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SMART COLLEGE USING THE INTERNET OF THINGS

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ABSTRACT

The concept of a smart building is emerging in multiple continents, where enhanced building lighting controls, building monitoring, private safety, security, motion detection, and optimization systems are being deployed on a building scale. The main objective of this paper is to present the design and implement a low cost wireless smart college system. The system will be developed to enable controlling various devices via IoT. The main feature of this system is that it will use regular home appliances/devices with no or minimal modification. The proposed design will include the user interface system that will take the commands from the user, the communication system that carries the user commands to the terminals, and the action taken by the terminals when receiving the user command from the main controller.

KEYWORDS

Smart building, IoT, Embedded systems, Sensors.

1.INTRODUCTION

One of the emerging technologies is the smart building technology,and there is an increasing interest in the Internet of Things (IoT) enabled smart buildings. An increasing number of things are being connected to the Internet at an exponential rate, resulting in the enrichment of the digital world [1]. There are a number of different domains in which Internet of Things (IoT) is facilitating and improving human life and work efficiency [2]. There is an increasing interest in using IoT devices for making buildings more smart and efficient [3]. For instance, a significant amount of energy is being consumed by buildings. The need for energy efficiency in buildings is critical, and one of the objectives of a "smart building" is to monitor, reduce and manage building energy consumption without compromising the occupant comfort and operational efficiency [4]. Within buildings, heating, ventilation and air conditioning systems contribute to significant energy consumption [5]. Smart homes promote comfort, luxury, entertainment, security, and world peace. Current existing smart homes need special kind of appliances to deal with, which equipped with a network adapter since they should connect to a wired network. Smart home technology originally depends on the wired network infrastructure, but after the huge improvements in that technology, it also supports the wireless communication over multiple frequencies to control the system. Smart building technology is a collective term for information- and communication technology as used in houses, where the various components are communicating via a local network. Smart home technology also makes the automatic communication with the surroundings possible, via the Internet, ordinary fixed telephones or mobile phones. Smart home technology gives a totally different flexibility and functionality than does conventional installations and environmental control systems, because of the programming, the integration and the units reacting on messages submitted through the network. The paper is organized as: firstly, introduction, secondly, it provides elements of iot, thirdly, it discusses the iot enabled smart buildings, fourthly, defined proposed system, fifthly, it provides the subsystems, sixthly, it discusses the results and at the end it concluded.

2.ELEMENTS OF IOT

Internet of Things (IoT) is a new revolution of the Internet. It makes Objects themselves recognizable, obtain intelligence, communicate information about themselves and they can access information that has been aggregated by other things [6]. IoT has been developed rapidly and a large number of enabling technologies have been proposed, it has entered the daily operation of many sectors. It application scenarios were identified and grouped into 14 domains, which are Transportation, Smart Home, Smart City, Lifestyle, Retail, Agriculture, Smart Factory, Supply chain, Emergency, Healthcare, User interaction, Culture and tourism, Environment and Energy [6]. Basically, there are

three IoT architecture layers, the client side (IoT Device Layer), operators on the server side (IoT Getaway Layer), a pathway for connecting clients and operators (IoT Platform Layer). In addition, the fundamental features of sustainable IoT architecture include functionality, scalability, availability, and maintainability [7]. Without addressing these conditions, the result of IoT architecture is a failure. In simple terms, the 4 Stage IoT architecture consists of sensors and actuators, internet gateways and Data Acquisition Systems, edge IT, and data center and cloud [8]. The Internet of Things describes a world in which everyday objects are connected to a network so that data can be shared

