Journal of Humanities, Science and Technology
(JOHUSAT) 2nd Edition October 2023

ORIGINAL ARTICLE

DESIGN AND IMPLEMENTATION OF HOME AUTOMATION USING INFRARED REMOTE CONTROL SYSTEM

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Abstract

Home appliance network (home automation) allows the user to effectively monitor and control house hole electrical appliances and equipment such as fan, lighting bulbs systems, and sockets. This home automation system makes peoples' lives easy. Though these systems are good, they are only effective for short distance of 10 meters. This research work is proposed to overcome the challenges of manual push-pull switching ON and OFF device of household electrical appliances with design and implementation of home automation using infrared remote control system.The system uses infrared remote systemto send a codecommands to microcontroller to turn on and off electrical devices. System development involves implementing the different hardware components such as (power supply, sensor, microcontroller, relays, breadboardand LCD) making up the system as well as code programming the system controller in microcontroller.The result of the system after testing showed that the system works satisfactorily and it is also considered to be a cost effective systemin the remote control of electrical appliances.

Keywords: Microcontroller, Relay,IR Remote Transmitter andLiquid Crystal Display

I. INTRODUCTION

Electricity became a part of modern life and one cannot think of a world without it. Electricity has many uses in our day to day life activities. It is used for lighting rooms, working fans and domestic appliances like using electric stoves, A/C and more. All these provide comfort to people. In factories, large machines are worked with the help of electricity. Essential items like food, cloth, paper and many other things are the product of electricity.Today we are living in 21st century where automation is playing important role in human life. Home automation allows us to control household appliances like light, door, fan, AC etc. It also provides home security and emergency system to be activated. Home automation not only refers to reduce human efforts but also energy efficiency and time saving. The main objective of home automation and security is to help handicapped and old aged people who will enable them to control home appliances and alert them in critical situations. The automation of features in one's home helps to promote security, comfort, energy efficiency, and convenience. Another benefit of home automation systems is the amount of labor, time,

energy and materials that is saved (Rama et.al. 2016).

II. REVIEW OF RELATED WORKS

According to Jandial et.al. (2017), proposed a system for controlling home appliances based on IR technology. An IR remote is used at the transmitter section to send commands to an IR receiver. At the receiver section, the received signal by the IR receiver is fed to an Arduino Nano ATmega 328 microcontroller. Thereafter, the microcontroller controls the appliances through relay and triacs. This system also has a low communication range of 10 meters maximum.

According to Diarah et.al. (2014), we will develop a system for remote control of domestic home electrical appliances such as lighting points, sockets on and off, and fans. This application of remote control home can be applied to these devices in homes, offices, industries, churches, conference rooms and hospitals at any time.

According to Piyare and Tazit (2011), proposed a home automation system that is based on Bluetooth technology. An Arduino Bluetooth (BT) board is used to connect electrical appliances through relays. A Bluetooth enabled cell phone is used to wirelessly communicate with the Arduino BT board to control the appliances. The system functionality was tested to cover less than 50 meters in a concrete building and range of 100 meters maximum, in an open space.

According to Narayanan and Gayathri (2013), developed a voice based home automation system using ZigBee technology. At the transmitter side, a microcontroller is used to transmit voice command from microphone via ZigBee transmitter. At the receiver side, the transmitted signal is received by a ZigBee receiver, and fed into another microcontroller for onward processing, and control of the connected appliances through relays. The system also detects presence of smoke, and sends message to user's mobile phone. However, the drawback associated with this system is low communication range (around 10 meters) due to ZigBee technology.

III. MATERIAL AND METHODOLOGY

This project design methodology can be divided into two sections. Hardware design and software design. Hardware design is the physical part of the system where the various components used in the design are integrated by soldering onto his Vero board power supply, microcontroller and relay while software design focuses on code programming the microcontroller using the embedded C language.

