

Food Quality Monitoring System

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Abstract: Food poisoning affects around 600 million people each year, with 4,20,000 people dying as a result. People frequently ingest damaged meals since there are no obvious signs of deterioration. Foods release gases like Methane, Ethylene and Ammonia when they decompose. This paper introduces Food Spoilage Detection by using sensor and displayed on character 16x2 LCD. We are living in the world, where one third food is wasted every year. It is more than enough to feed millions of people in the world. Most considerable reason for food wastage is food spoilage. Food spoilage can be detected in many ways. Our project mainly focuses food spoilage detection using Sensor. In components used in this project is LCD display, sensors and Arduino Uno. Sensors, LCD display is interfaced to Arduino Uno. By using sensors we can detect the gases coming from food. The sensor sends the data to LCD display where we can view whether food is spoiler. Software required to program Arduino Uno is Arduino Integrated development environment (IDE). Hardware required for this project is Arduino board, MQ3 sensor, character 16x2 LCD, USB cable, power supply and connecting wires.

Keywords: Arduino Uno, MQ3 sensor, character 16x2 Liquid Crystal Display.

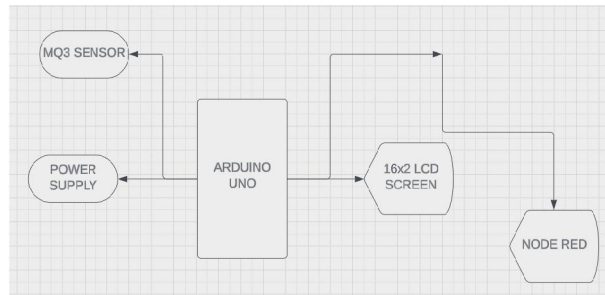
I. INTRODUCTION

In this project, a similar food quality monitoring device will be designed that will keep watch of environmental factors like alcohol content and exposure to light. The device is built on Arduino UNO which is a popular prototyping board. The Arduino board is interfaced with various sensors like, MQ3 to detect food spoil content and LDR to measure exposure to light. This is an IoT device and sends the measured sensor data to an IoT platform. The sensor data is also displayed on a character LCD interfaced with the Arduino UNO. The IoT platform used for logging and monitoring of sensor data is NODE RED. With the power of Internet of Things, the environmental factors affecting the food storage can be monitored from anywhere, anytime and from any device. Many such devices can be installed at a location for better monitoring and quality control. The Arduino Sketch running over the device implements the various functionalities of the project like reading sensor data, converting them into strings, displaying them on character LCD and passing them to the IoT platform. The Sketch is written, compiled and loaded using the Arduino IDE.

II. COMPONENTS REQUIRED

COMPONENTS	QUANTITY
ARDUINO UNO	1
MQ3 SENSOR	1
POTENTIOMETER	1
LDR	1
16x2 LCD SCREEN	1
CONNECTING WIRES	AS REQUIRED

III. BLOCK DIAGRAM



IV. METHODOLOGY

The food quality monitoring device designed in this project is based on Arduino UNO. So reader should have knowledge of How to start with Arduino. The Arduino has served as an IoT board in this project. Various sensors like MQ3 and LDR, and character LCD are interfaced to the Arduino.

The Arduino based IoT device has the following circuit connections:

Arduino UNO – The Arduino UNO is ATmega328 based microcontroller board. It is one of the most popular prototyping boards. The board comes with built-in arduino boot loader. It has 14 GPIO pins, 6 PWM pins, 6 Analog inputs and on board UART, SPI and TWI interfaces, an on-board resonator, a reset button, and holes for mounting pin headers. While programming the board, it can be connected to the PC using USB port and the board can runs on USB power. The Arduino UNO has 32 kb Flash memory, 1 kb EEPROM and 2kb SRAM. The board can be connected to different Arduino Shields for connectivity with Ethernet, Bluetooth, Wi-Fi, Zigbee or cellular network and it can be connected to most of the IoT platforms. The ATmega328 controller has the following pin configuration

21	AREF	Reference Voltage
22	GND	Ground
23	PC0	Analog Input
24	PC1	Analog Input
25	PC2	Analog Input
26	PC3	Analog Input
27	PC4	Analog Input
28	PC5	Analog Input

MQ3 Sensor – MQ3 alcohol sensor module is used to detect the presence of ethanol, where the sensitive material used for this sensor is SnO₂, whose conductivity is lower in clean air. It’s conductivity increases as the concentration of ethanol gases increases. It has high sensitivity to alcohol and has a good resistance to disturbances due to smoke, vapor and gasoline. This module provides both digital and analog outputs. It has a high sensitivity and fast response time. Sensor provides an analog resistive output based on alcohol concentration. MQ-3 is an analog as well as digital sensor. The presence of ethanol vapors in food is a sign of decay. So, by MQ3 sensor, it can be detected if food has started decaying. The sensor has four pins – Analog Out, Digital Output, VCC and Ground. The VCC and ground are connected to the common VCC and Ground. The digital output pin is not used therefore is kept not connected. The output of the sensor is drawn from the analog output pin which is connected to the pin A0 of the Arduino board.

