CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

Normally we just push the refrigerator door closed, hoping that the door gasket magnet will hold it. Often the door does not stay closed tightly in many households either due to the weakening of the mechanical components(screws and nuts) that is supposed to hold it tight, or sometimes the refrigerator maybe too filled up thereby disallowing the refrigerator door to take its proper position. Carrying out multi activities at a time most especially in the kitchen or in the shop may make one to forget totally to close the refrigerator door. Most children in the house do not generally bother to keep the refrigerator door properly closed.

If the refrigerator door is not properly closed, the cooling will be lost, the refrigerator tends to work more, thus increasing the power bill and exhausting the compressor thereby making it liable to mechanical fault. These will definitely have negative effects on the family economy. The effects are not only affecting the people that can afford the refrigerator of their own but also to low income earning families, the students, and even some of the office users that will not be able to buy the cold contents(pure water, soft drinks, juice, etc.) that are satisfactory.

This project is aimed at finding solution to the abovementioned problems by designing and developing a device that gives an alarm whenever the refrigerator door either not being properly closed or left opened for over 20 secs by reminding the user with an alarm. The alarm will continue to sound as long as the refrigerator door is opened, telling you to do your job fast and close the refrigerator door. It also serves as a security guard against unauthorized person intending to open the refrigerator unaware.

- **SCOPE OF PROJECT**

The scope of this project entails the design and construction of a device that gives an alarm when the refrigerator door is left open for over 20sec. This was achieved by using a modular approach. The power unit was made up of both 230V AC and rechargeable battery for backup in case of electric power failure. The timing part that was made up of 555 timers IC and other passive components enables the device to follow a specific timing pattern that the user desired. Logic unit enables the output signal of the IC to be inverted to suit the aim of the project. The part carrying the name "alarm" is the buzzer that serves as the basic component for the output module.

- **SPECIFIC AIM**

The specific aim of this project is to design and construct a device that will give an alarm if the door of the refrigerator is left open for over 20 seconds.

- **AIMS**

1. To continuously keep the refrigerator content cool.

2. To reduce the electric power bill since the refrigerator tends to work more if the door is left open.

3. To prevent unnecessarily exhausting of the Compressor.

1.2 OBJECTIVES

1. Determine the average time lapse between opening a refrigerator, taking something or putting something and closing it, then build a system that will ensure that the refrigerator is closed after this period.

2. Determine the common causes of refrigerator faults.

1.3 METHODOLGY

In achieving this device, the literature review of the device was first done(majorly through internet service) to know the basic background and the level of improvements that can be added In designing it, a modular method was employed. Each module was independently designed, constructed and tested. Upon testing, the modules were found working as expected. The casing was designed to accommodate the alarm circuit, power supply circuit and provisions for buzzer, the switch cable and the power cable. The device was also tested again after the casing..

CHAPTER 2: LITERATURE SURVEY

2.1 LITERATURE SURVEY

Electronic control systems have been in existence for years now and have been affecting virtually all the areas of human endeavors. One of these electronic control systems is refrigerator door alarm.

The first refrigerator door alarm was designed in 1999.Unfortunately that circuit stopped operating when the battery voltage falls below about 2.6-2.7volts. This was due to the 4060 CMOS IC used. In some cases, devices made by some manufacturers fail to operate even at nominal3v supply voltage.

A simple remedy to this shortcoming could be the substitution of the original IC specified with a 74HC4060 chip. This should allow circuit operation down to 2V but, unfortunately, this IC is not easily available.

For this reasons an equivalent circuit using about the same parts was developed by Italian inventor flariodellepiane, in order to allow safe operation even when the battery voltage falls down to about 1.3y' The challenges that the circuit designed by this great Italian inventor faced were:

1. How the sensor device (photoresistor) will be used in a type of refrigerator that their light is always ON whether it is closed or opened (fridge use in restaurant,)

2. How we can power the device with a rechargeable source as to avoid unnecessary changing of the Battery when its life-span reach

2.1.1 OTHER CONTROL SYSTEMS THAT ARE EMPLOYED IN FRIDGE ARE:

1. THERMOSTAT CONTROL SYSTEM: It is designed to keep the interior temperature i constant via internal and external sensors and independent of any external temperature fluctuations. The multisensory control regulates temperature precisely under all conditions for optimal food storage and preservation. Food remains fresh and aromatic for a longer period. The interior temperature is also kept at its optimal consistently.

