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IOT based Food Quality Detection system using REST API in Django

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Abstract - Food quality detection is an important task in the food industry to ensure that the food being produced is safe for consumption. With a myriad of food variants with increasing globalization and an increasing number of food chains, food quality is sometimes hindered in various aspects to attain a healthy diet. In some cases, this contamination leads to various diseases which can be disastrous.

The quality of food must be assured at all times. So to avoid the problems associated with food without human interpretation we need such a device that helps to determine the quality of food. In this paper, we propose a system that uses IoT sensors to detect the quality of food and REST API in Django to analyse the data collected by these sensors.

The system provides an automated way of monitoring food quality and alerts the stakeholders if the quality falls below the desired level. This study illustrates the application of several sensors in the food sector. The sensors, which include pH sensors, gas sensors, and temperature sensors, aid in determining the state of food by comparing the readings returned by the device to the parameters established on the earlier one. Restaurants, homes, and small-scale businesses can all benefit from this system.

***Key Words*:** food quality, food wastage, REST API, sensors, quality detection

1. INTRODUCTION

It is essential to keep up with the security and cleanliness of the food to keep it new and consumable which helps in diminishing food wastage. One answer for this is to keep up with appropriate ecological circumstances for the put-away food to control the pace of disintegration. There are various boundaries on which food deterioration depends, the boundaries like humidity, microscopic organisms, alcohol content, and temperature are the central point upon which the pace of decay of food relies. Assuming the temperature of the stockpiling is between 40F ° to 140F °, it is a risk zone because during that temperature microbes develop quickly, multiplying their number in 20 min. Additionally, the dampness in the food extra space ought to be associated with 50-55% to keep the nature of the food at high, to the extent that this would be possible.

The venture includes the information procuring and controlling framework applications, which are challenging to create and incite. The nature of the food should be observed and it should be kept from spoiling and rotting by the climatic elements. Along these lines, this API is proposed to send quality monitoring devices to food stores.

The principal expectation of the task is to present a model for detecting the quality of food. The model contains ESP32 and different sensors like DHT11 to screen temperature and stickiness, and MQ3 to identify alcohol content. This entire model is an IoT-based installed framework that senses the deliberate sensor data to an IoT stage. Through an API we build an easy interface to display the food quality.

2. PROBLEM STATEMENT

We propose an API setup using the Django framework to determine the freshness of food and provide accurate results for food spoilage conditions.

To detect the freshness of food using a moisture sensor, humidity, and temperature sensors and receive an accurate representation of the state of the food package.

Based on the combination of the sensor outputs, the food quality should be detected. The data is then sent to the API that predicts the food quality based on the given set of parameters and can be displayed on any interface through the API.

3. LITERATURE SURVEY

A review of food quality checking frameworks that presently exist or have been proposed giving both their assets and shortcomings. A study on our proposed system is done comparing it with these food quality monitoring systems focusing more on how our system addresses its weaknesses.

1. "IoT Based Food Quality Detection and Monitoring System" by P. V. Thakare and P. B. Lahoti: This paper proposes an IoT-based food quality detection and monitoring system that uses REST API in Django for data exchange. The system uses various sensors to measure parameters such as temperature, humidity, and pH to detect food quality. The authors have implemented the system and evaluated its performance.

2. "An IoT-based Smart Food Quality Monitoring System" by A. K. Yadav and S. K. Singh: This paper proposes an IoT-based smart food quality monitoring system that uses REST API in Django for data exchange. The system uses various sensors to measure parameters such as temperature, humidity, and pH to detect food quality. The authors have implemented the system and evaluated its performance.

3. "IoT Based Real-Time Food Quality Monitoring System Using REST API and Cloud Computing" by Y. Zhao, J. Liu, and C. Xie: This paper presents an IoT-based real-time food quality monitoring system that uses REST API in Django for data exchange and cloud computing for data processing. The system is designed to detect food quality using various sensors and transmit data to the cloud for real-time analysis. The authors have implemented the system and evaluated its performance.

