International Journal of Pure and Applied Mathematics
Volume 118 No. 9 2018, 21-32
ISSN: 1311-8080 (printed version); ISSN: 1314-3395 (on-line version)
url: http://www.ijpam.eu
Special Issue

ijpam.eu

IoT BASED MILK MONITORING SYSTEM FOR DETECTION OF MILK ADULTERATION

Dr. G. Rajakumar[1], Dr. T.Ananth Kumar[2], Dr. T.S. Arun Samuel[3], Dr. E.Muthu Kumaran[4]

[1]Dept. of Electronics and Communication Engineering, Francis Xavier Engineering College, Tirunelveli, India.
[2]Dept. of Electronics and Communication Engineering, IFET College of Engineering, India.
[3]Dept. of Electronics and Communication Engineering, National Engineering College, Kovilpatti, India
[4]Dr.B.R.Ambedkar Institute of Technology, Port Blair, India.

Abstract.

Sustenance security in provincial and urban zones is an extremely huge, as it nearly influences the soundness of nationals. Late examinations detect that crude milk contains pathogenic life forms which could bring about contamination if devoured which can build the rate of infections and break down the personal satisfaction. Thus, creating apparatuses for constant and shrewd detecting is required for quality checking and to settle on reasonable and opportune choice. The work aimed to present some aspects regarding milk quality and quantity estimation. The Internet of Things (IoT) based system allows users to know the groupings of gases in crude milk continuously. As the milk is kept for several days, the expansion of bacterium will get increased which ends up in undesirable smell, style and harmful substances. Hence there is a necessity for monitoring system to discover and determine the spoilage of milk and turn out into a healthy product. Consequently, the toxic substances in milk are identified before to maintain a strategic distance from entanglements in the underlying stage for a decent last item. In this proposed system, Microbial activity is determined using gas sensor, high quality milk should have no salinity, so salinity of the milk is measured by using a salinity sensor and also level of the milk will be measured by using a level sensor. In addition to that customer should have their own card for accessing the milk diaries.

Keywords:Internet of Things (IoT) based system, Arduino, EM-18 module.

1. INTRODUCTION

The Internet of things (IoT) describes network of material devices, means of transport, and erstwhile equipment surrounded with electronics, software, sensors, actuators, and system connectivity which allow these items to gather and swap over data. The IoT permit things to be intelligence or forced distantly diagonally active system communications, make chance for supplementary straight combination of the material earth into computer-based organization, and resultant in enhanced effectiveness, correctness and financial advantage in calculation to compressed human being interference. Milk is a perishable product. Consequently, it is typically handled locally inside a couple of hours of being gathered [1]. In the United States, there are a few hundred thousand dairy ranches and a few thousand milk preparing plants. Dairy cows are milked twice a day using mechanical vacuum milking machines. The raw milk flows through stainless steel or glass pipes to a refrigerated bulk milk tank where it is cooled to about 40° F (4.4° C).

2

It's more harmful for child and pregnant women [4]. To avoid this there is a need of real time monitoring system which always keeps an eye on the quality of the milk [5]. It is serious concern and steps have been taken towards it, and many existing systems are there which only monitors the microbial activity. By this system will be able to monitor maximum aspects of milk like microbial activity, adulteration, quality etc. Accordingly, this work helps in early identification of dangerous substances in milk to maintain a strategic distance from entanglements in the underlying stage for a decent last item [6].

