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Implementation of Arduino Based House Automation using Bluetooth, Infrared

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ABSTRACT: house control and monitoring system using Bluetooth and infrared. In Bluetooth with android smart phone connectivity and for accessing and controlling devices and appliances remotely using Android based Smart phone applications. In IR-based house Appliances Control System is a control system using which the user can control different home appliances with a remote controller. The future system does not require a dedicated server PC with respect to similar systems and offers a novel communication protocol to monitor and control the house environment with more than just the switching functionality. House automation using Bluetooth is a residence incorporating a communications network that connects the electrical appliances and services allowing them to be remotely controlled, monitored or accessed. house automation System includes different approaches to achieve multiple objectives range from enhancing comfort in daily life to enabling a more independent life for elderly and handicapped people. The system design is based on Arduino Microcontroller using C/C++, language software, Bluetooth and infrared (IR) which is used in different monitoring and control processes. This project the combination hardware and software implementation of a multiple form control system for house automation, combines both hardware and software technologies. The system results show that it can be classified as comfortable, secure, private, economic and safe house automation in addition to its great flexibility and reliability.

KEYWORDS: Android Smartphone, house Automation, Bluetooth, house, Controlling, infrared, Arduino, IR Sensor, remote control etc.

I. INTRODUCTION

Now a day's Wireless technologies are becoming more popular around the world and the consumers appreciate this wireless lifestyle. Home automations one of the major applications of wireless technologies house automation involves the monitoring and control of activities such as lighting, heating, ventilation, air conditioning (HVAC), electrical appliances, sound systems security cameras, door locks, and alarms etc. house Automation can definitely make life at home much easier. For that the millions of people affected by disabilities and also the elderly people, it can make a life changing difference. Our project presents the overall design of home Automation System (CAS) with low cost both integration Bluetooth and infrared system. This system is designed to help and provide support in order to fulfil the needs of elderly and disabled people in home. Also, the main control system implements wireless Bluetooth and infrared technology to provide remote access from smart phone and remote control.

II. LITERATURE REVIEW

House automation was first introduced into the world market in the 1970s, but it failed to meet the expectations of people and was unsuccessful. There were various reasons associated with the failure of the home automation system. The system was neither user friendly nor cost efficient. Currently, the foremost point to be kept in mind when designing a house automation system is that it should be cost-efficient and easy to install. K. Y. Lee and J. W. Choi

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[1], in their research on the Housing Learning and Improvement Network in 2003, defined a Smart Home as a “unit where all the appliances of the house are connected together and controlled and monitored remotely”. T. Tamura et. al. [2], in their research, constructed the welfare techno houses in Japan in 2003. The motive behind the project was to monitor the health of the disabled and older people living in the home, thereby improving their quality of life. D. J. Cook et. al. [3] successfully conducted by the Home project at the University of Texas, Arlington. Here sensors to detect the state of the environment, and with the help of controllers, took the necessary action to maintain equilibrium. These sensors form an ad-hoc network to make the decisions. Kanmaet. al. [4] conducted a medical research to monitor people who require medical help and present a wireless solution at the University of McGill in Canada. The project made use of cell phones and inexpensive sensors. It worked by making use of wireless protocols such as Bluetooth, ZIGBEE, as well as GSM and analyzing data through an adaptive architecture. The research had an architecture that consisted of three main parts. The major benefit of this project is that it could be implemented at an inexpensive price in a short span of time. In the past few years, significant research has been conducted in the field of Smart Homes to make the technology better for handicapped and elderly people. N. Sriskanthan et al. [5] shows the implementation of a home automation system using Bluetooth. They use a host controller, which is implemented on a PC, is connected to a micro-controller-based sensor and device controllers. Home Automation Protocol (HAP) is proposed to make the communication between devices possible. The system allows more than one device controller to be connected to the host controller. H. Kanma et al. [6] also proposes a home automation system using Bluetooth that can be accessed remotely through GPRS. The paper discusses controlling and updating home devices along with fault detection and diagnostics remotely. The hardware required for establishing Bluetooth communication is readily available and the technology also provides the necessary bandwidth for the operation in a home. R. A. Ramlee et al. [7] presents the not only overall design of Home Automation System (HAS) but also this system is designed to assist and provide support in order to fulfil the needs of elderly and disabled in home. S. Benjamin Arul [8] provides the overall design of a wireless home automation system (WHAS) which has been built and implemented and useful for elderly and disabled people with an easy-to-use home automation system that can be fully operated based on speech commands. In this system, the automation centres on recognition of voice commands of user and uses low-power RF ZigBee wireless communication modules for the communication between the automation center and the system. Sharon Panth & Jivani Mahesh et al. [9] proposed a methodology to automate home by using android for mobile phone. Here author discusses the use of android mobile phone's inbuilt facility i.e. Bluetooth to automate home along with the use of an ATME89C51, 8-bit microcontroller. Pawan Sharma & Joshi Deepika et al. [10] has proposed a methodology about controlling home appliances through remote operated master switch via infrared technology. They have introduced a unique remote-control circuit to permit the automatic control of switches and switchboards from a remote location that does not require any internet network as well as mobile network or battery. It was a completely hardware-based system and does not require any software to control and monitor the system. Samiran Maiti & Pabitra Kumar Nandi et al. [11] proposed a solution of home appliance controlling by the use of IR remote control signal decoder. Author discusses about the use of NEC555 timer IC, decade counter, Triac along with IR sensor to automate home. It is also a hardware-based project.

