CHAPTER 01

INTRODUCTION

1.1 Introduction

Currently A study has been developed on mini fridge products where using a thermoelectric system of peltier which produces cold and heat for learning and it needs for the final year project, B.Sc in Mechanical Engineering. This study is aimed at improving the use of the system in the fridge as well as adding convenience for consumers to use the fridge well and comfortably. This is in line with the needs of users who need the convenience of any fridge and easy to use in line with the development of technology developed through existing products in the market. This study focuses on how to develop a fridge product system so that this product can provide the user with the convenience. To develop the system, thermoelectric peltier. The thermoelectric, also often called as peltier coolant that utilizes the peltier effect when passed through the current, this device will transfer heat from one side to the other. In conclusion, this system has been successful in helping to increase knowledge and convenience to consumers and will probably be one of the obligatory products in every home in the future.

All of them have the same main purpose, which is to know when a product is running out of stock and then giving a notification to the user. The differences are the ways in which they detect the amount of product remaining along with some additional features offered by the researcher. The Node MCU are used as the product sensor and to process data from the sensor. Therefore, this fridge is not only detected the product when it is out of stock and gave the notification to users, but it also allows users to check the contents of the fridge, order food items, record transaction history and super form a variety of configurations. The main purpose of this system is to convert conventional refrigerator into a Peltier refrigerator, so this system should be portable. Every refrigerator has different environment, so the system should be able to adapt to the environment. To satisfy this requirement, this system needs to do calibration when the sensors are placed in new environment. User can do calibration with the sensors by turning off the Node MCU, place the sensor on the new place, make sure there is no item above the sensor, put the calibration switch on ON position, and turn on the Node MCU.

The system will read the environment value. After that, don’t forget to turn off the calibration switch. A saved environment value in the allows NodeMCU to get the environment values without repeating calibration process when there is power failure. To insert new item into the refrigerator, user should scan the barcode first and then put the item above one of the sensors. When the new item is placed, NodeMCU will identify the change in sensor values and make sure there is no failure. If failure occurs, NodeMCU rings the buzzer. If there’s no failure, NodeMCU send the sensors data to server. Server will crosscheck the sensors data. If there is no failure, the system will identify the good and save the information.

1.2 Objective of the project

Refrigerator is a home appliance that used to preserve the quality of perishable food products. Several studies from previous researchers have show that the quality of food products directly depends on temperature and air distribution inside the storage compartment. Currently, most of the refrigerators that available in market are powered by electricity. This is became restriction to people to use refrigerator for outdoor activities such as outdoor sport, fishing activity and for medical purpose which is to deliver special medical to village. Because of that, this project introduces a design of a small DC powered R. A portable refrigerator is simply a refrigerator that it can easily be moved to any direction with little application of force. This involves the removal of heat from a low temperature level and rejecting it to a relatively higher temperature level. There is no need to AC current but we can easily operate it by DC current. DC current can be taken anywhere of remote area that we want to take. Which we can storage food, medicine and water.

CHAPTER 02

Theoretical Aspects

2.1 Power Supply Unit

DC power Supply is mainly transformation of AC voltage to DC Voltage by using a step down transformer to step down the AC voltage from 230V to 12V or 24V AC voltage. Then this AC voltage will be converted to DC by using a bridge rectifier that is decorated using 4 diodes. One polarity capacitor will purify the pulsating dc and then voltage regulator will regulate a fixed dc voltage as output voltage.

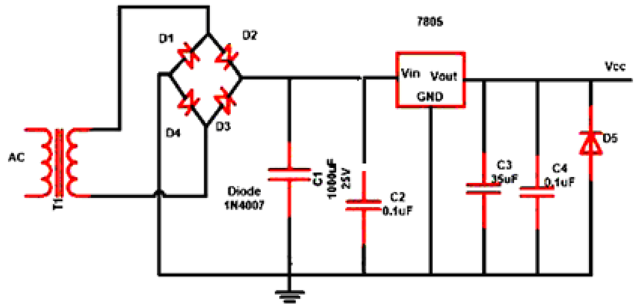

Figure 2.1: AC to DC Converter.

