FACE RECOGNITION BASED ATTENDANCE SYSTEM

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ABSTRACT

In this digital era, face recognition system plays a vital role in almost every sector. Face recognition is one of the mostly used biometrics. It can used for security, authentication, identification, and has got many more advantages. Despite of having low accuracy when compared to other techniques such as iris recognition, fingerprint recognition etc., it is being widely used due to its contactless and non-invasive process. Furthermore, face recognition system can also be used for attendance marking in schools, colleges, offices, etc. This system aims to build a class attendance system which uses the concept of face recognition as existing manual attendance system is time consuming and cumbersome to maintain. And there may be chances of proxy attendance. Thus, the need for this system increases. This system consists of four phases- database creation, face detection, face recognition, attendance updation.

Database is created by the images of the students in class. Face recognition, fingerprint recognition, and other biometric authentication methods are gradually becoming the most promising means for identifying a person's face. We can use them in our phones, laptops, offices, and other devices. However, candidates' attendance is still taken manually, which takes a long time and is extremely inefficient. To preserve that valuable time, we needed an automated operating attendance system that eliminated all of the drawbacks of collecting attendance on paper. We're putting together a system that's both efficient and dependable. Using OpenCV, we created a face recognition-based attendance system. We can apply our attendance system anywhere, not just for students. For face detecting and recognizing, the Haar Cascade algorithm is utilized.

The main purpose of this project is to build a face recognition-based attendance system for educational institution to enhance and upgrade the current attendance system into more efficient and effective as compared to before. The current old system has a lot of ambiguity that caused inaccurate and inefficient of attendance taking. Many problems arise when the authority is unable to enforce the regulation that exist in the old system. The technology working behind will be the face recognition system. The human face is one of the natural traits that can uniquely identify an individual. Therefore, it is used to trace identity as the possibilities for a face to deviate or being duplicated is low. In this project, face databases will be created to pump data into the recognizer algorithm. Then, during the attendance taking session, faces will be compared against the database to seek for identity. When an individual is identified, its attendance will be taken down automatically saving necessary information into a excel sheet. At the end of the day, the excel sheet containing attendance information regarding all individuals are mailed to the respective faculty.

Keywords-

Face Recognition, Face Detection, Haar-Cascade classifier, Local Binary Pattern Histogram, Attendance system, Automated attendance, Image Processing, Face detection, Feature matching, Face recognition, OpenCV, NumPy.

1. INTRODUCTION

Traditional method of attendance marking is a tedious task in many schools and colleges. It is also an extra burden to the faculties who should mark attendance by manually calling the names of students that might take some amount of time of the entire session. This is time consuming task.

Apart of it there are some chances of proxy attendance. Therefore, many institutes started deploying different other techniques for recording attendance like use of Radio Frequency Identification (RFID), iris recognition, fingerprint recognition and so on.

However, these systems are queue based which might consume more time and are intrusive in nature.

Face recognition has set an important biometric feature, which can be easily acquirable and is non-intrusive. Face recognition-based systems are relatively oblivious to various facial expression.

Human face plays an important role in our day-to-day life mostly for identification of a person. Face recognition is a part of biometric identification that extracts the facial features of a face and then stores it as a unique face print to uniquely recognize a person. Biometric face recognition technology has gained the attention of many researchers because of its wide application. Face recognition technology is better than other biometric based recognition techniques like finger-print, palm-print, iris because of its non-contact process. Recognition techniques using face recognition can also recognize a person from a distance, without any contact or interaction with person. The face recognition techniques are currently implemented in social media websites like Facebook, at the airports, railway stations etc.

Face recognition system consists of two categories: verification and face identification. Face verification is a one-to-one matching process. It compares face image against the template face images and in a 1 to N problems that compares a query face images.

The face identification is responsible to check whether the face marches or not i.e., to determine whether the face is valid or not.

