Survey on IoT Based Farm Freshness Mobile Application

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SURVEY ON IOT BASED FARM FRESHNESS MOBILE APPLICATION

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Abstract: **Food safety and hygiene are major concerns when it comes to preventing food waste. In India's major markets the fruits and vegetables are getting wasted due to temperature and humidity fluctuations. The quality of the food (fruits and vegetables) should be examined, and they should be guarded from rotting and decaying due to atmospheric aspects like temperatures, moisture, and shade, which help farmers conserve the food (fruits and vegetables) while in transit. An Android application based on the Internet of Things will be built in this article to monitor environmental elements such as heat, moisture, alcohol percentage, and light exposed.**

The Arduino UNO, a well-known popular tooling board, is at the heart of this device. Different sensors are interfaced to the Microcontroller board such as the DHT11, MQ3, LDR, 16x2 LCD, ESP8266 Wi-Fi, and Image sensor, which are all connected to an Android app where the user is notified with real-time data that defines the food quality. ML will be used to analyze the image captured by the app and predict the condition of the food. The app includes a chatbot that provides information on food quality. The app will suggest nearby organic stores based on the user's location.

Keywords: Arduino UNO, ESP8266 Wi-Fi, LDR, 16x2 LCD, DHT-11, MQ3, Image sensor, Android Application, Machine Learning.

I. INTRODUCTION

The increased interest in food quality and safety needs the development of reliable and sensitive research methodologies, as well as technologies to preserve food quality and freshness [1]. In hilly areas, fruits like apples and oranges, as well as vegetables like carrots, are grown. These products must be safely transported to other parts of the world. As a result, it must be monitored throughout the transportation process. Green leaves are wasted in markets due to temperature and humidity fluctuations. The food we eat can be contaminated by any type of contamination that occurs as a result of storage or chemical changes in the food. Due to food preservation, the majority of people in some countries struggle for food on a daily basis. A technology that can assist people in determining the freshness or quality of food is needed.

One of the main goals of the IoT-based Farm Freshness Mobile Application is to detect the gas released by spoiled food and alert the user to the fact that the food is spoiled, as well as to inspect the food. Today's research scholars are discovering a new field of study that is related to food recognition. The methods used were extremely expensive to implement. The detection of spoiled food is much easier when two approaches are used. The detection of the various gases released from food can be done in a variety of ways.

The proposed system is built around the Arduino UNO, a most well-known microcontroller board. This board is connected to a variety of sensors, including the DHT11, which measures heat and humid, the MQ3, which distinguishes substance of alcohol, and the LDR, which measures light exposure.

This is an Internet of Things device that sends data from sensors to an IoT platform To connect to the internet, the Arduino is interfaced with ESP8266 Wi-Fi through a Wi-Fi switch. Values from the sensors can also be seen on an LCD coupled to Arduino UNO. The IoT platform Freeboard.io is used for storing and verifying sensor data. Environmental indicators governing food storage may now be monitored from anywhere, at any time, and via any device due to the Internet of Things [2].It includes a mobile application that notifies the user in real time and has a variety of other features.

Thus, an IoT-based farm freshness mobile application is addressed in this research, which continuously monitors the parameters that must be maintained in order to prevent food deterioration, such as temperature, humidity, and light intensity. After being acquired by various sensors, the data is compared to the needed parameter threshold values in the cloud. Stakeholders are notified of these operations, as well as the food spoilage alarm, using an app [3].

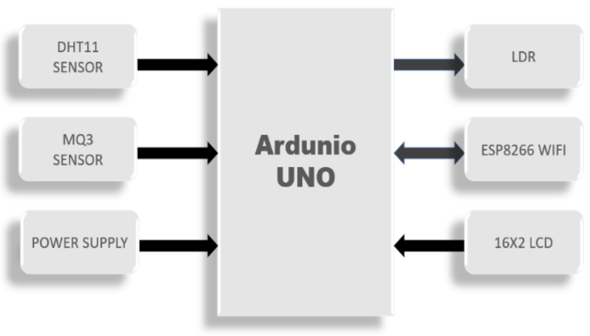

Fig 1.1 Block Diagram of the system.

