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Milk Quality Tester

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Abstract**—**The project presents a modern device for quality inspection of milk based on smart sensor technology. As milk is the major food for all the infants, it has to be monitored for the safety of the child. The main objective of the project is to bring out the product (i.e. compact device) which determines the quality and the safety of milk for consumption. This project determines many parameters of milk by using smart sensor technology. Here, we consider parameters like temperature and pH to determine the quality of the milk. The Temperature sensor is used to determine the hotness or coldness of milk. The pH sensor is used to determine the pH of the milk (i.e. whether acidic or basic or neutral in its nature). The nitrogen sensor is used to determine the protein content in the milk. The protein content can be used to determine the melamine is present in the milk or not. All these sensors are thus inbuilt inside the case and the output is thus shown with the help of monitoring displays (LED) externally. The Bluetooth device can be used to send report to the mobile (About the quality of milk).

Keywords**—***Milk, Milk Quality, Dairy Products, pH value, Milk Safety.*

I. INTRODUCTION

Milk is a white liquid produced by the mammary glands of mammals. It is the primary source of the nutrition for young mammals before them able to digest other types of food. As an agricultural product, milk is extracted from mammals during or soon after pregnancy and used as food for the humans. Throughout the world, more than 11 billion consumers of milk and milk products are there and 70% of child deaths every year are attributed to malnutrition. Thus milk is a major food for the infants.

Milk testing and quality control is an essential component of any milk processing industry whether small, medium or large scale. Milk being made up of 87% water is prone to adulteration by unscrupulous middlemen and unfaithful farm workers. Moreover, its high nutritive value makes it an ideal medium for the rapid multiplication of bacteria, particularly under unhygienic production and storage at ambient temperatures. We know that, in order for any process to make good dairy products, good quality raw materials are essential. A milk processor or handler will only be assured of the quality of raw milk if certain basic quality tests are carried out at various stages transportation of milk from the producer to the processor and finally to the consumer. As milk infection is a growing cause for human illness and death, there is a continually increasing demand to maintain the safe milk supply. Rapid methods are needed to analyze the of milk is essential for the survival of living beings on earth.

II. COMPOSITION OF MILK

A. Proteins

Milk proteins particularly caseins, have an appropriate amino acid composition for the growth and development of the infants. Other proteins in milk includes an array of enzymes, proteins involved in transporting nutrients, proteins involved in disease resistance (antibodies and others), growth factors ,etc. The protein component of milk is composed of numerous specific proteins. The primary group of milk proteins is the caseins. All other proteins in cow milk are beta-lactoglobulin and alpha-lactalbumin. The major milk proteins, including the caseins, beta-lactoglobulin and alpha-lactalbumin, are synthesized in the mammary epithelial cells and are only produced by the mammary gland. The immunoglobulin and serum albumin in milk are not synthesized by the epithelial cells. Instead, they are absorbed from the blood (both serum albumin and the immunoglobulins). An exception to this is that a limited amount of immunoglobulin is synthesized by lymphocytes which reside in the mammary tissue (called plasma cells). These latter cells provide the mammary gland with local immunity. Caseins have an appropriate amino acid composition that is important for growth and development of the nursing young.

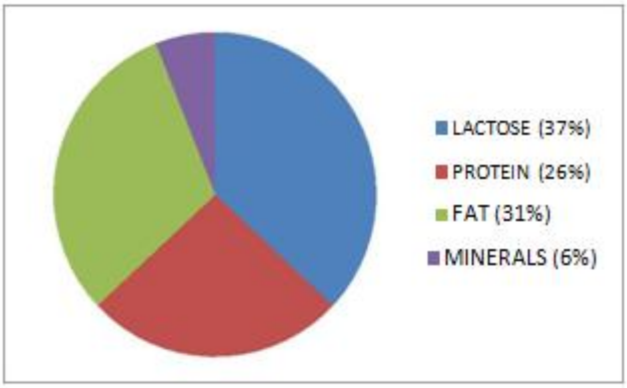


Figure 1.1 Composition of milk

The proteins in milk are of great quality, that is to say, they contain all the essential amino acids, and elements that our bodies cannot produce. It is important to remember that proteins are the building blocks of all living tissue. Milk proteins have roughly the same composition as the egg protein, except for the amounts of methionine and cysteine, significantly lower. Indeed, the sulfur amino acids are the limiting factors in milk. Casein and, even more, the complex milk protein contains good proportion of all amino acids essential for growth and maintenance. The denomination crude protein (CP) includes protein (TP) and non-protein nitrogen (including urea). The protein content is an important feature of the milk. The TP determines market value of milk, the higher the TP value is compared to a reference, the more money the producer will get. In fact, the more TP, the higher the yield of cheese making. Milk proteins represent 95% of crude protein, but the remaining 5% is free amino acids, small peptides and non-protein nitrogen. Protein comprises either only amino acid (beta-lactoglobulin, alpha-lactalbumin) or amino acid and phosphoric acid (alpha and beta casein) with a carbohydrate portion (sometimes even k casein).

