Bluetooth based Home Automation using Arduino

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***Abstract*:- Technology is a never ending process. To be able to design a product using the current technology that will be beneficial to the lives of others is a huge contribution to the community. This paper presents the design and implementation of a low cost but yet flexible and secure cell phone based home automation system. The design is based on a standalone Arduino BT board and the home appliances are connected to the input/ output ports of this board via relays. The communication between the cell phone and the Arduino BT board is wireless. This system is designed to be low cost and scalable allowing variety of devices to be controlled with minimum changes to its core. Password protection is being used to only allow authorized users from accessing the appliances at home.**

Keywords- Home automation; Smartphone; Arduino; Bluetooth; Home appliances.

I. INTRODUCTION

Home automation system is use of information technologies and control system to reduce the human labor. The rapid growth

of technologies influence us to use smartphones to remotely control the home appliances. An automated devices has ability to work with versatility, diligence and with lowest error rate. The idea of home automation system is a significant issue for Researchers and home appliances companies. Automation system not only helps to decrease the human labor but it also saves time and energy. Early home automation systems were used in labor saving machines but nowadays its main objective is provide facilities to elderly and handicapped people to perform their daily routine tasks and control the home appliances remotely. A Bluetooth based wireless home automation system can be implement with a low cost and it is easy to install in an existing home. A research work proved that Bluetooth system are faster than wireless and GSM systems. Bluetooth technology has ability to transmit data serially up to 3 Mbps within a physical range of 10m to 100m depending on the type of Blue tooth device. The design of proposed method is based on Arduino board, Bluetooth module, sensors and smartphone application. Bluetooth module HC-05 is interfaced with Arduino board and home appliances are connected with Arduino board via relay. Smartphone application is used for serial communication between smartphone and Bluetooth module which is further connected with Arduino board.

II. RELATED WORK

Several remote controlled home automation systems have been studied. R.Piyare and M.Tazil research work 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. Similarly, another study presented home automation system using Bluetooth and android application. 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 introduced for handicapped and elderly people. XBee transceivers was 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 chipKIT. 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. Bluetooth technology was used to provide remote controlled wireless access to user.

III. SYSTEM DESCRIPTION.

The proposed system has two main parts hardware and software. The hardware part consists of three main hardware components smartphone, Arduino board and Bluetooth module. Software part consist of Arduino integrated development environment (IDE) and Bluetooth terminal smartphone application which is used for wireless communication between smartphone and Arduino board.

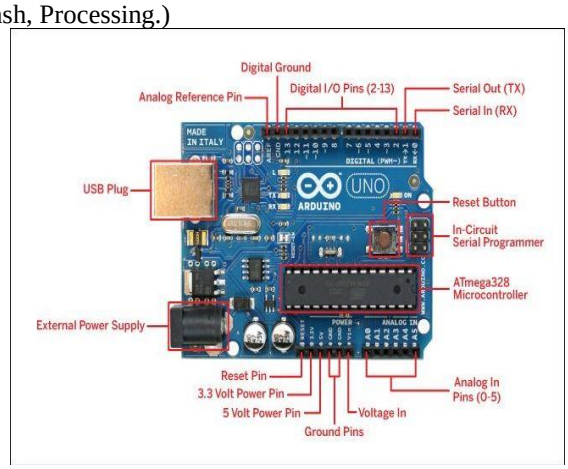
IV. HARDWARE ARCHITECTURE

The proposed home automation system contains three hardware components smartphone, Arduino board and Bluetooth module. Smartphone is used to communicate with Arduino board using a smartphone application and Bluetooth technology. In this research work Bluetooth module HC 05 and Arduino Uno are used for hardware implementation.

A. Arduino Uno

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing

platform based on a simple microcontroller board, and a development environment for writing software for the board. Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can communicate with software running on your computer (e.g. Flash, Processing.)



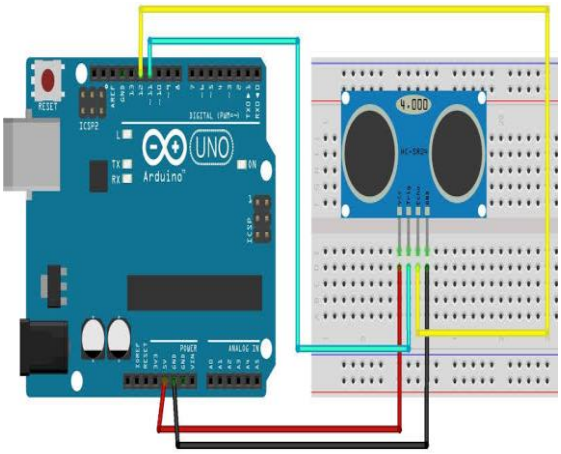
The boards can be assembled by hand or purchased preassembled; the open source IDE can be downloaded for free. The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

B. Bluetooth module HC-05

Bluetooth module HC-05 is used for wireless communication between Arduino Uno and smartphone. HC-05 is a slave device and it can operates at power 3.6 to 6 volts. It has 6 pins: State, RXD, TXD, GND, VCC and EN. For serial communication connect TXD pin of Blue tooth module HC-06 with RX (pin 0) of Arduino Uno and RXD pin with TX (pin 1) of Arduino Uno. Connection diagram of Adriano and Bluetooth (BT) module is illustrated.

