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HOME AUTOMATION USING BLUETOOTH - A REVIEW

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ABSTRACT

This paper reviews home automation using Bluetooth. Home automation becomes very popular among researcher. Past two decades researchers are working with home automation. Home automation using wireless device becomes popular. Several wireless devices are available like Bluetooth, Zigbee and GSM. Researchers are targeting Bluetooth based home automation because of its cost. Many mobile phones have an in build Bluetooth. This paper discussed about various techniques involved to control the home appliances, controller used and number of devices controlled.

Keywords: home automation, bluetooth, wireless communication, android.

1. INTRODUCTION

Home automation is the usage of information technology and computer for controlling home appliances and various other devices. It can be simple control of a light bulb to a complex network based on computer or microcontroller which can have varying levels of automation and intelligence. It means that one can control devices from any corner of the world. The term can be used for isolated programmable devices, like thermostats and sprinkler systems, but it more specifically explains or focuses on places or homes where almost everything like lights, devices, electrical outlets, heating and cooling systems can be controlled over a network [1][2][3][4][5][6][7][8][9]. Study of applications of IT (information technology) to create intelligent home topography is known as Domotics [3]. It can be used in home security systems which include the alarm system, and all of the smoke detectors, doors, windows, locks, surveillance cameras and any other sensors which are linked to it[1][2][4][6]. Gas leak, fire alarm, carbon monoxide, or water leaks can also be included as detection systems. It is prominently used for reasons of security, ease, and energy efficiency. Its popularity recently has recently increased because of much higher affordability and simplicity through tablet connectivity and Smartphone. The idea about the "Internet of Things" is the recent hot topic of debate under HAS.

Home Automation Systems can be implemented by two ways i.e. Wired or Wireless Technology. Wired HAS (Home Automation Systems): In a wired HAS structure's existing electrical wiring and cable are used to connect all the devices. The signal is carried by the electrical wires, so they are called as power line systems. These types of systems are said to be unsuccessful in large homes and areas as the signal gets weaken travelling through long stretches of wire so phase couplers are required to maintain strong transmission which increases the cost of the system.

Wireless Home Automation Systems: RF (Radio frequency) signals are being used under Wireless Home Automation System [3][8]. This type of system is very useful in large buildings and businesses. Repetition of signal to upto 3 other wireless devices is there when a wireless device receives a signal. As a result, it travels to a larger distance before fading away. This system is typically referred to as a mesh network. Following are the various devices available in the market for facilitate communication between two devices:-

a) Bluetooth Modules: The operating frequency for Bluetooth is between 2400 and 2483.5 MHz, or 2402 and 2480 MHz including guard bands 2 MHz wide at the bottom end and 3.5 MHz wide at the top [5][8]. They usually range from 0-100 meters.

b)XBee Modules: Xbee modules have different operating frequencies and range depending upon the series being chosen. It varies from 0 to 100 km.

c) GSM: GSM have operating frequency in the range of 380.2-1989 MHz.

2. RELATED WORK

In [1], they proposed an automation system where devices like T.V sets, fans, lights etc. can be controlled by an android app over Bluegiga WT11 Bluetooth module. Cheap and flexible secure cell phone based automation system has been introduced. Arduino BT board has been used to connect the devices. Wireless communication was established between cell phone and devices. Different home or office devices were connected to the Arduino BT board via relays. It has been done to provide sufficiently high voltage and current compatibility. Commands were sent from an application in phone to turn ON/OFF a device. For indicating the devices actual status after it has received the command (ON/OFF) from the phone a feedback circuit has been designed and implemented. After sending the command to turn ON a device, the feedback circuit detects the current to give an output signal by turning ON a led on the switching circuitry indicating that the device is switched ON. However, if the device malfunctions it means that the command hasn't been implemented successfully.

Host Controller (HC) implemented on a Personal Computer (PC) and a microcontroller based temperature-sensor/fan-controller was proposed in [2]. This system was able to communicate with the host via the Bluetooth link. For facilitating the master–slave communication the system was based on HAP (Home Automation Protocol). The protocol ensures a prioritized, interlocked exchange of data. Addition and removal of devices was also supported

on the network. Ericson's Bluetooth development kit was used for the development. For client modules a microcontroller was used as a device controller.

The project in [3] utilizes two types of communication: wireless and wired. CytronBlueBee, which is a Bluetooth module, was used to enable the controller to wirelessly communicate with an Android phone. The home appliances were physically connected to the controller via relays. The Android phone sends a signal to the controller. The signal received was processed for controlling the home appliance accordingly. At the same time, the controller sends the status (ON/OFF) of the home appliance to the Android phone. The Android application was developed in Java programming using Eclipse IDE with Android platform API8: Android 2.2 (Froyo), the lowest Android version that the application can support.

