International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 04 | Apr 2020 www.irjet.net p-ISSN: 2395-0072

An Efficient System to Detect Freshness and Quality of Food

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Abstract - *The food quality tracking system based on the Internet of things is an integrated monitoring and management information system, which consists of intelligent database technology, radio frequency identification technology, food safety technology, network technology, as well as other practical high-tech techniques. The food we consume provides nourishment and gives energy to our body which helps us to perform our day to day activities. 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. Eating unhealthy food can cause several foodborne diseases which may harm our health. This IoT based system aims to detect the quality and freshness of food using biosensor and electrical sensors. A smart system can detect the freshness of household food like dairy items, fruits, and food items. The identification and selection of a hydrogen sensor, Moisture sensor, and Gas sensor to develop a sensible food freshness detector ensures the freshness of food and tells whether or not to eat it or bin it. A web application is developed to display the results of checking food items by the device. Users can register a complaint and post reviews on the web portal if the system does not provide efficient results by filling an online form.*

***Key Words*: Food freshness, Food quality, LCD, Arduino, Moisture Sensor, Hydrogen gas sensor.**

1. INTRODUCTION

Today, in most of the hostel mess and government schools' kitchen everybody is getting affected by the food they consume. Milk, fruits like banana and other foods 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. The potential of hydrogen (pH) is used to specify the alkalinity or acidity of milk. Variation in pH can affect taste, flavor, shelf-life of dairy products. When foods start decaying it produces some gases like ethanol in it. These gases increase with time. The purpose of this system is to detect early food spoilage before signs are visible. Based on the research, the hypothesis is that, as food decay, 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. Increased water content in food items changes its chemical composition and pH level. The measurement of parameters like pH level, moisture, 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 analysis of routine measurements aims to detect changes in the nutritional value of food. 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 dairy, fruits which can reduce food poisoning.

2. MOTIVATION

Thirty students from Telangana Minority Residential School in Hyderabad's Asif Nagar were admitted to Niloufer Hospital after they fell sick eating lunch served at the mess on MONDAY, JULY 08, 2019. The students suffered from vomiting and severe abdominal pain. the students were within the age range of around 10 to 13. They ate the hostel food on Sunday afternoon and immediately presented with stomach pain and vomiting. They were delivered to the hospital on Monday morning and admitted. Each year, approximately 600 million people fall sick and 420,000 people die from the illness. Often, people consume spoiled foods because there's no significantly visible sign of food spoilage.

3. LITERATURE SURVEY

Paper 1: "EFresh – A Device to Detect Food Freshness" September 2018

In this paper authors Naveed Shahzad, Usman Khalid used biosensor and electrical sensors to check out the freshness of food. A smart system that may sight the freshness of food like farm things, meat, and fruits. The identification and choice of hydrogen ion concentration device, moisture sensor, and the Gas sensor is used to develop a wise food freshness detector that ensures the freshness of food and tells whether or not to eat it or bin it. An android application is developed to select the type of food to be checked.

The system ensures the quality of food, whether it is good for eating or not. It does not provide the facility to complain if the device does not provide accurate results. The feedback may recover the issues related to the device.

Paper 2: "Detection and classification of bacteria in common street foods using electronic nose and support vector machine"2017

Authors Jessie R. Balbin, Julius T. Sese, Crissa Vin R. Babaan focused on the classification of bacteria in street food. Street food features a major impact on the culture and however, as a result of the dearth of information on correct food preparation, the cleanliness and quality of street food are neglected. A bad microorganism that causes diarrheal diseases and it's exhausting to sight whether or not the microorganism exists, by using an electronic nose, and image processing.

This paper aims to design an electronic nose with gas sensors that will detect three common types of bacteria on street foods, namely Enterococcus faecalis, Escherichia coli and Staphylococcus aureus; and to classify if the said bacteria are present in the pre-cooking stage and the bacteria are still present after cooking. The electronic nose system detects the bacteria in the sample street food during the pre-cooking stage and Support Vector Machine detects the bacteria in the sample street food during the post-cooking stage. This system lacks the detection of other parameters like moisture, gas level in food.

Paper 3: "Real-Time Milk Monitoring System"2018

Authors Prof. Kadam P. R, Miss. Shinde K. P. describes the scenario of smart city services that are provided to manage the city's assets by integrating information and communication technology (ICT) and the Internet of things (IoT). Different sensors, terminals with a variety of topologies and different application requires security for managing them. To make money day by day the quality of food decreases and it affects the health of people and this creates food safety problems. In this paper, the presented model detects the raw milk for spoilage detection. From the last decade, researches are coming up with different efficient methods for detecting spoilage of milk.

This paper states different studies that show that raw milk contains the bacteria which are harmful to human beings, so there is a need to develop one real-time system which will monitor the quality of milk distributed to the people or getting used for dairy products. The proposed system work with a set of different sensors which are connected to the Arduino board and in turn all data will get passed to the android app and according to the value, the system checks the quality of milk and user can easily identify the quality of milk, the user is getting. Along with milk, a system must check other items which will make the system more effective.

