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Construction of Home Automation Control System Using Bluetooth

Nkamuo Chinwe Juliana[1*]

[1] Department of Science Laboratory and Technology, Federal Polytechnic, Oko, Nigeria

Email Address

chybenas1@gmail.com (Nkamuo Chinwe Juliana)
*Correspondence: chybenas1@gmail.com

Abstract:

This research work is aimed at constructing a control system that enables the complete control of multiple home and office appliances using android device with the help of Bluetooth technology. The development of this system is categorized into hardware and software. The hardware development involves all the components that make up the system and their various interconnections. The software involves the writing of the program in C programming language which was used to control the hardware. The system is based on embedded technology and can act as a security guard of the home. It functioned satisfactorily when subjected to test and met the objectives of the research work. This work gives basic idea of how to control various home appliances using Smart phone. This work is based on Android. So, the overall implementation cost is very cheap and it is affordable by a common person. In the future, sensors should be incorporated so that it can monitor some surrounding conditions around the house and also the communication can be improved by using internet web-based technology.

1. Introduction

Home automation or domotics [1] is building automation for a home, called a smart home or smart house. A home automation system will monitor and/or control home attributes such as lighting, climate, entertainment systems, and appliances. It may also include home security such as access control and alarm systems. When connected with the Internet, home devices are an important constituent of the Internet of Things [2].

The concept of home automation has been around since the late 1970s. But with the enhancement of technology and smart services, people's expectations have changed a lot during the course of time to perfectly turn the traditional house into smart home, and also think that what a home should do or how the services should be provided and accessed at home to became a smart home and so has the idea of home automation systems [3].

The Bluetooth wireless technology will serve primarily as a replacement of the interconnect cables between a variety of personal devices, including notebook computers, cellular phones, personal digital assistants (PDAs), digital cameras, etc. The Bluetooth wireless technology aims to serve as the universal low cost, user friendly, air interface that will replace the plethora of proprietary cables that people need to carry and use to connect their personal devices.

Generally, Home Automation System Consist of these components, User Interface, mode of Transmission, Central Controller, Electronic devices [4]. The Home automation is an attractive package for those ones who are dealing with busy life and also for the one with physical Disability. Home automation system is also for the Elder peoples who are the important part of the living population. Using home automation system will reduce expenditures and is more beneficial than attending medical Centers [5].

A controlled system which is based on Android device with the help of Bluetooth Technology that effectively allows real time control of home/office appliances within hundreds of meters (100 m) is the proposed project for this research work.

1.1. Bluetooth Based Smart Home

Bluetooth is a short-ranged wireless technology which is generally used to establish communication between several different devices for transferring of media or instructions [6]. It uses radio waves having short wavelengths that cannot cover up large distances (maximum 100m) It can be used to connect devices. The work of [7] shows the implementation of smart home using Bluetooth and a host controller, which is implemented on a PC and connected to a microcontroller-based sensor and device controllers. It is proposed to make the communication between devices possible. The system allows multiple device controllers to be connected to the host controller. In some ideal conditions bluetooth has the highest upto some 100m range. Comparatively bluetooth communication usually consumes higher power, so the batteries of devices need to be frequently recharged or replaced. Bluetooth technology should only be used when there is quick short-lived communication with a very small concern of security.

1.2. Wi-fi Based Smart Home

Wireless-Fidelity which is popularly known as Wifi uses radio waves for the transmission of data. It provides high-speed internet and network connections. It is a wireless medium for communicating to different locations in the house and connecting different devices. It can be used in variety of specification which varies with the purpose. Equipment can be placed anywhere. No unnecessary cords are required in your home. There is no need for additional ethernet output and it also provides a wide range and is more efficient. Wi-fi is a popular choice among people.

1.3. Mobile-based Smart Home

Mobile-based smart homes are striking to companies because of the fame of mobile phones and GSM. The work of Alheraish [9], proposes a smart home system using SMS. This system detects the illegitimate invasions at home and allows only legitimate users to alter the passkey for the gate and control lights in the house. The illegitimate invasions into the home are identified by monitoring the state of the home door which is done using sensors. The work of U. Saeed et al., [8] also proposes an

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SMS-based home automation system. In this system an android application made to run on the user's mobile phone. Legitimate users can log in to the application using their username and password and remotely control along with some of the functions from the list of available user actions. The application will send the required notification to the user.

2. Materials and Methods

The materials used in the development of the device constructed in this work are locally available. The components are few in number and they include; AT89C52 Microcontroller IC, Crystal oscillator (11.0592MHZ), Relay (12v/10A), Transformer, Resistors (1K,10K,100K,5KVR), Transistor, Bluetooth module, Capacitor (10nF,100nF,0.1nF,30nF), Regulator IC (LM317), Reset Switch, Jumper Wire, Vero Board, IC sockets (40pins), Light Emitting Diode (LED).

