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FOOD QUALITY MONITORING SYSTEM

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Abstract—**The "Food Quality Monitoring System" project addresses the critical issue of food safety and food spoilage. There are many factors which damage the food quality such as Temperature, Humidity, Atmospheric gases and other harmful means. This project proposes an innovative solution by integrating Internet of Things (IoT) technology with a network of sensors to monitor key atmospheric factors affecting food quality, including temperature, humidity and alcohol content. The initiated project is built with ESP 32 Microcontroller which is interfaced with MQ3 and DHT-11 sensors. This sensor data can be uploaded and displayed on LCD. This project leverages modern technology to address significant challenges in food management, offering a scalable solution for improving food quality and safety in the region.**

Keywords—**Internet of Things, ESP32, I2C, MQ3, DHT11 sensor, 16X2 LCD display.**

I. INTRODUCTION

Food security and spoilage detection is one of the major concerns to prevent food poisoning, digestive problem, allergic problem etc. This spoilage occurs due to changes in chemical combination within the food. Several viruses and bacteria cause food contamination which lead to countless food borne diseases. About 351,000 people die due to food poisoning globally every year. It is necessary to build a system which helps to detect the spoilage of food item in terms of various parameters. Our proposed project workson the detection of food quality with the use ofelectrical and biosensors like MQ3 and DH11.

The living system just works on the management of food through temperature, humid climate and alcohol content. The sudden variation in the temperature can change the chemical nature of the food and it will result in the spoilage of food. The variation in the humidity will turn the quality of food from fresh to damaged. Alcohol content being a crucial parameter, with the increase in alcohol content in food it encourages gastrointestinal issues, nutrient deficiency etc.

The proposed projects display the condition of the food by monitoring the alcohol content which is emitted from the food. The condition is then displayed in the Liquid Crystal Display (LCD) and visible in Serial Monitor.

II.LITERATURE REVIEW

In this section, an overview is made to discuss the earlier researches which were done regarding food spoilage, alcohol detection in the food, temperature and humidity valuation of food.

Cristiana et al. (2020) focuses on the storage of fruits and vegetables in stock using Internet of Things (IoT). They developed a system which monitors the Temperature, Humidity and light exposure of the fruits and vegetables that are stored. The monitoring of is made via an app where they keep the track of commodities safety and hygiene [4].

Sachin Dhawas et al. (2022) proposed a technique which monitors the effect of atmospheric gases like Nitrogen, Oxygen and Trace gases on the food. The project analyses the temperature, humidity and gas-emission by food as they affect the nutritional value of the food exposed to atmosphere. The analysed result is visible in LCD display and the message will be sent to the device which this application [8].

Nakka Smapath Naveen et al. (2019) proposed a method to provide a non-verbal communication to discuss the quality of food provided in the restaurants. The project provides the feedback of restaurant through food survey questions to evaluate the food quality, hygiene level and overall customer satisfaction. This feedback is posted intocloud which is accessible to all customers [5].

Prof. Dipti A. Gaikwad et al. (2024) proposed a project entitled as “Fruit Freshness Detection and Monitoring” which discusses the accurate freshness of fruit. Fruits contains many nutrients such as protein, vitamins, fibre, and minerals which makes it beneficial for daily consumption and also it has a higher chance of spoilage if left for longer time period. By using an alcohol detector sensor MQ3, it determines the ethanol concentration in the fruit. The concentration of ethanol increases when it starts losing its freshness. This project focuses on the maintenance of freshness during transportation of fruits from one location to another [16].

Seonyong Lee et al. (2022) initiated a work that focuses on more effective food quality analysis using chemoresistive gas sensors based on metal oxides, metal sulfides, carbon nanomaterials, polymers, and their composits. These methods are applied to detect the freshness of fruit such as nanostructure construction and heterostructure formation in real time [14].

Andrea Dodero et al. (2021) proposed research on the recent development regarding real-time analyses of food products

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via creative packaging technologies. This research highlights the usage of Optical Detection System. The indicator of food quality is firstly introduced, then real-time monitoring of food begins with various samples of food based on the nature of indicator. The indicator detects the O_2 level, CO_2 level and other specified gases including the pH value of each sample [17].

Ping Shao et al. (2021) researched on intelligent food packaging with to ensure food safety and to prevent from resource wastage. The freshness monitor thoroughly monitors the freshness in real-time without damaging of food samples. The objective of this research is to monitor the indicators such as carbon dioxide, volatile, salt- nitrogen sulphidesetc [15].

Ikram Shah et al. (2024) researched on the spoilage of fruits, vegetables and any edible products while delivering from one place to another. During transportation of vegetables which are stacked in an order, when stacked out, often the vegetables in the last basket turns unusable. The system aims to identify the vegetable crates which is at a high risk to get spoiled and delivering it more quickly to avoid the risk of spoilage [18].

Shantanu Trivedi et al. (2019) researched on food security and preserving food quality during food trade and transport. With the increase in food demand and food industry, trade, quality is matter of concern for seller, trader and government. The major objective of this study is to examine the food supply chain with required food security in allplaces like academicians, industry, researcher and policy makers [19].

Krishna Kumar Patel et al. (2012) inspected the quality of food and agriculture product with introduction to deep machine system. This inspection approach is based on image analysis and processing in food industry. This research considers fruits, vegetables and other food samples such as pizza, bakery product, cheese and noodles etc. The quality of food sample is monitored by image processing which provides a non- destructive, cost- effective techniques [20].

J. Anudeep et al. (2024) proposed a project detecting the adulteration of milk. Milk is major source of protein, vitamins, fat and minerals for both infants and adults. The project works on the recognition of milk contaminants and milk sensitivity by constantly tracking the significant parameters of the milk. The evaluation is observed in IoT platform through data analytics [21].

