

Design and Development of Low Cost IR based Home Automation System

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Abstract

Home Automation is an emerging concept in which by using a single device, control of home like switching on and off appliances, monitoring temperature, fire alarms, garage doors etc. is performed. In this research, a remote control is used to control several appliances, thus achieving a simple low cost home automation system. IR remote enables remote control of apparatus like TV, Air Conditioning, Washing machine, light, fan, etc. The main feature of a remote control is that it is specific to a device. For example, an IR remote control unit can only be used for that corresponding TV, However in this project, a single IR remote is used to control several devices at home. This is achieved by integrating all the devices to be controlled at home with a Arduino and IR based remote. The simulations and the results indicates promising results to automate the control of home using simple IR based remote with low cost.

Key Words: Home Automation, Infrared (IR), Arduino

1. INTRODUCTION

Home automation is a technology of controlling several devices of a home by wireless techniques. The concept of home automation is also called as “domotics”. It is the process of controlling the domestic electronics in the house using Internet of Things (IoT). The home automation can be carried out using a controller. Most of the times the controller is integrated with the grid so as to intelligent decisions based on the available input power. The concept of smart home using sophisticated controllers is being discussed widely off late [1]. The apparatus such as fan, lights, TV, AC’s at smart homes can be controlled wirelessly using several methods. The implementation of the concept of smart home and connected home is difficult in the developing countries like India as the cost involved is very high.

Even though home automation was introduced in 1970, it had failed to capture the market. This is due to the economy involved in the implementation of the said technology. The controllers and the electronic components were much costlier compared to these days. The second reason for the failure was inadequate knowledge of the customer in using of the installed device. Hence there was a need to switch to the low cost electronics for designing a home automation system.

There are many low cost technology for wireless transfer of the data from the user to the controller. Bluetooth and infrared are used in modern era to transfer the wireless data. Bluetooth technology is used when home automation is being carried using mobile as a controller. The use of InfraRed technology eliminates the usage of mobile and hence the cost of the overall system will also be considerably reduced.

The alternative low cost solution for a smart home is using an IR based remote for the control of the apparatus. The infrared remote is used in several applications to control the individual devices. Hence the approach for the project was to develop a prototype for controlling all the apparatus for the home with a single IR remote thus reducing the cost and increasing the simplicity [2].

2. BLOCK DIAGRAM OF THE PROPOSED SYSTEM

Figure 1 shows the proposed home automation system consists of a remote based on IR technology. The Arduino microcontroller is used as a central processing unit of the system. Arduino is an open source platform which uses its own software technology similar to the ‘C’ language to program the device. It is simple enough compared to other microcontroller which necessitates the study of internal architecture before starting with the programming step. The Arduino controller is used in this research as it is cheap and cost effective.

The programming of the controller can be done using the software supplied by the controller manufacturer in any PC based on Windows or Linux. The software name is also Arduino which can be connected to the hardware board to communicate and program the device. The device is connected to the PC using the open source USB technology. The advantage with the Arduino programming is the programmer doesn’t need any high level language learnt. The knowledge of basic ‘C’ language to design the Arduino ‘sketches’ is sufficient.

A remote control is primarily a convenience feature for the user, and can allow operation of devices that are out of convenient reach for direct operation of controls. Early television remote controls (1956–1977) used ultrasonic tones. Present-day remote controls are commonly consumer infrared devices which send digitally-coded pulses of infrared radiation to control functions such as power, volume, channels, playback, track change, heat, fan speed, or other features varying from device to device. An IR remote sensor is used for communication from the IR based remote to the controller. The IR based remote is used to control the lights, fans and heaters in the smart home [3].

The corresponding relays are first turned on/off when the user presses the designated button in the remote. The devices connected to the relays will be correspondingly turned on or off. Relays uses coils which are in turn energized by the output signals from the controller.

The feedback for the users is displayed on the Liquid Crystal Display (LCD) which informs the user the status , numbers of lights and fans which are switched on or off at a particular instant of time [3].