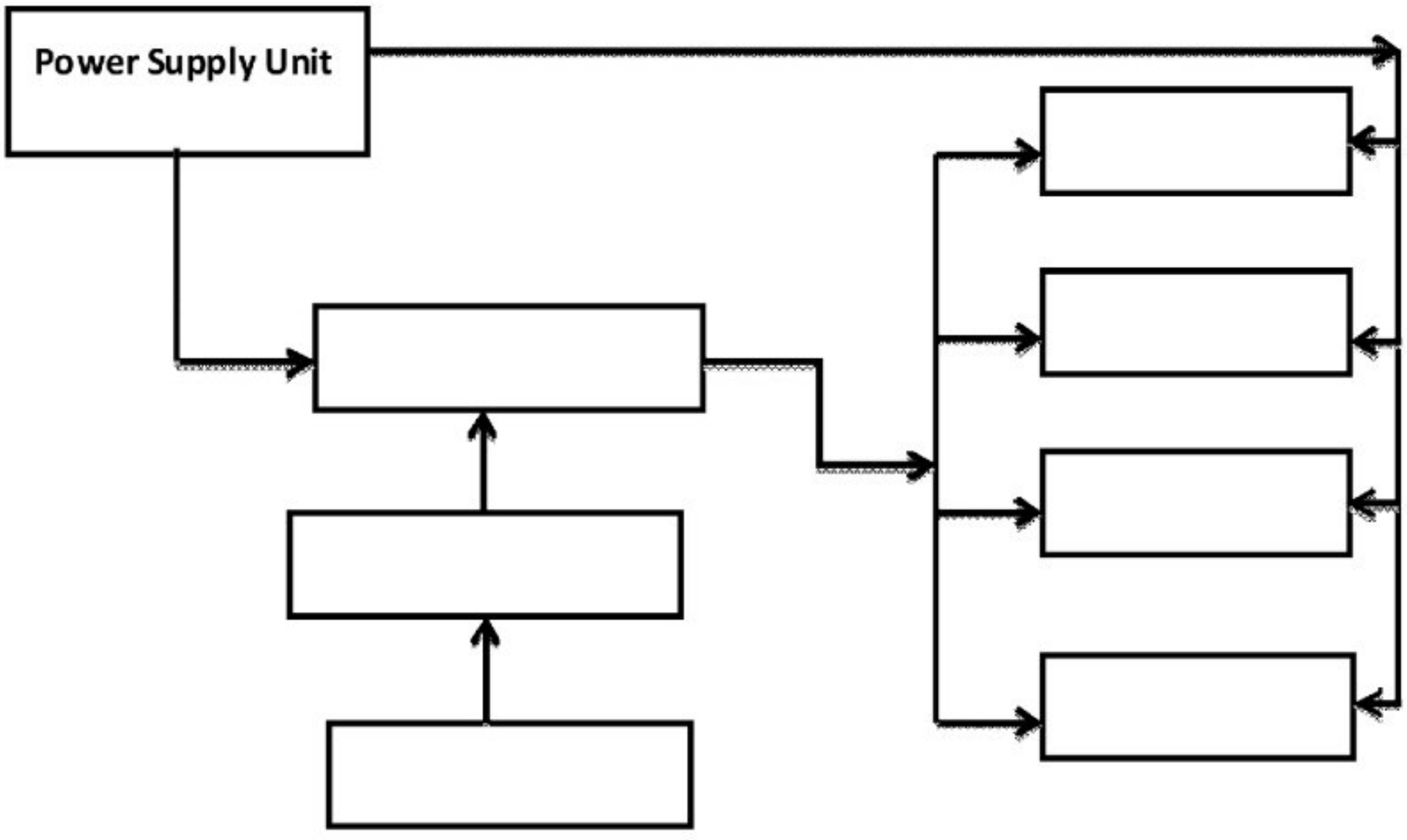

Figure 1: Block diagram of the project

HARDWARE IMPLEMENTATION

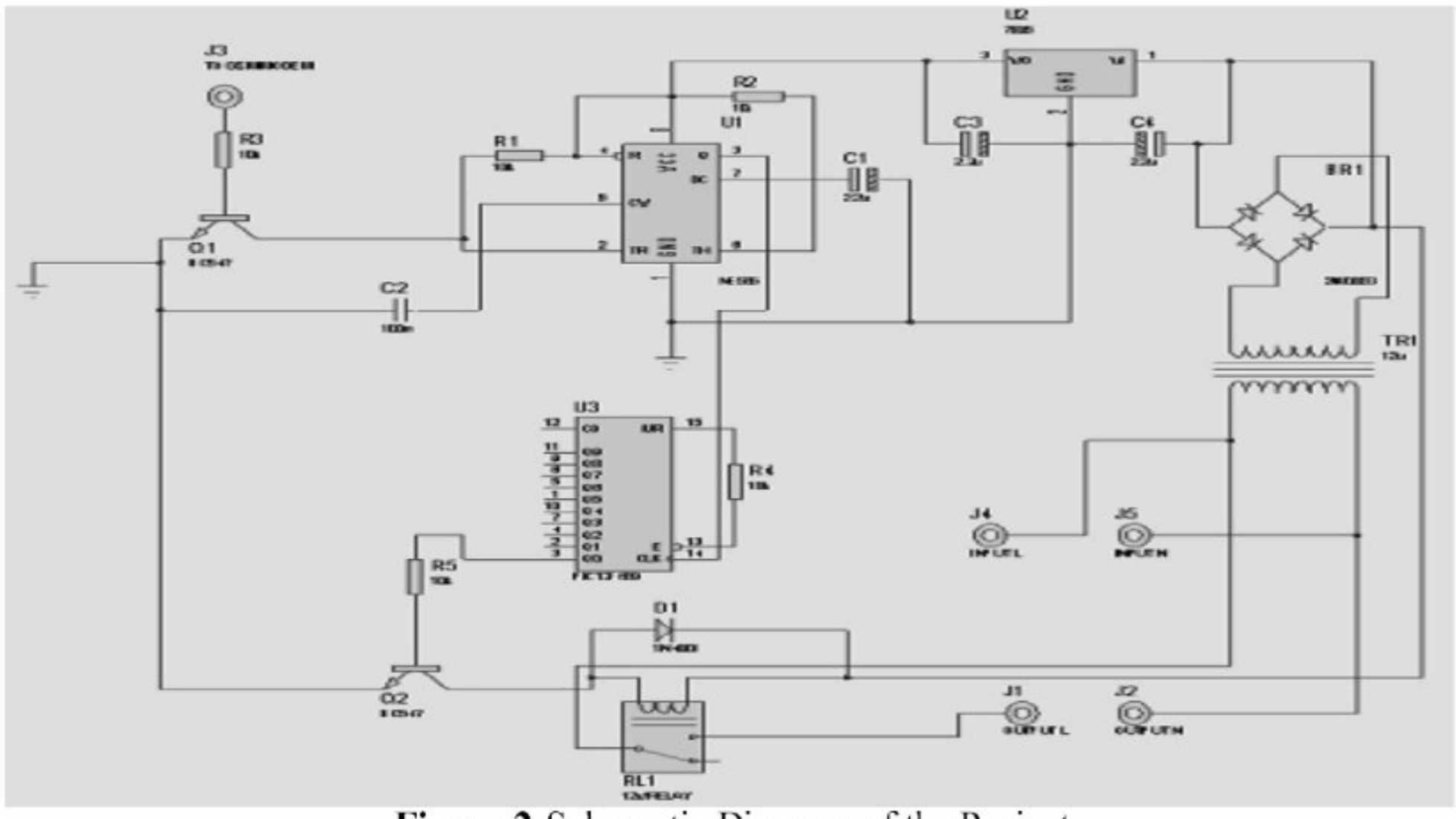

Figure 2: Schematic Diagram of the Project

a. Power Supply

Microcontrollers and other devices are powered by AC-DC adapters, as shown in Figure 3 below.

