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SMART MONITORING OF REFRIGERATOR

Project Report

Submitted for the course:

Sensors and Instrumentations (ECE1005)

Slot-TG1

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ABSTRACT:-

Rapid improvement in technology tend to use smarter devices in day to day life, one such device is refrigerator. In the modular kitchen and shops refrigerator plays a major role in preserving food items. There is a need for more efficient way to monitor the amount of food materials left for the forth coming days and in case of shop it is necessary to avail the required quantity to improve the business The problem with the old version refrigerators is that people had to constantly check for the remaining quantity of fruits and vegetables and also had to check for any spoilage of food and shortage of food. In these times when everyone is busy with work no one has time to check the refrigerator for the available goods. So instead a force sensor can be set up under the vegetable and fruit tray of the refrigerator to check for the updates. If the weight falls below the threshold value it will send a message to the phone that this food is going to be empty regarding the same for which you can tke action rather than going home after long hours at work and checking the fridge for availability of vegetables and then going to buy the required groceries.MQ3 module is used to check the spoilage of food. If in extreme conditions, the food in the refrigerator gets spoiled ,then,MQ3 module will send a message to the phone that the food is going to be spoiled.

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Literature review

Wu HH al.[1]In there project In this paper, we first describe the overall design of a low-cost Smart Refrigerator built with Raspberry.They have used raspberry pi which is very costlier than other microcontroller and also it does not have internal storage. Luk BG al.[2]in there paper they have showed A smart refrigerator system includes a plurality of compartments for storing food items and one or more tag readers. The smart refrigerator system may read a tag coupled to a food item using one of one or more tag readers. but this model used tag reader which have very shorter range we can not gather data from the fridge if we are out of the range of this tag reader .Alolayan Bushra [3]in there paper, their project based on Based on the technology of radio frequency identification (RFID), combined with Internet and information processing technology, intelligent refrigerator for food management is developed, food records the within the refrigerator is achieved.

INTRODUCTION:-

Artificial Refrigeration began in the mid-1750s, and developed in the early 1800s . In 1834,the first working vapor-compression refrigeration system was built . The first commercial ice-making machine was invented in 1854 . In 1913,refrigerators for home use were invented . From there lot of development had been taking place but still the refrigerator system lagged in terms of computational capacity . With tremendous improvement in technology, all devices are connected to the internet which forms the internet of things. The sensors are used to collect the data and send them to a host where it is intended to be processed over the internet. Improvement in the technologies, made our day-to-day life simpler. The technologies implemented using IoT in electrical appliances at homes made it smarter . One of those technologies is smart refrigerator which is used to store the food items. Refrigerators are used to prevent the spoilage of food and keep it fresh. It reduces illness and make our lifestyle healthier in the modern world . So here in this project we show how to monitor the refrigerator smartly from mobile .

METHODOLOGY:-

MATERIALS USED:

1.ARDUINO

2.GSM MODULE

3.FORCE SENSOR

4.MQ3 MODULE

a)TO CHECK THE QUANTITY OF FOOD:-

To check the quantity of Food present in the refrigerator force sensor is used to detect the threshold amount of vegetable in refrigerator . Arduino will store two types of value , one is maximum value and the other is minimum value . When Force sensor show minimum value then it will activate GSM module and send a message to the user that food is going to be empty and according to that if the user wants to buy the food he can place an order through online grocery shopping. The order can be placed just by accepting or rejecting the suggestion in the notification itself, which automatically places an order . The main focus is to develop a weight monitoring system and a mobile application to monitor and manage the smart fridge which makes the work done by humans simpler.