2. HUMIDITY CONTROL SYSTEM: It allows adjustment of both temperature and humidity levels the shelf-life of meat, fruit and vegetables. For example, low humidity is suitable for meat and fish while high humidity is ideal for keeping fruit and vegetables.

3. AIRFRESH FILTER: The Airfresh filter reduces odours of smell-intensive food (garlic, fish, durians, locust beans e.t.c) significantly and it also reduces the cross contamination of odours in the interior. It is a lifelong protection. Hence, the hassle of replacement is gone.

4. INVERTER COMPRESSOR: It assumes maximum energy efficiently and practically silent operation. The innovative variable speed compressor reacts to the needs of each compartment according to the load (refrigerator contents) conditions. The total energy consumption of the compressor variable adapts to the ambient temperature and load conditions controlled by several sensors.

5. LIGHT SYSTEM: It provides excellent illumination to the interior of the refrigerator. The clever positioning of the lightning in the side walls ensures that no storage space is lost. Some light systems are activated (ON) upon the opening of the refrigerator door while some are continuously ON depending on the usage.

2.1.2 OTHERS ELECTRONIC CONTROL SYSTEMS THAT ARE USED FOR VARIOUS PURPOSES ARE:

1. Intruder Alarm System: For security purposes.

2. Metal Detector: Applicable in Banks.

3. Glass Break Detector: For internal perimeter building protection.

4. Fire Detector: Protect from the risk of fire in its area of application.

5. Access Control and Bypass Codes: For Authorization.

2.2 THEORETICAL BACKGROUND

The basic theory that the design and construction of this device depends on is TIMING through a component known as "555 TIMER IC"

The 555 timer IC is an integrated circuit (chip) implementing a variety of timer and multi vibrator applications. The IC was designed by Hans R Camenzind in 1970 and brought to market in 1971 by Signetics (later acquired by Philips) .The original name was the SE555 (metal can)/ NESSS(plastic DIP) and the part was described as " The IC Time Machine" It has been claimed that the 555 gets its name from the three resistors used in typically early implementations, but Hans Canmenzind has stated that the number was arbitrary. As of 2003, it is estimated that 1 billion units are manufactured every year.

Depending on the manufacturer, the standard 555 package includes over 20 transistors, 2 diodes and 15 resistors on a silicon chip installed in an 8-pin mini dual-in-line package (DIP8). Variants available include the 556(a 14-pin DIP combining two 555s on one chip), and the 558(a 16-pin DIP combining four slightly modified 555s with DIS&THR connected internally, and TRI falling edge sensitive instead of level sensitive).

Ultra-low power versions of the 555 are also available, such as the 7555 and TLC555. The 7555 requires slightly differently wiring using fewer external components and less power.

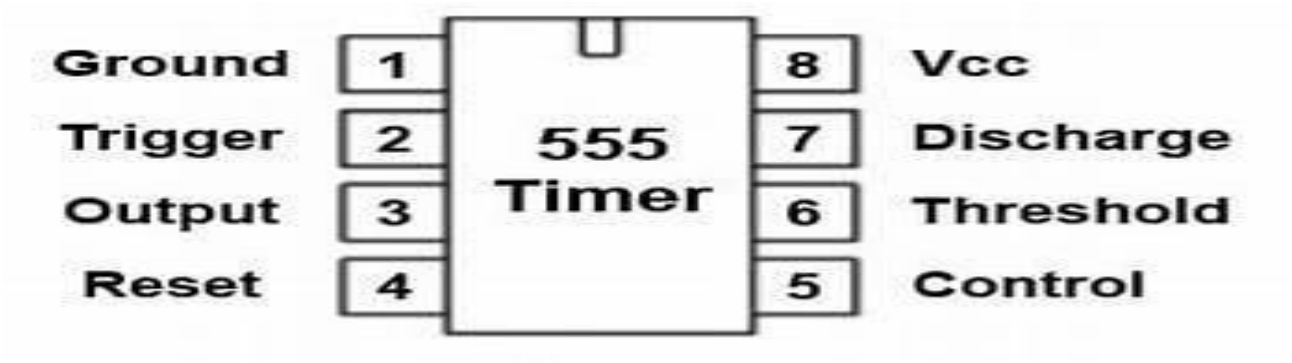

Fig 2.1: 555 TIMER IC showing its pins numbers and corresponding names.

