iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** I **Month of publication:** January 2023

DOI: https://doi.org/10.22214/ijraset.2023.48767

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue I Jan 2023- Available at www.ijraset.com

Computer Vision based Attendance Management System for Students

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Abstract: ***The purpose of this project is to build an attendance management system based on facial recognition features. In most educational institutions, the attendance of the students is taken manually, using an attendance sheet, by the faculty member in a classroom. The objective of this project is to minimize the time consumed in the process of monitoring the attendance of the students and to tackle the problem of proxy by almost eliminating the use of paper in the attendance taking process. Manually recorded attendance can be easily tampered with and manipulated. It is also not very easy to verify manual attendance. So, we are proposing a method that can estimate the attendance more precisely using all the results of face recognition, which are obtained by continuous observation. In this system, the enrollment of students will be a one-time process, Students may have their roll number or phone number as their unique ID, which should be unique for every student. Their images will be stored in the database. The attendance of the students will be tracked automatically for every hour. This system will overcome the problems that exist in manual or traditional attendance management systems.***

Keywords: Local Binary Pattern Histogram (LBPH), Convolutional Neural Network(CNN), Face Detection, Computer Vision(CV), Face Recognition, Support Vector Machine.

I. INTRODUCTION

The development of this system is aimed at accomplishing the digitization of the traditional system of recording attendance by the calling of names and by maintaining pen and paper records. These strategies of recording attendance are tedious and time-consuming, which is a very difficult task for the teachers. The purpose of building this attendance management system is to modernise the traditional methods of taking attendance. Automated attendance management system allows to take record of the presence of the students with minimal human efforts. In this paper, we have proposed a system that detects the faces of the students from the live videos of the classroom, and the attendance will be marked for the students whose detected faces are found in the database. This system takes minimum effort of the teachers and also saves the time of the class. In this system, we have used the Python module OpenCV. The OpenCV module has pre-trained classifiers for faces, eyes, etc. We can also create our own classifiers with OpenCV, as it comes with a trainer as well as a detector.

II. LITERATURE REVIEW

In paper [1], Jireh Robert Jam has designed a system, where the user can load an image and the system will automatically detect the number of faces on the image and will crop the faces from the image and store them in the database, that will be used for recognition of the faces. Viola-Jones Algorithm is used for face detection and Hidden Markov Models (HMM) and Singular Value Decomposition (SVD) for feature extraction and recognition of the faces. The algorithm gives 100% positive outcome with an image, however it totally depends on the illumination and frontal pose of the individuals. As the size of images is reduced to half, the detection rate fell to 62%. In order to best possible results, high resolution images with good illumination should be used, otherwise the system may not be able to get the best possible results.

In the research [2], the researchers Varsha Gupta and Dipesh Sharma had studied various Face Detection methods and algorithms, namely Viola Jones Face Detection Algorithm, Local Binary Pattern (LBP), AdaBoost Algorithm for Face detection, SMQT Features and SNOW Classifier Method, Neural Network Based Face Detection, and compared them on the basis of their advantages and disadvantages. Viola Jones algorithm gives fastest and accurate results, but take long training time and can't work properly in low illumination and darker faces. LBP has simple computation and is able to perform well in monotonic illumination changes, but can used only in greyscale and binary images.

In paper [3], the authors Sanmoy Paul and Sameer Kumar Acharya have studied about several algorithms for face recognition like, SVM, KNN, CNN.

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For detection of faces Haar Cascade algorithm is used. After the detection of human faces, PCA is applied to train and extract the distinct features of all the images, then the eigen faces are computed from the PCA components, then the facial recognition accuracies of SVM, CNN and KNN are compared. Through comparison, we get that KNN has lowest recognition accuracy and CNN yields the best. The accuracy of KNN is about 66%, accuracy of SVM was about 83% and the accuracy of CNN was 89% in the respective datasets. The biggest challenge in CNN is that, in order to achieve best recognition accuracy possible, the training dataset should be large.