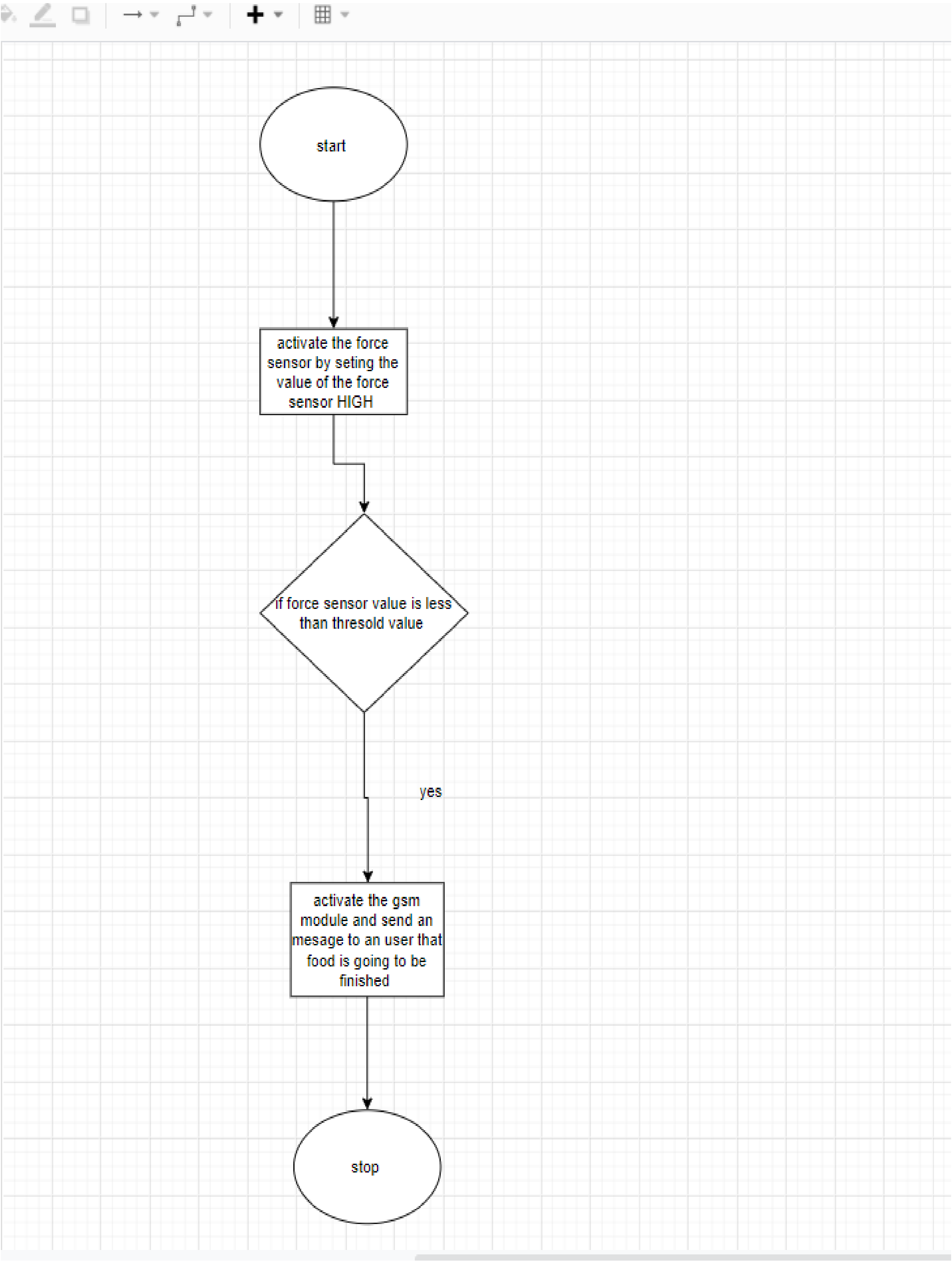

start
activate the force sensor by seting the value of the force sensor HIGH
if force sensor value is less than thresold value
yes
activate the gsm module and send an mesage to an user that food is going to be finished
stop

Fig-1 Flow Chart To Detect The Quantity Of food

b) **TO CHECK THE QUALITY OF FOOD:-**

To check the quality of the food first Arduino will activate the MQ3 module which will detect the excess formation of ethene which is the main cause to spoil the food so whenever the food is going To check the quality of the food, first Arduino will activate the MQ3 module which will detect to get spoiled depending on the concentration of Ethene sensed by the MQ3 module then the Arduino working will send a message through GSM Module to the mobile phone notifying that the respective food is going to be spoiled and further necessary actions to be taken . This is how the entire proposed IOT system will work when the food is on the verge of getting spoiled.

