

Smart lighting and switching using Internet of Things

Pradyumna Kumar¹

Piyush Rai²

Dr H.B. Yadav³

^{1,2} Department of Computer Science and Engineering

Institute of Engineering and Technology, Dr. R.M.L. Avadh University Ayodhya, U.P., India

³ Department of Technical Education, Uttar Pradesh, India

¹pradyumnajnv@gmail.com

²02piyushrai@gmail.com

³yadavaharikesh@gmail.com

Abstract: Nowadays, everyone wants to have comfortable living conditions within the home. Comfort within the home can be divided into many ways. There are various categories like comfort with the household appliances, security systems, gardening, and other monitoring systems of the home. All these things can be monitored with sensors. To make a smart home, the household appliance needs to act on commands given by the user via any mobile device or voice commands. Automation before introduction of Internet of Things (IoT) was done using radio frequency (RF), machine learning. However, IoT is cost effective, easy to implement and can control devices from any location which cannot be achieved through RF based and other automation technique. Therefore, This paper elaborate live IoT based working model for sensing and monitoring of smart lighting and switching.

Keywords : Internet of Things , Bluetooth, Wi-Fi, Radio Frequency , Home Automation System.

I. INTRODUCTION

Advance researches in technology brings changes to human life. Expectation of human's increases as technology evolves. Adaptability of new technology for comfort to live an advance life is on high demand [1]. In today's time internet plays very significant role in day to day life and key services are totally depends on it [2]. Services like Banking, transportation, medical and social life all controlled by internet [3]. Then how your personal space your home get rid of that. The IoT enables to control and monitor nearly all electronic, electrical & mechanical systems which are used in a house [4].

However controlling of these household devices are not new to the world. Television, Air Condition, Car locking system already controlled by Radio frequency, Infra Red, Wi-Fi, Zigbee, Z-Wave etc [5-7].

But question is that, are these controlling require internet? Answer is "NO". Therefore, the importance of IoT comes in existence for controlling monitoring commanding in smart way [8-9]. Nearly 48 Billion devices will get connected to internet in 2021[9].

Bluetooth advancing their technology to adopt IoT. The current range of Bluetooth 5.0 is greater 500 meter [9]. Therefore, we are using IoT to automate household devices using Arduino and HC 05 SPP (Serial Port Protocol) Bluetooth module..

The rest of the paper is organized as follows: the proposed model is discussed in Sect. II. In Sect. III, Hardware used is presented. Implementation & Experimental Results are discussed in Sect. IV. Conclusion is presented in Sect. V.

II. PROPOSED MODEL

Automation of lighting system in home have few challenges, one of the most important challenge is high cost of hardware and software. Security of deployed system is also a big challenge. The main purpose of this proposed model is to provide a low cost IoT system, for switching and lighting that can be controlled using a android mobile application.

The end user will control home appliances through the mobile application and this mobile application is connected through Bluetooth module which is connected with Arduino Uno. This model is secure, cheap and easy to implement. This system consists of Arduino Uno which have a microcontroller. Coding is required to be done for each appliances connected to this system in microcontroller. Microcontroller controls the relay which acts as smart switch when it gets data signal from Arduino connected with Bluetooth module HC 05. Relay drivers controls the switching of appliances

as per received signals. The proposed model architecture is shown in Fig. 1.

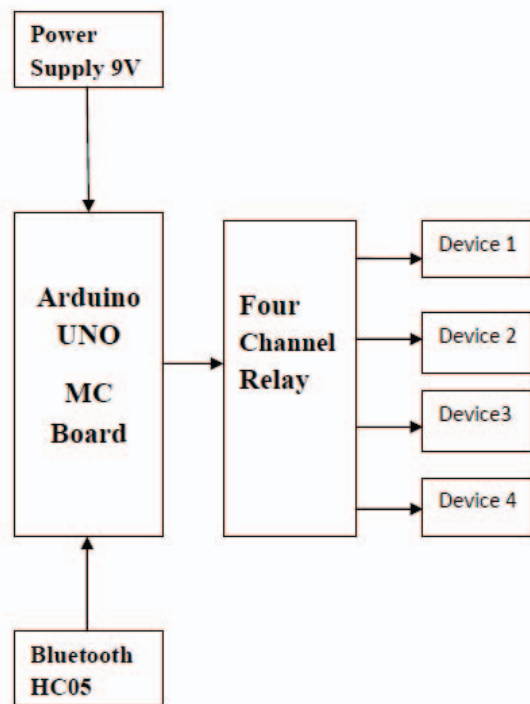


Fig. 1. Architecture of Proposed Model

In this system there are five key components Arduino, Bluetooth module, Relay drivers, android application and 9V battery as shown in Fig. 2 .