The purpose of this system is to build an attendance system which is based on face recognition techniques. Here face of an individual will be considered for marking attendance. Nowadays, face recognition is gaining more popularity and has been widely used. In this paper, we proposed a system which detects the faces of students from live streaming video of classroom and attendance will be marked if the detected face is found in the database. This new system will consume less time than compared to traditional methods.

But currently most of the facial recognition techniques is able to work fine only if the number of people in one frame is very few and under controlled illumination, proper position of faces and clear images. For face recognition purpose, there is a need for large data sets and complex features to uniquely identify the different subjects by manipulating different obstacles like illumination, pose and aging. During the recent few years, a good improvement has been made in facial recognition systems. In comparison to the last decade, one can observe an enormous development in the world of face recognition. Currently, most of the facial recognition systems perform well with limited faces in the frame. Moreover, these methodologies have been tested under controlled lighting conditions, proper face poses and non- blurry images. The system that is proposed for face recognition in this paper for attendance system is able to recognize multiple faces in a frame without any control on illumination, position of face.

Some of the drawbacks of the Existing System:

Cost→ The cost of implementing facial recognition attendance systems can be high, especially for smaller organizations with limited budgets.

Accuracy→ Despite the accuracy of the technology, there are still chances of errors in facial recognition systems. This can result in incorrect attendance records, which can create confusion and affect overall attendance management.

Privacy Concerns→ Facial recognition technology has been subject to criticism due to concerns regarding privacy, particularly regarding the collection and use of biometric data.

Security→ If facial recognition attendance systems are not properly secured, they can be vulnerable to hacking and other cyber-attacks. This can result in unauthorized access to sensitive information, such as attendance records.

Dependence on Technology→ Facial recognition attendance systems can be susceptible to technical glitches, which can cause delays and disrupt the attendance management process. Additionally, if the technology fails, alternative attendance tracking methods may not be in place.

Cultural sensitivity→ Facial recognition systems may not be effective for individuals with certain facial features or those who wear religious attire that covers their face, which can lead to discrimination and exclusion.

2. LITERATURE SURVEY

It is a proposed model of an automated attendance system. The model focuses on how face recognition incorporated with Radio Frequency Identification (RFID) detect the authorized students and counts as they get in and get out form the classroom. The system keeps the authentic record of every registered student. The system also keeps the data of every student registered for a particular course in the attendance log and provides necessary information according to the need. In this paper author has designed and implemented an attendance system which uses iris biometrics. Initially, the attendees were asked to register their details along with their unique iris template. At the time of attendance, the system automatically took class attendance by capturing the eye image of each attendee, recognizing their iris and searching for a match in the created database. The prototype was web based. The author has proposed an attendance system based on facial recognition. The algorithms like ViolaJones and Histogram of Oriented Gradients (HOG) features along with Support Vector Machine (SVM) classifier were used to implement the system. Various real time scenarios such as scaling, illumination, occlusions and pose was considered by the authors. Quantitative analysis was done on the basis of Peak Signal to Noise Ratio (PSNR) values and was implemented in MATLAB GUI. Author in this research to get best facial recognition algorithm (Eigenface and Fisherface) provided by the Open CV 2.4.8 by comparing the Receiver Operating Characteristics (ROC) curve and then implemented it in the attendance system. Based on the experiments carried out in this paper, the ROC curve proved that, Eigenface achieves, better result than Fisherface.

System implemented using Eigenface algorithm achieved an accuracy rate of 70% to 90%.

The author has proposed a method for student attendance system in classroom using face recognition technique by combining Discrete Wavelet Transforms (DWT) and Discrete Cosine Transform (DCT). These algorithms were used to extract the features of student's face followed by applying Radial Basis Function (RBF) for classifying the facial objects. This system achieved an accuracy rate of 82%.

