VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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Mini-Project Report

On

"FOOD QUALITY DETECTOR"

Submitted in Partial fulfillment of the Requirements for 6th Semester

Bachelor of Engineering in Electronics and Communication Engineering

Submitted by

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2021-22

K S SCHOOL OF ENGINEERING AND MANAGEMENT

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that the Mini-project work "**FOOD QUALITY DETECTOR**" carried out by **Bhavana S (1KG19EC013), Manjunath M (1KG19EC059), Samarth Srinivas (1KG19EC085), Steffi K Thomas (1KG19EC091)** bonafide students of KSSEM in partial fulfillment for the award of Bachelor of Engineering in Electronics and Communication Engineering under **Visvesvaraya Technological University, Belgaum** during the year 2022. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the departmental library. The report has been approved as it satisfies the academic requirements in respect of Mini-Project work prescribed for the said Degree.

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ACKNOWLEDGEMENT

The successful completion of this mini-project was made possible with the help of guidance received from our faculty members. We would like to avail this opportunity to express our sincere thanks and gratitude to all of them.

We are grateful to our management for providing the necessary infrastructure and an ambience environment to work. We express our profound gratitude to **Dr. K Rama Narasimha**, Principal and **Dr. Girish V Attimarad**, Head of Department of Electronics & Communication Engineering, KSSEM, Bengaluru for giving us opportunity and support to complete the project work.

We are grateful to my guide **Ms. Renuka V Tali**, Assistant Professor, Department of Electronics and Communication Engineering, KSSEM, Bengaluru for his/her valuable suggestions and advice throughout our work period.

We would also like to thank all the staff members of Department of Electronics and Communication Engineering and for their support and encouragement. Finally, we would like to thank all of our friends without whose help and encouragement this project would have been impossible.

Definitely most, we want to thank our family. Words cannot express our thanks to our family members for all their love and encouragement

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ABSTRACT

Food safety and hygiene are among the key concerns in order to prevent the wastage of food. However, for lack of technology and ignorance about the effects of humidity, temperature, exposure to light and alcohol content on foods, food safety is not maintained well enough. This has led to massive losses in many food stores resulting from food decay.

Currently, majority of food stores and warehouses still rely on manual monitoring of the atmospheric factors related to food quality. These conventional food inspection technologies are limited to weight, volume, color and aspect inspection and as a result do not provide a lot of information needed on quality of food.

The quality of the food needs to be monitored and it must be prevented from rotting and decaying by the atmospheric factors like temperature, humidity and dark.

This project is focused on such a food monitoring system which suggests systematic use of sensors to perform quality monitoring and control of food materials.

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CHAPTER -1

INTRODUCTION

1.1 Background

Food contamination can occur in the production process, but also a large part caused by the inefficient food handling because of inappropriate ambient conditions when the food is being transported and stored. There are many factors leading to food poisoning, typically changes in light intensity, temperature, alcohol content and humidity are important factors.

Today almost everybody is getting affected by the food they consume, it's not only about the junk food, but all the packed foods, vegetables, products consumed and used in daily life, as all of them do not offer quality since their temperature, moisture, oxygen content vary from time to time.

Majority of consumers only pay attention to the information provided on the packaging, i.e., the amount of ingredients used and their nutritional value but they forget that they are blindly risking their health by ignoring the environmental conditions to which these packets are subjected. Every product making firm just want to attract more and more costumers towards them and their main motive is to sell the product anyhow like by adding more flavors, coloring chemicals and preservatives to increase the taste and appearance but they forget that these money-making tactics are actually affecting the consumers' health.

High temperature and relative humidity favor the development of post-harvest decay organisms. More acidic tissue is generally attacked by fungi, while fruits and vegetables having pH above 4.5 are more commonly attacked by bacteria. A wide variety of foods can also undergo changes in color, flavor, and nutrient composition when exposed to light.

The extent of these changes depends on many factors including the composition of the food and the light source. Light exposure could result in color and vitamin loss. Light also may be responsible for the oxidation of fats. Some types of yeasts can also lead to spoilage. True yeast metabolizes sugar producing alcohol and carbon dioxide gas. This process is known as fermentation.

supermarket warehouses, supermarket shelf lives, farm output food stores and warehouses, food production industries, food shipment and containers and other food storage facilities. The system we propose is intended for food quality monitoring. In this project, a similar food quality monitoring device will be designed that will keep watch of quality of the food.

1.2 Problem statement

Spoiled food can be very harmful for people and should therefore not be consumed. Often, the growth of spoilage organisms results in the loss of whole batches of food.

Food safety and quality has been a major challenge in the food supply chain, stores and warehouses. It is the responsibility of all food service establishments, stores and ware houses to ensure proper safety and quality of food to ensure the health of their customers. Their primary focus should be on implementing the required quality assurance guidelines and standards resulting in process monitoring systems and preventive control measures.

It serves the purpose of preventive consumer health protection by maintaining the required standard ambient conditions needed to preserve the quality of food. However, existing systems have been unable to provide food safety guarantees.

Currently the performances and analysis of routine measurements, aimed at detecting changes in the nutritional or health status of the food does not guarantee that. To ensure food safety and to prevent food wastage, it should be monitored at every stage of supply chain.

1.3 Proposed Solution

This project proposes a system to analyze the ambient conditions under which the food item is being stored and transported. These quality monitoring devices keep a watch on the environmental factor that cause or pace up decay of the food. Later, the environmental factors can be controlled like by refrigeration, vacuum storage etc.

1.4 Aim

The food quality detecting system has the following aims and objectives. The system aims states the main function of the whole system and the system objectives identifies the individual tasks that the parts of the system should achieve.

1.4.1 System Aim

The complete system should be able to analyze the concentration of the methane gas only and conclude that whether the food is good or bad.

