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Food Quality Auditing and Survillance System by Using Internet of Things

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Abstract—Food plays a very important role in our day to day life. Due to rapid increase in globalization the quality of food is decreasing day by day. In most of the time food is typically processed in various ways to preserve freshness.. Various kinds preservatives or the ingredients are added in the food so that it looks like fresh or tempting. Now most of the food is preserved with the chemicals which cause the food decomposition. This decomposition leads to various diseases which results that the consumer wants healthy food. One solution for this is to maintain suitable environmental conditions. There are different parameters on which food decomposition depends; the rate at which food decomposes relies on a number of elements, including temperature, bacteria, and humidity. The people all over the world want organic food for healthy lifestyle. So to avoid the problems associated with the food without human interpretation we need a device which helps to determine the quality of food.So, in order to satisfy this consumer desire, we developed a tool that determines whether food is of good or poor quality. This project represents the use of various sensors in the field of the food industry. The sensors like gas sensor, temperature sensor help in identifying the condition of food. This system has a strong presence in homes, small businesses, and eateries.

Keywords—decomposition, environmental conditions, bacteria, temperature and humidity sensor, gas sensor, quality of food.

I. INTRODUCTION

In order to keep food fresh and edible and to reduce food waste, it is crucial to maintain food safety and hygiene. Today, practically everyone is influenced by the food they eat. This is not just true of junk food, but also of all packaged meals, vegetables, and other items used in daily life. These items all lack quality since their temperature, moisture content, and oxygen content change frequently. The majority of people only consider the information on the box, such as the number of components used and their nutritional worth, but they forget that by neglecting the environmental conditions these packets are subjected to, they are putting their health at danger [8]. Every company that makes products simply wants to draw in more and more customers, and their main goal is to sell the product in any way possible. For example, they may add more flavors, coloring agents, and preservatives to increase the product's taste and appearance, but they neglect to consider how these money-making strategies may affect the health of their customers. One solution for this is to maintain suitable environmental conditions for

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the stored food to control the rate of decomposition. Food decomposition is influenced by a number of variables; temperature, humidity, and bacteria are three important ones that affect how quickly food breaks down. It is harmful if the storage is between 39 and 141 degrees Fahrenheit because at certain temperatures, germs multiply quickly and double in number in just 22 minutes.[5] Similarly, to maintain the food's good quality for as long as feasible, the humidity in the food storage chamber should be between 49 and 56 percent. [5]. In order to monitor and control the temperature and humidity of the storage environment, we will develop a food monitoring device using the NodeMCU and Arduino IDE in this Internet of Things project. The MQ4 gas sensor module [2] is used to determine the state of the food, while the DHT11 sensor module is utilised to measure temperature and humidity. Methane gas, humidity, and temperature readings will all be taken in real time and sent to a website to be shown there. We will get an email alert if the temperature reaches the crucial level.

II. EXISTING SYSTEM

The given food where is it in solid, liquid and semisolid form a given by the texture analysis [4]. The local binary pattern (LBP) is the type of visual descriptor which basically determines the value of texture.

The other one is snapshot multispectral and hyperspectral data processing for estimating food quality parameters [1]. In this system by taking the snapshot of particular food the parameters like freshness, spoilage level, and storage temperature are obtained.

Food that has been spoiled should not be ingested because it can be very dangerous to individuals. Often, the growth of spoilage organisms results in the loss of whole food. Food safety and quality has been a major challenge in the food supply chain. It is the responsibility of all food service establishments, stores to ensure proper safety and quality of food to ensure the health of people. Their main priority should be putting the necessary quality assurance standards and guidelines into practice, which will lead to process monitoring systems and preventive control measures. It serves the purpose of preventive consumer health protection by maintaining the required standard ambient conditions needed to preserve the quality of food.

However, existing systems have been unable to provide food safety guarantees.Food safety needs to be checked at every step of the supply chain in order to guarantee it and avoid food waste. For the purposes of planning, policy analysis, program evaluation, and trend forecasting, food and nutrition monitoring and surveillance entails ongoing description of the system's components. The information gathered through monitoring and surveillance is to be truly useful, it must be processed and delivered to decision-makers in an acceptable format and in a timely manner. Information dissemination must involve interaction. Therefore, it is imperative that the sensors be integrated with a remote web server for data logging and a software program that permits data sharing.

