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IoT based Classroom Automation using Arduino

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ABSTRACT

The Internet has become a daily necessity to utmost of the effective participants in which we interact and communicate among ourselves by switching data and information sensed about the environment and atmosphere. From this IoT they relate autonomously to the real world events and offer us with services with or without direct human interference. In this project we use IoT for energy efficient Environmental Conditions recognizing and supervising in our Classroom. This gives a vast advantage on the smart Classroom systems using Internet of Things.

This project will help the teacher present in the classroom to allow them to control the classroom using android application in the Android smartphone. The overall system design is mainly based on Arduino Mega 2560. The appliances are to be controlled by the Android Application. The android application is developed using Blynk software or Blynk android application. We can supervise the state of sensors connected in the Arduino board and we can control the modules by simply enabling some options in the android application in our smart phone.

Keywords: *IoT, Classroom automation, Blynk, Automation, Arduino;*

I. Introduction

This project has four objectives that will be explained in details in the further. The first objective of the project is to automatically take attendance from students using their Fingerprint ID and record attendance. Students Fingerprint is recorded, saved in a database, and if the data is utilized and transmitted to a computer via scanner, the attendance can be recorded with greater efficiency.

The second objective is to automatically control the fan, lights and projector. The idea is to plant several sensors around the classroom and give a calculated feedback to the response these sensors receive. An example would be having PIR sensors around the class room that would detect the presence of human and turns the fan ON or OFF. For light control, there will be LDR and if the illumination in the classroom and turns the light ON/OFF according to the room's lighting changes from high to low.

The third objective is to erase the blackboard automatically. The idea is to reduce the discomforts experienced by the teacher while erasing the black board. By switching a button the board will be automatically erased by the help of dusters fixed in a way to erase the black board efficiently.

The last objective is to be overall cost effective. While the idea to improve classroom is the priority of this project work, importance is made to ensure that this system is affordable to all those who need it. The setup cost may initially be a bit high, but in the long run it is expected that there will be a reduction in both electricity and paper cost.

II. Motivation of the project

An ideal classroom is an environment in which teachers are able to focus completely on their lectures and the students are able to concentrate on the information they are being conveyed. Unfortunately, this does not happen in most of the Indian Classrooms. During first ten minutes of every class hours, time is usually wasted in many ways such as manually recording student's attendance one after another in the attendance register. Other disruptions also occur throughout class time such as temperature and light variation in summer and winter seasons respectively.

These problems cause affected students to wander around the class guessing for the right switch and adjusting it to equilibrate the environment back to satisfying or comfortable conditions. This causes disturbances for both teachers and all the other students, and so to eliminate these irritations an automated classroom is created which allows the classroom to become more efficient, and eliminate any human assistance in controlling the atmosphere.

III. Methodology

Through literature reviews we have formulated some of the existing methodologies and designed our system based on the difficulties faced by the existing authors.

A. Existing Methodology

There are two methods which is being followed previously. They are

1. Manual method
2. Automation without IoT and individual costly systems

The block diagram of Existing methodology is shown below in Fig.1

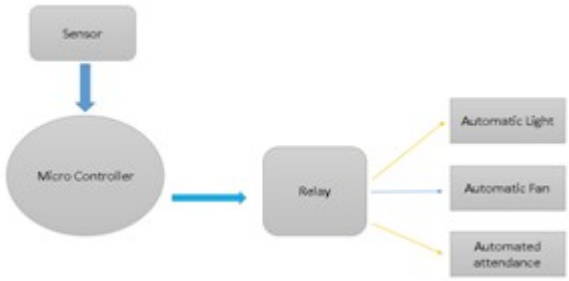


Fig.1. Block diagram of existing methodology

Advantages of the existing system are

- Manual methods are used in small schools with less number of students
- Automation can be implemented for only needy systems which may reduce cost
- The main disadvantages of this existing systems are given below
- Time consuming
- Relatively high cost
- Contains minimum number of automated systems
- Students and teachers will get disturbed
- Electricity is wasted dude to carelessness
- However in our system these disadvantages are overcome effectively.

B. Proposed System

The proposed system integrates all individual systems under one board. So that the cost of overall system will be reduced efficiently. The block diagram of proposed system is shown in Fig 2.