2.1. Power Supply Unit

The power supply unit consists of a 12V/10A step down transformer, a bridge rectifier, 1000NF/35V capacitor, status indicator LED; a 1k resistor limits the voltage entering the LED. The 220V/50Hz input supply into the transformer, passes through the rectifier which converts it to a DC voltage. Smoothening the DC is carried out by the capacitor. The voltage gives a voltage of 5vdc required as VCC. (Figure 1)
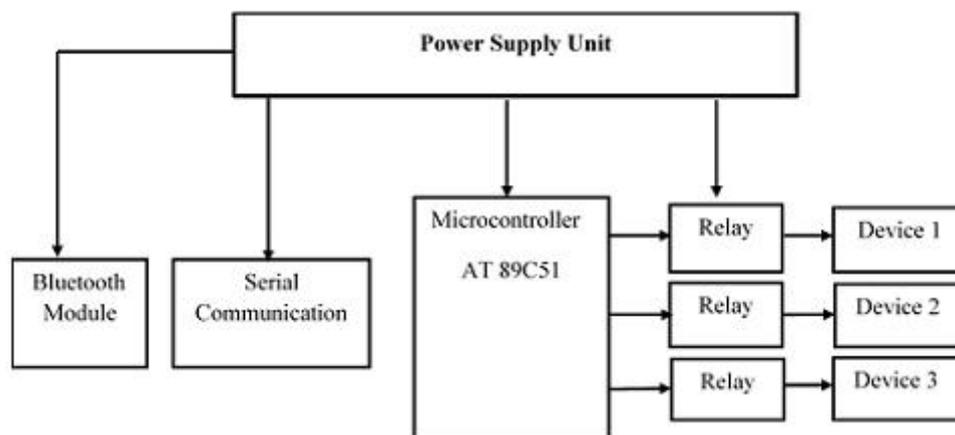

Figure 1. *Block Diagram of the System.*

2.2. Microcontroller Unit

This serves as the brain of the system. It controls all the other parts of the system. It fetches information from one part of the system to the other. It takes data from the input, processes it and displays it. It monitors the output of the receiver unit and once it is "HIGH" it processes it, stores it, switches the processed speed and displays it on a 7-segment screen.

2.3. Bluetooth Unit

The connection between Bluetooth and mobile phone is wireless. The connection is made by pairing the Bluetooth and the mobile phone. To do this, the phone is first switched ON while Bluetooth is OFF. Then the Bluetooth is switched ON so to enter pairing mode (the blue indicator light starts flashing quickly). The pass code 0000 is then entered to pair and connect the Bluetooth module and the phone.

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2.4. Serial Communication Unit

This involves the communication between the Bluetooth module and the microcontroller. The transmit line of the Bluetooth is connected to the receiver line of the microcontroller and vice versa. When a letter is typed through the android app and sent to the Bluetooth, the typed letter is sent to the microcontroller serially. Thus, the Bluetooth communicate with the microcontroller through serial communication.

2.5. Switching Unit

The switching circuit consists of a relay, a diode connected across it, a transistor with its base connected to a resistor. When the base voltage of the transistor is above 0.7v, the emitter-base junction of the transistor becomes forward biased and the transistor goes to saturation region. Thus, the transistor is switched on thereby energizing the relay.

