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IOT BASED FOOD SPOILAGE DETECTION SYSTEM

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ABSTRACT :-

About 351,000 people die of food poisoning globally every year. In some countries, majority of people struggle on daily basis for food, due to preservation of foods and use of chemicals to artificially increase the time span of food causes people illness. Food contamination is more dangerous because very often food does not look bad even though severely infected, it may appear quite normal. The presence of highly dangerous toxins and bacterial spores is often not detected until after an outbreak of food poisoning, laboratory examination uncovers the infecting agent. It is necessary to develop a system that can help people to identify the freshness of food or quality of food items. Based on the research, the hypothesis is that, as food decays, they emit certain gases which can be detected by Arduino based sensors, and the levels of these gases will vary depending on the extent of the decay. The measurement of parameters like alcohol, methane gas level in food items is necessary to determine freshness and quality of food. It serves the purpose of consumer health protection by maintaining the required standard to preserve the quality of food. The status of the food is not fresh all the time.

The proposed system will help people to identify the freshness of food or the quality of food items. Our purpose is that the system may give better quality and freshness in food. General awareness of nutrients in food must be known by the consumer. Food poisoning has been the source of innumerable diseases that has a bad effect on health. To avoid illness, we use sensors to determine the freshness of household food items like fruits which can reduce food poisoning. Project captures activities performed by IOT based food spoilage detection system. The food we consume can affect in any form of contamination that may occur due to storage or chemical reaction within the food. There are several viruses and bacteria that causes food contamination and leads to numerous foodborne diseases, for example Noro virus a very contagious virus caused by contaminated food or water. Most of the people die of food poisoning globally every year. It is essential to develop a system that can help people to identify the freshness of food or quality of food items. Our proposed system may give the good quality (freshness) management in food.[1]

KEYWORDS :-

FSD SYSTEM, FOOD POISONING, ARDUINO SENSORS, METHANE, HEALTH.

[I] INTRODUCTION :-

The food we consume provides nourishment and gives energy to our body, it gives us the ability to do daily activities and help improves our health in direct as well as indirect ways. A healthy and fresh diet is the most important way to keep ourselves fit. The food items kept at room temperature undergo rapid bacterial growth and chemical changes in food. Taking unhealthy food leads to bad health and can cause different food borne diseases. Indian scenario is even worse with foodborne illnesses causing outbreaks in almost every part of the country. Though most foodborne diseases are sporadic and often not reported in India, a nationwide study carried out recently reported an alarming prevalence of 13.2% at the household level. The scientific reports on the outbreak of foodborne diseases in India for the past 29 years indicated that a total of 37 outbreaks involving 3485 persons have been affected due to food poisoning. Today, in most of the hostel mess and government schools' kitchen everybody is getting affected by the food they consume. Fruits like banana and other food items used in daily life, as all of them do not offer quality since their moisture, harmful gases vary from time to time. To ensure food safety it should be monitored at every stage of the supply chain. When foods start decaying it produces some gases like ethanol, methane in it. These gases increase with time. The purpose of this system is to detect early food spoilage before signs are visible. 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. Therefore, it is useful to deploy quality monitoring devices at food stores. These quality monitoring devices keep a watch on the environmental factor that cause or pace up decay of the food.[2][3]

MATERIALS & METHODOLOGY :-

[II] MATERIALS :-

1) ARDUINO UNO R3 :-

• The Arduino Uno R3 is a microcontroller board based on a removable, dual-inline package (DIP) ATmega328 AVR microcontroller (as shown in FIG 1).

• It has 20 digital input/output pins (of which 6 can be used as PWM outputs and 6 can be used as analog inputs).

• Programs can be loaded on to it from the easy-to-use Arduino computer program.

Arduino Uno R3 Specifications-

The Arduino Uno R3 board includes the following specifications.

• It is an ATmega328P based Microcontroller.

• The Operating Voltage of the Arduino is 5V.

• The recommended input voltage ranges from 7V to 12V.

• The I/p voltage (limit) is 6V to 20V.

• Digital input and output pins-14.

• Digital input & output pins (PWM)-6.

• Analog i/p pins are 6.

• DC Current for each I/O Pin is 20 mA.

• DC Current used for 3.3V Pin is 50 mA.

• Flash Memory -32 KB, and 0.5 KB memory is used by the boot loader.

• SRAM is 2 KB.

• EEPROM is 1 KB.

• The speed of the CLK is 16 MHz.

• In Built LED.

• Length and width of the Arduino are 68.6 mm X 53.4 mm.

• The weight of the Arduino board is 25 g.

3) WIFI ESP8266 SENSOR :-

• The ESP8266 is a low-cost Wi-Fi microchip, with a full TCP/IP stack and microcontroller capability (as shown in FIG 1).