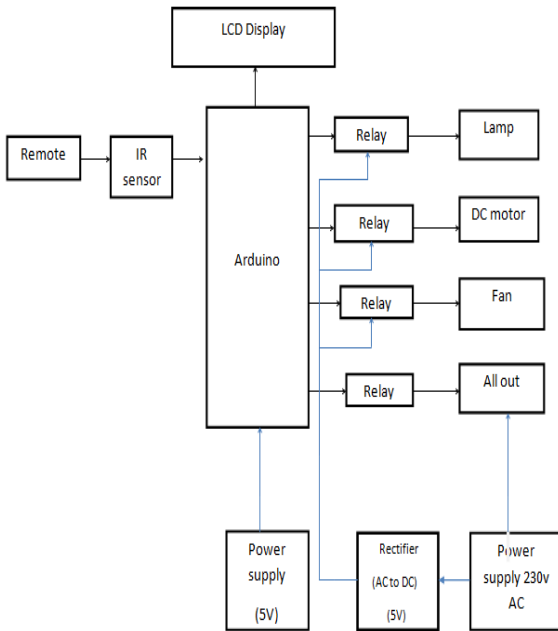


Fig. 1 Block diagram of the proposed system

3. FLOW CHART

The flowchart in Fig. 2 depicts the programming for the application process. The controller waits for the input from the IR sensor and remote. The remote sends the corresponding train of pulses after the user presses the desired button of the remote.

The controller receives the code transmitted from the remote and decodes it in the controller. The received information is decoded form in the first step of the simulation. [4].

Once the information is decoded for switching ON or OFF a particular device, the corresponding relay is triggered by the microcontroller and finally the corresponding device is switched ON and OFF using a simple IR remote.

Based on the information provided by the user to toggle the device ON or OFF by a single input from IR remote. As same button is used to toggle the device ON or OFF, the process first checks the present state of the device. Processing of information is done and necessary signal is generated to control the relay associated with the device.

The execution state of the device depends on the past state of the device. That is if the device is ON, it will be turned OFF and vice versa. The signal sent to relay by the controller plays a major role in deciding the future state of the device. This is followed across all the components and devices associated in the home automation process.

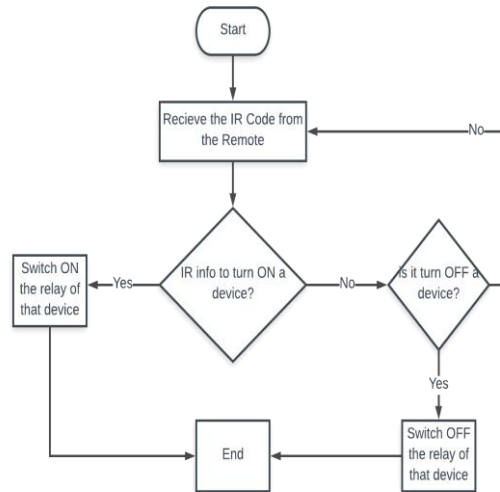


Fig. 2 Flowchart of the program

4. PROPOSED CIRCUIT SIMULATION

The designed circuit is simulated in the Proteus as shown in Fig. 3. The appropriate microcontroller is selected. For simulation purpose a number pad is used as a replacement for the IR remote.

As the user presses a number the information is decoded and the corresponding lights are turned on or off.

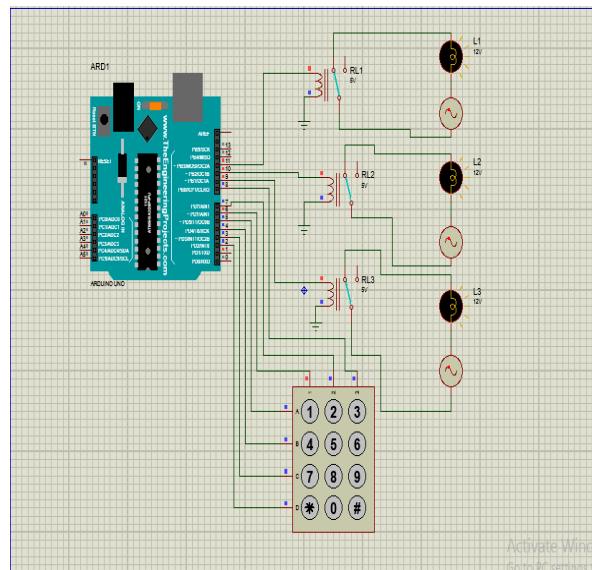


Fig. 3 Simulation result using Proteus

5. HARDWARE SET UP

Circuit Design

This section deals with circuit design which is implemented in the device to carry out its operation of its functionality as in Fig. 4. Circuit connection (Fig. 5) involves all hardware part and its connection between other components.