C. Ultrasonic Range Sensor HC-SR04

The ultrasonic sensor HC-SR04 has a transmitter and receiver. It uses sonar to calculate the distance from a physical objects. It has an excellent range of object detection from 2 cm to 400 cm (13 feet) with high accuracy. The ultrasonic sensors calculate the physical object's distance by transmitting ultrasonic wave and then detects its reflection wave.



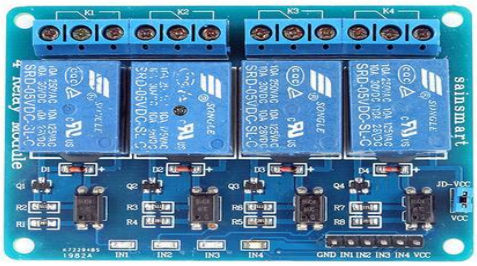
The working principle of ultrasonic sensor is demonstrated. Ping is input ultrasonic waves which are transmitted at the velocity of 340 mls and Echo is reflected output of sensor which is used to determine the distance. The ultrasonic sensor HC- SR04 parameter specification with their limitations. In proposed work ultrasonic sensor is used for the measurement of water level inside the water tank. It measure the distance of water level from the top of water tank and gives its report on smartphone application using Bluetooth technology.

D. 4 CHANNEL RELAY BOARD

4 Channel Relay Board is a simple and convenient way to interface 4 relays for switching application in your project. Very compact design can fit in small area, manly this board is made for low voltage application.

Features:

- 4-Channel Relay interface board, and each one needs 15-20mA Driver Current
- Both controlled by 12V and 5V input Voltage
- Equipped with high-current relay, AC250V 10A ; DC30V 10A
- Standard interface that can be controlled directly by microcontroller (Arduino , 8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic active low)
- Opto-isolated inputs
- Indication LED's for Relay output status.



Pin-out Instruction:

"Vcc"	Power(5V DC)
"GND"	GND
"in1"	Signal pin, connected with Arduino and control Relay 1
"in2"	Signal pin, connected with Arduino and control Relay 2
"in3"	Signal pin, connected with Arduino and control Relay 3
"in4"	Signal pin, connected with Arduino and control Relay 4
"COM"	Common pin, which usually directly connect with the" Gnd" unless you want to change the TTL mode(default the HIGH level activate)
"NO"	Normally Open Connection
"NC"	Normally Closed Connection
"C"(middle pin)	Common Connection, Which connected with the power for the load.

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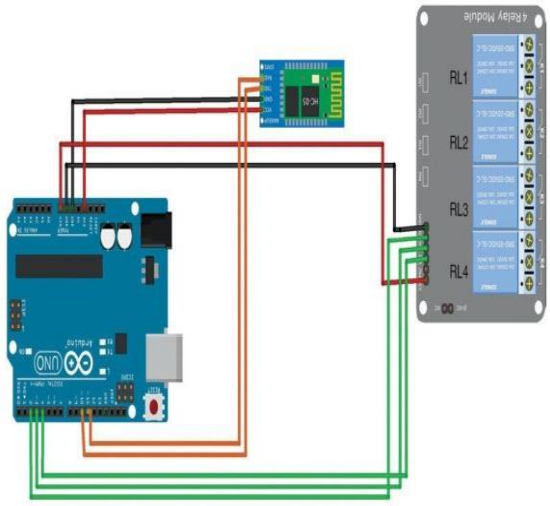
Note: the last pin “COM” “NC” “C” are not indicated on the Board, because there are no enough place for these. But we indicates the by a simple graphic for each Relay terminal.

Circuit diagram:



V. SOFTWARE ARCHITECTURE

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. The Arduino IDE code for turn ON and OFF Light is shown below.

```
if (state == '0') %condition check
{
Serial.println("LIGHT ON");
digitaIWrite(LIGHT, HIGH); %Turn On the Light
}
if (state == '1 ') %condition check
 {
Serial.println("LIGHT OFF");
digitaIWrite(LIGHT, LOW); %Turn OFF the Light
}
```

VI. CONCLUSION

In this paper we have introduced design and implementation of a low cost, flexible and wireless solution to the home automation. The system is secured for access from any user or intruder. The users are expected to acquire pairing password for the Arduino BT and the cell phone to access the home appliances. This adds a protection from unauthorized users. This system can be used as a test bed for any appliances that requires on-off switching applications without any internet connection.

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