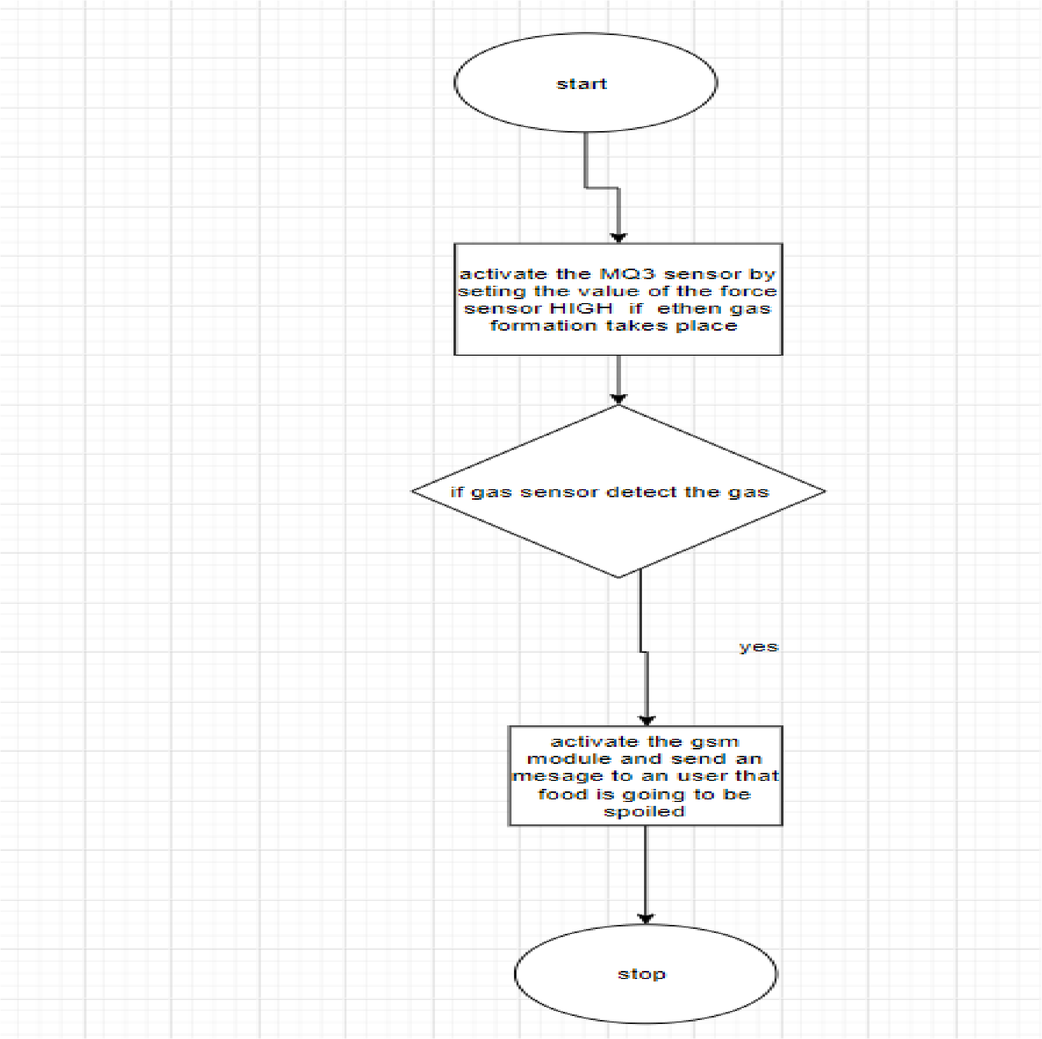

start
activate the MQ3 sensor by seting the value of the force sensor HIGH if ethen gas formation takes place
if gas sensor detect the gas
yes
activate the gsm module and send an mesage to an user that food is going to be spoiled
stop

Fig-2 To Determine The Quality Of Food

<u>ARDUINO CODE</u>:-

```
#include <SoftwareSerial.h>

#define gas_Pin 7

SoftwareSerial SIM900(2,3);

int gas_value;


void setup()

{

   Serial.begin(9600);

   SIM900.begin(19200);


   delay(20000);   // give time to log on to network.

}

void loop()

{




        gas_value = digitalRead(gas_Pin);

        int sensorValue = analogRead(A0);


        if( sensorValue==850)

       {
        SIM900.print("AT+CMGF=1\r");// AT command to send SMS message

        Serial.print("AT+CMGF=1\r" );

        delay(100);

        SIM900.println("AT + CMGS = \"+919609022562\"");// recipient's mobile number, in international format

         Serial.print("AT + CMGS = \"+919609022562\"" );


        delay(100);

        SIM900.println("food is going to empty.");          // message to send

        Serial.print("food is going to empty." );

        delay(100);

        SIM900.println((char)26);// End AT command with a ^Z, ASCII code 26

        Serial.print((char)26);

        delay(100);

        SIM900.println();

        delay(5000);                                       // give module time to send SMS


        //do {} while (1);


      }


      if(gas_value==1)

    {
```

```
    SIM900.print("AT+CMGF=1\r");// AT command to send SMS message
    Serial.print("AT+CMGF=1\r" );
    delay(100);
    SIM900.println("AT + CMGS = \"+919609022562\"");// recipient's mobile number, in international format
    Serial.print("AT + CMGS = \"+919609022562\"" );


    delay(100);
    SIM900.println("food is going to be spoiled.");        // message to send
    Serial.print("food is going to be spoiled." );
    delay(100);
    SIM900.println((char)26);// End AT command with a ^Z, ASCII code 26
    Serial.print((char)26);
     delay(100);
     SIM900.println();
     delay(5000);                                        // give module time to send SMS


    //do {} while (1);
  }
```