3. PROPOSED SYSTEM

All the students of the class must register themselves by entering the required details and then their images will be captured and stored in the dataset. During each session, faces will be detected from live streaming video of classroom. The faces detected will be compared with images present in the dataset. If match found, attendance will be marked for the respective student. At the end of each session, list of absentees will be mailed to the respective faculty handling the session.

The system architecture of the proposed system is given below,

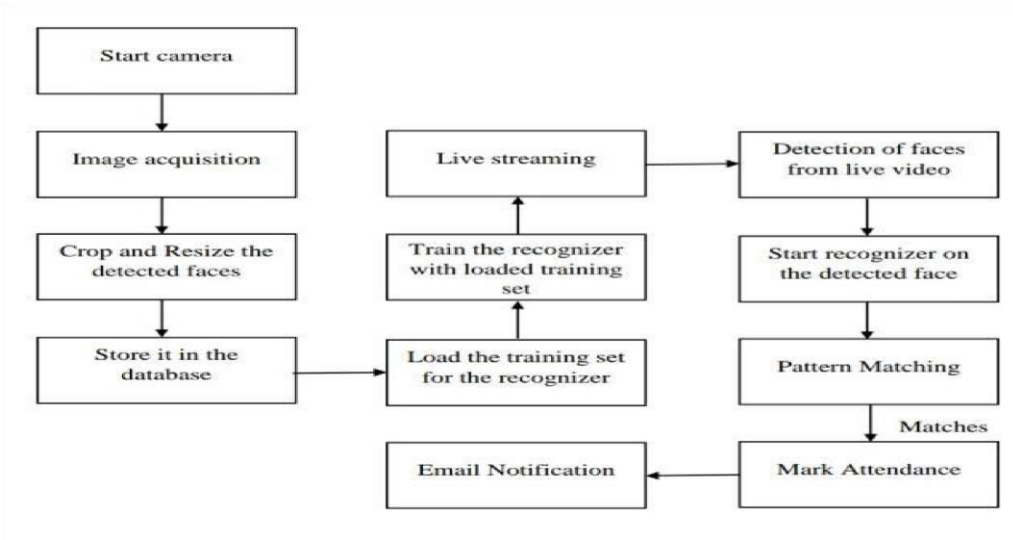


Figure-1: Architecture of Proposed System

This process can be divided into four stages,

1. Dataset Creation

Images of students are captured using a web cam. Multiple images of single student will be acquired with varied gestures and angles. These images undergo preprocessing. The images are cropped to obtain the Region of Interest (ROI) which will be further used in recognition process. Next step is to resize the cropped images to particular pixel position. Then these images will be converted from RGB to gray scale images. And then these images will be saved as the names of respective student in a folder.

2. Face Detection

Face detection here is performed using Haar-Cascade Classifier with OpenCV. Haar Cascade algorithm needs to be trained to detect human faces before it can be used for face detection. This is called feature extraction. The Haar cascade training data used is an xml filehaarcascade_frontalface_default.

The haar features shown in Fig.2. will be used for feature extraction.

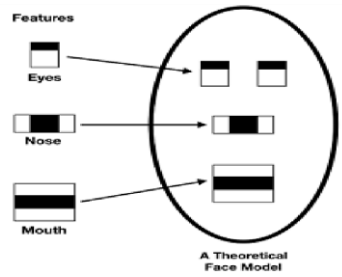


Figure-2: Haar Features

Here we are using detect Multi Scale module from OpenCV. This is required to create a rectangle around the faces in an image. It has got three parameters to consider- scale Factor, minimum Neighbors, minimum Size. Scale Factor is used to indicate how much an image must be reduced in each image scale. Minimum Neighbors specifies how many neighbors each candidate rectangle must have. Higher values usually detect less faces but

detects high quality in image. Minimum Size specifies the minimum object size. By default, it is (30,30) [8]. The parameters used in this system is scale Factor and minimum Neighbors with the values 1.3 and 5 respectively.

