International Journal of Signal Processing, Image Processing and Pattern Recognition
Vol.8, No.9 (2015), pp.175-180
http://dx.doi.org/10.14257/ijsip.2015.8.9.18

Automated Fare Calculation in Delhi Metro Using Face Recognition

Shrutika Shukla and Anuj Bhargava

Department of Electronics and Communication
S.R.C.E.M, Banmore
Gwalior, India
Shrutika2705@gmail.com, Anujbhargava5@gmail.com

Abstract

There has been tremendous advancement in the field of computing in the last two decades. Human face is the most dominant characteristic which is used to verify/authenticate a person amongst group of people. Face detection technology is developed for detecting facial features and ignores background images or cluttered images. Computer-based face recognition system has revolutionized the way the world works around these days, as government agencies (law and justice enforcement) are readily accepting this technology as a standard method for recognizing the uniqueness in a human beings [1]. Our proposed system is based on facial recognition that can be used by Delhi Metro System for easing up the process of fare calculation deduction system by means of automating the system using cameras placed at the entry gate, inside the metro rail and at the exit gate. This system will help in saving the man hours required for vending out tokens/ tickets/ smart cards in the metro system. This system will also increase the accuracy and will help in replacing traditional fare calculation activity which is perform daily.

Keywords: *Facial Feature, Image Segmentation*

1. Introduction

Since the dawn of scientific era and computer advancements especially in the field of internet, E- commerce and E-banking through safe portals the lives of people using these services have became tremendously easier. With the introduction of biometrics based system such as finger print detection, iris matching and facial recognition have provided strength to the security feature that is required while doing this financial truncation using online services such as buying tickets, reserving seats for a movie, buying software online, funds transfers. Our proposed system based on the facial detection and recognition algorithms which will automatically detect the face of the passenger and recognize it by matching with the existing database (Aadhar database) and calculate/deduct fare accordingly. This will be processed based on the distance travelled by the passenger and amount would be deducted from his or her bank account at the end of the journey.

2. Face Recognition Technology

Face Recognition Technology is gaining popularity day by day and the techniques that are being applied have witnessed a growing interest from the biometric community present around the globe. The face is recognized by segmentation of facial feature such as nose, eyes, ears and mouth are extracted from the person's image and later on processed by the software and one by one matched with the original image and other images present in the dataset. Face recognition technology in general sense can be classified on the basis of holistic approach or the global appearance of the face perceived by human eye and

processed by the brain whereas feature- based viewpoint which proposes the use of facial features such as eyes, nose, ears and mouth for identifying the person.

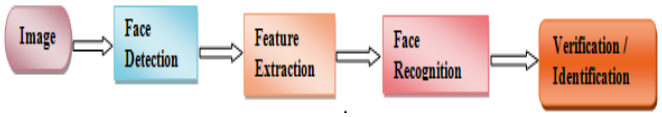


Figure 1. General Face Detection Algorithm

2.A. Face Detection and Recognition

Face detection is defined by focusing upon distinct facial features to determine the gender, age, ethnic origin etc. Face recognition system methods can be classified into three types: Face Detection, Feature Extraction and Face Recognition. Face has some identifiable features that camera captures in the form of images such as eyes, nose, ears and mouth which are used for implementation of face recognition algorithm. Face detection is different from recognition as detection will merely separate the face from the entire image or the cluttered image. While on the other hand, in the face recognition process we identify the distinct feature on the face and match it with the other image's facial feature and if they match with each other we can easily conclude that these images are of the same person [10].

2.B. Need for the System

There are two reasons behind developing the system, the first prominent reason is the applications in commercial and law enforcement field and the second reason is the availability of the technology feasible enough to design and implement the algorithms and formulate it into reality [2]. The Delhi Metro System daily caters to thousands of passengers and many amongst them are daily-commuters who are always in a hurry to reach their destination in time. They don't want to waste their time by standing in long queues and waiting to swipe their smart card just to board the train in the right time. The proposed system will mitigate/facilitated in the fare calculation and speed up the processes which usually take up time and man power. The proposed system will revolutionize the way the Delhi Metro works day in and day out. This system will also prove beneficial for the commuters as they need not carry a smart card or buy a token before the journey. This is an authorized system as government approved Aadhar Card would be linked to the bank account and also to the Delhi Metro System server.