2.6. Load Unit

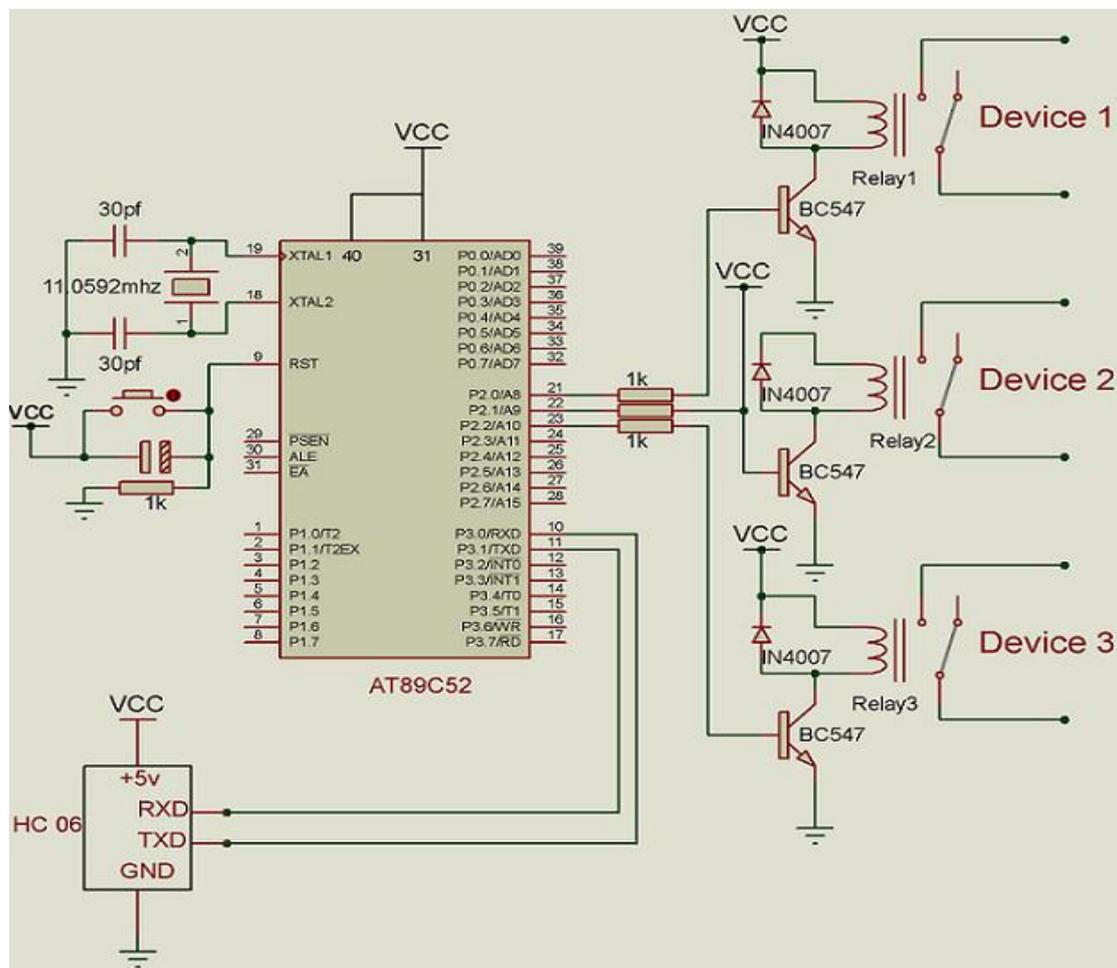This is the unit where all the appliances to be controlled are connected. (Figure 2)

Figure 2. *Circuit Diagram of Bluetooth Based Home Automation System.*

3. Results and Discussion

3.1. Principle of Operation

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A Bluetooth module is interfaced to 8051 Microcontroller. This Bluetooth Module receives the commands from the Android application that is installed on the Android device, using wireless communication (Bluetooth Technology). The program which is written to the 8051 microcontroller communicates with Bluetooth module serially to receive the commands. Microcontroller switches the electrical loads automatically based on the commands received from the Bluetooth.

3.2. Results

The prototype system was designed to receive signal from android device through Bluetooth Hyper terminal application to the Bluetooth module connected to the AT89c52 circuit. This was performed by typing an alphabet from an android app which has been set in AT89c52. The AT89c52 on reception of the signal turns ON or OFF the required appliance and directs the seven segments display to display the condition of the controlled appliance. (Table 1, Figure 3)

Table 1. *Results of Home Automation System Using Bluetooth (3-Loads).*

Command Letters	Corresponding Load Control
A	The first bulb came ON
B	The first bulb was switched OFF
C	The second bulb came ON
D	The second bulb was switched OFF
E	The socket came ON
F	The socket was switched OFF
G	The 3-Loads came ON
H	The 3-Loads were switched OFF

Figure 3. *Pictorial Diagram of a Home Automation Control System Using Bluetooth.*

4. Conclusions

The system can automatically switch ON and OFF bulbs, fan and other appliances connected to the socket remotely using mobile phone and this has proved that the need of being physically present in any location for tasks involving the control of the appliances within a household/office has been eliminated. Effort and time required in switching ON and OFF household/office appliances was also achieved since one can stay at any position within ten meters of the system and control the connected devices and appliances. This paper gives basic idea of how to control various home appliances and provide a security using Smart phone. This project is based on Android. Therefore, the overall implementation cost is very cheap and it is affordable by a common person.

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After a successful completion of this study, the following recommendations can be made; (i) voice commands can be implemented so that the persons without hands can also operate this system and (ii) sophisticated electrical appliances can be controlled. For example: Microwaves, Air conditioning temperature, etc. The system can be used in home, small offices to the big malls.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

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