II. LITEARTURE SURVEY

In paper [4], "IoT based project for food quality and monitoring," which consists of a various numbers of sensors which are activated based on the food item. The plate fits into any utensil and also has a panel for choosing the sort of food to be delivered.

In the paper [5], "Food freshness detector using IoT", For measuring freshness, the idea given by the author is sensing designs and their analytical features. With examples of The following topics are discussed: applications, indicators, antigens, microorganisms, artificial ingredients, and toxic metals.

paper [6], "Smart storage of food based on IoT", The proposed idea by the author is a kind of storage which can replenish the items in the kitchen automatically.Force Sensitive Resistor (FSR) is used to mainly detect the absence of a specific ingredients in the pantry box. The value of the sensor is read using an Arduino UNO.

Referring to paper [7], "Food monitoring system based on Bluetooth low energy and IoT",suggestion by author for remote data transfer, the system uses a GSM/GPRS public wireless network. The combination of all this things like web of things innovation, GSM/GPRS open remote system innovation, the internet will significantly lower the framework cost by enabling the infinite range of following acknowledgment, by improving the overall execution of the framework by increasing the performance.

In paper [8], A hyperspectral reflectance imaging technique in the spectral band of 400–720 nm was created to analyze exterior insect damage in jujube fruits. Insect-damaged stem-end/calyx-end/cheek areas of jujube samples were compared to untreated stem-end/calyx-end/cheek regions.per[8],"The Food quality and the security is observed utilizing the gas sensor which exhibit in keen bundling", Little gas sensors and little attempt tailored to the sort of nourishment bundling, and also use of customized gadget for conveying caution yield to the consumer, are recommended by the creators as entry variables in achieving the smart bundling.

In paper [9], "Perishable Food Quality Monitoring – The Internet of Things (IoT) Approach" Food wastage may be reduced by keeping an eye on the food which is perishable and maintaining it by watching Early warning indications of degradation This automatically helps to keep the food healthy and fresh. In this way, fruit quality may be assured by remotely monitoring the fruits when they are transitted from the farm to the shelf.
A wireless sensor network was also established in this research to follow fruits during shipment and even after storage.

In paper [10], "Arduino Based Smart IoT Food Quality Monitoring System" A food quality monitoring system will be built using an Arduino Uno microcontroller board , which will keep in track of the environmental elements such as temperature, moisture, percentage of the alcohol, and light exposure.

In paper [11], In recent years, computing systems have advanced at a breakneck pace, benefitting practically every facet of human activity. Mobility is currently considered as one of the highly desirable characteristic. Android-based apps are very helpful to a great extent in combining with database management systems as "smartphone"mobile phones have become more affordable in terms of price, quality, and performance..

In paper [12], The iot technology it is an idea which is a model based on the assumption that is a broad array of artefacts that can interact and collaborate with one another via wireless or cabled connections and it has a unique addressing schemes,which results in digital products and services which aims at sharing a single goal.

In paper [13], Nanosensors, which employs sensing devices like electronic noses, that are a novel advance in this domain.Again, To monitor the pH changes in food pH sensors are used, and they do not require batteries.

In paper [14], A imaging technique in the spectral band of 400–720 nm was created to analyze exterior insect damage in jujube fruits. Insect-damaged stem-end/calyx-end/cheek areas of jujube samples were compared to untreated stem-end/calyx-end/cheek regions.

In paper [15], "A sensor system for automatic food intake detection using non-invasive chewing monitoring."
This study provides us a basic sensor device, as well as related signal processing and various pattern recognition approaches for identifying different times of food consumption, which is based on non-invasive chewing monitoring.

In paper [16], The hue of bakery items was assessed using visual inspection, machine reading system,is constructed and discriminant analysis of the data gathered is done. A classification system was used to differentiate light and dark pigmented bakery goods.

In paper [17], "Food Intake Monitoring System for Mobile Devices," says the author. We present a real-time food intake monitoring system for mobile devices in this paper.

