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Smart Milk Quality Analysis and Grading using IOT

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Abstract - India's Agriculture is an important part of India's economy, and the dairy sector provides to the country's profitability. As we all know, the global has grown at a faster rate, with people embracing a more affluent lifestyle to meet shifting expectations and needs. As a result, it is critical to reform the current farming and dairy management practices in India in different criteria, such as PH, FAT, classifications of various milk characteristics, and so on. Another concern is that the process is done manually, which makes it susceptible to errors. As a result, it is necessary to reduce physical labor to improve results. The current system must be replaced with a new one that utilizes automated milk sample measuring technology. In our proposed system, we have developed a low-cost and reliable milk parameter detection and analysis system that uses an Arduino controller. On the other hand, the milk quality is checked, evaluated, and shown in a matter of seconds. As a result, the goal of implementing the suitable information technology stated in this project is to make information symmetric in the market, thereby minimizing problems of adverse selection and tedious work.

***Key Words*:** Micro-controller, IoT Module, TDS Sensor, pH Sensor, Load Cell, MQ135 Sensor

1. INTRODUCTION

Now a Agriculture is backbone of our country and dairy farming is joint business of Indian farmer. The Dairy industry in India is generally co-operative. The primary milk provided to the dairy are farmers who do not process their milk and give it in the raw form to the co-operative dairy. Since more number of farmers are depositing their milk in the dairy, it is a daily task of the dairy to assess the quality of milk from each farmer, verify it & meets the quality norms specified and make payments based on quality and quantity of milk. This rate depends on various factors like weight, FAT, CLR, alcohol & SNF of the milk. We are developing a system that will measure these parameters and accordingly calculate the payment automatically. Standard ranges of fat content and CLR of milk are specified by the government. User has to pour its milk sample in the beaker which is attached to the system and also place his milk CAN on weighing machine attached to system. Then system will display different parameters measured from the sample on the display,

viz;
1. Fat present in milk.
2. PH of milk.
3. Temperature of milk
4. Weight of milk.
5. Alcohol content

The fat content in milk is detected with the help of beer‟s lamberts principle which state that when light is pass through the liquid small amount of light is absorbed by it depending on the liquid density. This change in light intensity can be detected by LDR. So as fat increases in milk, variation in light intensity is observed so voltage across LDR changes which in turns decide fat of milk. For SNF measurement there is standard formula given by Indian Standard Institute,

SNF= (CLR/4) + (0.2*FAT) + 0.50

Where, CLR is correct lactometer reading.

The weight of milk is measured with the help of load cell, which convert weight change into resistance change. Load cell is electronic device used to convert force into an electrical signal. With the help of these parameters system will calculate price of milk. Price of milk is given by following equation, Price of milk = amount of milk * Rate of milk per degree fat (In liters) (In Rs) In this way automation process system will display: -Fat present in milk, SNF present in milk, Temperature of milk & Weight of milk.

1.2. LITERATURE REVIEW

A. Zakeri , et al. (IEEE Access, 2018). “Early Detection System for Proactive Management of Raw Milk Quality: An Australian Case Study”.[2]

In this Paper, the authors discussed for assessing and preventing milk with a high microbiological index from migrating farther downstream in a dairy supply chain, existing research takes a reactive stance. They contend that if the goal is to optimize milk life in terms of quality, such an approach is not the best course of action. They suggest a proactive strategy that keeps an eye on the parameters of temperature and level, which serve as the building blocks of the bacteria in milk. The state at which the storage tank should store the milk in compliance with standards is then determined using this information. The real condition of the tank is then compared to this status, and if they differ, it will urge the farmers to take the necessary preventive measures to regulate the quality of the milk. proactive management designed by Raw A rule-based system and machine learning approaches are used to mimic the milk quality approach. degree of precision They use it on milk in order to validate our strategy and show how it may be used. a farm in Australia's Queensland.

B. Shubhangi Verulkar, et al.(JETIR, 2019). “Milk Quality and Quantity Checker”. [3]

Authors described an users may verify the quality and amount of milk using an Internet of Things (IoT)-based system. The spread of germs will accelerate, and the milk will have an un-

favourable odour if it is kept in storage for a number of days. The health of humans is seriously endangered by these tainted milk-producing bacteria. In order to stop future diseases, society urgently needs milk surveillance. The major goal of this project was to create a sensor-based electrical system for tracking the behaviour of several compounds in milk that can change the qualities of pure milk. Consequently, a monitoring system is required to find and identify milk deterioration. By using a variety of sensors to keep an eye on the milk characteristics, this work illustrates a unique method of milk quality testing.

C. Sumitra Goswami, et al. (IJAEB, 2021). " Arduino-Based Milk Quality Monitoring System". [4]

Authors described the creation and use of an arduino controller-based system for the detection and analysis of milk parameters. The created system is lighter and smaller. It responds swiftly and uses little electricity to operate. It can therefore be used for portable applications. Future efforts will concentrate on raising the system's overall accuracy. It is also feasible to reduce the system's size and increase mobility so that it may be used freely in the field.