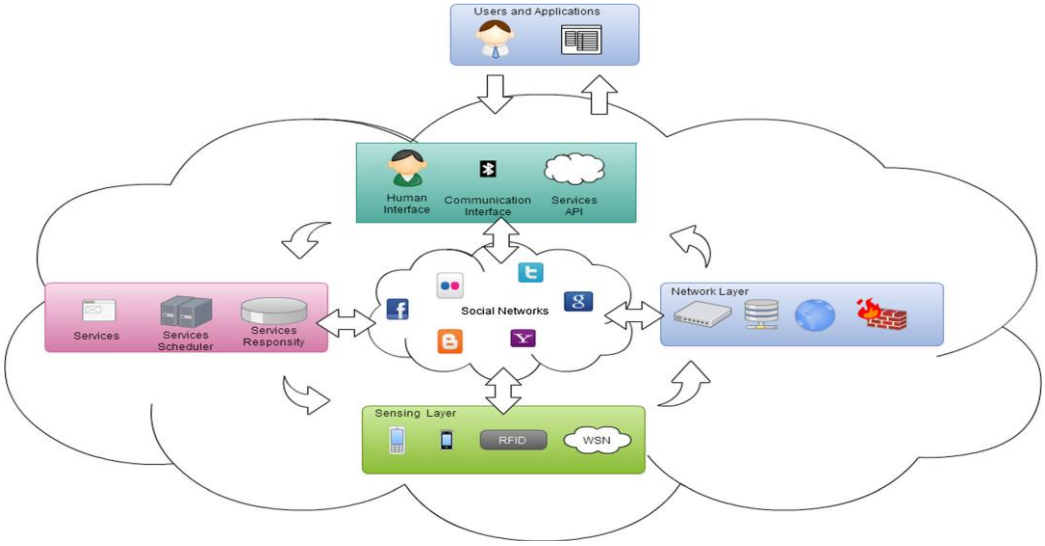


Figure 1. Architecture for the Social IoT

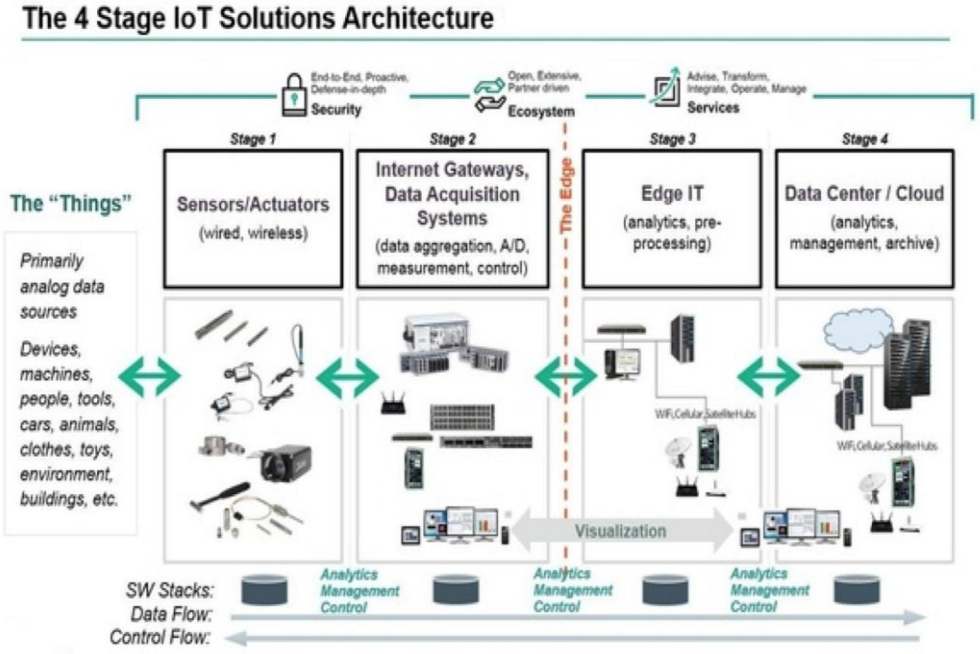


Figure 2. The detailed presentation of these stages can be found on the diagram below

IOT ENABLED SMART BUILDINGS

The Internet of Things (IoT) will be able to join plainly and seamlessly a large number of different and heterogeneous end structures. A related and cost-effective user-level IoT application is the support of IoT-enabled smart buildings. There is an increasing interest in using IoT devices for making buildings more smart and efficient[9]. Smart buildings provide safe, productive, and comfortable environment for its occupants without compromising on operational and energy performance. A smart building will have different infrastructural components that maintain the occupant comfort level[10]. In smart building technology is primarily used in residential homes and nursing homes,where the technology was installed during the building process. Smart buildings integrate and account information from different embedded devices or sources for intelligence, control, materials and construction as an entire building system. This is

to enhance adaptability with a view to meet the value drivers of the smart building: energy and efficiency, longevity, and comfort and satisfaction [11].

DESIGN APPROACH AND DETAILS (TECHNOLOGY & STRUCTURE & ELEMENTS)

The main objective of this paper is to design and implement a low cost wireless smart home system. The system will be developed to enable controlling various devices via radio frequency. A main feature of this system is that it will uses the regular home appliances/devices with no or minimal modification. The proposed design will include the user interface system that will take the commands from the user, the communication system that carries the user commands to the terminals, and the action taken by the terminals when receiving the user command from the main controller. In order to understand the potential of the technology, we will describe the different elements, which standards are relevant and what is applied in the design.

4.1. Associative Techniques

4.1.1. ESP8266_Microcontroller & Wi-Fi Integrated Circuit

The ESP8266 Wi-Fi module is a self-contained system-on-chip (SOC) with integrated TCP/IP protocol stacks that can give any microcontroller access to a Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions to another application processor.In this paper, the interface between the ESP8266 Wi-Fi module and arduino is studied for monitoring system application [12].

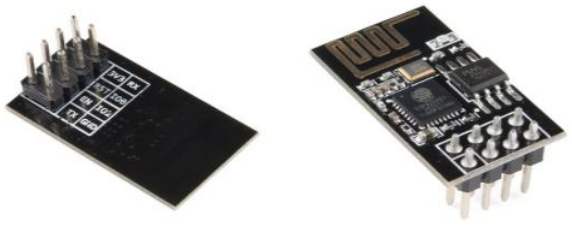


Figure 3. ESP8266.01 module & circuit diagram of ESP8266.01 module

4.1.2. Raspberry- pi Module

Raspberry Pi is a tiny single board computer, introduced by the Raspberry Pi Foundation, that comes with CPU, GPU, USB ports and i/o pins and capable of doing some simple functions like a regular computer. The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games. The Raspberry Pi has the ability to interact with the outside world, and has been used in a wide array of digital maker projects, from music machines and parent detectors at weather stations and tweeting birdhouses with infrared cameras. [13].

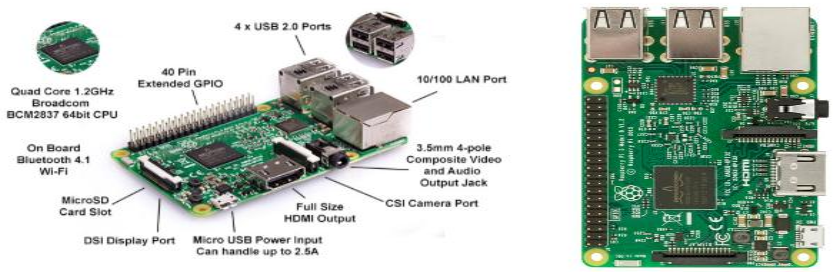


Figure4. Raspberry pi module

4.1.3 Arduino

Open Source electronic prototyping platform based on flexible, easy to use hardware and software. Arduino is used for building electronics projects, which consists of Physical programmable circuit board, and Piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. There are many other microcontrollers and microcontroller platforms available for physical computing .

