A Hybrid Facial Recognition System for Check-Ins

[1]Siddharth Malladi, [2]Dr G Swamy

[1]Student, [2]Associate Professor
Vignana Bharathi Institute of Technology

***Abstract*: Transport industries are currently evolving a prodigious change due to strict scrutiny and the governing safety protocols of the post COVID-19 era. Passengers of all transportation means, whether through airplanes or railways, are making their best choices to avoid big lines and unnecessary contact and interactions with the airport, transport staff. So, in order to achieve this, we are proposing a new system which uses Haar Cascades [7], Local Binary Patterns Histogram [4] as an amalgamation of algorithms to make a Facial Recognition system that checks the potential flyer's ticket details by taking a picture and cross checking it with the data (photos) present in the database. While booking their ticket itself, the flyer has to link his photo proof which gets stored in the database of the airline. Our introduced system is not only safer but also faster and more coherent which has a lower training time and threshold than the already existing systems.**

***Keywords*: Facial Recognition, Maritime Security, Port Security, Haar Cascades, Local Binary Patterns Histogram, Self-check-in**

Introduction

Processing and managing large data has become an essential part of everyday life and this technology is being deployed today in airports for automating immigration processes, ameliorated surveillance and security, coherent passenger travel and gathering of relevant statistical data concerning passenger movements. Manually implementing this is not only costly but also extremely inefficient in addition to a lot of tedious and continuous, stressful work. But as each human or any animal's face is unique, we can completely automate this tedious process without compromising ourselves on any factors. We can use these kinds of sophisticated systems not only for airport check-ins or surveillance, but also payment systems or social media log-ins.

In our proposed work we have implemented amplified techniques, methods for secure and efficient check-in and more using Facial Recognition. Survey of existing technologies is illustrated in part II, Methodology is put forward in part III, Conclusion in part IV, and Future Scope in part V.

Survey of Existing Technologies

Collins Aerospace and JetBlue, two airline companies based in the United States of America, wanted to enrich their customer experience and relieve the long standing boarding process into the airplanes and hence undertook a trial at the John F Kennedy International Airport (JFK) at New York in March of 2019.[6] Their aim was to make the customer travel experience smoother and no longer have the hurdle of boarding passes and long waiting times.

The London Heathrow Airport [6] also underwent similar trials in the same year of 2019 but with a slightly varied technology stack. While both JetBlue and the Heathrow airport used Facial Recognition, their methodologies are quite older compared to our proposed methodology. Our methodology, though comparatively slower, uses LBPH along with Haar Cascades which has a much higher efficiency and superior attainment rate with minimum fail conditions compared with the above previously used method.

Methodology

The steps to carry out this objective include:

- Recording a static image.
- Converting the image from BGR to GrayScale.
- Using the Haar Cascade algorithm which is used as a classifier.
- Calculating histogram by dividing the image into small wodges.
- Processing our input image data.
- Identification Output: True.
- Welcome aboard.