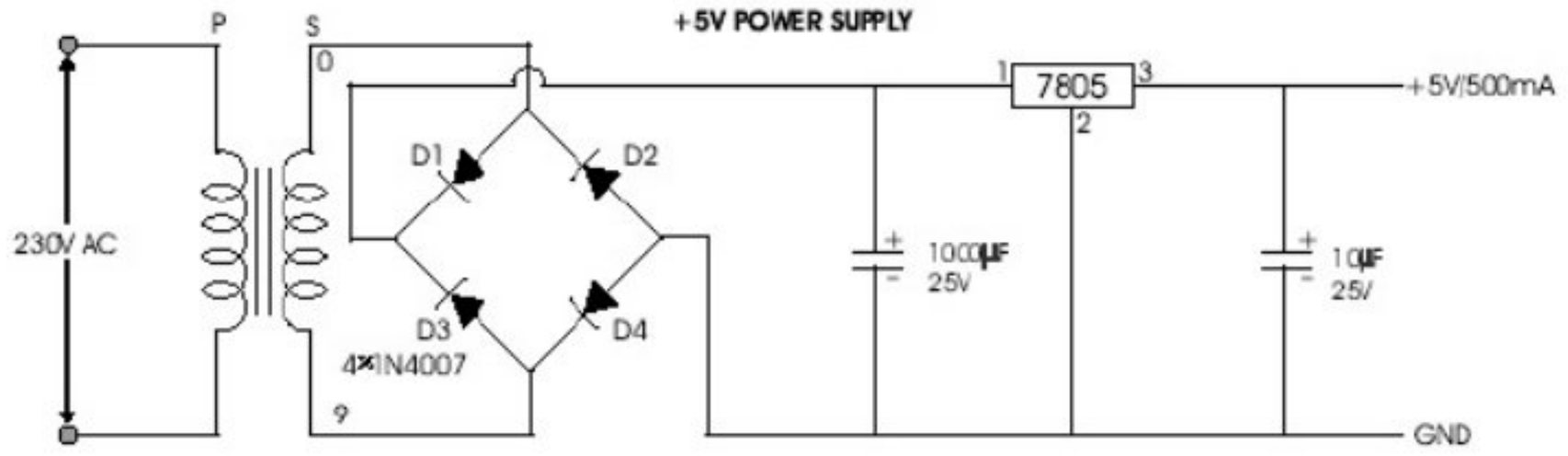

Figure 3: AC to DC Power Adapter

An AC voltage, typically 220V/50Hz rms, is connected to a transformer, which reduces this AC voltage to the desired DC output level of 12V/500mA. A diode rectifier then provides a full-wave rectified voltage, which is first filtered with a simple 1000uF/25V capacitor filter to produce a DC voltage. The resulting DC voltage usually has ripple or AC voltage fluctuations. The regulator circuit filters ripple and maintains the same DC value even if the DC input voltage changes or the load connected to the DC output voltage changes. This voltage regulation is typically achieved using one of the common voltage regulator IC packages. The positive terminal of the capacitor is connected to pin 1 of the 7805 voltage regulator and the negative terminal is connected to pin 2 of the regulator. This regulator produces a +5V output between pins 3 and 2 (ground) (Anierobi and Ananti 2022).

b. Microcontroller

The microcontroller executes the specific instruction(s) sent by the user that has been decoded by the infrared remoter devices. It then switches ON/OFF the corresponding relay(s) and consequently the electrical light will show. Abubakar et.at. (2020). the 16x2 LCD displays are interfaced with the 8051 microcontroller in 8bit or 4-bit mode. This differs in how data is send to LCD. Then the 4x4 key boardsare also interfaced with the microcontroller. 4-bit mode is generally used although it is not as speed as 8-bit mode but as the LCD's are also slow speed devices generally 4-bit mode is preferred.

c. Loads

The loads are the electrical appliances to be remotely controlled being connected to the system. This includes a television set, bulb, refrigerator, and any other electrical appliance requiring a 220/240V 50Hz AC power sourceAbubakar et.at. (2020). therefore, unit has slots for three bulbs and onesockets outlet as show in figure 5 below, in which other electrical appliances can be connected.

d. Relay

A relay is electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles

Figure 4: LCD Displaying Temperature Reading

f. IR Remote Transmitter

In present system, we have used universal TV remote. Every remote has its own protocol. But, one of the biggest advantages of using universal remote controller is that it can learn of brand new remote controllers, which did not exist yet while the universal remote was created. The specialty of our project is that, any remote can be used to drive different loads. But, the condition is bit pattern of the specific remote should be storedin the microcontroller (Abu et.al 2012).

Fig 5:infrared TV remote

When the infrared receiver on the circuit picks up the signal from the remote and verifies from the address code that it's supposed to carry out this command, it converts the light pulses back into the electrical signal. It then passes this signal to the microcontroller, which will use the information to switch the required device. Infrared remotes have a distance range of 10 meters, and they require line-of- sight. This means the infrared signal won't transmit through walls, you need a straight line to the device you're trying to control. Also, infrared light is so ubiquitous that interference can be a problem with IR remotes. Just a few everyday infrared light sources include sunlight, fluorescent bulbs and the human body. To avoid interference caused by other sources of infrared light, the infrared receiver on the circuit only responds to a particular wave length of infrared light, usually 980 nanometers (Diarah et.al. 2014).