D. S. Priya, et al. (IJTRD, 2017). "Milk Quality Tester".[5]

In this Paper, the authors analyzed and delivers a cutting-edge milk quality monitoring system based on Smart Sensor technology. All newborns main source of nutrition is milk, thus it is important to keep an eye on kids' security. The project's primary objective is to create products that assess the safety and quality of milk eaten. In order to determine several milk parameters, this study makes use of clever sensor technologies. To assess the milk's quality, variables including pH and temperature are taken into consideration. To assess if milk is warm or cold, temperature sensors are utilized. To detect the pH of milk, a pH sensor is utilized (that is, whether is acidic, basic or neutral). Milk's protein content is determined using the nitrogen sensor. If melamine is present in milk, it may be found by using the protein content. As a result, each of these sensors is integrated into the housing, and the monitoring indication displays the output outside (LED). Using a Bluetooth gadget, they may transmit a report to your smartphone (about milk quality).

2. PROPOSED SYSTEM

This device can be set up in a nearby dairy or milk vendor where farmers can drop off their milk. As a primary milk analyzer, this device can be used. When this unit is properly mounted and turned on with a 5-volt dc supply through the power supply module, it is ready to use. It begins by reading data from the various sensors connected to the PIC Controller. The pH of a milk sample is detected by a pH sensor. The pH of milk should be between 6.5 and 6.8. This gas sensor can detect microbial activity in milk or quantify toxic gas emissions from a milk sample. The temperature of the milk is determined by a temperature sensor, and the FAT is measured using the light. We are using the arduino to perform the background programming to calculate and provide the output with the inputs received from the sensors. These sensors measure the density, temperature and volume of the milk. Calculate the milk weight and other data send iot webpage and SMS.

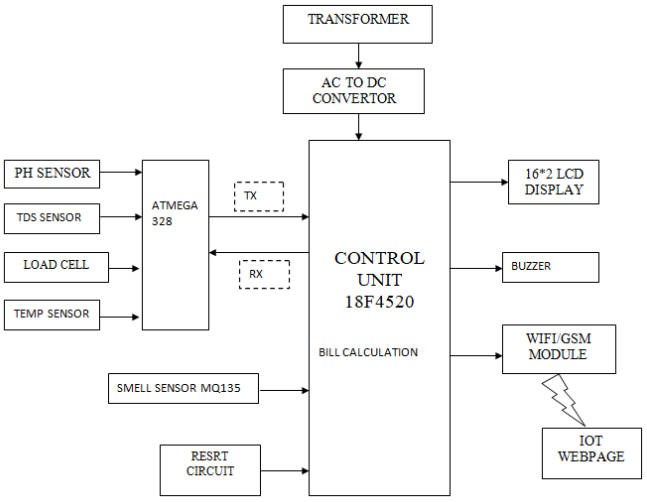

Fig -1: Block Diagram

2.1 PIC 18F4520 microcontroller:

It is an 8-bit enhanced flash PIC microcontroller that comes with nano Watt technology and is based on RISC architecture. Many electronic applications house this controller and cover wide areas ranging from home appliances, industrial automation, security system and end-user products. This microcontroller has made a renowned place in the market and becomes a major concern for university students for designing their projects, setting them free from the use of a plethora of components for a specific purpose, as this controller comes with inbuilt peripheral with the ability to perform multiple functions on a single chip.

- This microcontroller version comes with CPU, timers, 10-Bit ADC and other peripherals that are mainly used to develop a connection with external devices.
- This PIC version, like other models in the PIC community, contains everything that is required to make an embedded system and drive automation.
- The PIC18F4520 contains 256 bytes of EEPROM data memory, 1536 bytes of RAM, and program memory of 32K.
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- It also incorporates 2 Comparators,10-bit Analog-to-Digital (A/D) converter with 13 channels, and houses decent memory endurance around 1,000,000 for EEPROM and 100,000 for program memory.

Fig -2: PIC 16F886 Microcontroller

2.2 16*2 LCD Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs.

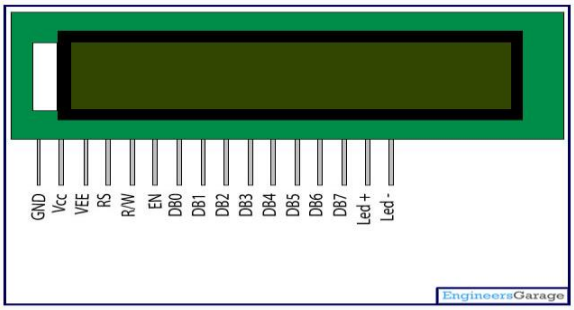

Fig -3: LCD Display

The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

2.3 PH Sensor:

The Analog pH Sensor Kit is specially designed for Arduino controllers and has a built-in simple, convenient, and practical connection and features. It has an LED that works as the Power Indicator, a BNC connector, and a PH2.0 sensor interface. To use it, just connect the pH sensor with the BND connector, and plug the PH2.0 interface into the analog input port of any Arduino controller. If pre-programmed, you will get the pH value easily. Comes in a compact plastic box with foams for better mobile storage.