2.2.1 THE THREE OPERATING MODES OF 555 TIMER IC

1. MONOSTABLE MODE: In this mode, the 555 functions as a "one- shot". Applications include timers, missing pulse detection, bounce free switches, touch switches, frequency divider, capacitance measurement, pulse-width modulation (PWM) etc.

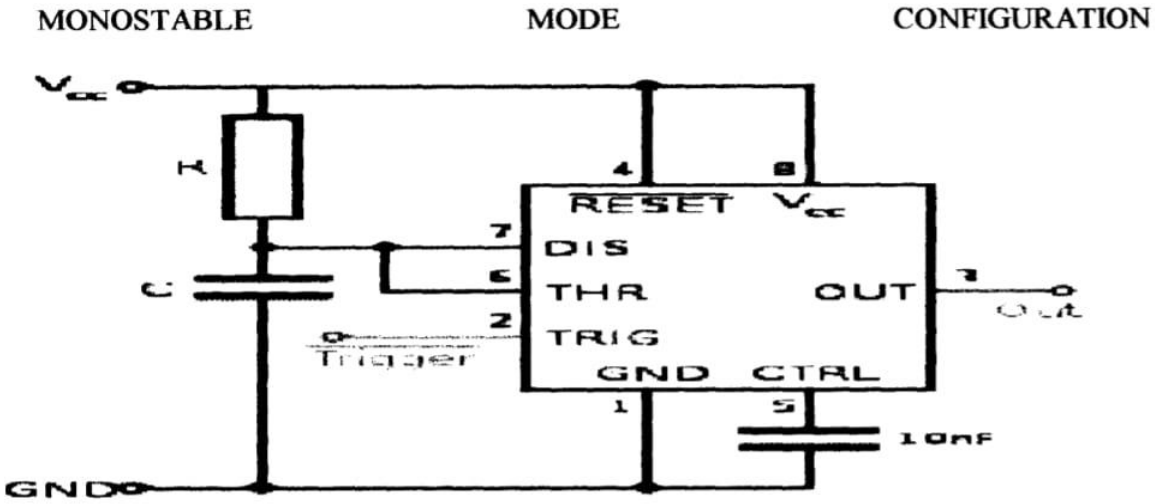

Fig 2.2.1: mono stable mode configuration

In the Mono stable mode, the 555 timer acts as a "one-shot" pulse generator. The pulse begins when the 555 timer receives a signal at the trigger input that falls below one- third of the voltage supply. The width of the pulse is determined by the time constant of a RC network, which consists of a capacitor(C) and a resistor(R).

The pulse ends when the change on the C equals 2/3 of the supply voltage. The pulse width can be lengthened or shortened to the need of the specific application by adjusting the values of R and C. The pulse width of time T, which is the time it takes to charge C to 2/3 of the supply voltage, is given by:

$T = RC \ln(3) = 1.1 RC$

Where T is in seconds, R is in ohms and C is in farads.

2. BISTABLE MODE :In Bi stable mode, the 555 timer acts as a basic flip-flop. The trigger and reset inputs (pins 2 and 4 respectively) are held high via pull-up resistors while the threshold input (pin 6) is simply grounded. Thus configured, pulling the trigger momentarily to ground acts as a "set" and transitions the output pin (pin 3) to Vee(high state). Pulling the reset input to ground acts as a "reset" and transitions the output pin to ground (low state). No capacitors are required in a bistable configuration. Pin 8(V cc) is, of course, tied to V cc while pin 1 (gnd) is grounded. Pins 5 and 7 (control and discharge) are left floating.

3. ASTABLE MODE: In A stable mode, the 555 timer puts a continuous stream of rectangular pulses having a specific frequency.

