DESIGN OF MILK ANALYSIS EMBEDDED SYSTEM FOR DAIRY FARMERS

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ABSTRACT

In recent years the National Dairy Development Board-initiated cooperative movement has led to a substantial increase in milk production in India. The two main reasons for this increase are the efficient collection of milk and higher profit for the producers, both of which have to some degree been influenced by information technology. The appropriate information technology described in this paper helped to make information symmetric in the market, thereby minimizing problems of adverse selection and tedious work. It is only recently that automation has been introduced into agriculture. In many dairy farms, computer aided control of physiological and sanitary parameters are already used and lead to a productivity increase and the elimination of some tedious operations. Embedded Technology is now in its prime and the wealth of knowledge available is mind-blowing. An embedded system can be defined as a control system or computer system designed to perform a specific task. Embedded systems are playing important roles in our lives every day, even though they might not necessarily be visible. This paper describes one of the applications of embedded system MILKOTESTER. It is Small compact, embedded in a single unit, requires less power and measure milk parameters like SNF (Solid but Not FAT), FAT, CLR, WEIGHT, PH, with less cost.

Keywords: - CLR-Corrected Lactometer Reading, Embedded System, SOC -System on Chip, SNF-Solid but not Fat
I. INTRODUCTION
With the initiatives of National Dairy Development Board (NDDB), out of 70,000 dairy cooperative societies in the country, around 26000 are using Electronic Milko-Testers (EMT) and around 2500 are using the PC connected electronic milko-tester machines (known as Automatic Milk Collection Systems - AMCS). These systems introduced very satisfactory milk collection methods and facilitated immediate payments to farmers based on the quality and quantity of milk delivered [1]. The success of these systems coupled with inexpensive connectivity opportunity offered by Internet, motivated the CEG-IIMA to enhance the PC at the Automatic Milk Collection Systems (AMCS) into a Dairy Information Services Kiosk (DISK) and offer an extensive knowledge and service delivery mechanism through a Dairy Portal. The DISK when used with a Dairy Portal of the Union, enhances the scope of services that would benefit the farmers as well as the dairy industry [2].

In general, Embedded System

- Is a system built to perform its duty, completely or partially independent of human intervention?
- Is specially designed to perform a few tasks in the most efficient way.
- Controlling and driving a motor, sensing temperature, etc

Real-Time Embedded Systems can be classified as

- Hard Real-Time Embedded Systems - systems with severe constraints on the timeliness of the response.
- Soft Real-Time Embedded Systems - systems which tolerate small variations in response times.
- Hybrid Real-Time Embedded Systems - systems which exhibit both hard and soft constraints on its performance.

II. EMBEDDED SYSTEM DESIGN CRITERIA

- Embedded Systems and Co-Design
  - Characteristics, applications
  - Co-design tasks
  - Core-based design
- Validation Issues in Embedded System Design
  - System modeling and validation
  - components
  - Emulation technologies
  - Compliance test environments
  - ISA simulation, co-simulation
  - Formal verification
- Software Issues in Embedded Systems
  - Software compilation and optimization techniques
  - Runtime and operating system support
  - Software analysis [3].
III. MILKOTESTER - EMBEDDED SYSTEM APPLICATION

With changing time and development in technology, we have considered designing such an instrument that will be useful to an animal farmer in India. Milk tester (called MILKOTESTER) is a very versatile device and is easily available in the form of palm hold, having input for analyzing milk, which shows in the form of LCD display. This is fully microcontroller based instrument low weight and easily accessible to the farmer.

Key Features of Milkotester
- Fast analysis-Allows a large number of measurement to be done
- Simple and light weight design.
- Low cost.
- Low power consumption.
- Easy to operate.
- Very small quantity of milk requirement.
- No acid or other chemicals are used.
- RS-232 PC interface.

IV. SYSTEM DESIGN

The task of the milk collection system is divided into stages:
- Actual measurement of the fat content, the CLR and the weight of the total milk from a single frame.
- Display of each measured quantity.
- Calculations :
  - Calculate the SNF content from formula, using values of the fat content and CLR Reading.
  - Calculate the amount to be paid to the farmer using the value of SNF calculated and the quantity of the milk.
- Store the results for each farmer on a memory as well as smart issued to the farmer.

In order to appreciate the performance and functionality of the ‘Milkotester’ and ‘AutoCLR’ it will be enlightening to have a brief insight into the manual methods of measuring fat content and CLR along with the working of our electronic equipment.

A. Milkotester:

An instrument to measure fat in milk using the opto-electronic principle is popularly referred as the ‘Milkotester’.

B. Principle of Working Milkotester:

The scattering of a beam of light by the fat globules present in the homogenized milk is the principle in the Milkotester. The amount of light scattered by the milk sample is a measure of the fat content in the milk.

C. Construction:

A high intensity LED is used as a light source. The light beam is made to pass through the sample solution contained in the test tube. A LDR is placed exactly on the opposite side of the test tube to detect the amount of light passing through the test tube unscattered. To obtain maximum sensitivity
the test tube is covered in wooden shield which has opening only for LED and LDR to pass through.