3. Face Recognition

Face recognition process can be divided into three steps prepare training data, train face recognizer, prediction. Here training data will be the images present in the dataset. They will be assigned with an integer label of the student it belongs to. These images are then used for face recognition. Face recognizer used in this system is Local Binary Pattern Histogram. Initially, the list of local binary patterns (LBP) of entire face is obtained. These LBPs are converted into decimal number and then histograms of all those decimal values are made. At the end, one histogram will be formed for each image in the training data. Later, during recognition process histogram of the face to be recognized is calculated and then compared with the already computed histograms and returns the best matched label associated with the student it belongs to.

4. Attendance Updation

After face recognition process, the recognized faces will be marked as present in the excel sheet and the rest will be marked as absent and the list of absentees will be mailed to the respective faculties. Faculties will be updated with monthly attendance sheet at the end of every month.

4. METHODOLOGY

The Software Requirement Specification (SRS) is aimed at defining the necessary functionalities and Uniform Resource Locator (URL) for the Intelligent Network Backup Tool. It intends to establish a clear understanding of the final product's features and specifications as envisioned by both the development team and the client. The requirement statements are prioritized and detailed in this document. It targets project developers, managers, users, testers, and documentation writers, providing them with information on design and implementation constraints, external interface requirements, system features, non-functional requirements, and dependencies. Identifying needs is crucial for businesses and organizations to evaluate their market performance and maintain a competitive edge.

a) Architecture of the proposed system

The proposed system seeks to automate the existing manual attendance system by utilizing face recognition technology. Its main objective is to capture and store each student's face for attendance purposes. Accurate detection of all facial features during the image capture process is vital. With facial recognition steps applied to the captured image, teachers no longer have to take attendance manually during class. This paper tackles the challenges commonly associated with manual attendance systems. To detect faces, Haar Cascade classifiers are utilized, while the Local Binary

Pattern Histogram (LBPH) algorithm is used to recognize student faces.

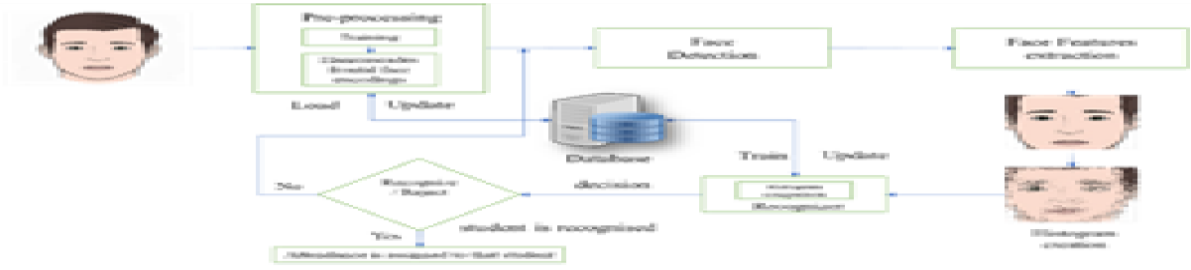


Figure-3: System Architecture

The proposed system for Face Recognition based Classroom attendance system. The system requires a camera installed in the classroom at a position where it could capture all the students in the classroom and thus capture their images effectively.

This image is processed to get the desired results.

b) Algorithms and Flow Diagrams

Face detection uses classifiers, which are algorithms that detect what is either a face (1) or not a face (0) in an image. It is a machine learning based approach where a cascade function is trained from a lot of positive (images of faces) and negative images (images without faces).

