iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** IV **Month of publication:** April 2021

DOI: https://doi.org/10.22214/ijraset.2021.33780

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue IV Apr 2021- Available at www.ijraset.com

Ticketless Rails and Criminal Detection (TRACD)

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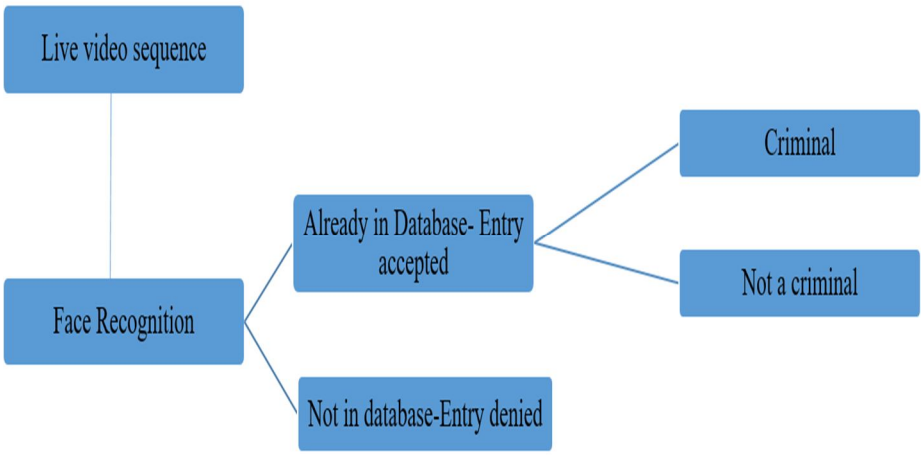
Abstract: ***Nowadays public transportation is used by many people across the globe to reach venues on time.Since there is a growing need for public transportation and apparently since there is a rapid increase in population, cross verification of renewal of passes or tickets has been a tedious task.Hence, there is a need to reduce this work by automating the process. And now by introducing TRACD (Ticketless Rails and Criminal Detection system), we can build a better system for auto-verification of the passengers using face recognition, based on the bookings made and ensure a ticket-free and wallet-free journey.The system also provides a Responsive User Interface along with an administration panel.Also, this system includes a criminal detection system which helps to spot the criminals based on the information (Images of criminals) provided by the Police department. In the event of spotting the person, an alarm is raised to the control room.***

I. INTRODUCTION

The problem faced by the railway department to verify the booking status of passengers, especially in case of overcrowding is tedious. It is not possible to give 24 hours of manual verification for entry and exit. Therefore, something unique has to be developed in order to help the railway department to continuously monitor the passenger's booking status. Thus, the idea to design a Face Recognition based Ticket verification system which will help the Railway department to monitor their passengers and prevent them from boarding in the train for free.

In this project, face recognition based algorithms are implemented for detection and processing. Different methods are –HOG Face Detector for Face Detection and Face landmark estimation to focus on each face and be able to understand that even if a face is turned in some weird direction or even under a bad lighting condition, it is still the same.



