Home Automation System Design Using Arduino Nano and HC06 Bluetooth Module

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Abstract: Home automation is rapidly playing an important role in today's technologically advancing world. The aim of automation is making life easier for the user by eliminating the rigorous nature of manually operating home appliances like fan, television, light and Home Theater. This paper propose a home automation using Arduino Nano and HC 06 Bluetooth module interfaced together and can wirelessly communicate with an Android or IOS mobile phone that is Bluetooth enabled. Using this system, a fan and a television is wirelessly controlled using Bluetooth terminal software downloaded from google play store. The system was design and tested using two LEDs, a yellow LED and red LED representing the television and the fan respectively. The result shows that home automation can be achieved using Arduino Nano and HC06 Bluetooth module interconnecting other appliances in the household as well.

Keywords: Home Automation; Arduino Nano; Bluetooth; Graphic User Interface (GUI); Mobile Phone

1. INTRODUCTION

Controlling home appliances automatically is a way of complementing people's effort especially the oldest, sick and disabled by making things around the home easy and accessible to them. Advances in technology has been able to make that possible with people having the control remote in their hands in the form of mobile phones. This automation is made even easier and handy by the advances in Nano technology with Arduino Nano, which is smaller, breadboard friendly and can be programmed and easily interfaced with HC06 Bluetooth module.

People nowadays have mobile phones with android/ios applications, which can easily be used as Graphic User Interface (GUI) for connecting with the Bluetooth and therefore creating user window that allows the user to type in string of command from the phone that is read by the Bluetooth module and is transmitted wirelessly to the Arduino Nano. This string of command enable the output pin of the Arduino that is connected to the switching circuit made with Bipolar Junction Transistor (BJT) and relay circuit that interconnect the alternating current(a.c) mains supply with the design and providing isolation between the a.c mains supply and the direct current (d.c) supply. The home appliance can be switched ON or OFF using commands that are sent from the mobile phone.

2. LITERATURE REVIEW

Researchers in the past have suggested different methods of achieving home automation; this section will provide the possible method suggested by these researchers.

Naresh, D. et al. presented a Bluetooth based home automation system using ARM9 as a standalone embedded system board to control home appliance connected to ARM7 and communication is established between the ARM7 and ARM9 with Bluetooth device[1]. While [2][3] in their work presented a method of Bluetooth based home automation system using cell phone and Arduino Bluetooth board.

[4] Presents a GSM base automation system using appinventor for android mobile phones. In his paper, massage can be sent via the phone and a controller connected to an appliance using GSM module turns OFF/ON the appliance.

Other studies such as presented in [5][6][7] has examples of Internet of things, which are automations that require network coverage, thus in areas where there may be inconsistent coverage, this could pose a big problem for users. The authors in [8] presented a low cost and flexible home control and environmental monitoring system. It employs an embedded micro-web server in Arduino Mega 2560 microcontroller, with IP connectivity for accessing and controlling devices and appliances remotely. These devices can be controlled through a web application or via Bluetooth Android based Smart phone applications. [9] Presented a home automation system using Arduino Uno and HC05 Bluetooth module to control home appliance using mobile phones.

Bluetooth employs UHF radio waves in the ISM band, in the range of 2.402 GHz to 2.48 GHz [10] and has the advantage that it is not control by network providers, once the mobile phone is Bluetooth enable; it guarantees automation just like a Bluetooth remote control.

3. METHODOLOGY

This paper presents home automation system that is able to control a fan and television set using Arduino Nano and Hc06 Bluetooth module with Bluetooth terminal application downloaded from google play sore. The Bluetooth terminal permits user to be able to send strings of command that turns ON/OFF these home appliances. The Bluetooth terminal application eliminates the complicated Java coding process and is user friendly. This application can be install on an android phone and provides GUI with which the user communicate using string that are easily understood.