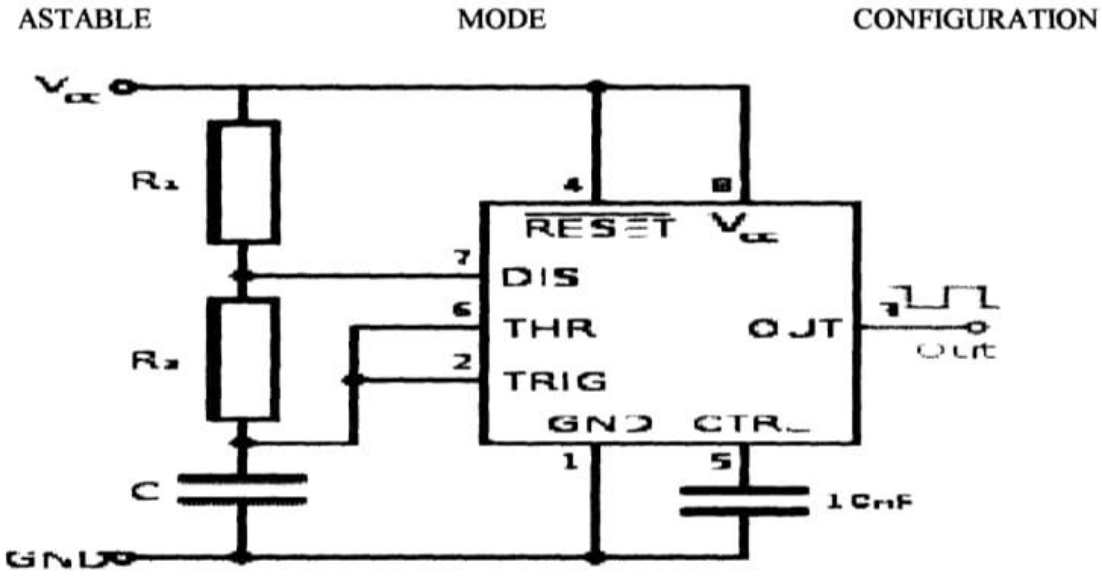

Fig 2.3: Bistable mode configuration

The resistor R1 is connected between Vee and the discharge pin (pin7) and another resistor R2 connected between the discharge pin (pin7), and the trigger pin (pin2) and the threshold (pin6) that share a common node. Hence, the capacitor is charged through R1 and R2, and discharged only through R2, since pin? has low impedance to ground during output low intervals of the cycle, therefore discharging the capacitor.

In the astable mode, the frequency of the pulse stream depends on the values of the R1,R2andC.

F= 1/ Ln (2)C.(R1+2R2)

The high time from each pulse is given by

high = Ln(2)(R1+R2).C

and the low time from each pulse is given by low = Ln(2) R2. C

where RI and R2 are the values of the resistors in ohms and C is the value of the capacitor in farad.

