

Scalable IoT Based Automated Methylene Dye Reduction Test for Assuring the Quality of Raw Milk

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Abstract— This work is mainly aiming in designing an automated system for carrying out the Methylene Dye Reduction Test (MBRT) in order to assure the quality of milk. In dairy industries, it is mandatory to check the quality of milk before procuring it from the local farmers. This automated MBRT test can help the dairy plant manager to assess the quality of more numbers of milk samples with minimal human intervention.

Index Terms—Automated MBRT, Scalable.

I. INTRODUCTION

The Methylene Dye Reduction Test [1] has widely been practiced in the dairy industries for assessing the microbiological quality of raw and pasteurized milk. This test is grounded on the fact that the blue color of the methylene dye solution added to the raw or pasteurized milk get decolorized when the oxygen present in the milk get exhausted due to microbial activity. The sooner the decolorization, worse is the bacteriological quality of milk assumed to be. This entire process is being carried out by human inspection. Now-a-days the milk industries have automated the entire dairy process. But the inspection for assuring the quality of raw milk (MBRT) has not been automated. Still the inspection process is fully dependent on human laborers. Due to the non-automated MBRT,

- 1) Laborers have to conduct the test and inspect them frequently over the duration of more than 8 hours.
- 2) Humans are affected by fatigue.
- 3) Humans are not accurate as the machines.

If the process is automated, unwanted human inspection can be avoided.

II. AUTOMATED MBRT

The raw milks are procured from the various farmers of the nearby geographical region and are kept in the container. The test samples are collected from the containers and are kept in the test tubes. Then the alkaline methylene blue dye is added to the test samples. Here the automation is done with the help of Raspberrypi loaded with Raspian operating system. Opencv package [7] installed for image processing in order to detect the color change occurred in the test samples. MBRT process is continuously monitored by the camera module and the video footages are given to the raspberrypi3 with Opencv package. With the help of Opencv-Python program, the mean value of blue color of the test sample is constantly monitored by the Raspberrypi. Whenever the mean value [4] of blue color becomes lower than the threshold value (because of decolorization due to microbial action), time taken for the decolorization of the blue dye is calculated. Based upon the decolorization time, the milk samples are classified [1].

Class 1. Excellent quality milk, not decolorized in 8 hours.

Class 2. Good quality milk, decolorized in less than 8 hours but not less than 6 hours.

Class 3. Fair quality milk, decolorized in less than 6 hours but not less than 2 hours.

Class 4. Poor quality milk, decolorized in less than 2 hours.

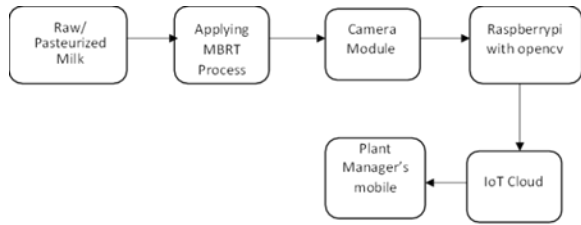


Figure 1 : Automated MBRT

The results of the MBRT test are intimated to the plant manager through mail with the help of Simple mail transfer protocol (SMTP). Instead of SMTP, we may use any cloud-based service to intimate and store the results. Based upon the result, the manager can assure the quality of raw milk.

Here, the main objectives of this project are 1) To automate the MBRT process. 2) The second objective is to update the results of the test to the dairy plant manager’s mobile. After applying the conventional MBRT on the milk samples, then camera sensors are deployed to acquire the data such as RGB mean value of the dye solution; Then the computations are made according to the decolorization and it is followed by the incorporation of the results.

III. SCALABILITY IN AUTOMATED MBRT

In this fast-paced world, the number of devices/things connected to the Internet are rapidly growing day by day. With the intention of improving the performance of the automated MBRT, it is essential to implement scalability in the automation process. Generally, the large-scale dairy industries procure the milk from the farmers of the nearby geographical region. Due to the large volumes of milk collection from the huge masses of farmer, the number of samples is also increasing accordingly. With the intention to speed up the MBRT process, it is necessary to implement scalability in the automation process. The entire scalable IoT based automated process is given below

1. Initially, the MBRT process is applied to the fresh raw milk sample batches. A single batch consists of 10 to 15 samples depending upon the camera sensors ability and the plant space availability.
2. Video footages are obtained from various milk batches and it is monitored by the Personal Computer (PC) with the help of computer vision

3. Milk samples are classified and the results are obtained to the cloud.
4. Results are intimated to the plant manager’s mobile for further action.

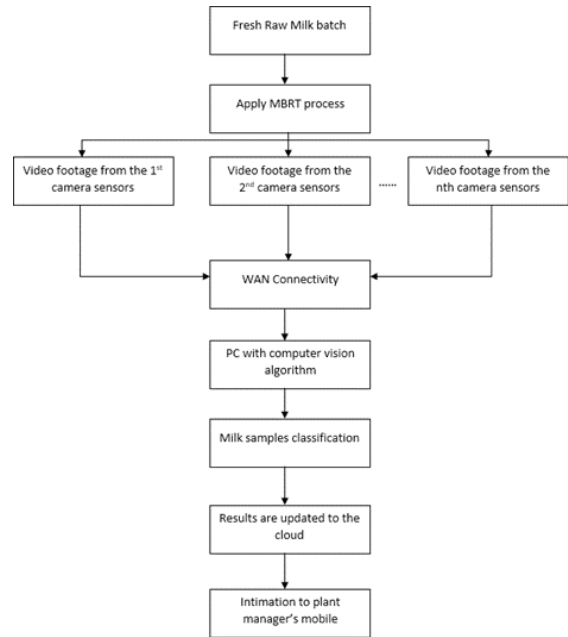


Figure 2 : Process flow diagram

IV. RESULTS AND DISCUSSION

With the help of this work, it is easier to automate MBRT process carried in milk industries. But the main concern is, water bath tub used for the MBRT process should be transparent, so that it is easier to detect the color transition.

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