International Journal of Research in Engineering, Science and Management
Volume-3, Issue-6, June-2020
www.ijresm.com | ISSN (Online): 2581-5792

Smart Ticket System for Metro Train

S. Priyanka[1], R. Abhishek[2], Ameen Pasha[3], M. Chandramouli Bhat[4], Darpan D. Raj[5*]
[1]*Assistant Professor, Department of Computer Science and Engineering, B. N. M. Institute of Technology, Bengaluru, India*
[2,3,4,5]*Student, Dept. of Computer Science and Engineering, B. N. M. Institute of Technology, Bengaluru, India*
*Corresponding author: darpanraj00@gmail.com

***Abstract*: Metro trains have gradually risen as the primary public transport. A growing number of people prefer to travel by subway over bus and other modes of travel. This in turn led to lengthy queues when tickets were collected. The main problems in the metro services with the current ticket system is that it is not flexible and efficient. The main objective is to use image recognition and artificial intelligence models to provide a ticket system so that no material-based ticket has to be used. The concept behind the proposed system is to promote everyday travel in an environmentally friendly mode of travel and to reduce traffic congestion. The proposed model would be portable because one can move from any part to another, as a pair of cameras are needed to finalize the bill at the entrance and exit. Customers will sign up to pay on their own time and this helps the new scheme to work.**

***Keywords*: Face recognition, Machine Learning, Metro Trains.**

1. Introduction

Everything in the world today is smart and digitalized. There have been a lot of advances in the transport sector. Public transport in India has always been an area where such new developments have turned their faces. Metro train service has been one of the newest public transportation modes that has improved the travel conditions in the country. Across many cities metro trains have become a very popular public transport because of less travel time to reach destination and people can avoid heavy traffic, pollution in cities. Metro train services have been experiencing a significant increase in ridership. Millions of people take the metro rail in cities, which is a low-cost, safe and convenient mode of transport. More than Rs 1 trillion was invested in metro rail projects in 2018-19, and the amount is expected to peak to Rs 1.8 trillion by 2021, according to a report by India Infrastructure Research. Anyone taking public transport in buzzing cities expects the ticketing system to be instantaneous because people expect to reach their destination fast. It is evident that there is crowded public transportation in some of the popular cities and a very high number of people travel per seat capacity. Over the years, several forms of ticketing systems have been in place throughout the world. Commuters get frustrated to line up for tickets or scan their smart cards. Also, commuters tend to take multiple public transportation to reach their destination. So, it is very important to automate the ticketing and payment system that is instantaneous.

Face recognition ticketing system is one such technology which is instantaneous and universally adaptable across multiple modes of transportations. Face recognition is a type of biometric application that can identify individuals in a digital image by analyzing and comparing patterns. Face biometric offers the possibility of identifying an individual, without any human assistance and does not require an expert for interpreting the identification correlation results.

2. Related Work

Manoj Panwar et al., [1] describes about gradual increase in pollution in India It shows about the gradual increase of usage of vehicles and pollution being correlated to each other. It is proved that along with increase in vehicles, there is increase in pollutants such as CO, NOs and other particulates. And it is proved that using Public transportation such as Metro Systems help in providing pollution free mode of transportation. ZHANG RUI et. al. [2] have done a survey on Biometric authentication. Reviewed the existing biometric authentication systems by focusing on the security and privacy solutions. Also analyzed the differences and summarized advantages and disadvantages of each biometric system. Particularly, discussed about problem of aliveness detection and privacy protection. Varun Kaushik et al., [3] focuses mainly on the type of Fool Proof ticketing system for public transport systems, where he describes about the implementation of two-way authentication method for the head count. RFID and Face Detection are two authentication systems. If both counts match, it implies that there is proper travel or else ticketless travel has occurred. It's limitation being that using two different technologies make the proposed model inflexible. Nataliya Boyko et al. [4] compares two popular computer vision librarieobjs, they are OpenCV and dlib, explore features, analyze pros and cons each of them and understand in what situation each of them suit the best Method. article generalizes the concept of face recognition. The scientific basis for facial recognition and the construction of a complete recognition system was described. comparative analysis of the productivity of both libraries in relation to - the time of execution to the number of iterations of the applied algorithms was presented. Neel Ramakant Borkar et al., [5] describes about the real time implementation of Face

