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An Approach for Efficient Home Automation using Arduino OS Smart phone

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Abstract: The main objective of this paper is to develop a home automation system using an Arduino board with Bluetooth being remotely controlled by any Android OS Smart phone. As technology is advancing so houses are also getting smarter. Modern houses are gradually shifting from conventional switches to centralized control system, involving remote controlled switches. Presently, conventional wall switches located in different parts of the house makes it difficult for the user to go near them to operate. Even more it becomes more difficult for the elderly or physically handicapped people to do so. Remote controlled home automation system provides a most modern solution with smart phones. In order to achieve this, a Bluetooth module is interfaced to the Arduino board at the receiver end while on the transmitter end, a GUI application on the cell phone sends ON/OFF commands to the receiver where loads are connected. By touching the specified location on the GUI, the loads can be turned ON/OFF remotely through this technology. The loads are operated by Arduino board through opto-isolators and thyristors using triacs.

Keywords: Smart Home, Home Automation, Android Smartphone, Arduino, Bluetooth.

INTRODUCTION

In the present day, security systems play an important role in the protection of lives and investment. This is achieved by the incorporation of various subsystems into the security system with a single control unit such as surveillance, intruder control, access control, fire detection, etc. A smart home is one that is equipped with lighting, heating, and electronic devices that can be controlled remotely by smart-phone or via the internet. An internet based home automation system focuses on controlling home electronic devices whether you are inside or outside your home [1]. Home automation gives an individual the ability to remotely or automatically control things around the home. A home appliance is a device or instrument designed to perform a specific function, especially an electrical device, such as a refrigerator, for household use. The words appliance and devices are used interchangeably. Automation is today's fact, where things are being controlled automatically, usually the basic tasks of turning ON/OFF certain devices and beyond, either remotely or in close proximity [2]. Automation lowers the human judgment to the lowest degree possible but does not completely eliminate it. The concept of remote management of household devices over the internet from anywhere, any time in the world today can be a reality. Assume a system where from the office desk, the user could view the status of the devices and decides to take control by tuning his TV set to his favorite channel, turns on the cooling system, say the air conditioner, and switches on or off some of the lights. This user could walk back home and only find a very comfortable, pleasant home. The recent developments in technology which permit the use of Bluetooth and Wi-Fi have enabled different devices to have capabilities of connecting with each other [3]. Using a WIFI shield to act as a Micro web server for the Arduino eliminates the need for wired connections between the Arduino board and computer which reduces cost and enables it to work as a standalone device [5]. The Wi-Fi shield needs connection to the internet from a wireless router or wireless hotspot and this would act as the gateway for the Arduino to communicate with the internet. Several remote controlled home automation systems have been studied. R. Piyare and M.Tazil research work [6] provided full functionality to remotely control home appliances via wireless communication between the Arduino BT and cell phone using Bluetooth technology. Arduino BT board was connected with home appliance and it was controlled by a Symbian OS cell phone application [7]. Similarly, another study presented home automation system using Bluetooth and android application [8]. However, this was designed only for 4 lights and it was not feasible to control more than 4 Home appliances. In another research work, XBee based home automation system [9] introduced for handicapped and elderly people. XBee transceivers were used for wireless communication between the master control panel board and the remote control device. A home monitoring and automation system was also studied, it was implemented by using Arduino Uno and Digilent chip KIT [10]. Although this system mentioned as low cost system but it is much expensive than Bluetooth base home automation system. A low cost and wireless controlled automation system was designed by researchers [11]. Bluetooth technology was used to provide remote controlled wireless access to user. With this in mind, an internet based home automation system for remote control of home appliances is designed.

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OVERVIEW OF THE SMART HOME

The basic block diagram of the smart home system is shown in figure 1. A micro-controller is used to obtain values of physical conditions through sensors connected to it [4]. These integrated sensors such as the temperature sensor read temperature values [12], the gas sensor detects smoke [13] and cooking gas to avoid fire outbreak. The automatic switching on and off of the light is controlled by the Light Dependent Resistor (LDR) [14] which determines the day light intensity. Also to incorporate security in our design, a motion detector is integrated using Passive Infrared Sensor (PIR) [15] to detect movement in the home when the security system is turned on. A relay switch [16] is used to send control signals from the micro-controller to the electronic device used to achieve the switching on and off action. A web portal is designed with a one-

factor authentication system (username and password) [17] to check authenticity of the home user. It acts as an input device to control the home appliances and also acts as an output device to read the values of the physical conditions. The mobile application also utilizes this same procedure to act as an input and output device.