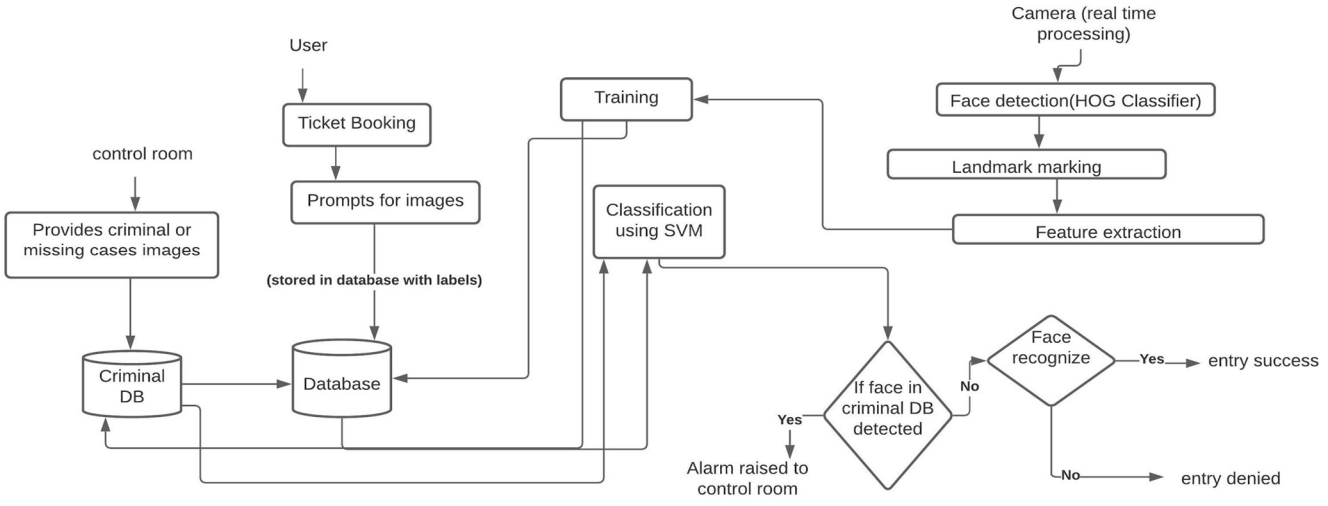
II. GOALS AND OBJECTIVES

A. To build a better system for auto-verification of the passengers using face recognition based on the bookings made.
B. To make the recognition process much more efficient using deep learning.
C. To ensure a ticket-free and wallet-free journey.
D. To introduce a live streaming system for continuous monitoring and verification.
E. To build a system which can raise an alert when a criminal's face is detected.
F. A system which can also identify a person who is missing.

III. LITERATURE SURVEY

1) *"Bus Transportation using Face Recognition System" by Vivekanand S Gogi.* This paper overcomes the various age-old issues that may arise when the conductor manually collects the money and provides the respective number of tickets to each and every person travelling on a bus by introducing a face recognition system at every bus stop and alloting one conductor per bus stop.
2) *"Automatic Passenger Counter Evaluation" by Thomas J. Kimpel, James Strathman, David Griffin, Steve Callas and Richard L Gerhart.* In this, video surveillance cameras were used instead of ride passes to establish reference values for determining APC(Automatic Passenger Counter) accuracy and precision.
3) *"Biometric Bus Ticketing System In Mauritius" by Sathiapriya Ramiah, Veerajay Gooljar and Hemalata Vasudavan.* In this, the authors conducted preliminary reading on the transportation system in Mauritius and the technologies which can be used for the upcoming smart cities.This paper makes use of PCA(Principal Component Analysis) as the statistical methods for recognition of face which operates by performing a reduction in dimensions through extraction of multi-dimensional data of principal components.
4) *"Implementation of face recognition algorithm for biometrics based time attendance system" by Adrian Rhesa Septian Siswanto, Anto Satriyo Nugroho and Maulahikmah Gadolinium.This* paper revolves around the main purpose of getting the best facial recognition algorithm (Eigenface and Fisherface) provided by the OpenCV 2.4.8 by comparing the ROC (Receiver Operating Characteristics) curve and implementing it in a attendance recording system. Based on the experiment, using the ROC curve they were able to prove that using the training set, Eigenface achieves better results than Fisherface. Thus Eigenface when implemented inside the Attendance recording system returns between 70% to 90% similarity for face images.
5) *"LBPH based improved face recognition at low resolution by" Aftab Ahmed, Jiandong Guo, Fayaz Ali, Farha Deeba and Awais Ahmed.* This paper operates better at the minimum low resolution of 35px to identify the human face in various angles, side poses, and tracking the face during human motion. They have designed the dataset for both training and classification. This paper uses the Local Binary Patterns Histogram (LBPH) algorithm architecture to solve the human face recognition problem in real-time at a low level of resolution. Recognizing individual faces automatically has become one of the most challenging parts of the past decade in computer vision. However, this paper says that the law enforcement agencies are not enough to detect and recognize any person through the video monitoring cameras further efficiently because of several factors like blur conditions, illumination, resolution, and lighting which still serves to be a major problem in the face recognition era.
6) *"Attendance System based on face recognition using LBPH" by Dr. B. Kameswara Rao, Anusha Baratam, Gudla Shiridi Venkata Sai, B.Radhika, and A.Vineeth.* In this project, a computerized system will be able to detect and recognize human faces that are being captured through a surveillance camera and this proposed system uses a Haar cascade classifier to find the positive and negative of the face and LBPH (Local binary pattern histogram) algorithm for face recognition by using python programming language and OpenCV library.

A. *System Architecture Of Proposed System*



B. Working Of The Proposed System

The system includes the ticket booking part done by the user where the relevant images of the user/passenger is fed by them to the system and all of these images are automatically stored in the database based on the bookings made by the user. Also, the data from the control room for criminal identification / missing cases can also be fed to the database. Further, the system trains itself using single triplet training.

When coming to a real time situation, a live streaming takes place where the detection of faces is done using HOG classifier and further landmark marking and feature extraction is done and the face is classified using SVM. If the recognized face is available in the criminal DB, an alarm is raised to the control room. Otherwise, the entry of that particular person is accepted or denied based on the bookings available.

