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SMART MILK QUALITY ANALYSIS AND GRADING USING IOT

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Abstract - India is a predominantly agricultural region. As a result, each dairy has a significant number of milk depositors. Analyzing each depositor's milk and manually maintaining the data is incredibly challenging. This idea would be extremely helpful in addressing this issue. Our idea is the design and implementation of a microcontroller-based device for detecting and grading milk parameters. Milk quantity, pH, CLR, and SNF are among the parameters. These parameters are measured by using different sensors. Many dairies depend primarily on CLR and fat content tests to assess milk purity, which are not accurate. But in this idea every milk parameter value can be used to rate the milk. After calculating the quality of the milk, the total cost will be calculated automatically. Then every detail about the milk and cost will be updated in database. Whenever it is needed the user can easily get it from the simple mobile application. This is a low-cost and effective approach that would be very useful in the future automated world.

Keywords - *Node MCU, pH meter, SNF, CLR, Milk, and Adulteration.*

I. INTRODUCTION

In India, the diary market is generally cooperative. If more people deposit their milk in the diary, it becomes more difficult for the diary to decide the quality of milk from each person in compliance with government requirements for deciding the quality and quantity of milk and making payments. Adulteration of milk can now be detected using a number of techniques. These calculations are time consuming and costly. Water, caustic soda, formalin, and urea are among the harmful additives used in milk sold by many vendors. This project will help us to overcome those threats. Since this project is programmed, there will be no human errors. Many vendors market synthetic milk with no nutritional value for monetary benefit. When another material is added to milk to increase the amount of milk available, the milk content is lost. To resolve these problems, we designed a smart milk analyzer that analyses milk, detects adulteration, and assigns a grade. The findings can be viewed on a mobile screen. The design of a microcontroller-based device that tests and displays milk parameters such as pH, CLR (Corrected Lactometer Reading), and SNF is described in this project (Solid but Not Fat) A lactometer and a pH detector are used to calculate the pH and CLR, respectively. On the LCD column, the milk parameters are shown. The basic protocol for detecting this form of fraud fails when the adulterant is present. when other substances are added to the adulteration as a result, more sophisticated and long-lasting methods are needed. Water adulteration in milk is a common occurrence that lowers nutritional value and industrial yield while also posing a significant pollution risk. Adulteration of milk consumed by people in developing countries like India has serious consequences, because tarnishing has serious consequences. Adulteration of milk consumed by people in developing countries such as India has significant consequences, as tarnishing has a negative impact on issues such as hygiene, corruption, and so on. deterioration of wellbeing, corruption, and so forth

II.LITERATURE REVIEW

In [1] Adulteration in milk consumed by people in developing countries like India has serious effects, as tarnishing causes serious issues like health loss, corruption, and so on.

In [2] The most popular method for detecting water adulteration in milk is to use a Cryoscope. When other adulterants are added to milk, such as urea, the equipment may produce inaccurate results.

The Author states in [3] that "Milk adulteration with water is a widespread problem that reduces nutritional value and industrial yield while also posing a significant pollution risk." The basic treatment for detecting this type of crime is cryoscopy, but it fails when the adulteration is done in conjunction with other substances. As a result, modern, more long-lasting techniques are needed.

In [4] the author describes the design and implementation of an Arduino-based device for detecting milk parameters. Milk quantity, pH, CLR, and SNF are among the parameters. The quantity, pH, and CLR of the milk are measured using an ultrasonic sensor, a pH sensor, and a lactometer, respectively. The value of SNF can be measured and analyzed qualitatively using the values of FAT and CLR. The Arduino controller is connected to the sensors. The programmer developed allows the parameters to be read and viewed on the LCD screen. The amount of milk is seen