4.2. Proposed Smart College Description

The smrat college system is a system using the concept of iot, the system has the technical specifications.
In this paper will present some of these specifications, such as the energy efficient LED lighting, fire alarm system, smart water management, smart Attendance, automatio security&safty system , and central sound system

4.4. The Design Approach

4.4.1 Light System"

4.4.1.1. First Circuit: On / Off Lamp by using motion Sensor

This circuit makes the automatic room lights using Arduino and PIR Sensor, where the lights in the room will automatically turn ON and OFF by detecting the presence of a human. Such Automatic Room Lights can be implemented in your garages, staircases, bathrooms, etc. Where we do not need continuous light, but only when we are present. With the help of an automatic room light control system, there is no need to worry about electricity as the lights get automatically off when there is no person.

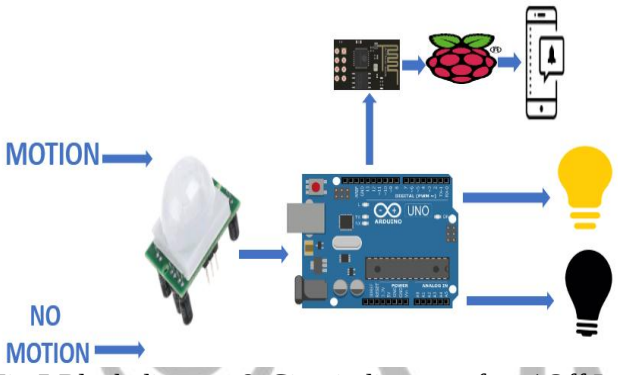


Fig 5 Block diagram & Circuit diagram of on / Off Lamp by using motion Sensor

In this circuit it can sense motion by Pyro electric ("Passive") Infrared Sensors (PIR), almost always used to detect whether a human has moved in or out of the sensor range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason, they are commonly found in appliances and gadgets used in homes or businesses. PIRs are basically made by a Pyro electric sensor, which can detect levels of infrared radiation. The sensor in a motion detector is actually split in two halves, because we are looking to detect motion (change) not average IR levels. The two halves are wired up so that they cancel each other out. If one half sees more or less IR radiation than the other, the output will swing high or low (Fig. 6-a-Fig. 6-b).

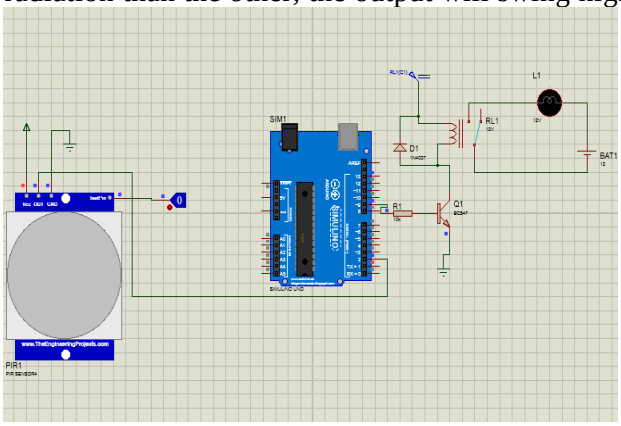


Fig.6-a Case of no motion detected

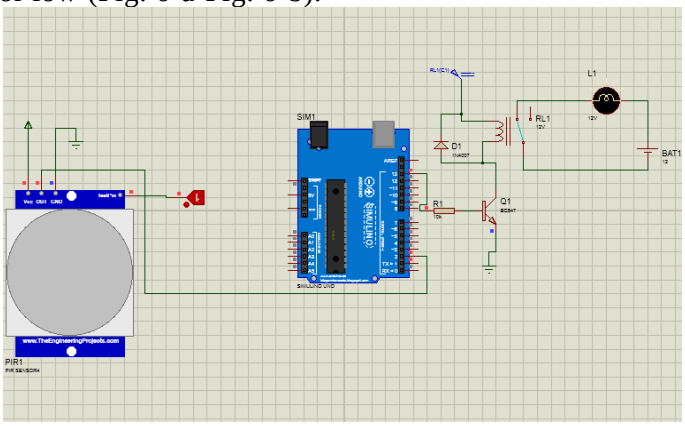
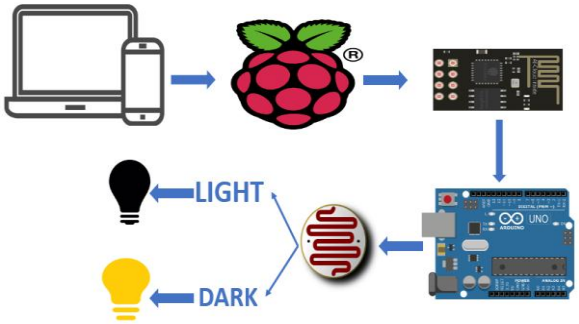


Fig 3.6-b Case of motion detected

4.4.1.2. Second Circuit "Control Brightness of lamp"

Using a light sensor, some wires, and Lamp to create an automatic night light that will turn on when you turn off the lights. Using Arduino Mega 2560, lamp, relay module, 10K Ohm resistor, LDR resistor.



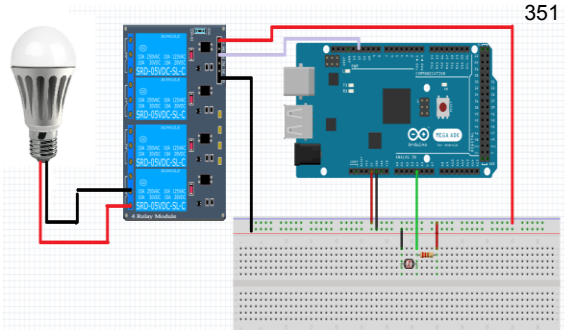


Fig 7-a Block diagram of Control Brightness of lamp Fig 7-b Circuit diagram of Control Brightness of lamp

The resistance of a photo resistor (or light-dependent resistor, LDR, or photo-conductive cell) decreases with increasing incident light intensity, and in the dark, a photo resistor can have a resistance as high as several mega ohms (MΩ), while in the light, photo resistor can have a resistance as low as a few hundred ohms