III. Methodology

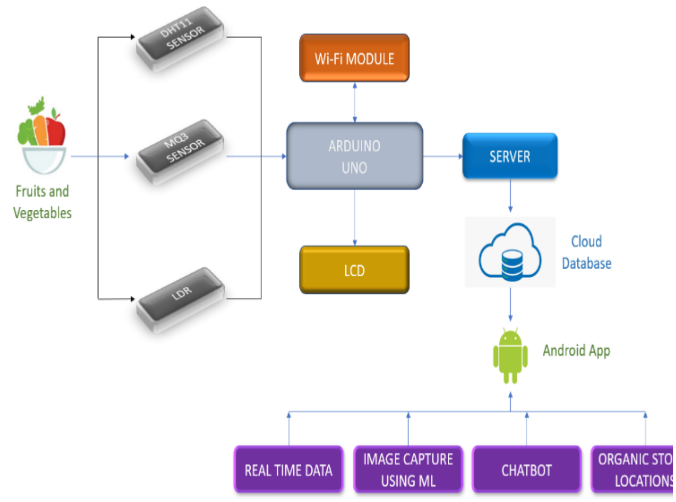

Fig 3.1 Architectural Design of the system.

The primary goal of this system to deliver a electronic device equipped with sensors that can detect food quality. Sensors are used to measure various food parameters such as oxygen level, temperature, moisture, and ethanol. The design's block diagram is shown in Figure 3.1. The device is made up of an Arduino UNO microcontroller, a temperature sensor, a moisture sensor, and ethanol gas sensor. The Arduino collects all of the sensor data and then converts the values to strings Sensor data has been bundled into proper strings and transmitted to LCD for display. Data is transmitted to ThingSpeak Server using ESP8266 Wi-Fi module that is paired to Arduino. A dashboard or information broker is essential for displaying and collecting data uploaded to the ThingSpeak server. [18].
It provides three components for creating a dashboard:

1) Data Sources - Data is obtained by external sources using data sources. Data broker serviced, JavaScript apps, and JSON files getting content from an HTTP server are examples of external sources. The data source in the project is a JSON file that gets data from the ThingSpeak server.

2) Widgets -The Widgets are small pieces of software that enable you show data in a textual or graphical format. Text, graph, gauge, and more widgets are available in Freeboard.io.

3) Panes - These are used to group widgets together.
It is integrated with an Android application that will provide real-time data on the condition of the food (fruits and vegetables), allowing farmers to discard food by knowing the quality of the food based on real-time data and also helps stakeholders about the quality of food during transportation [19]. The user can also capture images from the app, which will analyze the image using Machine Learning algorithms and inform the user whether it is rotten or fresh using the trained data. This app will also include a chatbot that will provide users with all of the information they need about food quality monitoring and how to keep food from spoiling. This app will provide nearby organic store locations based on the user's location so that the user can buy fresh food with less chemicals in it.

IV. Hardware Required

A. Arduino UNO

This microcontroller board is user-friendly that can be used to create digital devices, sensory circuits, and interactive devices. To control and also to interact with a large number of sensors to measure various parameters, a programming language such as C or C++ is used. The board has various input, output, and other pins for interfacing with devices such as an LCD and a Wi-Fi modem.

Fig 4.1 Arduino Board.

B. LDR Sensor

This sensor is connected to controller's input analogue pin via an potential divider circuit and provides a voltage. Using the built-in ADC channel the potential difference is been read and converted.

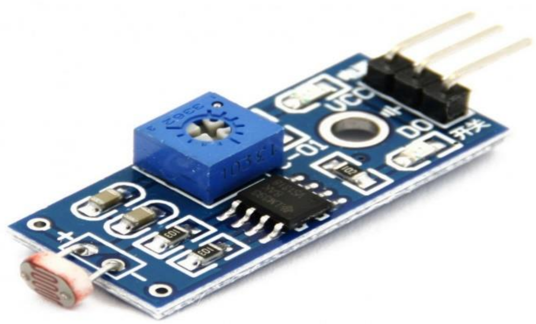

Fig 4.2 LDR Sensor.

