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Smart Attendance System using Dlib Pre-Trained Neural Network

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***Abstract* — Recognizing and remembering various people is the most frequent task, which the human brain performs. With regard to this, the process of attendance becomes one of the hectic tasks, which requires subsequent modernization. The spread of COVID- 19 is also drastically increasing and are pushed to the situation of wearing mask the entire time. This brings in a situation of misidentifying the individuals and are also prone to impersonation in many official gatherings such as exams, meetings, etc. This cannot be decreased by unmasking their face in this pandemic situation just for the purpose of verification as it may lead to increase in COVID risk. Here, this research study implements a contactless face recognition system with a simple and smart database, which can take in any form of data as per the convenience. This system solves the above problem by making the face recognition smart using Histogram of Oriented Gradients (HOG) and Support Vector Machine (SVM) classifier. The main task of the system is to recognize the user's face (live) and automatically mark the time of recognition directly in the Google sheet along with the alphabets of P(Present), A(absent) or L(late) according to the given time range. This system makes effective use of google sheet for easy share ability, accessibility, and error free management. This can be used for number of purposes such as exam centers, schools, colleges, companies, hospitals and various other places in order to verify the people (contact less).**

Keywords— Face Recognition, Support Vector Machine (SVM), Histogram of Oriented Gradients (HOG), Covid-19

I. INTRODUCTION

As in this era, there are number of tasks that require a smart way of automation are yet performed manually [7]. One such traditional process used almost in all sectors is nothing other than the attendance system. This seems to be a time-consuming task and indeed increases the burden when there are a greater number of people who are to be considered in the attendance process and error prone [11].

Thus, this needs a quick, easy implementable and efficient solution in order to overcome the existing way of approach. As known already, face recognition is one of the most important biometric features that is highly safe and reliable solution for identification [5], an enhanced system can be developed with popular technologies and improved results.[1]

II. OBJECTIVE

The main motive of the paper is to come up with a system that takes into account of the live streaming images for recognition along with a simple database of the candidates in order to properly identify and automatically mark the attendance in an easily sharable platform in order to prove the completeness of our aimed project.

III. SCOPE

The attendance system provides a number of benefits, including user friendliness, reduced manual work, data management, time tracking, and many more. It can be used not just at schools and colleges to track attendance, but also in a variety of other situations.

- The system can accurately recognize a person's face, which can be utilized in exam centers to verify candidates' identities along with the arrival time.
- In hospitals, the system can be used to keep track of entry and exit of spectators, in order to maintain safety of patients.
- The system can also be installed on conference room's doors and other restricted areas to allow entry of authorized personnel only.
- The system can be used to track employee entry and exit timings in order to compute their working hours in businesses and workplaces as well as employee management [16], [17].
- An alarm can be associated to this system, and connected to CCTV cameras, which can be used to detect offenders passing by the camera for the suspect database.
- The technology can be used in voting booths to allow only authorized applicants to vote only once and deny them if they try to vote again.
- As in our proposed projects, it can be commonly used in schools and colleges for daily attendance and to keep track of late pupils [14].
- This system can also be used in Electoral Registration, Banking, Electronic Commerce, National IDs, and Passport verification, etc.

IV. LITERATURE SURVEY

Attendance system is vital in almost every field. At the same time, there has been a significant concern with

traditional approaches to this system, as the manual attendance management system relies entirely on skilled personnel, but the main issue is that humans are not flawless. They must identify each of the candidate's face in order to record their attendance which seems to be a difficult task. Thus, to make the identification process simple, we have one such existing approach which uses iris classification to detect the person's face. This takes good control and consider the iris for comparison and ultimately leads to better results. This system requires IR light source and sensor and also won't be possible with a basic webcam. One of the most common biometric approaches is attendance using fingerprint reader [13] but it involves physical contact. Another paper proposes a smart classroom system built with twenty 50kg load sensors, ZKTeco ZK4500 fingerprint reader and five HX711 amplifiers [12], but it's expensive.

Along with this, there is a technique of identification using Radio Frequency Identification (RFID). This system is pulled down, as it is expensive and the difference in phase values of RF characteristics, tends to be less accurate when the physical features are similar and also due to volatility of the signal, there are high chances of misidentification of individuals [10]. In addition to this, the detected face is to be compared to the database after recognition. For comparison, one such approach uses the method of timestamping which eventually requires a large database thereby increasing the memory requirements and thus not feasible [9].

The other approach employs the traditional facial recognition approach based on eigenface for comparison and accuracy of attendance [15]. Hence, for saving the recognition data and attendance marking, an existing system tends to use excel sheets to save the details automatically by reducing the manual work [6]. Most of the systems store their data on a cloud server which is expensive and complex [19]. Thus, eventually sharing of data becomes a hectic task as the data is stored locally on the computer and needs instantaneous updates.