III. PROPOSED SYSTEM

A. Methodology

This project proposes a system to analyze the ambient conditions under which the food item is being stored.The proposed system is to make electronic device that detect food spoilage. So, in this proposed system we are using the Temperature, humidity and gas value of the food item enumerate by a Temperature and humidity sensor, gas-sensor. In this system, we use an NodeMCU ESP8266 as the heart of the system to interface the gas sensors and temperature sensor. This sensor calculates level of freshness and quality of food through interpreting reading taken from food. The output is shown on the web and a warning email will also be triggered. The proposed solution is designed to use an IoT platform used for logging and monitoring of sensor data. With the power of Internet of Things, the environmental factors affecting the food can be monitored from anywhere, anytime and from any device. Thus we can easily identify the quality of food whether it is good or bad.

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- **Temperature and Humidity Sensor:**

A sensor called a temperature and humidity sensor may simply measure temperature and humidity by converting the electrical impulses of temperature and humidity. Temperature humidity transmitters generally measure the amount of temperature and relative humidity in the air, and convert it into electrical signals or other signal forms according to certain rules and output the device to the instrument or software to meet the environmental monitoring needs of users.
A temperature and humidity sensor called the DHT11 produces calibrated digital output. Any microcontroller, including Arduino, Raspberry Pi, and others, may connect with the DHT11 to produce immediate results. A low-cost humidity and temperature sensor with great long-term stability and dependability is the DHT11.
It measures the ambient air using a thermistor and a capacitive humidity sensor, and it generates a digital signal on the data pin (no analogue input pins needed). It is relatively easy to use, and libraries and example codes are offered for the Raspberry Pi and Arduino.

The pull-up resistor needed to operate the DHT11 sensor is included in this module, making it simple to connect it to an Arduino or microcontroller. The sensor can be used with just three connections: Vcc, Gnd, and Output.
Due to its special digital signal acquisition approach and temperature & humidity sensing technology, it has great reliability and outstanding long-term stability.

- **Gas Sensor:**

MQ4 is a gas sensing module, which is used to measure methane gas in the atmosphere. It contains Gas sensing layer, which is made up of SnO_2. SnO_2 is sensitive to gases like LPG, CH4, H2, CO, Alcohol, and smoke. Methane gas (CH4) is released as food decomposes, and the MQ4 sensor can be used to measure this gas to track the quality of the food.

The MQ4 Methane Gas Sensor measures the amount of methane gas in the atmosphere and produces an analogue voltage as a result. Leak detection is designed for concentration detecting ranges of 300 ppm to 10,000 ppm.
The sensor, for instance, could pick up if a gas burner was left on but unlit. The sensor uses less than 150 mA at 5 V and can function in temperatures ranging from -10 to 50°C.

- **Power Supply:**

Any electronic system needs power to function, and the power supply provides that power. Selecting the proper source can make all the difference between a gadget operating at peak performance and one that might produce erratic results.
The circuit operates on 5V DC. The AC mains is used as the primary source of power. As the supply from the mains is converted or stepped down by rectifier and 7805 power IC as an adapter.

- **Thing Speak:**

Assembling, visualizing, and analyzing real-time data streams in the cloud is possible with the help of the IoT analytics platform service ThingSpeak. Data sent by your devices to ThingSpeak is instantly visualized by ThingSpeak.
You can collect, visualize, and analyze real-time data streams in the cloud with ThingSpeak. ThingSpeak's main capabilities include the following.

1. It is simple to set up devices to communicate with ThingSpeak using well-liked IoT protocols.
2. Real-time visualization of your sensor data.
3. Aggregate information from outside sources on demand.
4. Make sense of your IoT data by utilizing MATLAB's strength.
5. Automate your IoT analytics based on events or schedules.
6. IoT systems can be prototyped and built without the need for web servers or software development.