C. MQ-3 Gas Sensor

Ethanol related gas emissions is been detected by MQ3 sensor. Food and fruits produce ethanol-like fumes when they spoil. The MQ-3 sensor detects different types of gases which will generate an analogue voltage that is proportional to their concentrations. The output analogue is connected to an ADC on the Arduino's analogue pin, which converts the analogue value to a digital value.

Fig 4.3 MQ3 GAS Sensor.

D. 16X2 LCD DISPLAY

A liquid crystal display(LCD) is display module that produces the visible image shown in Figure 5. A 16 x 2 LCD display is a very basic module that is frequently used in circuits. It divides a 16-character-per-line display into two lines. LCD characters are displaced into 5x7 matrixes in this method. The ARDUINO is connected to the LCD display, which flashes the information sent by the gas sensor about the food quality.

Fig 4.4 LCD Display.

E. DHT11 SENSOR

This Sensor is a digital sensor combines with a thermometers and a capacitance humidity sensor. For 2 seconds, it sends out a real-time heat and moisture content. The sensor can read temperatures of range 0° C and 50°C and relative humidity range 20% and 95% when driven by a 3.5 to 5.5 V source. The key components of the DHT11 sensor are the moisture sensing component and the NTC temperature probe (or Thermistor). Thermistors are temperature-sensitive variable resistors that vary resistance in response to variations in heat. They both sense the environment temperature and moisture content and send the information to the IC. VCC, Ground, data-Out, and NC are the four pins on the sensor. The VCC and Ground pins are respectively linked .

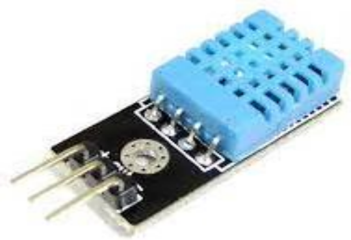

Fig 4.5 DHT11 Sensor.

F. WI-FI MODEM- ESP8266

The ESP8266 is used as an external Wi-Fi module that can be connected to any microcontroller via the serial UART and can be used as a Wi-Fi enabled microcontroller by creating a new firmware with the provided SDK, or can be used directly as an AT Command set microcontroller. The ESP8266 Wi-Fi Module is connected to Wi-Fi network via an integrated TCP/IP protocol stack. The ESP8266 had the capability of hosting All Wi-Fi networking operations can be offloaded from other application processors via a software or transferring all Wi-Fi networking activities to a different application processor. The AT command set software is preprogrammed with each ESP8266 module.

Fig 4.6 Wi-Fi Modem ESP 8266.

TABLE I. FRUITS AND VEGETABLES WITH THEIR AMBIENT VALUES OF TEMPERATURE, HUMIDITY AND LIGHT INTENSITY

Fruits or vegetables	Temperature required (°C)	Humidity required (%)	Light intensity required
Tomato	55-60	85-90	neutral
Potato	38-40	85-90	high
Spinach	32	90-95	low
Onion	32	70-75	high
Cluster beans	45-50	85-90	low
Watermelon	50-55	85-90	high
Apples	30-35	90-95	high
Pear	29-31	90	low

TABLE II. COMPONENTS REQUIRED:

COMPONENTS	QUANTITY
Arduino Uno	1
MQ3 Sensor	1
LDR	1
DHT11 Sensor	1
ESP8266 Wi-Fi	1
16x2 LCD Screen	1
Connecting wires	1

V. CIRCUIT DIAGRAM

This IoT based Arduino gadget must be deployed in a grocery. Once correctly placed and switched ON, this connects to the internet through Wi-Fi modem and begins read this guide from the interfaced sensors – DHT11 heat and moisture sensor, MQ-3 sensor, and LDR sensor. Because the sensor employs a 1-wire protocol that can only be implemented in firmware, it can't be directly coupled to a board's digital pin. A start signal is given to the entry pin once it has been tuned to input. A LOW of 18 milliseconds is followed by a HIGH of 20 to 40 milliseconds, then another LOW of 80 microseconds and a HIGH of 80 microseconds. The pin is set to digital output when the start signal is deliverd, and the temperature and moisture readings are latched out using 40-bit reference points. The first two bytes of the five-byte data are taken by the integer and decimal sections of the data.