2.2 Relay Board

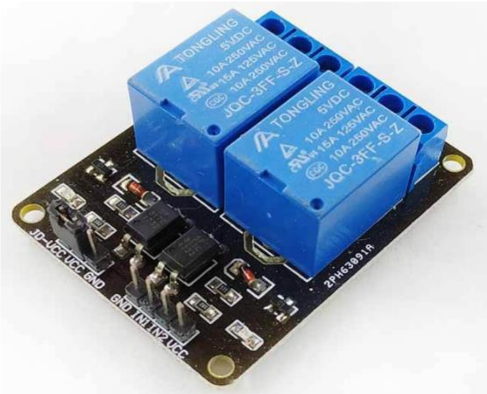

Figure 2.3: 2-Channel Relay Module

In this picture we attached here a four relay included relay module board. It's called 5V 4-channel relay module board, each channel of this relay module need 15 to 20mA current to drive this system. You can use tzhis module to control any appliance or equipment of high voltage or Low Voltage. It has an interface with standard value of controlling that can be controlled by Arduino Uno or any Microcontroller. In this relay module, when there have no signal available from microcontroller at that time signal light or indicator light will be turn on. On the other hand, when there have data signal will be available at that time the indicator light will be turn off. In this system we need to know about single relay. There have 5 pin all over the every relay. 3 pins are situated at left side of relay. Middle pin of this tree pin is the input pin for input voltage another 2 pin are connected with two terminal of magnetic coil. This coil will produce magnetic field when it will connected with 5V or 12V dc voltage. Right side 2 pins are input and output pin for controlling line which one name is Normally open (NO) and another name is Normally Closed (NC). You can use any pin for your requirement.

2.3 Node MCU ESP8266

Here we use a Node MCU or ESP8266 development Board which is transformation of ESP12E module and containing the ESP8266 chip which capacity is 32-bit LX106 RISE. It supports RTOS and it can operate 80MHz to 160MHz with adjustable clock frequency. It contain and also of flash memory to store data and programs. In this module we find and Bluetooth and deep sleep operating features that make it ideal for Projects.

Figure 2.7: Node MCU ESP8266

It consists of a Tensilica L106 32-bit micro controller a transceiver. It has 11 input/output (I/O) pins. And it has a dedicated analog input for the programming purpose. It is programmable and it can be modified in several ways and that is the reason why this chip is the most prevalent IoT device in the market. Main advantages are the reduction in size, cost, and increased convenience. This proposed system is flexible. I.e. apart from the above-listed components, our system can be interfaced with other sensors according to the user requirement.

2.4 Peltier Module

TheTEC1-12706 40x40mm Thermoelectric Cooler 6A Peltier Module is the simple application of Peltier Thermoelectric Effect. The module features 127 semiconductor couples in the area of 40mmx40mm which very effectively cools and heats up to90°C.

Thermoelectric coolers also are known as TEC or Peltier Module create a temperature differential on each side. One side gets hot and the other side gets cool. Therefore, they can be used to either warm something up or cool something down, depending on which side you use. You can also take advantage of a temperature differential to generate electricity.

This Peltier works very well as long as you remove the heat from the hot side. After turning on the device, the hot side will heat quickly, the cold side will cool quickly. If you do not remove the heat from the hot side (with a heat sink or other device), the Peltier will quickly reach stasis and do nothing. We recommend using an old computer CPUheatsinkor another block of metal to pull heat from the hot side. We were able to use a computer power supply and CPU heatsink to make the cold side so uncomfortable we could not hold our finger to it

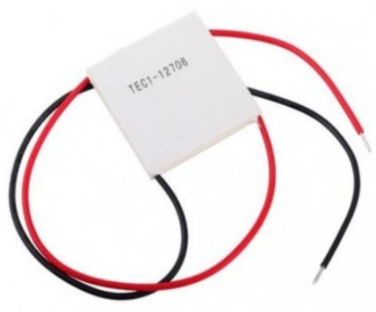

Figure 2.8: Peltier Module

2.5 SMPS -1

This power supply is used here to make sure the power for all components. It will provide 12 volt dc supply but there have no voltage regulator to fix output voltage. For that reason you have to use extra voltage regulator to give required voltage for each components.

Figure 2.9: Implemented 12V DC power unit.

Specification:

110-220 V AC Input +-15% 12v 30A (Maximum) DC Output , 60W Power Output Terminal Board Design for Easy connections (9 Pin Terminal Board L,N, E, +V, -V) Short Circuit Protection Passive Cooling Design with Heat SinkSturdy Steel Bod Adjustable output voltage is 10v to 12.5v.

2.6 SMPS-2

This power supply is used here to make sure the power for all components. It will provide 5 volt dc supply but there have no voltage regulator to fix output voltage. For that reason you have to use extra voltage regulator to give required voltage for each components.