4. "A Review of IoT-Based Food Quality Monitoring Systems" by N. B. Patel and R. H. Patel: This paper provides a comprehensive review of various IoT-based food quality monitoring systems. The authors have discussed the advantages and limitations of different

approaches and technologies used in such systems. They have also identified the challenges that need to be addressed to develop efficient and reliable food quality monitoring systems.

These systems are designed to detect various parameters such as temperature, humidity, and gas emissions to ensure food safety and quality. The papers reviewed in this survey propose different system architectures and evaluation methods to address the challenges of developing efficient and reliable food quality monitoring systems.

Advantages of using REST API:

1. Easy integration: REST APIs are designed to be easy to integrate with other systems. This means that developers can easily connect their applications to the food quality detection system using REST API.

2. Scalability: REST APIs are scalable and can handle large volumes of data without affecting the system's performance. This is particularly important in IoT-based systems where a large number of sensors are involved.

3. Flexibility: REST APIs allow developers to access data in different formats, including JSON and XML. This makes it easy to integrate data from different sources and use it in various applications.

4. Security: REST APIs use standard security protocols such as OAuth and SSL to ensure that data is transmitted securely over the network.

4. PROPOSED SOLUTION

This venture proposes an API to investigate the encompassing circumstances under which the food is being put away and shipped. The proposed arrangement detects the temperature, humidity, and alcohol content under general climate as these boundaries influence the healthy benefits of food things. This API framework utilizes capacity units embedded with different electronic sensors which can peruse those boundaries influencing food materials.

This system aims to make an API that detects food spoilage and, with the help of an IoT device, fetches the values of the food item tested. So, in this proposed system we inculcated the temperature, gas, and pH value of the food item enumerated by a temperature sensor, gas sensor, and PH Sensor which works based on the transducer type.

Tools and Technologies

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So, in this proposed system we inculcated the temperature, gas, and pH value of the food item enumerated by a temperature sensor, gas sensor, and PH Sensor which works based on the transducer type. Sensors may be electrochemical, optical, mass, or calorimetric.

From [10], we referred to the circuit diagram to support the input values for our proposed system.

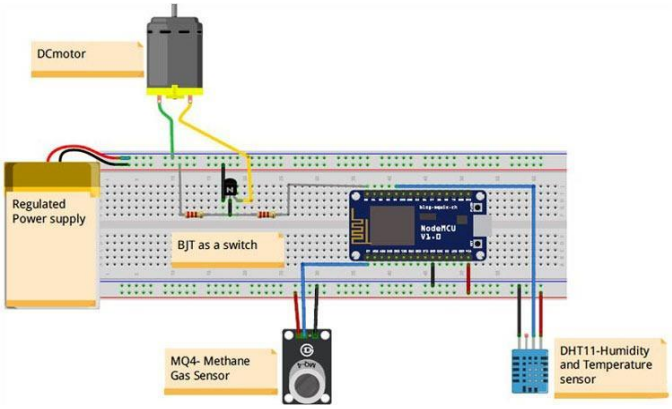

Fig -1: Circuit Diagram for the input variables of the food sample through the IoT setup

1. ESP8266 Wifi Module – A SOC microprocessor called the ESP8266 Wi-Fi module is mostly used to create end-point Internet of Things (IoT) applications. It is known as a standalone wireless transceiver and is relatively inexpensive. It is utilized to make it possible for various embedded system applications to connect to the internet.

2. Power Supply: The circuit operates on 5V DC. The AC mains are used as the primary source of power. The supply from the mains is converted or stepped down by a rectifier and 7805 power IC as an adapter.