3. Drawbacks of Various Systems

Limitations are bound to occur in the systems designed by humans. As humans can strive to achieve perfection but possibility of error occurrence is always present. There are various systems besides facial recognition system which prone to inaccuracy due to the following errors:

Table 1

Table of the system	Drawbacks
RFID –based	Unethical usage by the passengers
Fingerprint - based	It is time consuming as somebody has to clean the finger print device after a certain number of inputs. It's a contact based system therefore prone to errors as well as diseases.
Iris – based	Invasion of privacy of the user.
Wireless – based	Poor performance due to topographical situation.

4. Proposed Methodology

Methodology

System development methodology is a formal documentation of involving phases of system development life cycle (SDLC). It is written for defining precise objectives for each phase which will produce results and these results can be feed as input for the next phase [8]. In our proposed system we will be using Viola-Jones Algorithm for detecting various facial features on the human face image that we have captured.

Algorithm Pseudo code of proposed system

```
1. Capture the passenger image from the video input.
2. Apply Viola-Jones Algorithm for face detection.
3. Extracting the face portion using bound box methods (face segmentation).
4. Comparing the captured image with the stored image linked through Aadhar Card.
5. if Image matches then
       Passenger is allowed to move towards platform
   else
       The passenger must be instructed to buy a token or a smart card.
6. if The passenger boards the metro then
       Face recognition is again performed using camera placed in the metro
   else
       No amount will be deducted.
7. The passenger is allocated 30 minutes in addition to total travel time of the particular journey.
8. Upon de-boarding the metro a final Face recognition will be performed in order to deduct the total fare.
```

VIOLA –JONES ALGORITHM

In 2001, Paul Viola and Michael Jones proposed the real-time object detection framework which provides competitive object detection rates in real-time. Besides solving the face detection problem it is trained to provide solution for other types of objects as well. For the purpose of easing up the job Viola-Jones algorithm limits itself to problems related to frontal view of the face [9].

Our Proposed Algorithm

Our algorithm works of the basis of viola- Jones algorithm, we are extracting facial feature from the entire face and matching these features with the stored image in the database. This algorithm is run three times for a passenger in his/her entire journey for accurate calculation of the fare that needs to be deducted.

4.A. Pre-assumptions of the System

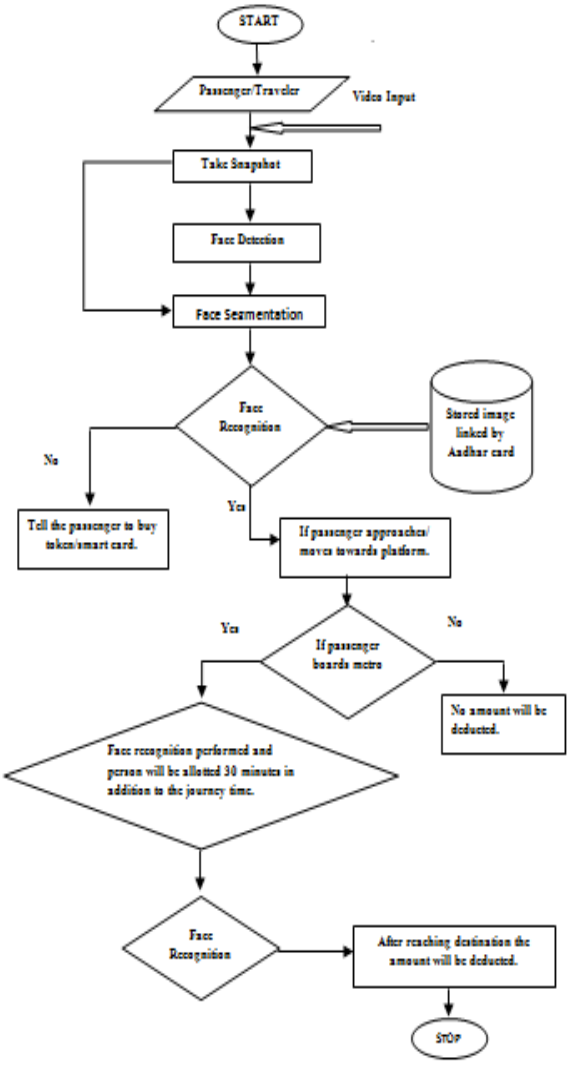
1. We are assuming that the proximity with respect to the camera placed in front of the passenger who wishes to travel must be around 30-50 cm.
2. Mirror image and side-pose image will not be considered/ processed by the system.
3. Illumination factor will not be considered while the image is being processed.
4. A person is wearing any colored lenses goggles will not be considered while the image is being processed.