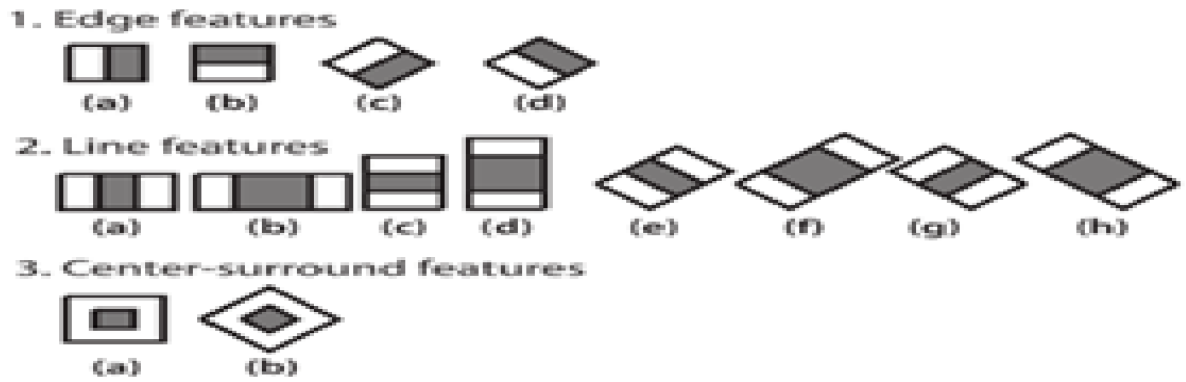


Figure-4: Feature Extraction

In feature extraction, the algorithm uses training data to best identity features that it can consider a face.

c) Local Binary Pattern Histogram (LBPH) Algorithm

The Local Binary Pattern (LBP) was initially introduced in 1994 and has proven to be an influential character in texture classification. Studies have shown that the combination of LBP with histograms of oriented gradients (HOG) descriptor significantly enhances detection accuracy for certain datasets. By utilizing LBP in combination with histograms, we can create a straightforward data vector to represent facial images.

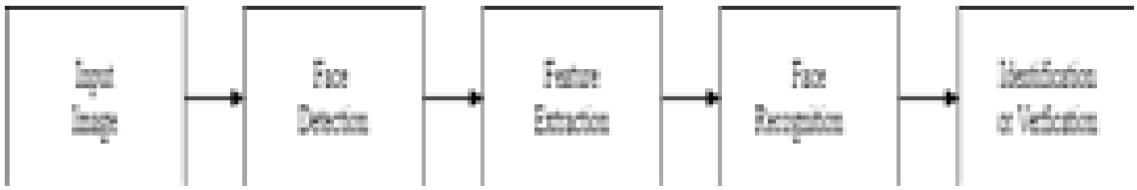


Figure-5: General Face Recognition Structure

The provided flow diagram depicts the image captured by the camera as the input, which is then subjected to the face detection algorithm to convert the original image into a grayscale image for feature extraction. Next, the input image undergoes a comparison process with the current image, utilizing verification and identification techniques to ensure a dependable recognition outcome.

d) Applying the LBPH Operations

The first step in LBPH computation is to produce an intermediate image that enhances the original image by highlighting the facial features. The algorithm utilizes a sliding window method, which relies on the radius and neighbor parameters, to achieve this objective.

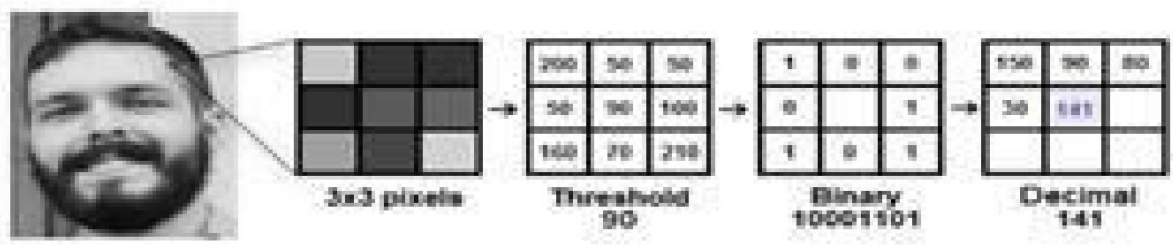


Figure-6: LBPH operation

Based on the image above, let's break it into several small steps so we can understand it easily:

From a grayscale facial image, we can extract a 3x3 pixel window.