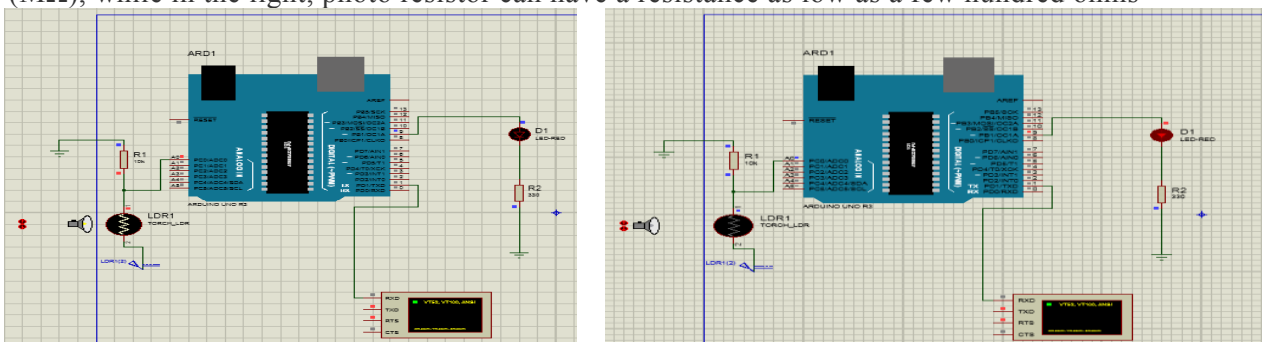
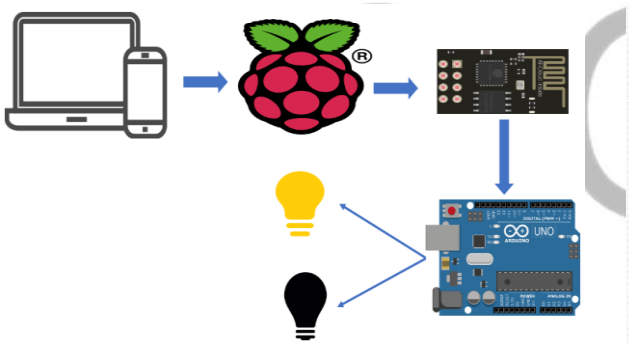


Fig. 8.Two Cases of (existing light - existing dark)

*4.4.1.3. Third Circuit "Open/**Close lamp**"*

Open and close lamps automatically using android application, it consists of Arduino Mega 2560, lamp, and relay module.



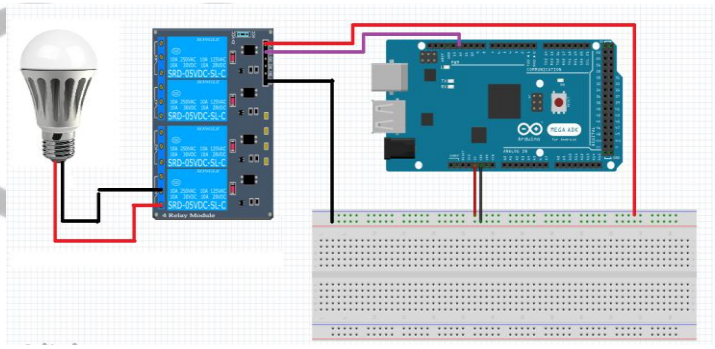
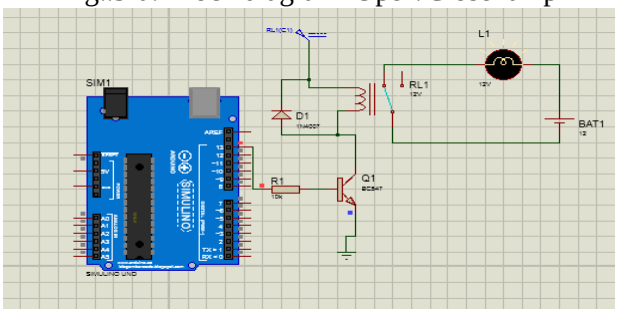


Fig..9-a. Block diagram Open/Close lamp Fig.9-b. Circuit diagram of Open/Close lamp



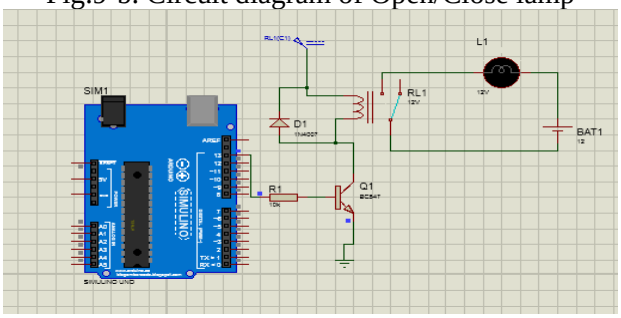
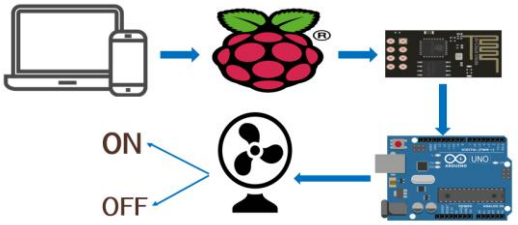


Fig. 10-a. ON state Fig. 10-b. OFF state

4.4.2 Design Approach "Fan Controlling System"

Open and close fan automatically using android was designed in this paper using Arduino MEGA2560, Esp8266 ESP-01s Wi-Fi Module, Relay module, and Ac Fan