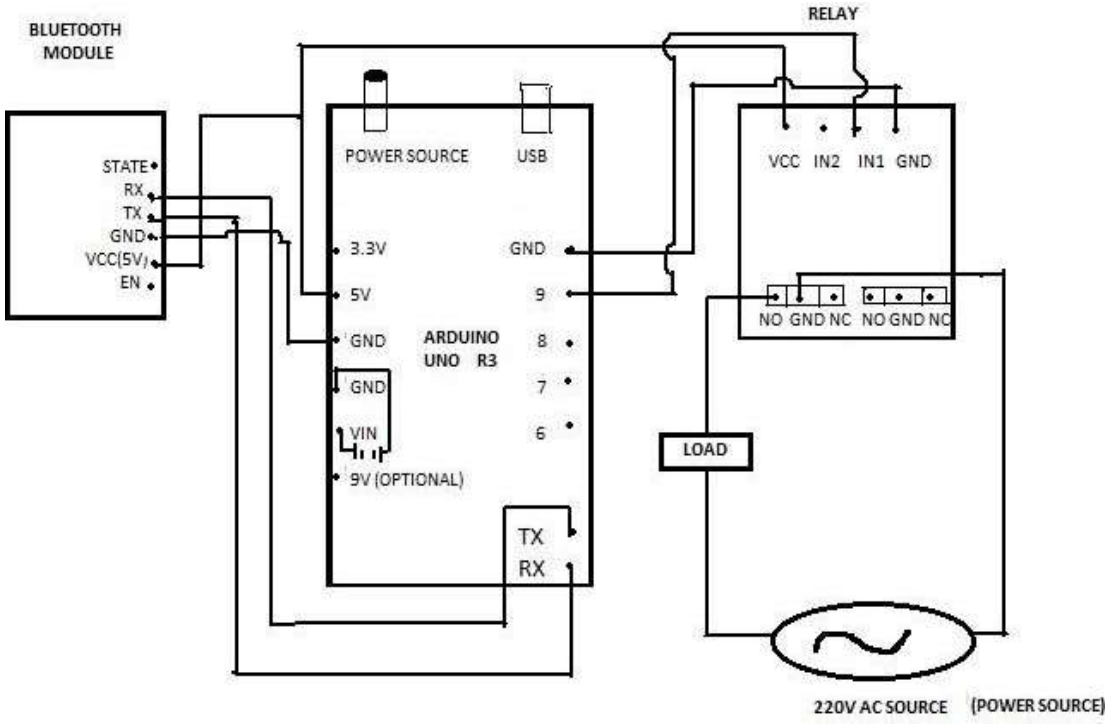

Figure-1: Block Diagram of Home Automation system.

DESIGN AND IMPLEMENTATION

A low cost and efficient smart home system is presented in our design. This system has two main modules: the hardware interface module and the software communication module. At the heart of this system is the Arduino Mega 2560 microcontroller which is also capable of functioning as a micro web server and the interface for all the hardware modules.

All communication and controls in this system pass through the microcontroller. As we can see in figure 2, the smart home system offers feature such as environmental monitoring using the temperature, humidity, gas and smoke sensors. It also offers switching functionalities to control lighting, fans/air conditioners, and other home appliances connected to the relay system. Another feature of this system is the intrusion detection which it offers using the motion sensor and all these can be controlled from the Android smart phone app or web application.