in liters. This is a low-cost and effective method of detecting milk adulteration.
The design and implementation of an Arduino controller-based device for detecting milk parameters is given in [5]. pH, CLR, and SNF are a few of the parameters to consider. The amount, pH, and CLR of the milk are all measured using the pH sensor and lactometer. SNF can be measured and analyzed qualitatively using the values of FAT and CLR. The Arduino controller communicates with the sensors. Reading the parameters and displaying them on the LCD panel is possible thanks to the software created. In liters, the amount of milk is seen. This is an inexpensive and effective method of detecting milk adulteration. Also, using IOT (Internet of Things) technology, the milk industry should be able to submit real-time milk reading information to the government, assisting in the prevention of illicit activities such as milk quality during milk pocket processing.
Adulteration of milk can be difficult to track and identify. Adulteration of milk can result in the degradation of dairy industry products as well as health risks for end users. The need for an effective, low-cost adulteration identification technique has continued, not only among consumers, but also among food quality management organizations at various levels [6].
Because of misleading commercials, improper media emphasis, and food adulteration, consumers have a difficult time choosing only one food item. The main target of these wrongdoings is the customer, who unwittingly consumes tainted foods and suffers as a result [7].
Problems and disputes involving consumers, especially those involving consumer rights and legal protection. Consumers must arm themselves against these issues in order to face these obstacles effectively, since they are not automatically covered by the market's functioning [8].
Milk is an essential food source for babies and children's development as well as adult health maintenance. Milk is an ideal food because it is easily digested and consumed. It is a child's and infant's only natural food. It is primarily a good source of protein, fat, carbohydrates, vitamins, and minerals of high quality. Protein in the diet provides the amino acids needed for infant and child development. It is also necessary for tissue maintenance in adults.
Milk is one of the products that can be tampered with in a variety of ways, lowering the quality of subsequent dairy products. Adding a low-value ingredient to milk extends its shelf life (watering of milk, milk of different species, addition of whey, etc.) also known as "economic adulteration" has been often practiced. [9]
To detect the fraudulent addition of rennet whey, a by-product of the dairy industry, to milk, various methods were created. Indirect methods, based on the determination of specific protein fractions, and direct methods, which separate protein mixtures into components, were developed for the analysis of casein/whey protein ratio. The ratio of whey protein to casein protein can be calculated indirectly. Polarographic and second and fourth derivative spectroscopy methods were used to determine the whey protein to casein protein ratio indirectly. Direct protein fraction determination relies on time-consuming electrophoretic, chromatographic, and immunoturbidimetric methods. [10] The study of glycomacropeptide GMP, also known as caseinomacropeptide, has recently been based on detecting fraudulent milk manipulation with whey (CMP). It is a bioactive 64-amino-acid glycopeptide that is released enzymatically in whey from k-casein by the action of chymosin during cheese production. The GMP structure lacks aromatic amino acids and maintains a net negative charge even at pH 3 [11].
The European Commission used two gel-filtration HPLC methods for GMP detection when analysing powder milk tainted [12].
New GMP analysis strategies based on immunochemical assays have also been created. The use of an ELISA assay targeting bovine GMP has been effective. Operon has developed a monoclonal antibody-based fast immunochromatographic test (Immunostick c-GMP). GMP recognition has been used to identify and track fraudulent whey addition to milk powders and UHT milks, as well as the renneting process. Despite the fact that adding whey to milk does not pose a health risk, it has been demonstrated that supplementing infant formula with GMP improves trace mineral absorption[13]. As a result, trace mineral levels in formulations must be reduced. [14] is an example Anodically bonded silicon-Pyrex derivative microchannels with local probes make up each on-chip viscometer. The anodic bonding allows for relatively high pressure levels in the channels (up to 10bars), as well as a wide range of shear stress and shear rate values. Alternate microstriations may be used to demonstrate dielectrophoretic and electrorheological effects. The computational and comparative experimental analysis of a microfluidic-device that performs blending studies by analysing the interface location of the fluid occupancy in a micro-channel and its variations is defined in this work [15]. The unit, which was created in acrylic using a well-known micro-fabrication technique, is re-usable, re-calibrated, and can be integrated with existing systems.