1.4.2 System Objectives

The proposed system should be able to:

- Detect the emission of methane gas.
- Detect the quality of the food in the food store.
- Collect data from the sensors and pass to LCD for display and respective LED to blink for good and bad condition.

CHAPTER-2

BLOCK DIAGRAM

BLOCK DIAGRAM

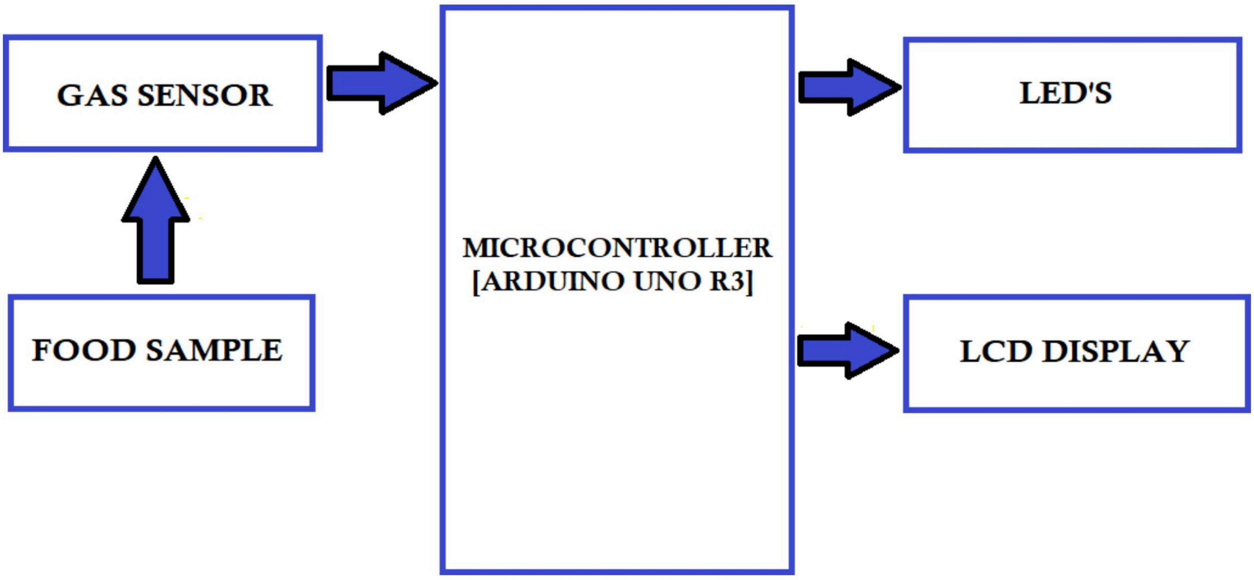


Fig.2.1 Block diagram of the system.

The above figure is the block diagram of our project, where food sample represents the food products that we keep for the testing purpose. So, when we place the food sample to the MQ4 gas sensor it will detect the amount of methane gas that is present in the food sample and it gives the analog output as we should monitor continuously. The data which is detected by the gas sensor is transferred to the Arduino UNO R3 which is an embedded system basically a microcontroller. So, the system will convert the received analog data to the digital data. The digital data which is obtained is transferred to LED and LCD. Where we can see the output via LED (light emitted diode), here we used 2 LED's green and red, where green represents food is good and bad represents the food is bad and LCD (liquid crystal display) which displays the CH_4 amount and food quality. Hence, we can conclude that food is tested.

CHAPTER-3

HARDWARE COMPONENTS

& SOFTWARE REQUIREMENTS

3.1 HARDWARE COMPONENTS:

3.1.1 ARDUINO UNO R3:

Arduino UNO is a microcontroller board based on the **ATMega328P**. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

Its features are as follows –

i. ATMega328P Processor

ii. Memory
   - AVR CPU at up to 16 MHz
   - 32KB Flash
   - 2KB SRAM
   - 1KB EEPROM

iii. Power
   - 2.7-5.5 volts

iv. Security
   - Power On Reset (POR)
   - Brown Out Detection (BOD)

v. Peripherals
   - 2x 8-bit Timer/Counter with a dedicated period register and compare channels
   - 1x 16-bit Timer/Counter with a dedicated period register, input capture and compare channels.
   - 1x USART with fractional baud rate generator and start-of-frame detection.
   - 1x controller/peripheral Serial Peripheral Interface (SPI)