The window can be represented as a 3x3 matrix that includes the intensity values of each pixel, ranging from 0 to 255.

The central value of the matrix acts as the threshold, used to define new values from its eight neighbors.

For each neighbour of the central value, we assign a new binary value based on whether its intensity is equal to or greater than the threshold. If it is, we set the binary value to 1; otherwise, we set it to 0.

The matrix now contains only binary values (excluding the central value), which we concatenate line by line into a new binary value (e.g., 10001101). Note that the approach for concatenating binary values may vary among different authors (e.g., clockwise direction), but the outcome will remain the same.

Next, we convert the binary value to a decimal value and set it as the central value of the matrix, which corresponds to a pixel from the original image.

Following this LBP (local binary pattern) procedure, we obtain a new image that better highlights the facial characteristics of the original image.

e) Extracting the Histograms

To further process the image, it is divided into multiple rectangular regions using Grid X and Grid Y parameters. Each region is analyzed to generate a histogram based on the frequency of LBP codes found within that particular region. This process is repeated for each grid in the image to obtain a set of histograms that represent the distribution of LBP features for each region. As the image is ingrayscale, each histogram will contain 256 positions (0~255) that represent the frequency of pixel intensity occurrences in the respective region. After generating histograms for each region of the image, the next step is to concatenate them to create a larger, overall histogram. If we have an 8x8 grid, for example, the final histogram will contain 8x8x256=16,384 positions. This final histogram encapsulates the essential characteristics of the original image.

f) Performing the Face Recognition

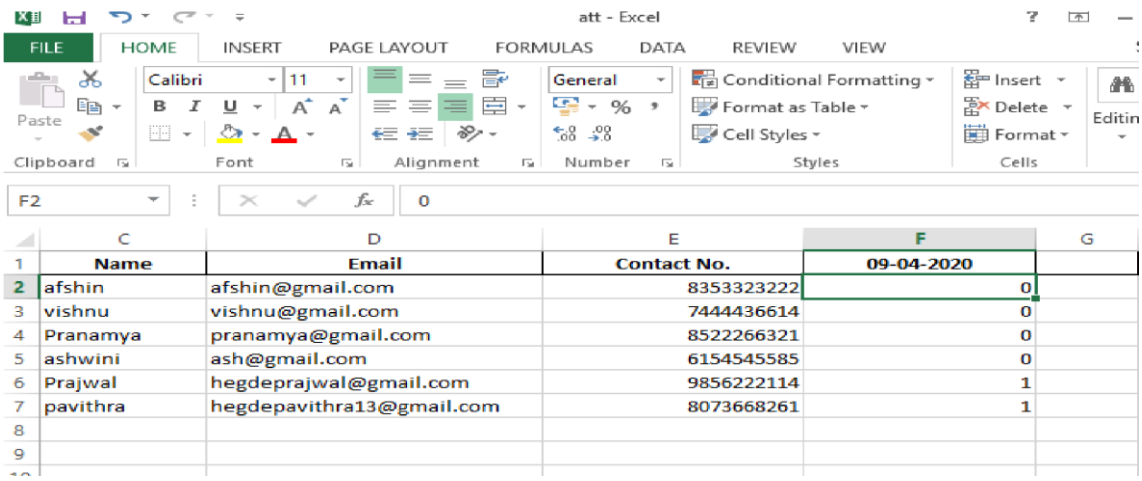
In this stage, the algorithm has completed its training process. Each histogram generated during training represents an image in the training dataset. To recognize a new input image, we repeat the same steps as before, creating a histogram that represents its features. We can then compare this histogram to the histograms in the training dataset to find the closest match. Several approaches can be used to compare histograms and calculate the distance between them, such as Euclidean distance, chi-square, absolute value, and others. In this case, we can use the Euclidean distance formula, which is a commonly used method.