TABLE – II

Process	Method	Description
Feature Detection (Constructor definition)	**vision.CascadeObjectDetector**	The cascade object detector uses the Viola-Jones algorithm to detect people's faces, noses, eyes, mouth, or upper body. detector = vision Cascade Object Detector creates a System object, detector, that detects objects using the Viola-Jones algorithm. The Classification Model property controls the type of object to detect. By default, the detector is configured to detect faces.
Feature Detection (Multi-Scale object detection)	**step(DETECTOR, I)**	BBOX = step(DETECTOR,I) returns BBOX, an *M*-by-4 matrix defining *M* bounding boxes containing the detected objects. This method performs multi-scale object detection on the input image, I. Each row of the output matrix, BBOX, contains a four-element vector, [x y width height], that specifies in pixels, the upper left corner and size of a bounding box. The input image I, must be a grayscale or truecolor (RGB) image.
Rectangle Object	**`rectangle('PropertyName',propertyvalue,...)`**	rectangle('PropertyName',propertyvalue,...) draws the rectangle using the values for the property name/property value pairs specified and default values for all other properties
Converts RGB image to Grayscale	**rgb2gray(I)**	Convert RGB image or colormap to grayscale. rgb2gray(RGB) converts the truecolor image RGB to the grayscale intensity image I. Thergb2gray function converts RGB images to grayscale by eliminating the hue and saturation information while retaining the luminance.
Feature Matching	**detectSURFFeatures (I)**	detectSURFFeatures(I) returns a SURFPoints object, points, containing information about SURF features detected in the 2-D grayscale input image I. The detectSURFFeaturesfunction implements the Speeded-Up Robust Features (SURF) algorithm to find blob features.
Strongest points	**selectStrongest(N)**	cornerPoints.selectStrongest(N) returns N number of points with strongest metrics.
Extracts the features from the scene	**extractFeatures(I, points)**	extractFeatures(I,points) returns extracted feature vectors, also known as descriptors, and their corresponding locations, from a binary or intensity image. The function derives the descriptors from pixels surrounding an interest point. The pixels represent and match features specified by a single-point location. Each single-point specifies the center location of a neighbourhood. The method you use for descriptor extraction depends on the class of the input points.
Matches the features	**`matchFeatures(features1,features2)`**	Match Features (features1,features2) also returns the distance between the matching features indexed by index Pairs.
Displays the features	**`showMatchedFeatures(I1,I2,matchedPoints1,matchedPoints2,method)`**	showMatchedFeatures(I1,I2,matchedPoints1,matchedPoints2,method) displays images I1and I2 using the visualization style specified by the method parameter.
Segmentation	**imcrop**	`imcrop(I, rect)` crops the image `I`. Rectangle is a four-element position vector [xmin ymin width height] that specifies the size and position of the crop rectangle.