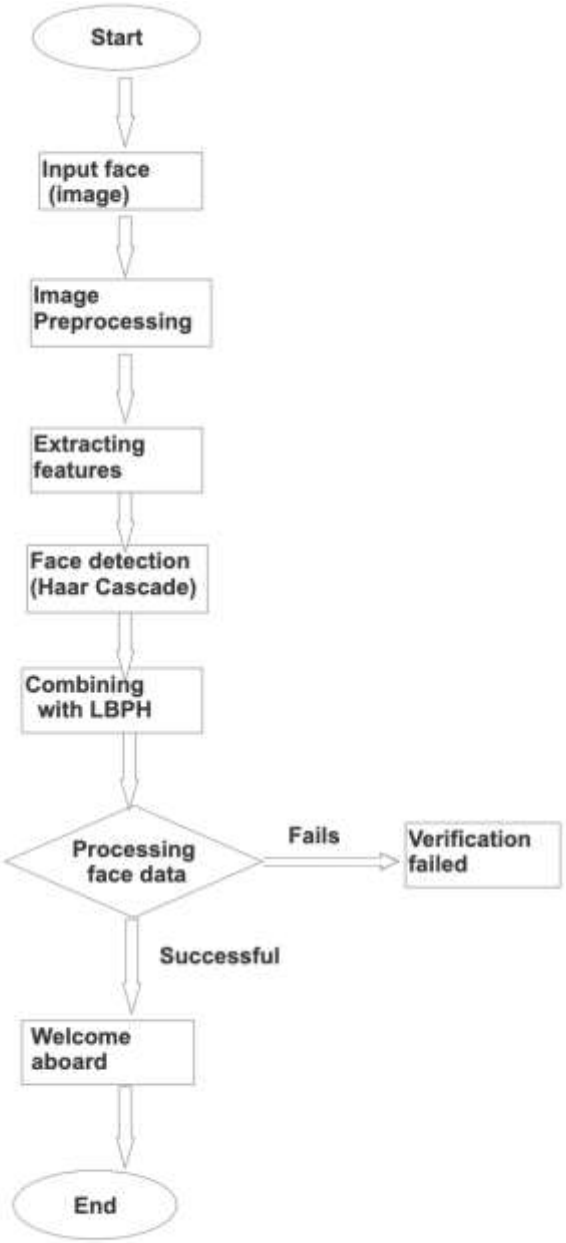


Fig. Thorough flowchart of our approach

A. Converting Input Image into GrayScale

When converting our input RGB image to Grayscale, we need to take the RGB (Red, Green, Blue) values for each pixel and make a single output, usually taking the mean of the 3. [1]

```
from skimage import color
from skimage import io
img = color.rgb2gray(io.imread('image.png'))
```

B. Haar Cascades

Haar Cascades[7] is a Machine Learning algorithm which could be brought into play for identifying faces and for detecting generic objects alike. Just like any machine learning to have a high success rate, Haar Cascades needs an abundant number of images in its database which are to be divided into positive and negative images [7] which are eventually used for training. The output image is further segregated by dwindling down the zone of interest. The output value is identified by using AdaBoost which systematically selects the best of all values.

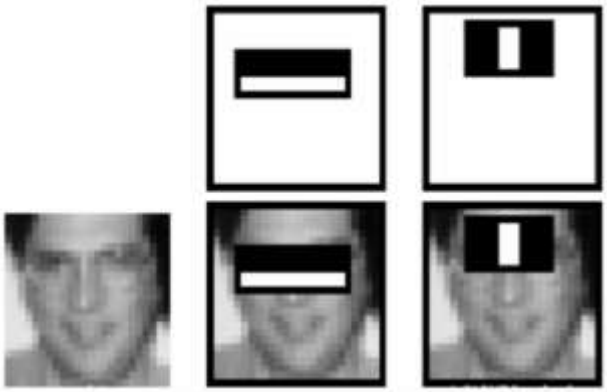


Fig. - Feature extraction using Haar Cascades

C. Local Binary Patterns Histogram

Local Binary Patterns is an embellished composition supervisor that flags and considers each pixel as a binary number, by thresholding every pixel element and which is represented by the following formula: [3]

