International Journal of Interdisciplinary Innovative Research & Development (IJIIRD)

ISSN: 2456-236X

Vol. 03 Issue 01 | 2018

Enhanced Automation of Milk Analyzer Using Internet of Things (IoT) and Data Mining

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ABSTRACT

Dairy industry is one of the businesses which assume a noteworthy part in India's farming based economy. Dairy cultivating incorporates raising and dealing with milk yielding cattle, acquiring milk and preparing of milk for different dairy items. Dairy items contribute significantly to the exporting industry and contribute significantly for the nation's development. The plan and advancement utilizing IoT is genuinely costly right now and the current frameworks are also expensive. We plan to develop a low cost upgrade to the existing Milk analyzer machine and connect the small VMCC's together to create an efficient network for improving the quality of milk. We aim to establish wireless communication between milk automation system (Ekomilk) and Server and replace the currently used RS232 Interface by making use of Raspberry-Pi 3 which will provide portability. The goal of the system is to minimize the overall cost of and enhance efficiency and also classify the data using Data mining technique- Naive Bayes classifer. The project is based on IoT and replaces the currently used software application by a web application.

Keywords—Milk Analyzer, Automation System, Data Mining, Data Classification

1. INTRODUCTION

The idea of this project is to upgrade an as of now utilized Milk Automation machine (Ekomilk) by making utilization of Internet of Things (IoT).The Internet of things (IoT) is the arrangement of physical contraptions, vehicles, home machines other introduced with equipment, programming, sensors, actuators, and framework organizes which engages these articles to interface and exchange data. Everything is particularly identifiable through its implanted figuring framework however can between work inside the current Internet infrastructure. These gadgets gather valuable information with the assistance of different existing advancements and after that self-sufficiently stream the information between other devices. The vision of the Internet of things has developed because of a merging of various advances, including omnipresent remote correspondence, continuous examination, machine learning, item sensors, and inserted frameworks. This implies the conventional fields of inserted frameworks, remote sensor systems, control frameworks, computerization (counting home and building Automation), and others all add to empowering the Internet of things. The improvements incorporate change of the current wired framework into a remote framework, utilizing IoT and transformation of a Desktop application into a web application utilizing most recent web advances.

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[1] In this example of milk analyzer, the task can make use of a number of milk analyzer machines to function and each one functions in a rather similar fashion. Here, for example we are considering an analyzer Ekomilk-Ultra Pro.
[2] Ultrasonic Milk Analyzers are intended for quick and financially savvy examination of the fat substance, non fat drain solids (SNF), protein, drain thickness for both bovine and sheep drain and added water to drain also.
[3] Key Features of these types of Milk Analyzers are:

- Quick Analysis - Allows an expansive number of estimations to be finished.

- Simple and lightweight outline.
- Cost powerful.
- Low power utilization.
- Very little amount of drain required.
- No corrosive or different chemicals are utilized.
- Measuring exactness change should be possible by the client.

[4] Environmental Conditions:

- Encompassing air temperature 15° - 30°C
- Drain temperature 15° - 30°C
- Relative moistness 30% - 80%

[5] Measuring Parameters:

- Fatness from 0,5% to 9% with accuracy ± 0.1%
- Solids non fat (SNF) from 6% to 12% with accuracy ± 0.2%
- Milk density from 1.0260 g/cm3 to 1.0330 g/cm3 ± 0.0005 g/cm3
- Protein from 2% to 6% with accuracy ± 0.2%
- Freezing point from 0 to -1.000 °C with accuracy ± 0.015°C
- Added water to milk from 0% to 60% with accuracy ± 5%
- pH* from 0.00 to 14 pH with accuracy ± 0.02
- Conductivity* from 2 to 20 mS/cm ± 1 % mS/cm (18°C)
- Temperature* from 0 to 50 °C with accuracy ± 0.1°C

2. RELATED WORK

[1] Tanveer Rahman et.al. have proposed Fire Detection System in a readymade garment industry by using Raspberry Pi as a central server and arduino as secondary devices .In this paper, we have propounded a system which is capable to detect fire and can provide the location of the affected region. Raspberry Pi 3 has been used to control multiple Arduino which are integrated with a couple of sensors and camera.