• This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections.

5) BUZZER :-

A Piezo buzzer is an electric device used to produce a tone. These lightweight and simply constructed buzzers are inexpensive yet reliable and come in a range of sizes and frequencies to meet the needs of nearly any application (as shown in FIG 1).

7) USB :-

The USB port in the Arduino board is used to connect the board to the computer using the USB cable. The cable acts as a serial port and as the power supply to interface the board (as shown in FIG 1).

2) MQ4 SENSOR :-

• This methane gas sensor detects the concentration of methane gas in the air and outputs its reading as an analogue voltage. (as shown in FIG 1).

• The concentration sensing range of 300 ppm to 10,000 ppm is suitable for leak detection.

• . The sensor can operate at temperatures from -10 to 50°C and consumes less than 150 mA at 5 V.

4) BREADBOARD :-

• A Breadboard is a widely used tool to design and test circuit. (as shown in FIG 1).

• We do not need to solder wires and components to make a circuit while using a bread board.

• It is easier to mount components & reuse them.

• Since, components are not soldered we can change our circuit design at any point without any hassle. Other components we have used are connecting wires, green and red LEDs, power supply, etc.

6) POWER SUPPLY :-

The Arduino can be powered via the USB connection or with an external power supply. External power can come either from an AC- to- DC adapter (wall-wart) or battery. The circuit operates on 5V DC. We can also provide power supply through laptop or PC connected through USB or through battery (as shown in FIG 1).

FIGURE 1:- ARDUINO UNO,MQ4 SENSOR,WIFI ESP8266 SENSOR,BUZZER,BREADBOARD, POWER SUPPLY,USB CABLE.

[III] METHODOLOGY :-

1. IMPLEMENTATION :-

This Arduino based FSD system should be installed in food store. Once it is properly installed and powered on, it connects with the internet via the Wi-Fi module and starts reading data from the interfaced sensor –MQ4 Sensor. The MQ4 sensor detects the emission of methane types of gases. If the food/fruits get spoiled, they emit the methane type of gases. The MQ4 sensor detects the concentration of such gases and outputs an analog voltage proportional to the concentration of the gas. The analog output is passed to the analog pin of the Arduino which has an inbuilt ADC that converts the analog to a digital value. The Arduino collects data from the sensor and converts the values to the strings. The sensor data wrapped as proper strings. Wi-Fi module connected to the Arduino uploads the data to Server where the processing of data takes place. The values are compared to the threshold values which gives the result that whether the food is fresh or not with a predefined algorithm. The values are sent back to the Arduino. Arduino displays the output on Blynk app dashboard "Food spoiled" depending upon the food freshness level (i.e. depending upon methane content). It also display the range of methane content in ppm.[4]

2. PROCESS :-

1. A customer needs to download 'Space Wix' app there he/she can request to signup/login with user credentials. Once owner logins, he should be able to see the dashboard where he/she will have to create project with any title say 'FSD SYSTEM'. There it is required to set hardware component through which sensor data is going to be sent to the server. Also the connection type is to be mentioned say Wi-Fi (or Ethernet, USB, etc..).
2. Store manager will approve the login request. On approval, an approval email would be sent to the customer's email id. Email id of the customer is a valid user. He will be provided with a auth token which is to be used for programming for NodeMCU to connect to the blynk server.
3. He will have to specify the ssid and the password of the Wi-Fi in the required program to connect to FSD System to the internet. Manager should be able to see following reports

•Methane Range in the fruits as sensed by the sensor.

•"Food Spoiled" message when it is detected range above 250 ppm.

3. A soon as the manager gets the text on the Blynk app dashboard, he is expected to take actions regarding the spoiled food and also consuming those fruits which are at the stage of spoilage.
4. It requires hardware PC/laptop with 2 GB hard-disk and 256 MB RAM or an android phone

and it can be used to power the Arduino.[5]

3. FSD MODEL :-

FSD System is lit with a green LED until it comes in contact with the spoiled food emitting methane or more precisely fruits. As soon as the sensor senses any spoiled fruit it triggers a buzzer and a red LED is lit. The range or value of methane measured in ppm by the sensor is displayed on the dashboard of 'Blynk app'. Also, with the help of ESP8266 Wi-Fi module the specific range can be seen through any IOT project-based websites like Thingspeak.com or any applications like Blynk or any other cloud which can be used as a IOT portal.