## 4. BLOCK REPRESENTATION OF THE SYSTEM

Figure 1 represents the block diagram of the proposed automation system. The input is a mobile phone that is equipped with Bluetooth and serves as the GUI where the command is send to the HC06 Bluetooth module. The Bluetooth module receives the command within 10meters coverage area and pass it to Arduino Nano. The Arduino Nano reads the command through a serial port and compares the command from the Arduino and if the command match, the Arduino will execute. The switching circuit comprises of a transistor and relay which as a switch and as an isolation point respectively.
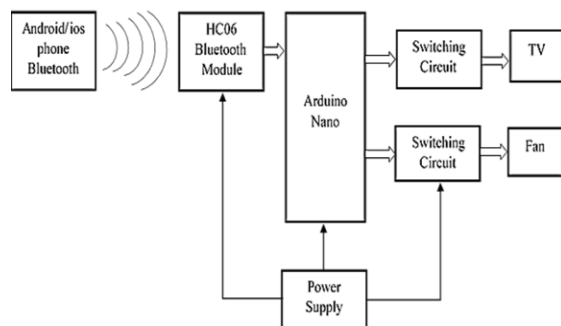
**Figure 1.** Block Representation of Home Automation System

4.1 Interfacing Arduino Nano with HC06 Module

The HC06 Bluetooth module used in this project is a slave device. That means, on its own, it cannot initiate a connection but rather, a master Bluetooth device (such as smart phones and PC) state the connection.
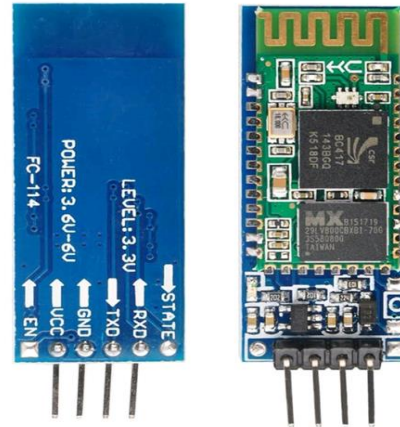
Figure 2. HC06 Bluetooth Module

The Arduino used for this design is the Arduino Nano microcontroller board that is based on the Atmega328p, which is widely used in robotics, embedded systems, automation, Internet of Things (IoT) and electronics project [9]. The Arduino Nano is selected because it is relatively small, easy to program and breadboard-friendly. Figure 3 shows the pin out of the Arduino Nano.
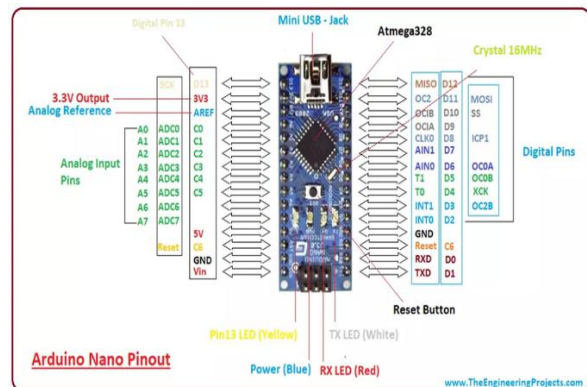
Figure 3. Arduino Nano Pin Out

The communication protocol between HC06 and android is universal synchronous asynchronous Receiver Transmitter (USART). The HC06 Bluetooth use the serial protocol, which support AT command listed in the data sheet. The received pin of the HC06 is a 3.3V login and the transmit pin of the Arduino is a 5V logic which means for the Arduino to effectively communicate with the HC06, a voltage divider is needed at the HC06 receive pin. Thus, figure 4 shows the connection between the Bluetooth and Arduino.
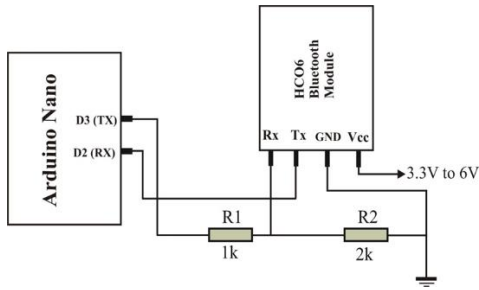
Figure 4. Interfacing HC06 and Arduino Nano

