi Sudha, Alekhya Thadagonda, Amrutha Tiruveedhula

[1]Assistant Professor, Student, Student,
Department of Computer Science and Engineering,
CBIT(A), Gandipet, Hyderabad-75, India.

Abstract : A Point of Sale (POS) is an electronic banking outlet that enables customers to complete the basic financial transactions using debit or credit cards without the aid of bank representative or teller. It is an electronic banking outlet that enables customers to complete the basic financial transactions using debit or credit cards without the aid of bank representative or teller. The Traditional POS system runs on closed networks and the user data is stored on local servers. They need to be updated manually on-site. POS systems generally accept credit and debit cards to process bills. It is found that there is increase in levels of fraud among the users of credit and debit card. So there is a requirement to build a system that can store the data securely and also do the transactions without giving scope to any fraudulent activities. For the effective and efficient operations of security systems, accurate and automatic recognition of persons is becoming increasingly important. As a solution our proposed system 'Cloud Based POS System with Face Recognition and Password with Cloud implementation' is proposed as a method of payment making POS systems both card less and cashless. FaceNet which was proposed by Google Researchers was used for implementing face verification and recognition, along with password verification as a two-step authentication. We use FaceNet and Multi-Task Cascaded Convolutional Neural Network, for detection and identification of faces. This POS system will do more, than just accepting payments. Here we also try to Integrate Cloud Computing (CC) with the system which makes it more secure. The combination of POS system with Cloud Computing will make our new system more reliable and faster. It is studied that this technique is not very expensive and it gives us an accuracy rate of about 96.75%

***IndexTerms* -. POS, Cloud Computing, FaceNet, MTCNN , Face Recognition.**

I. INTRODUCTION

A point-of-sale system, or POS, is the place where a customer makes a payment for product or services at a store. Simply put, every time a customer makes a purchase at a store, they are completing a point-of-sale transaction. It is a combination of hardware and software and used primarily by a business to process customer purchases.

POS systems generally accept cash, credit and debit cards to process bills. In recent times in credit card transactions many fraud and security issues are present. Cryptographic keys were fetched and are utilized to achieve privileged access and sensitive information of card holders are stolen. Also, credit card thefts are becoming quite common. It is found that there is increase in levels of fraud among the users of credit and debit card. Information is being stolen by the hackers and used to make fraud transaction. It has been seen that the card information gets stored in POS s.In order to decrease the crime happening in massive level a protection profile for Point of Sales System, there is need to enhance the security of the users. Now there exists no Point-of-Sale system that gives full security to the users. Thus, a Point-of-Sale System with an innovative feature such as secure payment gateway by two step authentication, i.e. face recognition using FaceNet and password verification, that make forecasts at a real store considering the real time data specific to the domain and at the same time providing users security with the credit card data is needed, to improve the current models.

II. LITERATURE SURVEY

There are many existing solutions available for the secure payment at the payment gateway. The incorporation of fingerprint biometric recognition as an additional layer of protection to the customary pin and password requirements to gain permission to pay for goods purchased and services rendered using point of sale device can guarantee the secured transaction[11]. But it is possible that our fingerprints can be identified from public photographs that show our hands. Therefore, fingerprint scanning can't guarantee the secured transactions. And hence, Iris scan was introduced at the authentication level of the existing POS machine[12]. The experimental results shows that the system could significantly minimize cardholder fraud at the POS machine but not at a high rate. Currently, face recognition is used as a technology to provide multiple security in various practices likes verification of identity, access authority, observation, to replace passwords and identity cards that are no longer safe. The use of face recognition has the benefit of verifying personal data because, inhuman faces things like irises, retinas, faces are very unique to each other. For the effective and efficient operations of security systems, accurate and automatic recognition of persons is becoming increasingly important.

