A project report on

FOOD SPOILAGE DETECTION PROJECT

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INTRODUCTION

Food safety and hygiene is a major concern in order to prevent the food wastage. 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. Therefore, it is useful to deploy quality monitoring devices at food stores. These quality monitoring devices keep a watch on the environmental factors that cause or pace up decay of the food. Later, the environmental factors can be controlled like refrigeration, vacuum storage etc. In this project, a similar food quality monitoring device will be designed that will keep watch of environmental factors like temperature, humidity, gas 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 DHT-22 to monitor temperature and humidity, MQ3 to detect gas content and LDR to measure exposure to light. This is an IoT device and sends the measured sensor data to an IoT platform. The ESP8266 Wi-Fi Modem is interfaced with the Arduino to connect it to the internet via Wi-Fi router. 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 Freeboard.io. With the power of the 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.

CIRCUIT COMPONENTS

S. No.	Component	Price	Qty
1.	NODE MCU	300	1
2.	MQ3 SENSOR	200	1
3.	DHT11	90	2
4.	LCD DISPLAY	250	2
5.	RESISTORS	20	1
6.	CONNECTING WIRES	60	24

COMPONENTS DETAILS:

NODE MCU: -
ESP8266 is the name of a micro controller designed by Espressif Systems. The ESP8266 itself is a self contained WiFi networking solution offering as a bridge from existing microcontroller to WiFi and is also capable of running self-contained applications. This module comes with a built in USB connector and a rich assortment of pin-outs. With a micro USB cable, you can connect a NodeMCU device to your laptop and flash it without any trouble, just like Arduino. It is also immediately breadboard friendly.

MQ3 SENSOR: -
WiFi networking solution offering as a bridge from existing microcontroller to WiFi and is also capable of running self-contained applications. This module comes with a built in USB connector and a rich assortment of pin-outs. With a micro USB cable, you can connect a NodeMCU device to your laptop and flash it without any trouble, just like Arduino. It is also immediately breadboard.

DHT11: -
DHT11 output calibrated digital signal. It utilises exclusive digital-signal-collecting-technique and humidity sensing technology, assuring its reliability and stability.Its sensing elements are connected with 8-bit single-chip computer. Every sensor of this model is temperature compensated and calibrated in an accurate calibration chamber and the calibration-coefficient is saved in type of programme in OTP memory, when the sensor is detecting, it will cite coefficient from memory.

LCD DISPLAY: -

16x2 LCD display is a very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in a 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

WORKING OF THE CIRCUIT

The MQ3 sensor is connected to a NodeMCU ESP8266 microcontroller. The AOUT pin is connected to the analog input pin of the microcontroller. The sensor detects the level of Methane-emitted from the food of interest. According to the MQ3 sensor's analog measurement scale, food is considered spoiled if the value recorded by the sensor is greater than 250 and less than 400. The sensor requires calibration due to its sensitivity. This data is sent to the 16X2 LCD through the I2C module. Connecting an LCD directly to a NodeMCU board is a very tedious task. 12 jumper wires are required to connect the LCD to the microcontroller board. An external potentiometer is also required to adjust the contrast of the LCD. The I2C module reduces the connections to 4 wires for power pins and SCL and SDA pins for communication. This is an IoT-based system where the required information is sent to the customer/user. The ESP8266 board has a built-in Wi-Fi module, so it is connected to the internet. The IoT platform used to log and display sensor information is Blynk IoT. From anywhere in the world, at any time, from any device, you can use the Internet of Things to observe food spoilage affected by the components of the ecosystem.

ADVANTAGES

1. Real-Time Monitoring
The system provides continuous monitoring of temperature, humidity, and gas emissions, enabling timely detection of spoilage indicators.

2. Cost-Effective Implementation
Utilizing affordable components like NodeMCU, DHT11, and MQ3 sensors makes the system economically viable for both domestic and commercial applications.

3. User-Friendly Interface
The 16x2 LCD display offers a straightforward interface to display real-time data, making it accessible for users without technical expertise.

4. IoT Integration for Remote Access
With built-in Wi-Fi capabilities of the NodeMCU, the system can be integrated with IoT platforms like Blynk, allowing users to monitor conditions remotely via smartphones or computers.

5. Proactive Food Safety Measures
Early detection of spoilage conditions helps in taking preventive actions, thereby reducing food waste and ensuring food safety

DISADVANTAGES

1. Limited Sensor Accuracy
The DHT11 sensor has a limited accuracy range for temperature and humidity measurements, which might affect the precision of spoilage detection.

2. Calibration Requirements
Sensors like MQ3 require proper calibration to ensure accurate gas detection, which can be a complex process for non-expert users.

3. Environmental Sensitivity
External environmental factors such as airflow, ambient gases, and temperature fluctuations can influence sensor readings, potentially leading to false positives or negatives.

4. Limited Detection Scope
The system primarily detects ethanol and similar gases; it may not effectively identify spoilage indicators for all types of food, especially those emitting different gases.

5. Maintenance and Power Dependency
The system requires regular maintenance, including sensor cleaning and recalibration. Additionally, it depends on a continuous power supply, and any interruptions can affect its functionality

APPLICATIONS

1. Household Kitchens

In domestic settings, this system can monitor the freshness of perishable items like fruits, vegetables, dairy, and meat. By alerting users to unfavorable storage conditions, it helps in preventing foodborne illnesses and reducing household food waste.

2. Restaurants and Cafeterias

Food service establishments can implement this system to ensure that ingredients are stored under optimal conditions. Real-time monitoring aids in maintaining food quality, complying with health regulations, and minimizing inventory losses due to spoilage.

3. Supermarkets and Grocery Stores

Retailers can use this system to monitor storage areas and display units, ensuring that products remain fresh for consumers. Early detection of spoilage can prevent the sale of compromised goods and reduce product returns.

4. Cold Storage and Warehouses

Large-scale storage facilities can benefit from this system by maintaining consistent environmental conditions. Continuous monitoring helps in preserving the quality of bulk-stored food items and reducing large-scale spoilage incidents.

5. Food Transportation and Logistics

During the transit of perishable goods, this system can monitor conditions within transport vehicles. Ensuring optimal temperature and humidity levels during transportation helps in maintaining product quality upon delivery.

Future Scope

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 neural 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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