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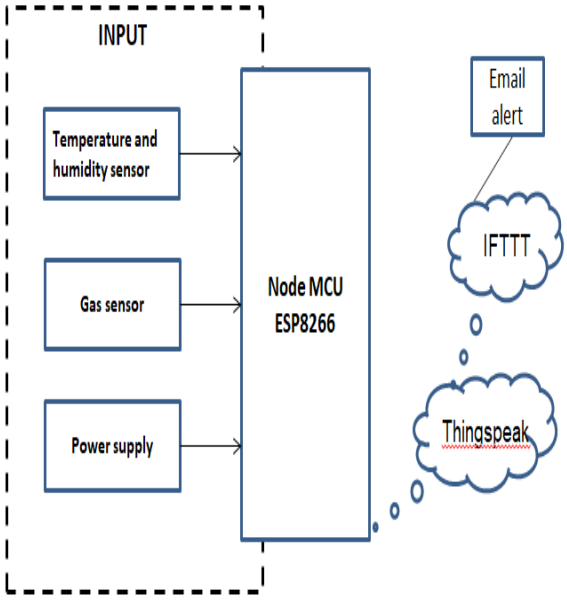
- **IFTTT:**

The programming conditional expression "if this, then that" is where IFTTT gets its name. The business offers a software platform that links applications, gadgets, and services created by various developers in order to start one or more automations involving those applications, gadgets, and services.
The automations are carried out via applets, which function something like macros and link various apps to carry out automatic activities. Using the IFTTT website or mobile apps (and/or the IFTTT widgets in the mobile apps), you can activate or deactivate an applet. IFTTT's user-friendly, uncomplicated interface allows you to develop your own applets or modify pre-existing ones.



Block Diagram

B. System Objectives

The system should be able to;

a) Read temperature and relative humidity .

c) Detect the emission of methane type of gases.

d) Collect data from all the sensors and for display.

e) Monitor the sensor data visually online.

C. Steps followed in Implementation

The following steps should be followed in implementing the project.

1. *Interfacing of MQ4 Sensor with Node MCU ESP8266*:-Initially before starting the project the MQ4 sensor should measure the value of ppm from the gas sensor. Leak detection is designed for concentration detecting ranges of 300 ppm to 10,000 ppm.
2. *Interfacing of DHT11 sensor with Node MCU ESP8266:*-DHT11do not require any calibration since it is already calibrated in the labs. We only need to connect the DHT11 with Node MCU. This study's temperature range is 0 to 50 degrees Celsius, and its humidity range is 20 to 90 percent
3. *Monitoring of Food Quality using ThingSpeak:*-To display the sensor data on web we will use a software platform called ThingSpeak
4. *Warning E-mail alert:*-If the values exceed the permissible limit an E-mail alert is sent using IFTTT software.

IV. RESULT AND DISCUSSION

The proposed system makes a use of sensors which gives the values of corresponding parameters and makes the controller so that it will display the quality of food. The objective of the project is to design a Iot based food quality detection and monitoring system capable of reading temperature and relative humidity, and detecting the emission of methane type of gases. The system should also be able to collect data from all the sensors and pass the data and further monitor the sensor data visually online.

The system has been designed around NodeMCU ESP8266 microcontroller, MQ4 gas sensor and DHT11 sensor. Once it is properly installed and powered on, it connects with the internet via WiFi modem and start reading data from the interfaced sensors – DHT-11 temperature and humidity sensor and MQ4 gas Sensor . The ESP8266 collects data from all the sensors and convert the values to the strings. To show and track data that has been uploaded to the ThingSpeak server. Methane gas, humidity, and temperature readings

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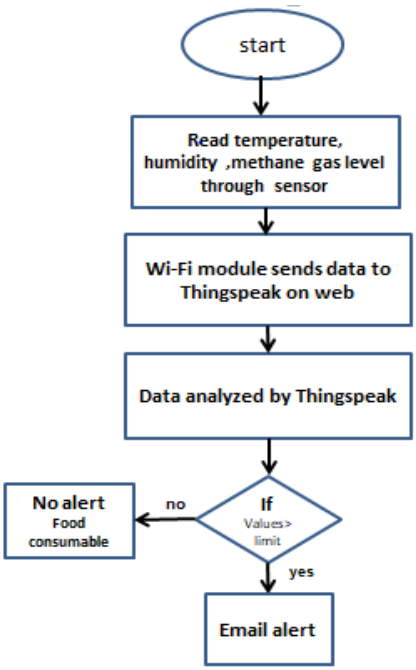
will all be taken in real time and forwarded to a website to be shown there. We will receive an email warning if the temperature reaches the crucial level, and the fan will also be turned on automatically.