In the paper [4], E. Francy Irudaya Rani, R. Vedhapriyavadhana, S. Jeyabala, S. Jothi Monika, C. Krishnammal, the authors have engineered an automated attendance system for lecturers to record student's using face detecting concepts. Automated attendance systems based on image processing techniques have been envisioned for the purpose of reducing the drawbacks in the manual systems. Here, the camera detects and recognizes the student that enters the door and sends their information to the admin to generate 3D Facial Model, then the system will update the attendance once the student's face is matched with the database. In addition to this, the system is designed in such a way that it will send the information of the students, who are absent, to the corresponding student house through messaging. This system can contribute a lot to improve the goodwill of any institution.

In research [5] S. H. Lin, an introduction of the face recognition technology is given. The paper covered the general structure of face recognition, the various components that may arise during recognition that affect the performance of the recognizer, and various face recognition algorithms. Several face recognition algorithms are briefly explained in this paper, such as: Eigen face, Neural Networks.

In study [6] Adrian Rhesa Septian Siswanto, Anto Satriyo Nugroho, Maulahikmah Galinium, the researchers had done research to get the best face recognition algorithm. The algorithms, which are provided by Open CV, PCA and LDA (eigenface and fisherface) are implemented and the ROC curve is compared. Based on the experimentation carried out by the researcher, it is concluded that the Eigenfaces approach is superior to the Fisherface approach.

In study [7] Mathana Gopala Krishnan, Balaji, Shyam Babu, to reduce the faculty effort and to manage the time effectively. The authors proposed automated attendance system using face recognition which is very useful for school and colleges for taking attendance. The system takes attendance for particular amount of time and after the time expires the system automatically closes the attendance. The system will recognize the face and saves the details regarding attendance in database automatically. System also includes the feature which is create the list of students who are absent in a particular day. The system uses the eigenface approach for face recognition. The method analyzes and computes eigenfaces which are faces composed of eigen-vectors. The method also compares the eigenfaces to identify the presence of a person and its identity.

In paper [8], the authors Abdul Matin, Firoz Mahmud, Tasnim Binte Shawkat, proposed two stages of authentication for recognizing a candidate. In the first stage, the candidate's face is matched with all stored faces and only a few best-matched samples are isolated to use as second stage training samples. Here in both stages, PCA is used for extracting significant features of the face. Proposed approach shows 1.5% better accuracy for ORL face database.

In Wei-Lun Chao's paper [9] on 'Face Recognition' general ideas and structures of recognition, important issues and factors of human faces, critical techniques and algorithms and their comparison are discussed.

III. METHODOLOGY

The task is to develop an attendance system for the students. The first step for this is to develop a simple and handy interface that will allow the user to capture the images; then the images will need to be pre-processed so that they are ready for feature extraction, after which the facial features will be extracted from the images; and finally, classification of the images will be done to determine the recognized faces.

In the base paper [3], we have seen that CNN had given the best results in the respective dataset. So, we studied the CNN and LBP algorithms in detail and computed their outcomes using this proposed approach in order to compare both their results.

On comparing the results of both algorithms on the same dataset, we have seen that LBP gives slightly better results than CNN. In order to increase the accuracy of the system and get over the false recognition rate, both LBP and CNN are used in the proposed approach. Since LBP and CNN are both different algorithms, they have different working principles. So, to ensure that the system is working to its full capacity, the face of an individual is classified as a recognized face only if it is identified by both algorithms, i.e., LBP and CNN.

As we have seen in our comparisons, the accuracy of LBP is slightly higher than CNN. So, the proposed algorithm is designed in such a way that the priority of LBP is higher than that of CNN; if there is no common outcome value between the results of CNN and LBP, then the system will not recognize any face.

