IOT BASED FOOD SPOILAGE DETECTION SYSTEM

A project report submitted

in partial fulfilment of the requirements for the degree of

Bachelor of Technology

in

Electronics and Communication Engineering

by

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July 2023

DECLARATION

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Signature of the student's

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Date:15-07-2023

Place: Nuzvid

CERTIFICATE

This is to certify that the work entitled "**IOT BASED FOOD SPOILAGE DETECTION SYSTEM**" is a bonafide record of authentic work carried out by S180829,S180318,S180386,S181021,S180997 under my supervision and guidance for the partial fulfilment of the requirement of the award for thr degree of Bachelor of Technology in the Department of Electronics and Communication Engineering at RGUKT-SRIKAKULAM.

The results embodied in the work have not been submitted to any other university or institute for the award of any degree or diploma. This thesis, in our opinion, is worthy of consideration for the award of the degree of Bachelor of Technology in accordance with the regulations of the institute.

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Signature of External Examine

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With sincere regards

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ABSTRACT

This project aims to develop an IoT-based food spoilage detection system with NIR spectroscopy integration. The system incorporates a network of sensors to monitor environmental conditions such as temperature and humidity in food storage units. Real-time data collected from the sensors is analyzed using machine learning algorithms to detect potential signs of food spoilage. Additionally, NIR spectroscopy technology is integrated to authenticate food items, identify adulteration, and assess freshness. The system alerts users of potential spoilage events via a user-friendly interface and can be seamlessly integrated with existing food storage infrastructure. By combining IoT and NIR spectroscopy, this project offers a comprehensive solution for effective food spoilage detection and food authentication.

Chapter - 2
INTRODUCTION

The food we consumes provides nourishment and gives energy to our body, it gives us the ability to do daily activities and help improves our health in direct as well as indirect ways. A healthy and fresh diet is the most important way to keep ourselves fit. The food items kept at room temperature undergo rapid bacterial growth and chemical changes in food. Taking unhealthy food leads to bad health, and can cause different food borne diseases. Indian scenario is even worse with foodborne illnesses causing outbreaks in almost every part of the country. Though most foodborne diseases are sporadic and often not reported in India, a nationwide study carried out recently reported an alarming prevalence of 13.2% at the household level. The scientific reports on the outbreak of foodborne diseases in India for the past 29 (1980–2009) years indicated that a total of 37 outbreaks involving 3485 persons have been affected due to food poisoning

PROBLEM STATEMENT :

Now-a-days everyone is getting affected after consuming spoiled food, sometimes it leads to food poisoning. The spoiled food not only affects the health of people but also increases in the food waste. So, there is need to check the quality of the stored food time to time which will also help in reduction of food waste. then odor identification will be done.

PROJECT OBJECTIVE :

To develop a Hardware product which will sense the food specifically fruits and can identify their quality. Here we will use the methane sensor which will measures the alcohol content, CH4 gas, LPG, Air as well as CO.

SCOPE OF THIS PROJECT:

The scope of an IoT-based food spoilage detection system project includes developing a network of sensors to monitor environmental conditions, collecting and analyzing sensor data, implementing an alert system, designing a user interface, and integrating the system with existing food storage infrastructure.

The scope of the project includes integrating NIR spectroscopy technology into the food spoilage detection system. This involves developing calibration models for authenticating food items, detecting adulteration, and assessing freshness using NIR spectroscopy.

The scope of the proposed system can be expanded by including more products like dairy, fruits etc. The system can incorporate different other sensors like pressure, temperature, moisture etc. Different other techniques like nano technology, artificial neutral network can be also be used for further improvement in result. These techniques can use this data for better result in future about food spoilage.