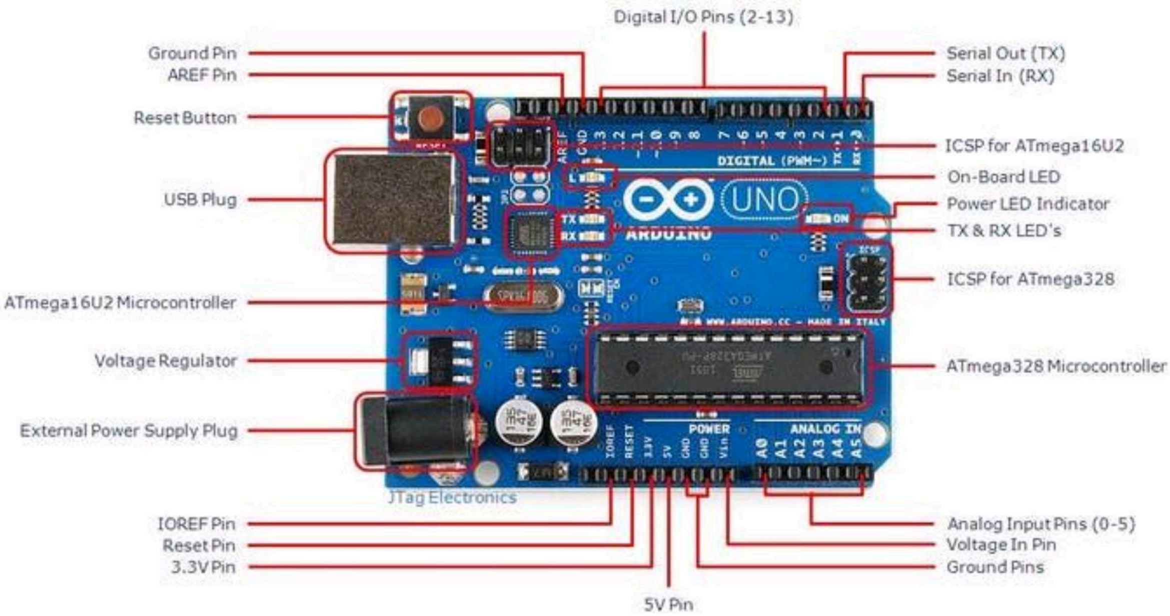


Fig.3.1 Arduino UNO R3

3.1.2 MQ4 GAS SENSORS:

This methane gas sensor detects the concentration of methane gas in the air and outputs its reading as an analog voltage. The concentration sensing range of 300 ppm to 10,000 ppm is suitable for leak detection. For example, the sensor could detect if someone left a gas stove on but not lit. The sensor can operate at temperatures from -10 to 50°C and consumes less than 150 mA at 5 V.

- Features and Specification.
- Straightforward drive circuit.
- Long-lasting & Quick response time.
- Inconsequential smoke and alcohol sensitivity.

Fig.3.2. MQ4 Sensor

- Has high sensitivity for Methane (CH_4) and natural gas.
- Wide range coverage than most detector technologies.
- Semiconductor type sensor.
- More than 24 hours preheat time.

- 20Ω load resistance.
- Lower than 95%RH (Related humidity).
- 750 MW ≥ heat consumption.
- 14 to 122 degrees Fahrenheit operating temperature.
- 1 TTL Compatible interface output (ALR) and 1 TTL compatible interface input (HSW).
- 200ppm to 10000ppm gas detection concentration
- 5V±0.1 VCC power requirement.
- 5V and 0.1 DO Output.
- 0.1V to 0.3V AO output.
- 21% oxygen concentration (when in standard condition).

	Parts	Materials
1	Gas sensing layer	SnO_2
2	Electrode	Au
3	Electrode line	Pt
4	Heater coil	Ni-Cr alloy
5	Tubular ceramic	Al_2O_3
6	Anti-explosion network	Stainless steel gauze (SUS316 100-mesh)
7	Clamp ring	Copper plating Ni
8	Resin base	Bakelite
9	Tube Pin	Copper plating Ni

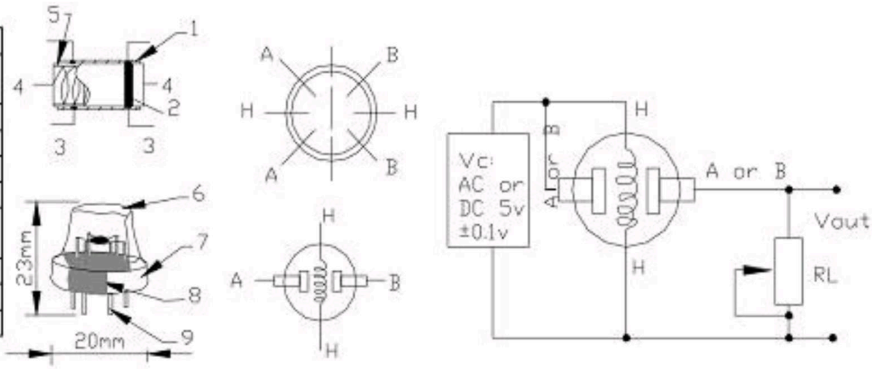


Fig.3.3 Structure and configuration, basic measuring circuit.

3.1.3 LCD DISPLAY (16x2) WITH I2C MODULE:

An LCD screen is an electronic display module that uses liquid crystal to produce a visible image. The 16×2 LCD display is a very basic module commonly used in DIYs and circuits. The 16×2 translates to a display 16 characters per line in 2 such lines. In this LCD each character is displayed in a 5×7pixel matrix.

I2C Module has an inbuilt PCF8574 I2C chip that converts I2C serial data to parallel data for the LCD display.

These modules are currently supplied with a default I2C address of either 0x27 or 0x3F. To determine which version, you have to check the black I2C adaptor board on the underside of the module. If there a 3sets of pads labelled A0, A1, & A2 then the default address will be 0x3F. If there are no pads the default address will be 0x27.The module has a contrast adjustment pot on the underside of the display. This may require adjusting for the screen to display text correctly.

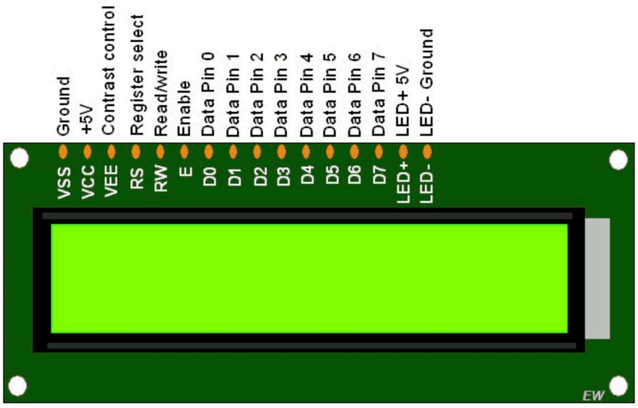


Fig.3.4. LCD (16x2) display

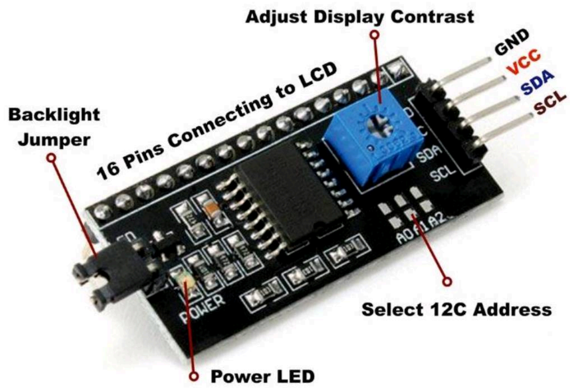


Fig.3.5. I2C Bus

3.1.4 LED:

A light-emitting diode (LED) is a semiconductor device that emits light when an electric current flows through it. When current passes through an LED, the electrons recombine with holes emitting light in the process. LEDs allow the current to flow in the forward direction and blocks the current in the reverse direction.