2. LITERATURE REVIEW

Lucas de Souza Ribeiro et. al. [2] states that using a cryoscope, detection of water adulteration in milk can be performed. The GaAsSb sensors, which show quick reaction and great affectability to the NIR range, were utilized to distinguish diffusely reflected light. The proposed instrument was tried on milk tests corrupted with water. The outcomes displayed high coefficients of assurance, higher than 0.99. In this manner, the created framework might be utilized for identification of milk debasement. Carla Margarida Duarte et. al.[9] developed a attractive counter that identifies the nearness of Streptococcus agalactiae (a Group B Streptococci) in crude milk. This gadget permits the investigation of crude milk without crossing over the microfluidic channels, making this incorporated stage exceptionally appealing for quick bacteriological pollution screening. Wesley Becari et.al. [7] developed a methodology for the detection of bovine milk adulteration by applying electrical impedance measurements. The classification of the results is proposed through ak- nearest neighbors algorithm that allows to quantitatively qualify the samples of pure and adulterated milk. Pallavi Gupta et. al [5] displayed another framework, which is utilized for the location and estimation of corruption of clarified butterfat, a classification of anhydrous milk fat. Identification of defilement by at least 20% of creature muscle versus fat's in clarified margarine is effectively and monetarily done. Dari de O. Toginho Filho and Vanerli Beloti [3] proposed a model of a computerized photometer, microcontrolled, versatile gadget, which utilizes three LEDs with discharge in the NIR area and was created without the utilization of focal points, filters or moving parts. The outcomes demonstrate that the model reaction resembles the one of a business cryoscope, yet quicker.

3. PROPOSED SYSTEM

In this IoT system, we aimed to present some aspects regarding milk quality and quantity estimation. So, in this proposed system each customer should have their own card for accessing the milk diaries. High quality milk must have no salinity, so salinity of the milk is measured by using a salinity sensor for detecting adulteration of milk and level of the milk will be measured by using a level sensor for measuring the quantity of the milk. When the milk is stored for long, the microbial activity gets started which gives the milk a foul smell which can be detected using a gas sensor. In the existing system only the gas sensors are used for detection of early microbial activity which makes it useless when it comes to detection of adulteration of milk, our proposed system detects both aspects, adulteration as well as early microbial activity in milk.

3.1. Working Principle

Here, IoT based Arduino Microcontroller is used which can drive by 5V DC supply; the quality of the milk is maintained by using the smart sensors the temperature sensor helps in monitoring the temperature of the milk. The viscosity sensor measures the viscosity of the milk, the gas sensor used to detect the odour of the milk, the milk level sensor is used to measure quantity of milk, and the salinity sensor detects the salinity of the milk. The RFID reader reads the RFID card which consists of the customer details and the payment details, if the predefined customer makes the successful payment the motor will be switched on denoting the milk is filling. If there is an unknown entry or the insufficient payment the buzzer will be blown, all these statuses will be shown figure 1 in LCD.

