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Bluetooth Home Automation System

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Abstract— *Innovation is a lifelong process. Designing a product through available technology that will be beneficial to the lives of others is a huge contribution to the society. This paper puts forward the design and implementation of a low cost yet flexible and secure Android based home automation system. The design of the project is based on a Arduino UNO board and the home appliances are connected to the input/output ports of this board via relays. The interaction between the smartphone and the Arduino UNO is wireless. This project is designed to be low cost yet scalable which allows large variety of devices to be controlled with miniscule changes to its core.*

Keywords— ***bluetooth, automation, android, mobile application, arduino, microcontroller.***

I. INTRODUCTION

Home automation systems are an attempt to use technology control systems to increase human convenience. The exponential growth of technology empowers us to use smartphones to remotely control our home and appliances. Such an automated device has the ability to work with flexibility, meticulousness and also with a low error rate. The prospect of home automation is a substantial issue for engineers, researchers and home appliance businesses as automation systems help to decrease the human labor and also save time, money and effort. Earlier home automation systems were meant to be used in machines to reduce labor but nowadays its objective has expanded to provide facilities to the elderly and also handicapped people to aid them in performing their daily tasks and remotely control the home appliances. A wireless home automation system based on Bluetooth can be implemented at a cheap cost and it is easy to install in homes. Research work has proved that Bluetooth system are faster compared to other systems, namely wireless and GSM. This is because Bluetooth technology has the ability to transmit data serially up to 3 Mbps within a physical range of 10m to 100m depending on the type of Bluetooth device. In the proposed design, a home automation system is built based on Arduino UNO, HC-05 Bluetooth module interfaced with the Arduino, various sensors and an Android smartphone application. The home appliances can be connected to the Arduino UNO board via relay. The purpose of Andoid application is to facilitate serial communication between smartphone and Bluetooth module.

II. LITERATURE REVIEW

Faisal Baig et al have described a system for remotely controlling home appliances. Their paper discussed two methods for regulating household appliances. One method is to utilize the mobile as a remote control and the other is to use voice to text SMS. The system was created to remotely monitor appliances, which necessitates the use of a mobile application on a phone and the use of voice commands. The Android intent API 2.01 isthen used by the mobile application to convert the spoken command into text, which is then sent over the GSM network. Kajal Purwar and her colleagues used the Raspberry Pi module and a speech to command converter to create a Home Automation system. This technology can automate many home appliances. Because the speech to command converter takes some time to translate it to commands, this system may cause some

delays. Sarthak Jain et al built a Collaborative Home Automation System based on Raspberry Pi-based with the use of e-mail, thus creating a simple system utilizing the Raspberry Pi and the e-mail algorithm, and concluding that it is better for large traffic than the prior approaches. Because of its ease of use and efficiency, they chose python programmingand the Raspberry Pi.

III. SYSTEM DESCRIPTION.

The descripted system has two main parts: hardware and software. The hardware part comprises three components: smartphone, Arduino UNO board and the HC-05 Bluetooth module. The software part consists the Arduino IDE (integrated development environment) and the Android application "BT terminal" which aids in wireless communication between the phone and Arduino UNO.

IV. HARDWARE ARCHITECTURE

As mentioned earlier, the planned home automation system contains three hardware components: Android smartphone, Arduino U N O board and HC-05 Bluetooth module. The smartphone is used to interactwith Arduino UNO board through a smartphone application and Bluetooth technology. Thus, in this research work, HC-05 Bluetooth module and Arduino UNO are used for hardwareimplementation.

A. Arduino UNO

Arduino, as a tool, helps in building computers that can detect and manipulate more of the physical world than an ordinary desktop computer. It is an open-source

computing platform built on a simple microcontroller board, and it has its own development environment which allows us to write software for the board. Arduino may be used for a variety of purposes, including creating interactive objects and receiving input from a variety of switches and sensors, as well as controlling a variety of lights, motors, and other physical outputs. Arduino projects can be self-contained or can interact with software, (e.g. Flash, Processing.) on a computer.