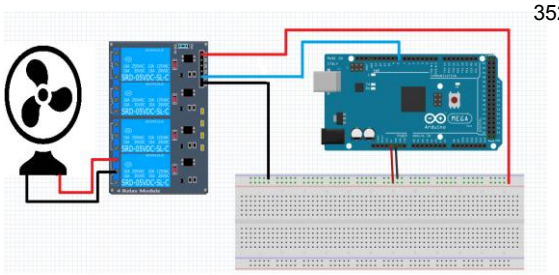
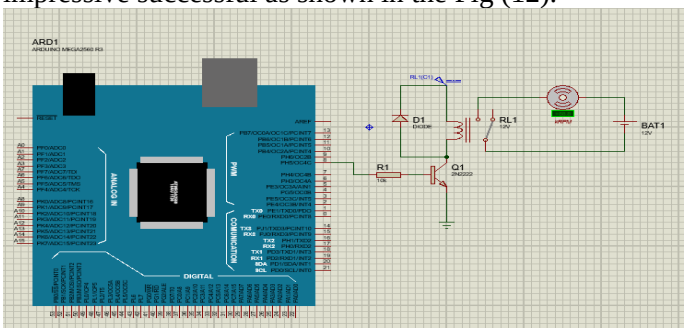


Fig.11-a. Block diagram of fan controlling system Fig. 11-b. Circuit diagram of fan controlling system

The circuit using one of the most popular software Proteus, which we have simulated the circuit and the results were impressive successful as shown in the Fig (12).



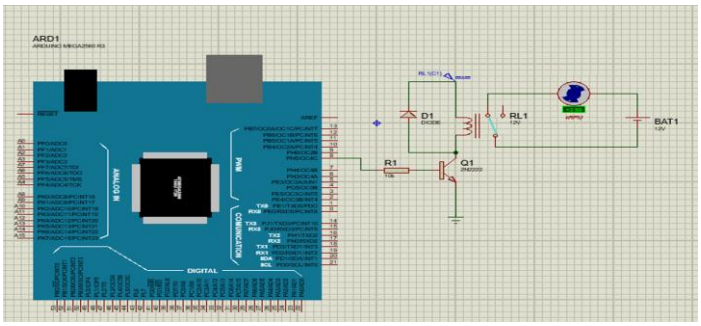


Fig 12-a. Circuit simulation fan OFF Fig 12-b. Circuit simulation fan ON

4.4.3. Design Approach "Fan Speed Control and Light Dimmer"

The following circuit is suited for Fan Speed Control and Light Dimmer. It is in all its simplicity just a resistor to trigger the gate via the disc in the Optocoupler, which are made up of an LED and a light sensitive device, all wrapped up in one package, no electrical connection between the two devices, the light sensitive device may be a photodiode, phototransistor, or more esoteric devices such as Thyristor.

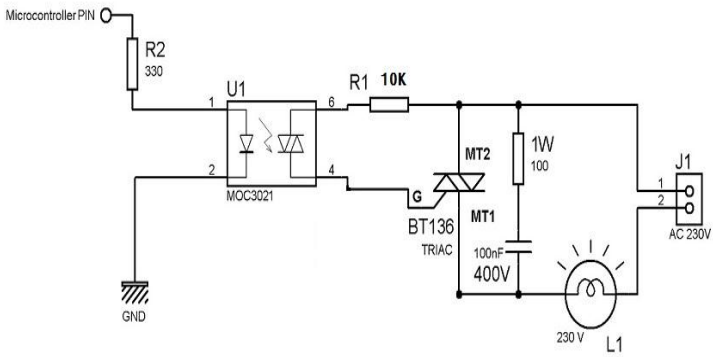


Fig. .13 Block diagram of fan speed control and light dimmer

4.4.4. Design Approach "Automatic Curtains"

In this section we created a lower cost alternative to motorized curtain rods, as well as making curtains Wi-Fi controllable. In order to open curtain, motor turns clockwise causing clips to move away each other and curtain begins to open. When the state of IR sensor (2 &3) goes from High to Low, curtains are completely opened and the motor will stop. In order to close the curtains, motor turns counter clockwise causing clips to move toward center of the lining and curtains begins to close. When the state of IR sensor (1) goes from Low to High, curtains are completely closed and the motor will stop. The L293D IC receives signals from the microprocessor and transmits the relative signal to the motors. It has two voltage pins, one of which is used to draw current for the working of the L293D and the other is used to apply voltage to the motors. The L293D switches its output signal according to the input received from the microprocessor. The L293D is a 16 pin IC, with eight pins, on each side, dedicated to the controlling of a motor. The basic diagram of H-bridge is given below: In the given diagram, the arrow on the left points to the higher potential side of the input voltage of the circuit. Now if the switches S1 & S4 are kept in a closed position while the switches S2 & S3 are kept in an open position, meaning that the circuit gets shorted across the switches S1 & S4. This creates a path for the current to flow, starting from the V input to switch S1 to the motor, then to switch S4 and then the exiting from the circuit. This flow of the current would make the motor turn in one direction.

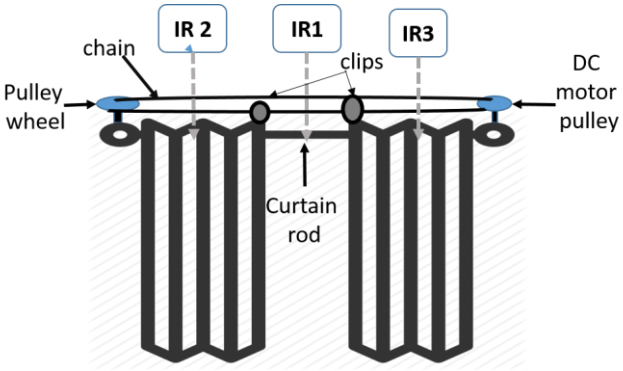


Fig 14 Working principle of circuit (Arduino- DC motor- Pulley wheel- L293D motor driver- IR sensor.-Curtains).