4.2 Switching Circuit

The switching circuit comprises of a Silicon NPN low power high frequency bipolar transistor (2N3904) and a 5V, 10A relay for proper isolation between the mains and the control circuit. The interconnection of these components together with a free wheel diode give rise to the switching circuit of figure 5.
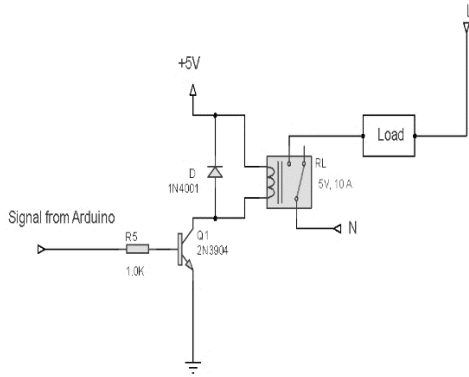

Figure 5. Switching Circuit

4.3 Flowchart for the Home Automation System

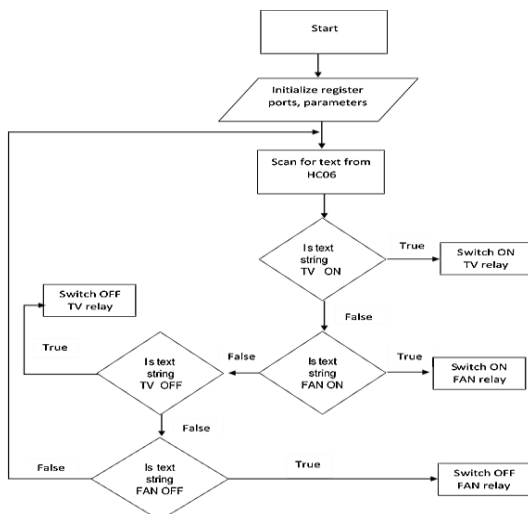The flowchart representing the home automation system for ON/OFF appliance is shown in figure 6.

Figure 6. Flowchart for Home Automation System.

4.4 Hardware Implementation

Figure 7 shows the complete circuit design of the home automation system using proteus 8 professional. Figure 8 and 9 is the screen shot of the component layout and constructed prototype using YELLOW LED for TV and RED LED for FAN.
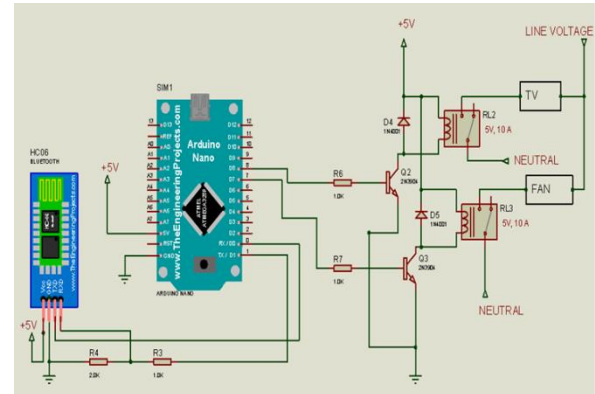

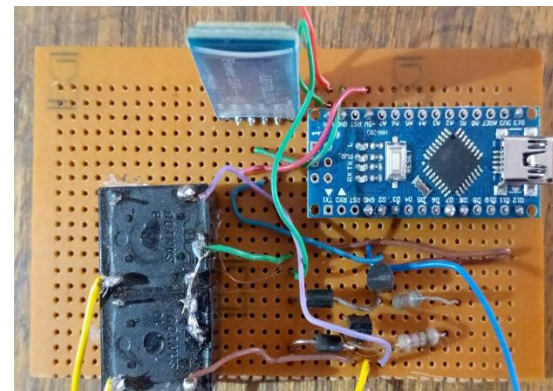**Figure 7.** Circuit Design using Proteus 8 Professional

