ANALYSIS AND CLASSIFICATION OF MILK QUALITY USING ELECTRONIC SENSORY ORGANS

PROJECT REFERENCE NO.: 40S_BE_0129

COLLEGE : SAMBHRAM INSTITUTE OF TECHNOLOGY, BENGALURU
BRANCH : DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING
GUIDE : PROF. RAJASHEKHAR B.S.
STUDENTS : MS. AKSHATHA K.B.
               MS. ASHIKA M.S.
               MS. ASHWINI M.S.
               MS. KRITIKA M.S.

Introduction:
Milk is the nutritional food for living mammals, which is good for health. It is an emulsion or colloid of butterfat globules within a water based fluid that contains dissolved carbohydrates and protein aggregates with minerals. The quality of milk is essential for the survival of living beings on earth. In this project it is to analyze the quality of milk by determining the adulterants that are added in the fresh milk. Adulteration reduces the quality of milk and can even make it hazardous. Adulterants like soap, salt, table sugar and H2O2 may be added to milk. These are determined by the use of electronic methods. The country’s dairy industry faces several hurdles in ensuring product quality and safety. The aim of this project is to develop new instrumentation methods and sensor systems for milk quality analysis to enable inspection and traceability of produce.

In most cases, the diaries use a device called lactometer to detect the quality of milk based on the amount of water added to it. Even though lactometer is generally used to measure the purity of milk it is not reliable instrument, it fails to give the correct assessment of purity if the density of skimmed milk is made equal to that of pure milk by adding water in an appropriate proportion. Hence, to overcome the disadvantage of Lactometer, an embedded unit is designed to determine the purity of milk.

The developed system is very much useful for the easy analysis of the milk sample and determines whether the given sample is adulterated or not. The project is interfaced with the microcontroller which processes and classifies the milk sample which is finally displayed on LCD screen. This is an interestingly new project in the field of electronics. It helps to analyze the milk samples based on milk pH, conductivity, temperature and odor in small diaries.

Objectives:
The presence of adulterants is determined by the use of electronic devices such as electronic nose (e-nose), electronic tongue (e-tongue) and ph sensor.
• The quality of milk sample is tested by checking the ph level by using the ph sensor. As the milk ph changes during spoilage, the voltage across the electrode varies, shifting the resonant frequency of the sensor.
• Electronic nose is a device intended to detect odors or flavors. It is composed of an array of nonselective sensors which transforms chemical information into an electrical or optical one;
such information then gets to be transformed into digital form suitable for computer processing.

- An electronic tongue is a sensor which measures and compares taste of liquid or solid samples, and it can also be used to identify and recognize specific components in a solution. In this approach, experiments are conducted using an electronic tongue (conductivity) to virtually monitor the quality of milk.
- Temperature sensor is used to measure the temperature of the milk, if the temperature is above or below certain limit it results in bacterial formation and is not fit for consumption.

**Methodology:**

This project is mainly directed towards monitoring the quality of milk. The monitoring system mainly has four different modules. Using these modules the quality of milk is determined on the standard survey basis. The modules are listed as follows:


1] **pH:** As we know, every liquid has its own pH value according to temperature and other dependent parameters. So the milk has pH of range 6.5-6.7, above and below this range it is totally considered as abnormalities in its quality. Here it monitors the pH and provides a visual alert via LCD, which displays the pH level and indicates if it is normal or abnormal, in simple words good quality or bad quality.

2] **Temperature:** Milk has its own temperature criteria which should be maintained during storage, even if the milk is mixed with water or with any toxic materials the temperature of the milk will not be in the normal range. Generally milk will be safe at the temperature range of 35-40°C above or below which the formation of bacteria occurs and thus not fit for consumption. The survey will be carried out on safe temperature zone according to which the LCD will display the quality of milk.

3] **Odor:** The concentration of odor will vary from fresh milk to toxic milk. When the toxicity in milk is high it tends to release toxic gases which come out as bad odor from the milk, when milk is preserved for a very long time or due to external contamination. So it’s necessary to detect the gases releasing out from sample which are nothing but bad odor in general. After any such detection of gases the quality of milk will be displayed on LCD.

4] **Taste:** Taste is something which is dependent on the pH of particular substance. Initially, take a fresh milk sample which will have the normal pH value. The taste depends on chemical substances involved in milk and those chemical substances will have its own pH value, but in overall including all the chemical substances which forms fresh milk will have its pH in the range 6.5-6.7. So any toxic material or milk preserved for very long time will literally have additional chemical substances in it, which are not consumable and those toxic contamination formed are developed by addition of toxic materials externally or by long preservation process and will develop different taste or bad taste, so this will be indicated on LCD that how far it is consumable.

**Block diagram:**

The Fig.1 represents the block diagram of the system; it consists of following parameters to be measured such as temperature, odor, taste, pH. The milk sample is used as source; liquid temperature sensor (DS18B20) is used to measure temperature, air quality sensor is used to sense
the odor and pH sensor is used for pH measurements. Microcontroller pic18f4520 is used as embedded processor. Output of the embedded processor is analyzed and classified into corresponding classes and is finally displayed on LCD screen.

![Block diagram of Analysis and Classification Milk Quality](image)

**Results and discussion:**

![Working Model](image)

The concepts discussed above were successfully implemented and developed into a working model. The fig.2 shows the final working model of the project. The values obtained from various sensors in the model is analyzed, calibrated, configured and classified into different grades. These grades determine the quality of the milk based on the various parameters. The system indicates the presence of adulterants such as sugar, soap, salt, and H$_2$O$_2$ in the milk. The operation of the system is controlled by hex keypad. The final result is displayed on the LCD screen.

![Test for Adulterated milk](image)
Based on the pH range for each sample, it is classified as good, normal, abnormal, average and bad; it also indicates whether the sample is acidic, basic and slight basic. The odor is classified as good, average, and bad. Taste is classified as edible and non-edible. The traces of adulterant present in the milk are displayed during the Adulterant test. Considering all the obtained experimental values and their classification, the milk is classified as grade A, B, C, D and E as shown in fig.3.

**Scope and future work**

- The project proposed is beneficial to the society by giving measure to reduce the adulteration practice in milk.
- This device is used in small diaries for the quality analysis of milk.
- It provides quality assurance for farmers and consumers.
- It can also be used by the normal people, where an individual should know about the quality of milk that he consumes in his daily life.
- It can be used by milk traders for computerized milk analysis.

In future this project can be made more accurate by using pH sensor that is highly sensitive for small variation in pH and by using conductivity sensor that have high precision. The project can also be improved by using odor sensor that is sensitive to particular gases.