Design and Implementation of Iot Enabled Smart Classroom for Sustainable Campus

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Abstract – Intelligent campuses are built on Internet of Things (IoT) technology, and aim to achieve intelligent campus administration and service. With the introduction of intelligent thermostats, medical wearable appliances connected marketing equipment and others, IoT will certainly facilitate our lives. Resource management systems (RMS) are a significant research direction in IoT. In the current state of RMS research relatively few studies have been able to benefit from a highly useful interior location, especially in smart classrooms. This study has been the outcome of discovering a solution for the development of intelligent classrooms on campuses. In some of the research we analyzed, studies connected to intelligent classroom and significant factors were found for technology and education in intelligent classrooms. But a smart classroom solution can't be found throughout the university. Therefore, in this work, we develop and propose our own intelligent classroom architecture for construction and maintenance of smart classrooms. The intelligent classroom is developed to monitor and regularize activities such as tasks, projects, tutorial presentations and student monitoring or academic monitoring by the faculty, mentor or consultant in real time. Smart campuses can manage collected data more efficiently, bringing comfort to campus service and management, compared with the traditional campus platform. In this study, Raspberry pi with LCD display and the Internet Smartphone were incorporated into the smart classroom concept. This will bring automation, electrical device control, classroom environment monitoring, and also dynamic class scheduling display, and voice recordings. Using the open source application open.cv facial recognition, automatic updating of student attendance is used.

Keywords – Raspberry pi, LCD, Sensors, IoT.

I. INTRODUCTION

Internet of Things, essentially named as 'IoT' is a trend setting innovation which the universities are beginning to adjust into their task [1-2]. IoT is just a UI that a management of the university can incorporate into practically all the electrical/electronic gadgets to change them into a more intelligent one. This innovation is additionally favored by a large group of enterprises for the assortment of uses including examination of gathered information, cloud information stockpiling, triggering an activity, remote notice and so forth [3]. Traditional classroom model requires equal time to be spent on both teaching and managing the workflow of the classroom. As a result, faculty and the management of the institution cannot make good students with great knowledge. This is a less efficient methodology to get practiced. Thus, in order to achieve maximum utilization of the class hours, a new system is needed to take care of the workflow which highly reduces the time of faculty not to stick with managerial works but to increase the time of teaching and interaction with students [9].

The smart campus is an open, innovative, joint and smart integrated platform for information services. With thorough research and broad usage of IoT technology the problem of connection of people to something not taken into account in the traditional Internet can be resolved. The technology for IoT is utilized in the development of smart campuses, which may transform the interactive mode between different companies and on-campus individuals, increase information transfer efficiency, make reactions more flexible, and develop an intelligent IoT campus service system.

Figure-1: innovative smart campus.

The figure -1 illustrates the fundamental structure that will contribute to competitiveness in a symbiotic interaction between the networks of people, companies, technology, infrastructure, consumption, power and space to ensure a sustainable future. The architecture comprises an intelligent classroom prototype, an integration technology model and measurements supporting intelligent teaching operations. The intelligent prototype of the classroom includes the import functions of the classroom based on the study. The technological integration model is new and ideal for vast building of intelligent classrooms. This provides details, illustrations and examples of the way the suggested architecture is implemented. In the proposed technological integration approach, Raspberry Pi has been applied as a major function.
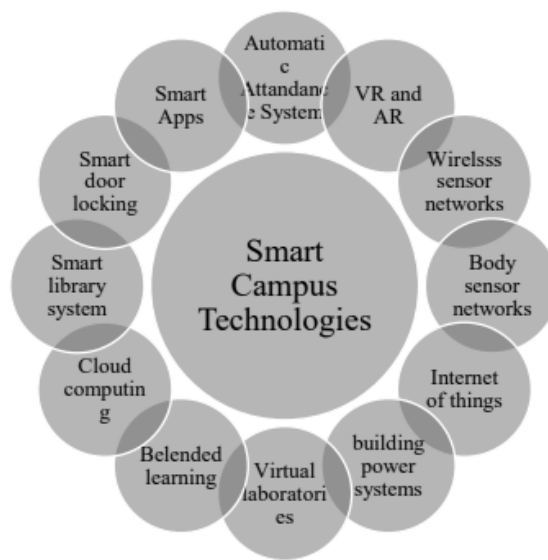

Figure-2: Sustainable Smart Campus structure.