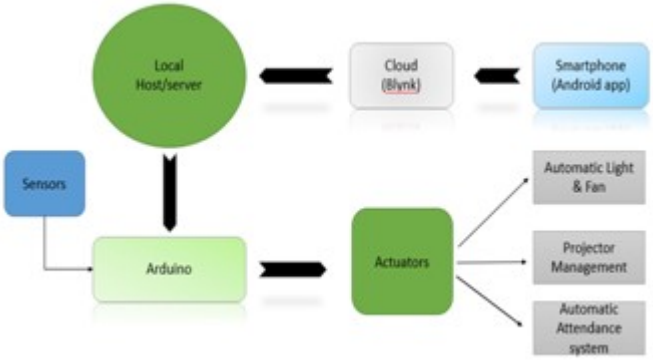


Fig.2. Block diagram of proposed system

The proposed system contains the following subsystems

1. **Automated attendance system using fingerprint sensor:** The automatic attendance management technique that integrates fingerprint authentication into the process of attendance management using Arduino and computer. It Comprises of two processes namely; enrolment of ID and authentication of ID. During enrolment, the biometrics of the Student is captured and is stored in a flash memory along with the person's id Number. The main objective of the enrolment module is to register the user using Student's id and fingerprints into a flash memory after feature Collection. During authentication, the biometrics of the Student is captured and are compared with all those that already exists in the flash memory to determine a match for marking the automated attendance. The working of Fingerprint based attendance system is given below in Fig.4.

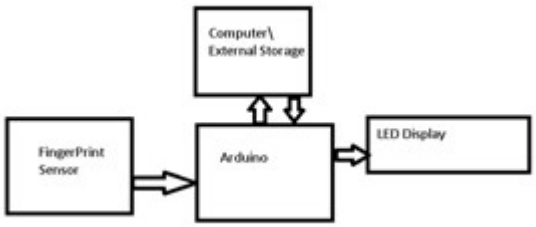


Fig 4: Fingerprint based attendance system

2. **Automatic Fan and Light Control:** In many classrooms after the class is over the students and teachers leave the school without switching OFF them, at the time of closing the classrooms the security staffs tend to switch OFF them. Hence electrical energy is wasted during the unwanted time. To overcome this PIR sensor and LDR are used to automatically Control them. PIR detects the human presence inside the classroom and switches ON only if there is any human inside the class. LDR detects illumination of the room. During dark hours it will switch on the Lights and vice versa. The block diagram is shown below in Fig.5.

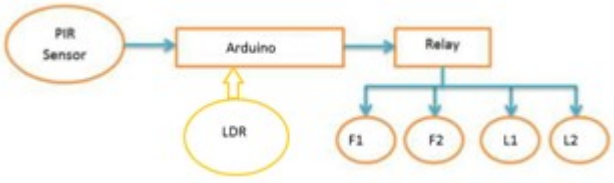


Fig.5: Automatic Fan and Light Control

3. **Automatic black board erasing system**: After every lecture is over one has to erase the black board manually. This takes more time and the dust particles affects breathing of the person who is erasing the board. So In order to overcome this, automatically black board is erased by simply pushing a button ON/OFF.A vertically fixed framed powered by electric motor slides through a guide way in a manner to erase the contents in the black board. The sample Board cleaning system is shown in below Fig.6.

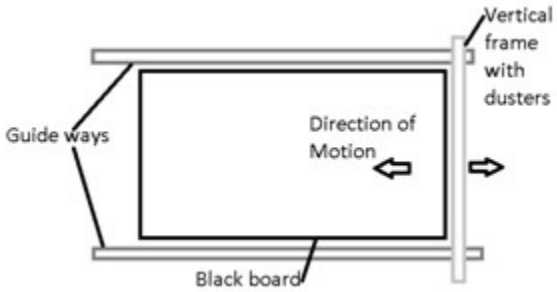


Fig 6: Automatic black board erasing system

4. **Projector Control System**: In flipped classroom teaching methods projectors are often used in the lecture. While changing the classroom to projector adapting environment we have to manually roll the curtains down , open the projector screen and switch off the lights This is automatically done with the a android application. By simply enabling a button in the application all these things are done automatically with less time consumption. The overall function of Projector management system is shown in Fig.7.

