

# Design and Analysis of a Sensor for Measurement of Fat Content in Milk using IoT Technique

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**Abstract**— The internet of thing is revolutionizing the agriculture industry and enabling the farmers to contend with enormous challenges they face new creative IOT applications are tending to the cost adequacy of milk generation. Farmers themselves are recognizing that they can capitalize on the opportunity IOT presents to capture real economic value. The dairy farming is important business of Indian farmer. Dairies collect milk from farmer everyday & payments for this milk are done according to the rates per liters. This rate depends on various factors like FAT, CLR & SNF of the milk, But mainly on the fat in the milk. We are developing a system that will measure these parameters. This is only recently that automation has been introduced into agriculture. Thus the spot calculation of fat present in milk will play the vital role in the business development of farmers. Also the system which farmers can operate without experts from industry will help to increase profit of farmers. This paper describes one of the applications of embedded system or optical system. It is Small compact, embedded in a single unit, requires less power and measure milk parameters like FAT, CLR SNF (Solid but Not FAT) with less cost. . This system is based on the principal of photometric measurement of light scattered by the milk sample. . The light is scattered by the fat globules present in the milk then by using this method with help of IOT module these reading can send over internet. And thus these actual values of fat content on the spot could be fetched by dairies anywhere by using IOT technology and farmers will be able to have increased values of milk as per market .The main advantage of this system is that there is no dependency of farmer over the specific dairies to determine the fat content and no experts will needed so as to calculate the milk content.

**Key words:** FAT, CLR -Corrected Lactometer Reading, SNF-Solid but Not Fat, Embedded System

## I. INTRODUCTION

According to time, there is a need to change milk collection and dairy operating system. There are some reasons to change existing system. Firstly the specific experts are required to calculate the amount of fat present in milk .Also the machinery is required so farmers are required to bring their milk to dairy and let milk be tested by person at dairy, the process of testing of milk by measuring FAT, density and quantity is time consuming. Hence, farmers have to stay in line. Secondly, some milk collections in small villages do not have costly milk analyzing equipment's. In this situation milk sample can be tested after milk collection process which can take two or more hours. During this time collected milk stored in plastic bags or bottles which can lead to unhygienic conditions. Another reason is all measurement done noted and calculated manually which can lead to error or mistake during calculation. To reduce manual work and for faster

milk collection there is a need to replace existing system to system using the system where milk collection parameters can be measured automatically and in low cost. The Dairy industry in India is generally co-operative .The primary milk provided to the dairy are farmers who do not process their milk and give it in the raw form to the co-operative dairy. Since more number of farmer are depositing their milk in the dairy, it is a daily task of the dairy to assess the quality of milk from each farmer, verify it & meets the quality norms specified and make payments based on quality and quantity of milk. Though several tests are available for quality assessment of milk like the content of protein, water, detergent, lactose, etc, most dairies use only the FAT content test and CLR (Corrected Lactometer Reading) to judge milk quality. Standard ranges of FAT content and CLR of milk are specified by the government and it is necessary for the milk to satisfy this quality norms. In measuring fat content we have used the principle of optical scattering of light by fat globules present in the homogenized milk thus diverting totally from the usual method of separating the fat by burning it with acid, centrifuging it and measuring on a calibrated scale, measuring the specific gravity of the milk or the CLR. To overcome the obstacles of present methods of milk analysis we are designing a system so as to have spot calculation of fat present in milk. . The amount of light scattered by the milk sample is a measure of the fat content in the milk. Sensor is a device that detects the quantities required and provides a corresponding output generally as electrical or optical signal. A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices

## II. RELATED WORK

As installment for the milk to agriculturists depend on the nature of the milk which they conveyed to the dairy and the quality is settled on Fat, CLR, SNF and Weight of milk. Subsequently there are different strategies existing to gauge Fat, CLR and SNF and some of them are depicted beneath.