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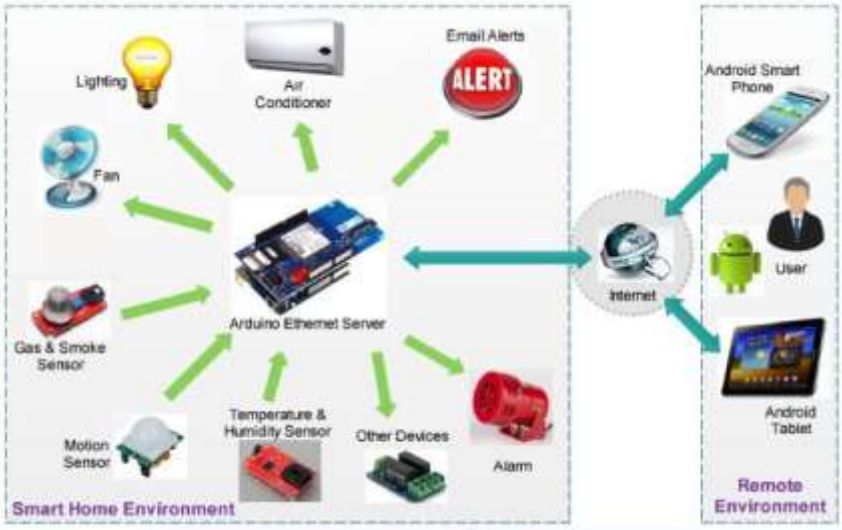

Figure 2: System architecture of the smart home system.

A real time notifications and status of different devices shown to user via mobile application. User can easily command and manage the home even from outside the home.

A. Hardware Requirements

Following hardware devices and sensors are used to build the proposed system:

1) Arduino UNO
2) Servomotor
3) Stepper Motor
4) Light Dependent Resister (LDR)
5) Power Relay Board
6) DC Motor
7) ACS712 Current Sensor
8) Magnetic Sensor
9) Flame sensor
10) Water Level Sensor
11) Temperature Sensor
12) DHT11 Humidity Sensor
13) Soil Moisture Sensor
14) Gas Sensor

a) Arduino UNO: Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as output.

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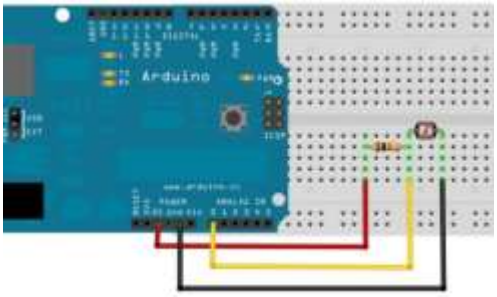
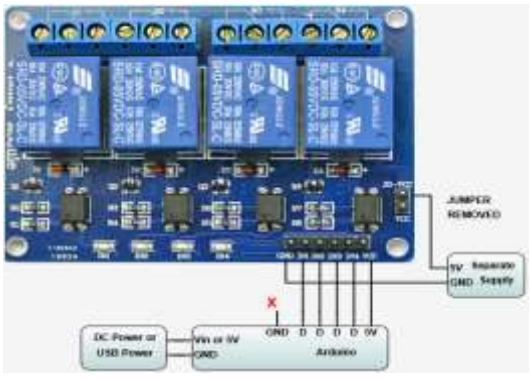
b) Servomotor: A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback.

c) Stepper Motor: A stepper motor, also known as step motor or stepping motor, is a brushless DC electric motor that divides a full rotation into a number of equal stepThe stepper motor is used for precise positioning with a motor, such as hard disk drives, robotics, antennas, telescopes, and some toys. Stepper motors cannot run at high speeds, but have a high holding torque.

d) Light Dependent Resister (LDR): The LDR is a special type of resistor that allows higher voltages to pass through it (low resistance) whenever there is a high intensity of light, and passes a low voltage (high resistance) whenever it is dark.



e) Power Relay Board: A power relay module is an electrical switch that is operated by an electromagnet.
The electromagnet is activated by a separate low-power signal from a microcontroller.
When activated, the electromagnet pulls to either open or close an electrical circuit.



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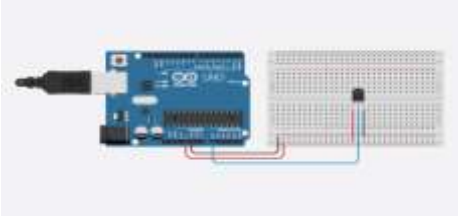
f) **DC Motor**: A DC motor (Direct Current motor) is the most common type of motor. DC motors normally have just two leads, one positive and one negative. If these two leads are connected directly to a battery, the motor will rotate and on switching the leads, the motor will rotate in the opposite direction.