III. SENSOR OPERATION

A. pH Sensor

In any process, pH is an important parameter to be measured and controlled. The pH of a solution indicates how acidic or basic (alkaline) it is. The pH term translates the values of the hydrogen ion concentration which ordinarily ranges between about 1 and 10-14 gram equivalents per liter into numbers between 0 and 14.

On the pH scale a very acidic solution has a low pH value such as 0, 1, or 2 while a very basic solution has a high pH value such as 12, 13, or 14. A neutral solution such as water has a pH of approximately 7. A pH measurement loop is made up of three components, the pH sensor which includes a measuring electrode, a reference electrode, and a temperature sensor; a preamplifier; and an analyzer hydrogen or transmitter. A pH measurement loop is essentially a battery where the positive terminal is the measuring electrode and the negative terminal is the reference electrode. The measuring electrode which is sensitive to the hydrogen ion develops a potential directly related to the hydrogen ion concentration of the solution. The reference electrode provides a stable potential against which the measuring electrode can be composed.

Figure 1.2 pH Sensor

When immersed in the solution, the reference electrode potential does not change with the changing hydrogen ion concentration. A solution in the reference electrode also makes contact with the sample solution and the measuring electrode through a junction, completing the circuit. The output of measuring electrode changes with temperature, so a temperature sensor is necessary to correct for this change in the output.

The pH sensor components are usually combined into one device called a combination pH electrode. The measuring electrode is usually glass and quite fragile. Recent developments have replaced the glass with more durable solid state sensors. The preamplifier is a signal conditioning device. It takes the high impedance pH electrode signal and changes it into allow impedance signal which the analyzer or transmitter can accept. The preamplifier also strengthens and stabilizers the signal, making it less susceptible to electrical noise.

B. Temperature Sensor

The LM35 series are precision integrated-circuit temperature devices with an output voltage linearly proportional to the Centigrade temperature. The LM35 device has an advantage over linear temperature sensors calibrated in Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling. The LM35 device does not require any external calibration or trimming to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range. Lower cost is assured by trimming and calibration at the wafer level. The low-output impedance, linear output and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power supplies, or with plus and minus supplies. As the LM35 device draws only 60 µA from the supply, it has very low self-heating of less than 0.1°C in still air. The LM35 device is rated to operate over a −55°C to 150°C temperature range, while the LM35C device is rated for a −40°C to 110°C range (−10° with improved accuracy). The LM35-series devices are available packaged in hermetic tos transistor packages, while the LM35C, LM35CA, and LM35D devices are available in the plastic TO-92 transistor package. The LM35D device is available in an 8-lead surface-mount small-outline package and a plastic TO-220 package.

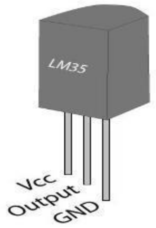


Figure 1.3 LM35-temperature sensor

C. Nitrogen Sensor

Nitrate concentration, which can be increased by acidic rainfall, fertilizer runoff from fields, and plant or animal decay or waste, is an important parameter in nearly all water quality studies. Use the Nitrate ISE to determine the concentration of the nitrate ion in a water sample. The Nitrate ISE has a combination-style, non-refillable, gel-filled electrode. Like all other PVC ISE membranes, the membrane on the ISE has a limited life expectancy. However, the replaceable module of ISE allows you to simply discard the used membrane module, and replace it with a new one.

Figure 1.4 Nitrogen Sensor

Determine protein content: Protein content=N × 6.38 in g

IV. PROBLEM STATEMENT & SOLUTION

A. Problem statement

In recent years, there are three major problems namely Food Safety, Human Safety and Water Safety. In that we choose Food Safety. Now a days, milk is major food for all infants. By taking survey about milk quality, we know that society did not consume good quality raw milk. So we have decided to do project for providing good quality milk by Milk Quality Tester. Everyone in the society need to know the quality of milk before consuming it. India is the world’s largest milk producer and consumer. However, the country’s dairy industry faces several challenges in terms of food quality and safety. This project aims to develop new sensors and instruments for milk quality analysis to enable inspection and traceability.

