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A Survey on an IoT Based Automated Classroom Appliances Controlling System

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ABSTRACT

Energy Conservation in the classroom environment is the need of the hour. Energy Efficiency is one of the important aspects of smart classroom monitoring. IoT can be used to monitor and to control the appliances present in the classroom with the advancement in integrated circuits technology. The sensors and the other endpoint devices are available in abundance and at a reasonable rate. By using these devices, the classroom environment can be made energy efficient. The data collected can be communicated using Wi-Fi to the cloud or local server. This helps in proper controlling and managing the appliances in the classroom effectively. Further, the scheduling can be adapted to switch on and off the appliances in the classroom. A web/mobile app can be developed for controlling the appliances.

Keywords : Raspberry Pi, PIR sensor, FSR sensor, Relay, LED, DHT11 sensor, DC motor, LCD, GSM module.

I. INTRODUCTION

The Internet of Things describes the network of physical objects that are connected to the sensors, the purpose of the sensor is for sharing information and data transformation with other devices systems over the internet. IoT in simple words is the network of interconnected devices or things that are embedded with software, sensors, network connectivity and electronic equipment that enables collecting and exchanging of data with other devices. It means taking all the things in the world and connecting them to the internet.

Every object and sensor around us will be part of a network for computing, storing and sending data. Many electrical appliances are modernized as per human needs. Electrical appliances including lights, fans, TV, refrigerator and air conditioner can now be connected to the internet. For example we can control the room temperature by optimizing an air conditioner before reaching home if it is connected to the internet. The sensors like PIR, FSR, DHT11 and other IoT components help in sensing. The benefits of IoT based Energy Management are cost saving.

Most of the Colleges and Universities use the traditional lighting system where we use switches to control the light, fans, projector and AC. People are habituated towards leaving the classroom without switching off the lights, fan, projector, etc.., which leads to unnecessary consumption of energy for organizations and paying huge amounts of bills from their budget. Using the IoT, web applications, the appliances can be controlled automatically. All the colleges and schools have timings, according to which the appliances in the classroom can be scheduled for switching it ON/OFF.

Fig. 1 denotes the application server operations, where Application server stores the data and it will send the signals to the Mobile and Web applications. These applications send the commands to control the electrical appliances for the operations. Then, the present status of the appliances will be notified to the respective faculty and the data will be stored in a cloud.

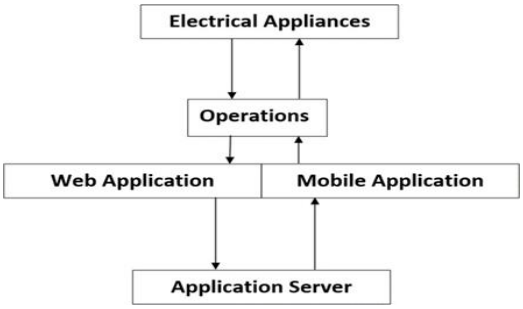

Fig. 1: Appliances Model

II. CLASSROOM APPLIANCES CONTROL APPROACHES

The Microcontroller can be connected to the internet, which allows us to access the cloud. The board is also connected to a relay board for controlling the electrical devices, which includes lights, fans and projector, and to detect the movement, PIR sensor is connected. The DHT11 is a temperature sensor, which helps to check the room temperature. If the room temperature crosses the specified threshold, then the window closes automatically with the help of a stepper motor. The System Architecture of the system is shown in Figure 2.

LDR (Light Dependent Resistor) sensor is used to indicate the presence or absence of light. Force Sensing Resistor (FSR406) is placed under the benches. The FSR sensor senses the acceptable load of the human, through the board, the signal will be sent to relay to control the electrical appliances. Also, the data will be sent to the cloud for monitoring the electrical appliances. Student's attendance can be recorded by facial recognition with the help of a camera and parents will receive information about the system if the status of the individual student is absent. LCD screens can be provided for displaying the faculty name, classroom schedule and absentee's name.

The system can use GSM to notify by sending messages whether the light is on or off. Once the data is collected from the sensor, the motion will be detected and the signal will be sent to the microcontroller. The microcontroller will turn on the light with the help of a relay board after that the cloud database is updated. When there are no people in the classroom then the admin will be notified with the help of the GSM module. All the data will be updated in real time so that the admin can view the data and switch on or off from any place. According to the scheduled time, the electrical devices can also be turned on or off. With the help of an application the whole system can be managed and monitored.