Figure 2.9: Implemented 5V DC power unit.

Specification:

110-220 V AC Input +-15% 5v 5A (Maximum) DC Output , 60W Power Output Terminal Board Design for Easy connections (5 Pin Terminal Board L,N, E, +V, -V) Short Circuit Protection Passive Cooling Design with Heat SinkSturdy Steel Bod Adjustable output voltage is 5v to 6.5v.

2.7 Heat sink

A heat sink (also commonly spelled heatsink[1]) is a passive heat exchanger that transfers the heat generated by an electronic or a mechanical device to a fluid medium, often air or a liquid coolant, where it is dissipated away from the device, thereby allowing regulation of the device's temperature. In computers, heat sinks are used to cool CPUs, GPUs, and some chipsets and RAM modules. Heat sinks are used with high-power semiconductor devices such as power transistors and optoelectronics such as lasers and light-emitting diodes (LEDs), where the heat dissipation ability of the component itself is insufficient to moderate its temperature.

A heat sink is designed to maximize its surface area in contact with the cooling medium surrounding it, such as the air. Air velocity, choice of material, protrusion design and surface treatment are factors that affect the performance of a heat sink. Heat sink attachment methods and thermal interface materials also affect the die temperature of the integrated circuit. Thermal adhesive or thermal paste improve the heat sink's performance by filling air gaps between the heat sink and the heat spreader on the device. A heat sink is usually made out of aluminium or copper.

Figure 2.10: Heatsink

2.8 Temperature Sensor

They are devices to measure temperature readings through electrical signals. The sensor is made up of two metals, which generate electrical voltage or resistance once it notices a change in temperature. The temperature sensor plays a critical role in maintaining a specific temperature within any equipment used to make anything from medicine to beer. To produce these types of content, the accuracy and responsiveness of the temperature and temperature control are critical to ensuring the end product is perfect. Temperature is the most common physical measurement type in industrial applications. Accurate measurements are vital in ensuring the success of these processes. There are many applications that are not-so-obvious, which use temperature sensors. Melting chocolate, using a blast furnace, controlling a hot air balloon, freezing substances in a lab, running a motor vehicle, and firing a kiln.

Temperature sensors come in different forms, which are used for different methods of temperature management. There are two categories of temperature sensors which are contact and non-contact. Contact sensors are used mainly in hazardous areas.

Figure 2.11: Temperature Sensor

2.9 Heat sink Paste

Thermal paste, or some oily thermal interface material, is necessary because it fills in the microscopic imperfections that otherwise trap air particles between the CPU and the heatsink, preventing the CPU from properly cooling.

Figure 2.12: Heatsink Paste

Heat sink compound is used to fill gaps between the CPU (central processing unit) or other heat generating components and the mechanical heat sink. The mechanical heat sink, a passive component made of a conductive metal, is placed over the CPU.

2.10 Water pump

WATER PUMP

Rotary vane vacuum pump works on a positive-displacement pumping principle. The design consists of a rotor, which is mounted eccentrically inside a cylindrical housing or stator. Blades, mounted inside the rotor, move in and out due to centrifugal force following the internal surface of the tank for water flow.

CHAPTER 03
System Development

3.1 System Block diagram

In this part of this project we added here Block diagram automatic refrigeration System. Here we are going to describe about our hardware part by showing part by part in this block diagram. We use here a ESP8266 or Node MCU to control this total system which is shown here in the right side of cooling chambers of this diagram. Right side middle point are added a SMPS, which is included here to produce needed ampere or voltage to operate this all instruments.

