Protection of home using Wireless Bluetooth Technology

Prof. Sanjay Ganar¹, Anurag Dhote², Aditya Shivhare³, Khrushanu Gaikwad⁴, Chinmay Mahure⁵
Department of Electronics & Telecommunication Engineering
Anjuman College of Engineering and Technology, Nagpur, Maharashtra, India

Abstract:
The past decade has seen significant advancement in the field of consumer electronics. Various ‘intelligent’ appliances such as cellular phones, air-conditioners, home security devices, home theatres, etc. are set to realize the concept of a smart home. They have given rise to a Personal Area Network in home environment, where all these appliances can be interconnected and monitored using a single controller. Busy families and individuals with physical limitation represent an attractive market for home automation and networking. A wireless home network that does not incur additional costs of wiring would be desirable. Bluetooth technology, which has emerged in late 1990s, is an ideal solution for this purpose. Home automation involves introducing a degree of computerized or automatic control to certain electrical and electronic systems in a building. These include lighting, temperature control, etc. This paper demonstrates a simple home automation system which contains a remote mobile host controller and several client modules (home appliances). The client modules communicate with the host controller through a wireless device such as a Bluetooth enabled mobile phone, in this case, an android based Smart phone.

Keywords: Home Automation System, Bluetooth Controller, Bluetooth Module HC-05, Microcontroller AVR, Smart Phone.

I. INTRODUCTION

Automation involves introducing a degree of computerized or automatic control to certain electrical and electronic systems in a building. These include lighting, temperature control, etc. The past decade has seen significant advancement in the field of consumer electronics. Various intelligent appliances such as cellular phone, air conditioners, home security devices, home theaters, etc., are set to realize the concept of a smart home. They have given rise to a Personal Area Network in home environment, where all these appliances can be interconnected and monitored using a single controller. This paper demonstrates an automation system which contains a remote mobile host controller and several client modules (e.g. Office, home appliances). The client modules communicate with the host controller through a wireless device such as a Bluetooth enabled mobile phone, in this case, an android based Smart phone. Although automation today is not a new thing but most advanced home automation systems in existence today require a big and expensive change of infrastructure. We have proposed an automation system that can control appliances like TVs, Fan, Tube lights from an android mobile using Bluetooth. In this a low cost secure cell phone based, flexible automation system is introduced. Devices are connected to the microcontroller based switching circuit. The communication between the cell phone and the microcontroller board is wireless. Additional devices can be connected into the system with little modifications. The phone will be Android OS based phone. The switching circuit will be having microcontroller coding to control the electronics devices like fans and lights etc. 8-bit microcontroller board based on the atmel AVR and the HC-05 Bluetooth module is used. It supports wireless serial communication over Bluetooth. This board has 32 digital input and output ports. The AVR can be programmed using the microcontroller’s high-level interactive embedded C language. The Bluetooth antenna in our module picks up the packets sent from the cell phone. Subsequently, these packets containing the device status as commands are pipelined through AVR microcontroller and the designed analogue circuitry according to the definition of each output. Different home or office appliances are connected to the digital output ports of the circuit via relays to provide sufficiently high currents and voltage compatibility. For test purposes, 25W, 240V lamps will be used. We send commands from an application which is developed in phone to turn ON/OFF a device. A feedback circuit has been designed and implemented to indicate the devices actual status after it receives the command (ON/OFF) from the cell phone. Once the command has been sent to turn ON a device, the feedback circuit senses the current and gives an output signal by turning ON a respective led on the switching circuitry indicating that the device is ON. Otherwise, the device is malfunctioning indicating that the command was not executed successfully. We can also operate the appliances of Home or Office in Bluetooth range area.

Figure 1. A Block diagram of Bluetooth based home automation

In this block diagram communication is in both direction between android mobile and Bluetooth module. This communication is done one by one only one at a time. This communication is called half duplex. Feedback is done by getting 220v. feedback circuitry is so deigned that microcontroller can easily sense.
II. PROPOSED METHODOLOGY

