

Android Application Based Physical Environment monitoring with Home/Office Automation System

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Abstract: This paper presents the design of Android Application Based Physical Environment monitoring with Home/Office Automation System which is low cost and wireless remote control. General idea of home/office automation shows the quality of human being at office/house. Prime focus of this technology is to control the office/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 Office/home. The main control system implements wireless Bluetooth technology to provide remote access from PC/laptop or Android 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 office/house with relatively low cost design also for physical environment monitoring, user-friendly interface and ease of installation.

Keywords:

LPC2148 development board, Bluetooth device, Android phone, Sensors, Controlled devices.

1. INTRODUCTION:

Today we are living in 21st century where automation is playing important role in human life. Focusing on the use of home area networks to improve disabled people's autonomy at home [1]. In recent years the popularity of home/office automation has been increasing due to higher affordability and simplicity by connecting through Smartphone. Home/office automation include controlling of lights, fans, appliances, security locks for gates and

doors, etc., which are used to improve comfort, energy efficiency and security in office/home.

Office/Home automation is useful for elderly 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. Office/home automation system provides the integration among all the electrical and electronic devices in office/house. The techniques used in office/home automation systems include controlling of electronic and electrical devices, such as entertainment systems, security systems, air conditioners, etc., As information technology has been integrated with the office/home appliances and systems, they are able to communicate in an integrated manner which results in energy saving and safety benefits.

In the past years, computational devices have turned faster, smaller, connected and cheaper. It brings the "intelligent house" vision, promised for decades, closer to reality. Thinking about users with disabilities, it is necessary to invest efforts in the research and development of accessible interfaces, through the perspective of a universal design that is easy to use and to learn how to use. The design for all, also called universal design, began focusing on physical aspects (buildings, urban spaces, transport, health, leisure), and nowadays is extended to the digital world (computer networks and communication systems). In this perspective, accessibility is defined as "a condition for autonomous and safe use of space, furniture and urban facilities, buildings, transport services and devices, systems and media and information by people with disabilities or reduced mobility.

Home/office automation not only refers to reduce human efforts but also energy efficiency and time saving. It is worth stressing that accessibility is not the creation of

exclusive spaces for people with disabilities, which could be a form of discrimination, but rather of thinking of systems and environments, which can be used by everyone. The work was developed starting with an interface design proposal, based on the research on accessible interfaces state of the art. The interface was deployed targeting Tablets and Smart Phones interoperability. Wireless technologies are becoming more popular around the world and the consumers appreciate this wireless lifestyle which gives them relief of the well known "cable chaos" that tends to grow under their desk. Now with the embedded Bluetooth technology, digital devices form a network in which the appliances and devices can communicate with each other.

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 project. In future, home/office appliance control is one of the major applications of Bluetooth technology. Operating over unlicensed, globally available frequency of 2400Hz, it can link digital devices within a range of 10m at the speed of up to 3Mbps depending on the Bluetooth device class [18]. With this capability of Bluetooth; here propose a home/office appliance control system based on Bluetooth technology.

2. LITERATURE SURVEY

Analyzing the state of the art, it is possible to notice that the works on user interface for home/office automation for people disabilities are very specific, usually addressing a single type of impairment. There are works focusing on elder lies, visually impaired people, hearing impaired, people with motor impairment and cognitive disabilities.

Yavuz and Hasan [5] presented a telephone and PIC based remote control system where pin-check algorithm has also been introduced where it was with cable network but not wireless communication. Neng has presented an architecture for home automation [6] where the system was based on a dedicated network. This system only shows how to solve home automation problems at software level and no hardware aspects were considered. Also to remote control of home appliances such as oven, air conditioner and computer by telephones which offer easy usage has been investigated by [7][8].

Communication takes place via a dedicated telephone line not via a Bluetooth technology. Other studies such as ones presented in [9] [10] has examples of web based automation. However, they are not too feasible to be carried out as a low cost solution [12].

Lately Al-Ali and AL-Rousan [13] introduced a low cost Java- Based Home Automation System, without highlighting the low level details of the type of peripherals that can be attached. N. Sriskanthan [14] explained the model for home automation using bluetooth via PC. But unfortunately the system lacks to support mobile technology. Muhammad Izhar Ramli [15] designed a prototype electrical device control system using Web. They also set the server with auto restart if the server condition is currently down. Pradeep G [16] proposed home automation system by using Bluetooth which saves lot of power and time using mechanism to save the preloaded list by not making it to setup connection all the time when required.

Smart home is not a new term for science society however; it is still far more away from people's vision and audition. As electronic technologies are converging, the field of home automation is expanding. Various smart systems have been proposed where the control is via Bluetooth, Internet, short message service (SMS) based, etc. Bluetooth capabilities are good and most of current laptop/notebook, tablets and cell phones have built-in adaptor that will indirectly reduce the cost of the system. However it limits the control to within the Bluetooth range of the environment while most other systems are not too feasible to be implemented as low cost solution.