### A. FAT measurement

#### 1) Gerber Method

In this test H<sub>2</sub>SO<sub>4</sub> is used to increase specific gravity of milk serum which makes greater difference between milk serum and fat globules. It also destroys stickiness of milk by dissolving all the SNF. The free fat globules rise to the surface by subsequent application of centrifugal force to this mixture and heat produced due to mixing of acid and milk, causing melting of fat. It facilitates the fat particles to come to the surface freely. The specific gravity of fat is 0.9 and that of acid milk mixtures is 1.43. This situation promotes complete separation of fat when proper centrifugal force is applied. Due to application of centrifugal force lighter substances

(Butter fat) are thrown towards centre and rest of serum portion that is heavier is thrown towards the periphery. Addition of amyl alcohol helps for separation of fat from the milk acid mixture and also prevents the charging of fat and sugar by the H<sub>2</sub>SO<sub>4</sub>.

### 2) E-Milk Tester (for Fat Measurement)

The instrument used to measure fat content instantaneously on a digital readout. It does not involve the use of corrosive chemicals. The light is scattered by the fat globules present in the milk. The amount of light scattered by the milk sample is a measure of the fat content in the milk. Sensor is a device that detects the quantities required and provides a corresponding output generally as electrical or optical signal. A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. The result of this process is more and more current starts flowing and hence it is said that the resistance of the device has decreased. Thus the change in the resistance of LDR is indication of the fat content. The circuit is calibrated using standards with sample of known fat values. For cow's milk fat must be 3.5 to 4.5 percent and for buffalo's it is 6-7 percent. If milk fat does not fall in acceptable ranges then milk sample will be rejected.

### B. CLR measurement

Lactometers are used for rapid determination of specific gravity. The method is based on law of floatation which states that when a solid is immersed in a liquid. It is subject to upward thrust equal to the weight of the liquid displaced by the body and acting in upward direction. Pure milk has a specific gravity of 1.026 to 1.032 grams per ml

#### 1) Manual Method

In this method 70ml milk is taken in a measuring cylinder & the density of milk is found by dipping a lactometer in a milk sample. Because of this the lactometer displaces in milk & by observing the calibrated scale marked on its stem the density of milk is known. These readings are noted manually in farmer's membership card.

## III. APPROACH

The proposed framework is gives the answer for beat the deterrents of present strategies for drain investigation clarified in past section, a "Plan and Analysis of a Sensor for Measurement of Fat substance in Milk utilizing optical system" is created which is straightforward in development, simple to work and which measures the parameters, for example, Fat, CLR and SNF of the drain and shows it on LCD show. The information shown on the LCD show is at the same time composed on this card.

We can utilize PC interface likewise to keep up the year-by-year record.

The Figure 2 shows block diagram of Milk collection centre& it mainly consist of following component.

- Power supply
- Raspberry Pi
- LCD Display
- ADC
- Optical Sensor

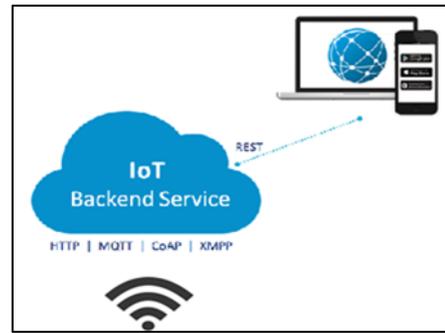


Fig. 1: Proposed framework

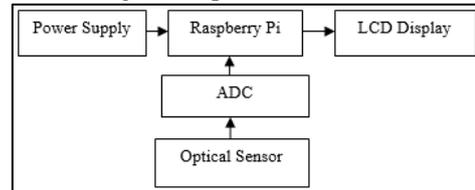


Fig. 2: Block diagram of Milk analyzer

### A. Working of Proposed System

As we are getting the values of fat content in milk using the optical sensor, and we are displaying the values on the LCD display. But the need of the project is to display the values over the internet and can be accessed by anyone over the internet. Now the values coming from the Optical sensor which is LDR and which works on the principle of photo conductivity are received by the controller which is a arduino board and these values are processed and are converted to analog to digital and are serially send to the Raspberry pi.

By using the Python language we have programmed the raspberry pi so as to receive the values of fat and store the values in specific described files. And now by using raspberry pi we are sending the values over the IOT.