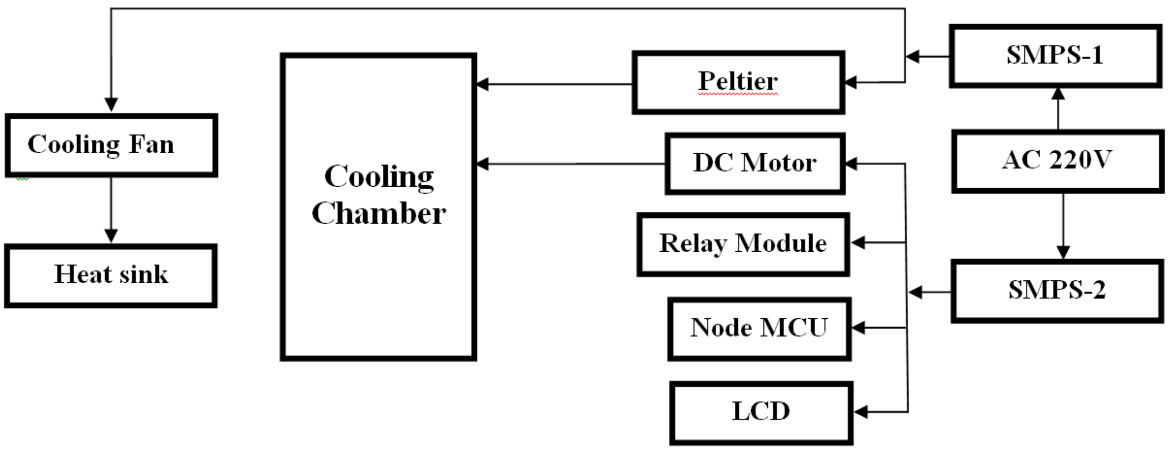

Figure 3.1: Block diagram of the proposed system

In the upper side of voltage regulator we included here a 2 channel relay module which will control our peltier and cooling fan. Peltier is basically used here to generate Hot temperature and cold temperature in both side serially. We will use cold side into our refrigerator. And hot side are used in outside. Cooling fan is used to flow air to heat sink in this way heat will spreed to air and heat sink comes to cool position. we use here a node MCU to control our total system. To make sure the power supply we use here a 30A, 12V SMPS. When temperature will be upper then 30 degree Celsius at that moment peltier will be on to reduce the temperature of cooling chamber. And cooling fan will start in background to reduce the temperature of Heat sink that is attached with Hot side of Peltier. We use here magnet to lock our door of cooling chamber. Relay module is used for receive instruction from node MCU to control cooling fan and peltier. Here we use lcd display to show the value of temperature and position of cooling chamber. We use here a buck converter that is mainly used to reduce the dc Voltage from 12V to 5V. that can operate our node MCU, Relay Module, LCD display properly.

3.2 Circuit Diagram

The main components are connected here as per pin diagram and input output direction also. All the components are connected with each other to complete this project.