Figure 8. Component Layout

Figure 9. Constructed Prototype of Home Automation System

5. TESTING AND RESULT

5.1 GUI for testing

The Home Automation System Design was tested using Bluetooth terminal application downloaded from google play store. Figure 10 shows the screen shot of the user terminal.
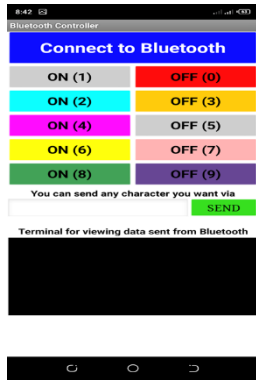

Figure 10. Mobile Application

The commands shown in table 1 can be sent via this terminal window.

Table 1. Bluetooth Terminal Command for Turning Appliances ON/OFF

s/N	Command	Refference
1	TV ON	Turns TV LED ON
2	TV OFF	Turns TV LED OFF
3	FAN ON	Turns FAN LED ON
4	FAN OFF	Turns FAN LED OFF

5.2 Result.

To connect to the HC06 Bluetooth module, a password is required (in this case; 1234) and then connection will be established between the mobile phone and the HC06.
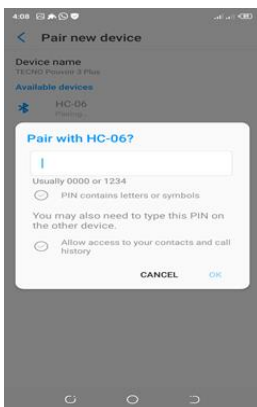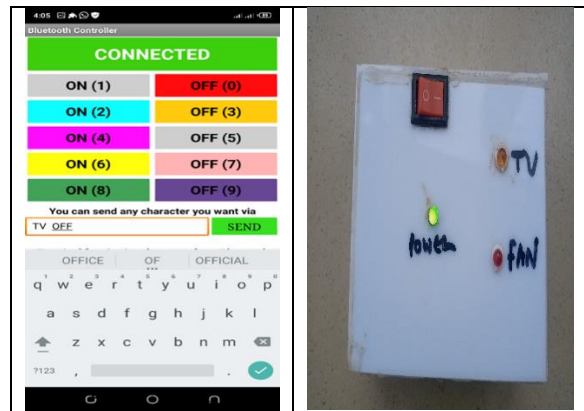

Figure 11. GUI for the Password

The screen shot for the first result (TV ON) is shown in figure 12 (a) and (b):

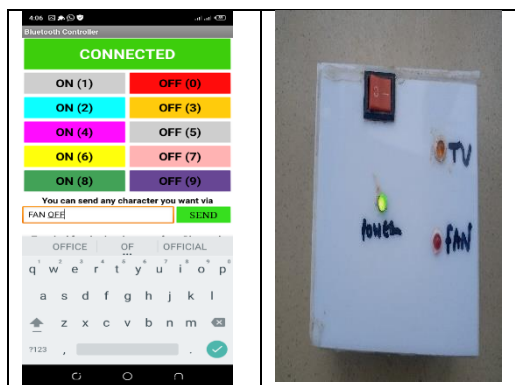The screen shot for the second result (TV OFF) is shown in figure 13 (a) and (b):

The screen shot for the third result (FAN ON) is shown in figure 14 (a) and (b):

The screen shot for the fourth result (FAN OFF) is shown in figure 15 (a) and (b):

6. CONCLUSION

The proposed Home Automation System Design prototype has been successfully implemented and test result shows that it works well. This system can be integrated with other house appliances to achieve control. The system is user friendly and is cost effective. The main aim is to have a centralized automated system control of home appliances. The appliance can be controlled and the status monitored from a remote location using the application.

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