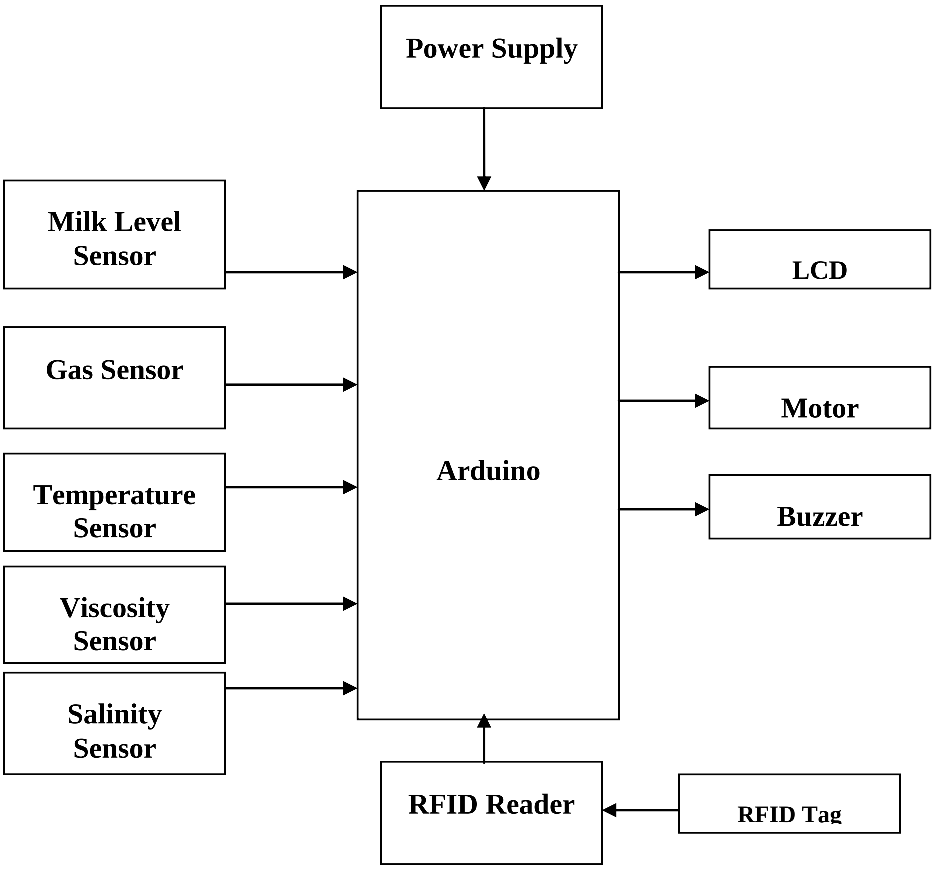


Figure 1 Proposed IoT based System

3.2. Arduino Uno

The Arduino Uno is a microcontroller board based on the IoT ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16

4

MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button as shown in figure 2.

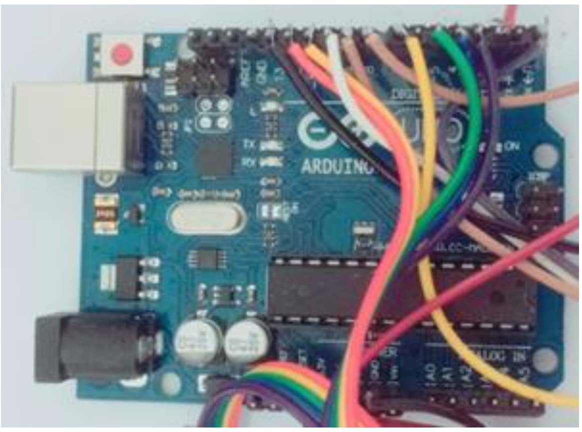


Figure 2 Arduino Board

Specification

- Microcontroller: IoT Enable ATmega328
- Operating Voltage: 5V
- Input Voltage (recommended):7-12V
- Input Voltage (limits): 620V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 40 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB (ATmega328)
- SRAM: 2 KB (ATmega328)
- EEPROM: 1 KB (ATmega328)
- Clock Speed: 16 MHz Power

3.3. Power Supply

The AC voltage, commonly 220V, is associated with a transformer, which steps that air conditioner voltage down to the level of the coveted dc yield. A diode rectifier at that point gives a full-wave redressed voltage that is at first sifted by a basic capacitor channel to deliver a dc voltage. This subsequent dc voltage generally has some swell or air conditioning voltage variety.

3.4. LM35 Temperature Sensor

The voltage yield of a LM335 increments by roughly 10 mV for each 1 degree Kelvin of ascend in temperature. Note that 1 degree Kelvin is equal to 1 degree Celsius. In the circuit, the output of the LM335 is fed into a 741 op-amp (any standard op-amp may be used) which is configured as a voltage follower. The primary capacity of the operation amp, consequently, is simply to buffer the LM335 yield with the goal that it isn't influenced by whatever heap is associated with this temperature sensor circuit as appeared in figure 3.

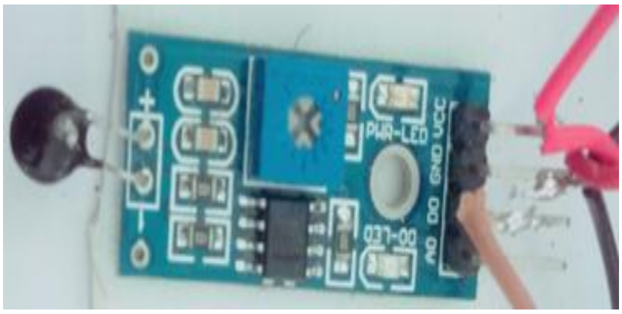


Figure 3 LM-35 Temperature sensors

3.5. Level Sensors

Level sensors sense the level of fluid and other liquid and fluidized solids, that show a higher free surface. Material that flow becomes flat in their containers since of gravity while mainly mass solids mound at an angle of repose to a peak as shown in figure 4.