IV. ALGORITHM

Face recognition is almost becoming more prevalent in every sphere of technology ranging from identity verification to robotics. There are many face recognition algorithms which have been implemented and some have perished because of its low accuracy and other factors like brightness and weird direction of the face. Speed and accuracy did play an important role in its shortcoming .But recent advancements in technology has paved way for more ideas and thus correlating them brought in better performance of algorithms.

Face recognition is not just a single problem. It is a series of subproblems each for a particular scenario.

A. Step 1: Face Detection

The initial step for any face recognition model is to detect a face. The face serves to be an important attribute to recognize an individual. Earlier the eigenface method and fisherface methodology was used in which the eigenface method makes use of PCA to reduce the dimension space of features of face. PCA breaks down the face image into sets of characteristic features called eigen face which is the main component of training. Poor separation power serves to be a major problem or short coming for PCA method. Here we have used a HOG classifier, which converts the original image into a HOG representation such that it takes in account all the important or major features of the image even if it is in a bad lighting condition. Here we need to find that portion of the image which resembles almost similar to the HOG pattern which was fetched from the training faces.

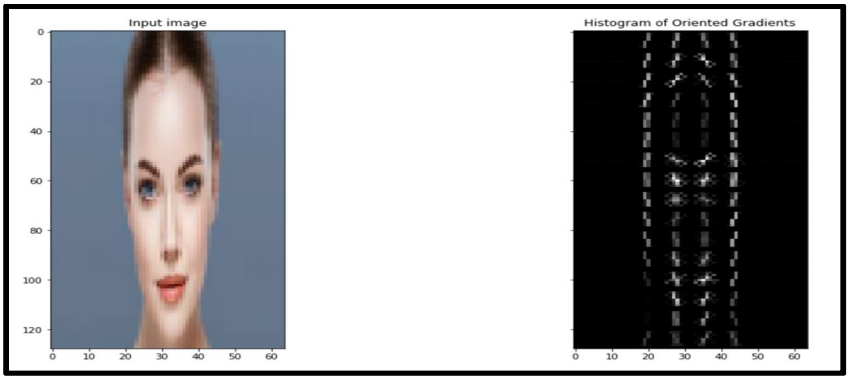


Fig 1: Hog Representation for an Image

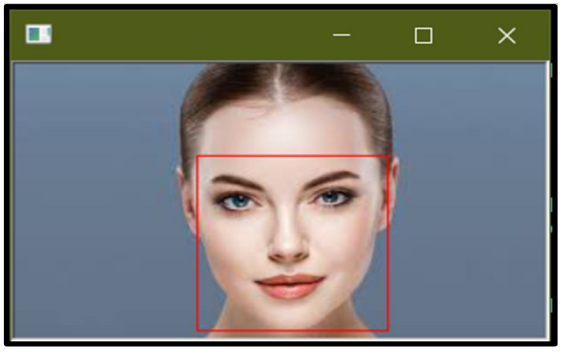


Fig 2: Face Bounded By A Rectangular Boundary Denoting A Detected Face

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B. Step 2: Face Landmark Estimation

Now we need to consider some extra factors like bad lighting conditions and the direction in which the face is turned. As humans it is easy to recognize and differentiate people, but computers need to be trained to compare facial features and recognize them.
For this we are going to use face landmark estimation.The basic ideology is to mark 68 specific points named landmarks on a face. This will train the algorithm to find these points in any face. We can scale, rotate and shear the picture as we know where the eyes and mouth are, such that it can be centered. Here we use a basic affine transformation.

predictor_model = "shape_predictor_68_face_landmarks.dat"
 # Get the the face's pose
pose_landmarks =face_pose_predictor(image,face_rect)
 # Draw the face landmarks
win.add_overlay(pose_landmarks)

C. Step 3: Face Recognition

Here the face recognition is done using a deep metric learning algorithm which is given by the dlib library. It uses deep convolutional networks to find features to assimilate various face samples. Here the output feature vector is an encoding of 128 real valued numbers which is used to quantify the previously detected face.
The training process works on 3 images at a time.
Consider two images of the same person and one image of an unknown person. The network is tweaked slightly such that the measurements generated by the images of the same person are similar and the other one is different. Repeating these steps a million times for various people will ensure that the neutral network can generate the 128 real valued encoding for every person and make it more efficient.