Light-emitting diodes are heavily doped p-n junctions. Based on the semiconductor material used and the amount of doping, an LED will emit a coloured light at a particular spectral wavelength when forward biased. As shown in the figure, an LED is encapsulated with a transparent cover so that emitted light can come out.

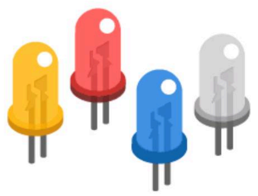


Fig.3.6. LED in different colors

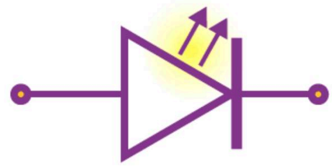


Fig.3.7. Circuit symbol of LED

3.1.5 BREADBOARD:

Breadboards are one of the most fundamental pieces when learning how to build circuits. In this tutorial, you will learn a little bit about what breadboards are, why they are called breadboards, and how to use one. Once you are done you should have a basic understanding of how breadboards work and be able to build a basic circuit on a breadboard.

An electronics breadboard (as opposed to the type on which sandwiches are made) is actually referring to a **solderless breadboard**. These are great units for making temporary circuits and prototyping, and they require absolutely no soldering.

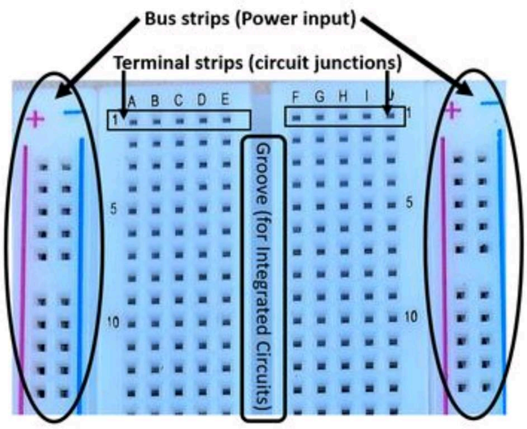


Fig.3.8. Inter connection of breadboard

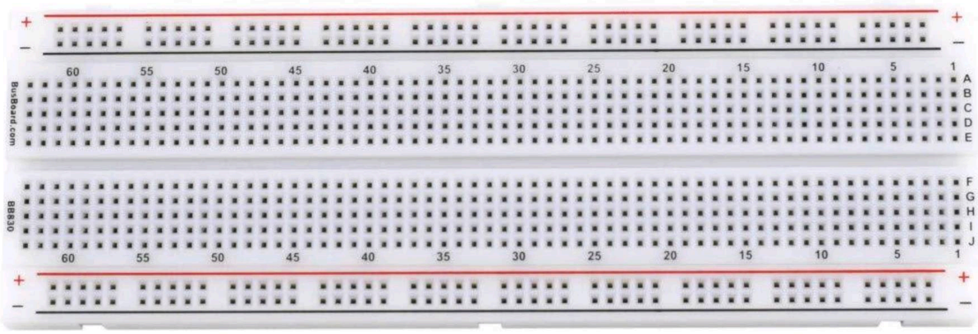


Fig.3.9. Breadboard.

Prototyping is the process of testing out an idea by creating a preliminary model from which other forms are developed or copied, and it is one of the most common uses for breadboards. If you aren’t sure how a circuit will react under a given set of parameters, it’s best to build a prototype and test it out.

3.1.6 JUMPERS:

A jump wire (also known as jumper, jumper wire, DuPont wire) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering.

Individual jump wires are fitted by inserting their "end connectors" into the slots provided in a breadboard, the header connector of a circuit board, or a piece of test equipment.

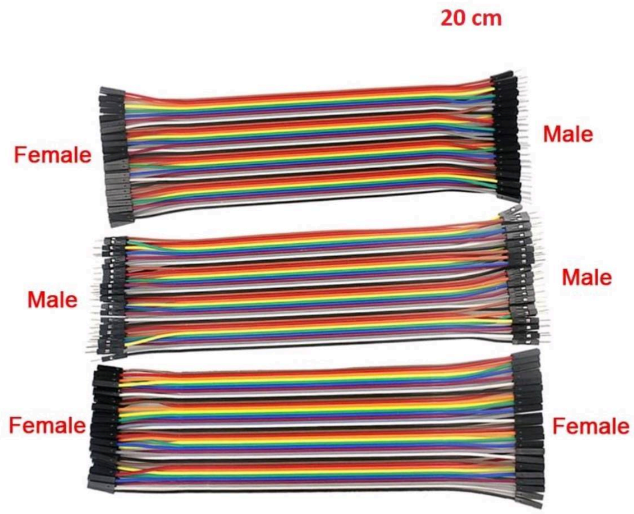


Fig.3.10. Types of jumper wires.

3.1.7 9V BATTERY:

The 9V battery is an extremely common battery that was first used in transistor radios. It features a rectangular prism shape that utilizes a pair of snap connectors which are located at the top of the battery. A wide array of both large and small battery manufacturers produce versions of the 9V battery. Possible chemistries of primary (non-rechargeable) 9V batteries include Alkaline, Carbon-Zinc (Heavy Duty), Lithium. Possible chemistries of secondary (rechargeable) 9V batteries include nickel-cadmium (NiCd) nickel-metal hydride (NiMH), and lithium ion. The performance and application of the battery can vary greatly between different chemistries, meaning that some chemistiries are better suited for some applications over others.