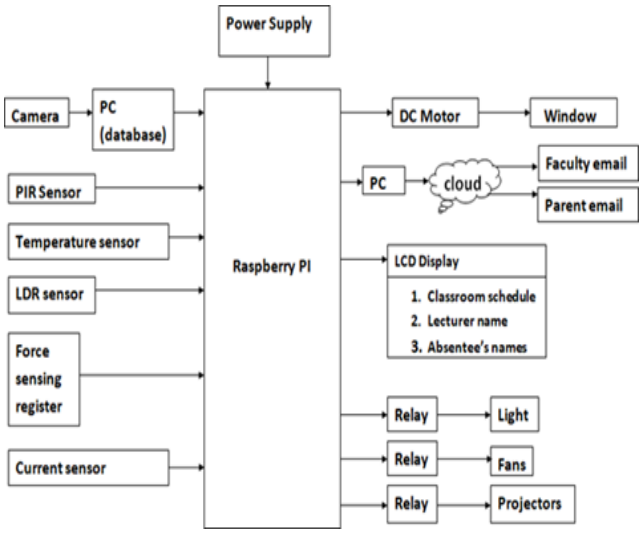

Fig 2: System Architecture of Classroom Appliances

2.1 Automatic Street Light Controlling System [2].

The four major components are used in this paper, Raspberry-Pi, ADC-module, LDR sensor and LEDs which are connected to each other as shown in Figure 3. The LDR sensor is connected to ADC and together with Raspberry Pi. The LED's and electric supply is connected to Raspberry-Pi. Further, the data is stored in the cloud. The amount of light is sensed by the LDR and the value of LDR helps to operate switches to turn on or off automatically. The values are sent to the ADC module, then the digital output value will be sent to Raspberry Pi. If the value of ADC crosses the threshold then automatically the LED will switch off. If it is dark, the LED will switch on. The data or the information will be sent to the Cloud. Here the software used is ThinkSpeak and for programming Python is used.

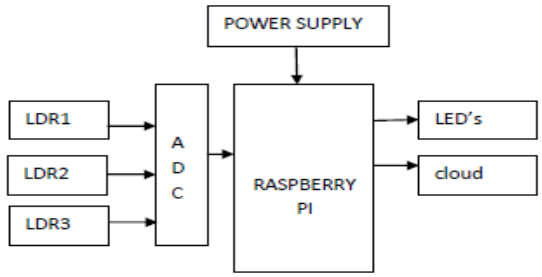

Fig 3 : Block diagram classroom appliances control

2.2 Design and Application of Intelligent Lighting Control System for Classrooms Based on PLC [3].

The PLC (Programmable Logic Controller) is used to control the Lights. Three control modes are used, which are Timing mode, Automatic control mode, and Manual mode. For processing the light sensor PLC plays an important role as the core component of the controlling system and for signal acquisition, infrared sensor and also light curtain sensor. In Timing mode, the lights will be controlled according to the schedule time. In Automatic mode the lights switches will be controlled automatically with the help of an android application or website.

In Manual mode, the lights switch will be operated manually. The power on or off lamp group is controlled. There is a limitation of working of PLCs under high temperature, vibrations conditions. The system setup is shown in Figure 4.

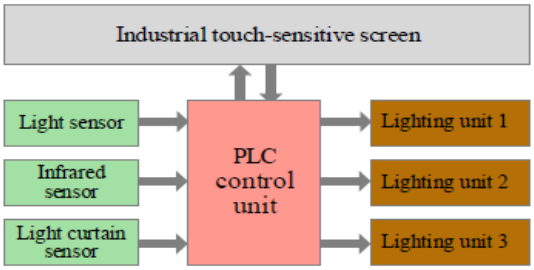

Fig 4: System Architecture based on PLC

2.3 Automatic Lighting and Control System for Classroom [4].

The system is divided into grids which are Hardware sensing unit, Processing unit, Control unit, Mobile application modules and Network module.

The system gives information about the energy consumption. Here, the Microcontroller used is Arduino Uno to which the PIR sensor is connected to detect the movements. To control the switches Relay is used. With the help of Bluetooth, a message from android is sent to Arduino to control the electrical

devices automatically. The GSM module is used for notification. The flow is shown in Figure 5.

2.4 IoT Based Home Automation Using NFC [5].

In this paper, the Microcontroller is connected to an LDR sensor, NFC reader and Relay which is further connected to lights, fans and lock. The GSM helps to send notifications to Android apps. NFC stands for Near Field Communication which is used like a central system which provides an automatic environment, where locking and unlocking of doors, switching on or off lights and fans, also TV, AC, and other home appliances is done.