$Hi = \sum x,y\ I\{\ fl(x,y) = i\ \}, i = 0,\ldots, n - 1$

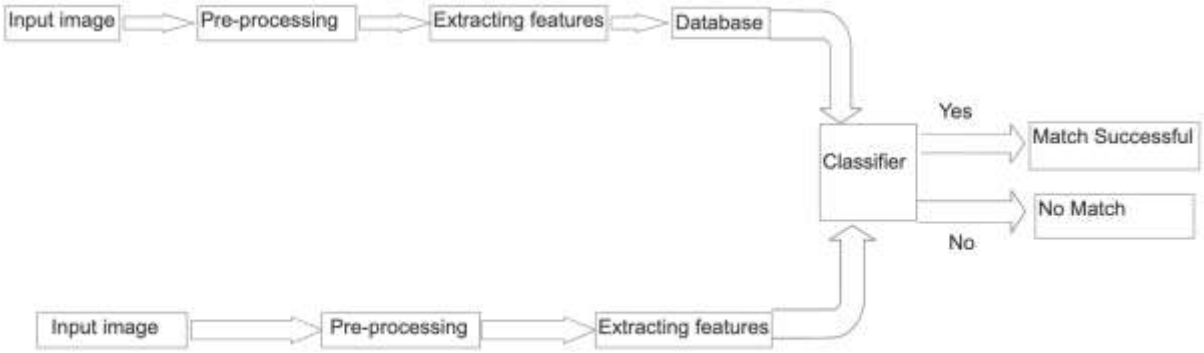
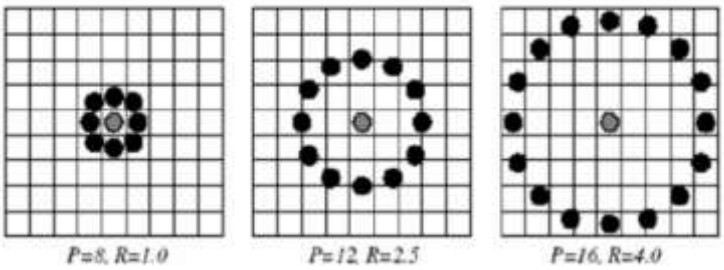


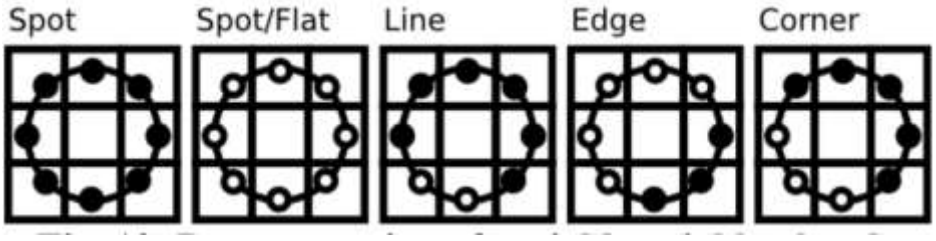
Fig: Flowchart of the system

A circular LBP operator could be interpreted as:
In which, (x_c, y_c) means i n is intensity of the neighbouring pixel and i c is the central pixel.

Using this function, we can obtain a set of 8 binary units from the 8 different neighbours which is made into a decimal integer known as LBP with a range of [0-255].



What we are really attempting to accomplish is aligning an incidental amount of adjournments on a circle. This is how it looks like: [5]



This way LPH is able to create histograms set for each region and finally amalgamate into one final histogram which is then weighed up with already stored image data in our database.

D. Accessing Registration and Welcoming

During the registration of their ticket, the passengers are indispensable to provide a photo along with their identity proof. (Aadhar Card, Pan Card etc). An itinerary will be sent asking the customers to confirm their identity proof image or send an updated image if their image shown in the ID proof was very old or lacking clarity.

Fig. - Customer sending their image during registration

When he/she reaches the airport, the customer will stand in front of the camera and once the image is loaded, it compares it with the images in the database and if a match is successful, it'll display "Welcome Aboard" and allow the customer to get into the flight. If a particular customer is not accepted inside, a security personal will attend the customer and do a manual cross check on the customer, and decide later actions.