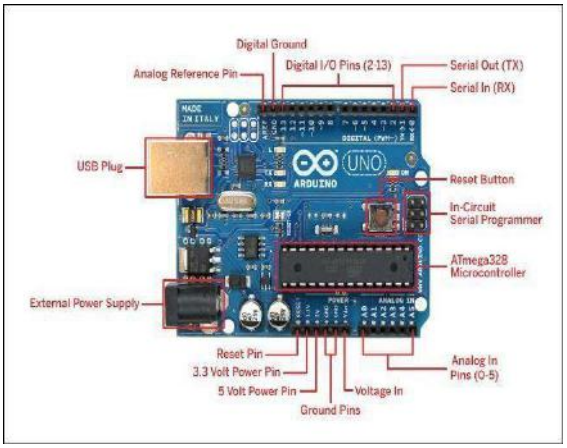

Fig.1: Arduino Uno Pin Description

The boards can be hand-assembled or purchased pre-assembled, with the open source IDE available for free download. The Arduino Uno is an ATmega328-based microcontroller board. Six analog inputs, a 16 MHz ceramic resonator, an ICSP header, a power jack, a reset button and a USB connection are among the 14 digital input/output pins (six of which can be used as PWM outputs). It has everything you need to get started with the microcontroller. It can be powered by connecting it to a computer through USB or with an AC-to-DC adapter or battery.

B. Bluetooth module HC-05

The HC-05 Bluetooth module is used to communicate wirelessly between an Arduino UNO and an Android smartphone. The HC-05 is a slave device that runs on 3.6 to 6 volts of power. State, RXD, TXD, GND, VCC, and EN are the six pins in an HC-05. Connect the TXD pin of the Bluetooth module HC-05 to RX (pin 0) of the Arduino Uno and the RXD pin to TX (pin 1) of the Arduino Uno for serial communication.

C. DHT-11 Sensor

The DHT11 is a frequently used temperatureand humidity sensor. A specialized NTC for temperature measurement is included in the sensor, as well as an 8-bit microcontroller for serial data output of temperature and humidity measurements. The sensor is factory calibrated, making it simple to connect to other microcontrollers. With an accuracy of 1°C and 1 percent, the sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90%.

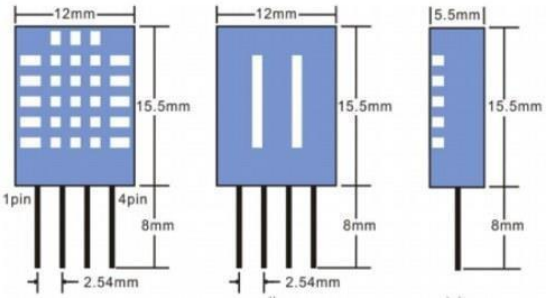

Fig.3: Dimensions of DHT-11 Sensor

D. 4 CHANNEL RELAY BOARD

The 4 Channel Relay Board is a simple and convenient solution to connect four relays in your project for switching purposes. It has a very condensed design which can fit in small area. It is primarily built for low voltage application.

Features:

a. In a relay interface board with 4-channels, every relay needs a driver current between 15-20mA
b. Both controlled by 12V and 5V input Voltage
c. Equipped with high-current relay, AC250V 10A ;DC30V 10A
d. Standard interface that can be controlled directly by microcontroller (Arduino, 8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic active low)
e. Opto-isolated inputs
f. Indication LED's for Relay output status.

E. LCD_I2C

I2C_LCD is a convenient-to-use display module. An 8-Bit I/O Expander chip – PCF8574 – is at the heart of the LCD-I2C. This chip transforms I2C data from an Arduino to the parallel data that the LCD display requires. A small trimpot is also included on the board for fine- tuning the display's contrast.