3. SYSTEM OVERVIEW

Figure 1 shows the block diagram of the Smartphone based Office/Home Automation with Environment Monitoring 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.

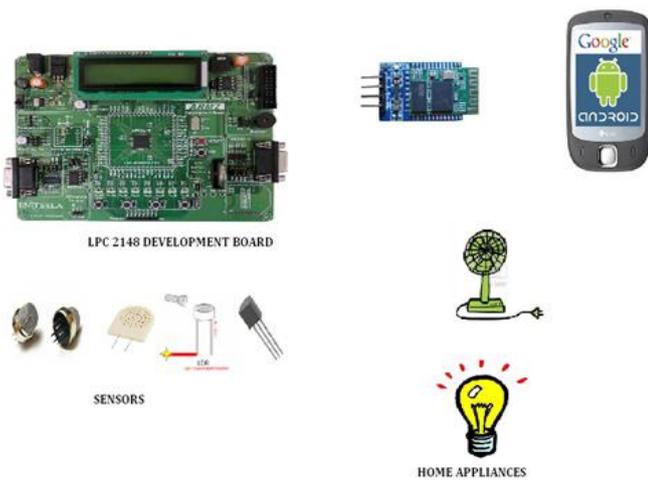


Fig 1: Functional Block Diagram of System

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. The temperature, LDR and Smoke values can be measured using the sensors that are connected to the main control board. The on/off commands status of office/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.

Thereby depending upon the requirement devices like bulb, fan, and chargers or electric cooker connected to socket can be turned on/off through command entered through Bluetooth. We can also regulate the devices like bulb or fan for that we are providing a socket which is connected to TRIAC circuit which controls the current flow so if we connect fan to the socket the speed of the fan will be altered or the intensity of light will be changed.

4. HARDWARE DESIGN

Figure 2 shows the hardware blocks present in main control board. In this project we are using ARM7 TDMI-S based NXP's (national semiconductors and Philips) LPC 2148 microcontroller in LQFP (Liquid Quad Flat package)

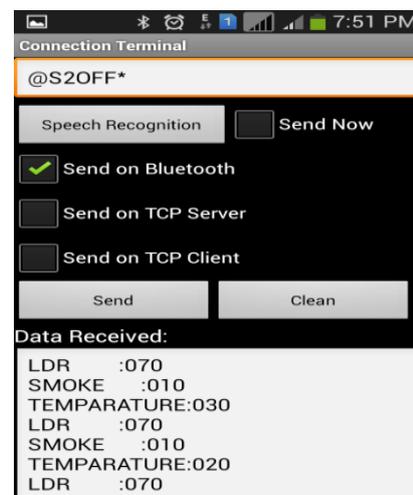
with 64 pins. One of the important feature is Power requirement of LPC2148 Microcontroller is 3.3VDC.

The power supply (3.3.v) for the LPC2148 is produced by using the power supply circuit which consists of mainly four components. 1. Transformer 2.Rectifier 3. Filter and 4.Regulator.The conversion AC to DC supply which includes four most basic steps, first voltage is step downed by using transformer, (2) rectifier for converting AC to dc (here we are not obtaining pure dc voltage), (3) so in the filter circuit, capacitor bypasses the AC to ground and it blocks dc voltage. (4) The obtained pure dc voltage is supplied to regulator for getting the required voltage which we need to give for the LPC2148.

In this project can check status of no. of products manufactured in different nodes. In order to integrate this interface with a home automation system, a development board with an embedded microcontroller was used. The interconnection between the android and the automation system was made using a Bluetooth connection that is currently available in most android models. A commercial Bluetooth module was used connected to the development board in order to execute the experiment.

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.

REMOTE SECTION



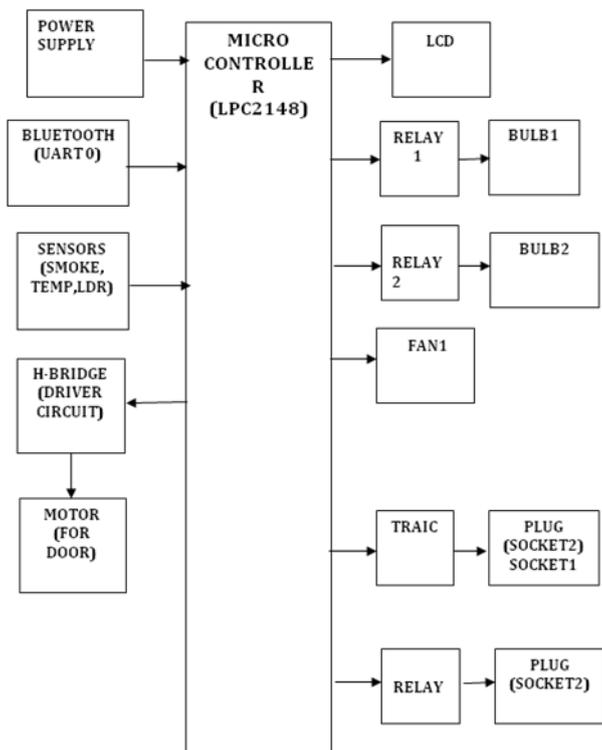


Fig 2: Main Control Board Hardware Block Diagram

The system designed is directly installed beside the electrical switches on the wall. 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 SENSORS