Face recognition, is one branch of computer science, is an ability to recognize or identify the person's identity by analysing the pattern-based facial contours of human faces. Face recognition has many methods in its application today. For example, Haar Cascade[5], Principal Component Analysis (PCA)[3], Linear Discriminant Analysis (LDA)[6], and Deep Learning[4][2]. Haar feature is a wavelet-based feature that decomposes image. The principle of the process is, the parameter of the image is detected whether it has face characteristic or not. If it has the separation stage of face and background, the image will be processed for further classification. The formula of Haar feature is, the average value of the result is above the threshold, it means the Haar feature exists. The closer the value to 1, the more likely we have found the face. Haar cascade face detection can detect images at different scales. But the major drawback is that it gives false results as well as it doesn't work on non-frontal images[5].

PCA is a multivariate technique that analyze a data table in which observations are described by several inter-correlated quantitative dependent variables[3]. It is a dimensional reduction method that is often used to reduce dimensions on a large enough dataset. You do this by changing variables in large datasets to smaller parts but still using the information on large datasets. Eigenface is one of the facial recognition methods based on the Principal Component Analysis (PCA) algorithm. One of the PCA methods is Eigenfaces. Eigenfaces is unsupervised and it ignores all the class labels. However, Eigenfaces are not optimized for class separation. Eigenvectors are derived from covariance matrix which has a high probability distribution and vector space dimension to recognize thepossibility of a face by reconstructing the face. The disadvantage of using PCA is a covariance matrix that is difficult to evaluate accurately, the difficulty of capturing invariance on PCA unless the data trainee provides information explicitly. The results of face preprocess will be compared with the training model. PCA results in loss of information if the number of Principal Components is not selected wisely.

LDA is a supervised data that is very strong against dimension reduction. By using supervised, LDA is able to work quite well on a dataset containing a greater number of face images [6]. The purpose of the LDA method is to detect groups of test objects based on the closest average. Each group has an average vector of each vector characteristic for each object. The closest measurement is using a distance metric. The advantages of LDA are the simple, fast and portable method, and are good for the initial project. The disadvantage of LDA is an old algorithm. PCA is mainly used for feature extraction while the LDA is used for classification.

There are many face recognition methods in Deep Learning, such as the use of Convolutional Neural Networks (CNN) and Artificial Neural Network (ANN). Another efficient technique for face recognition system based on Deep Learning using Convolutional Neural Network (CNN) with Dlib face alignment was then introduced. D-lib was used for face alignment of the frontal faces; the alignment could be effective for 45 degrees. This system uses computer vision technology for frontal faces detection by facial landmark detection. The major disadvantage is that it is trained on a minimum face size of 80*80 so it can't detect small faces in images. It is also very slow on the CPU.

FaceNet is one of the uses of face recognition based on Deep Learning [2]. That is a one-shot learning method using Euclidean space to calculate the similarity distance for each face. FaceNet is a fairly new method, introduced by Google researches in 2015, using Deep Convolutional Network method. The advantage of using the FaceNet method is that this model only requires minimal alignment in terms of cutting the face area quite tightly. FaceNet is able to provide accuracy of up to 99.63% from dataset Labelled Faces in the Wild (LFW) and 95.12% on the YouTube Faces DB.

III. DESIGN

The proposed System with two factor authentication will include two modules. One module for authentication of existing user and the other module is used to create a new account for new user.

The system will read input to verify if a customer is new user or an existing user. If the customer is a new user, the system will read user personal details along with his image and store the sensitive data in the cloud. If the customer is an existing user, the system will perform face verification followed by password verification and only after being authenticated can proceed with transaction.

3.1Algorithm

Step 0 : Start Phase.
Step 1: Import cv2 module of python library.
Step 2: Capture customer image and save it.
Step 3: Read the type of user.
Step 4: If user is an existing user jump to Step 8.
Step 5: Read a new password from user.
Step 6: upload captured image of customer to cloud.
Step 7: Terminate the process
Step 8 : Import MTCNN module of python
Step 9: Save the cropped and aligned image.
Step 10: Import FaceNet module of python
Step 11: Calculate embeddings for the image.
Step 12: Find distance between all pairs of embeddings.
Step 13: If there exists a pair with distance less than expected threshold return Success. Else terminate. Step 14: Redirect to payment gateway
Step 15: Perform password authentication.
Step 15: On receiving Success close the transaction.
Step 16: Send invoice message to customer mobile.
Step 17: Stop.