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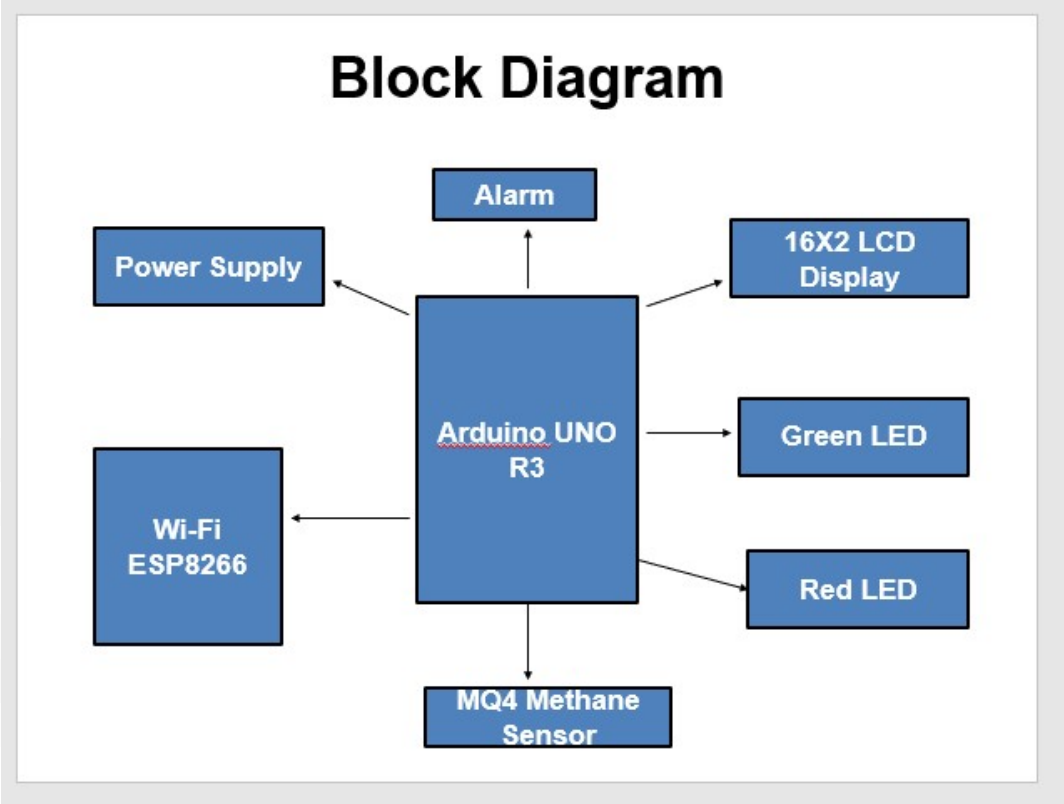
Chapter – 3

METHODOLOGY

3.BLOCK DIAGRAM OF FSD SYSTEM :



Arduino needs to be given a power supply it can given through may sources like barrel adapter, the USB connector by connecting it to a PC/laptop, batteries greater than 5V supply, using battery shield etc.We used USB connector from arduino to PC.Different components required are MQ4 Methane sensor, ESP8266 wifi wireless module, green led, red led, and few other components include bread board, connectors, resistors, batteries for other power sources required, buzzer etc.All these are connected to the arduino with the help of breadboard.A network can be estblished through a mobile hotspot which is sensed by ESP8266 wifi module and and our arduino can share the data sensed by the sensors connected to it to the IOT portal or any other cloud where user could know the range of methane in ppm

produced by the spoiled food.When the food spoilage is sensed by MQ4 methane sensor the buzzer is triggered and a red LED is lit.So user could could know about the food spoilage.Also a mail is generated by the iot based applications in our case (Blynk app) and is sent to the user of FSD system.

The technique for detection of spoiled food is much easier using two approaches. There are different approaches for the detection of the various gases that are released from food. The proposed system is based on Arduino UNO which is a recognized prototyping board which is interfaced with gas sensors like MQ4 to distinguish smell. The web switch which is a web modem connects the Arduino board to web net. The microcontroller board Arduino Uno along with food detection sensor MQ4 senses the gases coming out from the rotten food. The signal is transferred through a Wi-Fi device ESP 8266 AS. The signals are sent to the user through a server. The buzzer, LED and LCD panel will also show the output from the sensor which is connected with the Arduino.
All this data also can be seen in Blynk IOT app and website. Proper graph of gas detection verses time is displayed on website. By using Wi-Fi and Blynk IOT library we can achieve this.

The working principle of gas sensors is related to conductivity of sensor in fresh air and polluted air. Conductivity of sensor increases in polluted air and hence we can detect the presence of gas.