Recognition system using 2 different algorithms, they are Principle Component Analysis(PCA) and Linear Discriminant Analysis(LDA). And the author has used Gaussian Filering for pre-processing the face images in AT & T face dataset. The advantages of this paper is that using PCA & LDA together improves the accuracy to around 97% compared to LDA and PCA which have 94% and 91% respectively. Kewen Yan et al., [6] focused mainly on the working of Face Recogntion on Convolution neural network. Where-in preprocessing has been done by resizing the images, mirroring and normalizing the images. Dataset being used is AT & T. 99.82% was the accuracy obtained by the author. The limitation of the paper being that high processing and memory was required for faster recogniton and higher accuracy. Radhika C. Damale et al.[7] presents SVM, MLP and CNN face-recognition approaches. DNN is used for face detection. For SVM and MLP based approach, the features are extracted using PCA and LDA feature extraction algorithms. In CNN based approach, the images were directly feed to the CNN module as a feature vector. The proposed approach shows the good recognition accuracy for CNN based approach. Keerthi G S et al., [8] describes video based Face Recognition (VFR) technology which is the ability of a system to recognize a particular person in video based on the facial features. The author has developed the model using CNN which is used to increase the efficiency and performance of the system as well as it being cost efficient. The architecture developed by the author has been an inspiration in developing the model. Savitha G et al. [9] describes the processing involves in video-based face-recognition that is Image acquisition, Image segmentation, feature extraction, classification and face detection. The features extracted are used in training the classifiers for images that are processed. Florian Schroff et al., [10] describes face recognition using a system called Facenet, which maps the face images to a compact Euclidean spaces. Face Recognition, verification and clustering has been implemented by the author along with FaceNet embeddings as feature vectors. The author has used deep convolutional network. Wherein the author has used Labled Faces in the Wild (LFW) dataset which produces an accuracy of 99.63%. Each person's face is being recorded in 128 bytes, so it goes by the name 128-d face embeddings.

3. Proposed System

An online portal will be provided to metro commuters, employees and administrators. Users can create their Smart Ticket System account through portal or employee assistance in the station by providing personal details and face images. Portal provides a set of utilities to commuters, employees and administrators such as creating/deleting accounts, fetching station details and ride cost, adding money to commuter wallet.

On update or delete of each user to/from the database face recognition model gets updated by retraining the model. Here Face detection and image pre-processing before training the model is performed.

Having a Smart Ticket System account when a commuter walks towards the entry system, near the Automatic Fare Collection (AFC) machine a camera captures frame performs face detection, image pre-processing and face recognition for the captured face using the trained model to fetch user id. If the user has threshold balance in online wallet, the system stores entry details of the user, displays ride details on a display and AFC Gate opens.

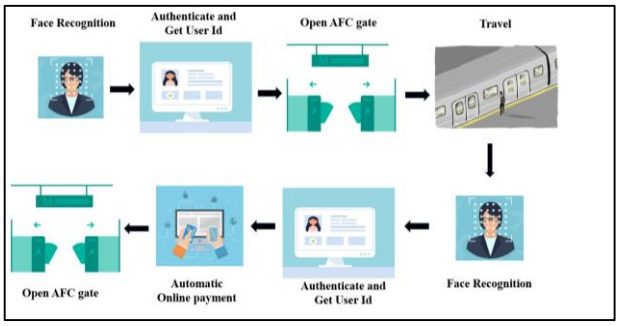

Fig. 1. Proposed systems

A user can travel to any desired destination, upon reaching the destination exiting system again performs capturing a frame, face detection, image pre-processing and face recognition using the trained model to fetch user id. System will automatically calculate the cost from source station to destination station for recognized user id and automatically deduct the amount from the online wallet. Upon successful completion of payment, ride details will be displayed and AFC gates opened so the user can end the ride.