Paper 4: "The Vegetable Freshness Monitoring System Using RFID with Oxygen and Carbon Dioxide Sensor"2012

In this paper authors Ki Hwan Eom, Min Chul Kim proposed an oxygen and carbonic acid gas concentration observation system for freshness management, which supports radio frequency identification (RFID). Freshness may be checked by varying factors as well as wetness, temperature, oxygen, and carbonic acid gas. This paper focuses on oxygen and carbon dioxide. The concentrations of these two gases are related to freshness and affect the food.

This system uses a device for observation of gases and connects the device with the associate RFID tag. The RFID system is relatively easy to manage. With this combined system, it calculated the freshness of vegetables.

4. IMPLEMENTATION

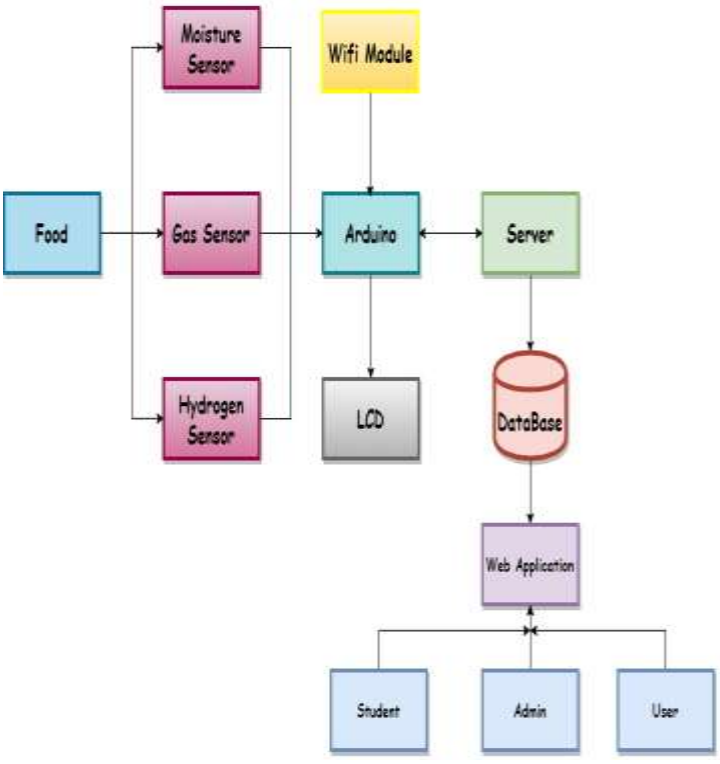

Fig 1. Block Diagram of Proposed System

The objective of this proposed system is to make an electronic device integrated with biosensors that can detect food spoilage. The use of sensors that can measure different parameters of food like pH, moisture, and ethanol, and methane level. The block diagram below shows the model of the device. The device consists of a microcontroller Arduino Uno, electrical and biosensors like Hydrogen sensor, moisture sensor, and ethanol gas sensor. The proposed solution senses ph level, moisture, harmful gases in related

food. The moisture sensor senses the moisture level with a moisture sensor and alcohol gas level with the MQ3 gas sensor and the hydrogen level with the help of hydrogen sensors from food samples. The hydrogen value is used to calculate the pH level of food. This Arduino based IoT device should be installed in food. 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 sensors – Hydrogen sensor, MQ3 Sensor and Moisture sensor. The MQ3 sensor detects the emission of ethanol types of gases. If the food/fruits get spoiled, they emit the ethanol type of gases. The MQ3 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 all the sensors 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 the LCD as "Good to eat" or "Not good to eat" depending upon the food freshness level. The server stores the results in the database. Admin, students and hostel organizations can view the result from the database by log in the web application. The code will get triggered and sends us our warning email when the food parameters cross the set value to notify the student that the food is not fresh.

In our proposed system, we are providing a web application at the user interface.
There will be 3 modules:
1. Admin
3. User
4. Student

Admin:

- Admin will register the user, i.e hostel organization with a particular device.
- Admin will store and manage all the data recorded from various devices to a server.
- He will also take care of the maintenance work of each device.

Hostel:

- Hostel organization will check the food quality and freshness with the help of the device regularly.
- The user will add students to the system.
- View results and student feedback on the website.

Student:

- The Student can log in with id and password.
- The student can post a review or lodge complaints in case of false results of the system.

5. DATA RESULTS

Freshness and Quality detection of Banana.