Fig.2: Dimensions of HC-05 Bluetooth Module

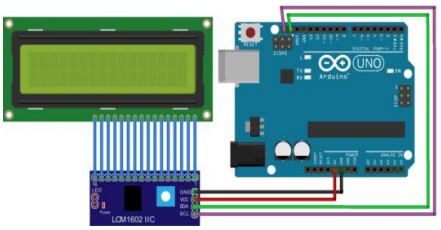

Fig.4: Interfacing Diagram of Arduino with LCD

Pin-out Instruction:

Pin Name	***Description***
"Vcc"	5V DC
"GND"	GND
"in1"	signal pin, connected with Arduino UNO and controlrelay 1
"in2"	signal pin, connected with Arduino UNO and controlrelay 2
"in3"	signal pin, connected with Arduino UNO and controlrelay 3
"in4"	signal pin, connected with Arduino UNO and controlrelay 4
"COM"	common pin, which usually directlyconnect 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 is connected with the power for the load.

Note: the last pins "COM" "NO" "NC" are not indicated on the board as there are not enough places for these. But we indicate them by a simple graphic for each relay terminal.

Circuit diagram:

V. SOFTWARE ARCHITECTURE

In this project work we have used two different softwares: Arduino Integrated Development Environment (IDE) and Android BT terminal application.

A. Arduino IDE

The entire programming for the suggested

system is done in the Arduino IDE tool, which stands for Integrated Development Environment. For serial connection between the Arduino board and the smartphone, the Baud rate is set at 9600 bits per second. The Arduino IDE command "Serial.Available 0" is used to accept data serially from a smartphone, and the command "Serial.printlnO" is used to transmit data serially from one Arduino board to smartphone.

The value of the received byte is stored in the state variable, which is subsequently compared to different conditions and the specific operation is performed. The code for turning on and off the light using the Arduino IDE is presented 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
}
```

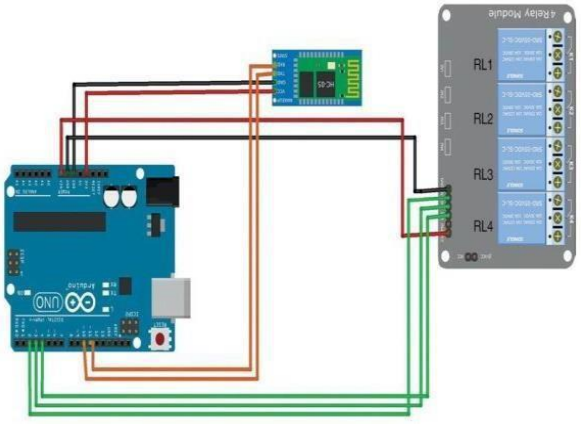

Fig.5: Interfacing Diagram of Arduino with HC-05 & 4-Channel Relay

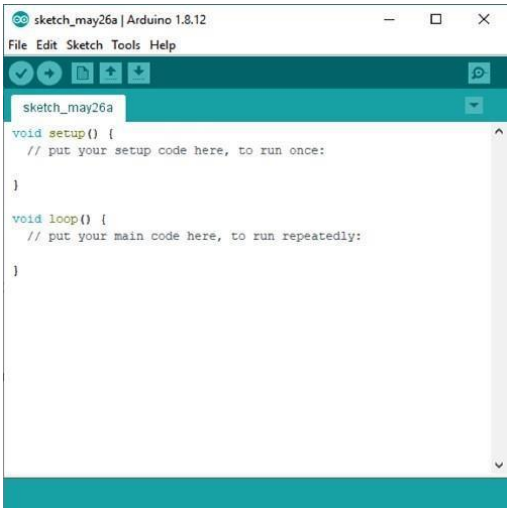

Fig.6: Arduino Sketch

B. Android Bluetooth Application

The Android application named "BT Terminal" will send text strings to a paired device. Another app named "BT Voice Control for Android" can also be used on the smart phone which can take voice commands in US English and then transfer them as text strings to a paired device.

Fig.7: Android Bluetooth Application

VI. CONCLUSION

As we saw, in this paper we have introduced the design and execution of a cheap, flexible and wireless solution for implementation of home automation. Our system will be secure from access by any trespasser as any users will be required to possess pairing password for the Arduino BT and the smartphone to access the control for any home appliances. This system can be utilized for any appliances that requires on-off switching applications without any internetconnectivity.

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