

IoT based detection of microbial activity in raw milk by using Intel Galileo Gen II.

Shinde Kajal P.¹, Yadav Shivashkti K.², Bajaniya Shivangi R³

Gholap Arati B.⁴, Kadam Pooja R.⁵

¹⁻⁴BE Student, Dept. of Computer Engineering, SBPCOE, India

⁵Professor, Dept. of Computer Engineering, SBPCOE, India

Abstract - Smart city is a bold new initiative by the Government of India to drive economic growth and to improve the quality of life of people. This attempt to recognize the technologies that can solve problems which cities must facing such as transportation system, poor air quality and health related issues. So they create a network of partner cities to share ideas for future progress. In the rural and urban areas the food safety is more important issue as it affects the health of citizen. Different studies shows that, raw milk contains different infective bacteria if such milk get consumed it will affect an illness and decline or injure quality of life. So, it is necessary to develop such tools which will a real time quality monitoring with smart sensing system to make on time decisions. In this project we are going to present real time monitoring system, a tool which allows recognizing concentration of different gases in raw milk. Stored raw milk may contain bacteria that result in unwanted smell, taste etc. In the existing system work has been done with ARM processors. We are proposing a system with unit of Intel Galileo Gen 2 and other sensors which help to identify different microbial activities in raw milk. We are designing GUI based system and its responses will be validated during real time. This system will able to analyse data and also data backup will be maintained in proposed system. Our work involves detecting microbial activity present in raw milk. System can detect such activity easily by checking presence of ethanol, acetic acid and acetaldehyde.

Key Words: Intel Galileo Gen II,SD I.2.9 Sensors, SD C.2.1 Network, SD J.7 Real Time.

1. INTRODUCTION

Smart city takes an initiative for identification of different new technologies which will help for solving the problems faced by citizen. The measurement of concentration of bacteria is very important issue in different technique like monitoring system and food assessment. Raw milk analysis is very necessary because an earlier study shows that raw milk having pathogenic organism that will results an increases in diseases and degrade the quality of life. The milk is requirement of human as most of Indians takes milk as a

food. Milk is defined as the outcomes of milking process showed in sanitized conditions of healthy cow. It is good source of nutrients such as proteins, vitamins and mineral salts not only for mammals but also for number of microorganism. The necessity of human is milk because it contains calcium and carbohydrates which will provide strength to human body. For the development of urbanization food safety is important. When fresh milk obtained from healthy cow then it contains fewer amounts of bacteria it will submitted to dairy farm and after that the dairy farm will mix-up with other milk so amount of bacteria will be increased. And also increases harmfulness of milk that affects human health. As we know that bacterial growth leads to the spoilage of milk with heavy production of off flavors which severely affects the milk quality. Generally people used cessation date to decide that milk is spoilage or not. In other way dairy industries uses Infrared Spectroscopy that provide biochemical information related to molecular interaction in between cells and tissues. Pasteurization process is nothing that heating milk at high temperature and then sweep to cooling state. Basically pasteurization process is used in drinks and food industries. That foils milk from spoilage for minimum time span. In many dairy industries, they use ARM processors, computer supported control of physiological and sanitary parameters and lead to improve productivity and also remove some dull operations.

Table 1 : shows that different Microorganism in milk

Food	Microorganisms Present in milk
Raw Milk	A wide variety of germs (Brusella, Listeria, Salmonella, etc.)
Pasteurized Milk	Coxiella burnetti, Poreformers, Listeria Monocytogenes.
Condensed Milk	Glaucus, Aspergillus repens, Torulopsis.
Dried milk	Bacillus, Micrococcus, Mucor.

Though pentanal, hexanal and isopentanal indicate copper received oxidation in milk can be suggestively identified through the present the pentanaldehyde, dimethyl sulfide etc. It is observed that head space of milk from the cow bearing genetic defect contains trimethylamine hence VOC's responsible flavor, quality of raw milk can be identified. So finding this type of microbial activities at the real time can be implemented as a part of smart city with IOT architecture.

In propose system, we are going to present real time monitoring system, a tool which allows recognizing concentration of different gases in the raw milk. Stored raw milk contain bacteria that result in unwanted smell, taste etc. With the help of Intel Galileo Gen II and other sensors, we are going to notice the bacteria or microbial in a raw milk and our idea is to publish these results on network. Which will be easily accessible by the customer or client those who want to access this tool.

