IOT Based Milk Adulteration Detection and Identification of A1 and A2 Type

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Abstract - The milk is the food liquid secreted by the mammary gland in highly evolved animals such as mammals. Better thickness and release from adulterants are two attributes of premium milk. The most profitable product offered by local retailers and general retailers as well. In any case, some adulterants are added in local areas to increase yield, which may have an impact on the milk's nutritional value. Using tainted milk results in serious health problems and is a major worry for the food industry. Therefore, it is essential to ensure milk by determining the kind and quantity of adulterants introduced to the milk. To really do this work, an Arduino Uno-microcontroller is used. The sensors are integrated into a flexible framework that breaks down the properties of milk into several assessments, which are then shown on an LCD screen and an Internet of Things platform. It is possible to prevent the problem that people and little diaries are pointing out by understanding the nature of milk and the ways in which it is contaminated.

Key Words: Arduino, pH sensor, Temperature sensor, LCD, TDS sensor, 4*4 Hexa keypad

1. INTRODUCTION

Because of its nutritional importance, milk is one of the staple meals that people consume everywhere in the globe. 3.3% protein, 5% lactose, 87% water, and 3.9% lipids are all found in milk. Adulteration of cow milk with milk from other animals is one of the most common forms of adulteration within the dairy sector. This concerns not just the authenticity and quality of the product, but also the safety of the customer for those who have cow milk allergies. In order to generate more rapid income, stores are adulterating food these days. Meals can be adulterated by mixing ingredients like starch and curry powder, blending papaya seeds with dark pepper, or ripening mangoes.
On a long shot, people suffer from this attempt at adulteration. Approximately 77.68 million metric tons of liquid cow milk are produced in India annually. To extend the milk's realistic shelf life, adulterants are frequently added. Formalin and acid are two additions that are added to milk as adulterants to extend the product's shelf life.

It is imperative to strictly maintain food quality, particularly milk quality, in order to ensure proper food management and human welfare. Thus, it is essential to develop quick, sensitive, trustworthy, and astute methods and sensor frameworks for monitoring food quality and early detection/identification of microorganisms. The most pressing specialized need in the dairy industry now is pathogen distinguishing proof. Machine learning algorithms can be used by consumers and regulatory agencies to analyse spectral data and provide useful information about the composition and quality of milk.

1.1 OBJECTIVE

The project aims to enlighten consumers about the quality of milk and empower them to make decisions based on knowledge. Giving customers knowledge about adulterants and the differences between A1 and A2 milk might enable them to make safer and healthier decisions.

1.2 MOTIVATION TO TAKE UP THE PROBLEM

It can be very inspiring to take on a project like "IoT-based Adulteration Detection for Milk Quality Assurance and Testing Samples for A1 and A2 Milk" for a number of reasons. Public health is strongly impacted by milk quality. Milk adulteration can cause major health problems. You are helping to ensure that people are consuming milk in a safer manner by creating a mechanism to identify adulteration.

There are lots of chances for innovation in this project. Creating an Internet of Things solution requires combining a number of different technologies, including data analytics, machine learning algorithms, and sensors. It might be intellectually fascinating to tackle the problem of developing a dependable and effective system.

A fundamental food consumed all around the world is milk. Its quality assurance has major financial ramifications. You can protect the livelihoods of dairy farmers and uphold the integrity of the dairy sector by identifying adulteration and differentiating between A1 and A2 milk.

1.3 RELATED WORK

Electrical Methods for the Detection of Bacteria: A few traditional methods for locating bacteria include the bacterial list, which identifies degradation when a shaded arrangement becomes dull due to enlarged digesting caused by replicating tiny organisms. One such model is the methylene blue reduction test. Nevertheless, there are a number of documented flaws in this test, such as laborious and repetitive processes and an inability to distinguish between different bacterial species. Lee and associates [1]. attempted to improve the methylene blue lowering technique by adding an amperometric sensor while maintaining its points of interest. Current change is measured by an amperometric sensor, which is constructed from a circuit consisting of a potentiostat and a few cathodes. Amperometric sensors are small and inexpensive, and they have been used to detect alterations in microorganisms, such as Escherichia coli, in a variety of media. Lee et al. administered ENT and milk E. coli vaccinations. There are two types of Coli structures that exhibit a clean state: aerogenes. A third model has methylene blue and milk in it. Methylene blue cannot stop being blue until an organism's metabolic development causes it to lose its ability to conceal itself. As a result, the E. coli's bacterial digestion reduced the amount of methylene blue in the three models and also brought about a shift in the current. Any existing variation greater than 0.05 μA was identified using the amperometric sensor and recorded. measurement of the initial estimated population of microorganisms in the example. confirming a reverse straight relationship with great exactness between the bacterial fixation logs in opposition to the discovery time. The growth of microorganisms has been linked exponentially across time, from vaccination to the underlying small alteration in the present. The outcomes were favorable. This technique's highlights include an exceptionally broad recognition scope of 102 - 104 CFU/mL and a discovery time that is 0.5 - 2 hours quicker than that obtained with the methylene blue reduction procedure. Furthermore, the amperometric sensor could record the data on its own, but the methylene blue reduction technique needed constant supervision and inspections every thirty minutes. The final tactic was typically crucial and reasonable; accuracy was also unimportant. However, this approach is unable to distinguish between cells that are appropriate and those that are not. Furthermore, a certain type of identification of microscopic creatures was insufficient. When other bacteria, like B. subtilis, Lactobacillus sp., Saccharomyces sp., and Staph. Aureus, were tested, the amperometric sensor could only detect the coliforms of E. Coli and Ent. Aerogenes; these germs produced an insignificant current change.