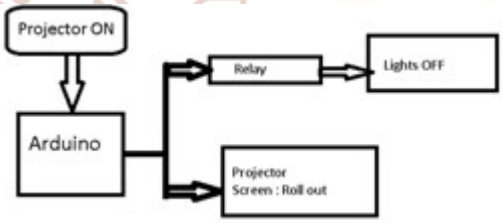


Fig 7: Projeector Control system

5. **Electronic Notice Board:** During class hours we get disturbed by frequent circulars coming in between the lecture. So an electronic notice board which is controlled by smartphone application is introduced in the classroom. In case of any important news to be shared to the students the staffs outside the classroom can simply send using this application. And the students get notified while a new information is sent to the classroom. By this the lecture will not be disturbed. The

working block diagram of Electronic notice board is given below in the Fig.8

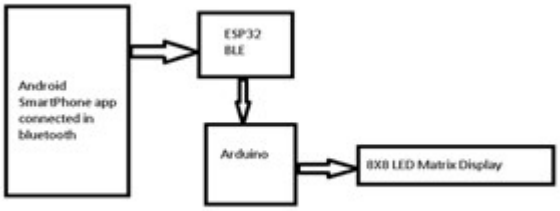


Fig.8: Electronic Notice Board

6. **Automatic Window Control System**: During rainy days the students sitting near the window can be easily affected by rain drops through the window. And we have to close it annually. So, the rain sensors which detect the rain outside will automatically close the window and the students will not get affected by the rain. The mechanism has simple rack and pinion setup for individual windows which is shown in the below Fig.9.

Fig 9: Automatic Window control system

Advantages of the proposed system are

- Integrated systems with Minimal Cost
- User friendly Interface
- Easily reprogrammable
- Students and teachers can concentrate on lecture
- Improvised energy saving

The main disadvantages of this proposed systems are given below

- Programming is more complex
- Can't be used in Intranet connections
- Electrical components must be handled with caution.

C. Procedure Flow

The system follows three steps in automating the classroom. They are

1. Sensing
2. Transmission of data
3. Monitoring and Controlling

The sensor is the starting point of the process. Once the data is received the microcontroller does its work according to the program stored in it. The Flow diagram is shown in Fig.10

Fig.10 Procedure flow

IV. Components

The selection of materials involves the study of their Characteristics, advantages, availability, cost, user friendly property of components that we want to use. In our project, we select each and every components by study thoroughly about them. By proceeding like that only, we had done our selection.

- The software and device chosen to programming the execution of our idea is Arduino IDE and Arduino Mega Board.
- The Software used to interface user and smartphone is Blynk software
- The device chosen to interface Blynk software and Arduino board is ESP32

The detailed description for selecting components is given below:

A. Arduino

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 chip. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Arduino Board is shown in Figure.11.

Fig.11.Arduino Mega (source: www.arduino.cc)

B. ESP-WROOM-32 / ESP2

ESP32-DevKitC is a small-sized ESP32-based development board produced by Espressif. Developers can connect these pins to peripherals as needed.

The Module is shown in Fig.12.

Fig 12: ESP32 (Source: www.esp32.net)

C. Blynk Software

Blynk is a smart platform with iOS and Android apps to control Arduino, Raspberry Pi and the other IoT modules over the Internet. It's a digital dashboard in your smartphone where you can build a graphic interface for your project by simply dragging and dropping widgets. It's really simple to set everything up and you'll start learning in less than 5 minutes. Blynk is not tied to some specific board or shield. Blynk was designed for the Internet of Things. It can control hardware remotely from any part of the world, it can display sensor data, and it can store data, visualize it and do many other cool things.

D. PIR Sensor

PIR sensor is more complicated than any other sensors because there are multiple variables that affect the sensors input and output. The PIR sensor itself has two slots in it; each slot is made of a special material that is sensitive to IR detectors. The PIR Sensor working is shown in Fig.13.

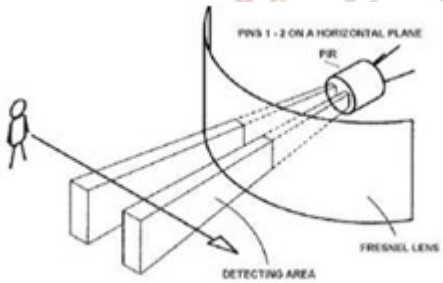


Fig.13. PIR Sensor working

E. Light Dependant Resistor

A light dependant resistor also known as a LDR, photo resistor, photoconductor or photocell, is a resistor whose resistance increases or decreases depending on the amount of light intensity

A LDRs can have a variety of resistance and functions. For example it can be used to turn on a light when the LDR is in darkness or to turn o¬ a light when the LDR is in light. It can also work the other way around so when the LDR is in light it turns on the circuit and when it's in darkness the resistance increase and disrupts the circuit.