2. LITERATURE SURVEY

The RTOS based electronic nose monitoring system uses array of sensors that detects bacterial activities in the headspace of milk container. The sensors which are used for expressed and adjusted to a several concentration of VOC's which is responsible for milk flavors. That monitoring system provides toxic bacterial count in the raw milk. This E-nose system tested various fields as scents and gases from different beverages. It is a classification of cold drink as blackcurrant juice, orange juice and mango juice. E-nose System provides good classification result by using two methods: PCA (Principal Component Analysis) and MLP (Multi-Layer Perception) [1] [2].

In food quality control and monitoring, Bacterial contamination is a central issue. Measurement of bacterial concentration by using SPC (Standard Plate Count), it gives reliable and accurate result but that take more time. Based on impedance technique any implemented sensor system can perform bacterial concentration and it allows an easy and efficient calculation of DT by using data transformation algorithm. It is estimate the Sample under Test bacterial concentration with good relationship with SPC [3].

Using milk blend detection system, it detects additional mixtures in milk such as sugar, urea and sodium chloride. This system consists of some sensors (Ammonia or Nitrogen, Sodium Chloride, PH and Sugar sensor) for sensing the components from milk. That system prevents the people from adulteration and preserve quality of milk [4].

The dairy industries are required high accuracy, reliability and instant measurement system for quality checking. Some system uses Electromagnetic sensors working with radio frequency. The most widely used method for preserving milk

is pasteurization. In ARM based temperature monitoring and pasteurization system, it provides more flexibility and accuracy for monitoring and controlling temperature. In this pasteurization technique heating and cooling temperature limits are predefined, if that overreach then valve is closed automatically [5].

2.1 Limitations of Existing System

In an existing system analysis of milk was too costly and less accuracy because they were uses advanced analytical instruments such as FTIR, UV-visible Spectrometer and chromatography. These instruments do not provide high portability, feasibility while handling which results in to more complexity.

3. PROPOSED SYSTEM

The proposed system consists of various TGS gas sensors as shown in fig1. The milk is placed 3cm away from sensors. The TGS gas sensor [2] gathers bacterial information from the raw milk and that data is converted to gas molecules. The TGS gas sensors [2] are interfaced with Intel Galileo Gen II processor which will process the data values in the form of voltage. And that processed data will store on cloud in the form of how many days that milk was stored also displays the message to the user as milk is spoiled or not.

The voltage level of tested raw milk is compared with voltage level of good raw milk which has been already tested. If that tested milk has minimum voltage levels then the raw milk is having good quality. And if tested milk has maximum voltage levels the it is indicated by glowing the LED.

The total bacterial information gathered from sensors will stored on the cloud with the help of Intel Galileo Gen II processor. And that data is updated timely.

3.1 TGS Gas Sensors

The system consists of three sensors which are as follow

- A. TGS 813
- B. TGS 822
- C. TGS 2620

These sensors give the bacterial information to Intel Galileo Gen II processor and it will do the processing and then displayed on LCD.

A. TGS 813

It is made by Figaro from Tin Oxide (SnO₂) semiconductor which has low conductivity in fresh air and also it has high sensitivity to methane, propane, butane [7]. It is used to

detect natural gases and LPG gas [7]. It can also detect wide range of gases with low cost.



Fig -1: TGS 813

When we are going to interface the gas sensors with processor shown in fig, output across the load resistor increases as sensors resistance decreases, depending on gas concentration. [7].