1. Module power supply: 5 VDC.
2. Measuring temperature: 0-50 ℃.
3. Response time: ≤ 1min.
4. pH sensor with BNC connector.
5. Gain adjustment Potentiometer.
6. Power indicator LED

Fig -4: Analog PH Sensor

2.4. TDS Sensor:

The Grove – TDS Sensor detects the Total Dissolved Solids (TDS) levels in the milk which can be used to indicate the water quality. The Grove – TDS Sensor can be applied in water quality applications such as TDS meter, well milk, aquarium, hydroponics, etc.

It supports 3.3/5V input voltage and 0 ~ 2.3V Output Voltage making it easy to be compatible with all Arduino Boards. The sensor also provides a waterproof probe, making the testing process much easier to handle.

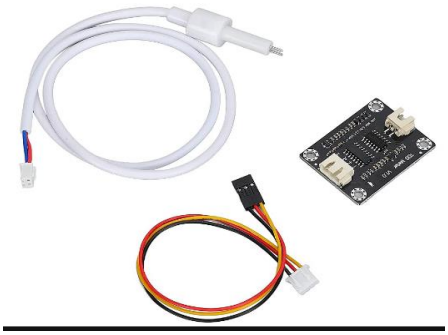

Fig -5: TDS Sensor

2.6. Temperature Sensor (DS18B20):

This is a 1 Meter Long Waterproof, sealed and pre-wired digital temperature sensor probe based on DS18B20 sensor. It is very handy for when you need to measure something far away, or in wet conditions. Because they are digital, you don't get any signal degradation even over long distance.

These 1-wire digital temperature sensors are fairly precise (±0.5°C over much of the range) and can give up to 12 bits of precision from the onboard digital-to-analog converter. They work great with any microcontroller using a single digital pin, and you can even connect multiple ones to the same pin, each one has a unique 64-bit ID burned in at the factory to differentiate them. Usable with 3.0-5.0V systems.

The only downside is they use the Dallas 1-Wire protocol, which is somewhat complex, and requires a bunch of code to parse out the communication. When using with

microcontroller put a 4.7k resistor to sensing pin, which is required as a pullup from the DATA to VCC line.

DS18B20 Sensor Technical specs:-

- Usable temperature range: -55 to 125°C (-67°F to +257°F)
- 9 to 12 bit selectable resolution
- Uses 1-Wire interface- requires only one digital pin for communication
- Unique 64 bit ID burned into chip
- Multiple sensors can share one pin
- ±0.5°C Accuracy from -10°C to +85°C
- Usable with 3.0V to 5.5V power/data

Fig -6: DS18B20sensor

2.7. Load Cell:

A load cell is a transducer that is used to create an electrical signal whose magnitude is directly proportional to the force being measured. The various types of load cells include hydraulic load cells, pneumatic load cells and strain gauge load cells.

This is a standard load cell for measuring weight upto 10 Kg. The output of the load cell is in mili-volts and cannot be directly measured by a micro-controller. So an ADC with high resolution or an instrumentation amplifier is required to make the output of the load cell readable to a micro-controller.

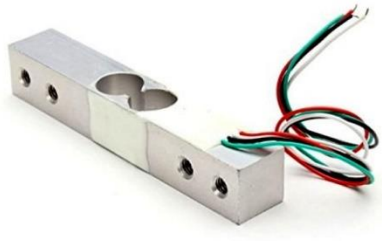

Fig -7: Load Cell

2.8. GSM Module:

SIM900A Modem is built with Dual Band GSM based SIM900A modem from SIMCOM. It works on frequencies 900MHz. SIM900A can search these two bands automatically. The frequency bands can also be set by AT Commands. The baud rate is configurable from 1200-115200 through AT command. SIM900A is an ultra-compact and wireless module. The Modem is coming interface, which allows you connect PC as well as microcontroller with RS232 Chip (MAX232). It is suitable for SMS, Voice as well as DATA transfer application in M2M interface. The onboard Regulated Power supply allows you to connect wide range unregulated power supply. Using this modem, you can make audio calls, SMS, Read SMS, attend the incoming calls and ect. through simple AT commands.

Fig -8: GSM SIM900

3. CONCLUSIONS

There are many new technologies included in the determination of adulterants in milk, but these technologies are still not affordable for small industries and farmers to evaluate milk quality and determine an exact price for milk based on that quality. Milk processing takes longer since it must first be evaluated for quality by measuring its FAT content, density, and quantity after being purchased from farmers. As this process is time-consuming hence farmers have to stay in line for an hour or more.

The major goal of the study is to identify the fat, which can be inferred by looking at all of the aforementioned systems. Hazardous gases such ammonia, hydrogen sulphide, benzene series steam, smoke, and others are accurately detected by the MQ135 gas sensor The quantity per litter calculation, IOT cloud for remote monitoring, and the level of milk humidity are also applied. Pure milk has a pH between 6.7 and 6.9 [1][6]. The nutrition, lactation season, and breed of the cow all have an impact on it. The range of certain animals' fat contents is 3.0 to 4.0 [1][5]. Cow milk has a 6 percent fat level, whereas buffalo milk has a 7-8 percent fat content.

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