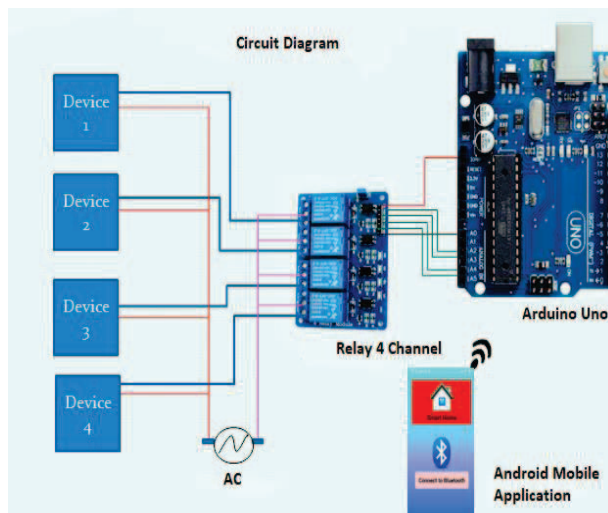


Fig. 2. Circuit Diagram of home automation

Following steps involved in the working process.

- 9V battery provide power to Arduino and Bluetooth module.
- Bluetooth and android smart phone application get connected to each other.
- Arduino connected with Bluetooth module that provide information to the microcontroller.
- Microcontroller sends the information to relay drivers which acts as smart switch.
- Home appliances connected to relay module.

III. HARDWARE USED

A. Arduino Uno

ATmega328P-Datasheet based Arduino Uno microcontroller is used in this model. The hardware used in the model is shown in Fig. 3.



Fig. 3. Arduino Uno

The operating voltage of Arduino is 5V and the recommended input voltage is a maximum of 12V. There are 14 digital input-output pins which are used to make pin to pin connection with other hardware like relay and Bluetooth.

There are six PWM (Pulse width modulation) pins available for output and six Input pins (Analog Pins) available. 20 mA DC current required per input-output pins.

Arduino microcontroller has three types of memory, flash memory of 32 KB, bootloader using .5KB to load other programs using a USB cable. SRAM in Arduino (ATmega328P) is of size 2KB and EEPROM – Electrically erasable programmable read only memory of size 1KB is available in ATmega328P.

Sixteen million instruction per second can be executed by this microcontroller it means clock speed is of 16Mhz. Light emitting diode can be connected to Pin no 13. Dimension of ATmega328P is of length 68.6mm and width is 53.4mm. This is very light weighted only 25g [11].

Arduino is low-cost, small-sized hardware which is used widely in IoT applications and home automation. This platform is very easy to implement and widely used.

B. Bluetooth Module HC 05

Bluetooth Low Energy (BLE) is a low power communication technology used by smart devices to communicate over short distance. HC05 module is used to connect with microcontroller and android application. HC 05 Bluetooth is shown in Fig. 4.

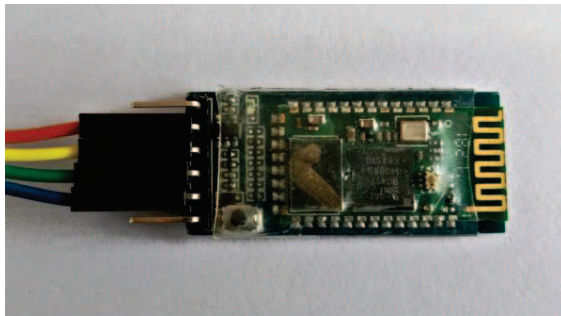


Fig. 4. HC 05 Bluetooth

Bluetooth module is connected through digital pins Rx and Tx digital pins (Rx-0 and Tx-1) of Arduino. Serial Port Protocol is used in HC 05 module which is very simple to use. This module consists of CSR Blue canter 04 - External single chip Bluetooth framework with CMOS and Adaptive frequency hopping feature. Size of this module is 12.7mm wide and 27 mm long.

C. Four Channel Relay Module

Relay module is connected to Arduino Uno which works on 5V and relay driver gets signal from microcontroller.

Relay is an electromagnetic switch its output is connected to the home appliances. Relay works on low voltage and current but its output is connected to the high voltage devices. Other important component of this system is Jumper wires to connect the

different hardware's pins. Four Channel Relay Module is shown in Fig. 5.