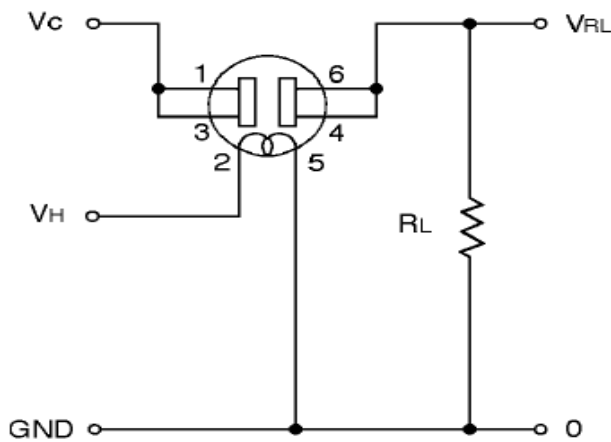


Fig-3: TGS 813 Circuit diagram [7]

B. TGS 822

It is made by Figaro from Tin Oxide (SnO_2) semiconductor which has low conductivity in fresh air and also highly sensitive to organic solvent vapors such as ethanol [8] It has high stability and reliability over long time.

When we are going to interface the gas sensor with Intel Galileo Gen II processor shown in fig, output across load resistor increases as sensors resistance decreases, depending upon concentration of gas.



Fig -2: TGS 822

When we are going to interface the gas sensor with Intel Galileo Gen II processor shown in fig, output across load resistor increases as sensors resistance decreases, depending upon concentration of gas.

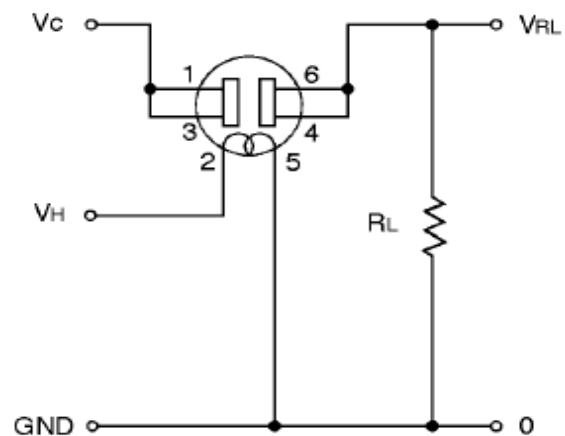


Fig-4: TGS 822 Circuit diagram [8]

C. TGS 2620

It is made up of metal oxide semiconductor layer form by alumina substrate [9]. It has high sensitivity towards alcohol and organic solvent vapours.

Circuit diagram require two input voltage

1. Heater voltage (V_H): It is applied to integrated heater. In order to maintain sensing element at specific temperature [9].
2. Circuit temperature (V_C): It is applied to allow measurement of voltage across a load resistor (R_L) which is connected in series with sensor [9].

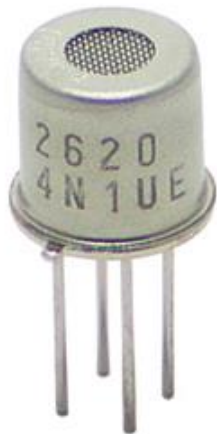


Fig -5: TGS 2620

A common power supply circuit can be used for both V_C and V_H to fulfill the sensor's electrical requirements. The value of load resistor (R_L) should be chosen to optimize the alarm threshold value, keeping power consumption (PS) of the semiconductor below a limit of 15mw. Power consumption will be highest when the value of R_S is equal to R_L on exposure of gas [9]

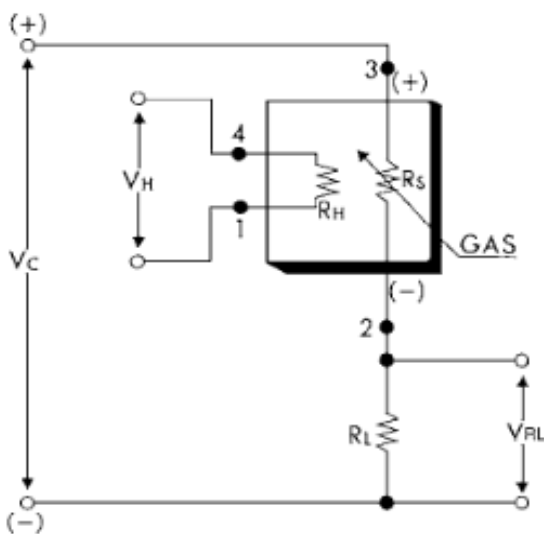


Fig-6: TGS 2620 Circuit diagram [9]

3.2 Intel Galileo Gen II

This board is used for transferring the information from sensors to the cloud so that the people will understand the quality of raw milk.