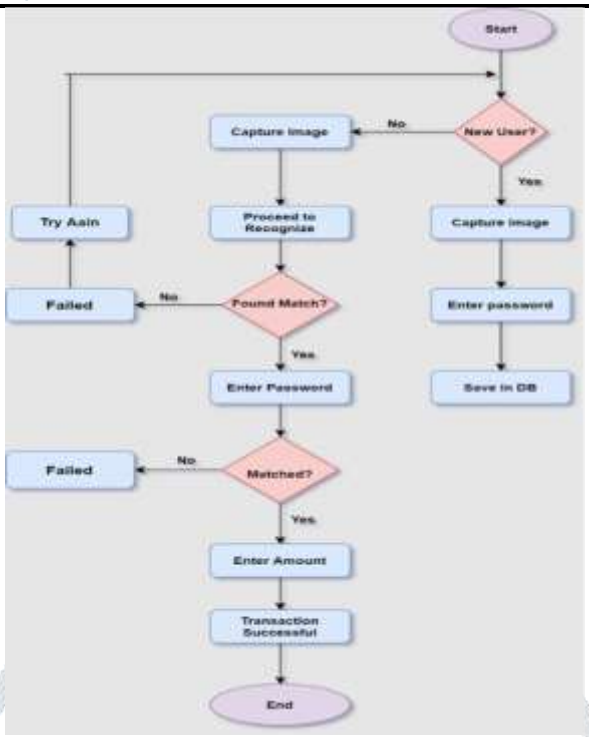

Fig 1: Flow chart for the proposed system

IV. IMPLEMENTATION

The proposed model will include a remote cloud storage of customer images. Also, we will have another system which will read dynamic data or the actual customer image from the terminal and match it with the pre-existing data and training model and classifies the given sample as authenticated or not.

4.1. MTCNN Model For Face Detection

Also the proposed model before recognising the customer image with anyone in the cloud the exact customer face must be cropped and then we feed it as input. In order to extract the main facial structure of a person we are using MTCNN algorithm. Multi-Task Convolutional Neural Network is a neural network design that aims to rate visual images and datasets. MTCNN or Multi-task Cascaded Neural Networks is a developed version of CNN [9]. Shows that the proposed MTCNN model show the innate bond between disclosure and the adjustment of the usage frames to increase the performance. Purpose of the proposed MTCNN is to form an avalanched structure and use it as material for multi-task knowledge to forecast the location of the face and it is marked in a coarse-to-fine method. Also, MTCNN aims the bond of 2 tasks. And in its application, MTCNN is able to detect real-time with fairly high accuracy.

The MTCNN model made from three networks , first is the Proposal Network (P-Net) which functions to get the face area and give some bounding boxes to the face. Second is the Refine Network (R-Net), which functions to remove some bounding boxes on the face by calibrating them and leaving only an accurate bounding box. And the last is the Output Network (O-Net). The workings of the O-Net are different from the previous layers, the O-Net takes the result of the R-Net in the form of a boundary box and divides it into three different layers: the first layer for face probabilities in the box, the second layer to give the boundary coordinates in the box, the last layer for the coordinates of the five landmarks of the face.

4.2. FaceNet Model for Face Recognition

Inorder to identify if a customer image exists in the cloud we use FaceNet recognition model. FaceNet is a method that uses deep convolutional networks to optimize its embedding, compared to using intermediate bottleneck layers as a test of previous deep learning approaches. This method is called one-shot learning. In more detail, this method can use a small sample of face images to produce the initial model, and when there are new models, the initial model can be used without retraining. FaceNet directly trains the face using the Euclidean space where the distance consists of similarities between facial models. When the results of similarities between face models are obtained, it will be easy to carry out face recognition and classification using FaceNet attached become feature vectors.

