IoT based Cloud Integrated Smart Classroom for Smart and A Sustainable Campus

Zehra Mohammed Inayathulla[1]
PG Student (M.tech)– DCN, Dept of ECE
GSSSIETW, Mysore
Karnataka, India

Smt. Shyamala. C [2]
Assistant Professor, Dept of ECE
GSSSIETW, Mysore,
Karnataka, India

***Abstract*: This paper introduces the smart technological applications which mainly deals with face recognition attendance monitoring system, device switching operation as well as location tracking system. The main idea behind developing this method is through the cloud integrated IoT operation. IoT(Internet of things) is the networking of physical objects that are embedded with sensors, software and other technologies for connecting and exchanging of data over internet. Furthermore, this integrated technology is hence been implemented to provide a smart and sustainable campus. IoT enabled devices finds simpler mechanisms thereby connecting digitally to ensure smart environment in schools and colleges. This project ensures the best method for student's attendance monitoring i.e, facial recognition technique as well as the controlling mechanism of devices in a classroom remotely and mapping of location throughout the campus.**

Keywords: Face recognition, IoT (Internet of things), Cloud Computing, Haar cascade algorithm.

I. INTRODUCTION

Internet of Things provides the attention in developing a modern technological aspect in schools and colleges. In this era, the idea of implementation of different comprehensive methods provides the concept of smart campus as well as a sustainable environment. Many schools, colleges, universities have been cultured with the idea behind the "new digitalization". The education system has been changed with the advancement in technologies. Classrooms are changed with the new teaching skills such as projectors and digital systems. To improvise the demand of getting simpler and better technology has been evolved in larger aspects. Hence, nowadays with the ever rising growth and development in the world IoT has taken a major contribution. The use of digital multimedia operation, networking and communication systems worldwide which marked the beginning of new internet world. Communication has been mainly developed through the internet of things. This technology provides the effective communication and controlling mechanism while being remotely located.

This paper focuses on handling the student's attendance database depending on the facial recognition method. Thus eventually it has been effective in managing the databases automatically [1]. The other set of application is the control of appliances which is regardless of wastage of electricity when there is no usage of such devices. Through the IoT cloud computing method, such appliances in a classrooms can be distantly monitored and controlled. This paper also focuses on the location mapping application wherein the location can be tracked easily by the visitors or the respective unknown people visiting the college [3]. This is mainly useful for the large campuses where each of the area of the campuses such as cafeteria, library, principal office, office rooms and many classrooms can be tracked. Due to the advancement in technology and modern developed school systems there is a need of change in the methods which can be found to make simpler and smarter[2] ,[5] . Hence, the location tracking systems are maintained with the use of mobile app which is connected via internet.

II. EXISTING SYSTEM

Nevertheless, there are some researches that report the development of smart classrooms wherein the attendance monitoring systems are found to be less productive with the implementation of biometric systems. This may be noted that sometimes there is lack of data when the fingerprint is correctly not been identified by such operation and sometimes when the fingers of the user can be rough where the fingerprint operation is delayed due to the lack of recognition in the biometric and such systems can create the time inefficiency where some of the schools and colleges are strict in monitoring the attendance. Earlier the researchers have developed with the RFID tags for individual students which causes the wastage of time which is spent on particular student. Hence, an automatically detection of particular student is mainly used to show the accurate time management and no loss of data. The other application that reports in the paper such as device control application and location mapping have found to be new , simper and better than other existing systems.

III. PROBLEM STATEMENT

Education has been crucial issue all over the world due to its contribution to the development in the society. This project aims at developing an efficient smart classroom system which is simpler and easier. Thereby this type of IoT based system counters the drawbacks of other existing system which does not perform well with the digital features. Also the user information is not in automatic and is not in application mode.

IV. PROPOSED SYSTEM

Different from the other previous works, the proposed model is designed to obtain and maintain the time management efficiency and reliability. In first application, this paper is associated to design and implement a system which is more competent towards the change in old attendance monitoring systems with all the features of sensitivity, illumination, rotational and scalability which is vigorous enough to be implemented in practical applications.

