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Home Automation Using IR (Infrared) Sensor & Arduino-Nano Single Board Microcontroller

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ABSTRACT: With the new inventions and advancements in technology in the field of electronics, the desire to live a better life is increasing day-by-day. The new technologies have emerged in almost every sector/field like medical field, industries, telecommunication, and aeronautics and now it has also entered in domestics' which is also known as home automation. Apart from their busy and hectic schedule, human beings want their day to day tasks to be done on a click of button. The new technologies and unique methodologies have tried to fulfil this wish of human beings to some extent by means of smart home or home automation. The main object of home automation is to provide a wireless communication link of the home appliances to the remote user and provide convenience and ease of work . There are several ways to automate home. This paper describes the design and implementation of home appliance controlling using IR sensors and arduino-nano single board microcontroller. Here, arduino-nano serves as the main controlling and monitoring unit. It accepts and decodes the signal received from TSOP1838 IR sensor and then the switching applications (turn on/off) is perform via Triac which is connected with optocoupler.

KEYWORDS: Infrared, Sensor, Automation, Triac, Optocoupler.

I.INTRODUCTION

The objective of proposed research work is to implement such a system that can reduce efforts, energy losses, provides a comfortable life, enhance living standards and can help the elderly, handicapped, disables as well as the normal beings to control the home appliances remotely.

A home automation systemmay be defined as the technological solution that enables automating the bulk of electronic, electrical& technology- based tasks within a home. It uses a combination of hardware and software technologies that enable control and management over appliances and devices within a home. A home with an automation system is also known as a smart home.Since, man's life and work are increasingly tight day- by- day with the rapid growth in communication and information technology. So there is an urgent need of such a system that can ease the day today task and allows access to the home appliances to the remote user.

In the proposed research work, we are propagating the use of wireless communication technology by using IR sensor and single microcontroller board to allow control over the electrical home appliances to the remote user. The proposed system is based on embedded system i.e. it is a combination of both hardware and software. The system consists of two units: one is the Transmitter section and other is the Receiver section. Transmitter section consists of a NEC remote and the Receiver section is consists of a PCB board over which- an IR Receiver module, dc power supply, arduino-nano single board microcontroller(controlling unit) ,zero crossing detector, ac source and Triac+ optocoupler followed by ac loads is mounted. The user will send the commands with the help of remote control and those signals will be sensed by the receiver IR module which further sends it to the arduino board. Arduino decodes the signals and performs the switch ON/OFF of home appliance via Triac.

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II. RELATED WORK / LITERATURE REVIEW

A smart home covers a variety of theoretical and practical approaches that deals with living today and in the future. There are several ways or methodologies to automate home through wireless communication technology. Some of them are as follows:-

(a) SharonPanth&Jivani Mahesh[1],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 ATMEL 89C51, 8 bit microcontroller.

(b) PawanSharma &JoshiDeepika[2], has proposed a methodology about controlling home appliances through remote operated master switch via infrared technology. They has 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.

(c) Samiran Maiti & Pabitra Kumar Nandi [3],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.

(d) Monika Rana & Ramandeep Singh [5], this paper shows an another way to automate home through a PC-Internet-Uno microcontroller based home automation system. The proposed system has two operational modes. The first one is manually-automated mode and the second one is self automated mode. The system consists of two main hardware components: the PC home sever and the arduino-uno microcontroller board.

(e) Naresh P Jawarkar & Vasif Ahmed [6], has demonstrated that home appliance controlling can also be done by microcontroller based remote monitoring using mobile through spoken commands.

(f) Satish Palaniappan & Naveen Hariharan[7], has shown the ways to provide remote accessing of home appliances to the user by using GSM technology and Zigbee technology.

III. PROPOSED TECHNIQUE TO AUTOMATE HOME

After considering all the above techniques, we have designed a system that aims to control the electrical appliances of home using IR sensor and arduino-nano single board microcontroller. The proposed system has no limitation of network, coverage and any GSM network. It also focuses on the elderly people, disables, normal beings and those people who face difficulties in speaking. It is affordable by everyone and easy to install.