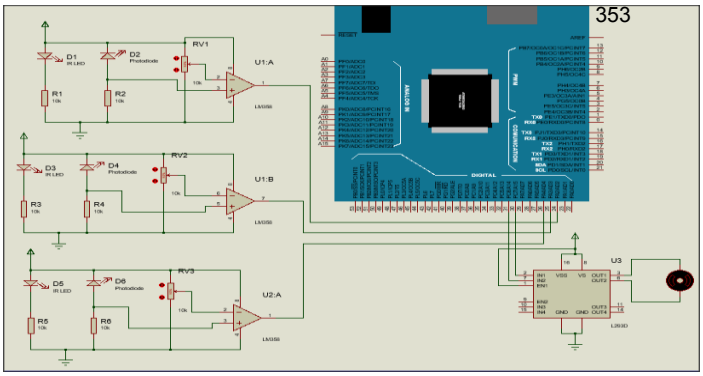


Fig 15 Circuit diagram of automatic curtains

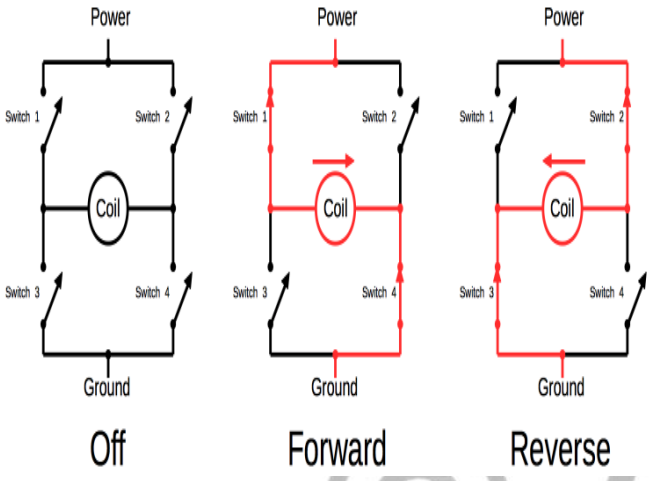


Fig 16. H-bridge

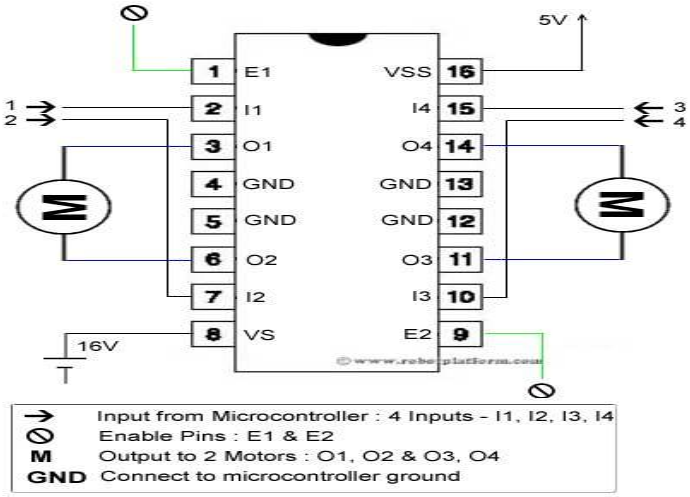


Fig 17 Pin diagram of L293D

4.4.8. Design Approach "Motion Security System"

It is a security system that detects movements and sends a signal to the control panel of your security system. They are sensitive to the slightest movement in an area and will be activated by a person walking by them, so you will know if there is someone in your home.

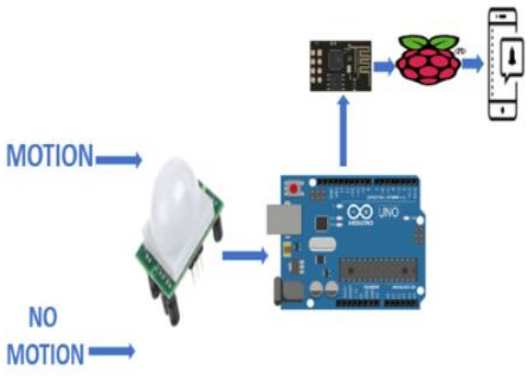


Fig.18-a. Block diagram of motion security system

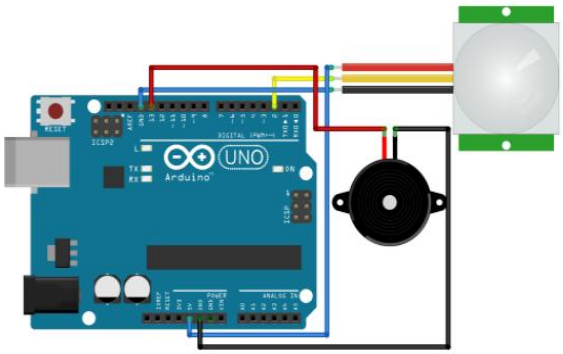


Fig 18-b. Circuit diagram of motion security system

A motion sensor is a device that notices moving objects, mainly people; it is frequently incorporated as components of systems that routinely performs a task or else alert a user of motion in a region. These sensors form a very important component of security, home control, energy efficiency, automated lighting control, and other helpful systems. It is small, inexpensive, low-power, easy to use and don't wear out.