CIRCUIT DIAGRAM:-

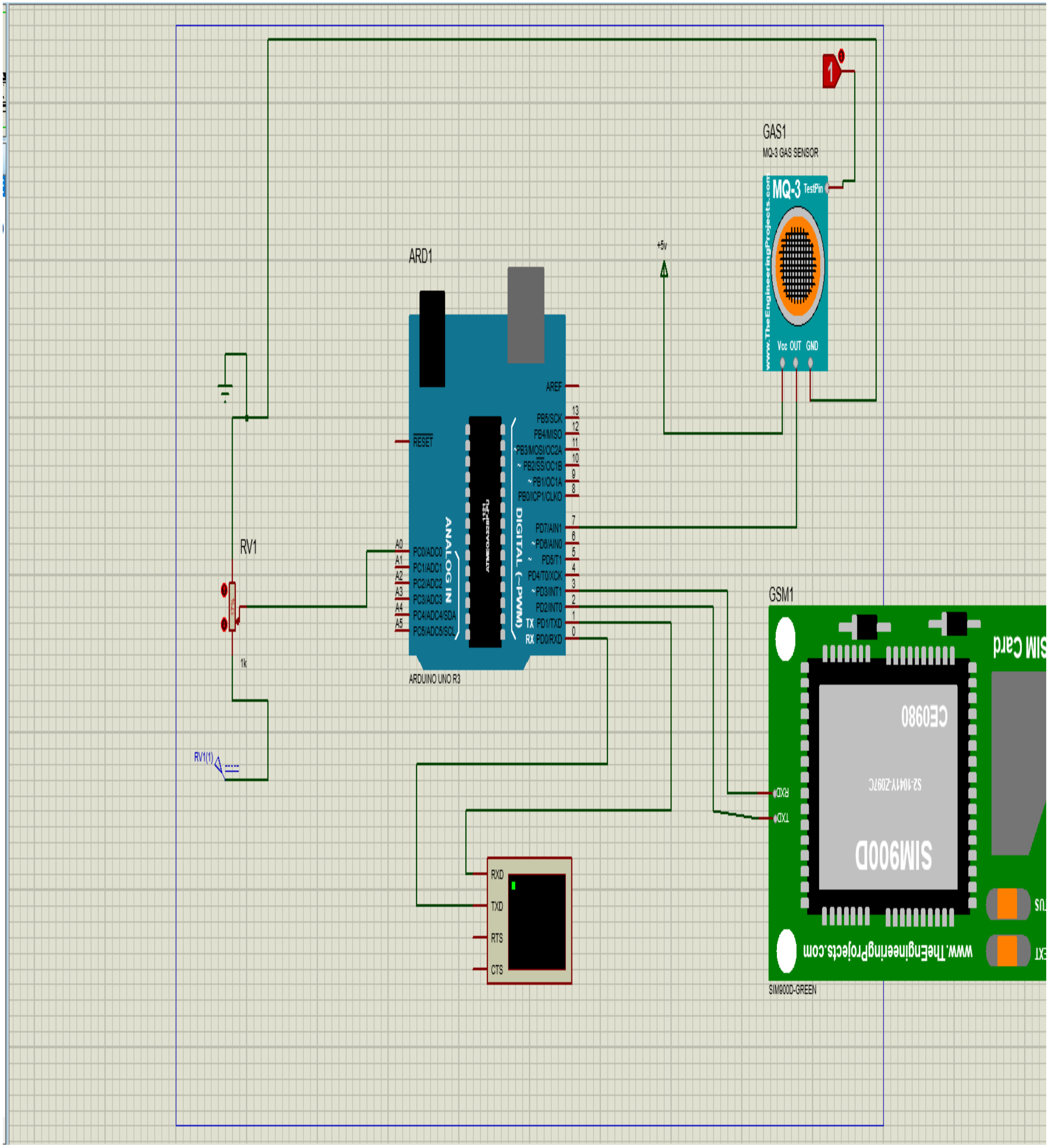
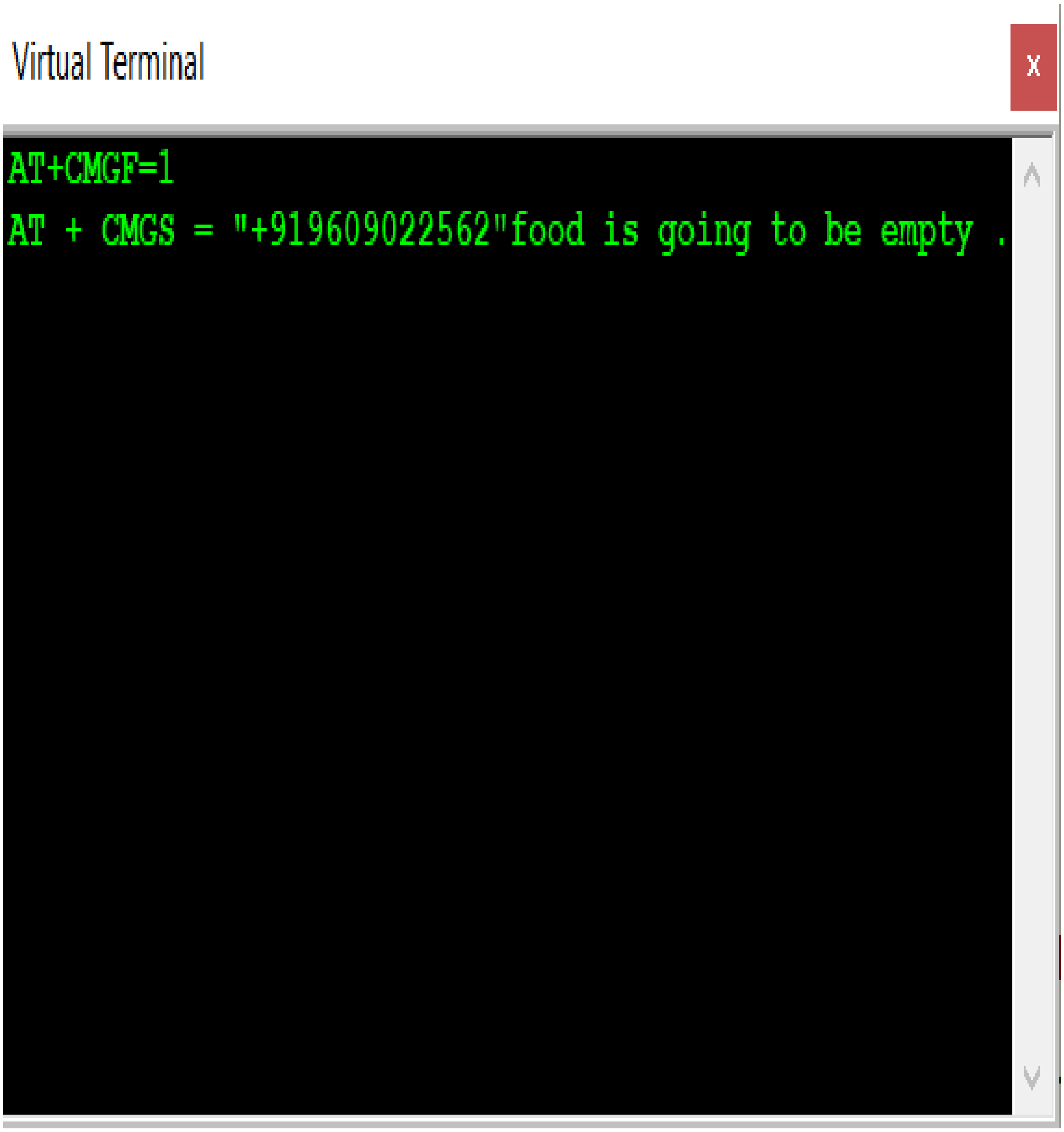


Fig-3 Circuit Diagram

RESULTS:-

a)TO DETECT THE QUANTITY OF FOOD:-

Here when force sensor show an minimum value then it will notify the user that food is going to be empty and an urgent need is there to place an order.