Fig.3.11. 9V Battery.

3.2 SOFTWARE:

3.2.1 ARDUINO IDE

Fig3.12. Arduino IDE symbol

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

Writing Sketches

Programs written using Arduino Software (IDE) are called **sketches**. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

File

- *New:* Creates a new instance of the editor, with the bare minimum structure of a sketch already in place.
- *Open:* Allows to load a sketch file browsing through the computer drives and folders.
- *Open Recent:* Provides a short list of the most recent sketches, ready to be opened.
- *Sketchbook*: Shows the current sketches within the sketchbook folder structure; clicking on any name opens the corresponding sketch in a new editor instance.
- *Examples:* Any example provided by the Arduino Software (IDE) or library shows up in this menu item. All the examples are structured in a tree that allows easy access by topic or library.

Edit

- *Undo/Redo:* Goes back of one or more steps you did while editing; when you go back, you may go forward with Redo.
  - *Cut:* Removes the selected text from the editor and places it into the clipboard.
  - *Copy:* Duplicates the selected text in the editor and places it into the clipboard.

- *Copy for Forum:* Copies the code of your sketch to the clipboard in a form suitable for posting to the forum, complete with syntax colouring.

Sketch

- *Verify/Compile:* Checks your sketch for errors compiling it; it will report memory usage for code and variables in the console area.

- *Upload:* Compiles and loads the binary file onto the configured board through the configured Port.

- *Upload Using Programmer:* This will overwrite the bootloader on the board; you will need to use Tools > Burn Bootloader to restore it and be able to Upload to USB serial port again. However, it allows you to use the full capacity of the Flash memory for your sketch. Please note that this command will NOT burn the fuses. To do so a *Tools -> Burn Bootloader* command must be executed.

Tools

- *Auto Format:* This formats your code nicely, i.e., indents it so that opening and closing curly braces line up, and that the statements inside curly braces are indented more.

- *Archive Sketch:* Archives a copy of the current sketch in .zip format. The archive is placed in the same directory as the sketch.

- *Fix Encoding & Reload:* Fixes possible discrepancies between the editor char map encoding and other operating systems char maps.

- *Serial Monitor:* Opens the serial monitor window and initiates the exchange of data with any connected board on the currently selected Port. This usually resets the board, if the board supports Reset over serial port opening.

- *Board:* Select the board that you're using. See below for descriptions_of_the various_boards.

- *Port:* This menu contains all the serial devices (real or virtual) on your machine. It should automatically refresh every time you open the top-level tools menu.

- *Programmer:* For selecting a hardware programmer when programming a board or chip and not using the onboard USB-serial connection. Normally you won't need this, but if you're burning a bootloader to a new microcontroller, you will use this.

- *Burn Bootloader:* The items in this menu allow you to burn a bootloader onto the microcontroller on an Arduino board. This is not required for normal use of an Arduino board but is useful if you purchase a new ATMega328P microcontroller (which normally come without a bootloader). Ensure that you've selected the correct board from the Boards menu before burning the bootloader on the target board. This command also set the right fuses.

CHAPTER-4

IMPLEMENTATION

4.1 CIRCUIT DIAGRAM

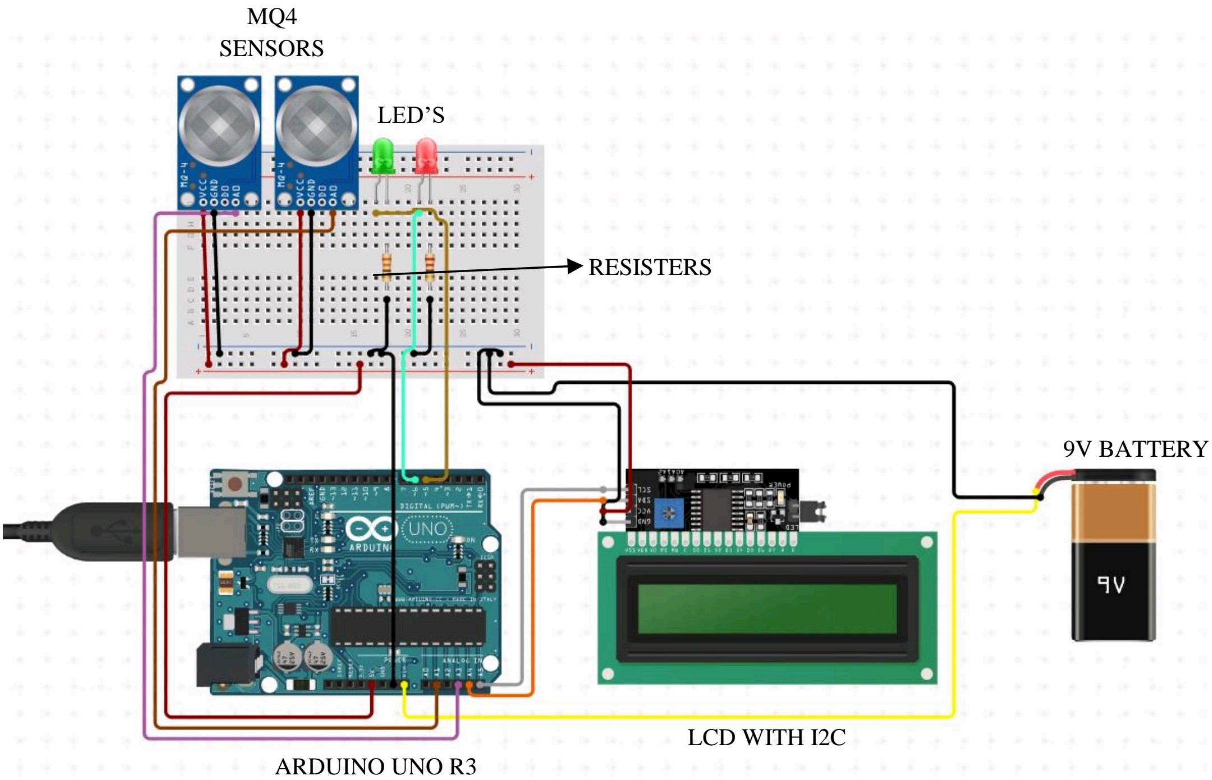


Fig.4.1 Circuit Diagram of the system.