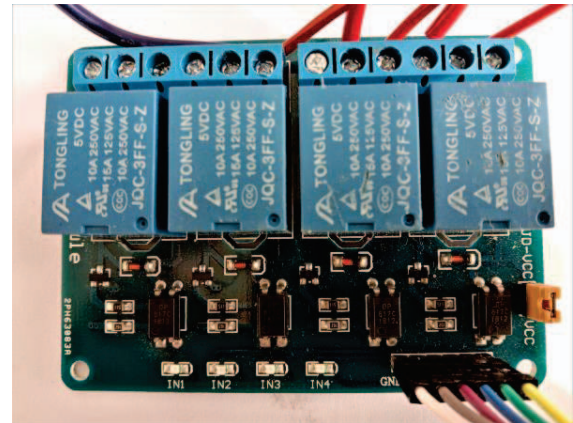


Fig. 5. Chanel Relay Module

This relay has six pins which are connected to the Arduino using jumper wires. These pins are named as GND, IN1, IN2, IN3, IN4 and VCC. GND stands for Ground and it is connected to the Ground of microcontroller board, VCC pin is used to take input of 5V and Input 1 to Input 4 is connected to 2,3,4,5 pins of board respectively.

IV. IMPLEMENTATION AND EXPERIMENT RESULTS

Experimental setup for smart lighting and switching is shown in Fig. 6.

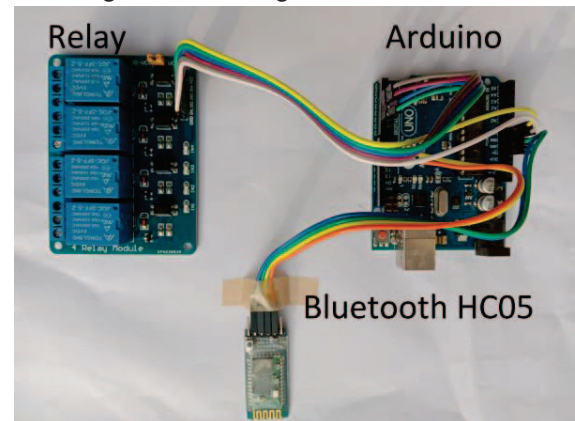


Fig. 6. Experimental setup

Fig. 6 shows Arduino, Relay module and Bluetooth HC05 Connected to each other. Switching of appliances get controlled by Relays. Relays are connected to 6, 7, 8, 9 pins of Arduino. Home appliances are connected to the COM terminal of relays. Relays works on low power signal received by

Arduino and perform Normally Open and Normally Close operation (NC-NO). Respective pins connection of Bluetooth and Arduino shown in Table I.

Table I: Pin Connections

Arduino	Bluetooth HC05
5V -	+5V (Vcc)
Ground	Ground-Connects System Ground
Rx	Transmit Data (Tx)
Tx	Receive Data (Rx)

Arduino software which is also known as Arduino Integrated Development Environment (IDE) is used to code for the microcontroller. USB Cable 2.0 A/B or USB to serial cable is used to transfer code from the computer to the Arduino board.

A Text editor and a text console are available in the IDE. This IDE is available in more than 30 languages. IDE is available for Unix, Windows and macOS operating systems. Arduino board coding can be done in the C/C++ language. Professional programmers and students know these two languages very well. This experimental setup is controlled by an android application. Arduino is programmed according to our experimental need. HC 05 Bluetooth module is connected to a Smartphone via Bluetooth.

This home automation –Internet of things based system is tested with different loads like fan, AC, Bulb, LED Tube light. User needs to install Android app in their Smartphone and using GUI (Arduino Bluetooth Home Automation android app) shown above in Fig. 6 get connected to Bluetooth and can give command for automated switching.

In this model, the android mobile application is used because the android platform is an open source and a very popular operating system for mobile and tablets with more than two billion active users base.

Android operating system available in more than 100 languages compared to iOS which available in approx 40 languages. Apart from that one can also develop GUI on windows and iOS platforms. Finally we are able to control switching and lighting using concept of Internet of things, Arduino Uno Microcontroller, Bluetooth, Relay and android application for GUI at very low cost.

V. CONCLUSION AND FUTURE SCOPE

This paper is focused on controlling of electrical and electronic device with a Smart phone. This is automation of household devices and fully controlled by a android mobile phone app known as Arduino Bluetooth Home Automation. Code writing cost is very less in this model. In future, enhancement in this model could be reduce the time delay in switching on/off of the given load, in current situation it took 2 to 3 seconds to perform given switching task, GUI setup can be made for other mobile operating system, Voice command in GUI in different languages, Use of Bluetooth higher version for increasing operating range.

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