2.3 BLOCK DIAGRAM OF FRIDGE DOOR ALARM

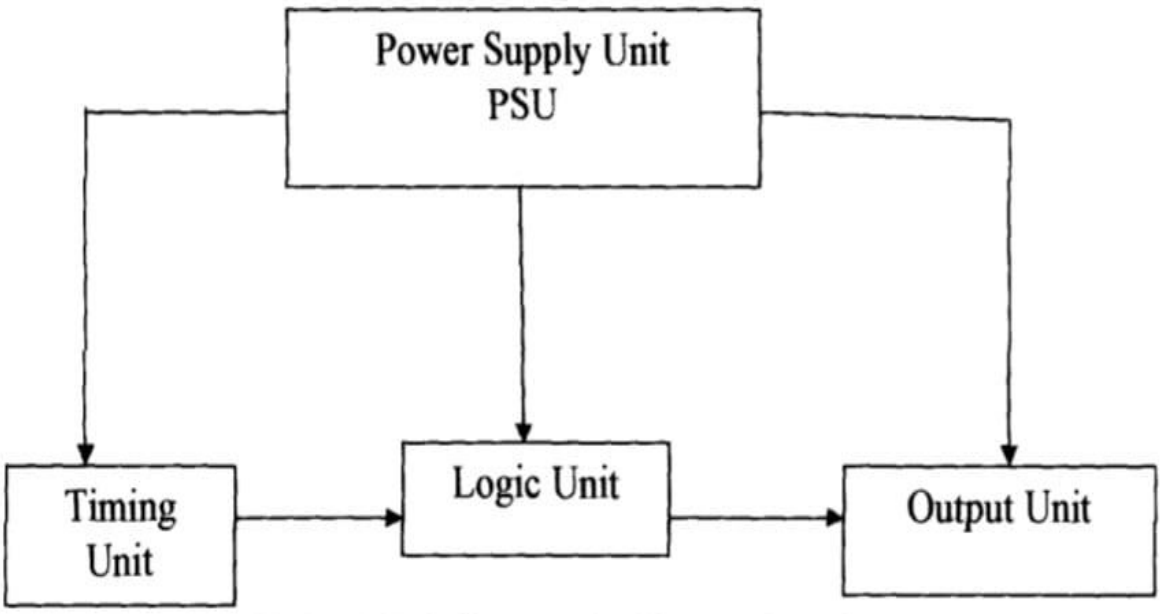

Fig 2.4: Block diagram of refrigerator door alarm

1. POWER SUPPLY UNIT: Is made up of both the AC and DC Supply. When there is electric power supply, the device depends on the AC and at same time charging the Rechargeable Battery of 9V But, once the AC supply fails (due to power failure from PHCN) the device will immediately switch to the 9V rechargeable battery with the help of a 9V Relay.

2. TIMING UNIT: This unit is made up of two 555 TIMER IC. One of the ICs is responsible for the delay time and the other is responsible for the beeper repetition rate of the alarm.

3. LOGIC UNIT: It contains basically 7404 NOT GATE IC, and voltage regulator of 7805 to power the IC The 7404 IC is responsible for the inversion of the output signal of the 555 TIMER IC.

4. OUTPUT UNIT: It contains 6V Buzzer that gives the expected output inform of an alarm

CHAPTER 3

3.1 HARDWARE REQUIRMENTS

1.555 TIMER IC

Fig 3.1 Structure of 555 timer IC

Astable multi vibrator has no stable states. The output swings between high and low based on the timing resistor and capacitor.

The formula to calculate the time delay is as below,

Time (Sec) = 1.1 x (R2 + R3) x C1

Here in this Fridge Door Open Alarm Circuit, we have used two 555 ICs, one for calculate the 'Fridge door Open time duration' after which the Buzzer should be triggered, and second 555 IC is for controlling the Buzzer beeping pattern. Below we have calculated Time delay for Buzzer to be triggered and selected the resistor values accordingly. Here the Time delay means the duration for which the Refrigerator Door is left open. This is done by first 555 IC in the circuit.

Time (Sec)=1.1 × (20kΩ ± 5%) × 10uFTime =30.4 secs Hence, R2=10kΩ ,R3=10kΩ in series and C1=10uF

Below we have calculated the Time Delay for second 555 IC, which is controlling Buzzer Beeping Time Period. In this case time delay is calculated as,

Time (Sec) =1.1 × (20kΩ ± 5%) × 10uF Time = 0.5 secs Hence, R5=10kΩ and C2=10uF (The buzzer turns ON and OFF at this time frame)

2.LDR(Light Dependent Resistor)

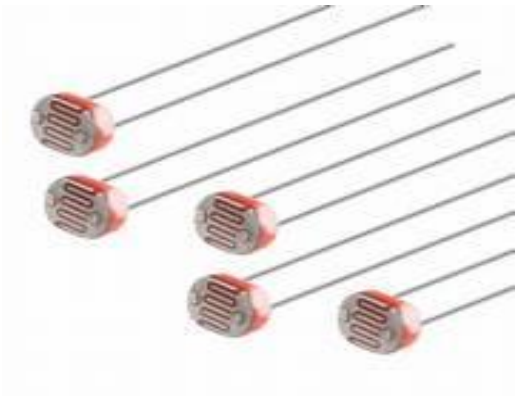

Fig :3.2 Structure of LDR

LDR works under the principle of Photo Conductivity. The conductance of the material inside the element increases when light falls over it. In terms of resistance, the value of resistance decreases when light falls over it and resistance will be large in dark surrounding. The resistance is directly proportional the light over the material. There are several types of LDR like 3mm LDR, 4mm LDR, 5mm LDR, 7mm LDR and etc. The part used here is 10 5mm LDR. Using the above data we have considered the resistance dividers as 10k with 5mm LDR.