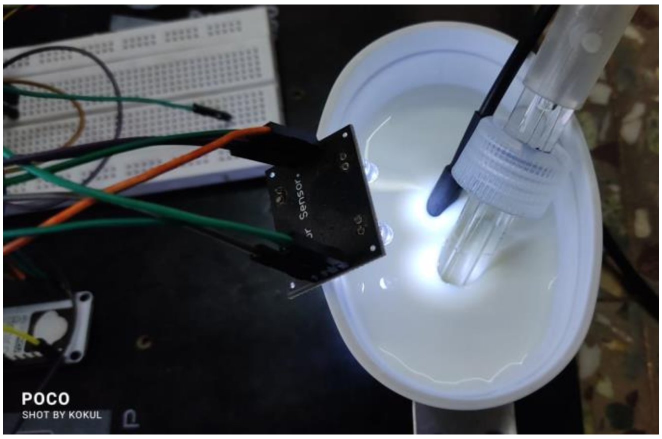

FIG.1 – Milk Testing Picture

III.PROBLEM DEFINITION

For milk selection parameters such as FAT, CLR, and PH, the milk analysis micro controller device is an essential product. This project proposes a method for preventing milk adulteration and grading milk consistency. This approach would be used to set up a system for calculating milk quantity and consistency. The milk will be rated according to its consistency. The price of milk is determined by the amount and quality of the milk. The parameter values as well as the expense will be updated in the database. A smartphone app allows the user to quickly access the results.

IV.PROPOSED WORK

The project's development is focused on the idea of using electronic sensors to detect milk adulteration. Since embedded systems can only provide advantages like size, weight, power consumption, and speed, it was decided to use Arduino in the production. This approach allows for the calculation of quantitative (volume) and qualitative parameters (pH, CLR and SNF). The system that was created is very thin. The unit constructed is smaller and lighter in scale. It has a low power consumption and a fast response time. To detect milk consistency in the current setup, a basic lactometer test is used. Dairies gather, weigh, and evaluate milk. Monitoring for adulteration is expensive. The project's development is focused on the idea of using electronic sensors to detect milk adulteration. Since embedded systems can only provide advantages like size, weight, power consumption, and speed, it was decided to use Arduino in the production. The unit constructed is smaller and lighter in scale. It has a low power consumption and a fast response time. The database will be updated with all of the information about the milk. A smartphone app allows the user to quickly see the data.

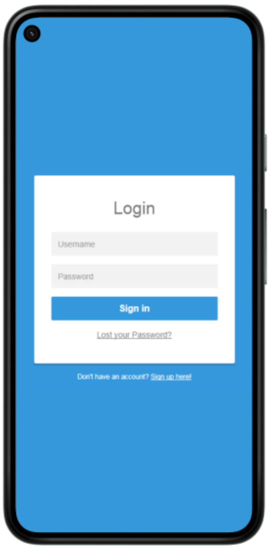

FIG.2 – Application Front Page

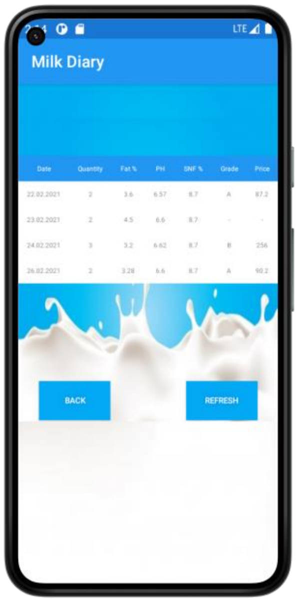

FIG.3 – Application Monitoring Page

V. BLOCK DIAGRAM

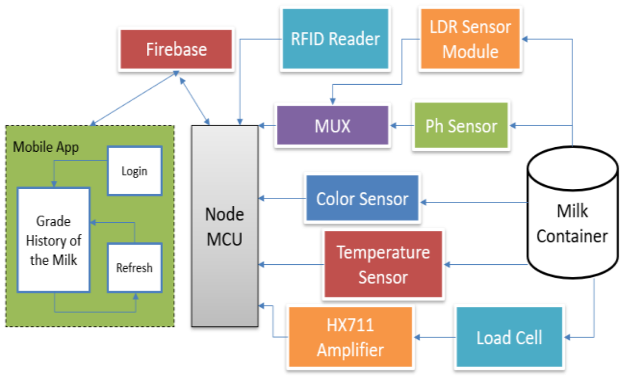

FIG.4 – Block Diagram

The system's operation is divided into two categories, as seen in the block diagram.:

1. Measurement of milk parameters using sensors,
   - ✓ Measurement of quantity
   - ✓ Measurement of quality (pH & CLR measurement)
2. The milk parameter values are obtained, processed using a microcontroller, and the results are viewed on an LCD panel and via a smartphone application.