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Volume 11 Issue I Jan 2023- Available at www.ijraset.com

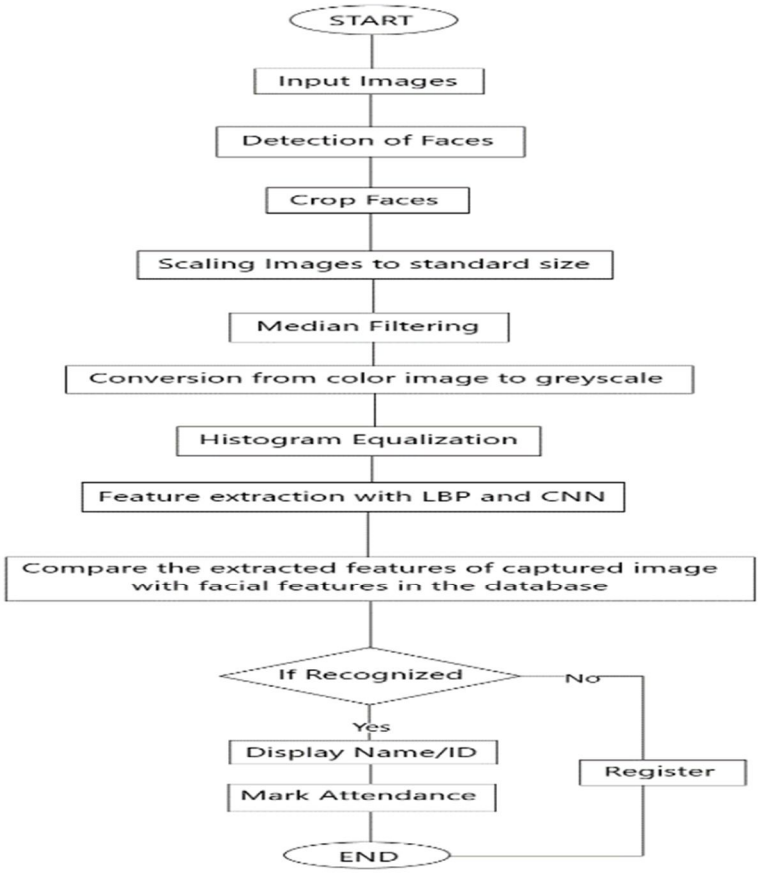


Fig.1 Flowchart of the system

For the training of the algorithm, first all input images will be taken or captured, then the faces will be detected from those photos, and the faces will be cropped from those photos and scaled to the standard size, i.e. 250x250. Then, median filtering will be done on the images, and if the images are colored, they will be converted to grayscale. After that, histogram equalization will be done, meaning the contrast of the images will be improved by stretching the range of their pixel intensity. Then the facial features will be extracted from the images using the discussed algorithm, and the extracted features will be stored in the database along with the students' names, IDs, and other details. so that this data can be used later on by the system to mark the attendance of the student by recognizing the faces and comparing the facial features with the features stored in the database. Attendance will be marked in a csv file if the face is recognized; otherwise, attendance will not be marked.

IV. IMPLEMENTATION

The key components that are used in the development of the project are the open source computer vision library (OpenCV), Tkinter, Pandas, Seaborn, and Python's csv module, which will be implemented in the Python programming language. The algorithms that are going to be used are LBP and CNN. The input images will be taken from the captured video frames of the camera, then the faces will be detected from the images captured, and faces will be cropped and scaled, after which median filtering, then the images will be converted into greyscale, then facial features will be extracted from the images, which will be stored in the database along with the particulars of the respective students and will be later used to compare and mark the presence of the students in the class.

OpenCV is the module with which the system will first take the images of the student and then store them in the database so that they can be used for face recognition, which allows the system to detect the faces and mark the attendance, given that the camera is turned on.Tkinter is the standard GUI library for Python. When tkinter is combined with Python, it provides a fast and easy way to create GUI applications. It provides various functions, such as buttons, canvas, labels, text-boxes, etc.

The python CSV module is used to upload the recorded attendance details in a sheet in csv format. Several other modules and libraries of Python are used to make the system more efficient and better.