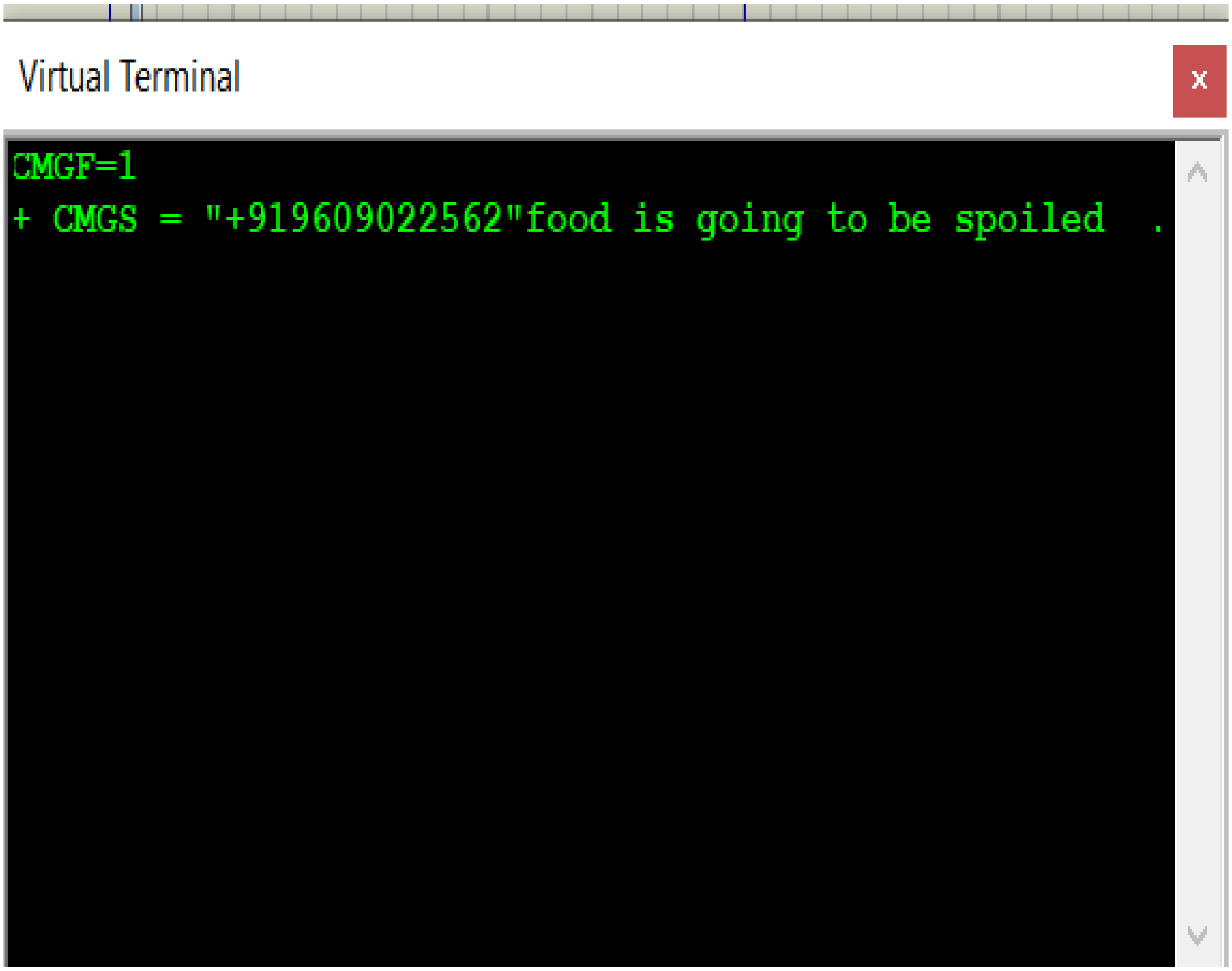


```
AT+CMGF=1
AT + CMGS = "+919609022562"food is going to be empty .
```

Fig-4result of detection of quantity of food

b)<u>TO DETECT THE QUALITY OF FOOD</u>:-

When the concentration of ethene from the spoiled food increases, the MQ3 sensor according to that will send the message to the mobile phone of the user through GSM module and urge for the food to be removed from the fridge.



```
CMGF=1
+ CMGS = "+919609022562"food is going to be spoiled  .
```