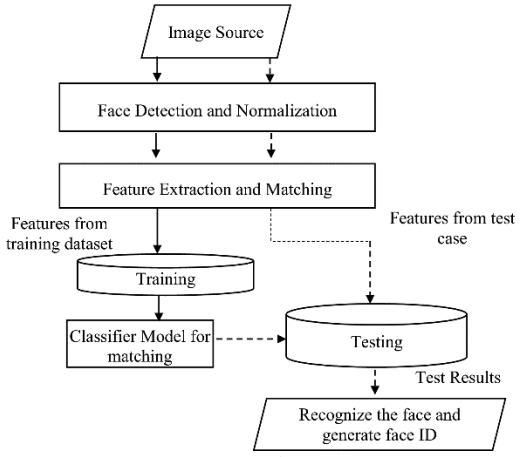

Figure 1: Block diagram for system architecture

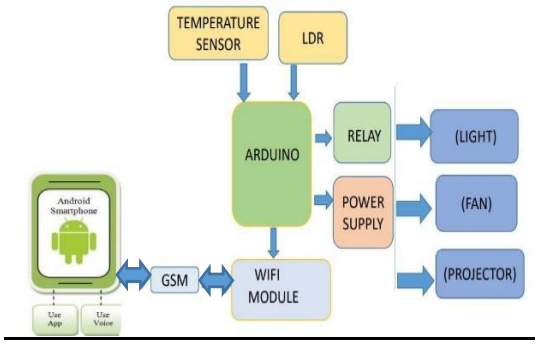

Figure 2: Block diagram for device controlling using IoT

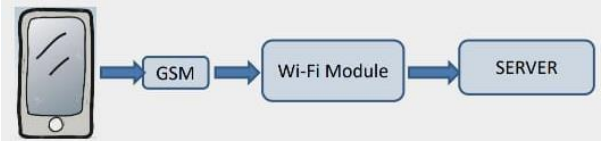

Figure 3: System block diagram of location mapping

A Facial recognition attendance system uses facial recognition technology to identify a person using the person's facial features and automatically mark the attendance which is as shown figure 1. The second application include device control operation which defines the process of controlling the device in accordance to the user needs as shown Figure 2. Hence, the devices include fans, lights, projectors etc, which can be controlled remotely. The other application is the location mapping which is used to physically locate and electronically record and map the campus as shown Figure 3. With the use of Arduino Uno, which is an open source simple microcontroller helps to control many devices automatically and flexibly.

V. IMPLEMENTATION

A Facial recognition attendance monitoring system:

At the moment, most of the attendance marking systems are still being developed in universities where attendances are handwritten on a piece of paper. On contrary to the classes with large number of strength of students in tutorial and laboratory sessions ,with different subjects, found to be regardless wherein the students sometimes have to sign on the attendance sheets for their confirmation of their true presence. Hence, this would rather be more tedious and exhaustive methods wherein large amount of time is lost in marking the attendance rather than focusing on the subjects both for the students and lecturers. This method is not flexible since there are chances of loss of attendance data.

It may be noted that due to this drawback of old systems researchers have introduced the RFID tags and biometric applications but these too have the several drawbacks since particular person sometimes waste their time and energy in accessing the tags and fingerprint operations. Hence, The automatic updates of attendance marking system is obtained with the facial recognition where the previously data stored is been updated with the facial recognition. In each of the classroom the camera is incorporated at the entrance of the door where in images of the students are captured and hence identified through the Haar cascade algorithm. Then the student's data is matched with the presence and automatically the data is updated in the attendance sheets. This camera is connected to the accessible devices such as laptop or desktops in classrooms and thus the information is processed after identification, whereas if a particular student is absent then the notification is sent to the following candidate's guardian through mail or phone record

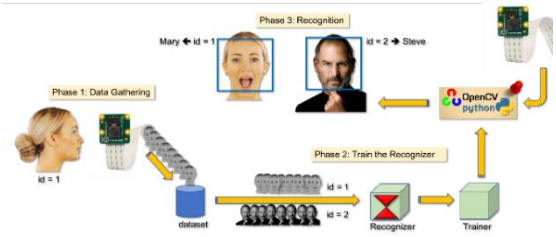

Figure 4: Face recognition implementation.

This system model can be differentiated into three working modules.

1. Face representation
2. Feature extraction
3. Classification

The first task involved is modelling a face. The faces representation is determined in the next two steps. The image obtained is transformed to match the different positions of images which are already present. The feature extraction determines the features of the face which are mapped as histograms. The last step involved is recognition of a familiar face. The system compares the faces captured in the camera with databases that are already stored.

The method presented in this paper is marking attendance using face recognition technique. As shown in Figure, the attendance is recorded by streaming the video of students with the help of a camera, that detect the faces in the image using the Haar cascade algorithm and then it compares the detected faces with the student database and marks the attendance. The attendance gets marked in a spreadsheet which gets converted into PDF file which is then mailed to the concerned e-mail Ids.

- Haar Cascade Algorithm*:*

Haar cascade algorithm is a machine learning based approach where lot of positive and negative images are used to train the

classifier. Hence, each image is trained to develop an effective detection and extraction with the software open CV platform

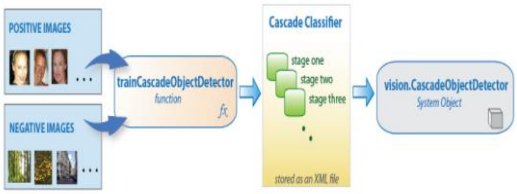

Figure 5: Haar cascade algorithm

- Open CV*:*

Open Source Computer Vision Library is an open source computer vision and machine learning software tool. Open CV was built to provide the common attribute for computer vision applications. Open CV makes it easy to utilize and modify the code. The library has more than 2500 algorithms that are optimized, which can be used to identify and recognize the faces, objects and classify the human actions in videos, track moving objects and track the camera movements. It has interfaces such as C++, Python MATLAB and java, as well as supports Windows, Linux, Mac OS and Android. In this model, Python is taken as programming interface with open CV.