F. Fingerprint Sensor

People have tiny ridges of skin on their fingers because this particular adaptation was extremely advantageous to the ancestors of the human species. The pattern of ridges and "valleys" on fingers make it easier for the hands to grip things, in the same way a rubber tread pattern helps a tire grip the road. Sample working of sensor is given below in Fig 14.

There are two types of Fingerprint sensors available. They are

1. Optical scanner
2. Capacitance scanner

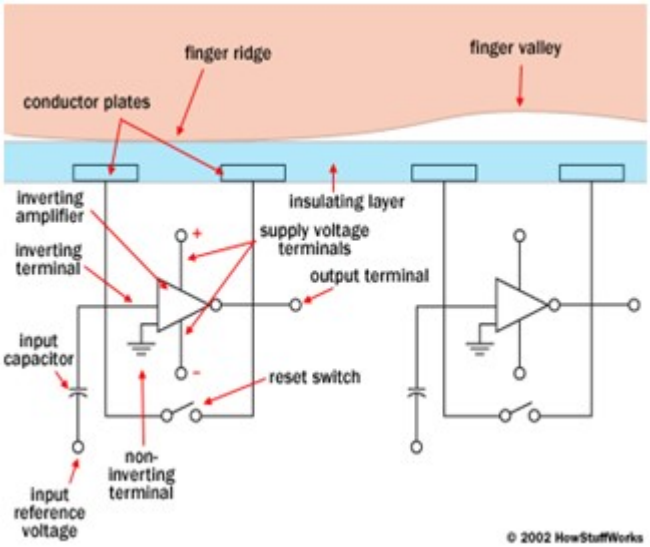


Fig.14.Capactive Finger print sensor (Source: www.Howstufworks.com)

G. Stepper Motor

A stepper motor is an electromechanical device which converts electrical pulses into discrete mechanical movements. The shaft or spindle of a stepper motor rotates in discrete step increments when electrical command pulses are applied to it in the proper sequence. The construction of the stepper motor is shown in Fig.15

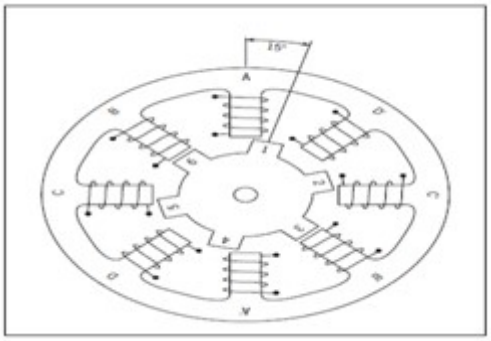


Fig.15.Construction of Stepper motor (Source: www.nptel.ni.in)

H. LED 8X8 Matrix

LED Matrix's are great fun, you can create funky patterns, scroll messages, or create something entirely bizarre. Sadly controlling one is a tad complicated. But once mastered is easily repeatable. Sample LED Matrix is shown in Figure.4.10. This matrix has the LED's anodes connected across rows (8 pins) then the red and green LED's cathodes attached across columns (8 pins each). To light an LED connect its rows anode to +5volts, and through a resistor, it's columns cathode to ground. Sample LED from Online is shown below in Fig 16.

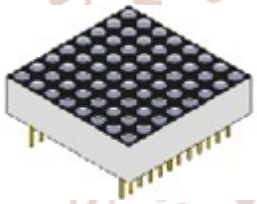


Fig 16: 8X8 LED Matrix (Source: www.amazon.in)

The Table 1 which is listed below contains the overall components used in this project.

Components	Type
Stepper Motor	10kg-cm, 5Kg-cm
Arduino	Arduino Mega 2560
ESP32	-
PIR Sensor	-
LDR Module	-
RTC	-
LED	8X8 Matrix
Fingerprint sensor	Capacitive type
Smartphone application	Android Application
Cables	0.5 SQ mm and other req
Belts & Pulleys	For servo dimensions
Framework and other components	Aluminum, wood, etc.

Table.1.Components used in the project

V. Programming

The programming is done in Arduino IDE software. During programming we have to keep in mind that all the systems should be automated and they should not get affected by the other parts of program.

The Sample coding is give n the future section.