3.BUZZER-1No.

Fig:3.3 Buzzer pin configuration

An audio signaling device like a beeper or buzzer may be electromechanical or mechanical type. The main function of this is to convert the signal from audio to sound. Generally, it is powered through DC voltage and used in timers, alarm devices, printers, alarms, computers, etc. Based on the various designs, it can generate different sounds like alarm, music, bell & siren.

The pin configuration of the buzzer is shown below. It includes two pins namely positive and negative. The positive terminal of this is represented with the '+' symbol or a longer terminal. This terminal is powered through 6Volts whereas the negative terminal is represented with the symbol or short terminal and it is connected to the GND terminal.

3.Diode(1N4007)-1No.

A diode is a basic PN junction semiconductor device well-known in the microelectronics world. Because it is constructed with P and N-type materials. It acts as a one-way switch that allows the current to flow in one direction and halts in the other direction.

1N4007 belongs to the silicon family of1N400X series. It is a general-purpose rectifying diode that serves its purpose of converting alternating current signals(AC) to direct current signals (DC) in electronic products.

4.Capcitors(10uF)-2No.

A capacitor in its most primitive form consists of two conductive plates separated by a dielectric medium. The term dielectric is just a fancy word for an insulator that can be polarized, i.e. form negative and positive charges on opposite faces. When voltage is applied across these two plates, current flows through the conductive plates. One side gets positively charged (lack of electrons) and the other side gets negatively charged (excess electrons). We're all familiar with the fact that unlike charges attract, so since the plates are oppositely charged, the charges on the plates attract.

5.Resistor(10Kohm)-3No.

Resistors are passive electronic components that limit the flow of electric current. They are designed to have a specific resistance value, measured in ohms (Ω). A 10k resistor is a

fundamental electronic component that plays a vital role in circuits by limiting the flow of electric current. Its resistance value is 10,000 ohms. These resistors are identified by a colour code, typically brown-black-orange-gold, where each colour represents a digit or multiplier.

6. Breadboard

A Breadboard is simply a board for prototyping or building circuits on. It allows you to place components and connections on the board to make circuits without soldering. The holes in the breadboard take care of your connections by physically holding onto parts or wires where you put them and electrically connecting them inside the board. The ease of use and speed are great for learning and quick prototyping of simple circuits. More complex circuits and high frequency circuits are less suited to bread boarding. Breadboard circuits are also not ideal for long term use like circuits built on per board (protoboard) or PCB (printed circuit board), but they also don't have the soldering (protoboard), or design and manufacturing costs (PCBs).

7.Connecting wires.

Connecting wires allows an electrical current to travel from one point on a circuit to another, because electricity needs a medium through which to move