g) **Magnetic Sensor**: The magnetic sensor is represented as a box connected to the ground and the 5V pin of the Arduino board. The sink is in fact a transistor that conducts when a magnet is close to the sensor and does not if the magnet is far from it. It is connected through a chain of resistors to the 3.3V Arduino pin.

h) **Flame sensor**: Flame sensor module has a **photodiode to detect the light and an op-amp to control the sensitivity**. It is used to detect fire and provide a HIGH signal upon the detection. Arduino reads the signal and provides alert by turning on the buzzer and LED.

i) **Water Level Sensor**: The water level sensor is used to detect water leakage, rainfall, tank overflow, or to measure the water level.

j) **Temperature Sensor**: The temperature sensor in Arduino converts the surrounding temperature to voltage. It further converts the voltage to Celcius, Celcius to Fahrenheit, and prints the Fahrenheit temperature on the LCD screen.



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k) Humidity Sensor: The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to circuit.

l) Soil Moisture Sensor: The soil moisture sensor consists of two probes which are used to measure the volumetric content of water. The two probes allow the current to pass through the soil and then it gets the resistance value to measure the moisture value.

m) Gas Sensor: Gas sensors (also known as gas detectors) are electronic devices that detect and identify different types of gasses. They are commonly used to detect toxic or explosive gasses and measure gas concentration. This type of sensor employs a chemi resistor which comes in contact and reacts with target gasses.

n) ACS712 Current Sensor: ACS712 is a current sensor that can operate on both AC and DC. This sensor operates at 5V and produces an analog voltage output proportional to the measured current.

B. Software Requirements

In this research work two software Arduino Integrated Development Environment (IDE) and Bluetooth terminal application are used.

A. Arduino IDE

IDE stands for Integrated Development Environment, entire programming for proposed system is done in Arduino IDE tool. Baud rate is set to 9600 bits per second for serial communication between Arduino board and smartphone. Arduino IDE command "Serial. A vailable 0" is used to receive data serially from smartphone and "Serial.printlnO" command is used to transmit data serially from Arduino board to smartphone. The code to receive data serial from smartphone. State variable is used to store the value of received byte and then it is compared with different condition and perform the specific operation.

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B. Arduino Bluetooth Management

An android app referred to as arduino bluetooth management is employed for wireless communication between the phone and arduino boards through HC-05 .

it's ability to transmit .American Standard Code for Information Interchange knowledge serially from smartphone to Arduino board exploitation Bluetooth module. ASCII {standard Code for data Interchange} (American Standard Code for Information Interchange) is that the commonest format for text files in computers and on the web. In an American Standard Code for Information Interchange file, every alphabetic, numeric, or special character is pictured with a 7-bit binary range (a string of seven 0s or 1s). 128 attainable characters area unit outlined according to the planned technique user are able to connect eight home appliances.

ADVANTAGE

1. Everything is automated so it is easy to use.
2. It is control by mobile application so no extra training is required.
3. We can change controlling system as our requirement.
4. It works on arduino based system so we can easily understand how it works.
5. It saves our time.
6. Every home appliance can control by one android application.
7. Easy installation and user friendly.

RESULT

According to the proposed plan the final outcome of this paper leads to the development of a home automation. Through this project, an automation system has been created so that we can easily control home appliances like as light, fan, tube light, AC, bulb, etc.

One of the objectives of this project is also to get us a smart automation and low cost project. In this paper we have also provided information about Arduino Uno, Bluetooth controller and relay module.
And the information about their work is given. Along with the component of home automation, its advantage has also been discussed.

The system is easy and secured for access from ant user or intruder. Final outcome of the project is given below in fig.