In the training process, FaceNet applies triplets by matching face to face with the online novel triplet mining method. Of course, this triplet consists of a collection of anchor images, where each image consists of positive and negative images. FaceNet consists of batch layers as input and deep architecture which is deep CNN followed by L2 normalization, that become the result of face embedding. FaceNet also pursued by the triplet loss in the training process.

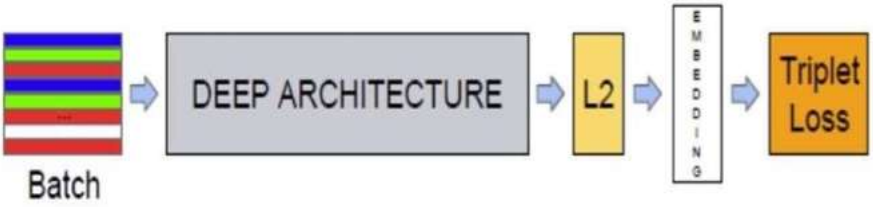

Fig 2: Model structure of FaceNet

Triplet loss training methods have three main elements anchor, positive and negative as shown in Fig 1. This triplet loss works by minimizing the distance between anchors positively and maximizing the distance between anchors negatively. Where this positive has the same identity as the anchor and negative has a different identity from the anchor. FaceNet trains its output directly into concise 128- dimensional embedding by applying triplet-based loss method depend on LMNN. It formed by two thumbnails of compared faces and thumbnails that do not match and the loss aim to distinguish between positive and negative pairs using a range of limit. Thumbnails were cut tightly on the face field, it didn't need 2D or 3D adjustment, apart from the ratio and translation implemented.

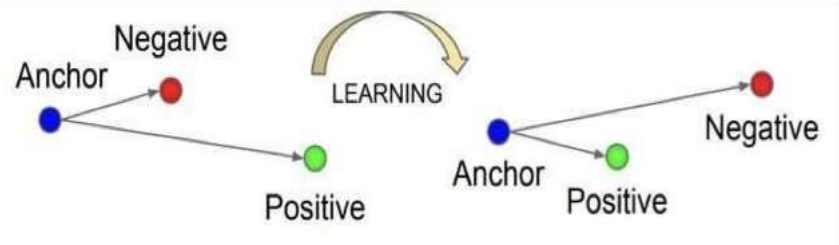

Fig 3: Triplet Loss training model

V. RESULTS AND ANALYSIS

The related results of the web-application built for Point of Sale System with Face Recognition and a brief description about them is described below.

Fig 4: Customer type Module

- This is the starting module for the application.
- Depending on the choice of the customer chooses regarding whether he is a new user or existing user, the page will redirect to the respective modules chosen by the customer.

Fig 5: New User Module

- This module will be landing on by selecting new user for customer type.
- Here we can select capture option, in-order to capture the customer image.
- Thereafter on clicking upload image option we can upload the captured image to cloud along with the given Id of the customer.

Fig 6: Create Password

- This button is used to create password for the customer so that it can be verified whenever he initiates the transaction.

- On press of create password button, the entered password gets stored in the cloud with the customer Id.

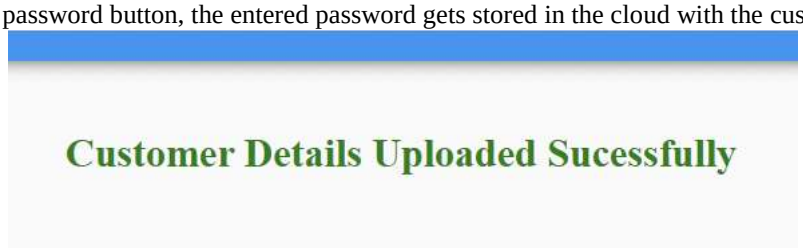

Fig 7: Success Page

- On uploading image and password successfully to S3 storage in cloud we will be redirected to success page.
- So the customer details are stored in the cloud and now he can initiate the transactions for the payment as he becomes the existing user.
- This module will be landing on by selecting Existing user for customer type in the customer type module.