Summary of Literature Review: In that existing literature review we got a home automation system designed by both Bluetooth or infrared that design to help elderly and handicapped people live a more independent life. If the project is made from only Bluetooth some peoples, they have no skills to use smart phone they cannot use the technology. And also, the peoples do not have possibilities to use the infrared or the remote control they also do not use this technology.

Hence for efficient usage both infrared and Bluetooth with low cost efficient system shown in fig.3.1.

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III. BLOCK DIAGRAM AND SYSTEM DESCRIPTION

Block Diagram s System Description:

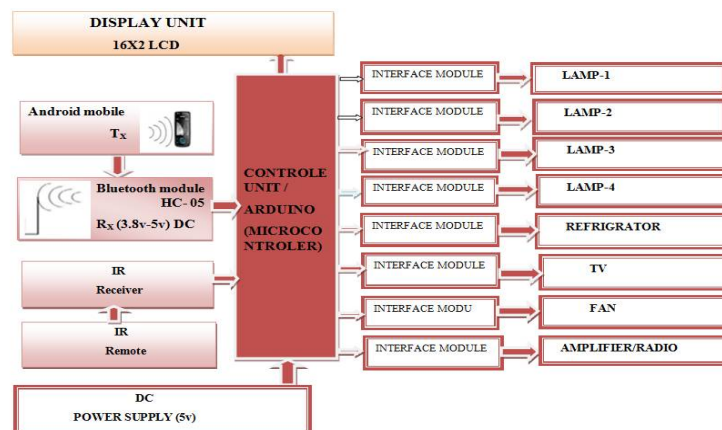


Fig 3.1: The block diagram of the system Arduino Based house Automation using Bluetooth and Infrared

The block diagram of the system is shown in Figure 3.1. It consists of Android device, HC-05 Bluetooth module, Arduino AT mega 2560, relay module, 16x2l cd display and house appliances. Android device uses Android (an Android application) to provide a user-friendly graphical user interface for the remote control of the home appliances, when the toggle buttons on the App are pressed; corresponding Bluetooth signals are sent from the Android device to the Bluetooth module which is connected to the Arduino. A Digital signal output Arduino controller the relay to open and closed the system according to the command. The PWM signal is used as a mode of communication between the home appliances and the output of the Arduino. it finds out which signal has been sent and Compares it to the predefined signals assigned for each appliance . A12v DC output power Supply of a 9v battery is used to power up the system.