**D. Working:**

This solution is then made to pass through a syringe needle to disperse the fat globules homogeneously throughout the sample the solution. Then this sample solution is introduced in the test tube and beam of light is passed through it. The more the fat content in the milk, more will be the amount of light scattered by the sample. Thus the light reaching the LDR will vary with the fat in the milk, 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. The voltages are also adjusted within a range suitable for the MUX following this circuitry.

The range of fat content acceptable to the market is fixed by the government to ensure the customer of the nutrition value of the milk.

- For cow’s milk fat should be in range of 3.5 to 4.5 percent.
- For buffalo’s it is 6-7 percent.

Thus it is possible to incorporate a program in the microcontroller to give the alarm for the milk which doesn’t fall in these ranges and so milk is rejected. This would also need a selector switch to enable the microcontroller to know whether it is cow or buffalo milk [4].

**E. Auto CLR:**

The specific gravity of the milk is measured using a ‘Lactometer’ and the temperature deviation of milk is taken into consideration and correction applied, the lactometer is called Correct Lactometer Reading (CLR). The Auto CLR is an instrument incorporating electronics to observe the lactometer reading. It is a patented instrument of its manufacturer ‘Solid State Technologies’. In this case the manual process is preserved, only electronics is ‘added’ to it make observation error free and apply the temperature correction automatically.

**F. Construction:**

A 120 ml cylinder is used to contain the milk sample. The lactometer is suspended in the freely movable and vertically arranged cylinder. The original position of lactometer is obtained by taking water in the cylinder and allowing the lactometer to attain a undisturbed position in which it shows ‘0’ on the scale.

**G. Working:**

Take 120 ml of milk is in cylinder. The lactometer moves in a vertical direction and attains a fixed floating position. The lactometer reading is calibrated on scale on lactometer itself. The reading on the lactometer corresponding to the level of the milk gives the lactometer reading. But in Auto CLR we measure this vertical movement electronically. The upper tip of the lactometer is attached to the float of the type is used in motorcycles to indicate fuel level. This float moves vertically along with motion of lactometer. Using a strain gauge attached to the float, the resistance change is calibrated as a measure of the lactometer reading [5].
V. RESULT

Farmers were the main beneficiaries of this project.

The main benefits of the automatic milk collection systems as compared to the conventional methods are as follows:

- Immediate payment for the milk delivered;
- Accurate information about the fat content, quantity of milk and the payment due to the farmer is displayed;
- Accuracy in weighing the milk on the MWS as against the manual process where milk was weighed using measuring containers which very often led to a financial loss to farmers;
- Immediate testing of the quality of milk as against testing after 2 to 3 hours of collection;
- The card reader unit ensures speed of operation and an error-free entry of identification number of the farmer;
- The elimination of manual registers for all kinds of information and data storage.

The photo below shows that the reading of milk sample displayed on LCD.
Each farmer is provided with a unique ID number. The daily transaction for each farmer is to be stored on the internal memory as well as on a smart card of the farmer. The Data base can be in the following table.

<table>
<thead>
<tr>
<th>Date</th>
<th>Qty</th>
<th>Fat</th>
<th>CLR</th>
<th>SNF</th>
<th>Rate</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>17/7/12</td>
<td>7.4</td>
<td>4.9</td>
<td>31</td>
<td>8.37</td>
<td>9.4</td>
<td>69.56</td>
</tr>
</tbody>
</table>
Table 1: Customer payment slip

<table>
<thead>
<tr>
<th>DAY</th>
<th>WT</th>
<th>FAT</th>
<th>CLR</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAY1</td>
<td>7.4</td>
<td>4.9</td>
<td>31</td>
</tr>
<tr>
<td>DAY2</td>
<td>7.3</td>
<td>4.8</td>
<td>31</td>
</tr>
<tr>
<td>DAY3</td>
<td>7.4</td>
<td>4.9</td>
<td>30</td>
</tr>
<tr>
<td>DAY4</td>
<td>7.2</td>
<td>4.2</td>
<td>29</td>
</tr>
<tr>
<td>DAY5</td>
<td>6</td>
<td>4</td>
<td>31</td>
</tr>
<tr>
<td>DAY6</td>
<td>6.5</td>
<td>4.3</td>
<td>30</td>
</tr>
<tr>
<td>DAY7</td>
<td>7.1</td>
<td>4.3</td>
<td>28</td>
</tr>
<tr>
<td>DAY8</td>
<td>7.8</td>
<td>4.6</td>
<td>30</td>
</tr>
<tr>
<td>DAY9</td>
<td>8</td>
<td>4.8</td>
<td>31</td>
</tr>
<tr>
<td>DAY10</td>
<td>7.5</td>
<td>4.7</td>
<td>30</td>
</tr>
</tbody>
</table>

Table 2: Milkotester Reading

![Figure 1.4: Day wise milk analysis](image)

Figure 1.4: Day wise milk analysis
VI. CONCLUSION

This paper is excellent blending of bio-chemistry and electronics engineering. The milk collection parameters such as weight, FAT & CLR are measured by this system gives same results as the existing systems which are more costly than the developed one. Use of smart cards to enter the daily billing for a former makes it convenient for the dairy management and farmer to keep account of the entries made for a month and beneficial to Indian farmer.

VII. ACKNOWLEDGEMENT

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VIII. REFERENCES