KartikRathod, Nilay Parikh, Aesha Parikh, Prof.Vrushank Shah, *et al.* in [4] proposed the designing of fully functional wireless home automation network using IEEE 802.15.4 protocols and ZigBee and evaluating its applications in a sensor network has been discussed. The sensors and two functional ZigBee modules were reticuled wirelessly. Each and every sensor in the network is a node and their collection is known as a mesh. A wireless network was used to control the mesh. Once established, the mesh was easy to maintain and alter. Addition and deletion of nodes to reconfigure mesh in order to meet future demands can be done easily. Manipulation of one part of the system without altering the remaining of the mesh could be done easily by ZigBee. ZigBee technology consumes very low power so it helps in setting up a low power, low cost, good or improved personal wireless network.

In [5], system with GUI (Graphical User Interface) was developed by utilizing the android applications in the mobile phone, PDA and computers. With this disabled people as well as other people can control the devices from a mobile phone app. The microcontroller used was PIC microcontroller, PIC16F877A. And the interface was developed for OS Windows 7 and Windows mobile. The UI system serially communicates with the Pic microcontroller through Bluetooth to control appliances by triggering relays interfaced with the microcontroller. It also displayed input data from humidity and temperature sensors. To allow monitoring of the home via Internet, an IP camera was included in the system. Single 5VDC SPDT (single pole double throw) relay and ULN2003APG relay driver was used which has 7 output and 7 input ports.

Shiu Kumar *et al,* proposed a low-cost and flexible smart home system. This system has Bluetooth and web services (REST full based). Smart home app was designed by using MIT app inventor tool. Ardunio Ethernet shield is used to run web server. Ardunio Mega 2560 acts as main controller of home system. Radio module is used (nRF24L01+) to communicate the signals as well as it coordinates with the other sensor nodes. Home system can be controlled through android app in the following ways: 1. Voice activation 2. Bluetooth based control 3. Internet based control. Authentication is required to use the app. If the entered password is correct, then only user can control the appliances. Google speech recognizer is used for voice controlled activation. Interrupts are used to get the value from sensors. RFCOMM is used to get back the values from sensors to master control. At a time, user can use any one method to control the appliances. Gate control, door lock and fire detection can be controlled in this method. This system also sends email to user in case of emergency is detected.

Kwang Yeol Lee *et al* [7] discussed the control of different home appliances over a Bluetooth. Pulse width modulation (PWM) technique is used to control the amount of power delivered to the motor. Motor speed can be controlled, by varying the duty cycle of PWM pulse. Twp PC's are used in this design. Server PC sends signals to Bluetooth device and the signal can be transferred to client PC which has connected with interfacing circuit and various appliances. The device attached Bluetooth can be controlled both manually and remotely. Server PC can be controlled over internet connection. Any change in UI, will send relevant signals to Bluetooth over air. Device values will get update once in every 3 seconds. Counter function is used to vary the PWM signals. Whenever signal changes, counter value will get increment by one. This counter value is compared with threshold value. According to the value, PC adjusts the duty cycle of PWM. In order to validate the result, test bed was controlled using this method. Sharon Panth*et al*, proposed Home Automation System (HAS) using Java Me and MoSync. HC-06 Bluetooth module is used to communicate microcontroller and android platform. Application file (.apk) was developed for user. Through the apk file user can control home appliances. An 8 bit 8051 microcontroller is used to control appliances. Tiny OS and Keil compiler was used to write the program. All appliances are connected through relay network. 8051 ports are connected with relay switch. According to user input, ports are activated which controls corresponding relay switch. Android application (.apk) was tested in various android operating system (OS) to control home appliances.

Ramlee*et al* [9], proposed two different types home automation. In this design, both wired and wireless techniques are used to control the home appliances. Home appliances can be controlled in three different ways. 1. Physical switches 2. Windows GUI 3. Smart phone. In first method, ports of PIC microcontroller are tied with switches and appliances are connected through relay with microcontroller. This connection is stand - alone connection. PIC controller monitors switch status continuously, if any signal changes at any input, controller activates/deactivates the appliances. In this method, user can eliminate physical switches and push buttons can be used to change the status. Techniques two and three provides wireless control of home appliances. Laptop or mobile Bluetooth are used to transmit or receive the signals from the board. Switch status are synchronized with laptop and mobile phone. When controller detects any changes at input, immediately it sends the updated information to both wireless devices. Similarly, elderly

