# IoT Based Classroom Environment Monitoring System

**D.Surendran, M.K.Bhuvana, Monica Murugesan, Saleekha**

***Abstract*: field communication systems and sensors are playing an important and fundamental role in the Internet of things. RFID is one of the Near field communication technology, and widely used in different sector, such as in transportation, store sales, education, animal husbandry and so on. Because of information can be shared wirelessly via Bluetooth, Wi-Fi, Radio Frequency and Zigbee. Facial recognition is one of the simple and effective bio-metric authentication systems. LBP is a cost effective and simply efficient algorithm for face recognition using two dimensional surface texture operators. This paper is providing a way of accessing and controlling classroom with RFID and Facial recognition techniques. The overall performance of the system is completely monitored via web based framework. The students attendance monitoring and energy preserving activities are controlled by sensors, actuators, RFID tags, RFID reader, camera and raspberry pi kit.***

***Index Terms*: RFID tags, Facial recognition, cloud database, PIR sensor, IoT, web framework.**

## I. INTRODUCTION

Manual attendance marking systems are widely used in many colleges and universities. Only some of the colleges are using biometric authentication system for attendance monitoring purpose. RFID tags are widely used for tracking purpose. So that RFID tag is given to or attached to the ID card of the students and staff for locating their presence in which classroom exactly. During examination the hall superintends will check whether the correct person is occupied in correct position and the student having their ID card. The RFID tag verification and Facial recognition technique will reduce, hall supervisor's checking time. Energy preserving mechanism is monitored and controlled through web based framework. The operational status of Lights, Fan, and Projector like electrical and electronic units inside the classroom are monitored and controlled with motion sensor, light sensor and temperature sensor. PIR sensor is used for detecting human movement inside the classroom or hall. The temperature sensor collects the temperature inside the classroom and if the temperature exceeds a particular threshold, then automatically Fan or air-conditioning system will be initiated to reduce the temperature.

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These sensing devices are initiated only if the classroom is opened by an authorized student or staff of the concern college.

## II. PROCEDURE FOR PAPER SUBMISSION

### A. Student Attendance System in Classroom Using Face Reorganization Technique

Radial Basis Function Neural network technique was proposed by Samuel Lukas et al, for face recognition. The authors were taken the students face images as training set and stored in image database. For feature extraction, the author were utilizing the combination of Discrete Wavelet Transforms (DWT), and Discrete Cosine Transforms(DCT). Discrete Wavelet Transform approach had been introduced due to highly flexible and efficient for sub band decompositioning of a signal. Two Dimensional DWT is the key operation in decomposition of image. From Discrete Fourier Transform, DCT is derived. Due to the de-correlation property and domain scaling of DCT, the coefficients were computed by 1-DDCT operation is applied at row and column of an image. From Multi-Layer Perceptron Network (MLPN), Radial Basis Function (Neural) Network is derived with slight different approach.

### B. A Smart Campus Internet of Things Framework

Support Vector Machine (SVM) machine learning algorithm for monitoring and controlling campus functionality, security, safety and smart energy consumption. Classroom scheduling technique was mainly focused by the authors. Classroom monitoring sensors are connected through Internet of things and all the classroom availability status is visible to everyone in the organization. So that, easily the meeting organizer will schedule the meeting room for a particular time. If the room is scheduled then, its status will be changed to scheduled or booked for the mentioned time duration. This system was implemented for focusing on warm booting of projector inside the meeting room or classroom, before assembling everyone to the room. So the projector starting and loading time is reduced. Meanwhile energy saving mechanisms was carried out by human detection sensors. For regular weekly meetings the room will be scheduled automatically for the mentioned time. In case the meeting was cancelled by the organizer, the room will be rescheduled and lights, projectors and air-conditioning systems will be turned OFF automatically. Classification and regression techniques were used to detect the occupancy status of the scheduled room.

### C. Automated Class Attendance System based on Face Recognition using PCA Algorithm

Student's frontal face image was captured and recognized with Principle Component Analysis algorithm (PCA). After capturing face image of the student, features are extracted and classified and tested with stored training database images. The Euclidean distance was calculated and the difference should be lies between 0 and 1. Then student's attendance details are send to concern staff through Email and Short message service (SMS) will be send to each student's parents.