### B. Working

As we are getting analog values from the LDR the values of FAT in milk in the analog form but as the raspberry pi is having the GPIO pins we can't send the values directly to the raspberry pi so we will need the analog to digital converter which can convert the analog values to digital coming from the LDR.

Thus when raspberry PI is getting the values it will process the values and will send towards the LCD, as well as the main part of project it will act as a server and will send the values over the internet. However one key aspect that makes the Raspberry Pi so brilliant for schools is its ability to execute "Python" coded programmers. This allows us along with the General Purpose Input Output (GPIO) pins to create programs that can control anything from a single LED to opening your garage door. Figure 3 and 3.1 shows the working view in our next section.

## IV. RESULTS AND ANALYSIS

The reading obtained from milk analyzer device that gives milk parameter as SNF, FAT and CLR is given below.

Milk/Method	Buffalo milk	Cow milk
GERBER method	6.00%	4.90%
Dairy machine	6.30%	3.50%
E-Tester method	6.50%	4.00%

Table 1: Results

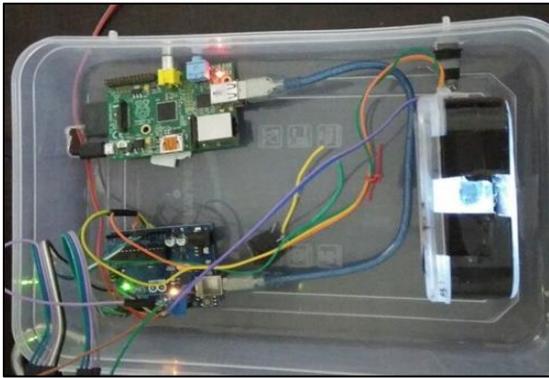


Fig. 3: E-Milk Tester

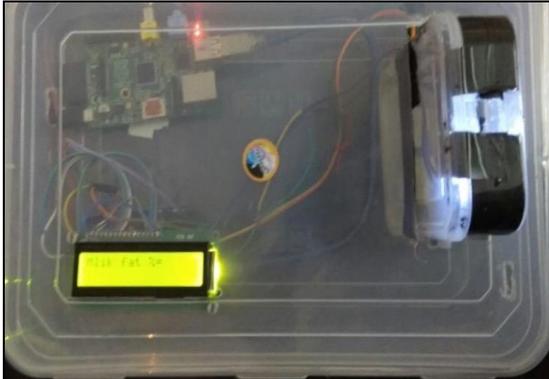


Fig. 4: E-Milk Tester

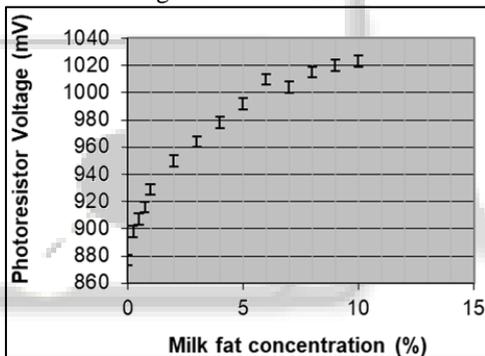


Fig. 5: Photo Resistor Graph

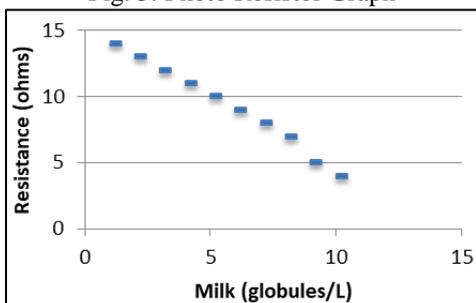


Fig. 6: Sample Graph

## V. CONCLUSION

In this paper the system provides the ability to justify the quality of milk. The exact values of FAT, SNF are displayed on LCD and simultaneously these values are sent over the internet and anybody can retrieve the values over the internet. Thus with this accurate values the farmers would get proper sale value of milk. The technology implanted in this system will definitely improve the delivery system by ensuring the reliable payment to farmers and also will minimize the corruption in the delivery system.

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