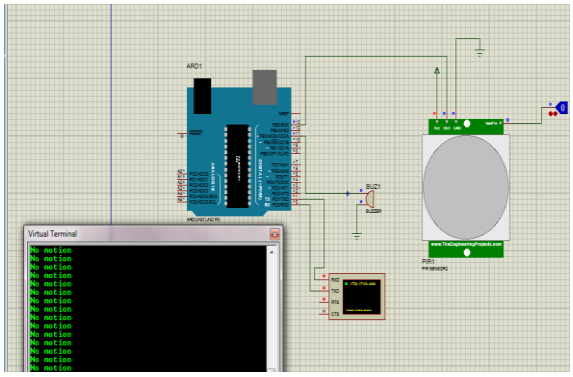


Fig19 Case of no motion detection

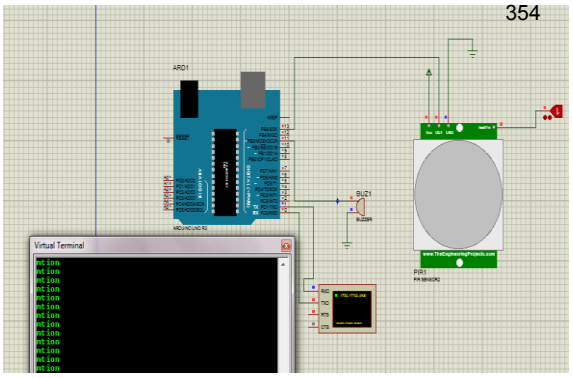


Fig20 Case of motion detection

4.4.9. Design Approach "Gases and Smoke Detection System"

Smoke Detectors are very useful in detecting smoke or fire in buildings; they are considered an important safety parameter. This circuit triggers the Buzzer when Smoke level becomes higher than 500 ppm, this threshold value can be changed in the Code according to the requirement. This circuit mainly uses MQ2 Smoke/Gas sensor and Arduino to detect and calculate the level of smoke. A buzzer is placed as an alarm which gets triggered when smoke level goes beyond 500 PPM, then read the sensor analog output voltage and when the smoke reaches a certain level, it will make a sound. The output can be an analog signal (A0) that can be read with an analog input of the Arduino or a digital output (D0) that can be read with digital input of the Arduino.

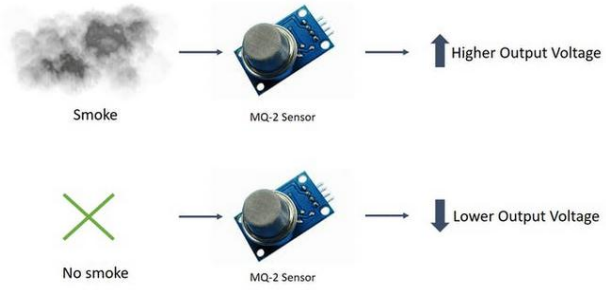


Fig21.Working principle of gas sensor

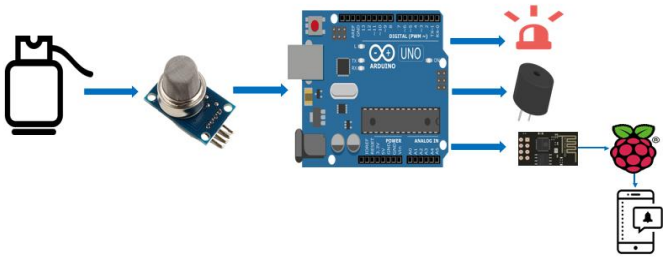


Fig 22. Block diagram of Gases and Smoke detection system

The MQ-2 Gas Sensor module is useful for gas leakage detecting in home and industry. It can detect LPG, I-butane, propane, methane, alcohol, hydrogen and smoke. The module has a built-in variable resistor to adjust the sensitivity of the sensor.

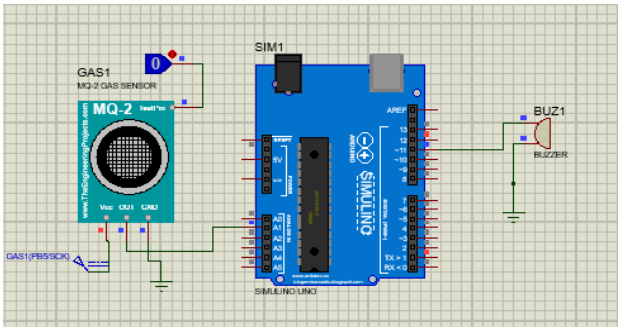


Figure 23-a. Case of no gas detection

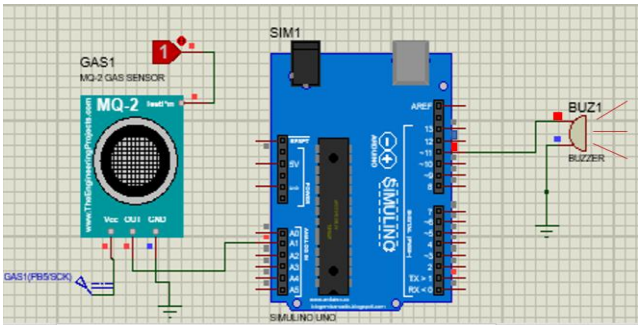


Figure 23-b. Case of gas detection

4.4.12. Design Approach "Fire System"

In this section, we will talk about one of the most important systems that must be implemented at any college, home, office or any building, it is the fire system. Our system will detect the fire throughout the flame sensor. After that the system will alarm and buzzing. Then the system will send notification to the users. After while the system will automatically shut down and cut off the electricity, to prevent the fire from breaking out.

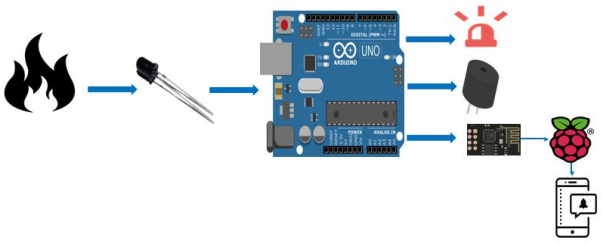


Figure 24-a. Block diagram of fire system

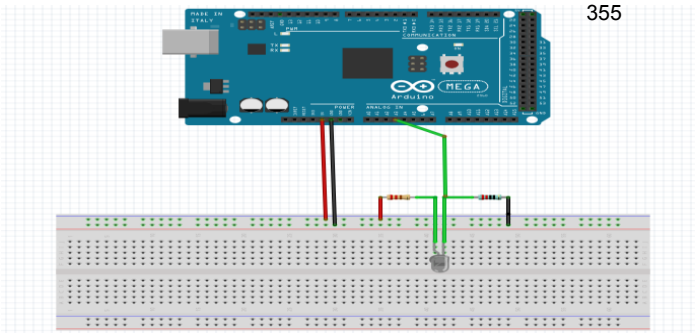


Figure 24-b. Circuit diagram of fire system

When the flame sensor ys-17 detects fire throughout, the Arduino will read analog input and compare it to the threshold that we set. Then Arduino will alarm and buzzer. Then the Arduino will publish a notification via the Wi-Fi module esp-01s. The android application will notify the users. The Arduino will cut off power to prevent disasters. Flame sensor is used for short-range fire detection and can be used to monitor projects or as a safety precaution to cut devices off / on. The flame sensor is very sensitive to IR wavelength at 760 nm ~ 1100 nm light. Analog output (A0): Real-time output voltage signal on the thermal resistance.