Chapter - 4

HARDWARE COMPONENTS:

1) **Arduino UNO R3:**

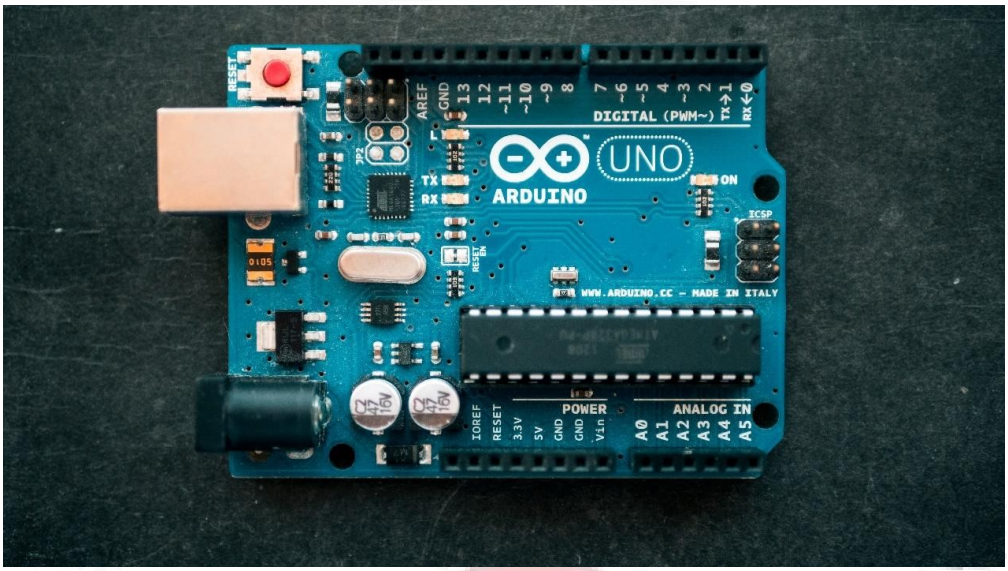


Fig.6.a. Arduino Uno Board

∗ The Arduino Uno R3 is a microcontroller board based on a removable, dual-inline package (DIP) ATmega328 AVR microcontroller.

∗ It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs).

∗Programs can be loaded on to it from the easy-to-use Arduino computer program.

2)MQ4 sensor:

∗This methane gas sensor detects the concentration of methane gas in the air and outputs its reading as an analogue voltage.

∗The concentration sensing range of 300 ppm to 10,000 ppm is suitable for leak detection.

∗ The sensor can operate at temperatures from -10 to 50°C and consumes less than 150 mA at 5 V\

Fig.7.a. MQ4 Methane Sensor

3) WIFI ESP8266 SENSOR :

∗The ESP8266 is a low-cost Wi-Fi microchip, with a a full TCP/IP stack and microcontroller capability.

∗ This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections

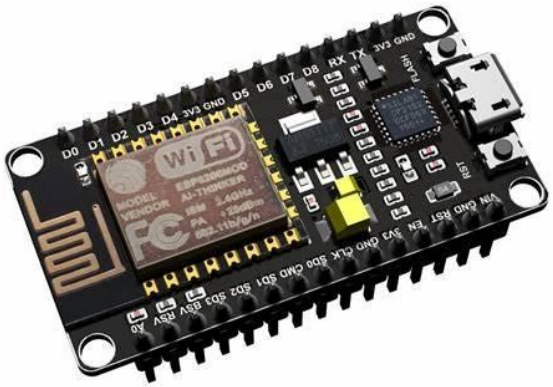


Fig.7.b.ESP8266 Wi-Fi Module

4)POWER SUPPLY

The Arduino can be powered via the USB connection or with an external power supply. External power can come either from an AC- to- DC adapter (wall-wart) or battery. The circuit operates on 5V DC. We can also provide power supply through laptop or PC connected through USB or through battery.