METHODOLOGY

In the proposed scheme, IR based wireless communication technology is implemented along with arduino- nano single board microcontroller. Here, the IR sensor is in-built in remote which send the coded infrared signal (as chosen by the user) to the IR module at the receiving section. The IR Receiver module isconnected to the controlling unit i.e. arduino-nano. The IR Receiver module passes the RC5coded data to the arduino nano board. The arduino board then compares the received RC5code with the codes stored in it and then decode it. On the basis of decoded data/signal it produces the relevant outputs i.e. switch ON/OFF of the desired appliances via BT136 Triac.

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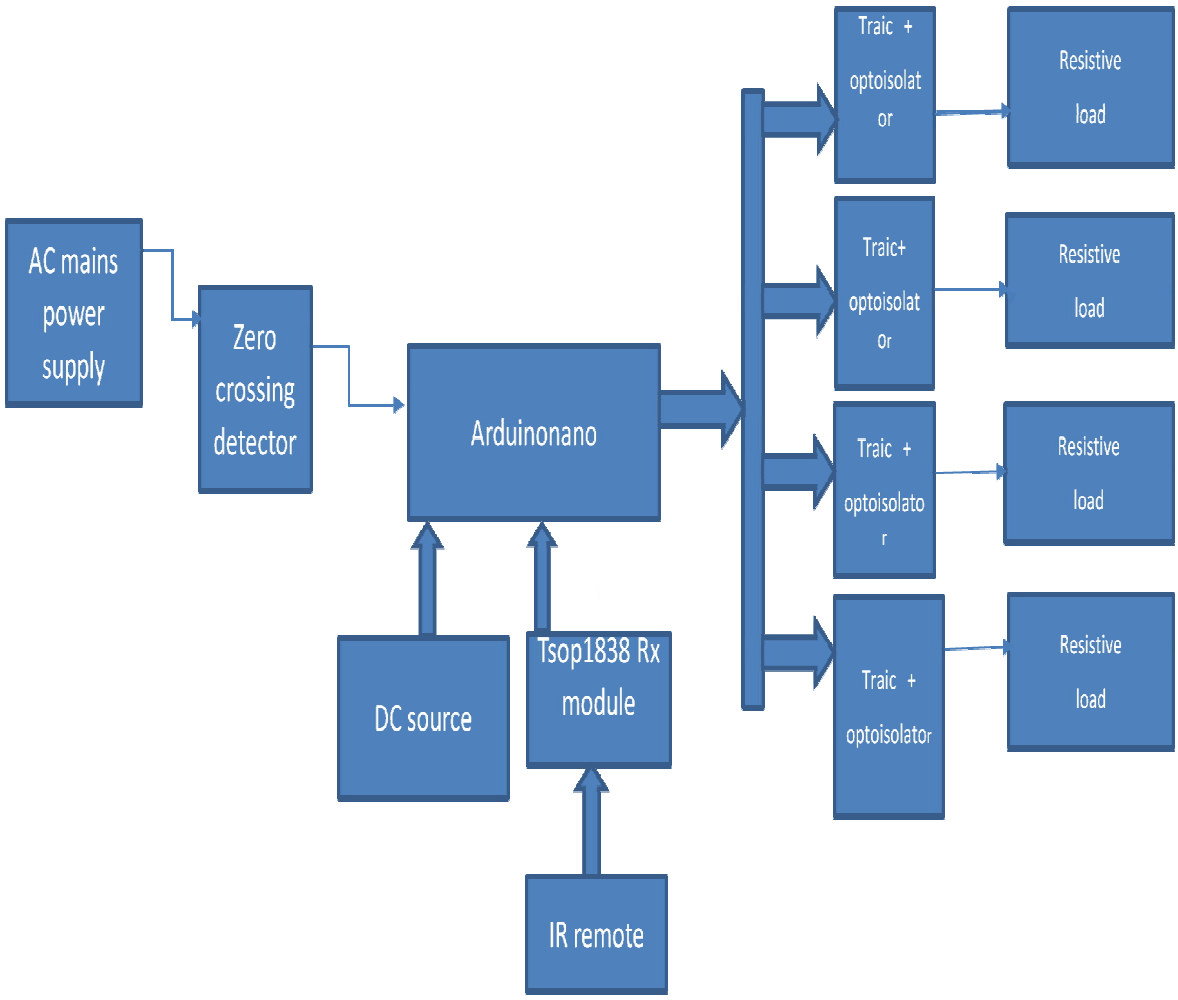

Figure1: Block diagram of home appliance control system using IR sensor and arduino-nano board.