The above figure represents the circuit diagram of the project, it consists of MQ4, Arduino, LCD with I2C, 9V battery and LEDs.

Pin connections are as follows-

- The positive terminal of 9V battery is given to VCC and negative terminal is given to GND of Arduino.
- The VCC pins of all the components are given to 5V and GND pins to GND of Arduino.
- Analog output A0 of one MQ4 to A3 pin and another to A1 pin of Arduino.
- LCD and I2C are connected.
- SCL & SDA of I2C to A4 & A5 of Arduino.

- Digital pin D5 & D6 to green LED & red LED respectively.

4.2 FLOWCHART

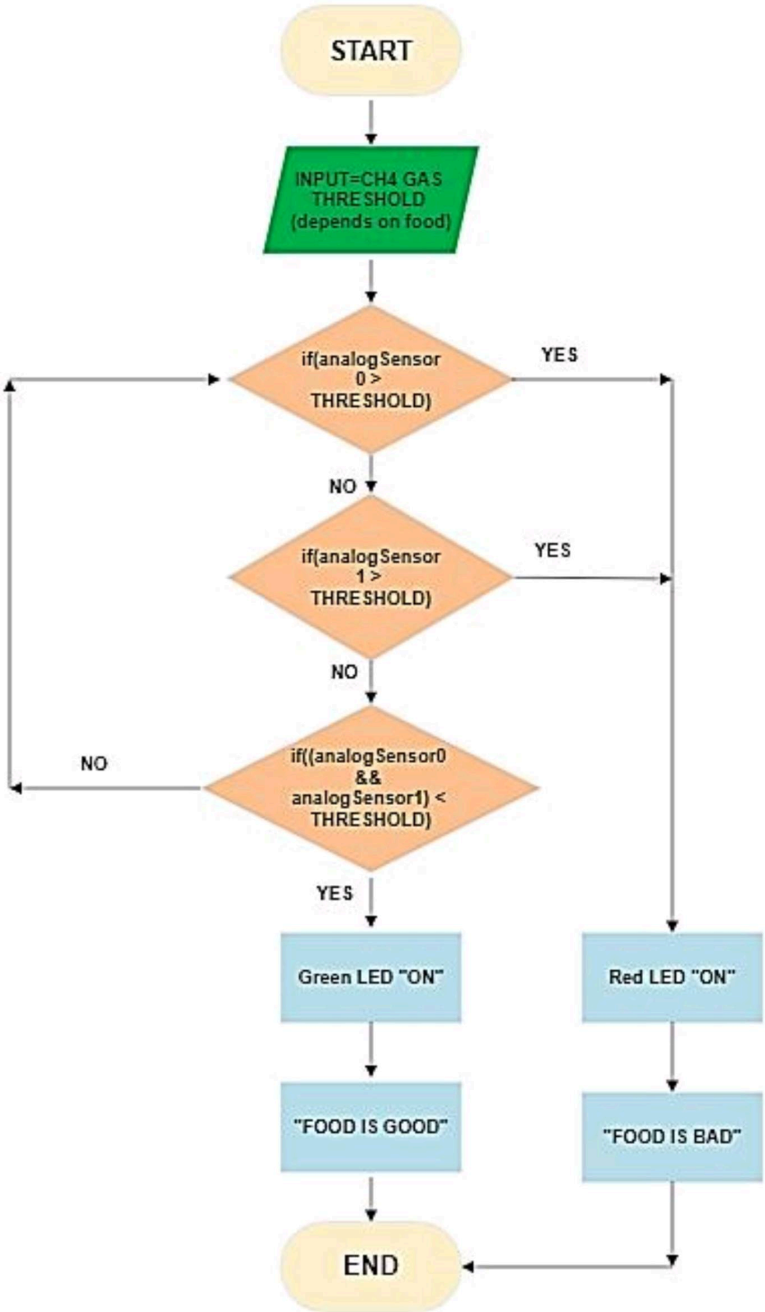


Fig.4.2 Flowchart of the system.

The above figure represents the flow chart, here in this project methane gas sensor senses the amount of methane emitted by the food sample . When the amount of methane gas is less than the given threshold value the gassensor0 will detect and turn 'ON' the green led representing "food is good" and when it is false red led will be 'ON' representing "food is bad". Similarly When the amount of methane gas is less than the given threshold value the gassensor1 will detect and turn 'ON' green led representing "food is good" and when it is false red led will be 'ON' representing "food is bad". Then the third condition is that when both the sensors that is gasSensor0 and gasSensor1 detects methane gas less than the threshold value green led will be 'ON' representing 'food is good' else red led will get turned 'ON' representing 'food is bad'.