Milk quality control is the use of approved tests to ensure the application of approved practices, standards and regulations concerning the milk and milk products. The tests are designed to ensure that milk products meet accepted standards for chemical composition. Testing milk and milk products for quality and monitoring, that milk accepted codes of practices costs money.

The reasons are:

1. The Milk Processor.

The milk processor who pays the producer must assure himself/herself that the milk received for processing is of normal composition and is suitable for processing into various dairy products.

2. The Consumer.

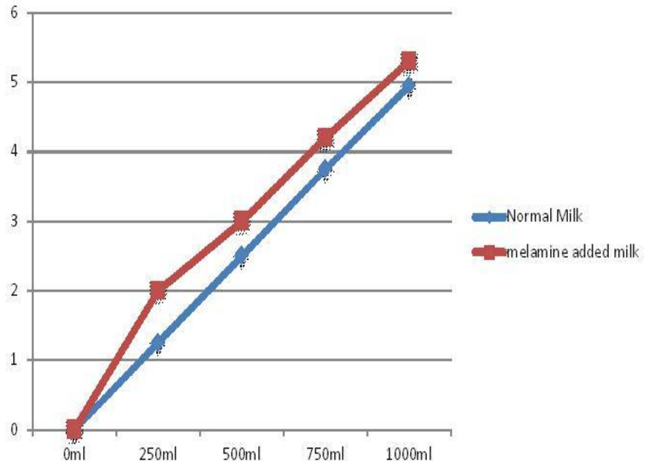
The consumer expects to pay a fair price for milk and milk products of acceptable to excellent quality.

3. To the Milk Producer.

The milk producer except a fair price in accordance with the quality of milk she/he produces.

B. Characteristic graph

Normal milk Vs Melamine added milk



C. Existing system:

- The size of instrument is large.
- Cost is high.
- These devices are not portable.
- In existing system, Milk samples are needed for testing.

D. Block Diagram

In recent years, there are three major problems namely Food Safety, Human Safety and Water Safety. In that we choose Food Safety. Now a day, the need of milk for children is very important. So we have decided to do project for providing good quality milk by Milk Quality Tester. The smart milk tester is mainly operated by Microcontroller (μC). This project consists of temperature sensor can be used to measure the temperature in the milk. The pH sensor can be used to measure the pH of the milk (whether it can be acidic or basic or neutral). The Nitrogen Sensor is can be used to determine the protein content in the milk.

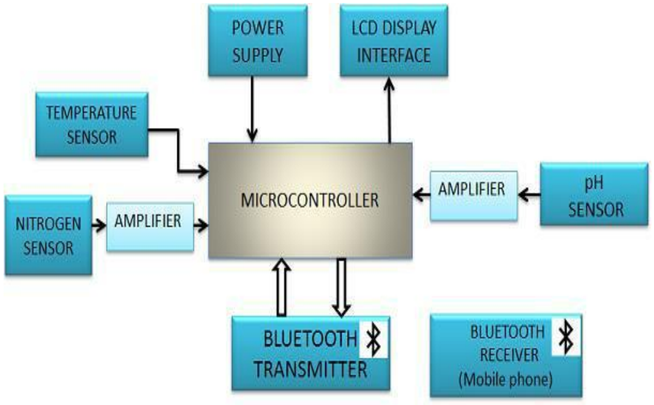
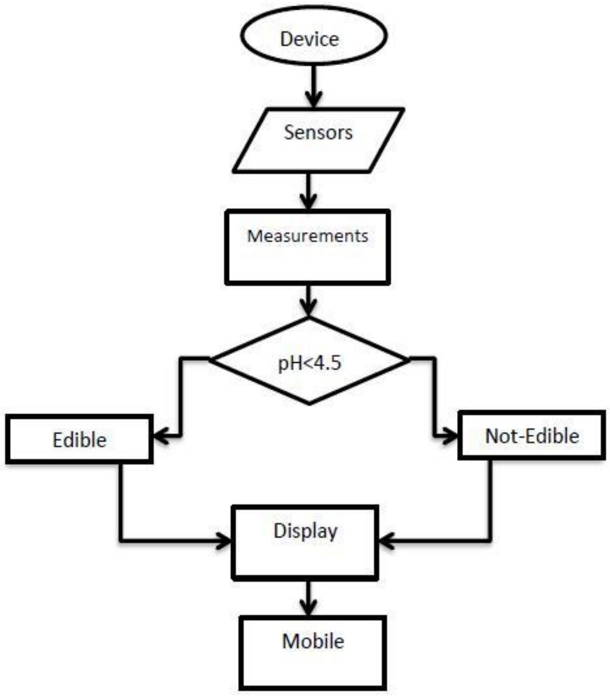