3. pH sensor: The hydrogen ion activity in the solution can be detected passively using a pH sensor. The alkalinity or alkalinity of a solution is determined using the PH, which stands for the potential of hydrogen. The pH meter is occasionally referred to as a potentiometric because it measures the difference in electrical potential between a pH electrode and a reference electrode as part of its operation. The pH or acidity of the solution is indicated by the change in electrical potential.

4. Temperature sensor: A thermostat is a device that operates at full capacity until a specific temperature is achieved, at which point it turns off to display the precise temperature of the food item. The temperature plays a significant role in deciding how fresh the food is. It uses the LM35 temperature sensor. For a wide range of temperature values, its output voltage directly relates to the Celsius temperature. The temperature in this sensor is calibrated in units of Kelvins (K).

Software models used in the project –

1. API - Django REST API
   a. Django REST framework (DRF) is a powerful and flexible toolkit for building Web APIs. Its main benefit is that it makes serialization much easier. Django REST framework is based on Django's class-based views.

   b. Within the Django project, a new app to house the API functionality is created.
   c. URL for the API is generated to use the key in various platforms.

d. Using the Django REST Framework particular parameters of the (FoodItem) as well as data posted from the firebase (FoodData) are compared to ensure the quality of the food by the binary values of the conditional statements.
e. The model is then deployed so that it can be used in an API.

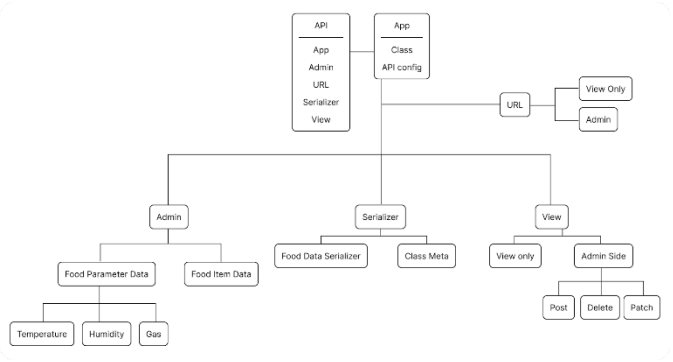

Fig -2: Architectural Diagram of API

The block diagram for this project is given in the image below:

1. The proposed system should be able to:
2. Read the temperature and relative humidity of the food.
3. Detects the emission of ethanol type of gases.
4. Collect data from all the sensors and pass it to the API where the data will be fetched.
5. Monitor the sensor data visually online.