First let's take a look at the circuit diagram. It uses a 5V Adapter as a separate power supply for the electro magnet connected to the JD Vcc and the Ground pin. The Arduino's 5V pin will be connected to the Vcc pin of the module and the pin number 7 to the In1 input pin for controlling the relay. Now for the HIGH Voltage part we need a power plug, a socket and a cable with two wires. One of the two wires will be cut and connected to the common and the normally open pin of the module output connector. So, with this configuration when it activate the relay, will get the high voltage circuit closes and working.

IV. SYSTEM DESIGN AND DEVELOPMENT

4.1 System Hardware development: the Bluetooth module & interfaced with the Arduino mega shown in fig 4.1a, and relay module and LCD separately in fig 4.1b. The signal is sent from the mobile phone android application using wireless system then, the data analysed by microcontroller. A Bluetooth module is two pins with the input pin connected to +5V, ground pin connected to ground. The Tx and Rx pins of the HC 05 Bluetooth are connected with the Arduino Mega Rx and Tx pins respectively. In infrared case R_x sensor consists of three pins with the input pin connected to +5V, ground pin connected to ground and signal pin connected to Arduino to control the system using remote control (Tx).The following figures show the hardware interfacing and connection set-up.

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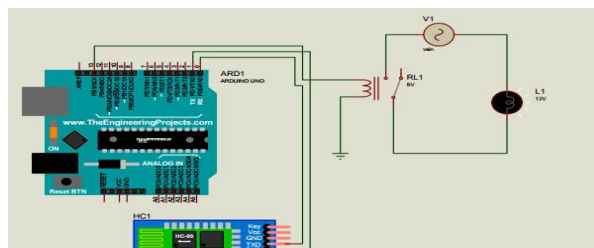


Fig 4.1.a Bluetooth module interfaced with Arduino

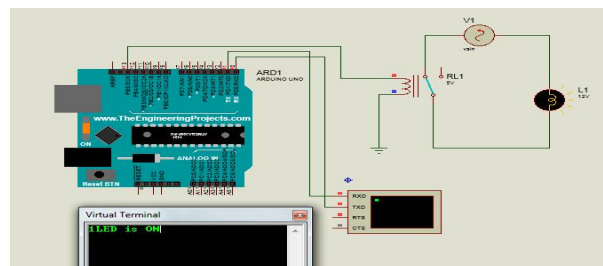


Fig4.1.b Bluetooth module interfaced with virtual display

In case of infrared (IR sensor), the remote control interface to the Adriano. The relay control by Adriano controls the relay module ON/OFF appliances also shown in fig 4.2.

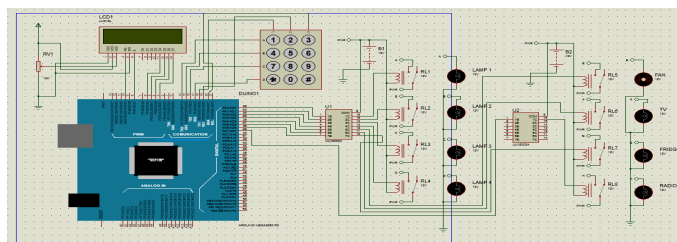


Fig 4.2 Interfacing IR sensor with Arduino

According to the above circuit diagram module pins are connected to Arduino Mega as per the under given table 4.2.

Table 4.2: Interfacing modules with microcontroller

S.no	Modules	Arduino Mega
1	Bluetooth	1, 0
2	Relay(Fan)	22
3	Relay(TV)	23
4	Relay(Fridge)	24
5	Relay(Radio)	25
6	Relay(Lamp 1)	26
7	Relay(Lamp 2)	27
8	Relay(Lamp 3)	28
9	Relay(Lamp 4)	29

Once the connections completes of circuit shown in Fig 4.2, then on the power supply, then the control commands are enter by using the mobile application at the transmitter section ends. The RF signal via the Bluetooth module connected to the receiver section and the received signal from the android mobile phone to the Arduino. The Arduino transmits a suitable message corresponding to the button pressed through the transmitter module in the form of radio frequencies. As a result, the relay connected to the particular load. The load is activated and turned ON or OFF. In this way, house automation system can be implemented by wireless communication.