This Project put forward the design of home automation system using Bluetooth Controller Android application. The Bluetooth controller freeware Android based application is developed for smart phone users. The home appliances are connected to the input/output ports of the embedded system board and Microcontroller is interfaced with Android application via HC-05 Bluetooth Module. Bluetooth technology designed to operate in a noisy radio frequency environment such as a home, the Bluetooth technology uses a fast acknowledgement and frequency-hopping scheme to make the link robust. Bluetooth technology would replace the cumbersome cables used today to connect the Printers, PC’s to any other digital device which is part of the Bluetooth network. The controlling device of the whole system is AVR an 8 Bit Microcontroller, Bluetooth Module and Relay Driver and Relay Board. The system is based on serial data transmission using Bluetooth wireless communication in order to facilitate the appliances control in a HAS. A user interface on the Android enabled mobile phone offers system connection and control utilities. The data received by Bluetooth module from Android application is fed as an input to Microcontroller. In achieving this control the Microcontroller is loaded with a C program written using Embedded C Language. The controller acts accordingly on the relays to switch connected electrical appliances. ULN 2003 relay driver, HC-05 Bluetooth module, AVR Studio 4 (IDE) for compiling C Language Code and USB AVR Programmer for burning the HEX file into Microcontroller.

Algorithms
About the algorithm used. What the system does is it simply receives the instructions in ASCII format from the bluetooth enabled Android smartphone using the bluetooth module and pass it on to the microcontroller. The microcontroller does the main processing part and for that purpose we need the code, please make your own. What happens when the controller receives a particular ASCII value it switches ON or OFF a relay. And the relay acts as a switch for A C appliances. I have used some flag variables which check whether a particular relay is ON or OFF. A particular ASCII value is assigned for one and only one relay. When an ASCII value is passed for the first time, it switches ON the relay and if the same value is passed again, the relay gets switched OFF.

III. DEVELOPMENT PLATFORM

This section describes the technologies used for developing the mobile phone application of the home Automation System. The mobile phone application development presented in this paper is based on the following technologies: Android [3], Bluetooth [2]. Android is a platform to developing and deploying android based applications on mobile devices supporting it. Bluetooth has its own benchmark as wireless communication technologies for short range communication provide a facility to create Android based mobile applications.

A. Android Application

Android is an open-source operating system. The Bluetooth controller Android Application shown in figure 2. The Android application available on Google Store. The same has been downloaded and installed on Samsung galaxy Pro mobile which is having Android version “2.3 GINGERBREAD” The home appliances are interfaced to the input/output ports of the embedded system board and Microcontroller is interfaced with Bluetooth Controller Android application wirelessly via HC-05 Bluetooth Module.

Figure 2. Android App GUI

I. Click scan Button for connect to device Search the Bluetooth devices present in the range.
II. After connected, Click Set Keys for setting Keys name and data to be sent.
III. Exchange data to and from paired Bluetooth devices.

B. Bluetooth Module

Wireless networks for short range communications have a wide spread usage of Bluetooth radio transmissions between 2400–2480 MHz by Telecom vendor Ericsson since 1994 [6] Bluetooth technology forms small ad hoc networks termed as Personal Area Networks (PANs) also provides a mechanism to emulate the RS-232 data cables, supervised by the Bluetooth Special Interest Group, since 1998. Modern mobile devices embed small, low-powered and cheap integrated chips functioning as short-range radio transceivers for Bluetooth radio communications. Device pairing, authentication, encryption and authorization techniques have given recognition to Bluetooth technology due to its vital security mechanisms. Different types of Bluetooth applications can be developed using Android platform architecture using the Bluetooth profiles. The device manufacturers provide the services using the support of these profiles in their devices to maintain compatibility for the Bluetooth technology.

Figure 3 HC-05 Bluetooth Module

Figure 3 shows the HC-05 Bluetooth Module. This module enables you to wireless transmit & receive serial data. It is a drop in replacement for wired serial connections allowing transparent two way data communication. You can simply use it for serial port replacement to establish connection between MCU or embedded project and PC for data transfer. The Bluetooth profile used in Home Automation System (HAS) Android mobile phone application is the Bluetooth Serial Port Profile. Normally, before commencing communication
Flowchart
The Program Flow chart Upon the execution of the program, it first checks if Bluetooth is already enabled on the phone. If Bluetooth is enabled, the device and service discovery process will run. The software will check if there are already predefined devices stored in the phone’s memory. If they do exist, they will be listed down for the user to select one. The program then checks to see if the selected device is in range. It will then verify if the device is a Bluetooth transceiver (Arduino BT board). Now if there are no devices stored in memory, the program will search for Bluetooth-enabled devices within the area. Once discovered, these devices will be displayed on the screen and also stored in memory. Once it is confirmed that the device is indeed a transceiver, the software will store the unique addresses of all the controller modules connected to it, in this case Arduino BT. If the address of a controller module has not been saved, then it will be designated a number i.e., „BTLAMP“. Otherwise, it will be given its saved name and will prompt the user to enter the pairing password for the Arduino BT board. Upon entering the correct password, the program stores all connected controller modules’ names inside the phone’s memory, then only the Main Menu user interface will be displayed. The Main Menu displays three options: „Options“, „List of Lamps“, and „Exit“. As shown in Figure 4. A „List of Lamps“ is a combination of one or more lights which have been preset to a certain status or state. These states are either ON or OFF. There are two options to choose from in the „List of Lamps“ interface: they are either LAMP ON or LAMP OFF. When the certain instruction has been chosen, the software will send data to the Arduino BT transceiver, which in turn will send the data to the controller modules. The „List of Lamps“ option in the Main Menu will display the entire controller modules saved in memory. The user can modify the lights” status from here. „Options“ will display instructions on how to use the software. Lastly, „Exit“ will let the user end the program.