The main task of this board is to act as mediator or we called microcontroller. It takes value from different sensors and then displays on LCD.

In addition to Arduino hardware and software compatibility, the Intel® Galileo board has several industry-standard I/O ports and features to expand native usage and capabilities beyond the Arduino shield ecosystem, which are described in next section of this document.

Fig 7 and Table 2 describe the key component of Intel Galileo board.

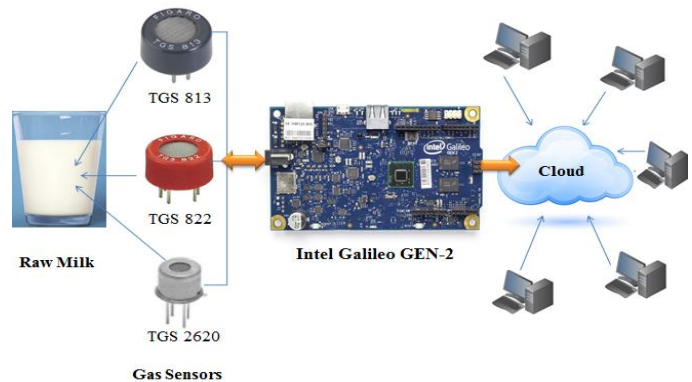


Fig-7: System Architecture

The system architecture consists of

- A. TGS Gas sensors
- B. Intel Galileo Gen II board
- C. Data server
- D. End user

A proposed system consists of hardware unit which contains Galileo board and sensors to sense the different gases to detect spoilage of milk. The software unit works on the IOT architecture in this admin will upload different results on the cloud and end user can get that result at real time when they are checking the quality of milk.

4. APPLICATIONS

1. In the milk dairies this system is useful for testing of raw milk collected from milk different sources. If in raw milk any objectionable microorganism found then that milk would be rejected.
2. At our home this system is useful for early detection of microbes from milk which is purchased from milk providers.

5. CONCLUSION

One key point of our system it is related with IOT (Internet of Thinking) because proposed system is a collaboration of sensors interfacing with Intel Galileo Gen II board which stores the results obtained from gas sensors on cloud and it is accessible to every user but it requires to login to site.

The system can be used to detect various bacteria present in raw milk. This system is very much cost effective and portable also. It is new innovation as it detects the different gases which spoil the milk and result of it can be accessible to every user.

REFERENCES

- [1] S. Ampuero, J.O. Bosset "The electronic nose applied to dairy products: a review," Received 20 December 2002; received in revised form 22 February 2003; accepted 3 March 2003.
- [2] Mazlina Mamat Salina Abdul Samad and Mahammad A. Hannan "An Electronic Nose for Reliable Measurement and Correct Classification of Beverages," 2011.
- [3] Marco Grossi, Massimo Lanzoni, Diego Matteuzzi and Bruno Ricco "Data Transformation Algorithm for Reliable Bacterial Concentration Detection Using the Impedance Method," Journal of Electrical Engineering Electronic Technology 2014.
- [4] Prof S.G.Galande Jhadav Dnyaneshwar B.Mhase Mayur D.Manakar Rahul J. "The Detection Of Urea, Sugar, Sodium Chloride, And Measurement Of Ph Parameter In The Milk By Using Arm Processor," 2015.
- [5] S.Boopathi, F.Parvez Ahmed, S.Thulasi Ram, T.Devika, Dr.N.Suthanthira Vanitha "ARM Based Temperature Monitoring and Control for Milk Pasteurization," International Journal of Engineering Trends and Technology (IJETT) Volume 16 Number 5 Oct 2014.
- [6] Dr.S.Asif Hussain, Dr.M.N.Giri Prasad, Chandra Shekar Ramaiah, S. Mazhar Hussain "Milk products monitoring system with ARM processor for early detection of microbial activity," International Conference on Big Data and Smart City 2016.
- [7] <http://www.figarosensor.com/products/813pdf.pdf>
- [8] <http://www.figarosensor.com/products/822pdf.Pdf>
- [9] <http://www.figarosensor.com/products/2620pdf.Pdf>
- [10] Jhony Tiago TELEKEN, Weber da Silva ROBAZZA, Gilmar de Almedia GOMES ISSN