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Bluetooth Based Home Automation Using Arduino and Android Application

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Abstract: The aim of this paper is to develop a Bluetooth based home automation system with Arduino UNO Board and Android application. Remote controlled home automation system provides a simpler solution with Android application technology. Remote operation is achieved by any smart-phone/tablet etc., with Android OS, Upon a GUI (Graphical User Interface) based touch screen operation.

Keywords: Arduino, Bluetooth module, Home Automation, Android application.

I. INTRODUCTION

Android operating system is one of the leading and most popularly preferred systems in smart phone. Smart phone affordability increases day by day due to their size and portability. Android GUI installed in smart phone. The operator has to touch on the screen of the phone to control the home appliances. This project is an android application which possesses the capability to control any sort of electrical appliances providing remote access from smart phone using Bluetooth [1]. Bluetooth technology is Wireless radio transmissions in a short distance providing a necessary technology to create convenience, intelligence and controllability [2]. This generates personal area network in home environment, where all these appliances can be interconnected and monitored using a single controller. Home automation involves a degree of computerized or automatic control to certain electrical and electronic systems in a building. Busy families, individuals with physical limitation represent very attractive market for such networking. This system will also assist and provide support in order to fulfill the needs of elderly and disabled in home. A smart home control and monitoring system utilizing smart phone, Android app and embedded micro web server, having IP connectivity to access and control various devices and appliances remotely, has been implemented [3].

II. WORKING PRINCIPLE

A. The system consists of an Arduino Uno, Bluetooth module, Relay drivers, step down transformer, Android application.

- 1) The Bluetooth module is used to connect the devices to operating the appliances within the range of Bluetooth.
- 2) The Arduino Uno helps in interfacing and processing the signals.
- 3) Relay drivers act as electro-magnetic switch used to ON and OFF the appliances.
- 4) Loads are connected by those relays individually.
- 5) These operations can be displayed on LCD screen.

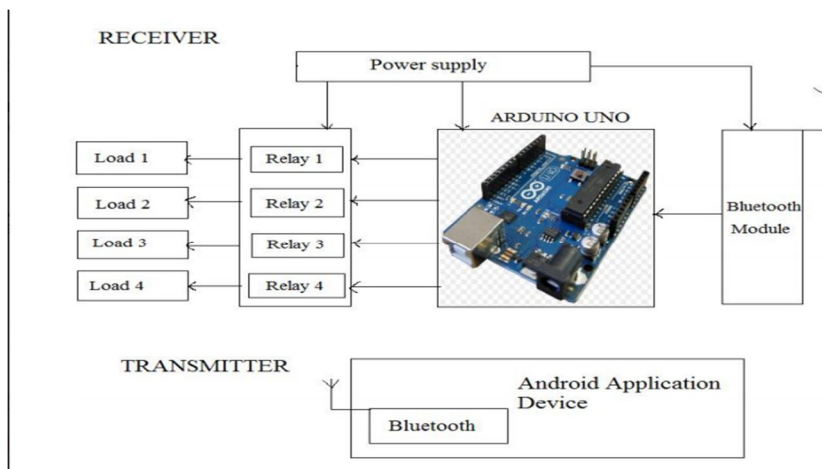


Figure 1 Block Diagram

Figure 1 given above represents the block diagram of the implemented system .These components can be accessed and controlled via smart-phone with fast response.