4.3 PROGRAM

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 16, 2);

int gasPin0=A3;
int gasPin1=A1;
int threshold = 550;
int red = 2;
int green= 3;

void setup ()
{
 lcd.begin();
 lcd.backlight();
 lcd.clear();

 Serial.begin(9600);
 pinMode(red, OUTPUT);
 pinMode(green, OUTPUT);
 pinMode(gasPin0,INPUT);
 pinMode(gasPin1,INPUT);
}
```

```
void loop()
{
 int analogSensor0 = analogRead(gasPin0);
 int analogSensor1 = analogRead(gasPin1);
 int analogSensor2 = max (analogRead(gasPin0) , analogRead(gasPin1));

 if (analogSensor0  > threshold)
   {
    digitalWrite(red, HIGH);
    digitalWrite(green, LOW);
    lcd.setCursor(0,0);
    lcd.print("food is  bad");
    Serial.println("food is Bad");
    delay(1000);
   }
   else if (analogSensor1 > threshold)
   {
    digitalWrite(red, HIGH);
    digitalWrite(green, LOW);
    lcd.setCursor(0,0);
    lcd.print("food is  bad");
    Serial.println("food is bad");
    delay(1000);
   }
   else if ((analogSensor0 && analogSensor1) < threshold)
   {
    digitalWrite(red, LOW);
    digitalWrite(green, HIGH);
    lcd.setCursor(0,0);
    lcd.print("food is good");
    Serial.println("food is good");
    delay(1000);
   }
  lcd.setCursor(0,1);
  lcd.print("CH4 Amt(ppm)=");
  lcd.print(analogSensor2);
  Serial.println("CH4 Amt(ppm)=");
  Serial.println(analogSensor2);
  delay(1000);
}
```

CHAPTER-5

RESULTS

This project can be divided into different stages.

- Stage 1: Choosing the right sensor.

Products	Gas Emitted
• Channa	• **Methane**
• Banana	• Ethylene ,Formaldehyde & **Methane**
• Cowpeas	• **Methane**
• Apple	• Ethylene ,Formaldehyde & **Methane**
• Onion	• Sulfoxides **Methane**(small amount)
• Coriander	• **Methane**
• Green Gram	• **Methane**
• Rice	• **Methane**

Table.5.1. Gas emitted from respective products.

As we can see from the above table most of the product like channa, apple, onion etc. emit methane gas when they get rotten , so as mq4 sensor specifically detects the concentration of methane we are using mq4 gas sensor.

- Stage 2: Setting the threshold value.

FOOD SAMPLES	AMOUNT OF CH4
Banana	444