User Requirements Analysis.

Components	Specification
Microcontroller	NodeMCU ESP8266 12E
Temperature and Humidity Sensor	DHT11 or DHT22
Gas Sensor	MQ4 Gas Sensor
Power Supply	5V DC

A. Process Flow Diagram

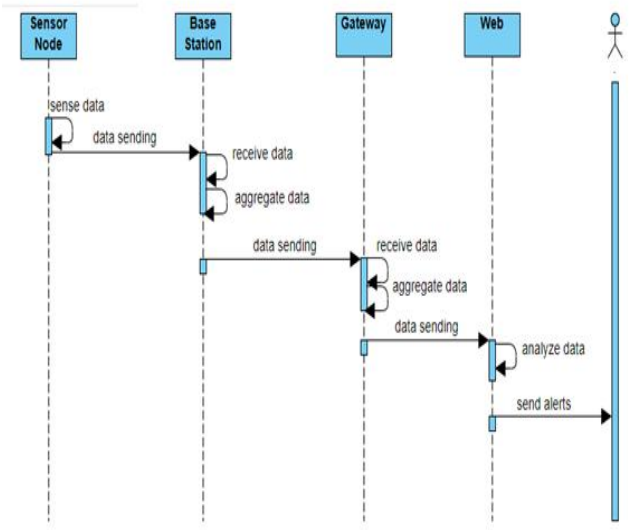


Process Flow Diagram

A gas sensor monitors the amount of gas in the space and translates the concentration variable to its equivalent voltage. Humidity sensors measure relative humidity, whereas temperature sensors detect the temperature of the air. To cut costs, the two sensors are frequently used in tandem. The data gathered by the sensors is sent to the Internet by the monitoring system. The concerned parties can monitor the temperature, humidity, and gas concentration in the food store through an open source Internet platform. If the values exceed the permissible limit an E-mail alerts are sent.

The study's maximum and minimum gas concentration levels are 10,000 ppm and 10 ppm, respectively. The suggested system should be capable of detecting concentration levels between the lowest and highest and uploading the data to an online portal. This study's temperature range is 0 to 50 degrees Celsius, and its humidity range is 20 to 90 percent. 5V DC should be used to power the circuit.

B. Sequence Diagram



Sequence Diagram

C. Output Figures

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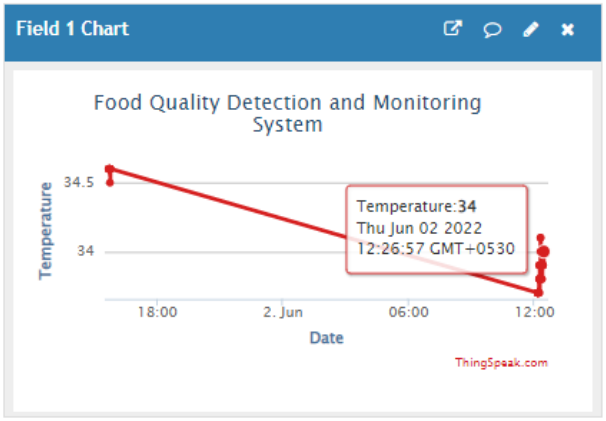