5)Buzzer:

A Piezo buzzer is an electric device used to produce a tone. These lightweight and simply constructed buzzers are inexpensive yet reliable and come in a range of sizes and frequencies to meet the needs of nearly any application

Fig.8.a. Buzzer

Chapter - 5

IMPLEMENTATION

This Arduino based FSD system should be installed in food store. Once it is properly installed and powered on, it connects with the internet via the Wi-Fi module and starts reading data from the interfaced sensor –MQ4 Sensor. The MQ4 sensor detects the emission of methane types of gases. If the food/fruits get spoiled, they emit the methane type of gases. The MQ4 sensor detects the concentration of such gases and outputs an analog voltage proportional to the concentration of the gas. The analog output is passed to the analog pin of the Arduino which has an inbuilt ADC that converts the analog to a digital value. The Arduino collects data from the sensor and converts the values to the strings. The sensor data wrapped as proper strings. Wi-Fi module connected to the Arduino uploads the data to Server where the processing of data takes place. The values are compared to the threshold values which gives the result that whether the food is fresh or not with a predefined algorithm. The values are sent back to the Arduino. Arduino displays the output on Blynk app dashboard "Food spoiled" depending upon the food freshness level (i.e. depending upon methane content). It also display the range of methane content in ppm.

Process:

1. A customer needs to download 'Space Wix' app there he/she can request to signup/login with user credentials. Once owner logins, he should be able to see the dashboard where he/she will have to create project with any title say 'FSD SYSTEM'. There it is required to set hardware component through which sensor data is going to be sent to the server. Also the connection type is to be mentioned say WiFi (or Ethernet, USB, etc..).

2. Store manager will approve the login request. On approval, an approval email would be sent to the customer's email id. Email id of the customer is a valid user.He will be provided with a auth token which is to be used for programming for NodeMCU to connect to the blynk server

3. He will have to specify the ssid and the password of the WiFi in the required program to connect to FSD System to the internet.

Manager should be able to see following reports

∗Methane Range in the fruits as sensed by the sensor.

∗"Food Spoiled" message when it is detected range above 250 ppm.

* A soon as the manager gets the text on the Blynk app dashboard, he is expected to take actions regarding the spoiled food and also consuming those fruits which are at the stage of spoilage.

4. It requires hardware PC/laptop with 2 GB hard-disk and 256 MB RAM or an android phone and it can be used to power the Arduino.

5.Set up a new IoT project on the platform and create a new device (representing your food spoilage detection system).

6.Obtain the necessary credentials (e.g., API key, device ID) from the cloud platform to authenticate your device.

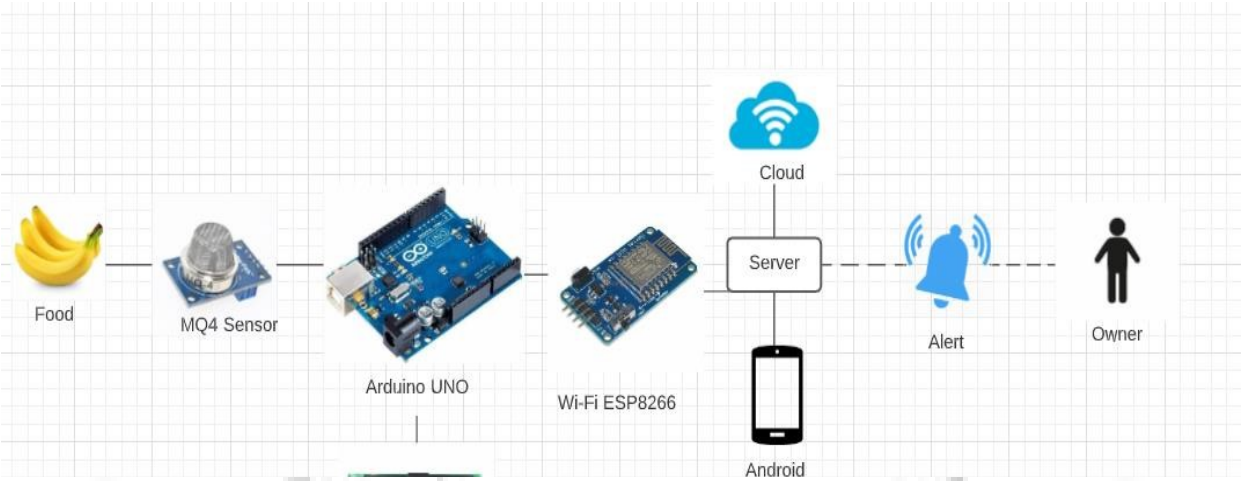
7.Configure the cloud platform to receive data from your IoT device and store it in a database.