Users will be notified about ride details, cost and time on completion of each ride. Users can also check details about his previous rides in the portal.

4. Algorithms

Whole idea is we run face recognition for 4-5 seconds, iteratively perform face recognition and append names continuously.

After running while loop for 4-5 sec. We use names_list and find the maximum number (max freq of names) time which name has occurred it the recognized id. To make sure that system does not recognize as false user we perform this max freq method.

A. Data collection

Fig. 2. CSE-A11 face dataset images

Fig 2. Shows the collection of images which is specifically made for smart metro ticket system. It consists of ten images of every user.

- Step 1:

Haar Cascade classifier is based on the Haar Wavelet technique to analyze pixels in the image into squares by function. This uses "integral image" concepts to compute the "features" detected. Haar Cascades uses the Ada-boost learning algorithm which selects a small number of important features from a large set to give an efficient result of classifiers then use cascading techniques to detect the face in an image. Haar cascade classifier is based on the Viola-Jones detection algorithm which is trained in given some input faces and non-faces and training a classifier that identifies a face.

The algorithm has four stages:

1. Haar Feature Selection.
2. Creating Integral Images.
3. Adaboost Training.
4. Cascading Classifiers.

- Step 2:

Traditional approach is directly compare the unknown face we found in Step 1 with all the pictures we have of people that have already been tagged. When we find a previously tagged face that looks very similar to our unknown face, it must be the same person.

As public trasportation generated huge amout of dataset from lange number of users, can't possibly loop through every previous-tagged face to compare it to every newly uploaded picture. That would take way too long. They need to be able to recognize faces in milliseconds, not hours.we need is a way to extract a few basic measurements from each face. Then we could measure our unknown face the same way and find the known face with the closest measurements.

Deep learning does a better job than humans at figuring out which parts of a face are important to measure. The solution is to train a Deep Convolutional Neural Network, but instead of training the network to recognize pictures objects like we did last time, we are going to train it to generate 128 measurements for each face.

The 128 measurements are called as face embeddings. The idea of reducing complicated raw data like a picture into a list of computer-generated numbers

After repeating this step millions of times for millions of images of thousands of different people, the neural network learns to reliably generate 128 measurements for each person. Any ten different pictures of the same person should give roughly the same measurements.

The fine folks at OpenFace already did this and they published several trained networks which we can directly use. Thanks Brandon Amos and team!

So all we need to do ourselves is run our face images through their pre-trained network to get the 128 measurements for each face.

- Step 3: Finding the person's name from the encoding.

All we have to do is find the person in our database of known people who has the closest measurements to our test image.

You can do that by using any basic machine learning classification algorithm. We'll use a simple linear SVM classifier, but lots of classification algorithms could work.

All we need to do is train a classifier that can take in the measurements from a new test image and tells which known person is the closest match. Running this classifier takes milliseconds. The result of the classifier is the name of the person!

- Face recognition:

All the above algorithms use image objects to work with face recognition. The better way to work with is to create lists of points. One such method employs the use of 128 different point defining each face. Using deep learning method, it can bring about a type of encoding that generates 128 different values each defining a image.

The triplet loss function takes three images. The main image, secondary image and a negative image. The deep learning method employed will generate 128 values such that they are closer to the values of images of same person and as far as possible to other persons. The weights of CNN network are tweaked in order to generate such possible numbers. As in the above figure, while training, 128 values are being recognized for every single person. These 128d values are very unique for every different person's face.