PIR & LDR

```
If (analogRead(photosensor) >= 850)
{// dark if the value of photosensor is bigger than 850
Serial.print("Dark");
PIRState = digitalRead(PIR);
// then get the value of the PIR sensor
 //if detect move the PIR State is HIGH if not move then is LOW
if(PIRState == HIGH) {
digitalWrite(relayfloor, LOW);
 // open the relay floor to give power on
leds delay(5000);
// delay to stay on the leds
Serial.print("Motion PIR");
// debugging show in serial monitor
PIRState == LOW;
// set the PIR State low no motion-movement
} else {
// if have not movement-motion close the
Serial.print("No motion");
digitalWrite(relayfloor, HIGH); }
} else {
// the photosensor take value for day and the relay close
// we not check the PIR sensore
 digitalWrite(relayfloor, HIGH);
Serial.print("Day No light need"); }
if (strcmp(packetBuffer, "Ledon") == 0) {
digitalWrite(relaydesk, LOW); replay = "leds desk on"; }
else if (strcmp(packetBuffer, "Ledoff") == 0) {
digitalWrite(relaydesk, HIGH); replay = "leds desk off"; }
```

Stepper Motor Control

```
int sensorReading = analogRead(A0);
int motorSpeed = map(sensorReading, 0, 1023, 0, 100);
  If (motorSpeed > 0) {
    myStepper.setSpeed(motorSpeed);
    myStepper.step(stepsPerRevolution / 100); }
```

LED Matrix

```
void setup() {
  // set up the LCD's number of columns and rows:
  lcd.begin(16, 2);
}
```

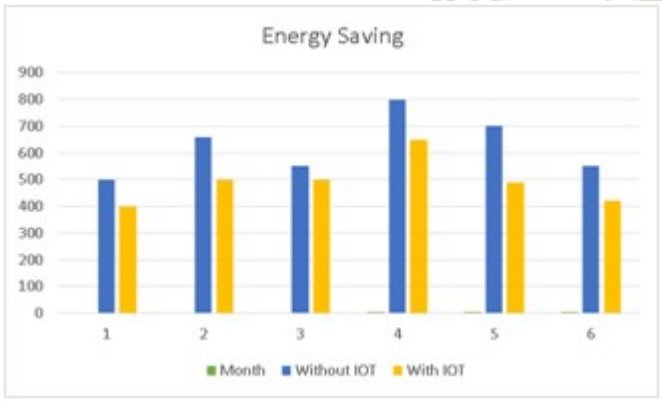
```
void loop() {
  // set the cursor to (0,0):
  lcd.setCursor(0, 0);
  // print from 0 to 9:
  for (int thisChar = 0; thisChar < 10; thisChar++) {
    lcd.print(thisChar);
    delay(500);
  }
  // set the cursor to (16,1):
  lcd.setCursor(16, 1);
  // set the display to automatically scroll:
  lcd.autoscroll();
  // print from 0 to 9:
  for (int thisChar = 0; thisChar < 10; thisChar++) {
    lcd.print(thisChar);
    delay(500);
  }
  // turn off automatic scrolling
  lcd.noAutoscroll();
  // clear screen for the next loop:
  lcd.clear();
}
```

VI. Outcome expected

There are two types of outcomes expected from this project. We have collected some data from college electric department and our department to achieve the required results.

A. Energy Saving

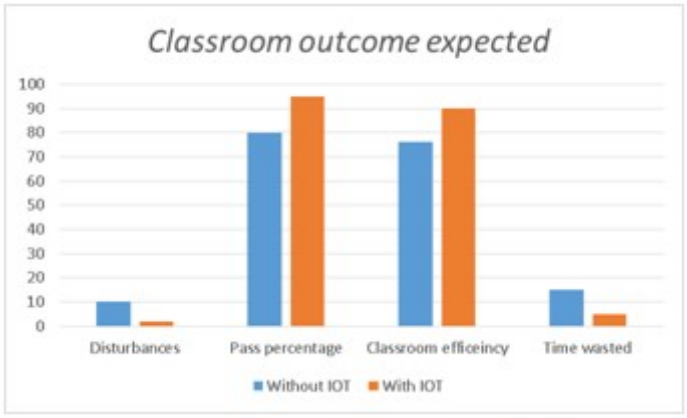
The data from the electric department which controls the power house of the college. The data is then compared with our assumption. The model graph is shown below in Graph1.



Graph 1: Assumed energy saving

B. Classroom outcome expected

The data from our department are sorted out and the required data are plotted in the below Graph 2.



Graph 2: Classroom Outcome Expected

VII. Acknowledgment

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