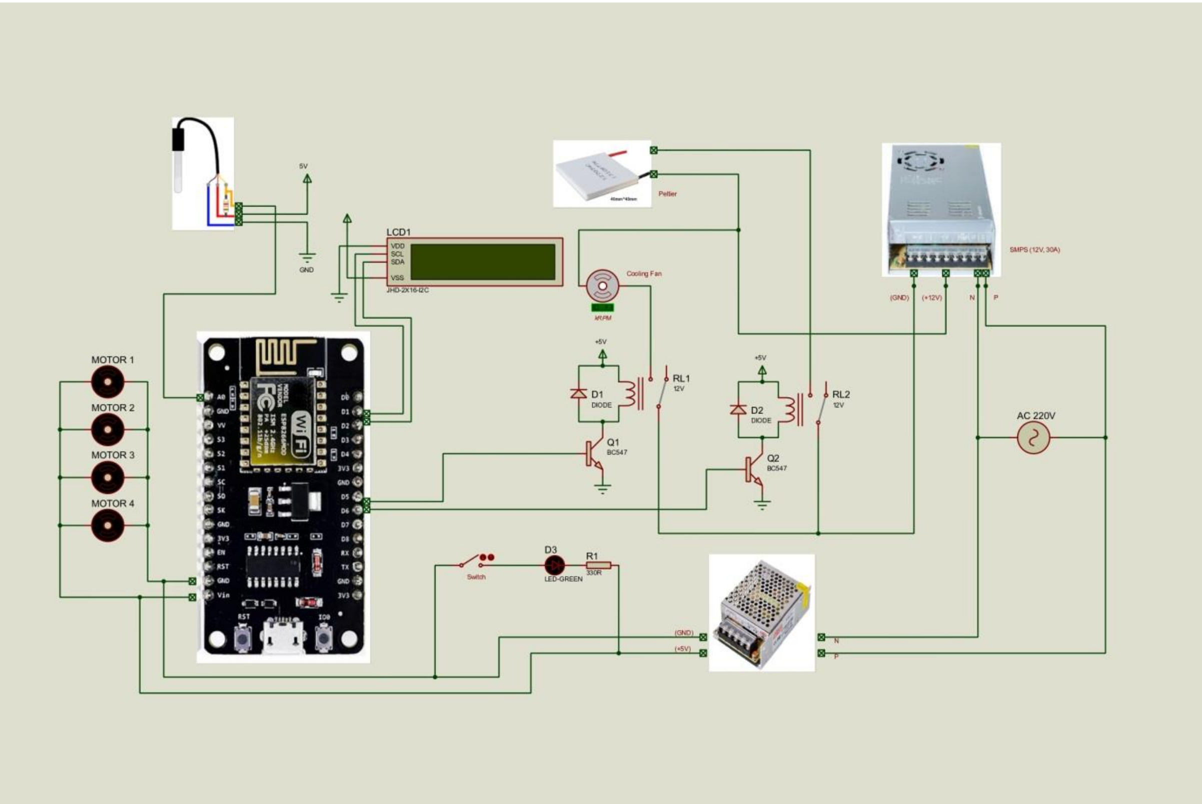

Figure 3.2: Complete circuit diagram of the project

In the Right side of this circuit diagram you see here that we included here an AC supply to make sure the power for all components but our all components are work on DC voltage. So we have to convert this AC voltage to DC voltage properly. To conversion of this voltage we use here Two SMPS, One is 12V SMPS and another is 5V SMPS. Which will Convert the ac voltage 220V AC to 12V DC and 5V DC serially. We use here a node MCU to control our total system. When primary data showing will be complete in our LCD at that moment peltier will be Turn ON to reduce the temperature of cooling chamber. And cooling fan will start in background to reduce the temperature of Heat sink that is attached with Hot side of Peltier. We use here magnet to lock our door of cooling chamber. Relay module is used for receive instruction from Node MCU to control cooling fan and peltier. To make sure light in our Cooling chamber, we use here a LED light and use a manual switch to turn on or off this LED. Here we use LCD display to show the value of temperature and position of cooling chamber. It can operate our node MCU, Relay Module, LCD display properly. The main part of this system is Node MCU.

3.3 Working Procedure

As discussed earlier, our project is all about providing peltier refrigeration system we use here a node MCU to control our total system. To make sure the power supply we use here a 30A, 12V SMPS. When temperature will be upper then 30 degree Celsius at that moment peltier will be on to reduce the temperature of cooling chamber. And cooling fan will start in background to reduce the temperature of Heat sink that is attached with Hot side of Peltier. We use here magnet to lock our door of cooling chamber. Relay module is used for receive instruction from node MCU to control cooling fan and peltier. Here we use lcd display to show the value of temperature and position of cooling chamber. We use here a buck converter that is mainly used to reduce the dc Voltage from 12V to 5V. that can operate our node MCU, Relay Module, LCD display properly.

CHAPTER 04
Hardware Implementation

4.1 Introduction

In this chapter we will show the hardware output of our project. In this system we use here a cooling chamber with cooling side of peltier. Which is used here to reduce the temperature of cooling chamber. Outside of cooling chamber included hot side of peltier and cooling fan to spreed the temperature of Heat sink.

4.2 Project Overview

This is the full over view of our project.