There we can see the range of methane produced by fruits which are spoiled. Normally the fresh fruits have methane content below 250 ppm, if it goes above this then it is an indication of fruit spoilage. So, with the help of these IOT project-based applications a message of "Food Spoiled" will be printed on the screen of 'Blynk app'.[6]

4. BLOCK DIAGRAM :-

Arduino needs to be given a power supply it can given through may sources like barrel adapter, the USB connector by connecting it to a PC/laptop, batteries greater than 5V supply, using battery shield etc. We used USB connector from Arduino to PC. Different components required are MQ4 Methane sensor, ESP8266 Wi-Fi wireless module, green led, red led, and few other components include bread board, connectors, resistors, batteries for other power sources required, buzzer etc. All these are connected to the Arduino with the help of breadboard. A network can be established through a mobile hotspot which is sensed by ESP8266 Wi-Fi module and our Arduino can share the data sensed by the sensors connected to it to the IOT portal or any other cloud where user could know the range of methane in ppm produced by the spoiled food. When the food spoilage is sensed by MQ4 methane sensor the buzzer is triggered and a red LED is lit. So user could know about the food spoilage. Also a mail is generated by the IOT based applications in our case (Blynk app) and is sent to the user of FSD system. (as shown in FIG 2).

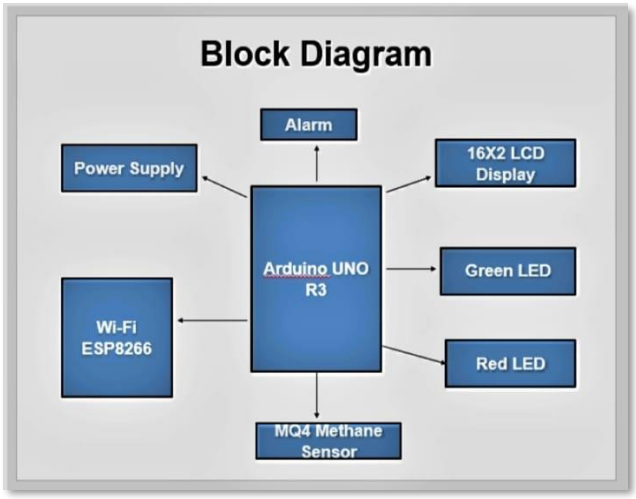

FIGURE 2:- BLOCK DIAGRAM OF FSD SYSTEM

[IV] RESULT :-

• Quality is monitored constantly by sensors and readings are displayed on screen.

• When abnormal readings are detected in any readings i.e., MQ4 sensor, it displays the food spoiling message on the LED screen.(as shown in Fig 3)

• It also displays a message of “Food Spoilage” on the Blynk application dashboard. .(as shown in Fig 4)

• The data over Dashboard gets updated every seconds.

• User will also be able to see the values on serial monitor of Arduino IDE and the specific graph on the serial plotter of Arduino IDE.

[V] FUTURE SCOPE:-

• Using high precision sensors to increase the area of sensing.
• We can modify the project by using two or more sensors which will display dual parameters on the screen.
• We can modify this project and use for big warehouses and go downs where manually checking of eatables is not possible.
• This FSD system can also be used by anyone who owns refrigerator or may not having refrigerator as sometimes person may forget to consume any food item before its expiry date so it gets spoiled and is overlooked so it can be useful to detect freshness of each item present in the fridge or else at home. In that also different sensor can be used.

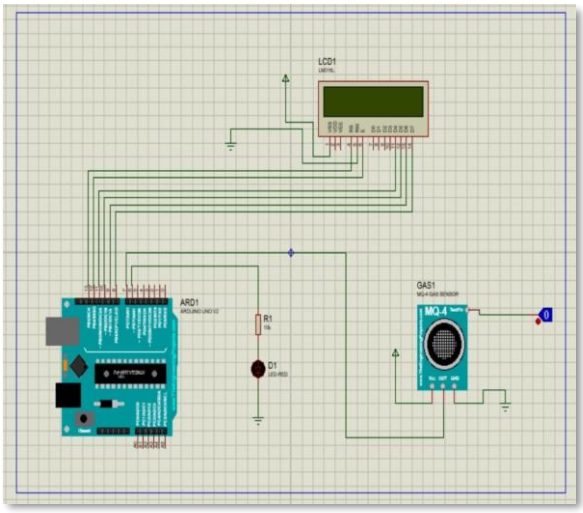

FIGURE 3 -CIRCUIT DIAGRAM OF FSD SYSTEM.

FIGURE 4- BLYNK IOT APP

[VI] CONCLUSION :-

- Food poisoning has been the source of innumerable diseases, to reduce and avoid illness we use sensors to determine the freshness of household food items like fruits.
- The Arduino sensors can detect gas emissions using sensors to detect the presence of these values among foods can help detect food spoilage early and prevent the consumption of spoiled food.
- These techniques can be further developed to include other types of gas sensors and foods to increase the sensitivity of such detection methods.
- This system consists of a hardware device i.e. Mq4 Methane Sensor which checks the quality and freshness of food.

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