Fig-5 result of detection of quantity of food

CONCLUSIONS:-

A Smart Refrigerator system has been proposed for sensing the weight of a food item which is placed in the vegetable and fruit trays of the refrigerator and urges the user to place an order to grocery shop if it going to finish . It also checks for the spoilage of food depending on the sensing of ethene concentration through MQ3 module and according to the situation sends the message on the user’s mobile phone and urges for the food to be removed .So in this way the smart refrigerator keep the record of quality and quantity of food in refrigerator . This Smart Refrigerator system saves manual effort and time in predicting the future needs

RECOMMENDATIONS:-

This smart refrigator system only provide the information regarding quality and quantity of food it will not advise the user about the dishes that can be made by remaing food that is present in the refrigator and it is also not able to detect any lekage of gas from compressor that can cause huge hazardous so in future this system may be expanded to detect any gas leakage from the fridge compressor to avoid any damages in the future and also which will create a full fledged IoT system for smart refrigeration . This system may also be made to display the content inside the fridge from a remote place based on the food available the refrigerator will advise user a different dishes that can be made by the food item that is remain inside the refrigerator .This can be done by integrating machine learning code in Arduino .

ACKNOWLEDGEMENTS:-

We would like to thank our faculty, Prof. Swati G , for helping and guiding us through the project . We would also like to thank researchgate.net for giving us the idea on how to create a fully fledged Iot System for Smart Refrigeration . We would also like to thank fellow researchers as reading their journals on Smart refrigeration system gave us an idea to proceed in a different way rather than making same IoT based smart refrigeration system . We would like to thank the below mentioned researchers and writers for their ideas which they presented in various conferences and also which helped us create a most required IoT system which the current world needs.

REFERENCES:-

[1]Wu HH, Chuang YT. Low-cost smart refrigerator. In2017 IEEE International Conference on Edge Computing (EDGE) 2017 Jun 25 (pp. 228-231). IEEE.

[2]Luk BG, Tang Y, Bates RC, inventors; PayPal Inc, assignee. Compartmentalized smart refrigerator with automated item management. United States patent US 9,449,208. 2016 Sep 20.

[3] Qiao S, Zhu H, Zheng L, Ding J. Intelligent refrigerator based on internet of things. In2017 IEEE International Conference on Computational Science and Engineering (CSE) and IEEE International Conference on Embedded and Ubiquitous Computing (EUC) 2017 Jul 21 (Vol. 2, pp. 406-409). IEEE.

[4] Alolayan Bushra (2014). Do I Really Have to Accept Smart Fridges? An empirical study. In the Proceedings of the Seventh International Conference on Advances in Computer-Human Interactions (ACHI 2014) pp186-191

Appendix A

About Sensor and network connectivity

Force Sensor - Force sensors are responsible for measuring the force acting on an object. As a golden rule, both tensile and pressure forces, as well as elastic deformations are measured.

Moreover, there are different variants in which force may be measured and determined through the sensors.

The required and desired measuring range and expected accuracy are the primary criteria to evaluate which kind of force transducer is suited for the respective application.

The more precise the values need to be and the smaller the measuring range, the more receptive the force sensors should be.

Gas Sensor: A gas sensor is a device which detects the presence or concentration of gases in the atmosphere. Based on the concentration of the gas the sensor produces a corresponding potential difference by changing the resistance of the material inside the sensor, which can be measured as output voltage. Based on this voltage value the type and concentration of the gas can be estimated.

The type of gas the sensor could detect depends on the **sensing material** present inside the sensor. Normally these sensors are available as modules with comparators as shown above. These comparators can be set for a particular threshold value of gas concentration. When the concentration of the gas exceeds this threshold the digital pin goes high. The analog pin can be used to measure the concentration of the gas.

GSM-Module: A **GSM Module** is basically a GSM Modem (like SIM 900) connected to a PCB with different types of output taken from the board – say TTL Output (for Arduino, 8051 and other microcontrollers) and RS232 Output to interface directly with a PC (personal computer).