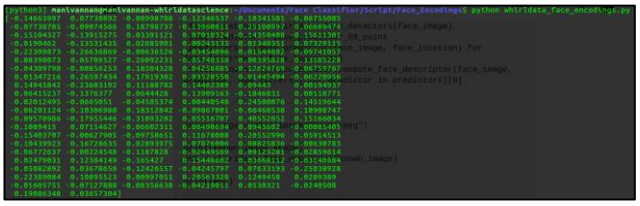

Fig. 3. 128D sample values

5. Performance Evaluation

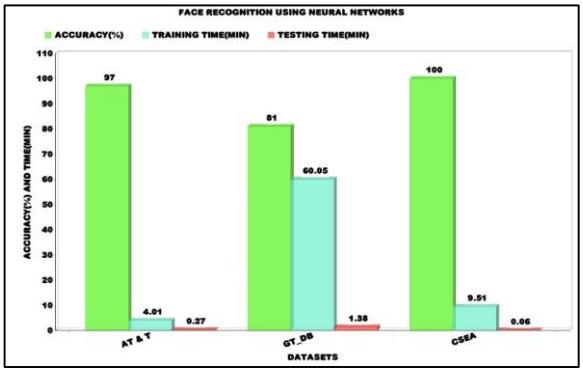

Fig. 4. Advanced face-recognition on different datasets

Fig. 5. shows the graph which has accuracy (in %) and time (in mins) on Y-axis and Dataset on the X-axis. Where the face recognition algorithm used is the Advanced Face Recognition model, testing has been done on 3 databases as mentioned

above, they are AT&T, GT_DB and CSEA11 databases. AT&T gives accuracy around 97%, for GT_DB accuracy is around 81% which is way less compared to 100% for CSEA11 dataset.

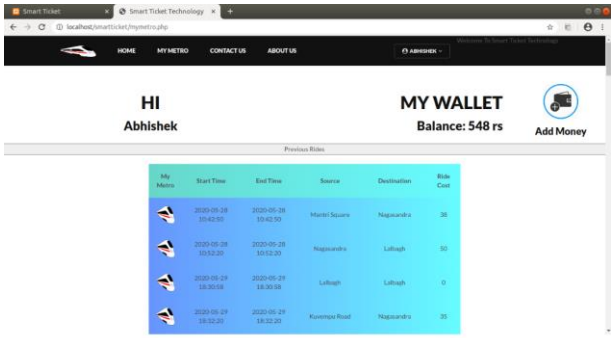

Fig. 5. User Ride Information

Fig. 6. shows the User ride history page once the person is logged in. The page displays the session name and wallet and starting station in-which the customer has visited and destination station. The ride cost is also mentioned along with date and time.

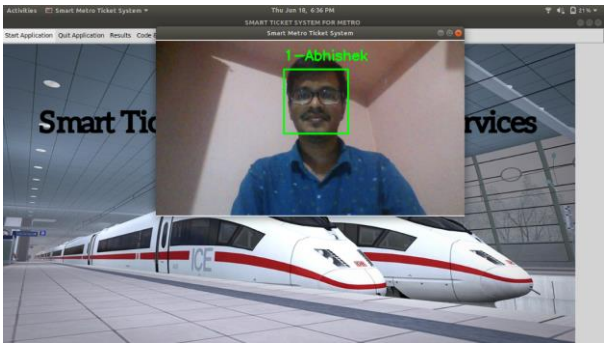

Fig. 6. Metro ride facial recognition

Fig. 7. shows the page during the person is authenticated. The page displays the predicted name and after this the entry page is opened if the entry station is empty or the exit station is opened.

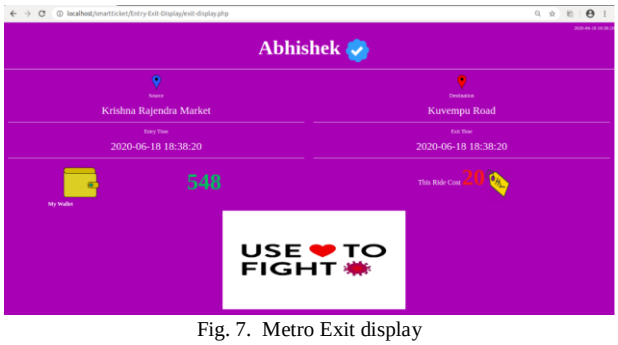

Fig. 7. Metro Exit display

Fig. 8. shows the exit page once the person is authenticated. The page displays the predicted name and wallet and starting station in-which the customer has visited. This page also shows the exit station and the cost of the ride. The balance amount is updated and shown.