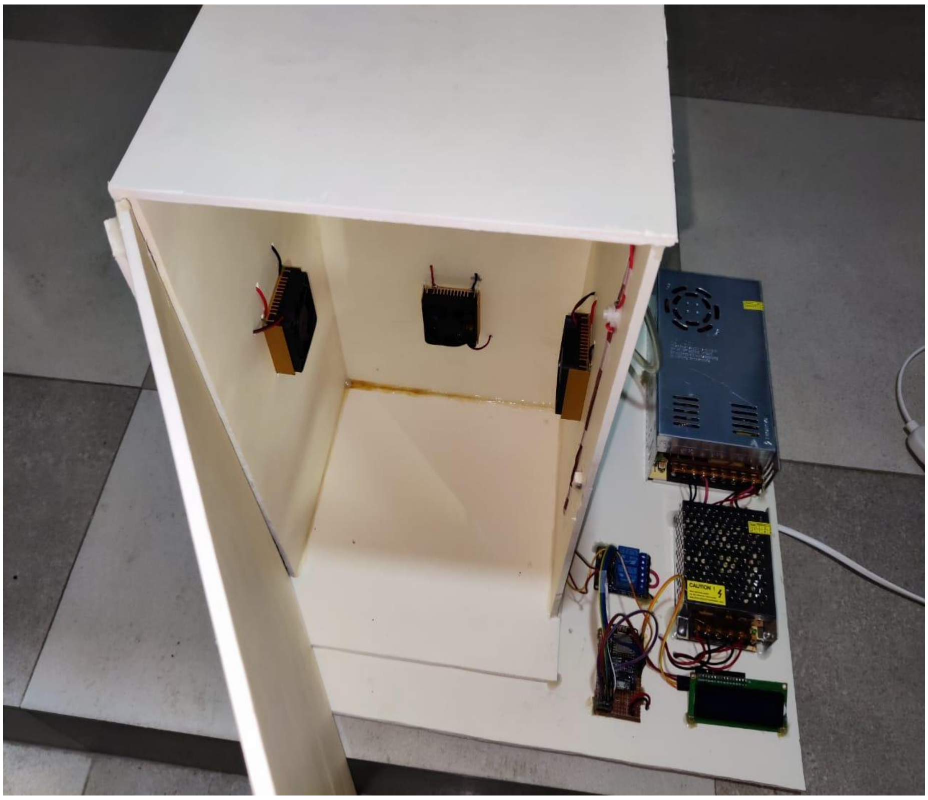

Figure 4.1: Project Overview

4.3 Results

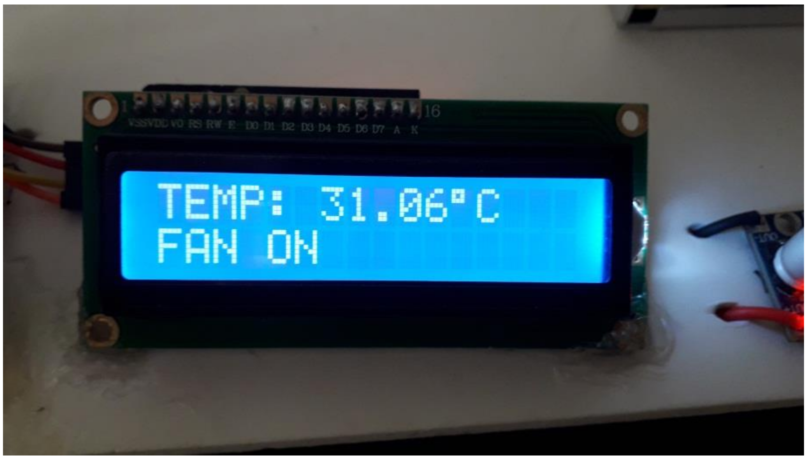

Figure 4.2: Showing Temperature

Heat Equation:

Q = Quantity of Heat m = Mass Of water s = Specific Heat Capacity

T1= Minimum Temperature T2 = Maximum Temperature

Mathematical calculation:

Q = 84000j

m = 2g

s = 4200j

T1 = 20

T2 = 30

$Q = ms\Delta T$

=2*4200*(30-20)

= 84000 j

CHAPTER 05

Advantage & Limitation

5.1 Advantage

- It can be easily moved one place to another place.
- Here DC current is used.
- By this it is possible to preserve goods.
- It can be easily carried in those remote areas where it is not to possible to carry a refrigerator easily.
- Its simple operation system.
- Currently, it is possible to use emergency medicines and food items in other programs including educational tours.
- It reduces to growth bacteria.

5.2 Conclusion

finally, it can be conveniently concluded that the project is quire challenging. However, it is undoubtedly interesting as well as inspirational as sufficient information and basis have been made available for future and further research relating to this project. we hope that the design will meet the day to day need for refrigeration.

REFERENCES

[1] M. Ngafifi, "Kemajuan Teknologi dan Pola Hidup Manusia dalam Perspektif Sosial Budaya," UNY, Yogyakarta, 2014.

[2] D. a. K. J. Joo, "Creative & active convergence model of IoT," Korea Institute for Industrial Economics & Trade, Korea, 2014.

[3] Ken Black, "What is a Smart Refrigerator?", 2017, Conjecture Corporation [Online]. Available: http://www.wisegeek.com/what-is-asmart-refrigerator.htm. [Accessed 01 May 2017].

[4] S. Griffiths, "Never run out of food again! Smart mat warns you when you're low on milk while Fridge Cam lets you remotely check what you already have during your weekly shop", 5 January 2016. [Online]. Available: http://www.dailymail.co.uk/sciencetech/article3385278/Never-run-food-Smart-mat-tells-low-milk-fridge-cam-shows-sinside-shopping.html. [Accessed 1 May 2017].

