Physical Environment Monitoring and Controlling of Home Automation System

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ABSTRACT
This paper presents the overall design of Home Automation System and physical environment monitoring with low cost and wireless remote control. General idea of home automation shows the quality of human being at house. Prime focus of this technology is to control the household equipment's like light, fan, door etc. automatically. In hazardous condition, it is useful for old aged and handicapped persons. Also, the smart home concept in the system improves the standard living at home. The main control system implements wireless Bluetooth technology to provide remote access from PC/laptop or smart phone. The design remains the existing electrical switches and provides more safety control on the switches with low voltage activating method. The system intended to control electrical appliances and devices in house with relatively low cost design also for physical environment monitoring, user-friendly interface and ease of installation.

Keywords
LPC2148 development board, Bluetooth device, Smart phone, Sensors, Controlled devices.

1. INTRODUCTION
Focusing on the use of home area networks to improve disabled people's autonomy at home, In this project presents a smart phone based accessible home appliance control [1].In recent years the popularity of home automation has been increasing due to higher affordability and simplicity by connecting through Smartphone. Home automation include controlling of lights, fans, appliances, security locks for gates and doors, etc., which are used to improve comfort, energy efficiency and security for home. Home automation is useful forelderly and disabled, who can control the things by staying at one place without the help of others and can increase the life quality of them.

A home automation system (HAS) provides the integration among all the electrical and electronic devices in a house. The techniques used in home automation systems include controlling of electronic and electrical devices, such as home entertainment systems, security systems, air conditioners, lawn watering systems, domestic robots, etc., As information technology has been integrated with the home appliances and systems, they are able to communicate in an integrated manner which results in energy saving and safety benefits. As the wireless technology is emerging day by day, several different connections are introduced such as Bluetooth, WIFI, ZIGBEE and GSM. Each of these connections has their unique specifications. Among the above mentioned wireless connections, Bluetooth is chosen with its suitable capabilities for designing this HAS project. Bluetooth with globally available frequencies of 2400Hz is able to provide connectivity up to 100 meters and speed up to 3Mbps depending on different Bluetooth device classes [2].

2. LITERATURE REVIEW
Based on the study of HAS project done by researchers and developers, [4] implemented Microcontroller in wireless HAS. For wireless connection, the system implemented a FM transmitter and receiver to establish a RF connection. The simplex connection between control board and controller limited that only one type of input (voice) to the system. [5] Implemented GSM, Internet and voice as wireless HAS. The system implemented microprocessor and GSM SMS control method by a GSM modem. The system [5] mentioned as low cost but the cost of GSM modem and microcontroller is not considered. Also, long term cost by the GSM is not fully accepted by every user. Project [3], [6-10] are Bluetooth based HAS design architecture. Where reference [6-8] proposed a Bluetooth based HAS that controls home appliances by a PC's GUI, but it does not provide portable remote function. For system [6-8], all the controls are performed only at the GUI on PC. [3], [9-10] are designed with cellular phone remote control to the system. Reference [3] implemented ArduinoBluetooth board in their HAS project with cell phone remote control. The project stated as low cost HAS system but the cost of Arduino BT board is not the best cost efficient solution. Moreover, the cell phone control is implemented by Symbian OS application. It does limit the users of the system as the Symbian based cell phones in market nowadays are very less. While reference [9] did not mentioned the specific type of phone's OS implemented for their phone application. Meanwhile reference [10] mentioned the phone control is designed in JAVA application but it also did not mention the specific phone's OS for the application. From the overall papers reviews, HAS according to [3-10] never mentioned about the existing physical electrical switches in their system.

3. SYSTEM OVERVIEW
Figure 1 shows the block diagram of the Android application based Physical Environment Monitoring and Controlling of Home Automation System i.e., control function of the system. The system is directly connected to the electrical and electronic devices present in the home such as fan, light, door etc., The Bluetooth connection is established between the system and the application which was designed and installed in the Android device.