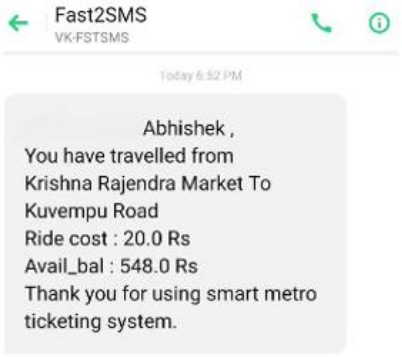

Fig. 8. SMS Notification

Fig. 9. shows SMS notification sent to metro commuter after Exit, which consists information like ride cost, remaining balance and routes.

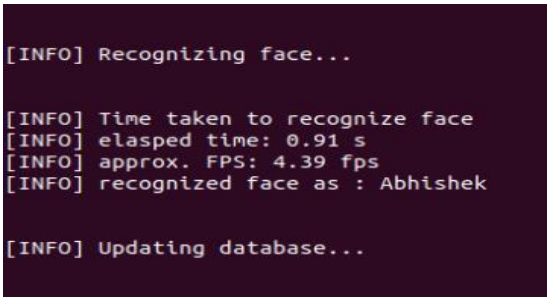

Fig. 9. Test case of recognition speed

Fig. 9. Shows testing working of facial recognition on speed. One image of the person required for testing. The image must be recognized at fast pace. The system correctly recognizes the face within 1 sec as we wished.

6. Conclusion

Smart Ticket System for metro provides a solution for many key factors of public transportation such as User friendly, Fool proof, Secure Authentication, Data analytics for business optimization of public transportation. The current project can be further enhanced by creating a better user-friendly GUI as application varies according to real time application. The model can be trained with images belonging to that particular locations in which it is used to improve the accuracy of prediction.

References

[1] Manoj Panwar, Deepak Kumar Singh, Veruval Devadas: "Analysis of environmental co-benefits of transportation sub-system of Delhi", 2018.
[2] Zhang Rui, and Zheng Yan: "A Survey on Biometric Authentication: Toward Secure and Privacy Preserving Identification", IEEE, 2018.
[3] Varun Kaushik, and Suhas P: "Fool Proof Ticketing System for Public Transport", Proceedings of the International Conference on Communication and Electronics Systems (ICCES 2018), 2018.
[4] Nataliya Boyko, Oleg Basystiuk, and Nataliya Shakhovska, "Performance Evaluation Comparison of Software for Face Recognition, based on Dlib and Opencv Library", IEEE Second International Conference on Data Stream Mining & Processing, August 21-25, 2018, Lviv, Ukraine.

[5] Neel Ramakant Borkar, and Sonia Kuwelkar, "Real-Time Implementation of Face Recognition System", Proceedings of the IEEE 2017 International Conference on Computing Methodologies and Communication (ICCMC), IEEE, 2017.
[6] Kewen Yan, Shaohui Huang, Yaoxian Song, Wei Liu, and Neng Fan: "Face Recognition Based on Convolution Neural Network", Proceedings of the 36th Chinese Control Conference, July 26-28, 2017, Dalian, China.
[7] Radhika C. Damale, and Bageshree V. Phatak: "Face Recognition Based Attendance System Using Machine Learning Algorithms", Proceedings of the second International Conference on Intelligent Computing and Control System (ICICCS 2018), IEEE 2018.
[8] Keerthi G S, and Usha C R: "Human face recognition in video using Convolutional Neural Network (CNN)", International Research Journal of Engineering and Technology, 2019.
[9] Savitha G and Keerthi G S, "Video based Face Recognition Using Image Processing Techniques", International Research Journal of Engineering and Technology, 2019.
[10] Florian Schroff, Dmitry Kalenichenko, James Philbin "FaceNet: A Unified Embedding for Face Recognition and Clustering," IEEE, 2015.