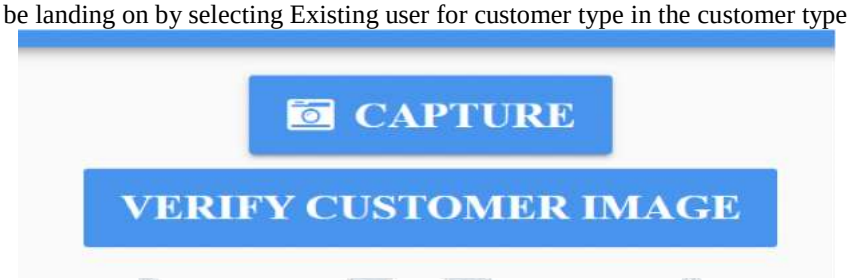

Fig 8: Existing User Module

- Before initiating the payment, he needs to verify whether he is an authenticated user or not.
- Therefore this module captures the image of the customer at the moment after he presses capture button.
- After pressing Verify Customer Image button, the system verifies the captured image with the customer images of existing users already stored in the cloud.

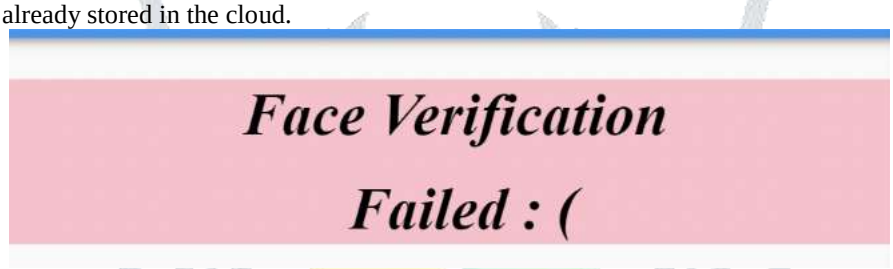

Fig 9: Face Verification failed

- If the face verification gets failed i.e., if there is no image found or matched with the captured customer's image, then the face verification gets failed.
- And it redirects to this page to make know that the face verification is failed and the transaction halts here.
- It means that the customer is new user he needs to create his account in order to complete the payment through this Point of sale system.

Fig 10: Verify Password

- After the image successfully getting verified, it will ask the customer to verify password.
- Here the customer needs to enter the password and this password gets verified with the password, that is with the customer's Id.
- This Id is read by the system as soon as the image gets successfully verified.

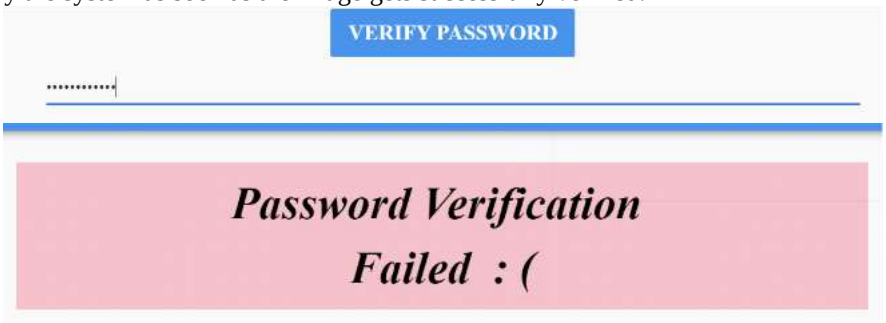

Fig 11: Password verification failed

- If the password entered by the customer is wrong then it redirects to the page saying that the password verification is failed.
- The transaction gets halted here.