Figure: Temperature Chart

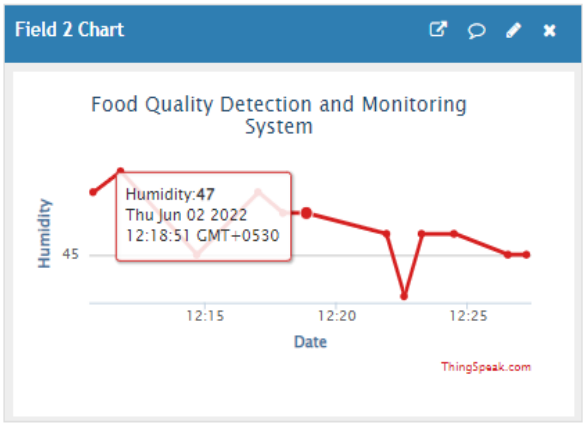

Figure: Humidity Chart

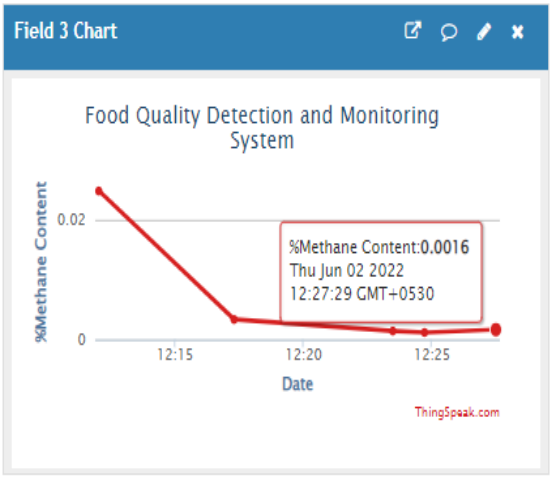

Figure: Methane Content Chart

The above output figures shows the graphical visualizations of the real time sensor data which has been collected from sensors and sent over the web for monitoring the quality of food.
The first field chart shows the room temperature , the second field chart shows the humidity level and the third field chart shows the concentration of methane content.