Using distant inquiry innovation to detect milk spoilage is a growing area of research known as "Remote Detection and Monitoring of Milk Spoilage." A detachable, strip-like magnetoelastic thick-film in conjunction with a compound or biochemical detecting layer—for instance, a catalyst that reverberates at a distinctive frequency—makes up the remote-inquiry magnetoelastic sensor stage [2].

Amperometric biosensors have been shown by Conzuelo et al. [3] to identify the lactose component of milk. A common core sign for evaluating milk quality and identifying areas of deviation from the norm is lactose focus. It has been found that the milk from cows with mastitis has a low lactose content. The chemical-based amperometric biosensor is a highly selective, versatile device that may be operated by faculty members who lack the necessary skills. The bioelectrode's structure is based on a self-assembled monolayer, a particular catalyst, and other synthetic materials. The lactose fixation-corresponding amperometric signal is offered by the compound response as an ascent.

Renny et al. [4] have revealed a piezoelectric sensor that can identify milk's urea concentration. It is an impetus-based sensor that detects the weight of the gas that is produced in the model when the urease process takes place. Potentiometric electronic tongues that use lipid/polymer layers are able to classify a wide variety of constituent substances into several groups, some of which are present in the natural systems' taste group. Capone et al. [5] used an E-nose to measure the progression of rancidity in UHT and purified milk over the course of eight and three days using five different SnO_2 thin films that were organized using sol-gel technology. As it is, the sensors are able to distinguish between the two types of milk and determine their level of rancidity.

2. PROPOSED SYSTEM

The global dairy sector is a major contributor to the vital nourishment that consumers receive. However, adulteration techniques frequently impair the integrity of milk quality, putting consumers' health at serious danger. Furthermore, there is an increasing demand for accurate techniques to detect and differentiate between A1 and A2 milk due to the growing practice of doing so in order to potentially reap health advantages.

The lack of a reliable, scalable, and real-time method for identifying milk adulteration and distinguishing between A1 and A2 milk types is the main issue this research attempts to solve. Conventional techniques for testing milk are insufficient to guarantee the safety and quality of milk products since they are frequently labour-intensive, time-consuming, and prone to mistakes. Furthermore, it's possible that the current technology for differentiating between A1 and A2 milk are too expensive or difficult to use widely.

3. SYSTEM ARCHITECTURE

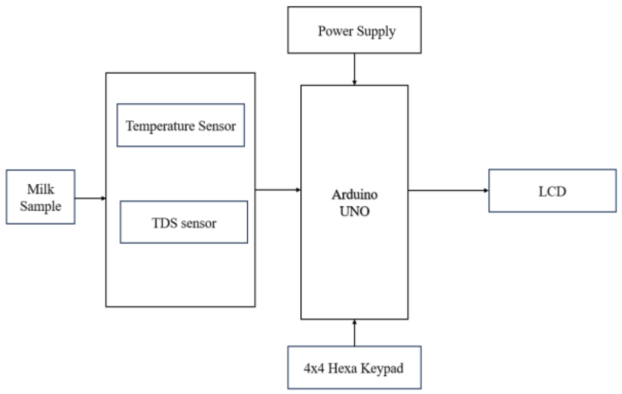

Fig 1: A schematic design for milk adulteration detection

Proposed IoT based device for milk adulteration detection consists of several major components, namely, the Gravity Analog V2 pH sensor; DS18B20 liquid temperature sensor; TDS Sensor; 20 × 4 alphanumeric LCD screen; 5V Power Supply; Arduino Mega 2560 microcontroller; and a 4 × 4 hex keypad are shown in fig 1. Schematics of the overall system can be visualized in

3.1 Temperature Sensor

Milk has its own temperature standards which ought to be kept up during stockpiling, regardless of whether the milk is blended in with water or with any harmful materials the temperature of the milk won't be in the typical range. For the most part milk will be sheltered at the standard temperature go above or beneath which the development of microscopic organisms happens and subsequently not fit for utilization. The overview will be completed on a safe temperature zone as per which the LCD will show the nature of milk. Fig. 2 shows the temperature sensor model ds18b20, which is used in this project. It has to be dipped in the milk sample during testing.