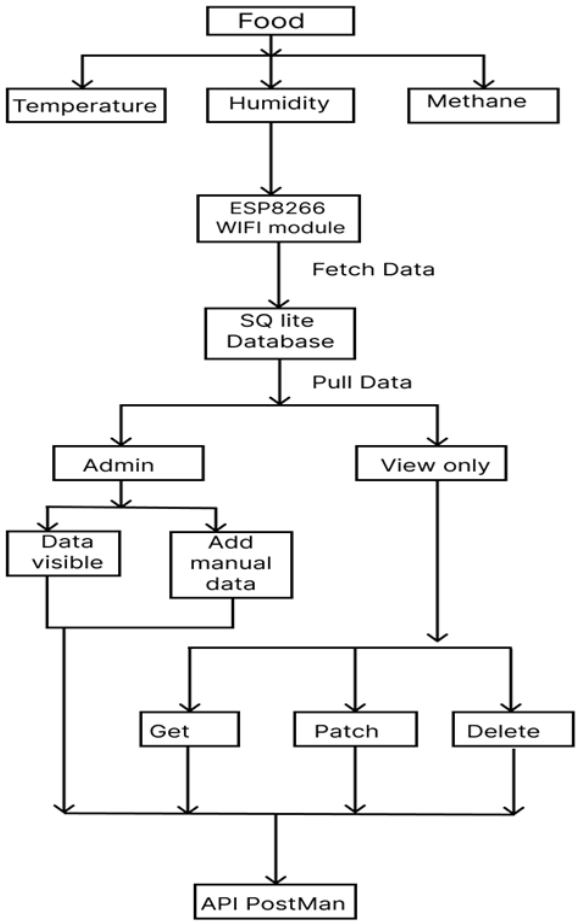

Fig -3: System flow describing the IoT and the API relation

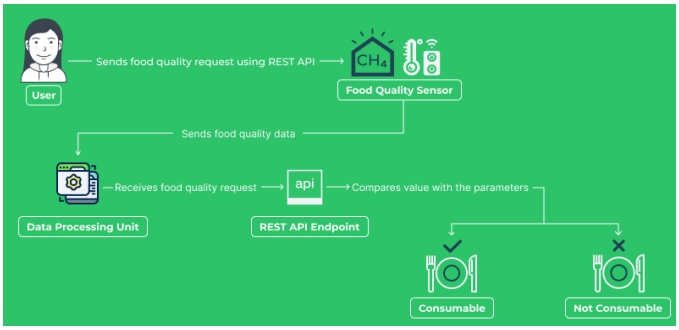

Fig -4: Use Case Diagram

The users of the system are the people who interact with the system to obtain information about the quality of the food. The following are the use cases for the users: View the food quality report Request for the food quality report.
The IoT devices are responsible for collecting data on food quality. The following are the use cases for the
Collect data on the food quality Send food quality data to the server
The server is responsible for processing the data collected by the IoT devices and making it available to users through a REST API.

5. RESULTS

The MQ3 sensors and the DHT11 sensor's combined data is gathered and converted to string values. Proper strings are used to transfer the sensor data to the LCD screen for display. The data is gathered at the API end via the Arduino board. A computerized dashboard or information representation is needed for displaying and monitoring data supplied to the Django Admin Framework.
In Fig. 4.1, the data accumulation by the sensors is programmed.