VI.GRAPH

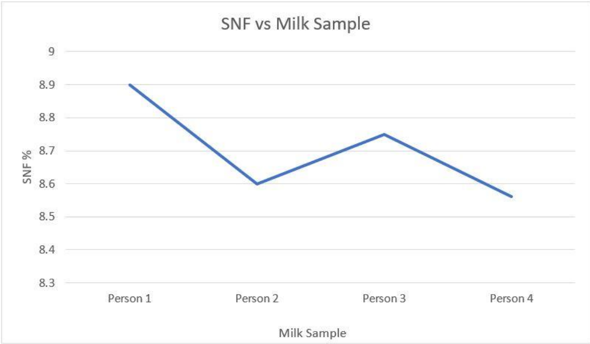

FIG.5 – SNF Vs Milk Sample

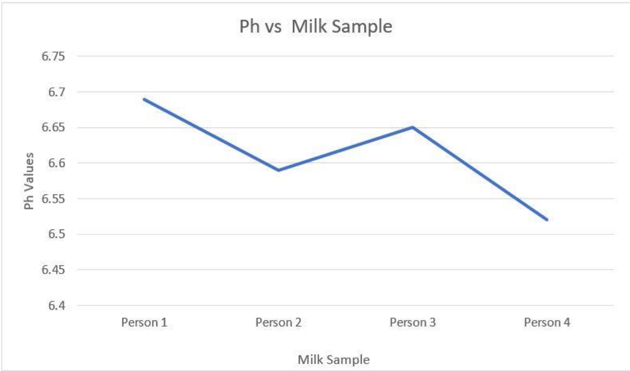

FIG.6 – PH Vs Milk Sample

VII.WORKING

PH measurement: With a value ranging from 0 to 14, a pH sensor tests the acidity or alkalinity of any liquid. The sensor's output voltage (analogue) is equal to the pH of the milk. The pH sensor output is connected to the microcontroller's analogue input pin via the pH sensor package. On the LCD screen, the pH value can be read and displayed.

RFID: We basically build RFID systems to resolve the issue of recalling identity numbers. Each consumer has their own Tag, which includes a unique id for them. There was a reader in the dairy. When the user places their tag on the reader, the machine recognizes their special id. This id will be used for the further processes.

Load Cell: To detect the weight of the milk in the container, we use a load cell with a HX711 amplifier. The milk container is positioned in the load cell, a transducer that transforms force into an observable electrical output. The electrical output from the Loadcell is obtained by the HX711 amplifier, which transforms it to observable results.

Color Sensor: A colour sensor is a type of "photoelectric sensor" that uses a transmitter and receiver to emit light and then detect light reflected back from the detector object. From one hand, a light can travel through the milk. A color sensor is mounted on the opposite end. It absorbs the light that passes through the milk and determines the color of the milk.

Temperature Sensor: The DS18B20 uses a 1-Wire interface to provide 9 to 12-bit (configurable) temperature readings from a central microprocessor, using only one wire (and ground). We used a waterproof temperature sensor that was mounted inside the milk jar to determine the temperature of the milk. The temperature of the milk is also used to determine its quality.