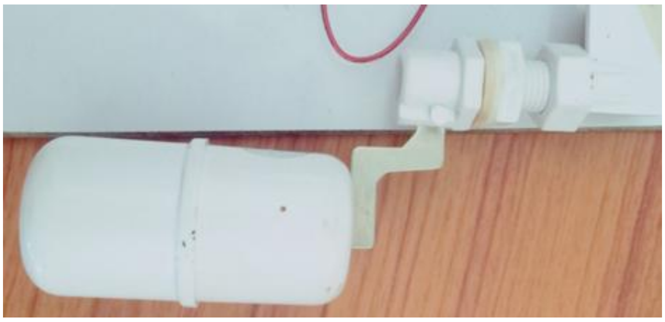


Figure 4 Level Sensor

3.6. Salinity Sensor

Measure water with a wide assortment of salinities, from salty water to sea water, and even hyper-saline conditions. You can likewise think about how saltiness influences lightness or screen saltiness esteems in estuaries where new water blends with sea water as appeared in figure 5.

6

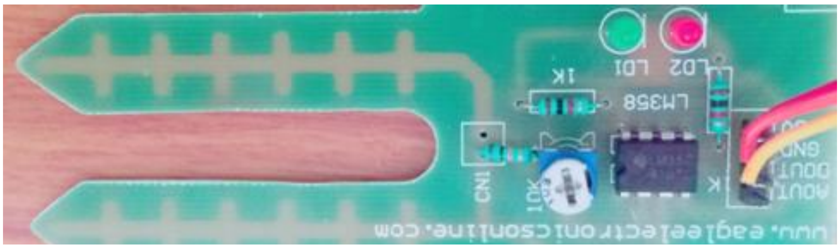


Figure 5 Salinity Sensor

3.7. Viscosity Sensor

The deflector diverts flow into the sensor to continually renew the sample in the measurement chamber. A built-in temperature detector (RTD) senses the actual temperature in the measurement chamber as shown in figure 6.

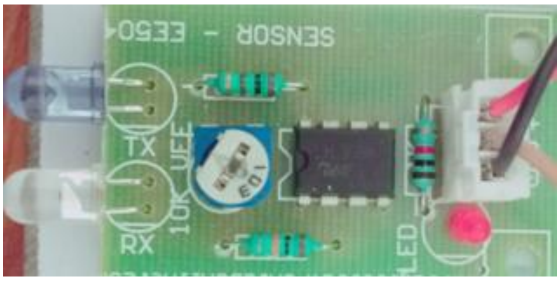


Figure 6 Viscosity Sensor

3.8. MQ6 Gas Sensor

Figure 7 MQ6 Gas Sensor

This sort of gas sensors is produced using tin dioxide (sno2) semiconductor which delivers a low conductivity in clean air. TGS 813 sensor is much touchy in nature to propane, Methane and furthermore butane. This kind of sensor is appropriate for checking LPG Gases and furthermore it reasonable in recognizing extensive variety of gases for mechanical applications. The huge preferred standpoint of this sensor is it is of minimal effort. MQ6 gas sensor instantly finds the focus in air where its basic electrical circuit changes over the conductivity charge in to a yield flag and its gas fixation relates thusly. This is a Figaro gas sensor which has images and sticks in the external body of the external circuit of sensor which is associated with yield over the heap resistor which increments quickly as protection Rs diminishes where it relies upon centralization of gas as appeared in figure 7.

3.9. RFID

Information inside a tag may give ID to a thing in fabricate, merchandise in travel, an area, the personality of a vehicle, a creature or person. For instance, the shade of paint for an auto body entering paint splash zone on the creation line, the set-up directions for an adaptable assembling cell or the show to go with a shipment of merchandise as appeared in figure 8.