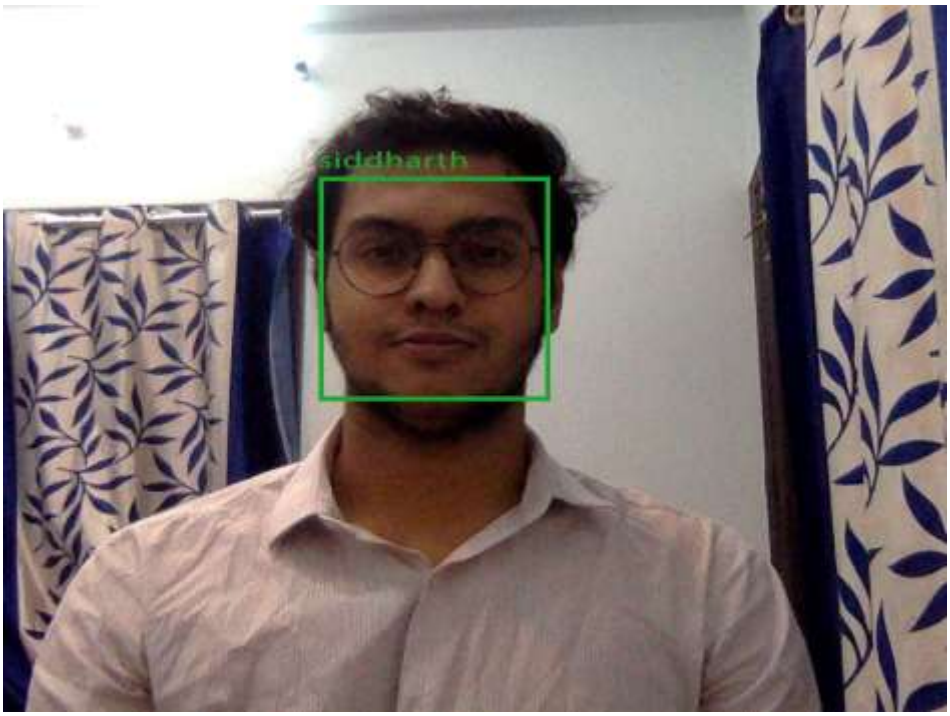


Fig. - Passenger identified and authorized to enter

Conclusion

This research paper, we have proposed a new, faster and more efficient way of self-check-ins which can be used in airports, railway stations which is more advanced than the current technology being used. Given the situation of the COVID-19 pandemic and how it changed travel and interaction forever, this is not only safer but provides the travellers a much richer experience. If an unauthorized person tries to access the check-in, the buffer value will supplement 2.2e+04 and access will be denied, alarming a nearby worker.

The amalgamation of Haar Cascades and Linear Binary Pattern Histograms has outperformed any existing algorithm with a much higher efficiency, along with the least noise interference.

Future Scope

In our proposed Facial Recognition system we have used LPBH along with Haar Cascades, but in the future we can combine additional algorithms like Convolutional Neural Networks [8] and Classification algorithms to attain an even better, near perfect accuracy along with additional benefits. The 8 basic pathological gaits and their detection and determination in a public setting may be put in use for security and surveillance enhancements. This proposed system can also be useful for the army and intelligence services for improving the state of security of a country.

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Authors' Profiles

Mr G Swamy is at present working as an Associate Professor in the Department of Computer Science and Engineering at VBIT, Hyderabad, India. He's had a teaching experience of over 17 years. He has obtained his PhD from OPJS University, Rajasthan, MTech from JNT University and BE from Osmania University, Hyderabad. His research interests include Data Mining, Software Engineering, Networking and machine learning. He has published 10 research papers in national and international journals and has attended 3 Conferences and has 1 patent.

Siddharth Malladi is a Computer Science and Engineering undergraduate student at VBIT, JNT University, Hyderabad, India. His research interests include Computer Vision, Natural Language Processing, Software Engineering, Data Mining. He has previously interned at RaftLabs, Ireland, UK. He has helped build Abhyas,a website that hosts online exams for the students of VBIT and has over 5000+ daily users, he has a very active GitHub profile where he puts ML and iOS projects. He has secured a regional rank of 16 in IEEEXtreme Programming Competition and also secured a project with THub Hyderabad through the SmartIndia Hackathon, 2020. He is also much interested in Entrepreneurship and is the Vice President of an NPO called Institute of Student Engineering, based in Hyderabad.