Ethanol is a naturally occurring substance also called Alcohol. Ethanol plumes can be used for artificial ripening of fruit. Fruit ripening is associated with changes in color, taste, sugar, and ethanol content. When fruit like banana starts ripening its chemical properties change and produces ethanol in a small amount. This amount increases with time. The MQ3 gas sensor is used to detect the production and concentration of ethanol in banana. MQ3 alcohol sensor is used to detect the presence of ethanol, where the sensitive material used for this sensor is SnO2, whose conductivity is lower in clean air. Its conductivity increases as the concentration of ethanol gases increases. It has a high sensitivity to alcohol and has good resistance to disturbances due to smoke, vapor, and gasoline. This module provides both digital and analog outputs. It has high sensitivity and fast response time. The sensor provides an analog resistive output based on alcohol concentration. MQ-3 is an analog as well as a digital sensor. The presence of ethanol vapors in food is a sign of decay. So, by the MQ3 sensor, it can be detected if food has started decaying.

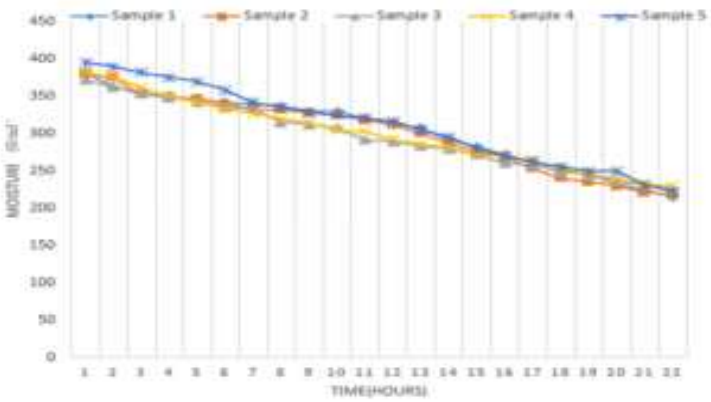

Fig.2- Ethanol Level of Banana Samples with Time

Freshness and Quality detection of Milk.

The lactose sugar in milk is converted into Lactic Acid by Lactic bacteria which lowers the pH level of milk, over time the Lactic acid level increases and a phase come when pH level decreases to such a level so that the Lactic acid provides help in the growth of bad bacteria which causes spoilage of milk. The standard pH of fresh milk is approximately 6.5-6.7. So the pH can be calculated by using a Hydrogen sensor i.e MQ8. To monitor the growth of spoiling bacteria in the milk we can use gas sensor array which will calculate the actual amount of volatile compounds that get

produced. These sensors can detect metabolism in specific bacteria in milk products. This technique gives us a major goal of fast identification, fast measurements of spoilage in milk. The selection of sensors is dependent on its chemical specifications and sensitivity and also other parameters like cost, power consumption, size, and compatibility. MQ3 is having a high sensitivity to Alcohol and Organic solvent vapors. A main important feature of MQ3 is its high sensitivity and quick response time to lower alcohol concentrations also with low conductivity in pure air.

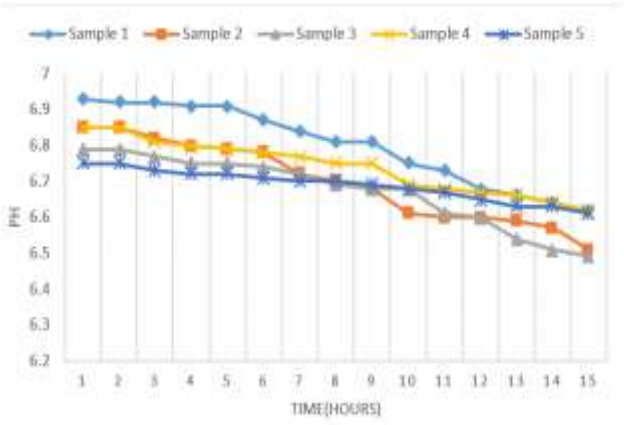

Fig 3. pH Trend of Milk Samples

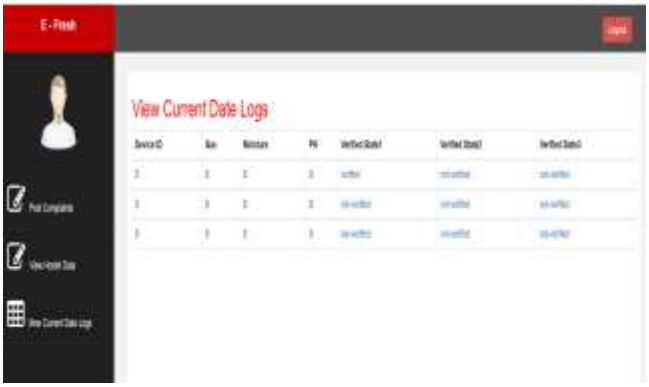

Fig 4. Data logs

Fig 5. Complaints log

6. CONCLUSION

Food poisoning has been the source of innumerable diseases, to reduce and avoid illness, we use biosensors and electrical sensors that determine the freshness of household food items like dairy items, fruits, and foods. Detecting naturally emitted gases such as Ethanol as food decay can be used to detect food spoilage. The Arduino sensors can detect gas emissions and other important constituents like pH and moisture levels from food items even before the presence of any visible signs of spoilage. 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 and a web application that checks the quality and freshness of food.

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