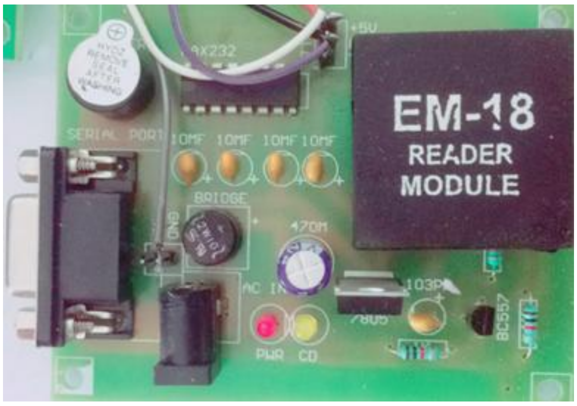
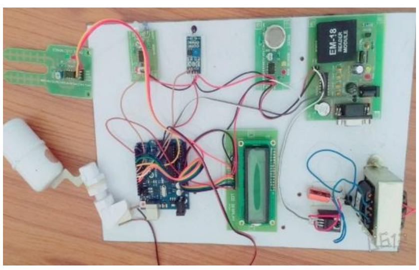
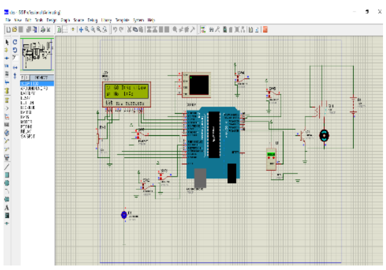


Figure 8 RFID

4. RESULT & DISCUSSION

This section shows the implementation results, which finally shows the different aspects of the milk. The whole process is controlled by an Arduino board. The analog data is sent to the Arduino using different sensory system. It is used to detect milk adulteration and early microbial activity by continuously monitoring the milk using various techniques.





8

Figure 9 Experimental Setup

In this paper, figure 9 intended to detect adulteration and microbial activity in milk. As the system is switched on, all the sensory system gets active and starts sensing for any abnormalities in the milk one after another.

If there is any abnormality found by the sensor, it informs the Arduino which automatically stops the process. In addition to this RFID is used for milk booths as each user can have their own card for accessing the milk booths. Thus, providing good quality milk to the people using sensors like MQ-6 gas sensor, salinity sensor and viscosity sensor etc.

The system is intended to detect adulteration and microbial activity in milk so the system must be fast as well as accurate. With the help of multiple sensors abnormalities in milk is detected, the detection must be continuous as well as automated. Thus, in this work the various sensors keep on monitoring the milk and transmit data to Arduino controller. The Arduino controller carries out the process of filling of milk as well as showing continuous result in the LCD in figure 10.

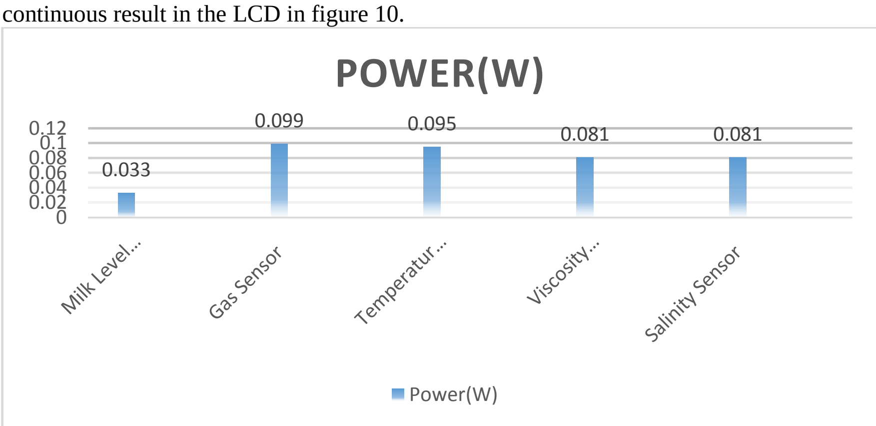


Figure 11. Power Analysis of Proposed System Component

Figure11 represents the Power Analysis of Proposed System Component which involves the power consumption of Milk Level Sensor, Gas Sensor, Temperature Sensor, Viscosity Sensor and Salinity Sensor. Figure 11 shows the design of proposed system with optimized power, because sensors are the major role play in the proposed system which is consuming the maximum power in the system. Hence, we should know about each sensor power consumption before going to design the proposed system.