Components of the System Developed

- Arduino Uno- The main control unit of the system
- Relay- used to switch on or off the components of the house
- Cables- used as wiring and connecting the various components in the house
- LCD display- A 16 x 2 LCD is used to display the status of the components in the house
- IR sensor – remote is used to transmit the data and receiver is connected to the controller

Procedure for hardware design

- Select suitable required components
- Made the connection as shown in the circuit diagram shown in Fig 4
- Write the program by using Arduino software
- Dump the program for Arduino board
- Give the power supply for relay 12V and Arduino board 5V
- Check output by using remote



Fig. 4 Hardware set up

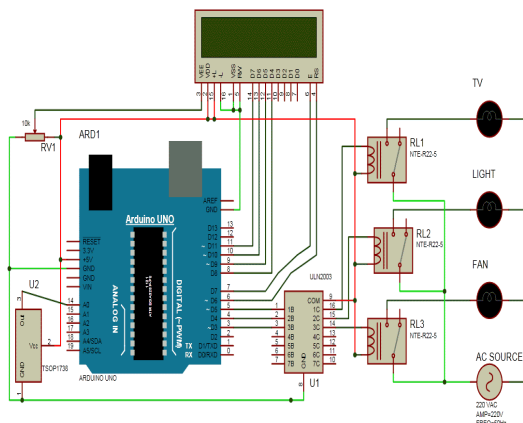


Fig. 5 Circuit diagram

Working Explanation:

When user presses any button of IR remote then it sends a code as a train 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 train 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 light, fan or other components in the house and also the respective result is displayed by using appropriate commands. Here in this research, we have used 4 different appliances that is a DC fan, DC bulb, DC motor and AC all out coil are used as a connected load.

6. RESULT AND CONCLUSION

The circuit is mounted on a wood board, interconnected to a relay. DC supply is given to Arduino board through adapter that provides a voltage of 5V for the kit as shown in Fig. 6.

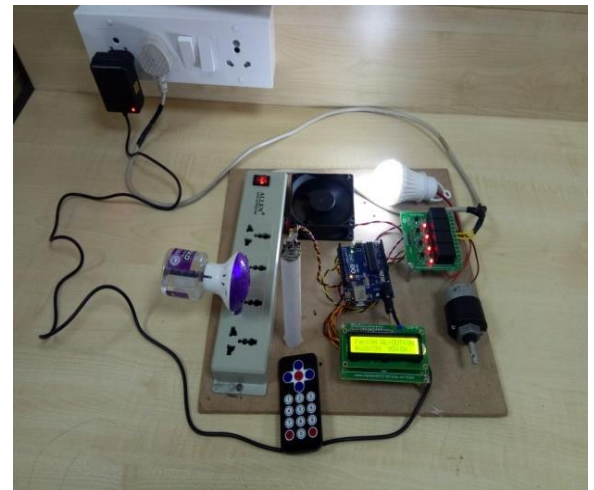


Fig. 6 Working hardware set up

The Fig. 6 shows the connection between the relays, home appliances, Arduino board, IR sensor and adapter. An adapter will provide the power supply to Arduino board to glow the DC bulb, Fan, Motor, All out coil and all other home appliances when the remote keys are pressed.

A simple low cost home automation system is designed and implemented which improves for the standard living in smart home. The system is also user friendly to disabled and elder people. The same is compared with the other systems developed using different technologies. It be seen that the cost of the Arduino based system costs 1.8 times cheaper than that of other home automation systems as shown in Fig. 7. The cost for the components to develop the low cost home automation system using IR remote control. The components are listed with the specifications and cost in Table 1.

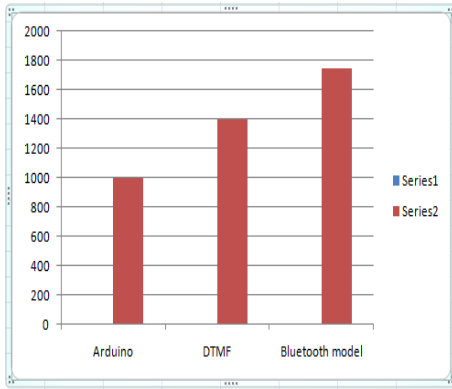


Fig. 7 Cost comparison of home automation systems using different components

Table 1. Cost of the components used

Electronic components	Rating	Quantity	Cost (in ₹)
LCD(16×2)	3.3V	1	100.00
IR Sensor	30 ft.	1	30.00
Arduino UNO	5volt	1	330.00
Relay	12 volt	1	150.00
Cables	--	--	20.00
Adapter	12 volt	1	170.00
Lamp	12 volt	1	80.00
DC Motor	12 volt	1	20.00
Fan	12 volt	1	45.00
All out	230 volt	1	80.00
Plug board	230 volt	1	80.00
Total			1105.00

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