[2]Anitha Varghese et.al.have proposed a Study of modern situation with high information rate necessities. Wi-Fi 802.11b/g innovation can be a decent answer for tending to the higher information rate needs. In this paper, we have examined the appropriateness of Wi-Fi as a contender for low power modern needs. Correlations have been given IEEE 802.15.4 remote innovation also.

[3] C King discusses about wireless communication, RF communication, serial and Ethernet port, etc It discusses about wireless communication, RF communication, serial and Ethernetport,etc. It is examined that two channel-unmindful jammers: an intermittent jammer that jams deterministically at a predetermined rate, and a memoryless jammer whose signs touch base as indicated by a Poisson procedure. We additionally grow new models for channel-mindful sticking, including a responsive jammer that exclusive jams non-impacting transmissions and an omniscient jammer that ideally modifies its system as indicated by current conditions of the partaking hubs. Our examination includes a hypothetical investigation of the immersion throughput of 802.11 under sticking, a broad recreation consider, and a testbed to direct genuine experimentation of sticking IEEE 802.11 utilizing GNU Radio and USRP stage. In our hypothetical investigation, we utilize a discrete-time Markov anchor examination to infer formulae for the immersion throughput of IEEE 802.11 under memoryless, responsive and omniscient sticking. One of our key outcomes is a portrayal of ideal omniscient sticking that sets up a lower bound on the immersion throughput of 802.11 under subjective jammer assaults. We approve the hypothetical investigation by methods for Qualnet reenactments. At long last, we measure this present reality execution of intermittent and memoryless jammers utilizing our GNU radio jammer model.

[4] Vivek Pardeshi et.al. proposed a novel method of monitoring of health of patients using IoT and Raspberry Pi. Discussion about monitoring of health of patients using IoT and Raspberry Pi. A cutting edge idea is well being checking of a patient remotely. It is a noteworthy advancement in medicinal field. Along these lines paper in view of the checking of the patient that is finished by the specialist constantly without really going to the patient. Wellbeing experts have built up a splendid and cheap wellbeing observing framework for giving

more happy with living to the general population experiencing different sicknesses utilizing driving innovations like remote correspondences, wearable and versatile remote well being checking gadget. Therefore, visits of specialists to the patients always are diminished as the data in regards to patient's well being specifically reaches to specialist's screen from anyplace the patient dwells.

[5]Yadav S.N, Mrs.Kulkarni V.A, Gholap S.G, "Design of Milk Analysis Embedded System for Dairy Farmers", IEEE 2014. 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.

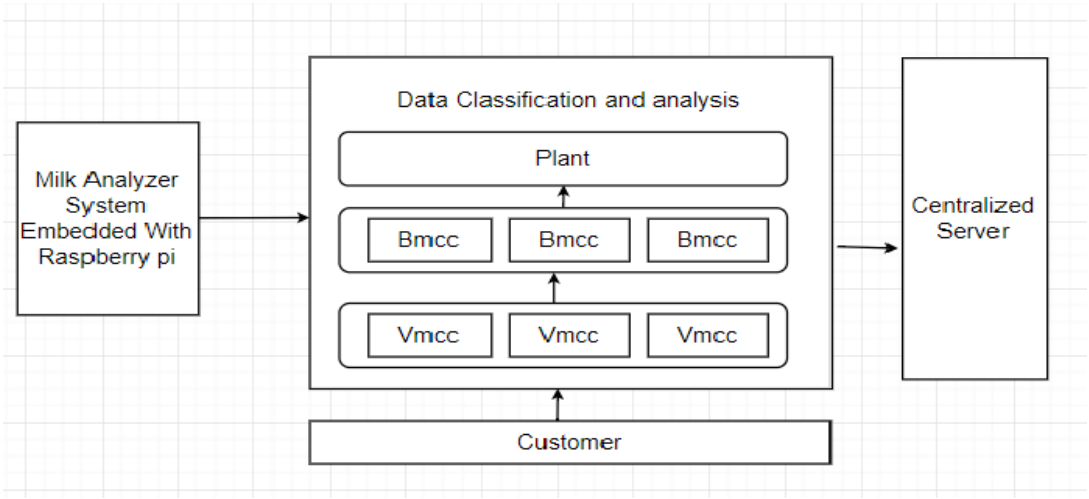
[6]Rupak Chakravarty, a paper on" IT at Milk collection centers in Cooperative Diaries: The National Dairy Development Board Experience", pp.37-47. This paper presents the design and development of Arduino controller based system to detect the parameters of milk. The parameters include pH, CLR and SNF. The pH sensor and lactometer are used to measure the quantity, pH and CLR of the milk respectively. Using the value of FAT and CLR the value of SNF can be calculated and studied qualitatively.