- Python:

Python is associated with multiple programming paradigms including structured, object oriented and functional programming. It is generally required for code readability which is more suited for the IoT applications. Design and code interface can be easily accessed with the Open CV platform. Its object oriented approach is to help users to analyse the logical codes in a better way.

B Device Controlling Using IoT:

Smart classroom, can be defined as the classroom equipped with the technology to help teaching and learning. It may be noticed, that from entering the class to leaving it much of the time teacher is engrossed in many of secondary nature jobs such as taking the attendance which consumes so much of the time and after that adjusting the lighting of the room, projectors etc. Thus teacher is left with a portion of the allotted time which in much cases is not suffice. To eliminate this drawback of olden school system smart classroom it would be the best rectification. It will be possible to control the switching operations such as light, fans, projectors etc as well as automatic attendance monitoring operations.

Even it allows the user to remain updated through mails and notifications. This model is based on the simplest smart automation system prototype which ranges from controlling of electrical devices in the room to the location mapping. This application can also be accessed on the local server with the help of routers that needs to be installed in every classroom and lecture halls. The concerned authorities would be accessing this application remotely. In this application there is a use of simple Arduino Uno microcontroller where controlling of electrical devices will take place, The lines of light, fans and projector are given to the different pins of Arduino Uno. The respective android app is used to command the Arduino Uno which is thereby connected to the different devices. There is a need of LM35 temperature sensors and LDR sensors in designing of this model. The temperature of the particular area is thoroughly monitored in control of devices whereby the need of fans in accordance to the user's needs and absence could be accessed eventually at some particular threshold value. The same method is applied to the other appliances such as lights and projectors where the light intensity is monitored via light sensors. Henceforth, this is featured with the remarkable automatic and remotely controlling application which is via IoT based computing system.

C. Location mapping in a smart campus

In this evolution from simple handheld mobile phones, today's smart phones have voyaged a long journey. Location mapping in a smart campus serves with the common interests and keeping the cost of service as low as possible is among its objective. The simplicity in the model development creates a larger demand in user's interest. Location mapping is referred to the technologies that physically locate and electronically record and map the particular area of the campus or universities. There are some cases where large infrastructures are built in the universities. There are numerous researches focusing on creating and developing the location maps in a smart campus to benefit the users for exploring the campus.

Figure 6: Location mapping general overview

The emergence of mobility platform, scope of its application in real world and the availability of API's opportune the users to explore rapidly evolving ideas and make them a reality. The main objective of this paper is to develop a smart phone application that guides the users in finding a certain location on a map such as classrooms, library, cafeteria, offices, laboratories etc. In this model, android application such as location map is generated via Blynk app through Wi-Fi module ESP8266 with its advance features and accessibility. The system will generate a route map for the user so that the user feels easy to find the location. Thus, it forms a guidance to the user which makes an extra features on an Android phone. Location of the places is navigated with Wi-Fi access points as well as the mobile apps deployed in the smart campus. As on today, there are multiple solutions spanning different technologies to create a smart campus. The evolution of the wireless networks and the GSM modules provided a significant remarkable history in development of smart architecture in campuses and the universities. The flexible communication based mobile

networking is achieved with the invention of smart location mapping via IoT. The smart campus with the advance location mapping systems is envisioned to provide a better guidance and support in contrast to the user's identity which is based on the easy accessibility anywhere and everywhere throughout the campus alignment.

VI. RESULTS

A. Facial recognition mechanism:

(a) Image acquisition**:**

The first step involved in the face recognition attendance monitoring system is the image acquisition where the images are captured at the moment, when a particular person is physically present in front of the camera. It depicts the flow of the image processing techniques which is accessed throughout the complete execution of attendance monitoring.

(b) Image enhancement:

The next process include Image enhancement which is the improvisation of the quality and information content of original data before processing.

(c) Image recognition:

Image recognition is the identification of a particular face or an object which is developed after detection of an image .This task is performed with the training of an image. The training of an image is achieved by the Haar cascade algorithm where it depicts the analysis of the some of negative and positive images.