CODE/PROGRAMM DESCRIPTION

In programming part of this project, we includes library for liquid crystal display and then we defines data and control pins for LCD and home appliances.

```
#include <Wire.h>
#include<LiquidCrystal.h>
LiquidCrystallcd(1, 2, 3, 4);
#include <Infrared remotecontrolo.h>
constint RECV_PIN=2;
IRrecvirrecv(RECV_PIN);
decode_results results;
LiquidCrystallcd(1,2,3,4);
#define relay 1 to light bulb 4
#define relay 2 to light bulb 3
#define relay 3 to light bulb 2
#define Light all bulbs together 1
int i=0,j=0,k=0,n=0,p=0;
```

After this serial communication is initialized at 9600 bps and gives direction to used pin. Void setup()

```
{lcd.begin(16,2); Serial.begin(9600);
lcd.clear();lcd.setCursor(0,0);pinMode(led,
OUTPUT); pinMode(bulb 4, OUTPUT);
pinMode(bulb 3, OUTPUT); pinMode(bulb 2,
OUTPUT);
lcd.setCursor(0,1);
lcd.print("HOME--AUTOMATION");
delay(2000);
lcd.clear();
lcd.setCursor(0,0);
lcd.print("-----SYSTEM-----");
lcd.setCursor(0,1);
lcd.print("----STARTING----");
delay(2000);
pinMode(relay1, OUTPUT);
pinMode(relay2, OUTPUT);
pinMode(relay3, OUTPUT);
pinMode(relay4, OUTPUT);
irrecv.enableIRIn();
irrecv.blink13(true);
lcd.clear();lcd.setCursor(0,0);
lcd.print("LD1, LD2, LD3, LD4");
lcd.setCursor(0,1);  lcd.print("OFF OFF OFF
OFF");}
void loop()
{ if (irrecv.decode(&results))
{ Serial.println(results.value,HEX);//Prints the
value in HEX/hexadecimal
delay(100);
lcd.setCursor(0,0);
lcd.print("LD1 LD2 LD3 LD4");
if(results.value==0x1FE01FE0)//change the
hex code of this line using your hex code in your
remote control
```

```
{ i++; int x=i%2;
digitalWrite(relay1, x);
lcd.setCursor(0,1);
if(x)
lcd.print("ON");els
lcd.print("OFF "); }
else   if(results.value==0x1FE02FD0)//change
the hex code of this line using your hex code in
your remote control
{ j++;int x=j%2;
digitalWrite(relay2, x);
lcd.setCursor(4,1);
if(x)
lcd.print("ON");
else
lcd.print("OFF");}
if(results.value==0x1FE03FC0)//change   the
hex code of this line using your hex code in your
remote control
{ k++; int x=k%2;
digitalWrite(relay3, x);
lcd.setCursor(8,1);
if(x)
lcd.print("ON");
else
lcd.print("OFF");}
if(results.value==0x1FE04FB0)//change   the
hex code of this line using your hex code in your
remote control
    {p++; int x=p%2;
digitalWrite(relay4, x);
lcd.setCursor(12,1);
if(x)
lcd.print("ON");
else
lcd.print("OFF");}
if(results.value==0x1FE31CE0)//change   the
hex code of this line using your hex code in your
remote control
      {n++; int x=n%2;
digitalWrite(relay1,x);
digitalWrite(relay2,x);
digitalWrite(relay3,x);
digitalWrite(relay4,x);
lcd.setCursor(0,1);
if(x)
lcd.print(" ON  ONON  ON");
else
lcd.print("OFF OFF OFF OFF");}
irrecv.resume();}}
```

. TEST AND RESULT

We tested the system. The observations are presented here with a brief explanation. LCD display output produces home electrical appliances with infrared remote control.