IV. RESULTS
Real implementation of HAS is shown in figure 7 and 7a. The steps for operating the Automation system listed as follows:

I. On powering up the hardware HC-05 Bluetooth Module make the Green LED flicker quickly. It indicates the HC-05 module is power up and this can be paired.

II. Open the Android application on mobile phone after that you will be asked for turning on the Bluetooth, Press YES to continue further.

III. Using scan key you can connect to HC-05 Module.

IV. On pairing with HC-05 Bluetooth Module the application appears with message “Connected to HC-05“ as shown in figure 7.

V. Now pressing the keys you can control the home appliances as per your requirement. On pressing “TV ON“ key (here for sake of feasibility lamp is connected) Lamp (Load) turned ON and feedback from controller is received i.e. TV ON.

V. Now pressing the keys you can control the home appliances as per your requirement. On pressing “TV ON“ key (here for sake of feasibility lamp is connected) Lamp (Load) turned ON and feedback from controller is received i.e. TV ON. Figure 7 Actual Testing of HAS

VI. On pressing “TV OFF“ key (here for sake of feasibility lamp is connected) Lamp (Load) turned OFF and feedback from controller is received i.e. TV OFF

Advantages:
1. Wireless control:-
   By using this project wireless control can be within the hands of user.

2. Monitoring:-
   This circuit allow monitoring of all appliance within range of communication with Bluetooth.

3. Status checking :-
   When user doesn’t know appliances is on off then user can only check the status only

4. Confirmation of changing switch state:-
   When switch is press ten two status will be shown on mobile phone i.e. old status and new status

5. Manual control:-
   Manual control is given so an unskilled user can be change the current status.

Disadvantages:-
1. Bluetooth range:-
   It is good to use Bluetooth for automation but automation is kept within a range of 10-30 metres. So control can be achieved from outside range.

2. Connection:-
   Application must be connected after disconnection from Bluetooth.

3. configuration of application software:-
   If new user want to connect then first download application software and then code must be enter and more configuration must be done.

V. CONCLUSIONS
In conclusion, this low cost system is designed to improve the standard living in home. The remote control function by smart phone provides help and assistance especially to disabled and elderly. In order to provide safety protection to the user, a low
voltage activating switches is replaced current electrical switches. Moreover, implementation of wireless Bluetooth connection in control board allows the system install in more simple way. The control board is directly installed beside the electrical switches whereby the switching connection is controlled by relay. Furthermore, flexible types of connections are designed as backup connections to the system. The connected GUIs are synchronized to the control board. They indicate the real-time switches status. The system is designed in user-friendly interface. The easy to use interface on Window and Android GUI provides simple control by the elderly and disabled people. For future work, the Window GUI will be implemented with speech recognition voice control. The android GUI will be implemented as a remote Bluetooth microphone to the Window GUI. All the voice signal inputs to the smart phone will be transmitted to the Window GUI for signal processing. Also, the push buttons implemented in low voltage activating switches will be replaced by capacitive sensing switches. All the future work is expected without spend extra cost, even one cent from the current system.

VI. REFERENCES

[1]. Electronics for you magazine June 2013


[3]. www.vp812.com


[6]. The official Bluetooth website from Bluetooth SIG: http://www.bluetooth.com

[7]. The 8051 microcontroller and embedded systems by Muhammad Ali Mazidi and Janice Gillispie Mazidi.


[9]. “Mobile Communications” by Jochen H. Schiller second Edition


[12]. http://www.atmel.com


[15].http://www.st.com