[7]Subhash Bhatnagar, "Empowering Dairy Farmers: A Portal and Dairy Information and Services Kiosk" The application uses Personal Computers at the milk collection Centers of theDairy Cooperative Societies (DCS) having connectivity to an Internet.

[8]Wolf, W.H., "Hardware-software co-design of embedded systems", IEEE Jul 1994, Page(s): 967 – 989 This paper surveys the design of embedded computer systems, which use software running on programmable computers to implement system functions. Creating an embedded computer system which meets its performance, cost, and design time goals is a hardware-software co-design problem-the design of the hardware and software components influence each other.

3. IMPLEMENTATION MODEL

Fig. 1: Architecture of System



The implemented system architecture shown in figure (a) is a data collection system based on the ethics of cloud storage. The system consists of Milk Collection centers networked with internet connectivity. The whole working of the system starts with VMC analyzing and collecting data using the automated EkoMilk machine, embedded with Raspberry Pi, and application developed using Python, interfaced using TFT display. The System is divided into various parts depending on its working. They are as follows:-

[1] Milk Collection and Analysis:-This is the First process in the system where VMCC consist of milk analyzer system embedded with raspberry pi.This analyzer system has local storage which is used to store data. VMCC collects the Sample of milk and this sample is provided as an input to automated ekomilk analyzer embedded with raspberry pi. The Ekomilk analyzer then analyzes the milk sample and provides us output in the form of

various factors. This various factors are protein, fat, SNF, added water; etc .This factors are stored locally with help of Raspberry Pi .

[2] Data analysis:The various factors obtained from Ekomilk analyzer are then further analyzed based on result.After receiving the data from ekomilk analyzer we have to decide factors such as price, etc. we will be using Naive-Bayes Classification Algorithm for our system. When we receive factors each factor decide the price of the milk our system which will be compared with rate chart .according to its analysis. Now for each factor a class will be generated and after result from above classes will lead to two final classes for Good Quality and Average Quality. If the Sample of Milk Falls under the probability of Good Quality it will indeed receive a good price according to the rate chart. .if its probability comes under Bad Quality it will Receive Amount according to rate chart. According to result summary report can be generated for individual unit .This summary report will help the plant for taking business related decision.

[3] Data upload:The local machine is connected in the network, the data collected locally at VMCC is uploaded to the centrally located webpage server. The multiple set of data generated from the Village Milk Collection Centres and stored at the central storage, can be accessed by the Bulk Milk Collection Centres(BMCC), for further analysis. And so on the data can be finally used by the Main Plant. The Received result are uploaded onto the webpage this Webpage is accessed By the milk plant they provide user id to various BMCC and VMCC when VMCC user upload data it will come into notice of BMCC and Plant and thus Plant already knows the result .If in-between anybody tries to adulterate the milk he will get Caught. When there is non-availability ofinternet connectivity, the data is stored in offline mode, preserved in the local storage. As the network connection is encountered, the data is uploaded to the cloud, thus maintaining data integrity and data availability.

4. Experimental Setup

The use of a single milk analyzer embedded with a Raspberry Pi- 3 is made for validating the proposed project, the specifications of the Raspberry Pi used are: A CPU with 4× ARM Cortex-A53, 1.2GHz and GPU with BroadCom VideoCore IV, RAM is 1GB LPDDR2 (900 MHz) with networking and Bluetooth capabilities. A 40 –pin header populated GPIO, MicroSD for storage and the following ports: HDMI, 3.5mm analogue audio-video jack, 4× USB 2.0, Ethernet, Camera Serial Interface (CSI), Display Serial Interface (DSI)