IV. WORKING OF THE CIRCUIT

The designed circuit has four units as- a dc power source, controlling unit (arduino-nano), Receiver IR module and switching section which is further connected to home loads. The arduino- nano is the heart and brain of this system. It is used to control and monitor the whole system. Arduino- nano is a popular open-source single board microcontroller. The arduino board has an 8 bit, 32 pin ATmega328 processor IC. The flash memory of ATmega328 is 32KB of which 2KB is utilized by bootloader. The SRAM of nano is 2KB along with 1KB of EEPROM. This board has 14 digital I/O ports of which 6 of them provide PWM outputs. The operating voltage of nano board is 5V. It has 2 ground pins, 2 reset pins and 1 supply voltage pin. Arduino is a pre-burned microcontroller using arduino IDE software, inwhich codes are designed and written is usually dumped into it via computer.

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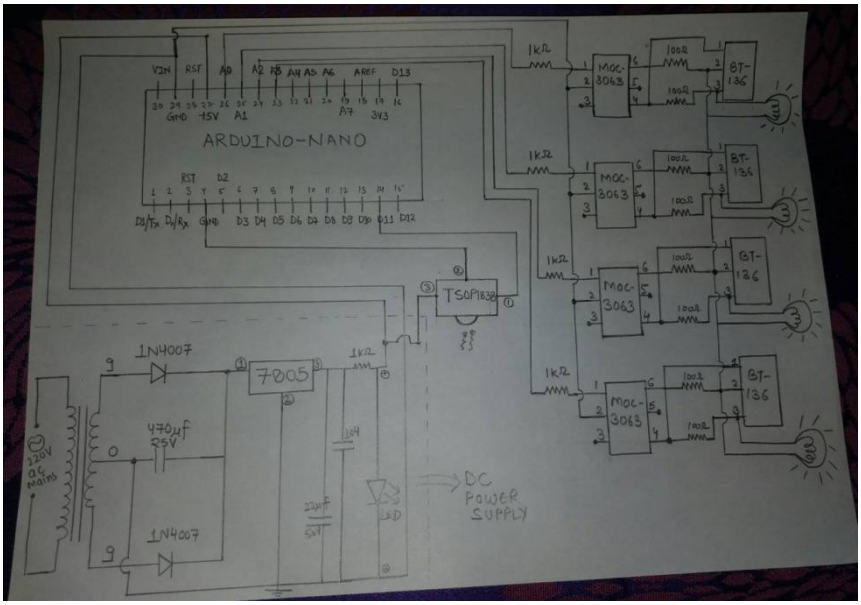

Figure 2: Circuit diagram of receiver section of home automation system.