IoT is a technology or system that integrates different heterogeneous platforms, such as artificial intelligence, big data and machine learning, the computer cloud, embedded devices, etc. An alternative is using embedded devices, such as ARM microcontrollers, Arduino boards, and Raspberry Pi boards to easily construct and configure an IoT system. The Raspberry Pi board is considered in our approach. Raspberry Pi is a small, cheap credit-card single-board computer.

The principal objective of this work is an efficient environment for learning. The smart classroom model was merged with Raspberry pi connected to LCD screen and the internet operated Smartphone. When a student enters class, the camera captures the face, extracts items, generates 3D points from the video camera, compares to the database to look at similar cloud server images, and automatically indicates their existence and missing status. Information on the participant shall also be forwarded to the faculty and the parent or guardian will also be notified of the missing of a student. Such data also appears on LCD screen at the same time. The PIR sensor can be used to identify the student movement detection i.e., students are entering or leaving the class, the sensor will notify Raspberry PI to turn on lights, fans in classroom when the students enter the class. The sensor will notify Raspberry PI and wait for a time when they leave the classroom to turn off lights and fans in classroom. And also the information about classroom reschedules or cancelled, and also environmental conditions i.e., temperature and humidity levels will be display in LCD.

This paper displays a technology that utilizes IoT along with cloud technology and application development platform like flutter to reduce the secondary work of mankind. This implementation let faculty to focus more on the primary work that is, teaching and to focus less on managing the workflow of the classroom.

II. PREVIOUS WORK

First paperdeals "Internet of Things – based Smart Classroom Environment" the system is based on ARM Microcontroller, which is open hardware platform; the board can be further customized in the future to make it more tailored for the specific needs of smart classrooms. We can also consider manufacturing an all-in-one board with all the components integrated, so the costs will be much less and make it more affordable. The resultant will make the system one step closer to commercial applications. This smart classroom system not only offers the solution to a problem but also lays the foundation for series of future projects (such as intelligent parking system, dynamic ticketing system, etc.). Finally, the data collected through the system can be analyzed and used for additional purposes, such as resource management, attendance checking, or tutor time tracking management. Next paper we are dealing with is "SMARTBENCHES IN CLASSROOM" this paper is based on a touch-based interface which will be stored in the cloud-based framework and can be only accessed through a security-based system using RFID [7]. These interfaces are provided in each bench in the class which makes them a smart bench. Students will interact with as notepad which helps them to take notes while listening to the class and it also help them for easy understanding and resource virtualization. New technological advancements in communication have led to a major change in teaching and learning models when we see based on education [8]. Next paper we are dealing with is "Experiences with IoT and AI in a Smart Campus for optimizing Classroom Usage" this paper provides 4 contributions to the implementation of IOT and AI in advancement of classroom. First contribution is about IoT sensing approaches for measuring class occupancy, and comparing them in terms of cost, accuracy, privacy, and ease of deployment/operation. Second contribution is 9 lecture halls of varying capacity across campus, collects and cleans live occupancy data spanning about 250 courses over two sessions, and draws

insights into attendance patterns, including identification of cancelled lectures and class tests, while also releasing our data openly to the public. Third contribution is to use AI techniques for predicting classroom attendance, applying them to real data, and accurately predicting future attendance with an error as low as 0.16. final contribution is to develop an optimal allocation of classes to rooms based on predicting attendance rather than enrolment, resulting in over 10% savings in room costs with very low risk of room overflows. Next paper is "Key Technologies of Smart Campus Teaching Platform Based on 5G Network" this paper is based on the 5G network implementation in the campus. it is considering the business demand and performance demands which is satisfied with 5G network. From the above discussed papers, we have considered some technologies like RFID, IOT & AI based infrastructure and cloud storage system. we are implementing them on our paper as cloud storage for handling smart application through which interaction between teacher and student take place. Then, RFID, IOT and AI based infrastructure were implemented for checking the student completion of work provided to them through the application and their RFID were added to the system as per the completion of the work. If the persons RFID is in the system. Then, the student is allowed into the class.