5. Data Mining

As the milk collection and sampling of the unit samples generates a large set of data, it can be used in further in-depth analysis for preventing adulteration and accurate fixation of prices of the milk. This can be achieved using the Data Mining techniques available at disposal. Data Mining can be termed as information mining capacity that doles out things in a gathering to target classifications or classes. The objective of order is to precisely foresee the objective class for each case in the information. It makes utilization of scientific strategies, for example, choice trees, straight programming, neural system and insights. In arrangement, we build up the product that can figure out how to characterize the information things into gatherings.Hence we make use of the supervised method of learning- Classification, to segregate the samples of milk into classes. The Naive Bayes Classifier is a powerful and independent classifier. The Training Set(TS) provided to the classifier is sample constituents I.e Fat, Solid Not Fat(SNF) and Quantity. The pseudo algorithm is as follows:

Step 1: Select generic data as the training set.

Step 2: Definition of range of each constraint I.e Good, Medium, Poor quality.

Step 3: Find probabilities of class attribute, $P\ (\text{class attribute}) = \frac{\text{no of unique labels}}{\text{total elements in TS}}$

Step 4: Defining the range of attributes separately

Step 5: Calculating the probabilities of individual elements under training set.

Step 6: Iterative selection of tuples for training the classifier.

Step 7: Calculate the tuple probabilities w.r.t to range.

Step 8: Multiplying the tuples with class probabilities.

Step 9: Calculate the estimate probability of each class.

Step 10: Apply Bayesian probability function to individual tuple and lable the data.

$$P(\text{attribute/tuple}) = \frac{P(\text{tuple /attr .}) * P(\text{attr .})}{P(\text{tuple})}$$

6. Implementation & Output

1) The analysis stage is initiated at the Plant stage of the hierarchy, where the abundance of data is found. The plant has the independence to classify the raw data, collected from heterogeneous sources for primitively and dynamically deciding the price of milk. The modified algorithm discussed previously helps us in the realization of the classification

2) If the deposition of milk occurs multiples times in a single day, then there might be a possibility that the classification can be ambiguous due to variety of samples. Hence individual dataset is classified iteratively in real time and then quality is labeled individually.

3) The dataset generated is huge in size and it is tiresome to analyze it for classification, hence our system has provisions for Graphical analysis using Pi-Charts. This enables the end user to extract the necessary dataset from the raw data, and provide abstract view of the entire system.

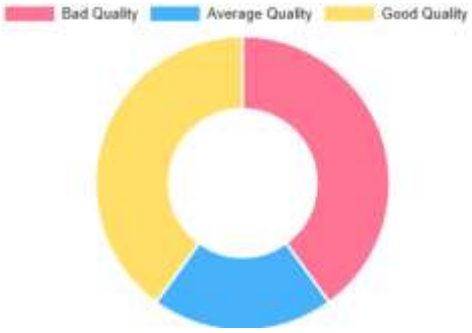


Fig.2 Pi-Chart for Quality of milk samples

Table1: Output of Naive Bayes Classifier

Code	Name	Average	Avg SNF	Total Coll.	Class
S1	Akshay	4.305	10.217	10	Fat Deficient
S2	Swaraj	3.6005	8.757	7	Fat Rich
S3	Pranav	2.5	7.2	1	Fat Deficient
S4	Apurv	3.175	7.55	8	Average Fat

7. Conclusion

In this paper, we clearly see, it would enable the farmers as well the milk collection centers to analyze the quality of milk collected. The prices and quality of the milk the regular end consumers consume would improve and it would enable the economy of the country to strengthen as a whole. Also the graphical analysis of the data would enable the decision makers with better knowledge and help them to fix prices dynamically thus enabling the end users with the benefits and the farmers with proper response for their deposition. The classification tool will enable the Plant level operators to put a brake on the issue of adulteration and avoiding the in-orbitant change in the price of the milk which would ultimately bring down the common man's cost expansiveness. The centralised nature of the system will enable the With the help of network of VMCC and BMCC, the process of collecting and analyzing data would prove helpful for the given community of developers and facilitate the developers.

8. References

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[2] Anitha Varghese et.al. have proposed a Study of industrial scenario with high data rate requirements. WiFi 802.11b/g technology [11], [12] can be a good solution for addressing the higher data rate needs.

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