Step 1: Pressing 4 on the bottom of the infrared

remote control causes the sensor to trigger relay 1 circuit on her LD 4, turning on the first lamp while LD 3, LD 2, and LD 1 remain off Let The infrared remote control works within a range of 10 meters and requires a straight line to the device you want to control. As shown in Figure 6 below,

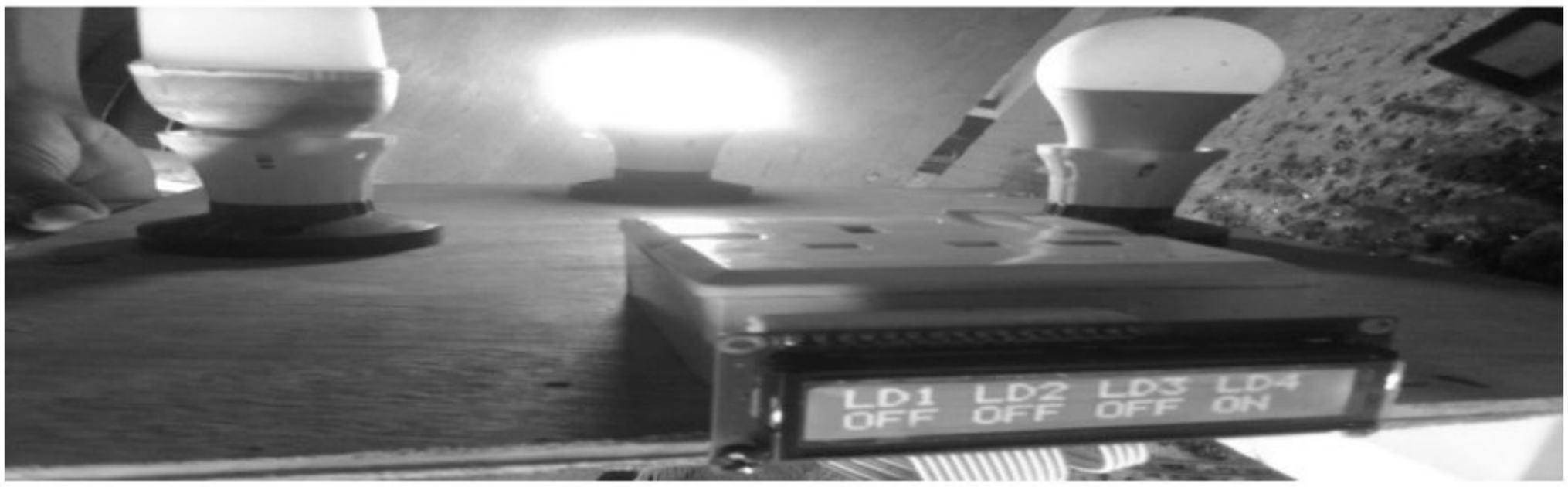

Figure 6: LD4 in Operation

Step 2: Press 3 on the remote control and the sensor will turn on the relay 2 circuit of LD 3, turning on the second bulb as shown in Figure 7 below. LD 4 leaves LD 2 and LD on. 1 is off.

Step 3: Press 2 on the bottom of the remote, the sensor will turn on the relay 3 circuit of LD 2, turning on the third light bulb, as shown in Figure 8 below. LD 3 and LD 4 are all on, but LD1 remains off.

Figure 7:LD3 in Operation

Figure 8: LD2 in Operation

Step 4: Press 1 on the bottom of the remote control, the sensor will trigger LD 2, LD 3, and LD 4 relays and all three lamps will turns off automatically as shown in Figure 9 below.

Figure 9: LD1 in Operation

I. CASING AND PACKAGING

After various components such as step down transformer, resistors, capacitors, PCBs, power adapters, LCD displays, full-wave bridge rectifiers, diodes, LEDs, and relays are soldered onto printed circuit boards (PCBs), continuity checks are performed using multi-meter. Make sure the components are connected properly. The work in this project is packaged in a fiber plastic case to reduce electromagnetic interference. The choice of a 50x20mm rectangle and 10mm thick fibre-reinforced plastic was also influenced by the fact that it is a household appliance that needs to be well shielded from the possibility of electric shock. I drilled a hole in the cover to fit the LCD screen.

Figure 10: Construction of a home electrical appliances using infrared remote control

I. CONCLUSION

The design and implementation of a home appliance with an infrared remote control has been successfully implemented, and all the various component units that make up the system are fully operational. The project came to fruition and literally a light bulb was used for demonstration. This project makes your life easier by controlling home appliances such as fans, light points, and sockets with a single push of an infrared remote control button.

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