III. PROPOSED METHODOLOGY

One method to describe IoT is relatively simple: We're sure that you're reading this content on your desktop or in a mobile device, and even on tablets. It is only evident, regardless of the device you view this content, that it is connected to the Internet.
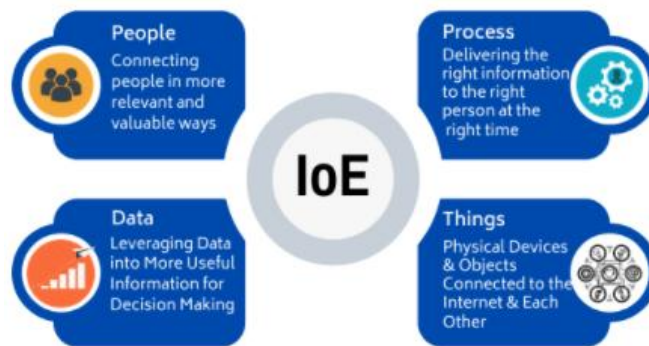

Figigure-3: overview of IoT.

We all know now that the Internet is one of people's best things. Imagine your outdated telephones that were not intelligent enough! You could only send and receive calls and texts with them. But today it's possible to listen to tunes, see films, live chat and much else. Connecting to various stuff you do with the Internet is one of the most wonderful stuff about IoT. I know that this is still puzzling, but you will realize how IoT has had a huge effect on the educational business when you read this article. IoT goes beyond the classroom in education. It demands a lot of interconnections particularly to the previously unconnected things and equipment. In order to ensure the physical environment is safe for children, educational institutions have started to take this technology extremely seriously for schools.

To provide a classroom with more interaction between students and faculty and to focus more on teaching and less on managing for the faculty the propped system is utilized. It also brings sincerity to the students on classroom activities and this suggested model is to ensure security with the door release system based on facial

recognition, automatic attendance system, classroom equipment automation and the measurement of the ambient temperature of classrooms, CO2, Humidity, etc., You should play the video lectures in the database with a voice command.
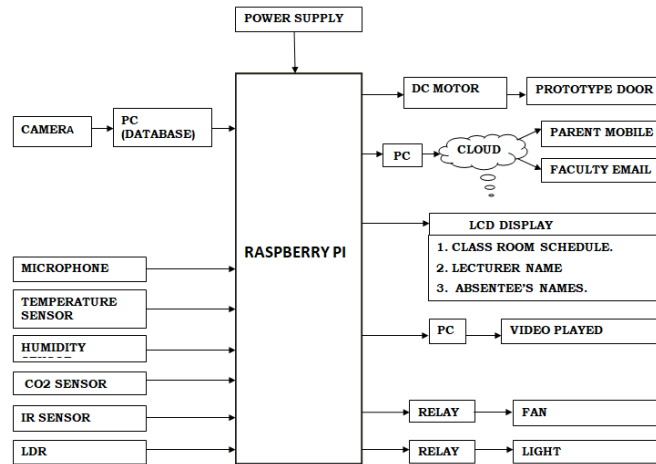

Figure-4: proposed system.

The prototype of the controlled classroom with the laptop and ARM7LPC2148 together with relays can be created. Students attend the classroom by facial recognition and parents will receive information about the system if the status of the individual student is absent.

Here some implementation strategy will be discussed as; Attendance monitoring, automatic door open or close when student or teacher should enter or leave the class, sensors placed to determine the lights, fans are turn on or off in classroom.

When the teacher and the student enter into the classroom, the door opening mechanism of the classrooms is to be opened, whereas the name of the teacher should appear on LCD screen but not when the student enters. If the classroom is dark then automatically the lights turn on and if the classroom temperature is high, the fans will be turned on. The classroom conditions are monitored completely by the sensors.
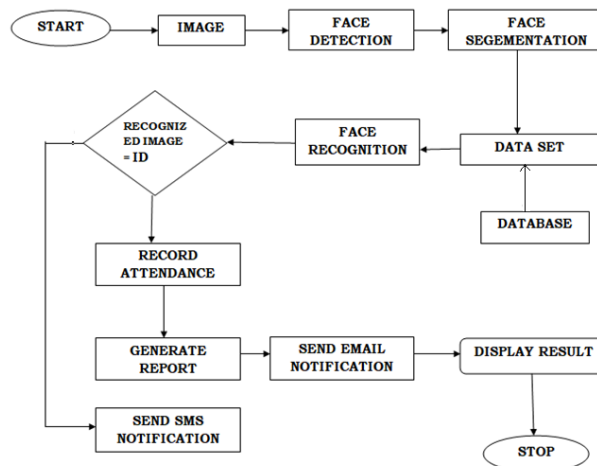
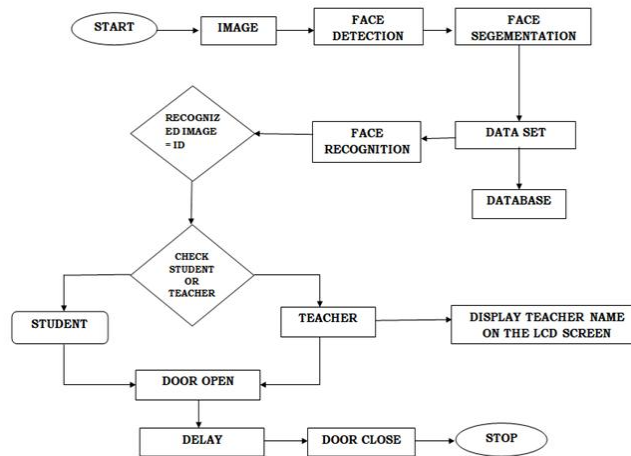**Figure-5:** flowchart of attendance monitor.