[5] G. S. Nayak, G. and P. C, "Intelligent Refrigerator with Monitoring Capability through," IJCA, 2011.

[6] R. S. Khosla, P. S. Chheda and S. R. Dedhia, "Smart Refrigerator," IJRITCC, Mumbai, 2016.

[7] Dallas, "DS18B20 Programmable Resolution 1-Wire® Digital Thermometer," [Online]. Available: https://cdn.sparkfun.com/datasheets/Sensors/Temp/DS18B20.pdf. [Accessed 10 May 2017].

APPENDIX

A. Programming Codes

```
// Include the libraries we need
#include <OneWire.h>
#include <DallasTemperature.h>
#include <LiquidCrystal_I2C.h>
LiquidCrystal_I2C lcd(0x27, 16, 2);
// Data wire is plugged into digital pin 2 on the Arduino
#define ONE_WIRE_BUS D5
// Setup a oneWire instance to communicate with any OneWire device
OneWire oneWire(ONE_WIRE_BUS);
// Pass oneWire reference to DallasTemperature library
DallasTemperature sensors(&oneWire);

int peltier = D6;
int fan=D7;

void setup(void)
{
  delay(1000);
  lcd.init();
  lcd.backlight();
  sensors.begin();
```

```
pinMode(D6, OUTPUT);
pinMode(D7, OUTPUT);

digitalWrite (D6,HIGH);
digitalWrite (D7,HIGH);

lcd.setCursor(2,0);
lcd.print("WELCOME TO");
delay(1000);
lcd.clear();

lcd.setCursor(1,0);
lcd.print("REFREZARATION");
lcd.setCursor(3,1);
lcd.print("SYSTEM");
delay(1000);
lcd.clear();

lcd.setCursor(0,0);
lcd.print("SUPERVISED BY");
lcd.setCursor(0,1);
lcd.print("Mainul Hasan");
delay(1000);
lcd.clear();
```

```
lcd.setCursor(0,0);
lcd.print("PRESENTED BY");
delay(1000);
lcd.clear();

lcd.setCursor(1,0);
lcd.print("Kawser Ahmed");
lcd.setCursor(1,1);
lcd.print("Ziaul Hoque");
delay(1000);
lcd.clear();

lcd.setCursor(1,0);
lcd.print("Kamruzzaman");
lcd.setCursor(1,1);
lcd.print("Abdur Rahim");
delay(1000);
lcd.clear();

lcd.setCursor(1,0);
lcd.print("Tajbin Ahmed");
delay(1000);
lcd.clear();
```

```
}
void loop(void)
{
  sensors.requestTemperatures();
  lcd.setCursor(0,0);
  lcd.print("TEMP: ");
  lcd.print(sensors.getTempCByIndex(0));
  lcd.print((char)223);
  lcd.print("C");
  delay(1000);
  lcd.clear();

  /////////////////TEMPERATURE HIGH ////////////////////

if (sensors.getTempCByIndex(0)>30)
{
  lcd.clear();
lcd.setCursor(0, 0);
lcd.print("IT'S HOT");
delay(1000);

  lcd.clear();
lcd.setCursor(0, 0);
lcd.print("PELTIER ON");
lcd.setCursor(0, 1);
```

```
lcd.print("FAN ON");
delay(1000);

digitalWrite (D6,LOW);
digitalWrite (D7,LOW);
}

//////////////////// TEMPERATURE MIDDLE //////////////////

if ((sensors.getTempCByIndex(0)<30)&& (sensors.getTempCByIndex(0)>15))
{
  lcd.clear();
lcd.setCursor(0, 0);
lcd.print("IT'S COLLING");
delay(1000);

  lcd.clear();
lcd.setCursor(0, 0);
lcd.print("PELTIER ON");
lcd.setCursor(0, 1);
lcd.print("FAN ON");
delay(1000);

digitalWrite (D6,LOW);
digitalWrite (D7,LOW);
```

```
}

////////////////////// TEMPERATURE LOW /////////////////////////

 if (sensors.getTempCByIndex(0)<15)
{
  lcd.clear();
lcd.setCursor(0, 0);
lcd.print("IT'S COLD");
delay(1000);

lcd.clear();
lcd.setCursor(0, 0);
lcd.print("PELTIER OFF");
lcd.setCursor(0, 1);
lcd.print("FAN ON");
delay(1000);

digitalWrite (D6,HIGH);
digitalWrite (D7,LOW);
}
}
```