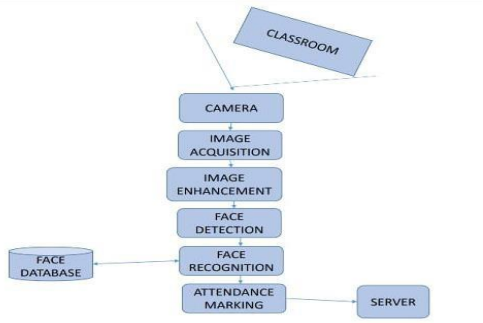

Figure 6: Flow diagram of Face recognition mechanism

(d) Face databases:

Face databases are generated earlier with the intimation of student's particular ID, name and the phone number such that email Id can also be include for the notification and updates.

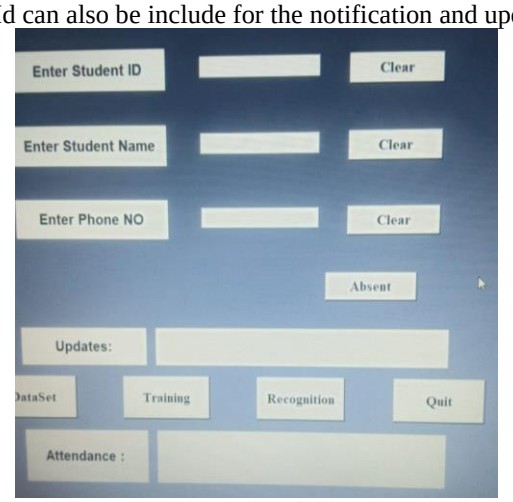

Figure 7: Database of the student

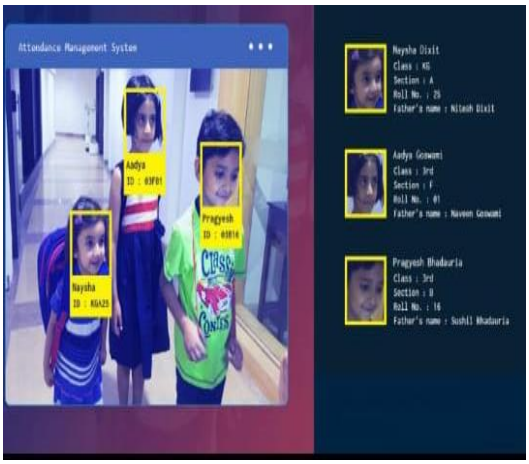

Figure 8: Image captured according to the database

The above processes as shown in figure 7 and 8 are in a flow on contrary to the attendance monitoring and maintenance also the information can be remotely accessed via automated IoT networks

B. Device control mechanism:

The device control operation is the functioning criteria of the devices or appliances associated with communication and networking features which is through an android smartphone and a WiFi module along with the different types of sensors. The microcontroller Arduino Uno is deployed in this model to provide the switching mechanisms. This include the light and fan control noting with the changes of particular threshold temperature as well as light intensity measures. The devices are operated via relay (which acts as a switch) automatically when the signals are passed through the Arduino depending on the sensors. This application is useful in large campuses where there is less manual work. The condition of the classroom is thoroughly monitored by the sensors depending on the darkness and brightness features of the light intensities also the same exists with the temperature sensors the devices such as fan or AC can be in ON or OFF mode which is as as shown below in the figure 8.

Figure 8: Device control results

C. Location Mapping through IoT:

Location mapping is associated as the guidance attribute to provide the aid in accordance to the user needs. This is concerned with the route map characteristic development, where a user can navigate to the places located distantly in the large campuses and infrastructures and the busy people working around the campuses. The following model is enhanced with the use of Blynk app as shown in figure 9 in a user's smartphone with android applications. Henceforth,

Information of the particular area can be developed through the app wherein WiFi module is taken into account. Thus a simple, though less cost application is evolved in such smart campuses.

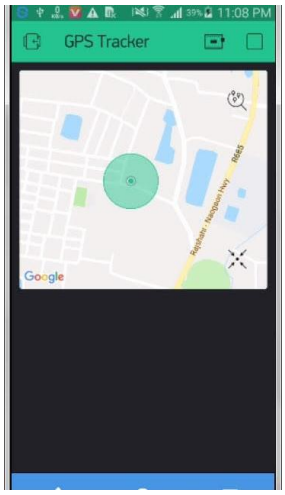

Figure 9: Location mapping using Blynk app

VIII CONCLUSION AND FUTURE SCOPE

The effective beneficial facial recognition method has been employed using Open CV platform and Anaconda a Python distribution as a software tool and Twilio account also with an Integrated Development Environment (IDE). In this paper we have discussed how the three different applications work for the different aspects. The IoT based Smart classroom for smart and sustainable campus will be an evolution in the educational environment resulting in high efficiency and effectiveness of classroom. This system will bring integrity among student community to complete the work on time Thus, the proposed education system model develops an intelligent, economic and environmentally sustainable campus. Also there can be future enhancements by applying this type of models in not only schools or universities but can also be implemented in working areas where there is high employment such as offices, hospitals etc.

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