CHAPTER 4: DESIGN AND IMPLEMENTATION

4.1 CIRCUIT DIAGRAM

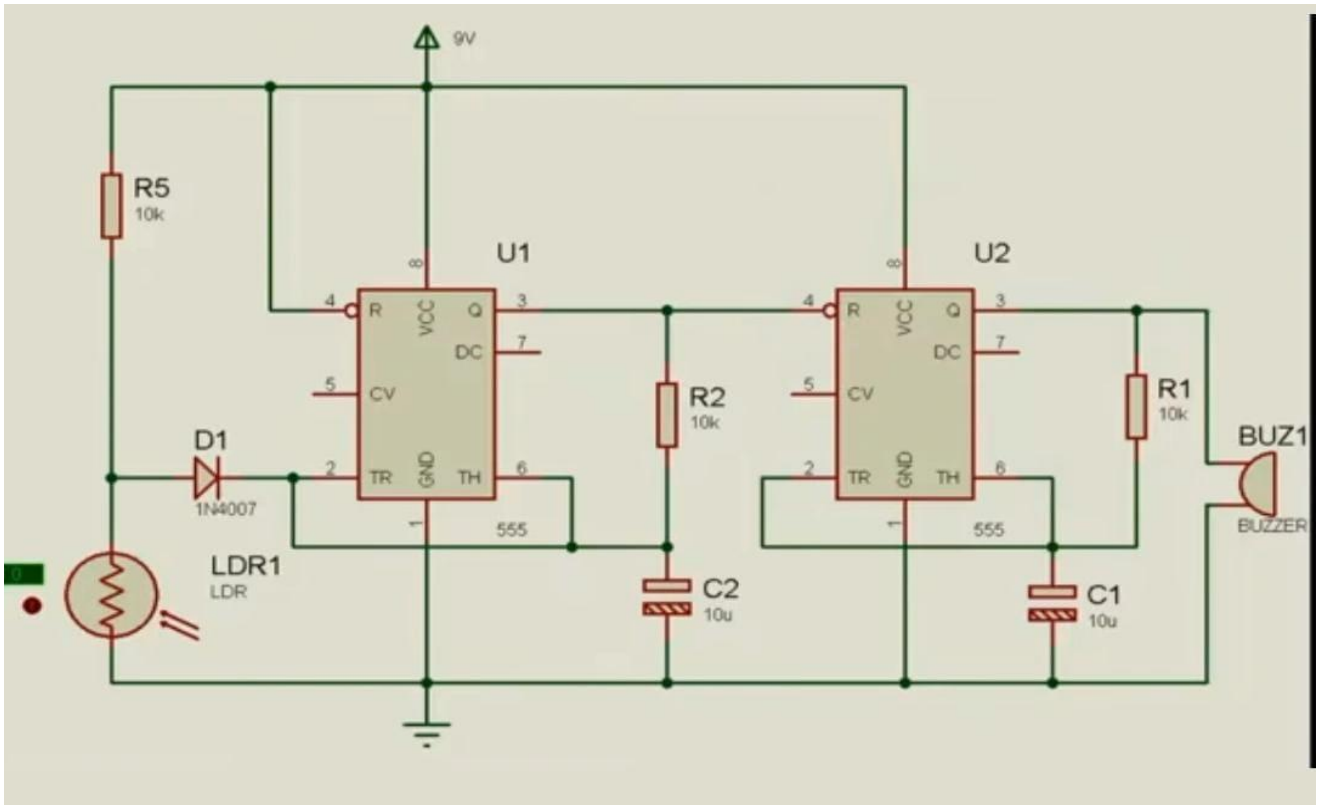

Fig:4.1 Circuit diagram of fridge door alarm

4.2 WORKING OF CIRCUIT DAIGRAM

The whole circuit is powered by a 9V battery. When the fridge door is closed, it is dark and the resistance of the LDR is nearly 1MΩ as given in datasheet. The output voltage of the potential divider appears across the capacitor and it remains in charged condition (Voltage higher than 2/3Vcc) making the output LOW. When we open the Fridge, the light falls over LDR which lowers down the resistance of LDR and causing the capacitor to discharge which in this RC combination it is 30 secs. After this (Voltage lower than 2/3Vcc), the output starts to oscillate at certain frequency and output is HIGH. Again, the capacitor charges and reaches a threshold continued by discharge of the capacitor. This continues till the LDR resistance goes high which will happen in the absence of light (door is closed). This makes the second

555 timer to oscillate and the output becomes HIGH and LOW causing the buzzer connected to output to beep in a pattern which is combinational cause of the first timer oscillations and the second timer internal oscillation. During HIGH condition of first timer output, the second timer master reset will happen. Thus, the capacitor C2 charges (Voltage higher than 2/3Vcc) and output goes LOW. In a short span the capacitor starts to discharge (Voltage lower than 2/3Vcc) causes the output HIGH. Hence, the buzzer connected to output becomes pulsed beep sound