Onion	492
Channa	523

Table.5.2 Amount of CH4 emitted by each product.

The above table implies that the threshold value is different for different products. So we cannot set the same threshold for all types of product. Hence we should change threshold value accordingly.

- Stage 3: Detection of methane gas.

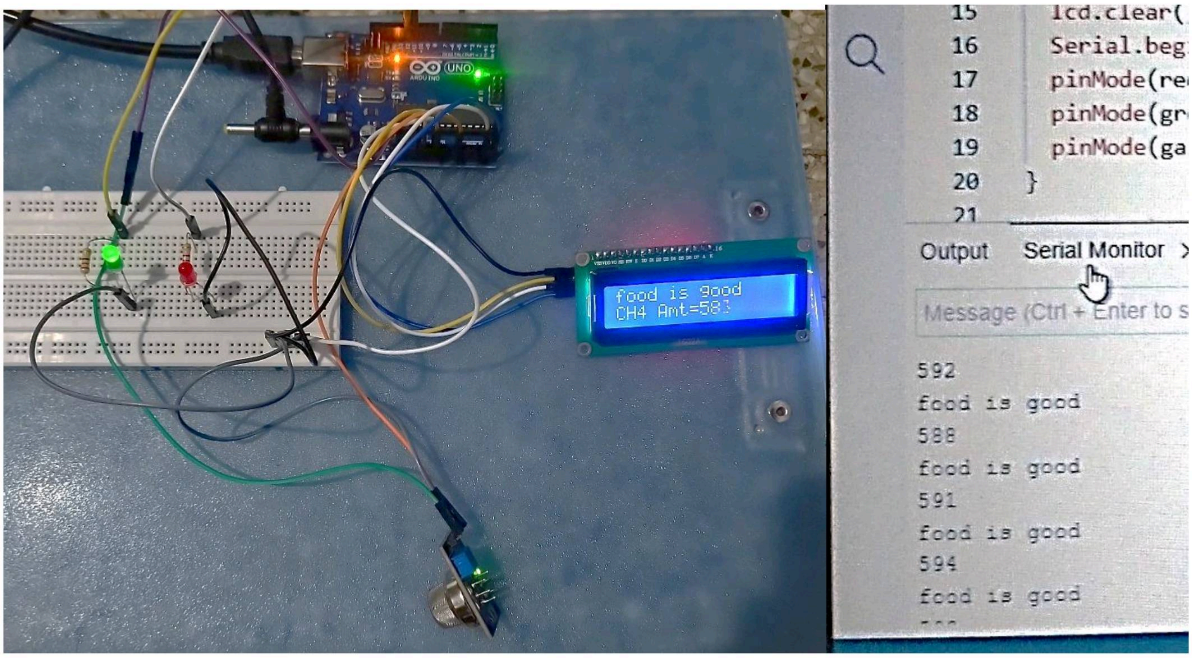


Fig.5.1 Project outcome before testing the rotten food

In the above figure the gas sensor takes the environment air as the sample

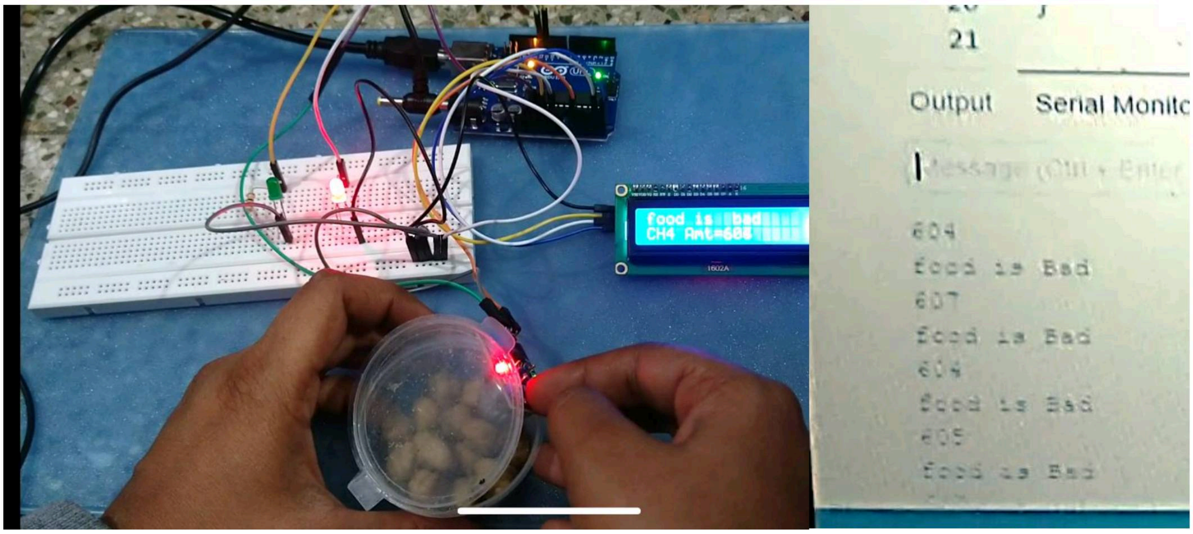
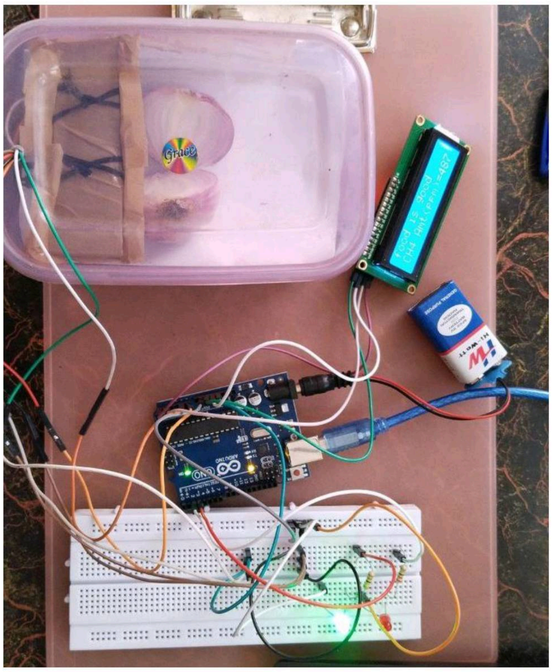


Fig.5.2 Testing rotten Channa

In the above image the methane gas spreads into air as soon as the lid of the box opens. We can over come this problem by placing the sensor in closed loop.



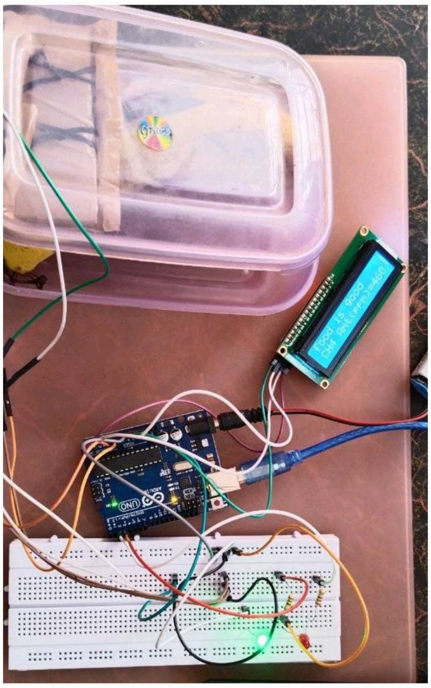
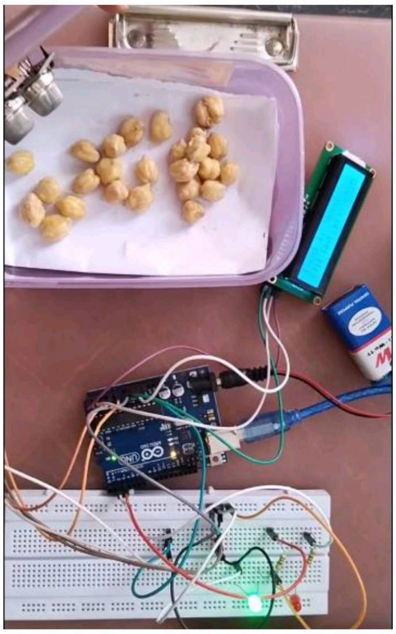


Fig.5.3. Fresh onion testing **Fig.5.4** Fresh banana testing



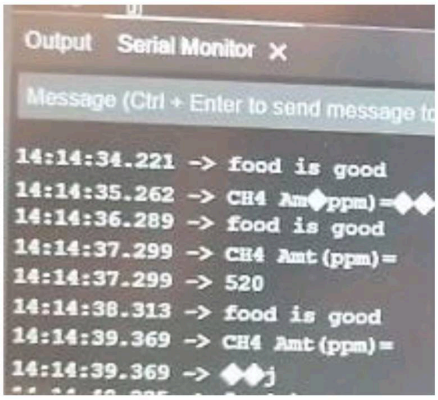


Fig.5.5. Fresh Channa testing **Fig.5.6.** serial monitoring of the Channa sample

In this model we have used two sensor for accuracy of the result in which when either of the sensor senses the methane gas perfectly the quality of the food is known.

CONCLUSION AND FUTURE SCOPE

CONCLUSION

- The food quality monitoring system was able to monitor the quality of the food and detect the emission of methane gas.
- It was also able collect data from the sensors and pass to LCD for display and lastly blink the respective LEDs for good and bad.

FUTURE SCOPE

- We can add different types of gas sensors as this project concentrates only on methane gas.
- A future and updated sensor, such as a nutrients sensor, can be used to upgrade the system.
- This system will evolve in the future not just in terms of food quality, but also in terms of calculating proteins, lipids, carbs, and a variety of other nutrients.
- The food quality monitoring system is applicable in areas such as, supermarket warehouse food production industry food shipment containers manufacturing of fruit jam and fruit juice

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