Here, we have used a 9-0-9V centre-tap step down transformer. This transformer is configured in form of a full wave centre-tap rectifier circuit along with two 1N4007 diodes and one 470microfarad capacitor at the secondary winding of the transformer. As arduino requires 5V to operate. So, we have used a voltage regulator IC7805 to provide 5V regulated output to power up the arduino-nano board. To make arduino functional, it is initially dumped with IR Receiver library. The source code, which is important to run the system, is written in arduino IDE software in computer and then transferred to arduino-nano board via USB cable. The IR sensor TSOP1838 that we have used here is of 38 KHz frequency and its range is 4 to 5 metres. The angle of perception of IR is 135- 140 degrees. The 3 pin TSOP1838 IR sensor is connected as- its first pin is connected to digital port 11 i.e. D_{11} of arduino, it is the point where the IR module will send the received signal to arduino board. The second pin is connected to ground terminal of ATmega328 IC (mounted on nano board) and at last, third pin is given +5V supply through arduino. The switching part is implemented via BT136 Triac, which is a power electronic device with three terminals. It can be used both as a bidirectional switch and for speed regulation. Triac is coupled with an MOC3063 optocoupler IC. MOC3063 is a 6 pin optocoupler IC with a zero-crossing circuit inside. The first pin of all four coupler ICs is connected to analog output pins $A_{O,}$ $A_{1,}$ A_2 andA_3 of arduino nano board respectively. The 2nd pin of all four MOC3063 is connected to ground terminal, 3 and 5 pin are not connected, 6 and 4 pin are connected to BT136 Triac's MT2and gate terminal through 100 ohm resistor. The home loads are connected to BT136 Triac. When the user press button on the NEC remote control, a coded infrared signal is transmitted. That transmitted signal is received by TSOP1838 IR Receiver sensor which is tuned to 38 KHz frequency. The TSOP1838 will send the received signal to the arduino-nano board via D_{11} port. The arduino now receives the coded signal and start comparing it with the codes already stored. After comparison, it decodes the received signal and then sends the signal to the coupler IC's through $A_{O,}$ $A_{1,}$ A_2 and A_3 ports. In an optocoupler IC, an LED is connected between pin 1 and 2 and a bilateral Triac driver is connected between pin 6 and 4 with a zero-crossing circuit. When the MOC3063 IC receives logic 1 from arduino board, the current starts flowing through LED from pin 1 and 2. The LED light falls on SCR causing 6 and 4 to close only at the zero cross of the supply voltage. And hence, connected load starts running.

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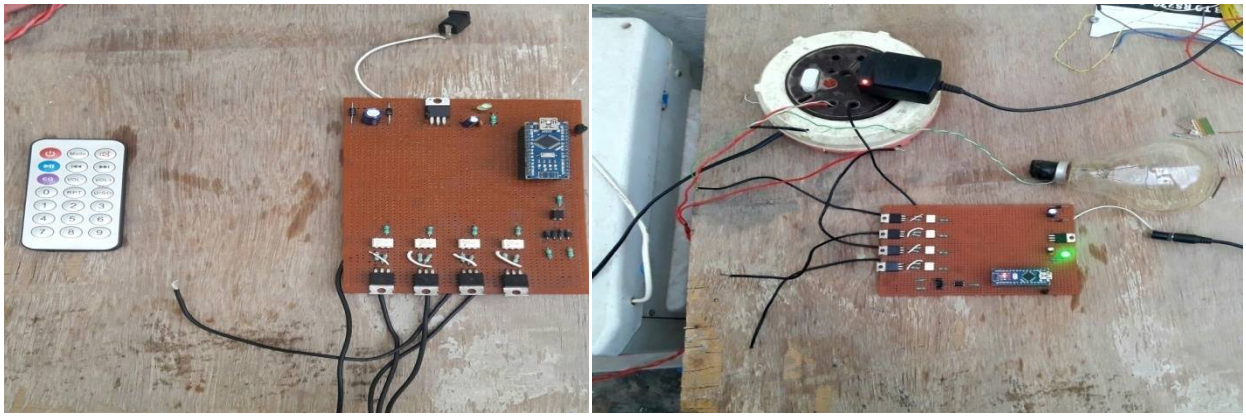
V. RESULT AND DISCUSSION

We haveimplemented the circuit successfully.The loads are connected though Traic to the circuit and the implemented model is functioning well.



(a) **(b)**

Figure 3: Designed hardware image (a) with no connected loads (b) with loads in off state

The given figure 3(a) is the image of the implemented hardware in off state with no connected loads. While the figure3 (b) shows the connection of load to the implemented circuit.Here we have used a fun and a bulb as load.The circuit in figure 3(b) is still in the off state with connected loads.