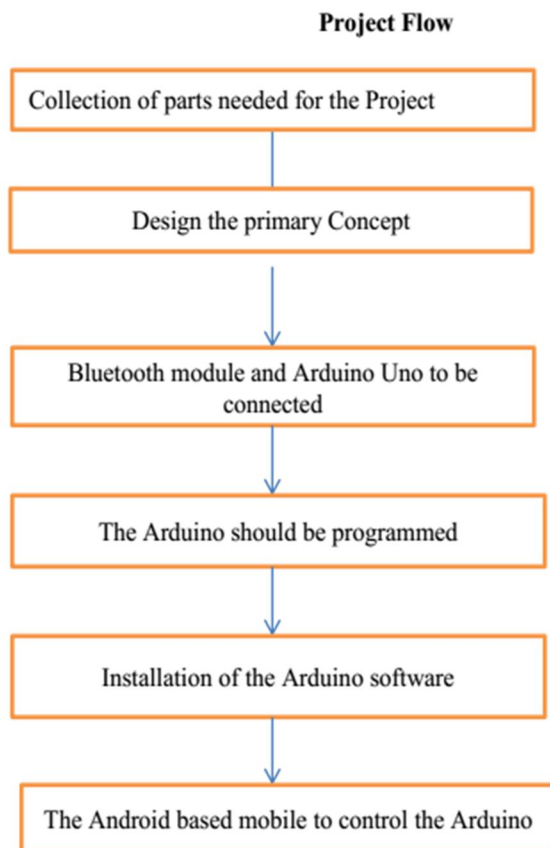


Figure 2 Block Diagram of Working of System

III. HARDWARE DESCRIPTION

A. Arduino uno

Arduino Uno is an AVR ATmega328P microcontroller based development board with six analogue input pins and 14 digital input/output (I/O) pins. The microcontroller has 32kB of ISP flash memory, 2kB RAM and 1kB EEPROM. The board provides serial communication capability via UART, SPI and I2C. The microcontroller can operate at a clock frequency of 16MHz [4]. The big advantage of Arduino is that, the website of Arduino is well designed and well organized. It is easy to use tool for designers which serve Encyclopaedia in this domain. The language of Arduino is high level programming language formed by blending with C language. It is easy to understand and user friendly language. It contains automatic unit conversion capability. That’s why, it can be said during debugging we don’t have to worry about the units conversions.



Figure 3 Arduino UNO

Microcontroller	Atmega 328
Operating Voltage	5V
Input Voltage(Recommended)	7-12V
Input Voltage Limitation	6-12V
Digital Input/Output Pins	14
Analog Input Pins	6
Clock Speed	16MHz
EEPROM	1KB

Figure 4 Specifications of Arduino UNO

B. Bluetooth module--hc-05

For the communication between mobile phone and microcontroller, Bluetooth module (HC-05) is used. HC-05 is easy to use with Bluetooth SPP (serial port protocol) and perform operation at 1.8 V. Serial port Bluetooth module have a Bluetooth 2.0+EDR(enhanced data rate),3Mbps modulation with complete 2.4GHZ radio transceiver and base band. Using Bluetooth profile and android platform architecture different type of Bluetooth applications can be developed .if the module is set to be in slave mode, it cannot initiate a connection to another Bluetooth devices rather than the intended smart phone, but can accept connections [5].when it is in master mode, the module can initiate a connection to other devices. The module contains 2 parts, the back plane and the main Bluetooth board. The implemented system is designed to operate in slave mode. Thus the system can be connected to Arduino with smart phone directly. Accordingly, the smart phone transmits the set of instructions to the Arduino through which the Arduino generates the set of output signals which, in turn, controls different devices via drives.

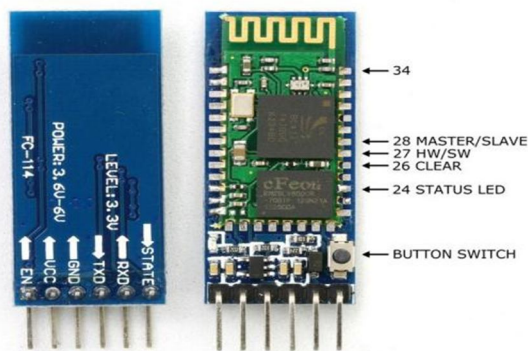


Figure 5 Bluetooth module (HC-05)

C. Relay

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect magnetically. One circuit allow switching another one while they are completely separate. They are often used to interface an electronic circuit (working at low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch 230V AC mains circuit. Thus a small sensor circuit can drive, say, a fan or an electric bulb. A relay switch can be divided into two parts: input and output. The input section has a coil which generates magnetic field when a small voltage from an electronic circuit is applied to it. This voltage is called the operating voltage. Commonly used relays are available in different configuration of operating voltages like 6V, 9V, 12v, 24V etc. The output section which connects or disconnect mechanically and it consists of

contactors. In a basic relay there are three contactors: normally open (NO), normally closed (NC) and common (COM). At no input state, the COM is connected to NC. When the operating voltage is applied the relay coil gets energized and the COM changes contact to NO. Different relay configurations are available like SPST, SPDT and DPDT which have different number of changeover contacts. By using proper combination of contactors, the electrical circuit can be switched on and off. Get inner details about the structure of a relay switch. The main operation in a relay comes in places where a low-power signal can be used to control a circuit. It is also used in places where only one signal can be used to control a lot of circuits. The application of relays started during the invention of telephones. They played an important role in switching calls in telephone exchanges. They were also used in long distance telegraphy. They were used to switch the signal coming from one source to another destination.