Hence, to tackle such problems, the proposed system is designed in such a way that it should be able to handle all of the above. The system is expected to be developed in a way to handle any kind of database with quick recognition along with easy sharing ability of data with minimal technology.

V. IMPLEMENATION

Attendance is a major process and it requires a lot of manual work, thus the proposed concept of a Smart Attendance system using face recognition has been implemented for marking attendance that is more secure and time efficient than the traditional way of attendance systems. This system stresses its simplicity by eradicating the need of traditional registers and instead uses the images of the person as the database. Any kind of ID proof that contains the human face (Aadhaar card, school ID card etc.) can be given as the database, as our system uses HOG (Histogram of Oriented Gradients) which efficiently detects and utilizes only the human face [4]. Whereas, the majority of the facial recognition approaches uses Labelled Faces in the Wild (LFW) dataset to train the suggested solution [18].

These faces are encoded using pre trained neural network and face encoding functions as face has about 80 to 90 nodal points [3]. Using the FACIAL_LANDMARKS_IDXS dictionary provided by face_utils of the imutils library the facial landmark detector is implemented which has 68 (x, y)-coordinates that map to specific facial features , thus using the facial regions can be accessed using simple python indexing, facial regions indexing are given as:

The mouth can be accessed through points - [48, 68], right eyebrow through points - [17, 22], left eyebrow through points - [22, 27], The right eye using [36, 42], The left eye with [42, 48], The nose using [27, 35] and the jaw via [0, 17].
The system detects the live (see Fig.1b) human faces through the webcam. To increase the speed of the system the captured face is reduced to 1/4th of its original size and thus encoded. Thus, for comparison, with the provided database the system uses a pre-trained machine learning model - SVM (Support Vector Machine) classifier (see Fig.1a). If the image in the database and the lively detected human face is matched, it displays their name with green rectangle box indication around their face. This also automatically marks the attendance on regularly basis along with the time of recognition as present / late based on the given time restriction, and absent if they are not recognized on that specific day in the google sheet that is linked using the Google Sheet API (see Fig.2).

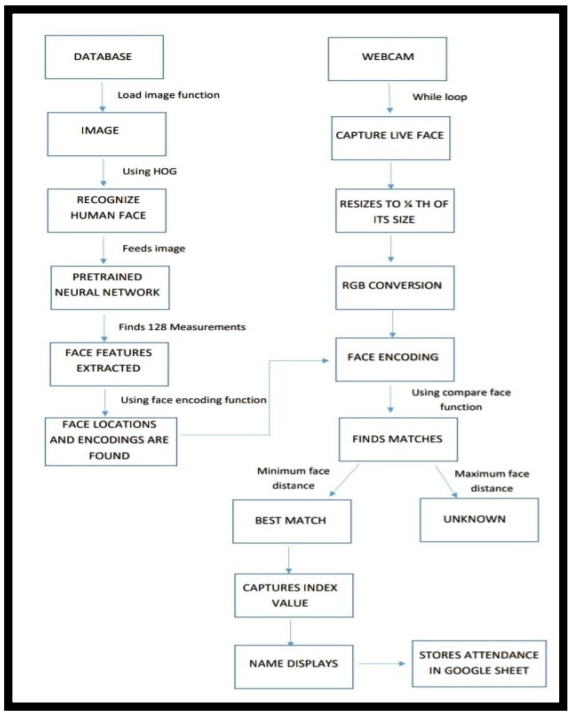

Fig. 1. BLOCK DIAGRAM
Face Recognition using DLIB and Automatic attendance Marking in Google Sheets

RESULTS:

Some of the features that stand unique in our thus proposed attendance system includes the following: Our system uses HOG, which is great capturing edges and corners in images compared to LBPH face recognition algorithm [2],

Here, images are divided into multiple grids using Grid X and Grid Y parameters and histograms representing the pixel intensity are extracted, these histograms represent the characteristics of the original image. However, both HOG and LBPH uses same kind of information, that is gradients around a pixel, but LBPH considers 8 directions for each pixel, whereas HOG which only uses 1 direction. HOG always holds a good recognition rate, in conditions, such as in the expression diversification, disorientation, and a change in the lighting performance and also great at capturing edges and corners in images, which is a limitation in LBPH which thereby makes it smartly recognizes partially covered face [20], be it with mask (see Fig.3a), coolers, scarf or even if the person is not facing the web camera in proper angle and light (see Fig.3c), thus enhancing the feature of 'Face recognition in varying angles'.