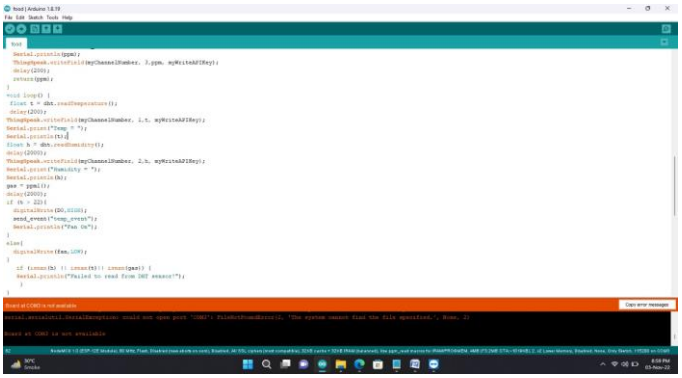

Fig -5: Sensor Programming of the IoT Setup using NodeMCU Module

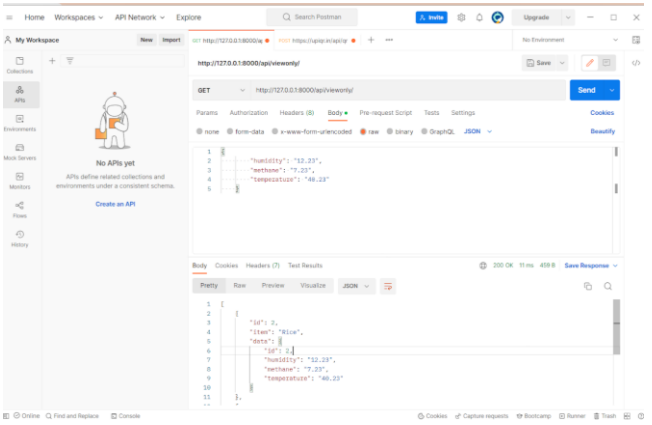

Fig -6: Working of the API with a given set of data

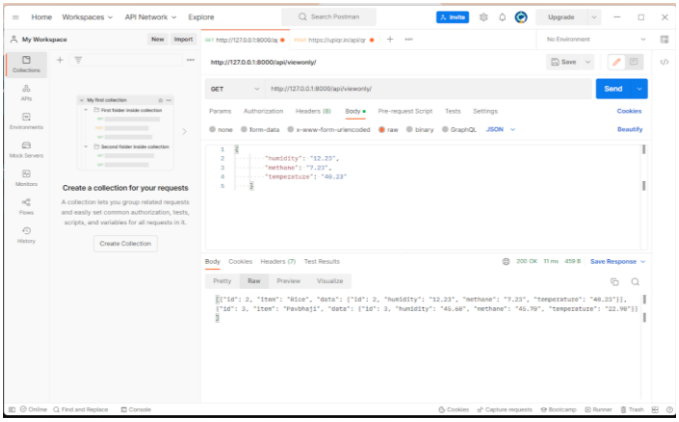

Fig -7: Item listing of the food samples in the IDE

Table 1 describes the following parameters used to compare and assure the quality of food.

Table -1: Parameters of selected food items

Sr. No.	Food Item/Category	Generic Components	Humidity Levels	Moisture Content	pH Levels
1.	Cooked Rice	Soaked Rice	60-70%	0.40-0.45 Aw	6.0 to 6.7
2.	Sandwich	Bread, Butter, Coriander, and vegetables.	40-60%	12.41 -27.54 %	5.3 to 5.5
3.	Milkshake	Milk, Fruit of Choice, sweetener, ice(optional)	-	0.8-1.0 Aw	6.7 to 6.9
4.	Pani Puri	Water, Semolina, Spices, Gram Beans, Tamarind, Coriander	-	0.95-1.0 Aw	2.0 to 3.9
5.	Roti	Wheat, Water, Oil	24-28%	0.254 Aw-0.323 Aw	6.0 to 6.8
6.	Dal (Any preparation)	-	-	0.6-0.9 Aw	^6.3
7.	Simple Bhaji Preparation (With any Vegetable)	Oil, Spices, Onion, Tomato, Any Vegetable	-	–	5.4 to 6.2
8.	Dosa(Any Preparation)	Fermented batter of ground black lentils and rice	20- 32%	0.5 - 0.8 Aw	3.6 to 4.1
9.	Fresh Juices	Fruit of any choice, sweetener	-	0.8-1 Aw	2.5 to 4.0
10.	Meat Preparation (Seafood/White Meat)	Meat of choice/Base of onion, tomato, gravy	61 - 85 %	0.6-0.72 Aw	5.7 to 6.1

When the food's quality or freshness is threatened, the system may send out real-time notifications, enabling prompt action to be done to avoid food waste or safety concerns.
The dashboard may offer a simple user interface for displaying sensor data such as temperature, humidity, gas, and weight. This makes it easier to see patterns or trends in the data that can point to problems with food quality or freshness.