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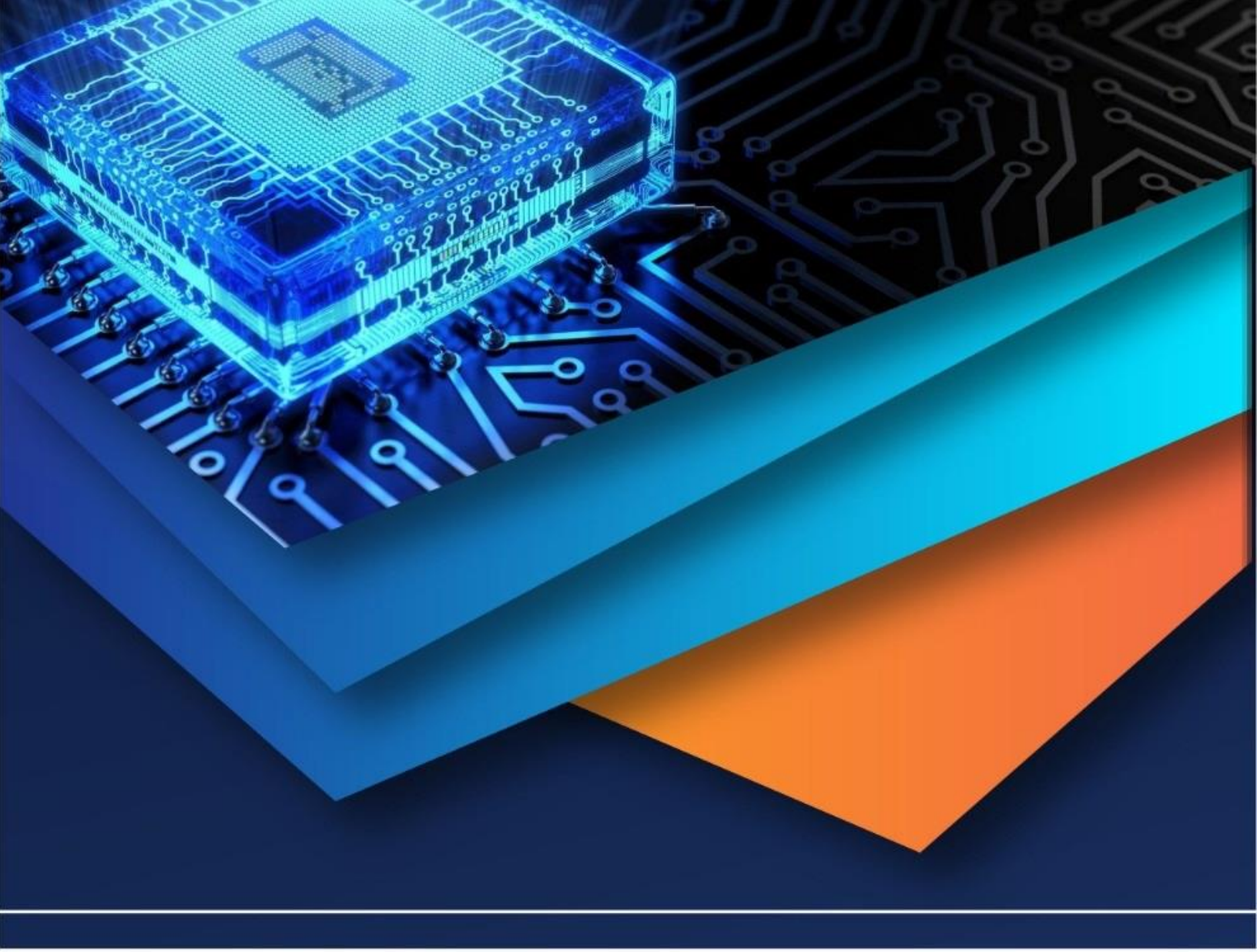
V. CONCLUSION

This system is designed to reduce the errors that occur in manual attendance recording system and to save the precious time of the class. So, an automated attendance management system for the students is thoroughly described in this paper. This system provides high-precision, real-time evaluation and maintenance of records. The proposed approach provides a method to identify the students by comparing their input images obtained from the frames of the recorded or live video with the facial features in the database used to train the system. The extraction of facial features and the recognition of faces are performed by both algorithms, i.e., LBP and CNN. Although we should use our own database for the development of the system, Yale's face database is also considered here to check and test the functioning of the system since it is easily available publicly. This system can also be modified and used for crime prevention, person verification, and other similar purposes.

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