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4.2 Development of the entire system

By using MIT app inventor 2 developer we develop our android application, this app is connected via HC-05 Bluetooth module which is already connected to an Arduino Mega. A digital signal coming from Arduino, it will be act as a relay controller. The relay will be used to control the different home appliances. Whole system will be controlled via a Bluetooth module as well as an Android App and for a simple interface to control. Wires should be connected to a power plug on one end to an appliance such as light, fan, Tv etc.

In this system, a 220V bulb, fan, Tv, fridge etc. are controlled using 8relay channel module. The programming code is uploaded to the Arduino board. When uploading the code to Arduino, the R_X and T_X pins of the Bluetooth module are removed to disable the Bluetooth. Since USB and Bluetooth use same T_X/R_X , it will throw an error when loading code if the Bluetooth is on. After making all the connections, LED on the module keeps blinking. This just ensures the device is powered properly. Developed App is installed on an Android mobile phone. After installation, Bluetooth devices the menu Android mobile phone is opened, HC-05 Bluetooth module is found and the required numbers pass-code is inserted and then the android phone with the Bluetooth module is paired. The Application is opened and "connect me to a Bluetooth device" is clicked. If the Bluetooth correctly paired, the LED blinking on Bluetooth module will stop. Now, the pin number on the App is clicked to control signal that connected to that pin which in turn control the corresponding appliance. When the buttons on the Application are pressed, related Bluetooth signals are sent from the android mobile phone to the Bluetooth module which is connected to the Arduino.

4.2.1 Android Application

In this system we have develop Android mobile application software to control all the home appliances. From Android phone we select any home appliance from the alternatives that appear in the App then we select ON /OFF. It allows establishing point-to-point connection with Bluetooth support devices. This technology is known by Android's support for the Bluetooth network stack which permits to exchange data wirelessly. Android Application shows below a phone application which is used to communicate and interface with the Arduino board. The cell phone application is developed using MIT App Inventor.



The major advantage of using this open-source platform instead of java is that it is extremely user friendly and easy to program. the software needs to be easy to understand and modify. Fig.4.4 shows the list of paired Bluetooth devices which is displayed in the application enabling a user to choose a Bluetooth device to connect to. The Bluetooth module needs to be paired manually before using the application. A person can choose the address of the Bluetooth

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module in order to connect with it and then communicate with the Arduino board. MIT App Inventor is an intuitive, visual programming environment that allows everyone to build fully functional apps for smart phones and tablets.

4.3. Load controlling simulation

In this simulation the main and first priority unit is load control which has been interfaced with microcontroller (Arduino). Load can be turned ON /OFF by sending command from mobile phone application using Bluetooth and infrared. In our simulation we have controlled eighth loads via microcontroller (Arduino). We can also receive update data of which load is ON /OFF. In this simulation to create a circuit diagram by using Proteus 8 professional (version 8.6) software with an Arduino, Bluetooth module and IR sensor that can control the entire system of home appliance. In this simulation we use command mode (cmd) for control Bluetooth module virtual terminal & in case infrared we use keypad. When press virtual terminal it sends command signal to switch ON/ OFF according to the assigned home appliances. Also at the same manner in infrared we press keypad it sends command signal to switch ON/ OFF according to the assigned home appliances. The following table shows the simulation command to control home appliance.



Fig.4.5 Programming of the Android Application

Table 4.4: command (cmd) and keypad command for load control

Device/load	Command A	Response	Command B	Response
Fan	Press 1	on	Press 1 again	off
TV	Press 2	on	Press 2 again	off
Refrigerator	Press 3	on	Press 3 again	off
Radio/Amplifier	Press 4	on	Press 4 again	off
Lamp 1	Press 5	on	Press 5 again	off
Lamp 2	Press 6	on	Press 6 again	off
Lamp 3	Press 7	on	Press 7 again	off
Lamp 4	Press 8	on	Press 8 again	off
All lamp	Press 9	on	Press 9 again	off
All power in case of (Bluetooth)	Press 0	on	Press 0 again	off
All power in case of (infrared)	Press *	on	Press * again	off