VIII. CIRCUIT DIAGRAM

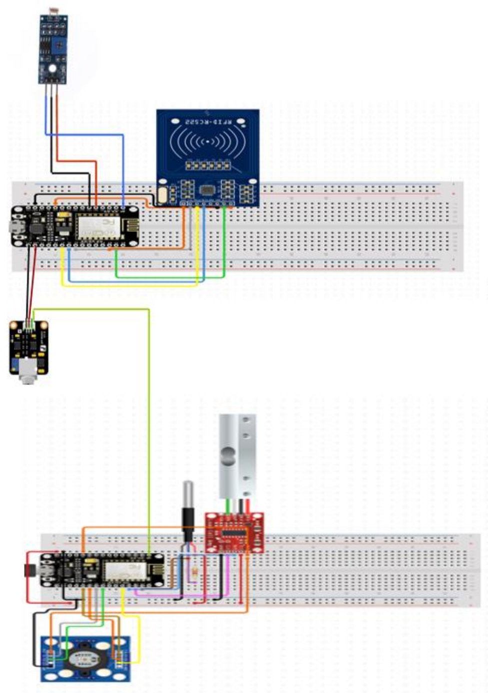

FIG.7- Circuit Diagram

IX. CLR MEASUREMENT USING LACTOMETER

The CLR is determined using a standard lactometer and the basic gravity theorem. A glass tube holds mercury or lead shots at the bottom of the lactometer.The basic gravity of pure milk ranges from 1.026 to 1.032 grammes per ml. The basic gravity of milk will be used to determine the amount of water in it.

SNF (Solid-not-fat) refers to the milk's lactose, sugars, nutrients, acids, and vitamins. FAT and SNF are added together to make gross milk solids. The SNF can be calculated by using the formula,

SNF= (CLR reading / 4) + (FAT*0.21) + 0.36

The proportionality constant is also calculated and used in the algorithm, allowing the CLR reading to be reflected directly on the smartphone app as well as on the LCD column. The SNF Value is determined using the normal FAT and CLR values. The amount to be added to the user's account will then be measured based on the milk's consistency and quantity. The firebase is updated with the final milk parameter values. In the firebase, the final milk parameter values as well as the cost of milk will be updated. Whenever a user needs to know more details, they can do so by using a simple smartphone application.

X.RESULT & DISCUSSION

Adulteration detection in milk is a time-consuming and costly process today. Furthermore, the majority of people are unaware of the proper milk grade. To address these issues, we developed a smart milk analyzer system that uses milk parameters such as pH, SNF, and Fat to analyse milk. Adulteration is detected and a rating is assigned. The grade will be provided based on the standard of the milk. The quantity and quality of milk decide the price of the milk. A unique identifier will be assigned to each person. The database will be updated with the parameter values as well as the cost for that id. All of the details about the milk will be changed in the database. The details can be viewed quickly and conveniently using a mobile application. It consumes very little power and responds quickly. On a regular basis, the consumer can use the smartphone application to track the parameters as well as the cost of milk.

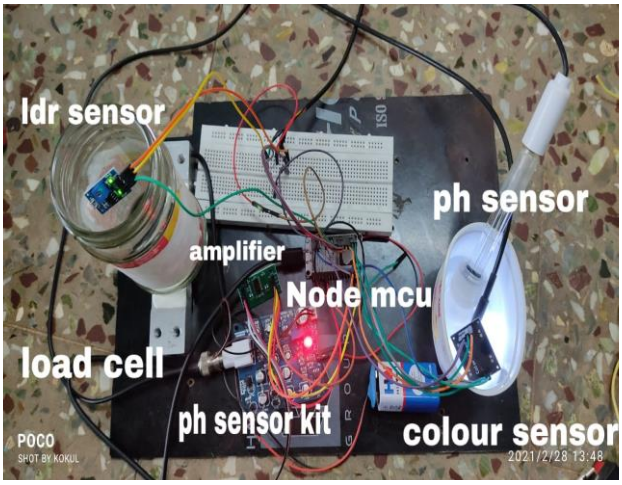

FIG.8 – Overall Structure Picture

XI.CONCLUSION

The designed framework is both smaller and lighter. It has a low power consumption and a fast response time. As a result, it can be used in lightweight applications. The customer will use the smartphone application to watch the parameters as well as the cost of milk on a daily basis.
The system's overall consistency will be the subject of future work. Efforts should also be taken to make the device more user-friendly. Simple components such as sensors, NodeMCU, and Lactometer are used in the proposed system, which are effectively combined and aid in the management of diary automation.

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