LDR Sensor – The LDR is used to sense the intensity of light. The sensor is connected to the A1 pin of the Arduino board. The sensor is connected in a potential divider circuit. The LDR provides an analog voltage which is converted to digital reading by the in-built ADC.

16X2 LCD – The 16X2 LCD display is connected to the Arduino board by connecting its data pins to pins 2 to 5 of the Arduino board. The RS and E pins of the LCD are connected to pins 10 and 9 of the Arduino board respectively. The RW pin of the LCD is grounded.

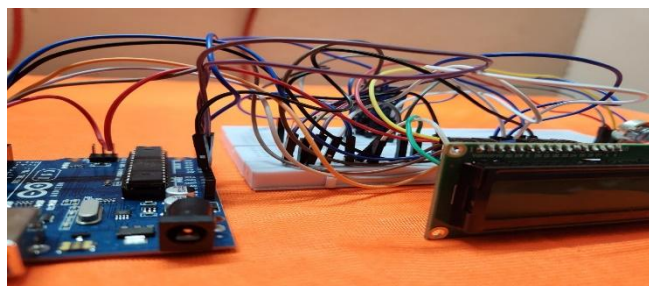
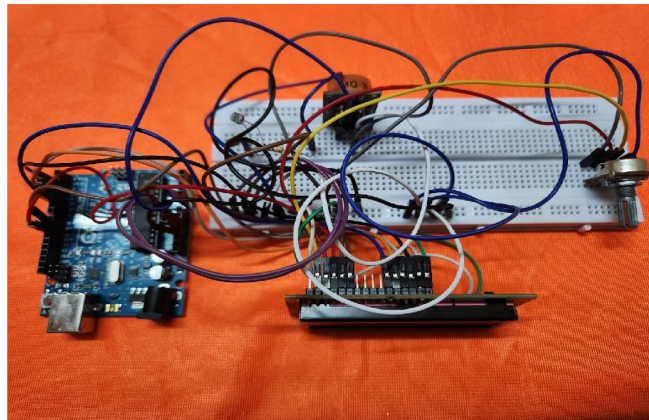
LCD	Arduino UNO
RS	10
RW	GRND
E	9
D7, D6, D5, D4	2, 3, 4, 5 respectively

POTENTIOMETER- The potentiometer is a resistor whose value for the resistance can be changed by turning its knob and is also known as variable resistor. This generic potentiometer normally has three pins; the pin in the middle is the output of the resistor whereas the other two pins can be used for giving supply and grounding the resistor. The LCD interfacing requires a potentiometer, The potentiometer is also an input device of Arduino that can be used for various purposes like controlling the brightness of LED or LCD by increasing or decreasing its resistance. In this write-up a potentiometer is interfaced with Arduino and its values are displayed on the LCD.

V. WORKING

This Arduino based IoT device should be installed in a food store. Once it is properly installed and powered on, it connects with the internet via Wi-Fi modem and start reading data from the interfaced sensors –MQ3 Sensor and the LDR sensor. The LDR sensor is connected in a potential divider circuit and inputs a voltage at the analog input pin of the controller. The voltage is read and digitized using in-built ADC channel. The MQ3 sensor detects the emission of ethanol type of gases. If the food/fruits get spoiled, they emit the ethanol type of gases. The MQ3 sensor detects the concentration of such gases and output an analog voltage proportional to the concentration of the gas. The analog output is passed to the analog pin of the Arduino which has inbuilt ADC that converts the analog to digital value. If the sensor value receiving by the MQ3 is below 350, then the food is fresh and when it exceeds 350, then the food is spoiled. Here 350 is the universal sensor value for MQ3 to detect the spoilage. The Arduino collects data from all the sensors and convert the values to the strings. The sensor data wrapped as proper strings are passed to the character LCD for display. We can monitor the sensor values using a IOT software called NODE-RED. For displaying and monitoring data uploaded to the NODERED, either a digital dashboard or data broker is needed. In this project, a digital dashboard called iot dashboards is used to monitor the sensor data visually online.

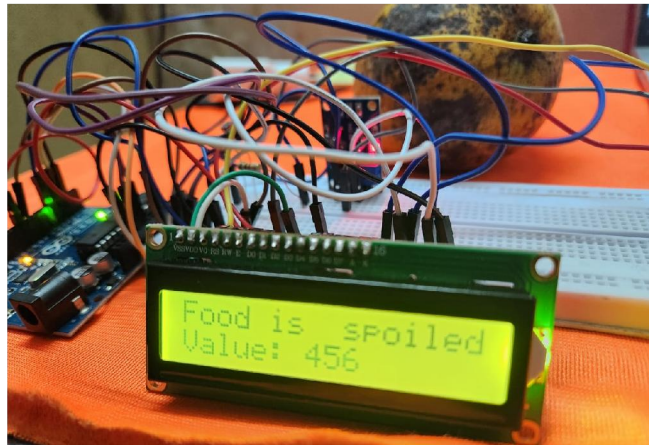
VI. HARDWARE IMPLEMENTATION CIRCUIT



When FRESH banana is kept near the sensor:



When Rotten mango is kept near the sensor:



VII. SOFTWARE IMPLEMENTATION

NODE-RED is a programming tool for wiring together hardware devices, APIs and online services in new and interesting ways. Node-RED provides a web browser-based flow editor, which can be used to create JavaScript functions. Elements of applications can be saved or shared for re-use. The runtime is built on Node.js. The flows created in Node-RED are stored using JSON. Since version 0.14, MQTT nodes can make properly configured TLS connections

FLOWS:

Node-RED Flow refers to the connection and sequencing of various input, output, and processing nodes within the Node-RED platform. Each node within a flow performs a unique and specific task. When data is transmitted to a node, the node processes it according to its designated function, before passing it on to the subsequent node in the flow.

THE NODES USED IN OUR PROJECT ARE:

SERIAL IN NODE
FUNCTION NODE
GAUGE NODE

SERIAL IN NODE:

We will be using the nodes in the node-red-contrib-serial port package for serial communications in Node-RED. To read serial inputs, drag and drop the serial in node. To write serial outputs, drag and drop the serial out node. On either

node, to configure the serial port, click the edit button for the “Serial Port” property. *The USB device must be plugged in when the device boots for Node-RED to have access to it.*

- Settings: The baud rate and other settings should match the baud rate of the serial device you are communicating with.
- Input: Choose when the node will output a message. Options include waiting for a split character (such as a line break, comma, or space), waiting for every n characters if the output is fixed-length, or you can set a timeout to get an output every n seconds.
- Output: Add character the output message (for example, add back the line break).

You can see that you are connected to a valid serial port if, after deploying, the node status is “connected”.

FUNCTION NODE:

- The function node is used to run JavaScript code against the msg object.
- The function node accepts a msg object as input and can return 0 or more message objects as output.
- This message object must have a payload property (msg.payload), and usually has other properties depending on the proceeding nodes.

The payload property that we have used in this is:

```
var m={payload:msg.payload.split(',')};
return m;
```

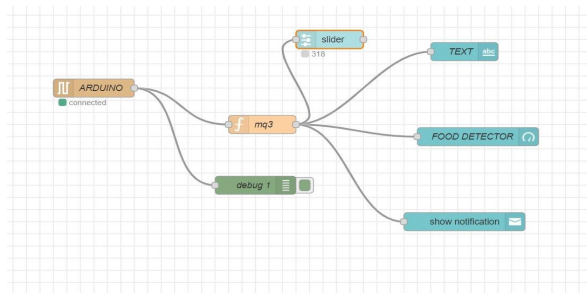
GAUGE NODE:

Once we place the nodes into the canvas, we connect the serial node to the function node, and the function node to the gauge node. We also add a comment node in order to better display each group, which will help us visualize everything as we continue to build our dashboard.

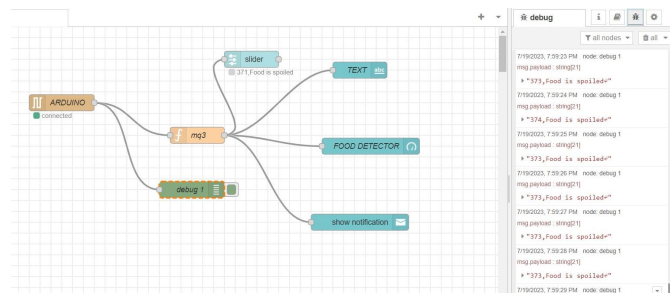
By using the gauge node we can visualize and monitor the sensor value obtained from the mq3 sensor which confirms whether the food is spoiled or not.

We are also using slider node, text node and notification node for better understanding of the receiving sensor value in dashboard.

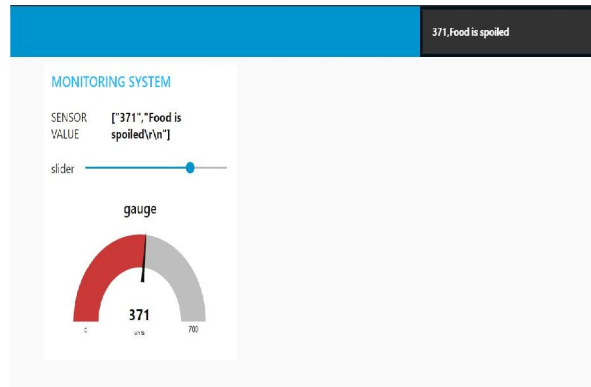
SIMULATION IN NODERED:



DEBUG WINDOW:



DASHBOARD:



VIII. CONCLUSION

The Arduino Uno board MQ3 sensors are able to sense the gas level and displayed on LCD whether food is spoiled or not. NODERED is used to determine and monitor the sensor value. Naturally fruits will emit ethanol gases which are used for detection of food spoilage. High amount of gas will represent food spoilage whereas moderate amount of gas represent food is fresh and low amount indicates surrounding gas content. This will reduce the food poisoning and contamination of food

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