K. Narsaiah et al. (2011) This review introduces a method to prevent food from spoilage. it focuses on the use of Optical Biosensors, which is more beneficial than Chromatography, culturing, colony counting etc. Optical Sensor detects pathogen, pesticides and drug residues in the food item. The work encourages the combination of fibre optics with food quality detection [22].

III. PROPOSED METHODOLOGY

Food monitoring and food spoilage detection is the major concern in today's time. The rising food-borne diseases is a reflection of inadequate food with lack of nutrition. With declining in food quality, diseases like diarrhea, Hepatitis, Viral gastroenteritis and heart diseases etc. There are various factors that disturbs the quality of food in daily lives such as irregular temperature, moisture present in atmosphere, chemical reaction within the food and the presence of alcohol content in food.

The evolution of multipurpose sensors is observed in past decades that aims to develop various IOT devices to simplify and technologically upgrade the society. The integration of these sensors with foodquality monitoring has paved a path to evaluate food quality in an intelligent way. Various sensors such as DHT11 and MQ3 is used in our proposed project to determine temperature, humidity and alcohol content of the food of interest. These aboveparameters are monitored through LCD display.

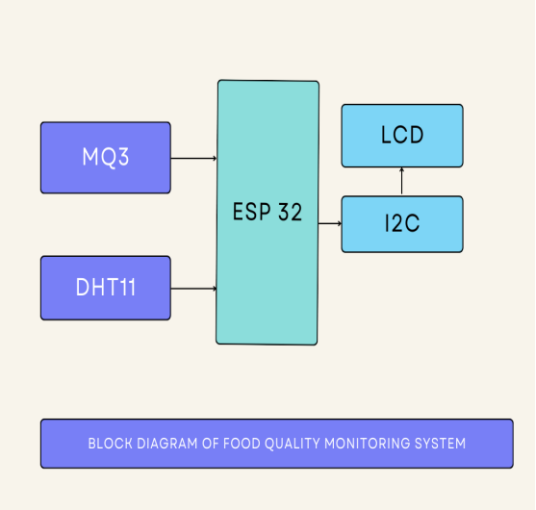

Fig. 1.BLOCK DIAGRAM OF PROJECT

The proposed project consists ESP 32 Microcontroller, it is a strong microcontroller which has both wi-fi module and Bluetooth module, developed by Espressif System. The software application applied in the system is Arduino IDE, which is a used for writing, compiling, and uploading code to Arduino-compatible microcontroller boards. Here, MQ3 is used to detect the Alcohol content of the food of interest and DHT 11 is used to detect the Temperature and Humidity of the food of interest. MQ3 Connected to the ESP32 microcontroller, the sensor detects the level of alcohol from the food of interest. According to the MQ3 sensor's analog measurement scale, food is considered spoiled when it greater than 250 and less than 400.

In Fig 1, It is showed that the data is sent to LCD Display to show the alcohol content, LCD is connected to ESP 32 through I2C. Similarly, DHT 11 is also connected to ESP 32

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microcontroller, the sensor detects the Temperature and Humidity of the food of interest. The temperature is measured between 40°F to 140°F. Similarly, temperature and humidity value are displayed on LCD and also visible in Arduino IDE serial monitor.

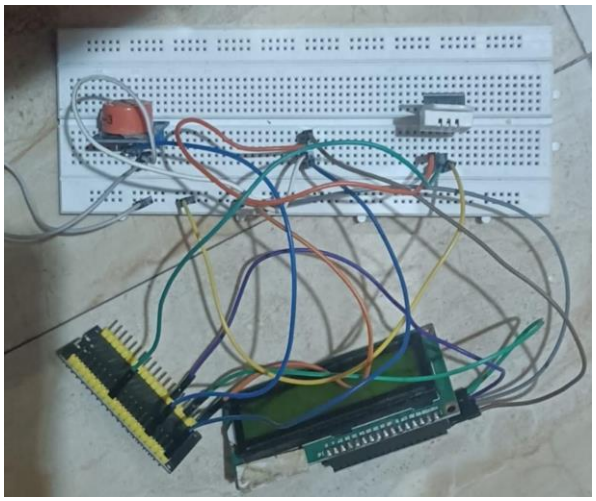

Fig. 2. CIRCUIT DIAGRAM

IV.EXPERIMENT AND RESULT

The IoT system of "Food Quality Monitoring System" constantly monitors the Temperature, Humidity and Alcohol content of the food in its surrounding. The values are observed in LCD display and also visible in Arduino IDE serial monitor.

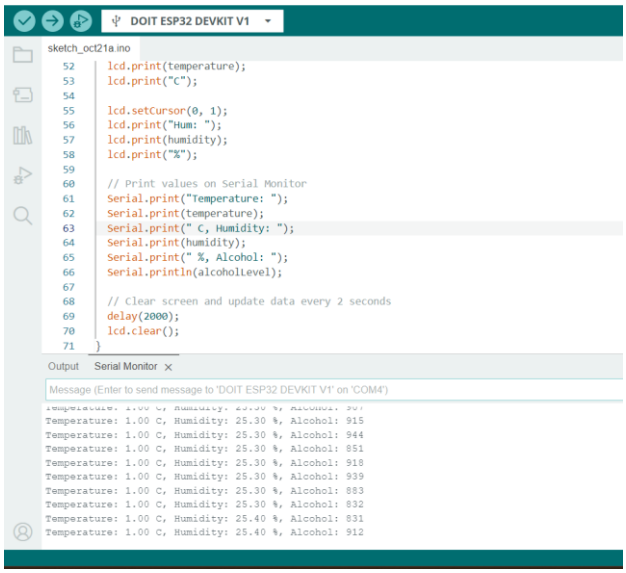

Fig. 3. SERIAL MONITOR OUTPUT

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