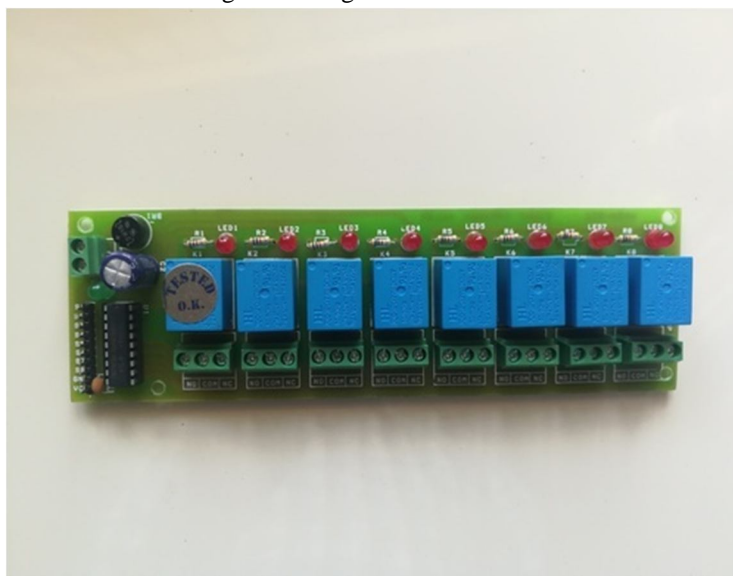


Figure 6 Relay Driver

D. Power Supply

The transformer is the static machine because there is no path for flowing of current from one arm to another. The current flows through arms by the electromagnetic force. The transformer having the two windings which are wound on the iron core. In step down transformer the primary winding have more number of turns than secondary winding. The power supply (AC) which is given to the primary winding and at the secondary winding we have to connect the load. Bridge rectifier is used in this project to convert AC voltage to DC voltage.

Let us assume transformer primary voltage is V_p , secondary voltage is V_s and number of turns in primary winding is N_p , number turns in the secondary winding is N_s . Then the relation between voltage and number of turns is $((V_p/V_s)=(N_p/N_s))$.

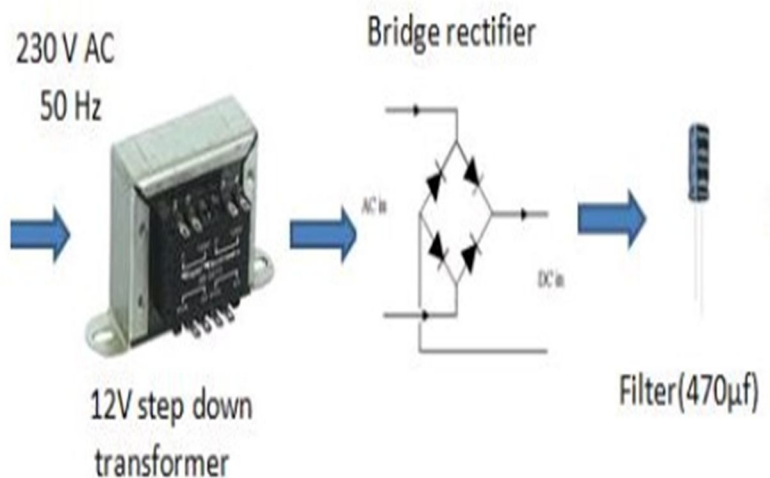


Figure 7 Step down transformer

IV. SOFTWARE DESCRIPTION

A. Arduino Ide

The software used here is Arduino IDE. The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open source software. The Arduino Integrated Development Environment – or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them. This software can be used with any Arduino board.



Figure 8 Arduino IDE

B. MIT App Inventor

MIT App Inventor is an intuitive, visual programming environment that allows everyone to build fully functional apps for smart phones and tablets. Those new to MIT App Inventor can have a simple first app up and running in less than 30 minutes. And what's more, our blocks based tool facilitates the creation of complex, high-impact apps in significantly less time than traditional programming environments. The MIT App Inventor project seeks to democratize software development by empowering all people, to move from technology consumption to technology creation.