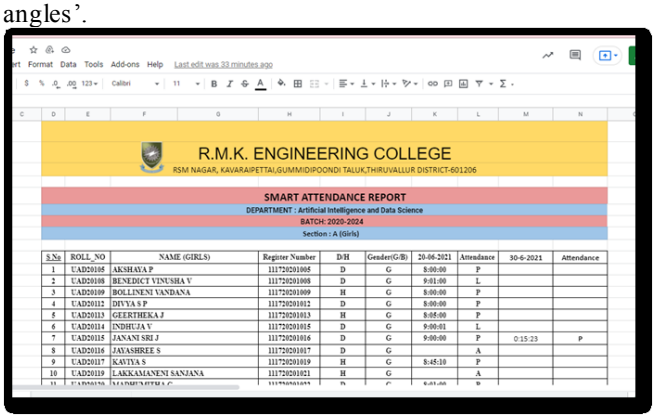

Fig. 2. Google Sheet that displays time of recognition along with Present, Absent or late is mentioned.

The existing system can handle only a single image-based face liveness detection [8], but our system detects with multiple faces, i.e., more than one person in the frame at a time (see Fig.3b). The system can also perform the same kind of recognition in dark or poor lightning as well. Our system is well suited to recognize any kind of person irrespective of their age, gender, color, height etc. The system is capable of indicating the person as "Unknown" if the person does not belong to the given database.

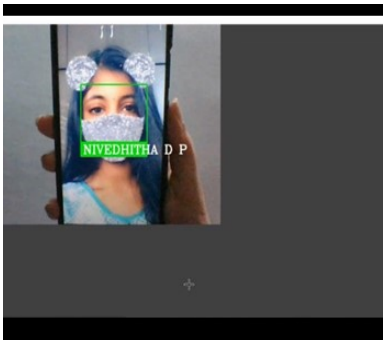

Fig. 3a. Attendance Marking with Mask

Intelligent Face recognition with mask during pandemic times.

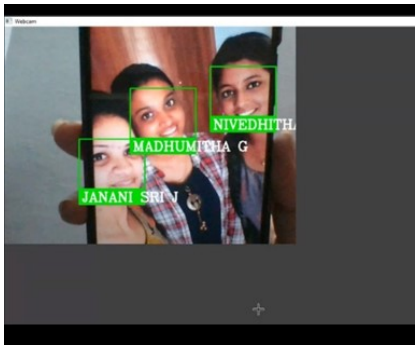

Fig. 3b. Group Recognition
Multiple face recognition for quick detection and attendance marking

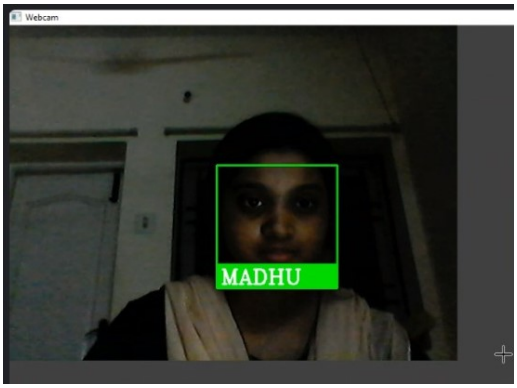

Fig. 3c. Recognition in Poor Lighting
Smartly recognizes even in dark, and poor lighting environment

EVALUATION METRICS

Here, Accuracy refers to the closeness of a measured value to a standard or known value. It is a metric for evaluating classification models. The accuracy of our system considering our own dataset is 95.23%.

F-measure/F1-Score:

F1-score is one of the important evaluation criteria in deep learning. It the harmonic mean of precision and recall i.e., it combines precision and recall into a single number. The F1 score computed for our system using our own dataset with HOG algorithm is 97.07%

1. FPS (Frames per second):

Our system uses Dlib which is fast and very lightweight so it can comfortably operate at 30fps in standard environments, and has the potential to detect facial landmarks even in a single millisecond provided in the most ideal conditions.

FUTURE SCOPE

As, authorization and face recognition along with timestamp has multiple ways of usage, these can be treated as a suitable way to detect suspects with their face data. Along with this simple attendance system can be extended by adding in the automatic messages of attendance to respective parents in case of schools or colleges. Similarly, this can be attached

with a facial thermometer especially in the pandemic situations which can also be embedded in the doors as a door lock system for authorization. These can indeed be enhanced to find the missing case, increasing the database storage in terms of virtual cloud. This in turn can bring the chance of authorizing the voters based on their voter Id as the database to prevent duplication in votes.

CONCLUSION

Attendance management plays an indispensable role of in almost all fields. At the same time, it has been a significant concern with traditional approaches towards this system as the manual attendance management system. So, this research work has made attendance system smart by using face recognition technology along with a pre-trained machine learning model, which makes the proposed system more accurate and time effective. The proposed system is not only confined to attendance and it can be extended to the level of verification and authentication as it is contactless and non-invasive technique.

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