Courtesy: Math Works, (2015),[5]

FLOW CHART



5. Related Work

1. Forensic Science

Forensic science is the scientific method of gathering and examining information about the past which is used by the court of law. The forensic medicine helps to decide the criminal cases. New methods help in criminal search. Modern methodologies help to identify the criminals before hand and thus prevent the crime. Face recognition technology is used on handheld devices to apprehend a suspect by comparing photo with existing databases on the device or on central systems connected through mobile networks. Similar to a fingerprint. Face recognition technology can help the administration to predict the crime and catch the offenders. Faces can be compared to image databases to recognize the absconding criminals [6].

2. Defense

Armed forces use the facial recognition system ready weapons to find out the terrorists before occurrence of the crime. The camera mounted on the gun can help the military man to identify the criminal [3].

3. Sephora's 3D Reality Mirror

3D reality mirror of Sephora is becoming popular. Its global success would make it popular in cosmetic world. Mode Face is in process to launch the new technology, which consists of a touch screen monitor and a camera. Mode Face will introduce a technical makeup mirror which would affect the beauty world. It tracks the facial features of a person in real time and virtual world. It helps the lady to apply eye shadow to your visage through a camera. [3].

4. Attendance System

Face recognition system is used to record the attendance of an employee. This i-face control system data can help to record the details which can further help in fixing salary etc.

6. Future Scope

Frontal face recognition system along with nose, eyes, ears, and mouth can be identify and applied in upcoming field called as augmented reality (AR). The helps in enhancing the physical real world appearance and beauty world etc [7].

7. Conclusion

Face recognition system is upcoming technology which finds the utility in the modern life. It doesn't require the physical presence in the recognition interface. The literature finding and search explains the working methodology. Every minute detail is highlighted [4].

References

[1] FBI (2015), "Face Recognition", Biometric Center of Excellence, Accessed from: http://www.fbi.gov/about-us/cjis/fingerprints_biometrics/biometric-center-of-excellence/modalities/facial-recognition, Accessed on: [21/01/2015]
[2] Zhao W. Y. & Chellappa R., "Image-based Face Recognition : Issues and Methods", Center for Automation Research, 2002, Accessed from: http://www.face-rec.org/interesting-papers/general/chapter_figure.pdf, Accessed on: [20/01/2015]
[3] Sephora Augmented Reality(2014), Sephora's Augmented Reality Mirror adds Virtual Makeup to Customer's Faces, Accessed from: http://www.psfk.com/2014/06/sephora-augmented-reality-mirror-try-on-makeup.html, Accessed on: [21/01/2015]
[4] Lin S.H., "An Introduction to Face Recognition Technology", Informing Science Special Issue on Multimedia Informing Technologies – Part 2, Vol.3,(1), 2000, Accessed from: http://www.inform.nu/Articles/Vol3/v3n1p01-07.pdf, Accessed on: [28/01/2015]
[5] MathWorks, http://in.mathworks.com/, 2015
[6] US-CERT(2008), Computer Forensics, Accessed from : https://www.uscert.gov/sites/default/files/publications/forensics.pdf, Accessed on: [28/01/2015]
[7] Azuma et. al, "Recent Advances in Augmented Reality", Computers & Graphics, November 2001, Accessed from : http://www.cc.gatech.edu/~blair/papers/ARsurveyCGA.pdf, Accessed on: [26/01/2015]
[8] Goddard W. & Melville S., "Research Methodology: An Introduction", 2nd Edition, Juta and Company, February 2007
[9] Jensen O.H., "Implementing the Viola-Jones Face Detection Algorithm", IMM-DTU, 2008, Accessed, From : http://etd.dtu.dk/thesis/223656/ep08_93.pdf, Accessed on : [26/01/2015]
[10] Chintalapati S & Raghunadh M.V "Automated Attendance Management System Based On Face Recognition Algorithms ",IEEE, 2013.Accessed from: http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=6724266&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxpls%2Fabs_all.jsp%3Farnumber%3D6724266, Accessed on: [28/01/2015]