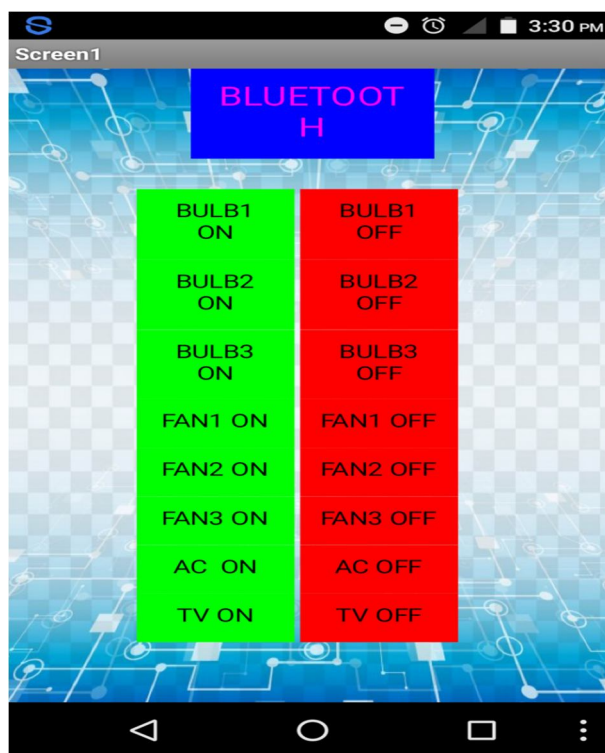


Figure 9 MIT App Inventor based App

V. HARDWARE IMPLEMENTAATION AND WORKING

It consists of two main hardware components: mobile phone and Arduino board. The mobile phone operates with android application which enables by the user to access the home appliances with ease. The BT module is used to connect the devices to operating the appliances within the range of Bluetooth. Relays act as electro-magnetic switch used to ON and OFF the appliances. Loads are connect by those relays individually.

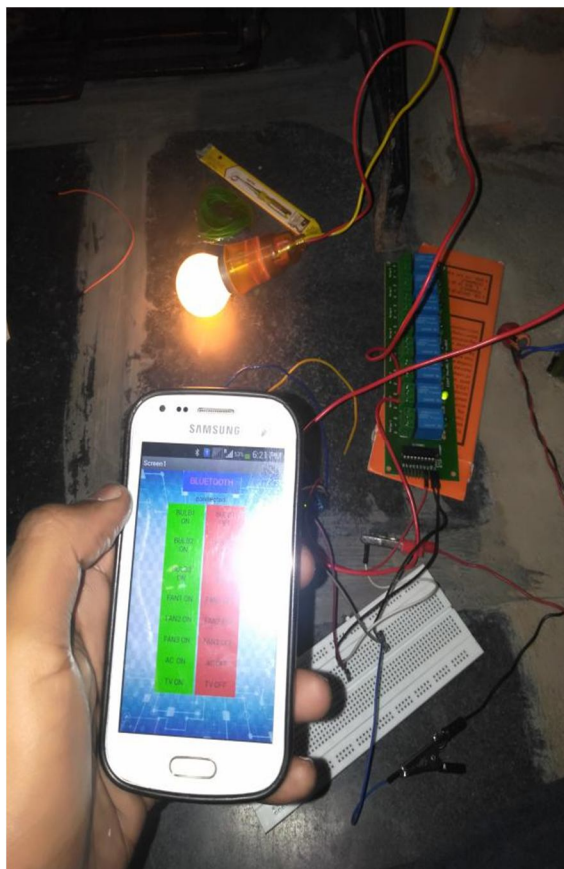


Figure 10 Hardware representation

VI. ADVANTAGES

- A. It is robust and easy to use system.
- B. There is no need for extra training of that person who is using it.
- C. All the control would be in your hands by using this home automation system.
- D. This project can provide the facility of monitoring all the appliances within the communication range through Bluetooth.
- E. The schematic of Arduino is open source, for the future enhancement of the project board can be extended to add more hardware features.

VII. CONCLUSION

In this paper we have introduced design and implementation of a low cost, reliable and flexible home automation. The system has been programmed to have Bluetooth communication capability. Which is simple to understand and easy to control. There is no need of any instruction manual. This adds a protection from unauthorized users.

VIII. FUTURE WORK

- A. Memory can be used to store the appliance status during power failure.
- B. Appliance scheduler/timer can be implemented using RTC (Real Time Clock).

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