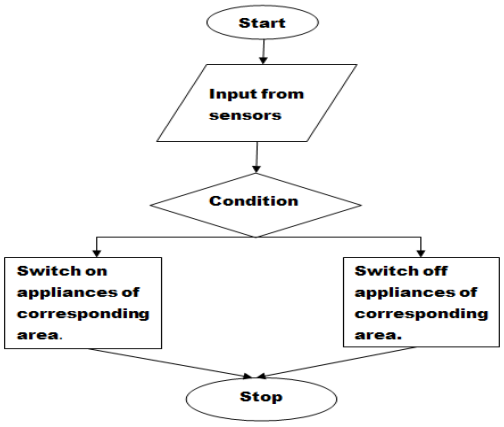

Fig 5: Flowchart Automatic Lighting and Control System

The main advantage is in real time the information will be sent to the customers about their current electrical power consumption. Due to internet traffic, real time updates may not happen on time. Figure 6 shows the overall setup.

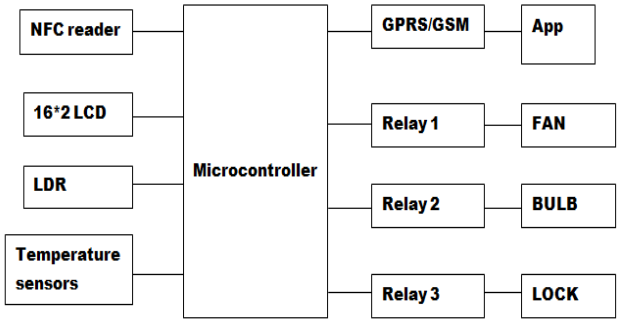

Fig 6: Block Diagram of Home Automation

2.5 Design And Implementation Of IoT Enabled Smart Classroom For Sustainable Campus[6].

The system includes automatic door open and close, recording the attendance automatically by facial recognition, all classroom equipment automation and measuring the temperature of the classroom. In this system, Raspberry Pi is used and all the sensors and equipment are connected to it. When the teachers or students are entering or leaving the classroom the door will automatically get opened and closed respectively.

When a teacher enters the classroom, the name of the teacher is displayed on the LCD screen. Attendance of the students are recorded automatically by facial recognition and it will send the attendance status to the respective teachers and the parents via mail. The light gets turned on automatically when the classroom is dark and if the room temperature crosses threshold temperature, the fan gets automatically turned on. The whole system is monitored by the sensors.

2.6 Theft Detection System Using PIR Sensor [7].

The system includes Raspberry Pi, PIR sensors, temperature sensors and sub motor with solenoid valve. This system collects the activities of the room through the camera and sends the image to mobile via dongle using a web application. PIR sensors detect the motion. The data is sent to the owner through the mail when the motion is detected by the camera. Once the mail is received by the owner, he/she can control all the devices using the mobile phone.

Further, the concerned can control the sub motor to release the chloroform gas. The chloroform gas is in the solenoid valve. The temperature sensors will calculate and detect the body temperature of burglars to indicate the person is present.

2.7 IoT Smart Window Using Sensor DHT11 [8].

The system includes temperature sensors, Arduino and stepper motor. The Microcontroller used here is an Arduino for interaction and sensing. IDE software and Arduino Programming Language is used by the system. The DHT11 sensor senses temperature and humidity. It is connected to the Arduino. Stepper motor is the DC motor, which converts electrical energy into mechanical energy. This will help to control the window.

The windows are connected to the motor which is connected to the Arduino and it is connected to the temperature sensors. The data collected by the sensors are given to the Arduino board and by using the programming language it can set the standard temperature. If the room temperature is higher than the normal temperature, then, with the help of a motor the window will open. Without the help of human interaction, the room temperature will be maintained. and it also provides window operation. The system helps to maintain the room temperature at standard level. The monitoring and controlling the operation of the window is done by the Android app.

2.8 Smart Home Lighting System [9]

The system uses a raspberry pi with Raspbian operating system installed on it. Virtual Network Computing (VNC) is used to view and control the system and to display the system monitoring status remotely. MySQL database is used to store the data that is required for the smart system application. The sequence diagram is shown in Figure 7. The modules are user, database, raspberry pi and home appliances.