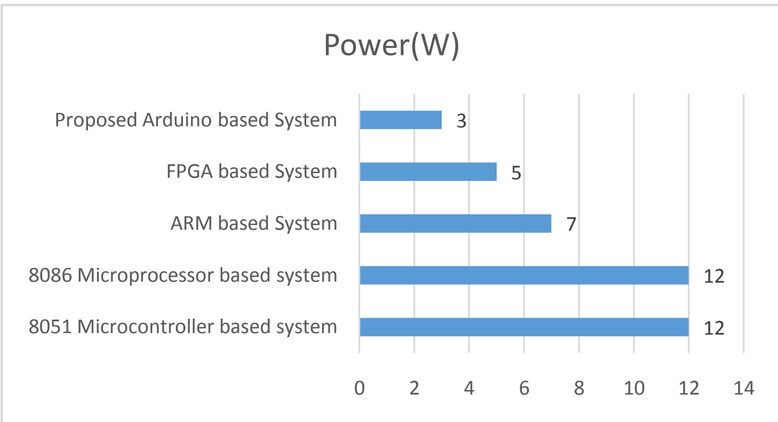


Figure 1

9

2. Power Analysis of different system

Figure 12 displays the Power Analysis of different system which is helpful to detect the adulteration level in the milk and power consumption. Figure 12 represents the battery backup level indication of existing and proposed system, which is helpful for battery backup requirement of each system. Finally, how much amount of power utilizes by proposed will be inferred from the figure 12. Hence the proposed system power consumption is 3 watts.

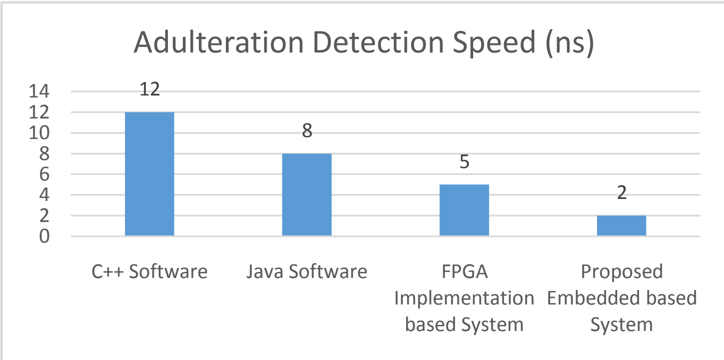


Figure 13 Adulteration Detection Speed in different platforms

Figure 13 represents the Adulteration Detection Speed with different platform which is helpful to show the fastest to detect the adulteration.

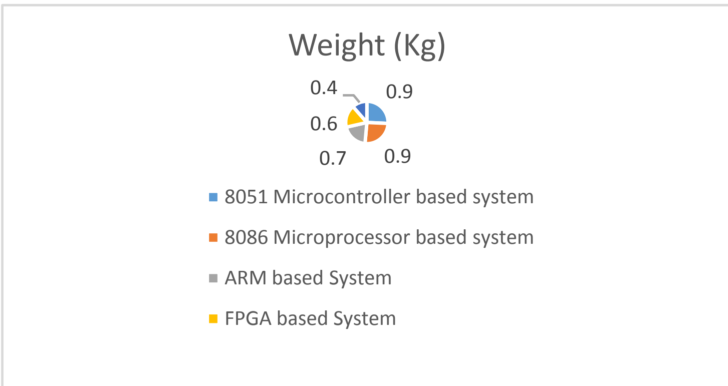


Figure 14 Weight analysis of different system

Here, the adulteration detection speed depends on the computation time of proposed system also how fastest way to detect the adulteration in order to avoid latency. Finally, Internet of Things (IoT) based proposed i.e Arduino Internet of Things (IoT) based proposed is better performance than the C++, Java and FPGA based system. Hence the proposed system adulteration detection speed only 2ns.

Figure 14 shows the weight analysis of different system which is representing the weight of each system. Here, the proposed system weight represents, which is helpful locate the system at which place and execution purpose. Because we can relocate the system according to their weight. Hence the proposed system carrying only 0.4 Kg weight.