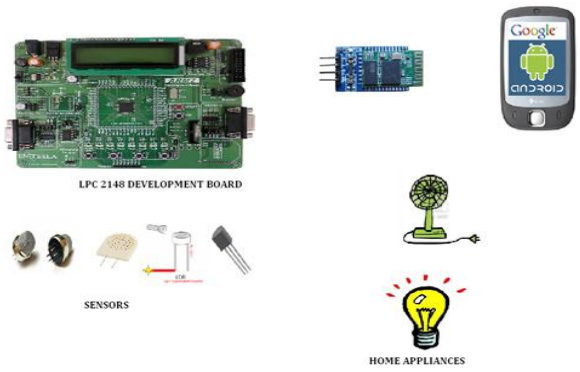


Fig1: Functional Block Diagram of System

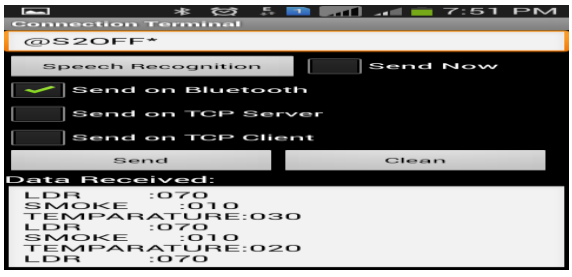
In order to improve the standard of living, the controlling of the home appliances is done by the Android application installed in Android device. The users can easily access the Android application by giving the commands on the touch-screen of Android device. This method is very much useful for the persons who are physically disabled and can't move on their own to the switches to turn on the appliances.Thetemperature, LDR and Smoke values can be measured using the sensors that are connected to the main control board. The indication from the sensors reminds or helps the user to turn on/ off the fan in the house. The on/off status of home appliances, temperature, LDR and Smoke readings are synchronized with the Android application present in the Android device. The monitoring of sensor reading is done in real-time; any changes in the sensor readings will be transmitted to the Android application present in Android device.

4. HARDWARE DESIGN

Figure 2 shows the hardware blocks present in main control board. ARM7 Microcontroller, ARM7 is considered for designing of this hardware due to its capability of performing serial communication using Bluetooth connection with the Android device. As the temperature, Smoke and LDR sensors are considered for getting the temperature, Smoke and LDR levels in the room. The Bluetooth module, BLUETOOTH BT24LT is chosen for establishing the connection between the Android device and the main control board due to its low cost.

The electrical current is directly connected to the main control board. The voltage regulator is constructed by Zero Crossing detection and opt coupler circuit which consists of transformer, rectifier and regulator. 3.3V to 5V DC output is needed for the specific components in the main control board.

REMOTESECTION



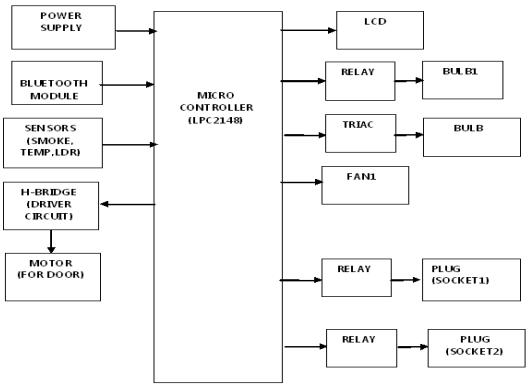


Fig 2: Main Control Board Hardware BlockDiagram

The system designed is directly installed beside the electrical switches on the wall. The installation of this systems does not need any wiring reinstallation and wiring on the wall, but the existing switches in directly connected to opt copular circuit inside the main control board. Depending on the requirement, multiple control boards can be installed in home. With these low cost components, the main control board is constructed in small size but still performs the strong functions of the system.