### D. RFID and Pose Invariant Face Verification Based Automated Classroom Attendance System

Based Automated Classroom Attendance System Fast Adaptive Neural Network Classifier (FANNC) was introduced by the authors, due to more efficient and layers level of classifier. Different head poses of each student are taken as training images and FANNC layers used to identify the correct student face. This system was implemented using face recognition and RFID tag reader. If both RFID and face are matched for a student, then attendance will be marked. Otherwise, If both are miss-matched then, proxy attendance will be noticed and notification will be sent to the relevant class tutor through email.

### E. IoT Based Smart Classroom System

Arduino with sensors and Ethernet were used to implement this system. Levels of security and authentication were implemented with RFID tag verification and face recognition. Human identification was detected using PIR sensors.

### F. Real Time Locating System Using RFID for Internet of Things

This system was implemented by Sai mounika and Kishore. IR sensors were used for counting the incoming and outgoing persons to the classroom. RFID tags alone used for attendance marking system.

### G. Iot Based Biometrics Implementation on Raspberry Pi

This system was designed in Raspberry Pi and webcam and fingerprint recognizer. Biometric encryption was done on captured biometric information of student of staff. Before storing the biometric information to the cloud database (Azure), AES-256 encryption algorithm was applied.

### H. EPSSR: Energy Preserving System for Smart Rooms

The Authors were used IR and IoT enabling technologies for monitoring and controlling activities of classroom automation. Infra-Red sensor counts the number of persons inside the classroom and person count is greater than zero, lights, and Fan will be automatically turned 'ON'. If the IR sensor count is equal to zero then, lights and fans will be automatically turned 'OFF'.So that, energy preserving model was designed for classroom.

Biometric authentication is the most secured authentication system for securing any important assets. So many biometric recognition techniques are widely used such as, iris, face, signature, fingerprint, DNA, hand vein and finger vein biometric authentication system. Face recognition is the cost effective system and mostly used in many security aspects. RFID is the system used for tracking things and gives high availability. Histogram based Local Binary Pattern algorithm is the simple and cost effective algorithm for biometric face recognition. Kullback-Leibler divergence(KLD) detects duplication between images stored in the database[10].

## III. PROPOSED SYSTEM

This classroom environment monitoring system consists of three modules. The first module will be implemented with RFID tags and RFID Reader for location tracking. Then face recognition biometric system will be implemented with Local Binary Pattern (LBP) algorithm. Raspberry Pi kit with connected web-camera will be used for capturing student's face image. Then local binary pattern algorithm is applied on cropped image and histogram intensity value is calculated for all the training images. Once both the RFID pin and corresponding student's face are matched, then their entry time with date, and classroom or meeting room location are send to the cloud database. Then motion sensors are activated for checking person count inside the classroom. If the person count is one then, the system initiates the relay units and actuators to turn 'ON' the lights, projector and fan or air-conditioning system. After completing the lecture, the staff or students may come out of the classroom. So while leaving from the classroom out time of each student is entered in the system. So all the students and staffs out time are updated to the database. If person count is become zero, the lights, projector and fan like electrical and electronics appliances will become turned 'OFF'. The second module implementation is to view the collected information through web page. These marked attendance details can be viewed in web based framework controller. Staff can view all students attendance report for monthly-wise or for a particular date or for a selected duration. In the third module, web page design is implement to view the current status of the classroom in real time. If any person occupied in the classroom, classroom status will be occupied, otherwise the status will be available. So that, we can schedule the classroom to conduct meetings in future.

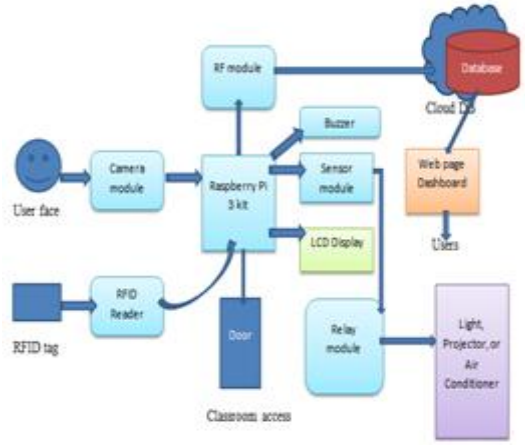


**Fig. 1 System Architecture**

### A. Advantages of Proposed System

- Classroom activities are monitored and controlled completely.
- Efficient system for tracking attendance percentage of each student.
- Reduces overall power consumption of the campus.