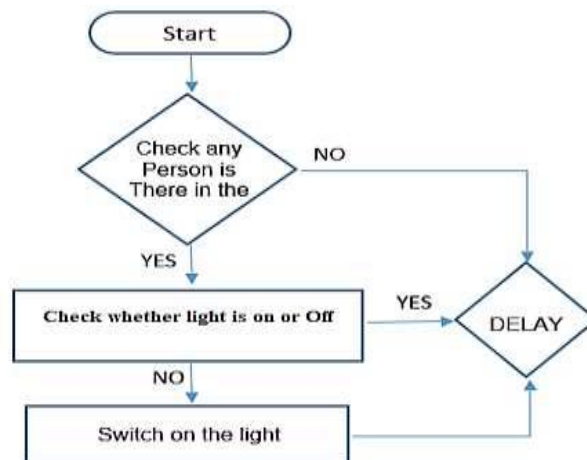**Figure-6:** flowchart of door operating and display teacher name on LCD screen.

Figure-7: flowchart of switching lights, fans ON or OFF.

3.1 RASPBERRY PI

This Raspberry Pi is a low cost computer in a credit card size that connects to a computer monitor or a television with a conventional mouse and keyboard. It is a small device able to study computer technology and learn how to program in languages like Scratch and Python. You can do everything from internet browsing and playing high-definition video, to constructing tablets, writing words and plays. You can do anything you may expect of a desk screen computer.
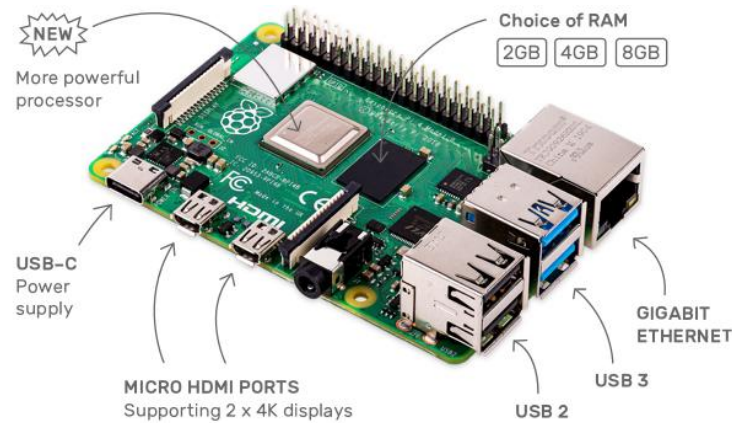
Figure-8: Raspberry Pi 4 board.

3.2 FACE RECOGNITION CAMERA

Recognition of the face is a means to identify or confirm the identity of an individual by utilizing his face. In pictures, videos or in real time, facial recognition algorithms can be used to identify persons. Face recognition is an emerging computing discipline of vision with various hardware and device applications. You can now incorporate facial recognition to your own manufacturer projects with embedded platforms such as the Raspberry Pi and open source computer vision frameworks like as Open CV in this project I will teach you how to create a treasure box, which can be unlocked using Raspberry Pi face recognition.
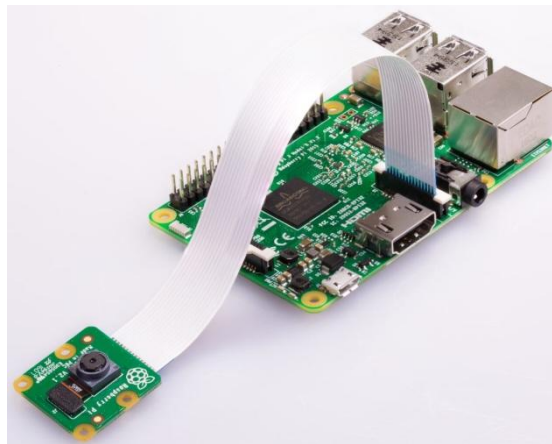

Figure-9: Face recognition PiCamera.