The output of the algorithm is the ID of the image that has the closest histogram to the input image. Additionally, the algorithm should provide the calculated distance between the histograms, which serves as a

measure of 'confidence'. It is important to note that a lower 'confidence' score is better because it indicates that the distance between the histograms is closer, and thus, the images are more likely to be a match.

5. RESULT & DISCUSSION

The users can interact with the system using a GUI. Here users will be mainly provided with three different options such as, student registration, faculty registration, and mark attendance. The students are supposed to enter all the required details in the student registration form. After clicking on register button, the web cam starts automatically and window pops up and starts detecting the faces in the frame. Then it automatically starts clicking photos until 60 samples are collected or CRTL+Q is pressed. These images then will be pre-processed and stored in training images folder. The faculties are supposed to register with the respective course codes along with their email-id in the faculty registration form provided. This is important because the list of absentees will be ultimately mailed to the respective faculties. In every session, respective faculty must enter their course code. Then after submitting the course code, the camera will start automatically. The face recognition window where two registered students are recognized and if in case, they were not registered it would have shown 'unknown'. By pressing CTRL+Q, the window will be closed and attendance will be updated in the excel sheet and names of absentees will be mailed to the respective faculty.



	C	D	E	F	G
1	Name	Email	Contact No.	09-04-2020	
2	afshin	afshin@gmail.com	8353323222	0	
3	vishnu	vishnu@gmail.com	7444436614	0	
4	Pranamya	pranamya@gmail.com	8522266321	0	
5	ashwini	ash@gmail.com	6154545585	0	
6	Prajwal	hegdeprajwal@gmail.com	9856222114	1	
7	pavithra	hegdepavithra13@gmail.com	8073668261	1	
8					
9					

Figure-7: Attendance sheet

The Figure 7 shows the attendance sheet updated after recognition process.

Recognized students are marked as '1' and absent students are marked as '0'. The list of absentees will be mailed to the respective faculty email-id.

6. CONCLUSION

The proposed system is designed to provide an automated attendance system for lectures, sections, and laboratories, allowing lecturers or teaching assistants to easily record student attendance. By utilizing face detection and recognition algorithms, this system saves time and effort, especially in classes with a large number of students. This automated system can improve an institution's goodwill by reducing drawbacks in the traditional manual system. Through thorough testing of the face detection and recognition algorithms, student attendance is marked by recognizing their face and storing the data in an attendance sheet. The system was developed from requirements to a complete system, including evaluation and testing, and achieved its objectives to the satisfaction of the client. Although some challenges were encountered during implementation, they were addressed and resolved. Strategies for future work and improvements to the system are discussed in this section.

Before the development of this project. There are many loopholes in the process of taking attendance using the old method which caused many troubles to most of the institutions. Therefore, the facial recognition feature embedded in the attendance monitoring system can not only ensure attendance to be taken accurately and also eliminated the flaws in the previous system. By using technology to conquer the defects cannot merely save resources but also reduces human intervention in the whole process by handling all the complicated task to the machine. The only cost to this solution is to have sufficient space in to store all the faces into the database storage. Fortunately, there is such existence of micro SD that can compensate with the volume of the data. In this project, the face database is successfully built. Apart from that, the face recognizing system is also working well. At the end, the system not only resolve troubles that exist in the old model but also provide convenience to the user to access the information collected by mailing the attendance sheet to the respected faculty.

FUTURE WORKS

The attendance marking system we have developed is successful in automatically recording attendance and generating an excel sheet in real-time. However, in order to create a dedicated system for educational institutions, a highly efficient algorithm that is not affected by varying lighting conditions in classrooms is necessary. Additionally, the system must utilize a camera with an optimal resolution. Another area for improvement is creating an online attendance database with automatic updates. This can be accomplished by installing a standalone module in the classroom with wireless internet access. Implementing these improvements would greatly enhance the functionality and usefulness of the paper.

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