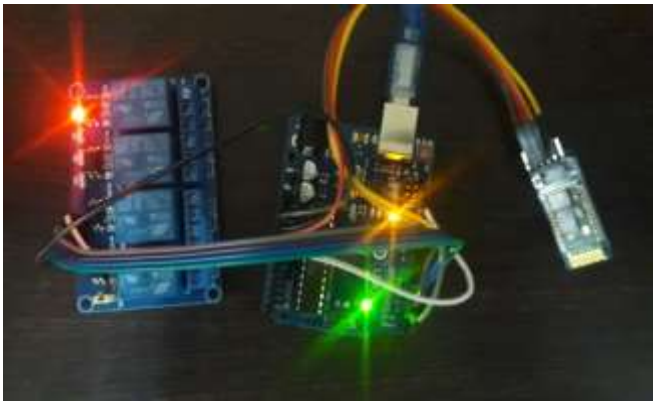

Fig (a) Arduino with relay module

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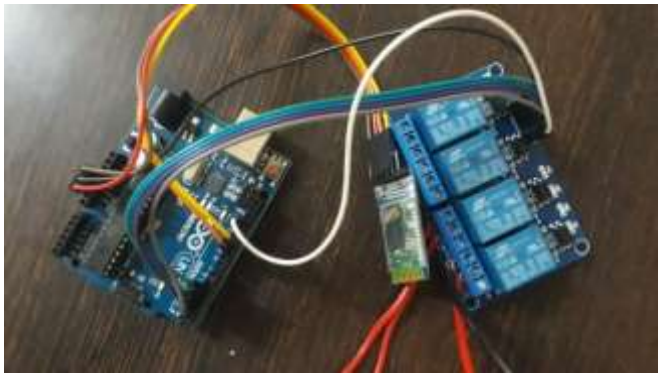

Fig (b) Arduino with Bluetooth

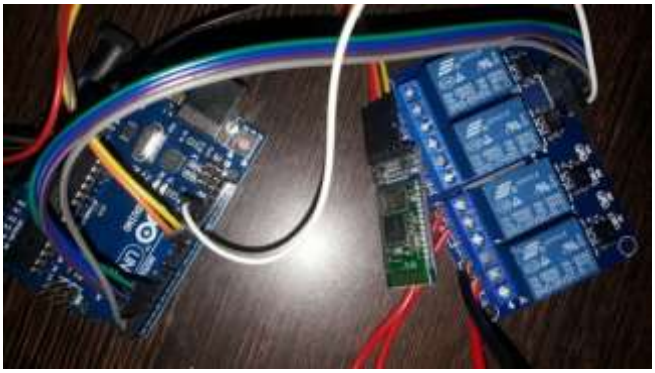

Fig (c) Relay module with Bluetooth

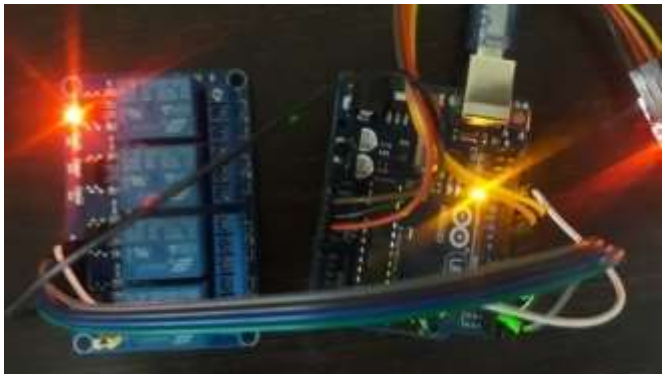

Fig (d) Home Automation

CONCLUSION

The system as the name indicates, 'Home automation' makes the system more flexible and provides attractive user interface compared to other home automation systems. In this system we integrate mobile devices into home automation systems. A novel architecture for a home automation system is proposed using the relatively new communication technologies. The system consists of mainly three components is a BLUETOOTH module, Arduino microcontroller and relay circuits .WIFI issued as the communication channel between android phone and the Arduino microcontroller. We hide the complexity of the notions involved in the home automation system by including them into a simple, but comprehensive set of related concepts .This simplification is needed to fit as much of the functionality on the limited space
offered by a mobile device's display. This paper proposes a low cost, secure, always accessible, auto-configurable, remotely controlled solution .The approach discussed in the paper is novel and has achieved the target to control home

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appliances remotely using the WiFi technology to connects system parts, satisfying user needs and requirements. WiFi technology capable solution has proved to be controlled remotely, provide home security and is cost-effective as compared to the previously existing systems. Hence we can conclude that there required goals and objectives of home automation system have been achieved. The system design and architecture were discussed, and prototype presents the basic level of home appliance control and remote monitoring has been implemented. Finally, the proposed system is better from the scalability and flexibility point of view than the commercially available home automation systems.

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