CHAPTER 5: RESULT

5.1 OUTPUT

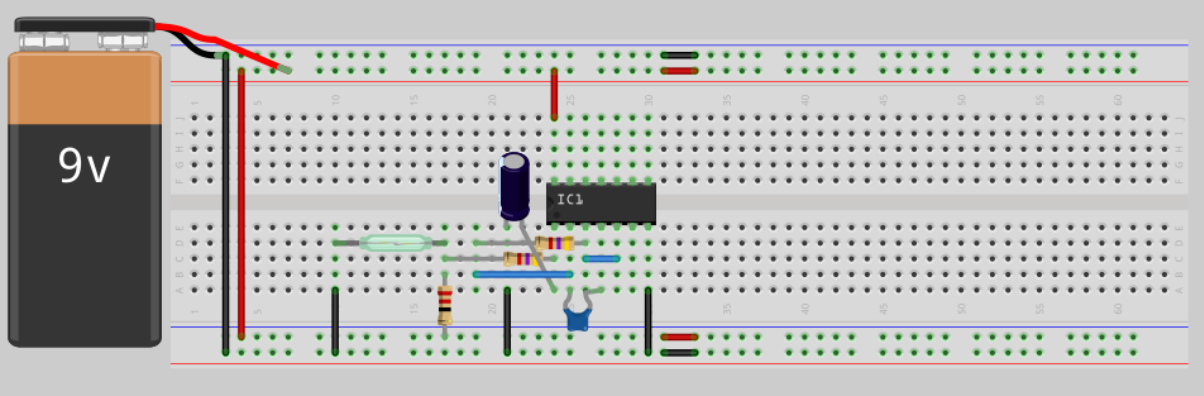

Fig:5.1 Complete circuit on Breadboard

Sure, in a typical fridge door alarm project, the result would be a system that alerts you whenever the fridge door is left open for an extended period. Here's what you might expect from such a project: The alarm system detects when the fridge door is open beyond a specified duration 30 seconds. It triggers an alarm sound or visual indicator (like LEDs) to notify that the door needs to be closed. Usually powered by batteries. It employs a magnetic reed switch or a similar sensor to detect the door open or closed state. Depending on the complexity, some projects may include features like integrating with a smartphone app for remote monitoring or adjusting alarm settings.

CHAPTER 6: ADVANTAGES, DISADVANTAGES & APPLICATIONS

6.1 ADVANTAGES

- The circuit for refrigerator door alarm is very simple and do not require embedded systems and programming.
- Refrigerator door alarm is very economical and its net cost is Rs. 200.
- The circuit introduces a time delay for an alarm with the help of capacitor (by varying its time constant) and zener diode instead of using a potentiometer. Hence less energy consumption and losses. This improves the life of device.
- The circuit provides three time delays of 2sec,30 sec and 45 sec which shows that this very circuit with certain modifications has numerous applications.

6.2 DISADVANTAGES

- The circuit uses three different capacitors for introducing three different time delay using a potentiometer would have given a continuous time delay.
- The device do not involve any automatic door closing mechanism.
- The model for refrigerator is designed for a limited door opening.

6.3 APPLICATIONS

With certain modifications the circuit for refrigerator door alarm has many applications.

- Using a LDR of higher sensitivity, when placed inside safes/lockers, it can be used as security alarm as the alarm will go on as soon as somebody unexpectedly unlock the safe/locker.
- This alarm can be used as a security alarm for cars and other vehicles if somebody open the door unexpectedly.
- By using a thermistor in place of LDR, the same circuit can be used as a fire alarm.
- The alarm can also be used in home security system and can be activated when required

CHAPTER 7: CONCLUSION & FUTURE SCOPE

7.1 CONCLUSION

The refrigerator door alarm is very economical and efficient device and can be practically used .Its simple circuitry is its asset. With certain modifications, same circuitry has numerous applications in the field of security.

7.2 FUTURE SCOPE

Although, the name of the project may be tagged "refrigerator door alarm device" but, the device itself can be used in any other places where contact or closeness is very paramount e.g. room door, residential gate, car door etc. All what is needed is to either increase or decrease the timing to suit the area of application. The device can be improved on by using a microcontroller in such a way that it is voice that we be heard instead of an alarm