## IV. EXPERIMENTAL RESULTS

Face recognition module of this classroom environment monitoring system is implemented in local binary pattern algorithm. Histogram intensity values are calculated with local binary operator. Frontal face of each student are captured and trained the system for authorization. Frontal face is captured in NxM width and height, then cropped by MxM dimension to focus the face image alone. MxM image is converted to gray scale image from its original color image. Then noise are removed from the gray scale image. Noise present in the image may be of blurring, Rayleigh, Gaussian, salt and pepper. Adaptive mean filter is applied for de-noising. In every region Local binary operator is applied on the gray scale image. The center pixel is considered and the remaining neighbor pixels are compared with the center pixel. If the center pixel is less than the neighbor pixel, the neighbor pixel value is replaced by '1', otherwise '0' is replaced to the neighbor pixel. Then intensity values are calculated by translating the binary values to its equivalent decimal values in the range of 0 to 255. From the intensity values, probability density function (PDF) is calculated for duplication identification. LBP operator example is shown in Fig.2.

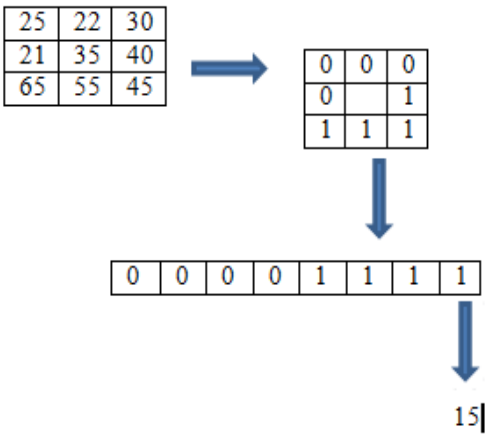


**Fig. 2 LBP Operator Example**

**Fig. 3 Captured original Image**

**Fig. 4 Cropped and Denoised image**

**Fig. 5 LBP image in database**

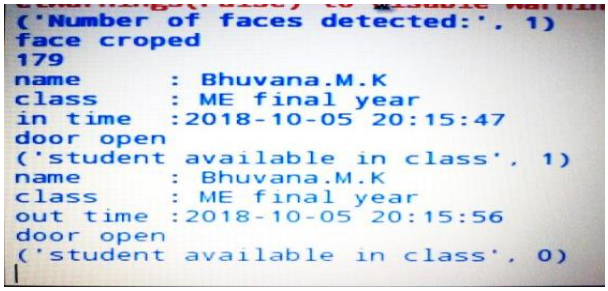


**Fig. 6 Attendance System's result**

Fig.3 to fig. 6 shows the experimental results of the classroom environment monitoring system. The captured image intensity details will besending to the cloud database and do comparison with existing images. If both the images are matched and RFID tags details are match, then the concern person will get classroom access. If once the RFID card was used by unauthorized person, then the card status will be deactivated. So malpractices will be avoided.

## V. WEB PAGE RESULTS

The web page design consists of student login and staff login options to view the corresponding student attendance report. Staff can be able to view all students' attendance report as shown in the screen shots.