Appendix B

About Microcontroller

Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

Hardware description of Arduino

In Arduino there are 14 pin Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(),digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.
In addition, some pins have specialized functions:Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.LED: 13. There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library. The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function.There are a couple of other pins on the board:AREF. Reference voltage for the analog

inputs. Used with analogReference().Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

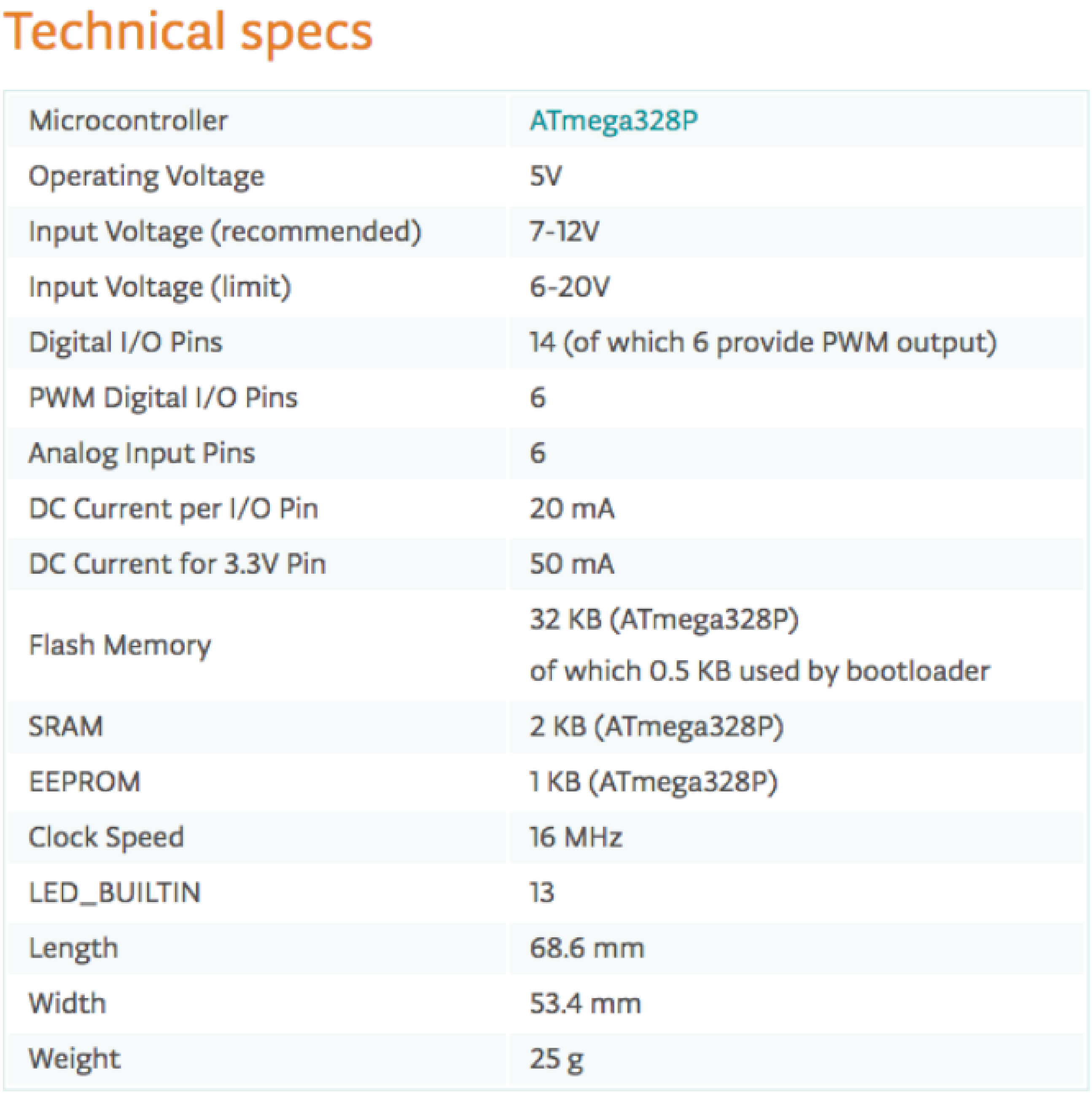
Power To arduino:

The Arduino/Genuino Uno board can be powered via the USB connection or with an external power supply. The power source is selected automatically.
External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the GND and Vin pin headers of the POWER connector. The board can operate on an external supply from 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may become unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts. The power pins are as follows: Vin. The input voltage to the Arduino/Genuino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.5V.This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. We don't advise it.3V3. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.GND. Ground pins.IOREF. This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.

Memory in Arduino :-

The ATmega328 has 32 KB (with 0.5 KB occupied by the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM

Appendix C



Technical specs

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g