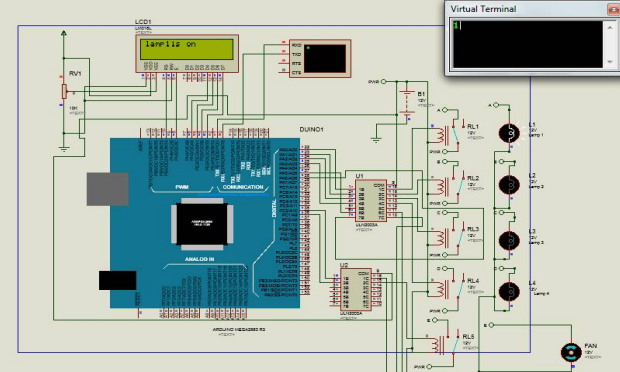
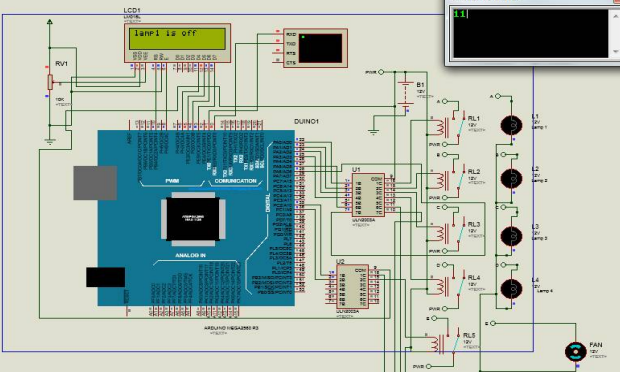
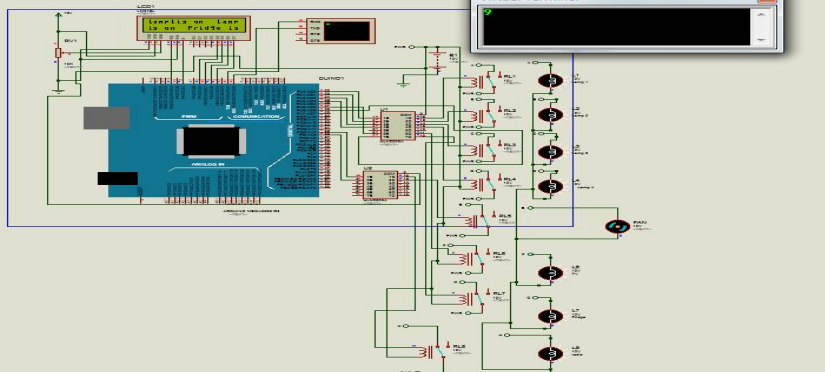
The following simulation shows the results of the out puts when we ON/OFF the lamps and the switches of appliances using Bluetooth.(only 3 cases were explained rest is similar)

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<p>case1. The simulation below shows when press one the lamp 1 is ON.</p>	<p>Case 2. The simulation below shows when press one again the lamp 1 is OFF.</p>
	
<p>Fig. 4.6: When lamp1 is ON Command shown in virtual terminal</p>	<p>Fig. 4.7: When lamp1 is OFF Command shown in virtual terminal</p>
<p>CASE 3: when all loads on</p>	
	
<p>Fig: 4.8 when all loads on</p>	

V. RESULTS

5.1 Results and Discussion

The whole systems are mainly divided into two operational modes. One is Bluetooth controlling mode another one is infrared, this system using android application and remote control. Every mode has been already described in brief in the previous chapters. In this chapter shown the simulation circuit diagram and the prototype of the system. In addition to that, we have also shown practically implemented circuit diagram of each unit. Finally, we have shown the performance analysis of the entire system and discussed results. The Bluetooth-based house automation system using an Android phone was successfully implemented. This prototype consists of a controller circuits, power sockets connecting the home appliances to the controller and an Android application (Bluetooth Home) providing the user interface for remotely controlling the home appliances.