5. SOFTWARE DESIGN

Software design section is divided into two sections (1) Main function of the system designed in ARM7 LPC2148 microcontroller and (2) Designing of Android application. Figure 3 illustrates the control flow in ARM7 LPC2148 microcontroller. The input to the main control board is detected by ARM7 LPC2148 microcontroller. Any input to ARM7 microcontroller will cause an interrupt to the main function loop of ARM7 LPC 2148. This will cause a change in the output peripherals connected to main control board.

The Android application is designed using Eclipse, ADK and JDK. Figure 4 illustrates the Android application i.e., installed and tested using the Android device which has Android 4.1.2.The application is simple to use, user can turn on and off the appliances that are connected to main control board by simply giving commands.

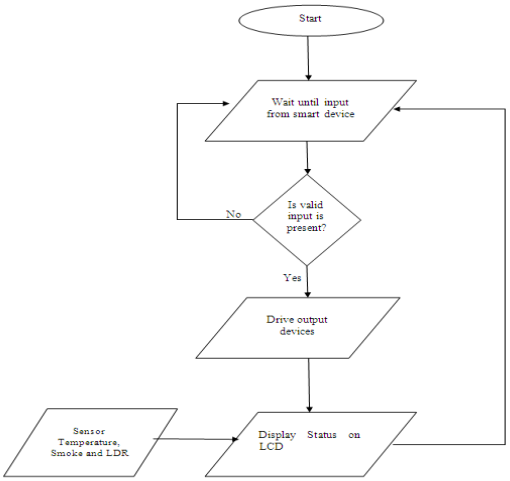
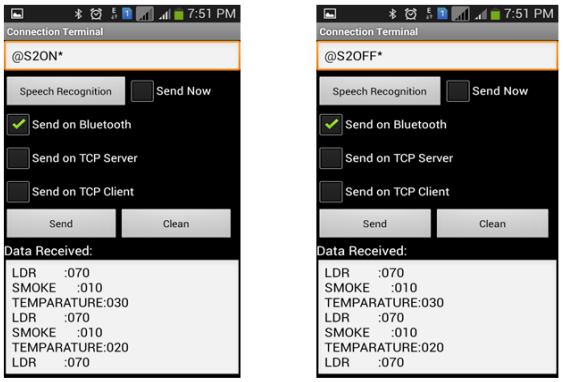


Fig 3: Control Flow in ARM7 LPC2148 Microcontroller



Fig(4): Android application testing

6. RESULTS

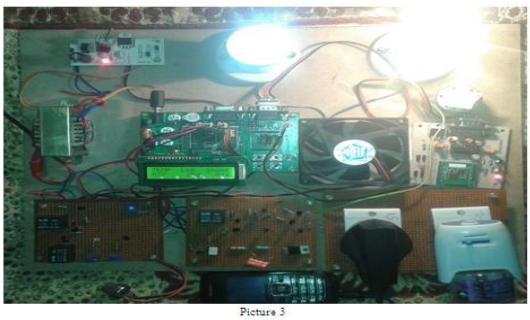
This system is tested and verified in the real time environment. The below pictures will you understand how perfectly the system is working.

Picture 1 is taken when the system is turned off. When the system is turned on then the bulb glows with the low intensity as show in picture 2. Forincreasing the intensity of light give command on Android Application then the intensity of the light will change. Pictures 3 show the bulb intensity at higher level.

In the similar way, the Fan speed also control. The temperature, Smoke and LDR values are displayed on the LCD present in the system and also in the Android Application.


Picture1


Picture2


Picture 3

7. CONCLUSION

In conclusion, this system is designed at low cost and is used to improve the standard of living in home. The wireless connectivity through the Android device provides help to the people especially to elderly and disabled. The implementation of the Bluetooth connection in control board allows the system to install in simple way. The control board can be directly installed besides the electrical switches. For future work, the Android application will be implemented with speech recognition to control appliances with voice commands. All the voice commands given to the Android device will be transmitted to the main control board after signal processing. All the future work can be implemented on the same system by changing the application in the Android device.

8. REFERENCES

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