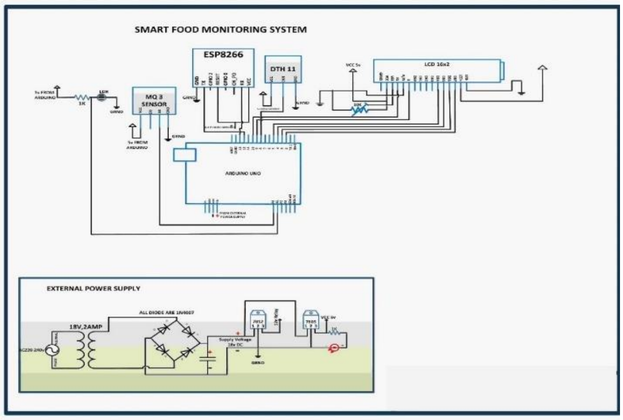

Fig 4.8 Circuit Connection.

VI. Software Required

A. *Android Studio*

For Android app development, the Android integrated development environment (IDE) is used. It focuses on IntelliJ IDEA, a Java integrated design environment that provides a code editor a long with developer tools for software development. To make application development on the Android operating system simpler, Android Studio contains a Gradle-based build system, emulator, code templates, and a GitHub connection. More than one source code and resource file types in every Android Studio project. App for Libraries modules, Android modules, and Google's App Engine modules are one of these modalities.

Fig 4.9 Android Studio.

VII. Results And Discussions

Food decay and spoilage result in food waste, but they also assist farmers in preserving food from decay during transportation to avoid food waste.

Freshness and quality of fruits and vegetables are determined using sensors. Food spoilage can be detected by detecting naturally emitted gases such as ethanol as a result of food decaying. The Arduino sensors can detect gas emissions and other crucial elements like temperature and moisture levels from food products even before any noticeable cause of rot. The sensors that detects and sense the values in foods can help to identify food deterioration early and avoiding contaminated food.

Visual indicators of spoiling such as mould or stink were noticed as a result of the Arduino-based gas and humidity sensors' capacity to detect visual indications of deterioration such as mould or scent. The amount of gas released was proportional to the degree of rotting of the meal. Small levels of methane and ammonia emissions induced by food degradation were detected using Arduino-based sensors. In comparison to the control, the levels of gas emissions were Hign20-fol when evident indications of degradation developed. While these effects were obvious in oranges, other foods examined, such as rice and milk, had substantially lower quantities of gases. As foods deteriorate, naturally generated gases such as ethylene, ammonia and methane, can be identified, indicating food decay. We were able to identify moisture levels in food products after plugging the moisture sensor into the Arduino sensors.

These techniques can be modified to include additional types of gas sensors and foods to improve the sensitivity of such detection methods. This system checks the quality and freshness of food using a hardware device and an Android application. This Android application is constantly connected to the IoT, making it easier for farmers to maintain food quality without having to check it frequently, as it also notifies the user if the food is decaying or the condition of the food is deteriorating.

Fig 5.1 Real Time Output Data

Improper preservation management is one of the leading causes of food waste, and with current technological advancements, this is a problem that may be solved to some extent. After reviewing several studies and answers to this problem, we've come to the conclusion that the field of IoT can provide a very effective solution. As a result, we explored an Internet of Things-based farm freshness mobile application that will manage several environmental elements like as intensity of light, moisture, temperature, and oxygen concentration, all of which must be kept at a certain level to prevent food deterioration. It also provides a user interface via an app, as well as warnings when food is spoiled, and our app will include a number of functions like real time data is notified to the stack holders and farmers which will help them while storing and transporting the food, prediction of food(fruits and vegetables) by analyzing it when the user takes the image through app using machine leaning algorithm, chatbot for users which will help them to get more information about preservation of food or about how to conserve it, the app will also have location access and will provide the user with nearby organic stores which can help the users to buy fresh food which are organic and less of chemicals.

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