Fig 2: Temperature Sensor

3.2 TDS Sensor

An electrical tool called a TDS (Total Dissolved Solids) sensor is used to determine how much dissolved solids are present in a liquid overall. Fig. 3 shows TDS sensors which measure the liquid's electrical conductivity. A liquid's conductivity increases in the presence of dissolved particles. The conductivity is measured by the sensor and correlated with the TDS concentration, which is often given in milligrams per litre (mg/L) or parts per million (ppm).

Fig 3: TDS Sensor

4. Methodology

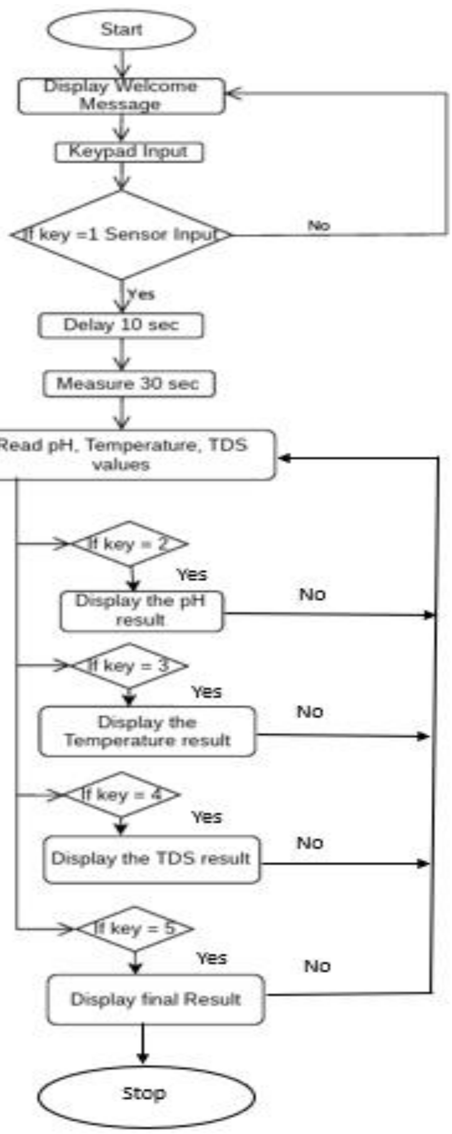

Fig 4: System Architecture

The goal of this study is to identify any contaminants in milk, such as urea, salt, water, detergent, etc. The addition of these materials to milk causes a change in pH, which can be detected using a pH sensor that produces an analog output. This analog output is then sent to the ESP32's analog pin, which interfaces with the microcontroller as shown in the fig 4. After performing certain mathematical operations, the pH of the milk is determined and displayed on LCD displays. Similar to temperature and TDS sensors, electrical conductivity is measured for additional parameters, and the results are shown on an LCD.

5. Result

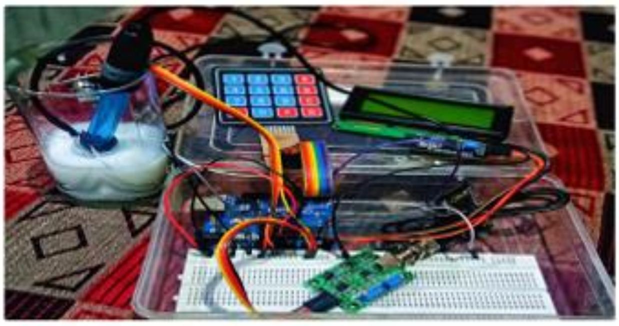

Fig 5. Snapshot of complete working model

6. CONCLUSIONS

In this study, we designed an Arduino UNO18F4520 microcontroller-based Internet of Things system. All of the sensors are connected to a minimal, flexible framework that groups and divides the characteristics of milk into different assessments, with the final yield being displayed on the LCD screen. The problem that individuals and tiny kids confront can be avoided by understanding the composition of milk and recognizing when it has been adulterated to avoid spreading deadly diseases.

This project may be completed in the future for state-of-the-art milk analyzers in both small and large milk dairies. It is anticipated that DBMS and IoT will be implemented for a charging framework. Each client will have a database containing information about the amount of milk consumed; payments will be made using charge or Mastercard's, and the system will operate on a monthly basis. The administration will also use this framework to track milk production and advertising. All data, from milk production to showcasing, will be stored on the executives' website, which is accessible to any client with a record in that company.

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