D. Step 4: Comparison Of Faces

Once the previous step is done (ie. after getting these 128 measurements), we can compare it using a common machine learning algorithm named SVM classifier.
This classifier returns true if the faces match, else returns false.
face_recognition.api.compare_faces(known_face_encodings,face_encoding_to_check,toler-ance=0.6)
This compares the face encodings of a candidate against the other to check if it matches.

V. CONCLUSION

Thereby, a better ticketless system for auto-verification of passengers and also a system which acts as a better alert system which can identify criminals can be much of use to society. Automating tedious tasks can help a lot in reduction of error since manual checking is prone to a lot of mistakes. Thus, this system automatically ensures if a passenger has booked a ticket before boarding or not. The extra feature added to the system is the criminal identification module which adds more value in terms of security. Hence, this system paves a way for automation, security and a ticketless travelling.

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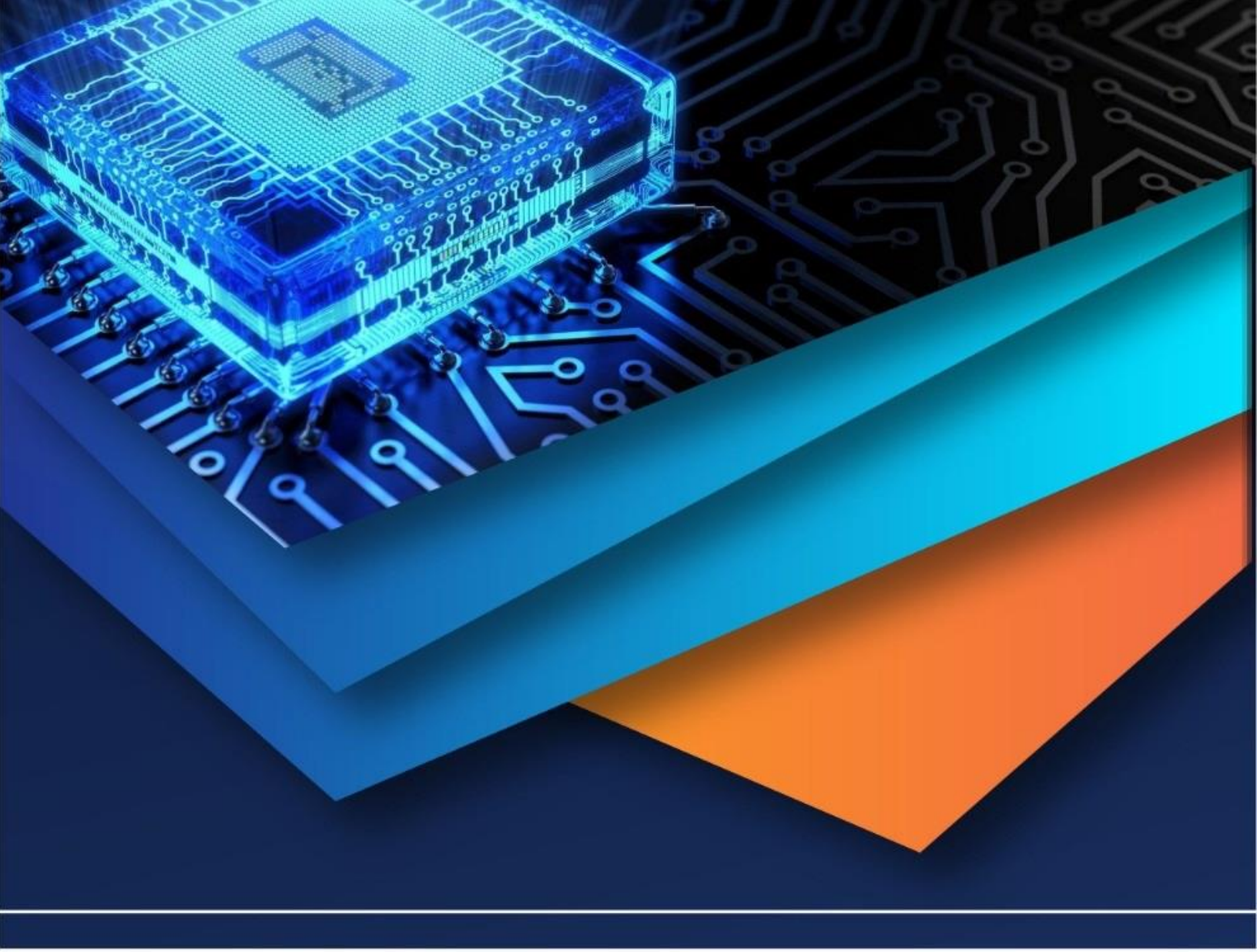

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