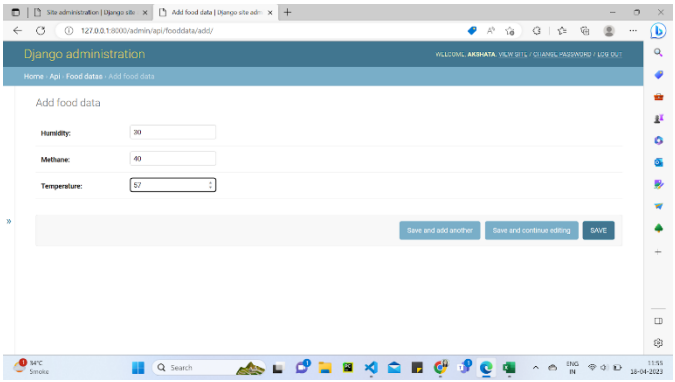

Fig -8: Django interface to provide data to the API

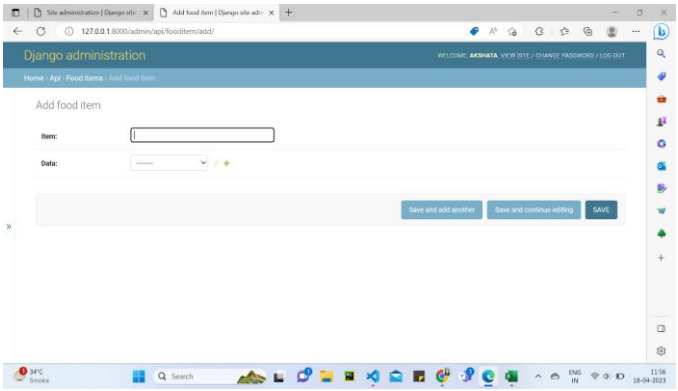

Fig -9: Item listing of the food samples in the IDE

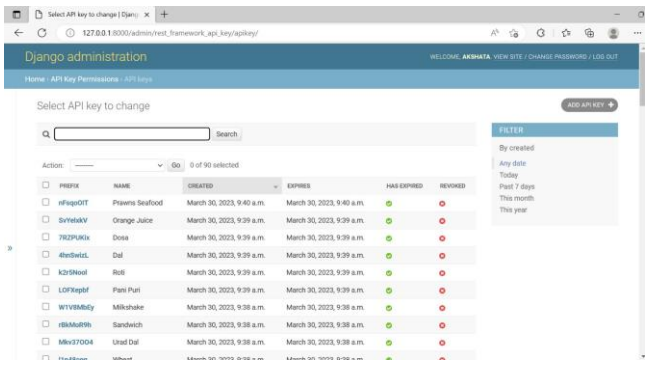

Fig -10: Item list showing the non – consumable products

6. CONCLUSIONS

In conclusion, the food sector has greatly improved food quality detection and management via the application of IoT technology. It is feasible to create a dependable and effective system for real-time monitoring and analysis of food quality by integrating REST API with Django.

The technology enables quick remedial steps to be done when necessary by providing remote monitoring of crucial parameters including temperature, humidity, and pH levels. Businesses may improve overall food safety and optimize their operations for detecting food quality by utilizing the strength of IoT devices and REST APIs in Django.

With the ability to gather and analyze data in real time, organizations can make data-driven decisions and take proactive measures to maintain the highest level of quality and safety for their products. Overall, the implementation of IoT-based food quality detection using REST API in Django is a valuable solution that can improve the quality of food products, reduce waste, and increase customer satisfaction.

6. SCOPE OF THE PROJECT

The scope of an IoT-based food quality detection system using REST API in Django is quite extensive, as it can be used in a variety of contexts where food quality and safety are of utmost importance. Some potential applications of such a system include:

1. Food storage: In industries such as agriculture, food manufacturing, and distribution, monitoring the storage conditions of food products is critical to ensure their quality and safety. An IoT-based system could be used to monitor temperature, humidity, and other factors affecting food products' freshness and shelf life.
2. Food Transportation: During transportation, food products are often subjected to environmental factors that can impact their quality. An IoT-based system could be used to monitor the conditions inside trucks, containers, or other modes of transportation to ensure that the food products are not exposed to unfavorable conditions that could affect their quality.
3. Food retail: In supermarkets and other retail settings, monitoring the quality and freshness of food products is critical to maintaining customer satisfaction and reducing waste. An IoT-based system could be used to monitor temperature, humidity, and other factors in real-time, allowing store managers to take action quickly when necessary.
4. Food safety: Monitoring food quality is about maintaining freshness and ensuring that the food products are safe to consume. An IoT-based system could be used to monitor for potential contamination, such as detecting harmful bacteria or other pathogens.

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10. Fig 1 - Circuit Diagram for the input variables of the food sample through the IoT setup - https://iotdesignpro.com/projects/iot-based-food-monitoring-system