5.2. Prototype Testing

After designing the software and the hardware architecture part, we implemented the working circuit diagram on the breadboard for testing purpose. Here input voltage generated by power supply. We can see the microcontroller

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output state changes for load . In addition, here we easily operated the android application from our mobile phone and control power of load.

5.2.1 Load Controlling using Bluetooth: In this project, the proposed system controls the electrical loads based on the data transmitted by the Android device. An Android application should be installed in user's mobile or tablet to control the loads. The Bluetooth module is interfaced to Microcontroller. This Bluetooth Module receives the orders from the Android application using wireless communication (Bluetooth Technology). The program which is written to the Arduino Mega microcontroller communicates with Bluetooth module serially to receive the commands. Microcontroller switches the relay automatically based on the commands received from the Bluetooth.

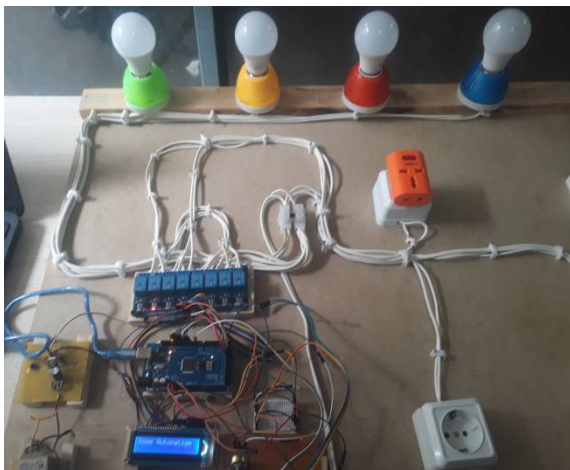


Fig.5.1 Image showing Bluetooth used for controlling house Automation System

here Arduino is used for controlling complete the process. We send some commands to controlling the system by using IR (MP3) remote to controlling AC home appliances. After receiving signal from IR remote, Arduino sends related signal to the relays which are responsible for switching ON or OFF of the home appliances.

When user presses any button of IR remote then it sends a code as a obtain ready encoded pulses using 38 KHz modulating frequency and the data is read by the IR receiver in the controller of the Arduino. Arduino decodes the received guide of pulses into a hex value and compares the decoded value with the predefined hex value of the pressed button. If the signal matches then Arduino executes the corresponding operation of switching ON or OFF the home appliances. In this project, we have used eight different appliances that is a four lamp, fan, TV, refrigerator and amplifier.

VI. CONCLUSION AND RECOMMENDATION

6.1 Conclusion

'House automation' makes the system more flexible and Provides attractive user interface compared to other home automation systems. Here target is to control home appliances using the wireless technology to connect system parts, simplify home automation system. Consequently, it can conclude that the required goals and objectives of house automation system have been achieved. It is based on Android application and Arduino platform both of which are FOSS (Free Open Source Software). So the overall implementation cost is very cheap and it is affordable price by a common person. Looking at the current situation, chosen Android platform so that most of the people can get benefit. The implementation consists of Android phone with house automation application, Arduino Mega. User can work together with the Android phone and send control signal to the Arduino, which in turn will control other embedded devices/sensors Here discussed a simple prototype, but in future it can be extended too many other areas.

6.2 Recommendation

Here done home automation system using Bluetooth and remote-control connection to control it from mobile phone and infrared remote control mechanism. If anyone is interested to make this project, they can add voice control (speech recognition) system. This project range maximum coverage is 10 meters distance. For high range of connection in future improve by WIFI or GPS system and also in future it can be expanded to many other areas. The application can be developed for stage other than android. SMS facility can be added for remote communication, Improvements can be made to improve this project. Some of the recommendation is:

Include Voice commands can be implemented so that the persons without hands can also operate this system. Sophisticated electrical appliances can be controlled. For example: Microwaves, Air conditioning temperature, etc.

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BIOGRAPHY



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