The input device gives the input to the user module and it goes to the database. The database consists of status values, by which appropriate operations are performed. The database sends the control signal to the raspberry pi which contains user input status to interact with the home appliances connected. It will receive the status from the database and send the control signal to the connected appliances to perform a specific operation. The appliances are operated according to the status values given by the user. Ease of use is one of the advantages. This system is very easy and operations can be performed at fingertips

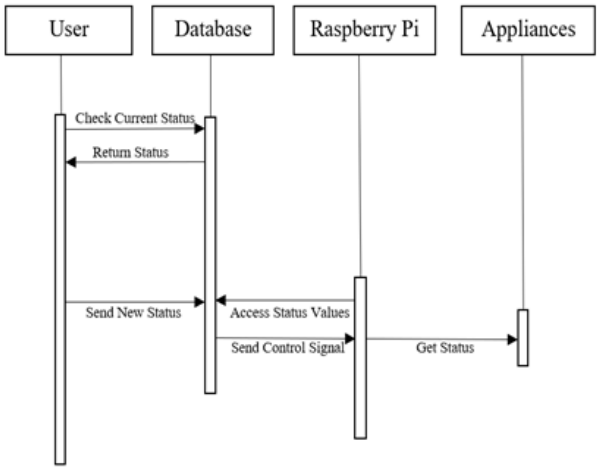

Fig 7 : sequence diagram of the smart light system

2.9 IoT Based Smart Surveillance Security System using Raspberry Pi[10].

This paper focuses on implementing safekeeping alert devices using IoT. Here, the mini computer Raspberry Pi is connected to a constant power supply, a web camera, which will detect and click shots or record videos when motion is detected. The setup is shown in Figure 8.

A memory card is also connected to Raspberry Pi with a Wifi Adapter and display Monitor. Raspberry Pi processes data and uploads the shots and videos to server and email notifications with shots and videos to server.

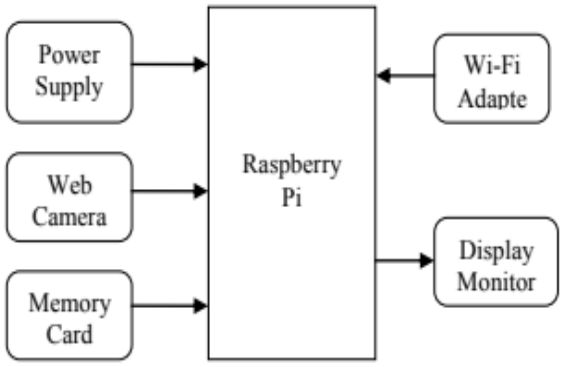

Fig 8: System Architecture

2.10 IoT Based Load Sensing Seats Controlling Lights and Fans [11]

This paper implements an automatic control of fans and lights of the room using IoT along with Arduino Uno. Here, a constant power supply along with force sensing resistor (FSR) is connected to Arduino Uno.

When seated, FSR sends value to Arduino uno through signal. Threshold value will be saved in the cloud which will be sent to Arduino Uno through the Wi-Fi module using google assistant. If the threshold value is more than the FSR value then lights and fans are turned ON. The lights and fans are controlled by a relay module. Arduino uno sends signals to the relay module to turn off or on the lights and fans. Power supply is also given to the relay module. Figure 9 shows the block diagram.

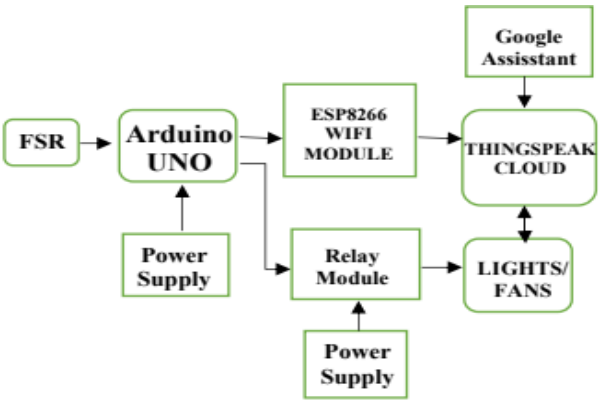

Fig 9 : Block Diagram

2.11 IoT Based Cloud Integrated Smart and Sustainable Classroom [12].

The system controls and informs whether the homework assignments are submitted on time and will send reminders to complete it. When the student enters the classroom, the student has to scan the RFID tag to the reader, if assignments are done they can go to class if not the buzzer will alert them to go to meet the respective teachers. Here, students submit assignments, other works on the website and all the information is stored and accessed in the cloud.

Report generation system consists of the system, administrator, and student. From the cloud storage, the generated file is sent to the IoT alert system.

2.12 loT based Power Efficient System Design using Automation for Classrooms [13].

In this paper, the sensors like PIR are connected to the Galileo Board. Threshold values are sent to the Galileo board through database to server and from client to board. If the PIR motion values are greater than threshold values then the Galileo board sends signals to relay switches to turn on the lights and fans. Relay switch controls the lights and fans. Here, the client sends and receives data to and from the server. Server transfers data between database and client. Database acts as a scheduler.