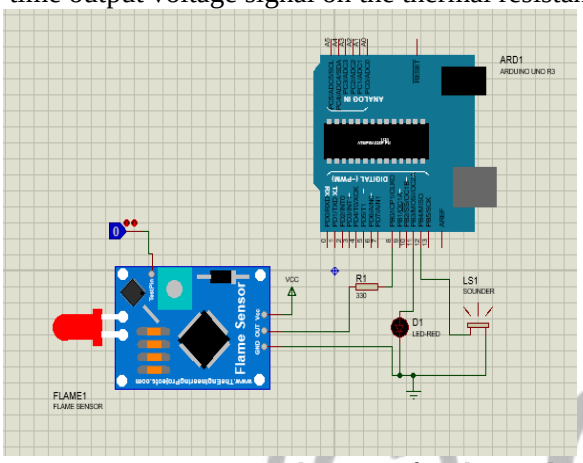


Fig. 25-a. Circuit simulation no fire detected

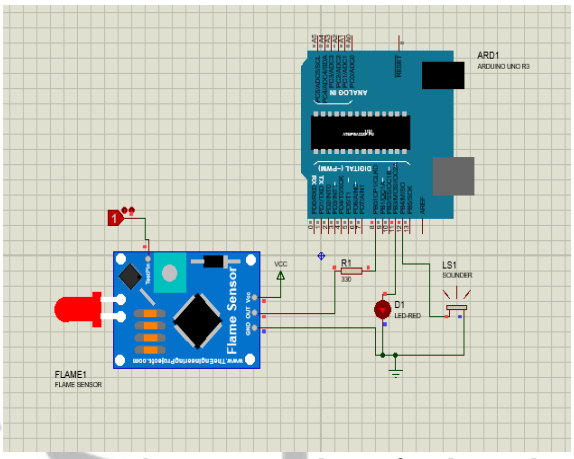


Fig . 25-b. Circuit simulation fire detected

4.4.13. Design Approach "Sound System"

The sound sensor module provides an easy way to detect sound and is generally used for detecting the sound intensity. This module can be used for security, switch, and monitoring applications. Its accuracy can be easily adjusted for the convenience of usage. It uses a microphone which supplies the input to an amplifier, peak detector and buffer. When the sensor detects a sound, it processes an output signal voltage which is sent to a microcontroller then performs the necessary processing.

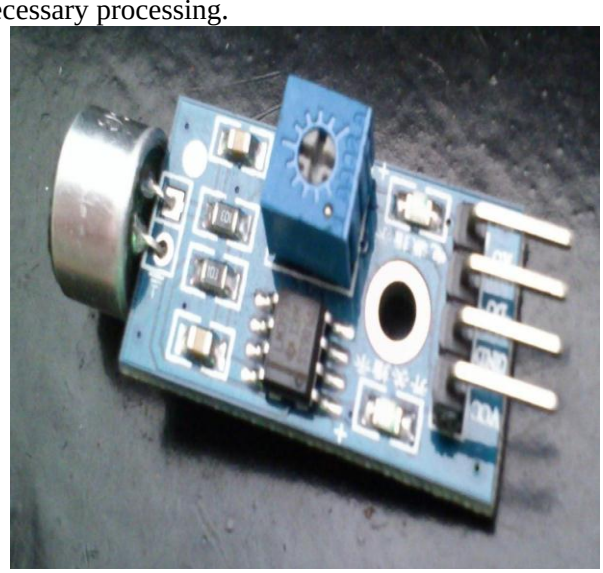


Fig.3.26. Sound Sensor Module

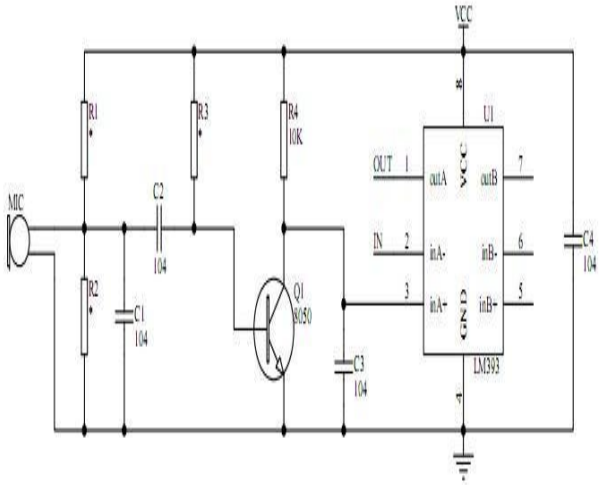


Fig.3.27. Schematic Diagram

5.FUTURE WORK

The next paper will present the user interface system that will take the commands from the user, it will include designing a user friendly interface which converts the commands coming from the users into binary commands. This interface could be GUI android, an SMS receiver and decoder, an infrared remote controller or a device that receives commands over the internet. The system will be developed to enable controlling various features within the smart college, including smart an attendance, safety and security systems.

6. CONCLUSION

The main objective of this paper is to design and implement a low cost wireless smart home system, which automatically control lighting systems, fans, fire systems, water management, irrigation systems and sound systems using simple and inexpensive electronic circuits. Trying to provide a more comfortable life within the college as well as saving in energy consumption. The design was applied to the Higher Institute of Engineering and Technology in New Damietta. A main feature of this system is that it will use the regular home appliances/devices with no or minimal modification.

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