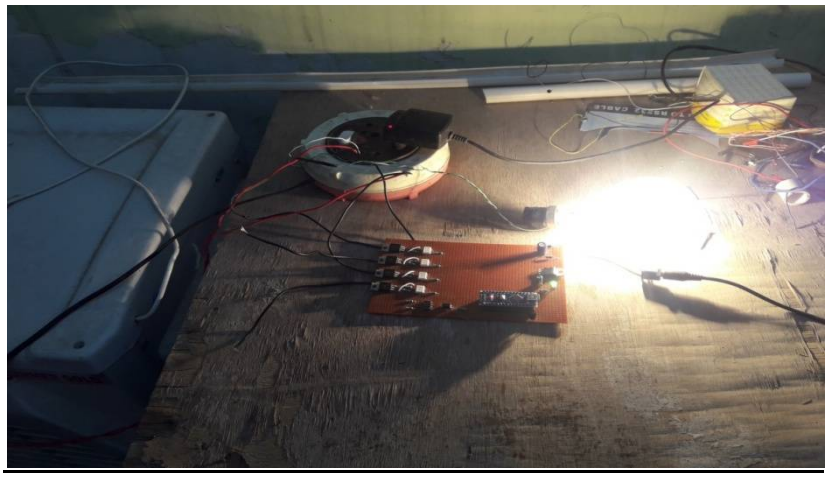


Figure 4: Designed hardware image with connected loads in on state

The figure 4 is the working model of the propsed research work.The load is connected with circuit and is in the ON state. The TSOP1838 is sensing the signal transmitted from NEC Remote and thus sending the signal's for further process.

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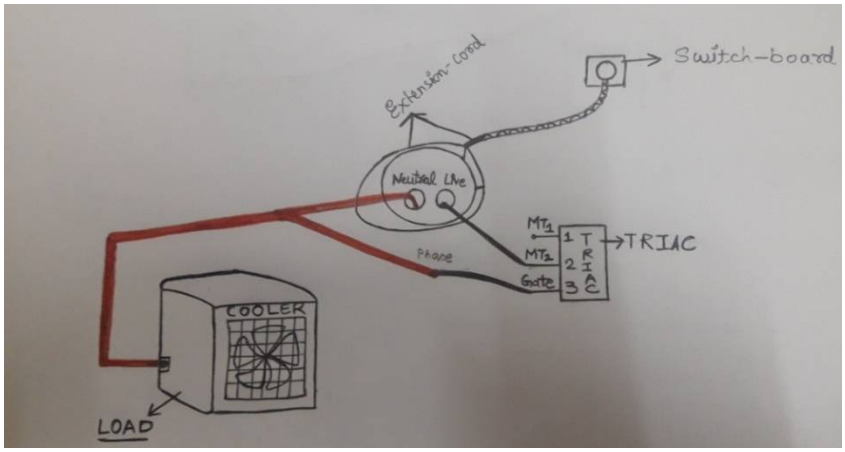

Figure 5: Wiring diagram of load to the AC mains through Triac

Figure 5 is the wiring diagram of the load to the AC mains through Triac. In this One terminal of load is connected to Neutral of AC mains (230V, 50 Hz) and the second terminal of load (phase) is connected to the gate terminal of Triac and the Live of the AC mains current is connected to the MT2 terminal of Triac through an optocoupler IC and a 100 ohm resistor. After pressing button 1 of the NEC remote, load 1 will start running and button 2 will turn ON the load 2. Buttons 4 and 5 of the remote will turn OFF the loads 1 and 2 respectively. And thus, the receiver part is demonstrated successfully.

VI.CONCLUSION& FURTHER RECOMMENDATIONS

In this paper, the proposed technique i.e. home automation through IR sensor and arduino- nano single board microcontroller has been discussed and its application for home appliancesis successfully demonstrated. The system is cheap, reliable, and easy to install and operate. However, this system is applicable to automate the appliances of single room only as IR sensor requires line of sight (LOS) to communicate. The same concept can be extended further to automate multiple rooms by using the combination of IR and RF sensors and the range can also be extended to few more metres by using higher range IR and RF sensors.

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