Figure 1.5 Block diagram of Milk Quality Tester

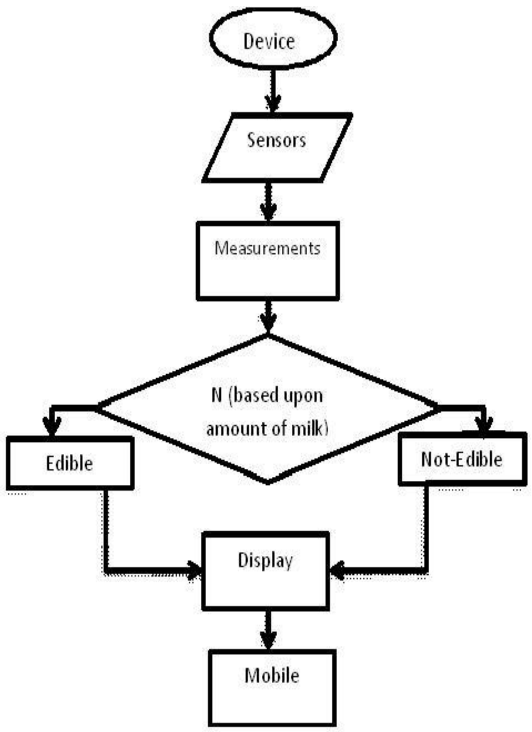
The protein content helps to identify the Melamine is present in the milk or not. It also display whether milk is edible or not. LCD interfaced with Microcontroller to display the value of temperature, pH in the milk. Bluetooth device can be used to send report to the mobile (About the quality of milk).

D. Flow Chart

1) Determine milk is edible or not with respect to pH value



2) Determine milk is edible or not with respect to nitrogen value



E. Circuit Diagram

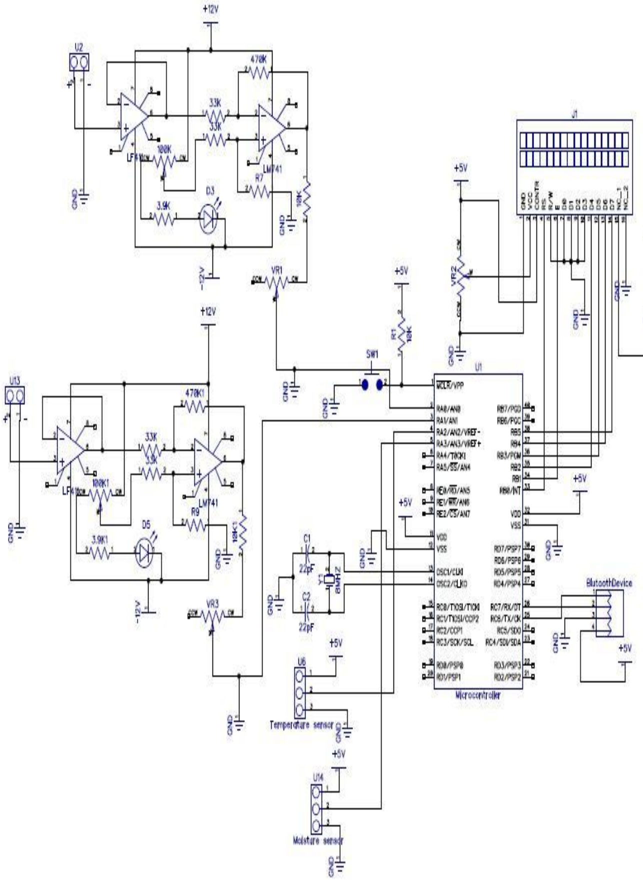


Figure 1.6 Circuit diagram of the system

CONCLUSION

Everyone in the society need to know the quality of milk before consuming it. Milk testing and quality control is an essential component of any milk processing industry whether small, medium or large scale. Milk quality control is the use of approved tests to ensure the application of approved practices, standards and regulations concerning the milk and milk products. The tests are designed to ensure that milk products meet accepted standards for chemical composition. Temperature sensor is used to determine the hotness or coldness of milk. The nitrogen sensor is used to determine the protein content in the milk. The protein content can be used to determine the melamine is present in the milk or not. The pH sensor is used to determine the pH of the milk (i.e. whether acidic or basic or neutral in its nature). All these sensors are thus inbuilt inside the case and the output is thus shown with the help of monitoring displays (LED) externally. Testing milk and milk products for quality and monitoring, that milk products, processors and marketing agencies adhere to accepted codes of practices costs money.

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