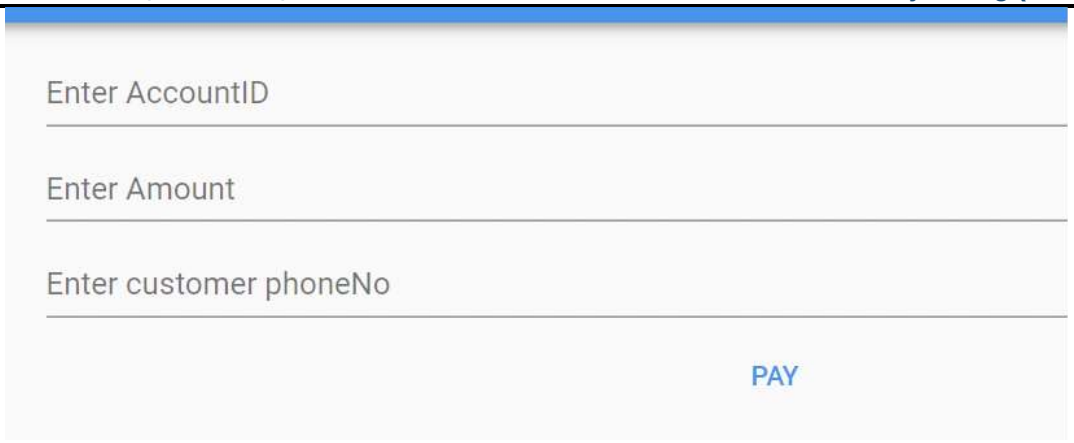

Fig 12: Payment Module

- After the password successfully gets verified, then it redirects to the payment module.
- Here the customer needs to enter his account Id, the amount he needs to pay and the phone number.
- The money gets deducted from the account after pressing the pay button.
- And a message is also sent to the customer's mobile.

Fig 13: Payment failed

- After initiating to pay the amount from the payment module, the system checks whether sufficient amount is present for the payment or not.
- If there is no enough money, then it cancels the transaction and redirects to the page that says "Payment Failed Not Enough money".

Fig 14: Thank You Page

- After the payment is successful, the system redirects to thankyou page.

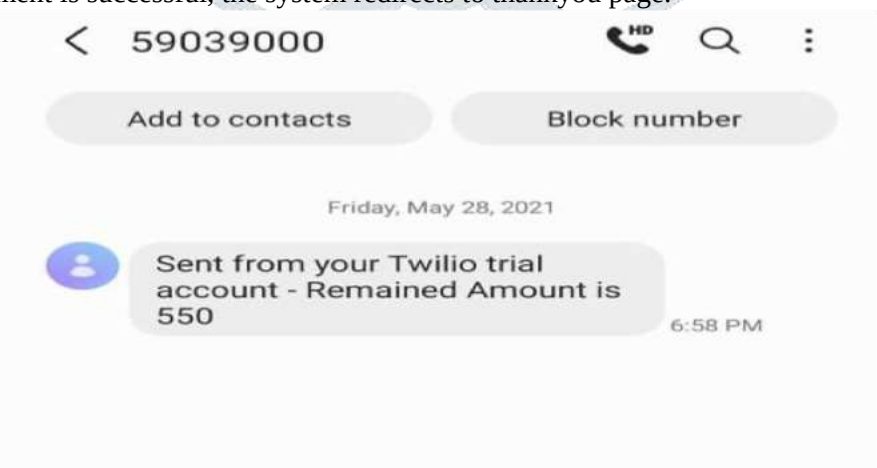

Fig 15: Message sent to mobile

VI. Conclusion and Future Work

This method would therefore decrease the credit card fraud everywhere. A person would now need not carry his credit card everywhere and go ahead with his payment for any transaction from anywhere. This can bring a great change by avoiding cards and also involving enhanced security at the same time to the customer. Also adding collaborating this with CRM module can provide great insights about the customer and boost the restaurant business further.

Accounts of the customers get blocked when hackers make wrong password tries for multiple times for signing in, into one's bank account. This blocked account can be unblocked only by original account user by manually visiting the bank. This feature can be enhanced in the future.

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