5. CONCLUSION AND FUTURE ENHANCEMENT

In this paper, we developed a IoT based system which gives faster and more accurate results. In our proposed system, Microbial activity is determined using gas sensor. The high-quality milk should have no salinity, so salinity of the milk is measured by using a salinity sensor and level of the milk will be measured by using a level sensor. In addition to that customer should have their own card for accessing the milk diaries. The milk collection parameters such as weight, FAT & CLR are measured by this system gives fast and more accurate results than the existing systems which are more costly than the developed one. As a future work, it is intended to implement IOT and DBMS for billing system, in which each user will have a data base of their own, in which the data is recorded for the amount of milk taken, in this payment can be done using debit or credit cards, payment can be done on monthly basis. Further this system will be used by the management for tracking the milk production and marketing, all the information from milk production to marketing will be stored in management's website which can be accessed by any user having account in that firm.

6. REFERENCES

[1] Pedinti Sankaran Venkateswaran; Abhishek Sharma; Santosh Dubey; Ajay Agarwal; Sanket Goel "Rapid and Automated Measurement of Milk Adulteration Using a 3D Printed Optofluidic Micro Viscometer (OMV)" IEEE Sensors Journal, Year: 2016, Volume: 16, Issue: 9, DOI: 10.1109/JSEN.2016.2527921

[2] Lucas de Souza Ribeiro; Fábio Augusto Gentilin; José Alexandre de França; Ana Lúcia de Souza Madureira Felício; Maria Bernadete de M. França "Development of a Hardware Platform for Detection of Milk Adulteration Based on Near-Infrared Diffuse Reflection" IEEE Transactions on Instrumentation and Measurement, Year: 2016, Volume: 65, Issue: 7, DOI: 10.1109/TIM.2016.2540946

[3] Maurício Moreira; José Alexandre de França; Dari de Oliveira Toginho Filho;Vanerli Beloti; Alberto Koji Yamada; Maria Bernadete de M. França; Lucas de Souza Ribeiro "A Low-Cost NIR Digital Photometer Based on InGaAs Sensors for the Detection of Milk Adulterations with Water" IEEE Sensors Journal, Year: 2016, Volume: 16, Issue: 10, DOI: 10.1109/JSEN.2016.2530873.

[4] Jinying Yin; Siqi Zhang; Hongyan Yang; Lijie Wang; Zhen Zhou "Influence of Fat Particle Size on Light Scattering Properties in Milk Quality Testing" Year: 2014, DOI: 10.1109/IMCCC.2014.157

[5] Pallavi Gupta; Anwar Sadat; Mohd Jamilur Rahman Khan "An Opto electro mechanical Sensor for Detecting Adulteration in Anhydrous Milk Fat" IEEE Sensors Journal, Year: 2014, Volume: 14, Issue: 9, DOI: 10.1109/JSEN.2014.2319113

[6] Ahmed Gad; Shesha H. Jayaram "Effect of Electric Pulse Parameters on Releasing Metallic Particles From Stainless Steel Electrodes during PEF Processing of Milk" IEEE Transactions on Industry Applications, Year: 2014, Volume: 50, Issue: 2, DOI: 10.1109/TIA.2013.2278424

[7] Gabriel Durante; Wesley Becari; Felipe A. S. Lima; Henrique E. M. Peres "Electrical Impedance Sensor for Real-Time Detection of Bovine Milk Adulteration" IEEE Sensors Journal, Year: 2016, Volume: 16, Issue: 4, DOI: 10.1109/JSEN.2015.2494624.

[8] G.Rajakumar, Dr.D.Manimegalai, "VLSI Implementation of DIP Based Edible Oil Adulteration Identification", International Journal of Advanced Research in Computer Science and Software Engineering (IJARCSSE), Volume 3 Issue 5, Page No 771 – 777, May 2013, ISSN: 2277 – 128X.

[9] Carla Margarida Duarte; Ana Carolina Fernandes; Filipe Arroyo Cardoso; Ricardo Bexiga; Susana Freitas Cardoso; Paulo J. P. Freitas "Magnetic Counter for Group B Streptococci Detection in Milk" IEEE Transactions on Magnetics, Year: 2015, Volume: 51, Issue: 1, Article Sequence Number: 5100304, DOI: 10.1109/TMAG.2014.2359574

[10] G.Rajakumar, Dr.D.Manimegalai, "FPGA Implementation of DIP based Adulteration Identification in Food Samples", International Journal of Computer Applications (IJCA), Volume 35, No.1, Page No 06 - 11,December 2011, ISSN 0975 – 8887.