5.1 TEMPERATURE-THERMISTOR (103)



Fig 4: TEMP-THERMISTOR (103)

The word thermistor is an acronym for thermal resistor, i.e., a temperature sensitive resistor. It is used to detect very small changes in temperature. The variation in temperature is reflected through appreciable variation of the resistance of the device. Thermistors with both negative-temperature-coefficients (NTC) and positive

temperature coefficient (PTC) are available, but NTC thermistors are more common. The negative-temperature coefficient means that the resistance increases with the increase in temperature.

5.2 SMOKE: MQ2 Combustible Gas Sensor

Used in gas leakage detecting equipments for detecting of LPG, iso-butane, propane, LNG combustible gases. The sensor does not get trigger with the noise of alcohol, cooking fumes and cigarette smoke.



Fig 5: Smoke MQ2

5.3 LIGHT SENSOR:

Light dependent sensor (LDR) LDRs or Light Dependent Resistors are very useful especially in light/dark sensor circuits. Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically.



Fig 6: Light Sensor

6 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 7 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 8 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.

7 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. When need to increase the intensity of light then give command on Android Application then the intensity of the light will be change. Pictures 3 show the bulb intensity at higher level.

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

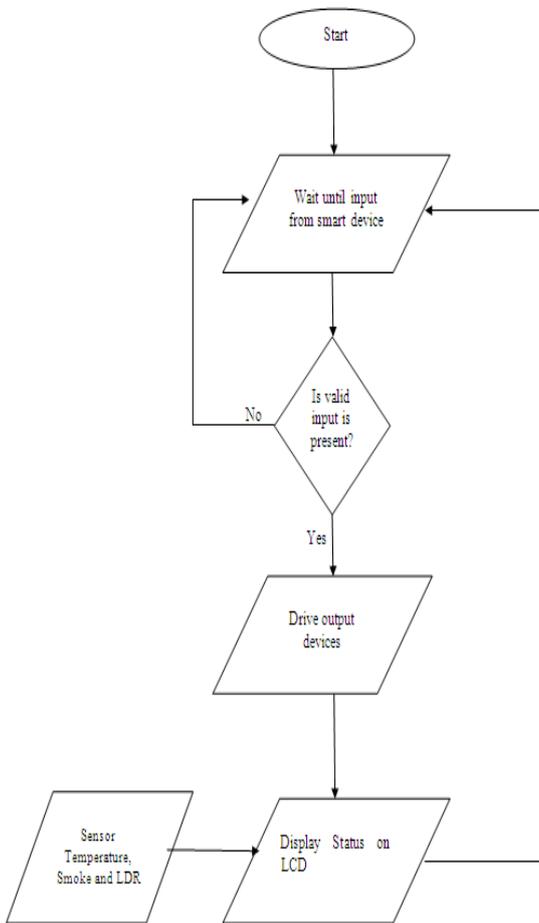


Fig 7: Control Flow in ARM7 LPC2148 Microcontroller



8 CONCLUSIONS

This user friendly prototype gives good results in monitoring and controlling the house/office parameters and devices. This could be very much useful for disabled people also such that sitting ideally at a place they can monitor and control the devices. This system is designed at low cost and is used to improve the standard of living in office/home. The system is design and prototyped to monitor and control the appliance status using an Android Bluetooth-enabled phone and Bluetooth modules.

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

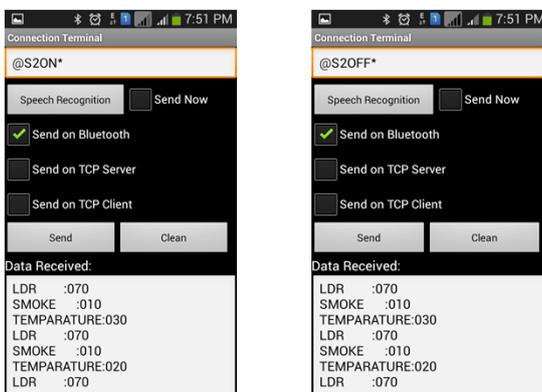


Fig 8: Android application testing

electrical switches. The Bluetooth module sends and receives commands from the Bluetooth-enabled phone and RFCOMM protocol will be used in communication among Bluetooth devices. Smart Living will gradually turn into a reality that consumers can control their home remotely and wirelessly.

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