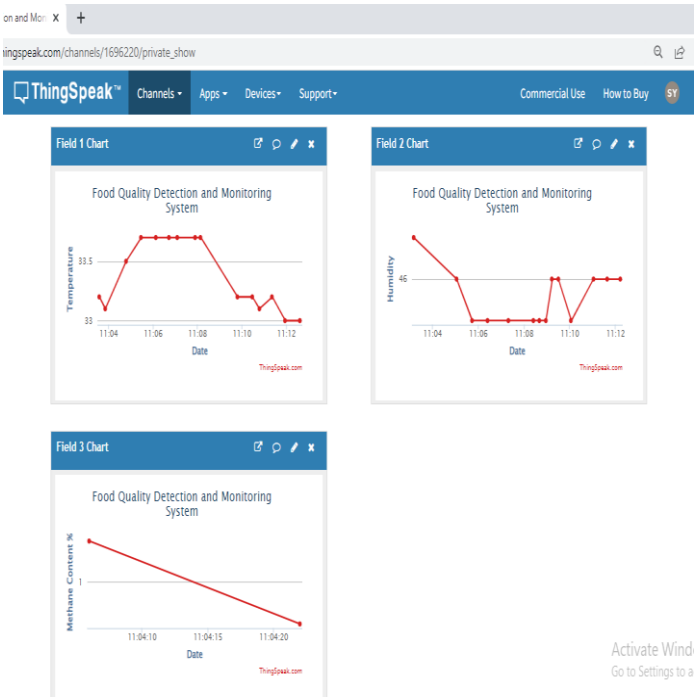

Figure -1 ThingSpeak Visualizations

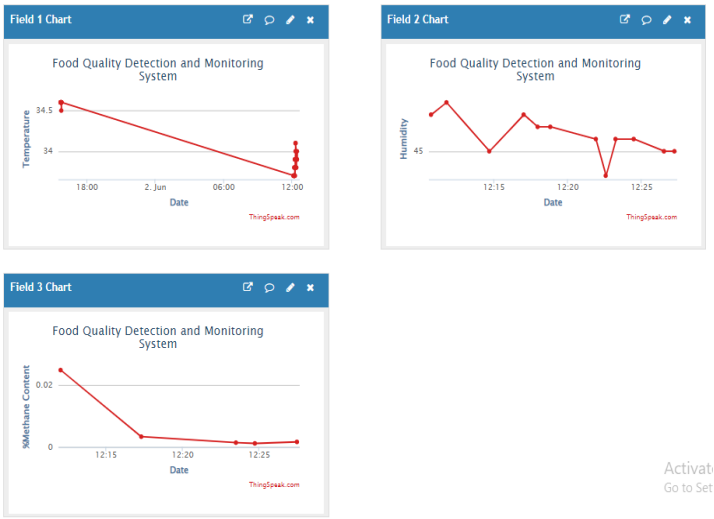

Figure -2 ThingSpeak Visualizations

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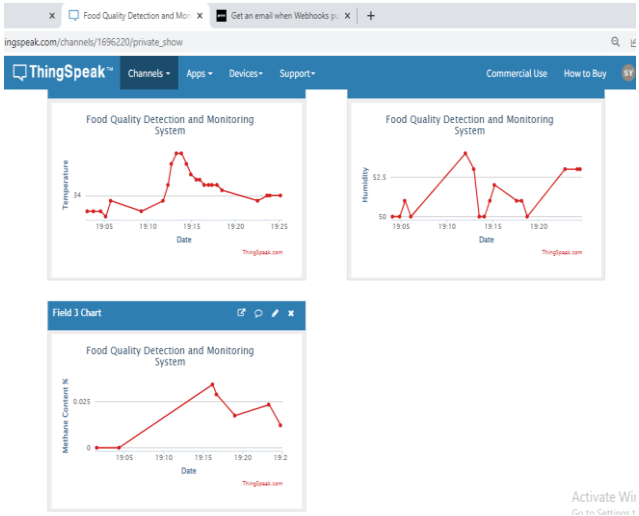

Figure -3 ThingSpeak Visualizations

The above graphical visualizations depicts the real time temperature, humidity and methane gas content which has be collected from the sensor and sent it on web that is ThingSpeak server for monitoring of food quality. The above output screenshots were taken at different time period.

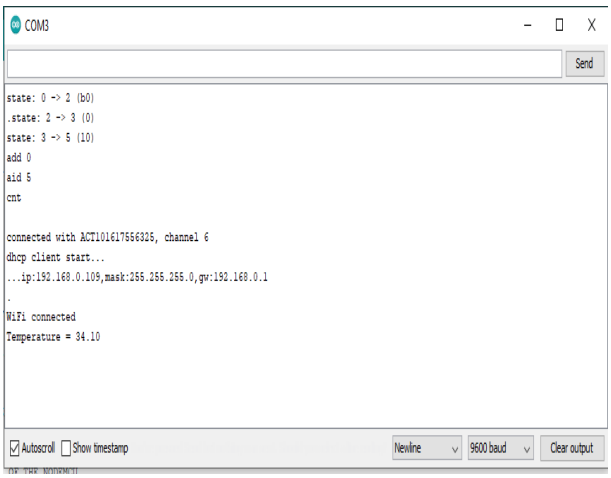

Figure-1 Serial Monitor

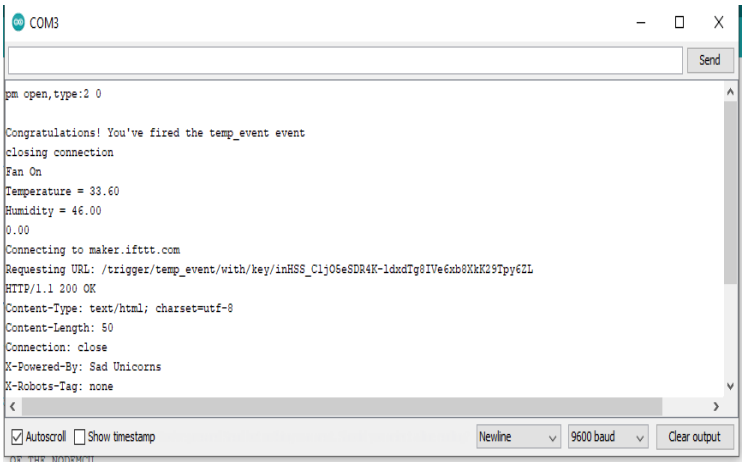

Figure-2 Serial Monitor

V. CONCLUSION

The food quality detection and monitoring system was able to read temperature and relative humidity in the food store, and detect the emission of methane type of gases. It was also able collect data from the entire sensors monitor the sensor data visually online. The sensors like the gas sensor, temperature and humidity sensor are interfaced with NodeMCU ESP8266 microcontroller and the obtained value is displayed on the web. This result helps to determine whether the quality of food is good or bad.

VI. FUTURE SCOPE

The system can be upgraded by using an upcoming and updated sensor such as nutrients sensor and various other gas sensors. In future, this system redevelops not only in food quality but by calculating the proteins, fats, carbohydrates and many more nutrients.

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