people can use these techniques and they can change input status by clicking the GUI buttons or by using android APP. PIC18F2550 microcontroller is used to detect switch positions. For sensing HSM-20G sensor is used for sensing temperature/humidity. In this paper, Bluetooth module (CytronBluebee) is used to establish the connection between control board and the GUIs. Figure-1 shows block diagram of controlling the home appliances and Table-1 shows the summary of devices controlled, method of control and type of controller.
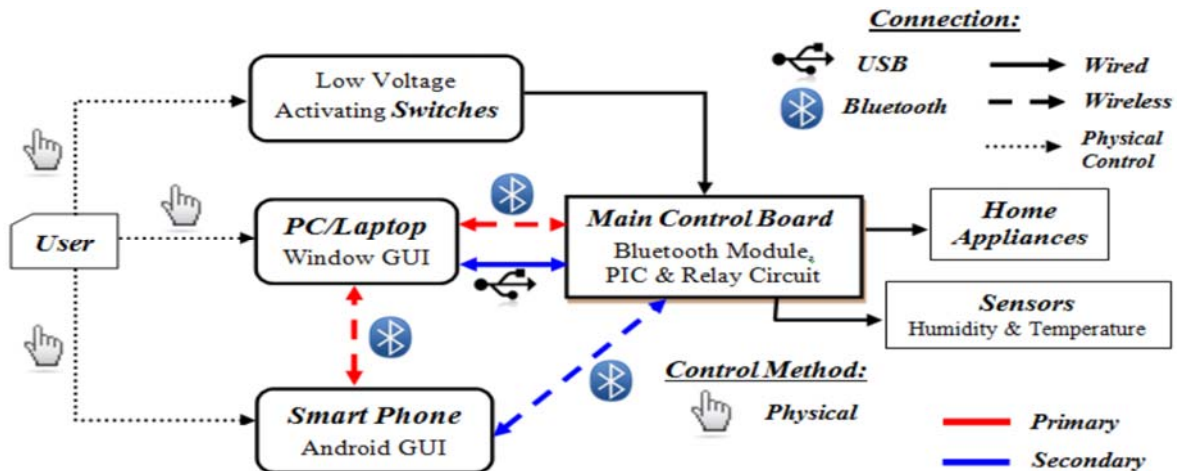

Figure-1. Block diagram of controlling the home appliances.

Table-1. Summary of various home automation & control method.

Paper	Devices controlled	Type of controller	Control method
1	25W, 240V lamps	Arduino BT Board	Smartphone App, Web Browser
2	Fan, Room Temperature	8 bit Microcontroller	PC
3	Bulbs	Arduino Mega 2560-R3 board	Android application
4	Home security systems and devices	AtMega16	Automatic(sensor network)
5	House lighting switch	microcontroller, PIC16F877A	User interface OS Windows 7 and Windows Mobile 6.
6	light switches and security systems	Arduino Uno and Ethernet	smart home app
7	Heater and Air conditioner	8 bit Microcontroller	Desktop PC
8	Switches and appliances in home	ATMEL AT89C51	Android Application
9	Light Bulbs	Microcontroller, PIC18F2550	PC/Laptop or Android Application

3. FUTURE WORK

Home automation can be extended to controlling the devices like fans, lights, bulbs, T.V, etc. by monitoring the heartbeat of an individual. The heartbeat is being monitored continuously via heartbeat sensor circuit. If suppose person forgets to switch of a device such as T.V, A.C etc. and falls asleep, then the proposed system is useful. Though there are various systems for home automation already available but none of them gives a provision like this. It will be helpful in saving energy and bringing down the annual cost of an individual's electricity bill thus helping both ways. The Heartbeat sensor circuit senses the heartbeat pulses tapped from the finger of the individual then it is wirelessly transmitted from one xbee module to another interfaced with the Arduino board for comparing the received value with the preset values of heartbeat. If it falls below the threshold (i.e. 60 bpm) then the relay which is continuously monitoring the state of the device will be triggered by a pulse from Arduino board to change the state of the devices.

4. CONCLUSIONS

Home automation using Bluetooth was discussed in this paper. In all techniques, researchers addressed control of device using Bluetooth and internet/wired. Researchers are used various type of microcontroller to control the appliances. Mostly people However, researcher not addressed if the person forgot to switch off the devices. Researchers need to address this problem also. Further, the work can be extended in following way. Monitor the person heart beat, when person sleep, heart rate drops to 45-55 bps. If the heart rate lies between the

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ranges, we can automatically turn off the device which is, attached to the mobile. This technique gives complete automation of the home appliances.

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