3.3 SENSORS

Here we are using different types of sensors are, light dependent resistor, temperature and humidity sensor, MQ-135 sensor for the purpose of detecting classroom intensity, surrounding temperature conditions with the wide ranges of gases.
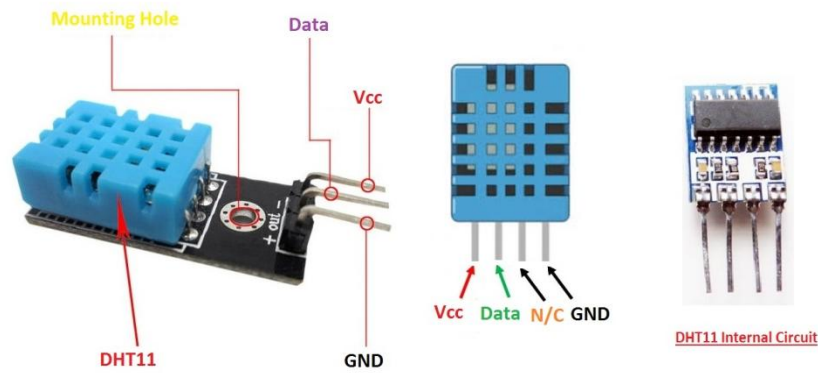
Figure-10: Temperature and Humidity sensor (DHT 11).
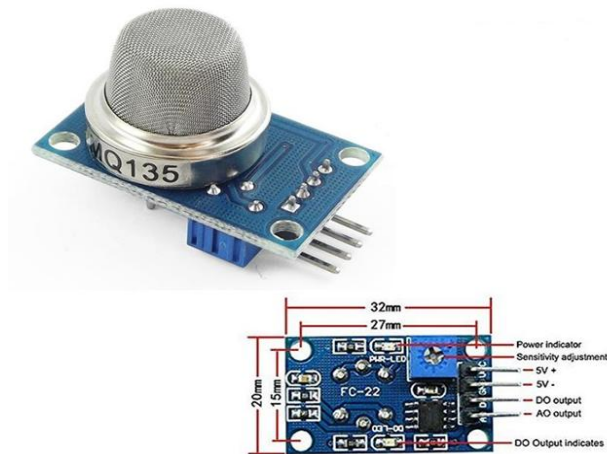

Figure-11: Light Dependent Resistor (LDR).

Figure-12:MQ-135 sensor.

V. RESULTS

The main goal of this proposed model is to provide security with face recognition based door unlocking system, automatic attendance system, automation of classroom appliances, measuring classroom environment parameters like Temperature, CO2, Humidity, The video lectures in the database should be played using voice command .

The security for classroom of providing door unlocking system that opens the door when students, teachers and other people who are accessible to the classroom and also identifying teacher to display his name on the LCD screen.
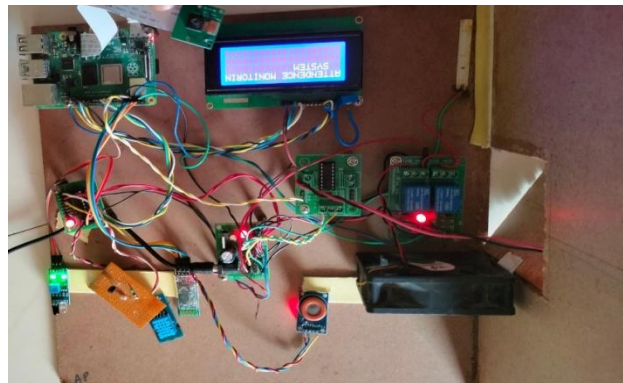

Figure-13: Prototype model of proposed method

Figure-14: Initially the LCD displays

Figure-15: Temperature measuring

VI. CONCLUSION

This study has been the outcome of discovering a solution for the development of intelligent classrooms on campuses. In some of the research we analyzed, studies connected to intelligent classroom and significant factors were found for technology and education in intelligent classrooms. But a smart classroom solution can't be found throughout the university. Therefore, in this work, we develop and propose our own intelligent classroom

architecture for construction and maintenance of smart classrooms. The intelligent classroom was successfully deployed with the raspberry pi. Intelligent participation enables to conveniently record the student's attendance.

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