Fig. 7 Home Page

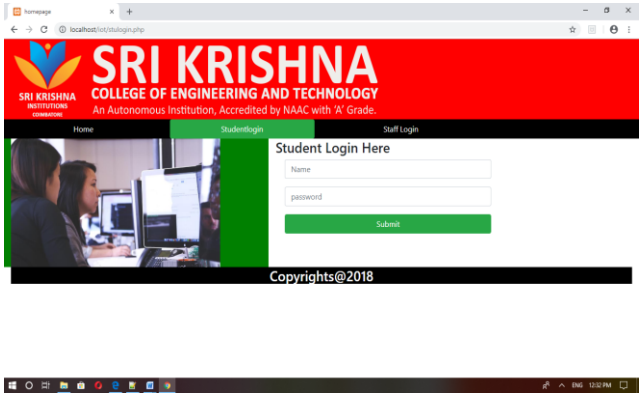


Fig. 8 Student Login Page


Fig. 9 Corresponding Student's Report

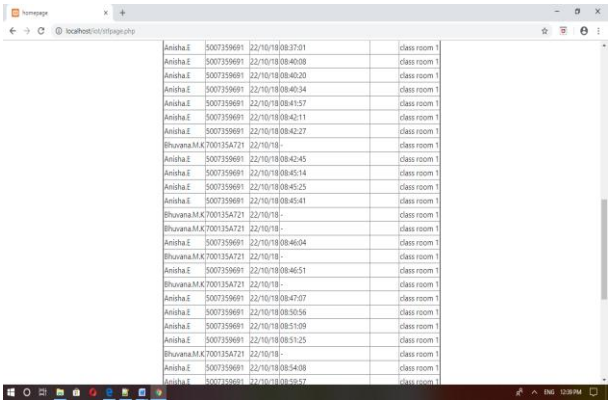

Fig. 10 All Students Report

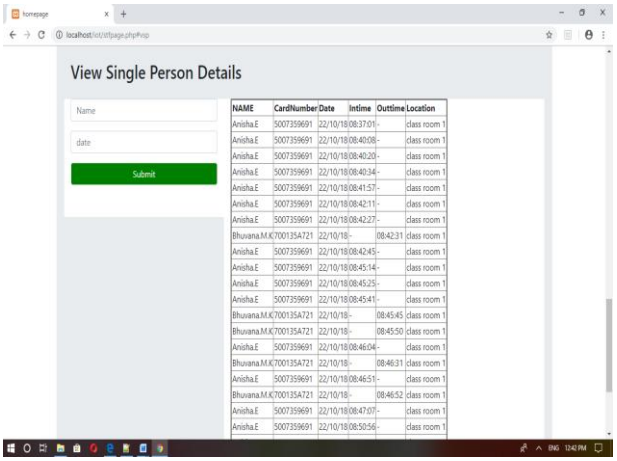


Fig.11 Single Person Detail

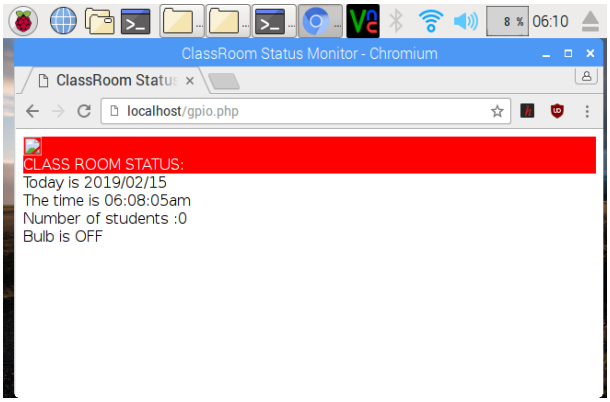


Fig. 12 Checking Classroom Status

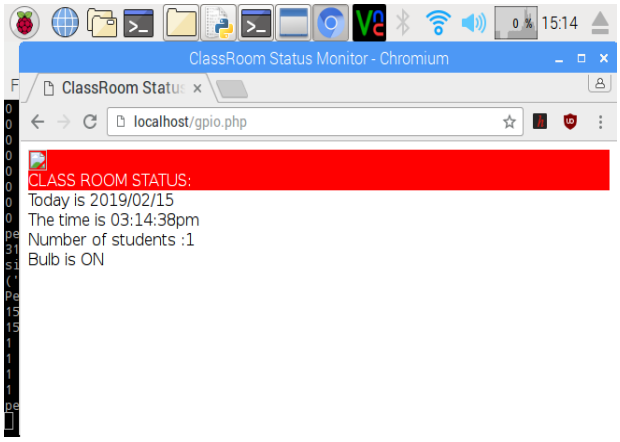


Fig. 13 Number of Students and Bulb ON Status

## VI. CONCLUSION

This automatic IoT based classroom environment monitoring and attendance tracking system can be effectively utilized in many organization and universities. Python Programming language is used to develop the system. All the captured date and timing detail are stored and retrieved from MySql database at the backend. Through the classroom availability status, we can schedule the room for meeting in future.

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