8.Test the entire system to ensure that the sensors are collecting data correctly, the microcontroller is sending data to the cloud, and the app is displaying the data accurately.

9.Deploy the system by setting up the food spoilage detection device at the desired location and making the mobile app available for users to download.

10.Users can now connect to the system by installing the mobile app, signing in (if required), and accessing the real-time and historical food spoilage data.

FSD MODEL



FSD System is lit with a green LED until it comes in contact with the spoiled food emitting methane or more precisely fruits. As soon as the sensor senses any spoiled fruit it triggers a buzzer and a red LED is lit. The range or value of methane measured in ppm by the sensor is displayed on the dashboard of 'Blynk app'. Also, with the help of ESP8266 Wi-Fi module the specific range can be seen through any IOT project-based websites like Thingspeak.com or any applications like Blynk or any other cloud which can be used as a IOT portal. There we can see the range of methane produced by fruits which are spoiled. Normally the fresh fruits have methane content below 250 ppm, if it goes above this then it is an indication of fruit spoilage. So, with the help of these IOT project-based applications a message of "Food Spoiled" will be printed on the screen of 'Blynk app'.

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RESULT AND DISCUSSION

RESULT

• Quality is monitored constantly by sensors and readings are displayed on screen.

• When abnormal readings are detected in any readings i.e., MQ4 sensor, it displays the food spoiling message the LED screen.

• It also displays a message of “Food Spoilage” on the Blynk application dashboard.

• The data over Dashboard gets updated every seconds.

• User will also be able to see the values on serial monitor of Arduino IDE and the specific graph on the serial plotter of Arduino IDE.

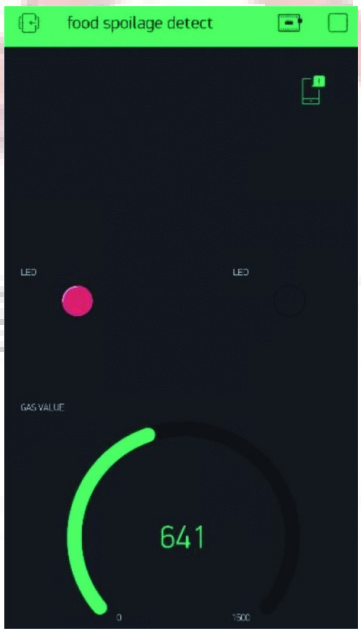

Fig.12.a.Blynk App Output

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CONCLUSION

Food poisoning has been the source of innumerable diseases, to reduce and avoid illness we use sensors to determine the freshness of household food items like fruits. The Arduino sensors can detect gas emissions Using sensors to detect the presence of these values among foods can help detect food spoilage early and prevent the consumption of spoiled food. These techniques can be further developed to include other types of gas sensors and foods to increase the sensitivity of such detection methods. This system consists of a hardware device i.e Mq4 Methane Sensor which checks the quality and freshness of food.

The gas sensor can detect gas emissions from food before it spoils. Customers are given information about the freshness of their food. It will be easier to maintain a healthy diet and avoid unhealthy foods with this assistance. Food companies can now include expiration dates on their products thanks to technological advancements. This makes calorie counting and portion control easier. Because most people buy pre-packaged foods from stores that emphasize the importance of expiration dates, there must be a way to track the food and determine if there are any problems.

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FUTURE SCOPE

*Using high precision sensors to increase the area of sensing

*We can modify the project by using two or more sensors which will display dual parameters on the screen.

*We can modify this project and use for big warehouses and go downs where manually checking of eatables is not possible.

*This FSD system can also be used by anyone who owns refrigerator or may not having refrigerator as sometimes person may forget to consume any food item before its expiry date so it gets spoiled and is overlooked so its can be useful to detect freshness of each item present in the fridge or else at home. In that also different sensors can be used.

*It is possible to increase the quantity by adding milk and fruits. Environmental variables such as pressure, temperature, and humidity are measured by some of the system's sensors. Nanotechnology and synthetic neural networks may be able to help.

*You can reduce the amount of food that goes bad by using this knowledge and these suggestions. In addition to factories, warehouses, and markets, this quality control system can help food storage and distribution facilities.

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