2.13 Smart Automation System for Controlling Various Appliances using a Mobile Device [14].

This system has resulted in the development of Android apps with a user-friendly Graphical User Interface that makes it simple to interface with the smart control system. This programme communicates with the control system over a cloud network via Wi-Fi and may respond fast.

The RGB LED panel light system, which regulates color, color temperature, and brightness, was

created with the need of the situation and lighting circumstances in mind. RGB LED panel lights are available, no systems for activity-based color modes have been developed. This crowd-sourced ceiling fan and air conditioning control system is superior to an individual preference system controlled by a standard remote controller. Only the android application and the human can control the system.

2.14 Intelligent Power Saving System using PIR Sensors [15].

The PIC (Peripheral Interface Controller) controls the monitors, fans, and lights. A non-inverting amplifier receives the PIR sensor's output. The PIC controller is set to take 0 as an input pulse, so the PIR sensor's output is inverted to 0. An inverting amplifier receives impulses from the PIR sensor once the motion is detected which will then send the impulse to the controller. The matching relay will be activated by the controller. The PIR sensor produces a constant output rather than a changing output. The intelligent power saving system with PIR sensor can be utilized in IT fields and computer labs to save energy. Figure 10 shows the overall working where PIR sensor is connected to PIC which is further connected to relay and monitor to control the lights and fans.

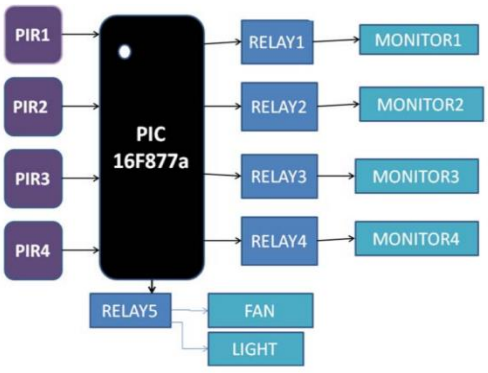

Fig 10: Working Structure of Intelligent Power Saving Systems Using PIR Sensors

2.15 Dynamically Controlling Exterior and Interior Window Coverings through IoT for Environmental Friendly Smart Homes [16].

In this study, the necessity of the home is defined with three levels of temperature. High, medium and low define the light intensity. The value of high, medium and low can be set from anywhere based on the necessity of home residents and preferences. Also automatic control of the appliance can be scheduled at any time. In this paper, climate zones are divided into two seasons: warm and cool. These two seasons' duration can be set by the system user. For automatic operation of curtains and also exterior coverings, It mainly focuses on the remote control based device programmable system based on necessity of the house for air conditioning, lighting control, heating.

III COMPONENTS

The components which can be used in the above approaches are described below:

3.1 RASPBERRY PI [2]: Mini computer with low cost with the physical size of a credit card. Runs various types of Linux and performs all tasks that a normal desktop can do. It allows interfacing sensors and actuators through the general-purpose GPIO pins.

3.2 LDR SENSOR [2]: An LDR is a device whose resistance varies with the intensity of light falling on it. Also called Photoresistor, photocell or photoconductor. The resistance of an LDR is highly sensitive to light and it varies with the wavelength of the incident light. An LDR is made of material with a high resistance such as cadmium sulfide(CdS), lead sulfide(PbS).

3.3 CAMERA [7]:HD Surveillance Camera using Raspberry Pi is a camera which records HD videos when some motion is detected in a particular area. Live Picture or video can be viewed from anywhere from any web browser even from our mobile browsers.

3.4 DHT11 SENSOR [8]: The DHT11 measures temperature and humidity. DHT11 is present in microcontrollers like RaspberryPi, Arduino and so

on. It is a less effort temperature and moisture sensor.

3.5 STEPPER MOTOR [8]:It is an electro-mechanical digital device. It has a permanent magnetic rotating shaft called a rotor and stationary electromagnets surrounding the rotor called the stator. It has typically 50 to 100 electromagnet poles. Also has 200 rotor teeth. It can rotate to close the windows.

3.6 CURRENT SENSOR: It helps to measure current without interrupting the actual circuit. It is used in many industries. ACS712 is one of the current sensors that convert the magnetic field created by the current that flows through the sensor to voltage directly proportional to it. It generates voltage linear with the current that flows through the sensor.

3.7 RELAY SWITCH: It is an electrical operating switch which uses electromagnet to mechanically operate the switch. It is necessary to control the switch or circuit by only one signal. Relay ensures complete electrical isolation between the controlling and the controlled circuits.

IV. CONCLUSION

The different methods to automatically control lights, fans and other electrical appliances are given and explained above using IoT. The main aim is to reduce the power consumption by switching off the appliances when not required.

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