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Temperature Monıtorıng of Chılling System Usıng IoT Techniques

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Abstract:- The chilling of milk in dairy sector is important to increase the life time of the milk as well as the quality of milk. The chilling of milk means rapid cooling of raw milk sufficiently at low temperature so that the growth of microorganisms present in the milk is tested. During the chilling process the temperature of milk should be reduced to less than 10°C. The manual process of monitoring the temperature of chilling system continuously is impossible and the continuous running of the compressor is not feasible. Maintaining the chill water temperature at the required level increases the efficiency and the cost of electricity is reduced due to the compressor maintenance. This project aims to continuously monitor the temperature of chiller using IoT techniques. The temperature monitoring sensor helps to send the reading of chiller temperature regularly. If the chiller temperature goes at high rate NodeMCU (Node Micro Controller Unit)-ESP8266 and IFTT application are used as an interface between the user and microcontroller to generate and send the notification to the end users.

Keywords:- *IoT Sensors, IFTTT, Energy Efficiency, Cloud Databases, Real Time Monitoring.*

I. INTRODUCTİON

The project focuses on implementing an Internet of Things (IoT) techniques for monitoring and managing the temperature in a chilling system. The chilling system aims to ensure precise temperature control, prevent inefficiencies, and minimize potential damage caused by temperature fluctuations in various environments, including industrial, commercial, or domestic settings. It is used to monitor, analyse, and control temperature conditions with precision and efficiency of the milk. The IoT application not only guarantees the quality and safety of dairy products but also brings about significant improvements in operational processes, energy conservation, and resource optimization. The chilling of milk in dairy industry is important to increase the age of milk to ensure its quality. Chill water is used as a medium of cooling in chillers to cool the milk inside the chiller. When the next shift milk arrives at center the chill water must be ready at 0 degree Celsius. For this the compressor must be started 5 hours before cooling process.

The project delivers the real time temperature of milk and chilling systems using IOT techniques. We will explore the fundamental principles and advantages of IOT in this context and demonstrate the potential to revolutionize storage and preservation of milk. Addition we will address the challenges for implementing the IOT-based temperature monitoring systems in dairy industry which will offer insights into practical solutions. Through the case studies we will demonstrate how IOT is possible to elevate the dairy industry by ensuring the freshest, highest-quality milk products. As we navigate this exploration, it will become evident that IoT is not just a technological advancement but a dairy industry transformation, enhancing both product quality and overall operational efficiency.

Transportation of goods, product storage, and other related costs rise in tandem with industries' continued growth and expansion of the maintenance effort needed to support them. These increasing maintenance needs can be made simpler with the help of IoT. In order to avoid mishaps and guarantee that the temperature is ideal for manufacturing, an Internet of things (IoT) based temperature monitoring system can be used to continuously monitor and regulate their temperature. If there is any deviation, the system can sound an alert. In order to keep products from spoiling, it can also be used inside transport vehicles to monitor the temperature of the containers.

- *Internet of Things(IOT)*

The Internet of Things (IoT) is a network of items that exchange and gather data. It is frequently recognized by the actual items that are linked to the network. Anything that has sensors, electronics, software, Internet connectivity, and other embedded features that enable data collection and transfer, such as gadgets, cars, or environments, might be considered an object. It enables data communication between "Things" without requiring computer or human-to-human

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contact. "Things" can refer to a wide range of objects in the Internet of Things, such as biochip transponders for farm animals, heart monitor implants, or built-in sensors for automobiles. It is a group of computing devices that work together to communicate data via a network and sense their surroundings through sensors without the need for any human communication. It is a contemporary technology with the ability to perceive, process, store, and send data. Additional uses for this data include machine learning and real-time analytics. Owing to its potential, Internet of Things applications—which range from cars to home appliances and let users operate gadgets without human assistance—are expanding daily.

II. LITERATURE REVIEW

S. Boopathi et al. (2016) was proposed by ARM Based Temperature Monitoring and Control for Milk Pasteurization. It is an embedded system that monitors and controls temperature; if the temperature rises over predetermined levels, the valve automatically closes.By utilizing an embedded controller, this system offers a more flexible and accurate means of monitoring and controlling the temperature of dairy products.

Hongmin Sun et al. (2016) In order to ensure the quality and safety of raw milk during transportation, recommended designing a real-time monitoring system based on the internet of things.As STM32F103 and other important technologies like GPS, GPRS, and RFID were used. To achieve the visualization that guaranteed raw milk quality and indicated the temperature of milk during the transporation process, real-time data collection and storage on the location of transport vehicles, the temperature of milk boxes, and real-time monitoring on the raw milk transport process could be carried out.

Wenli Zhang et al. (2018) Temperature Monitoring System for Raw Milk Transportation Based on TRIZ Theory, suggested that the temperature has a significant impact on the amount of bacteria present in raw milk, and that the right temperature can extend the raw milk's shelf life. The hardware design of the power supply and hardware layout has two main issues. The TRIZ (theory of inventive problem solving) theory is used to overcome these two issues. TRIZ theory finds the solution to a problem by analyzing the interactions between components, applying technical and physical contradictions, and combining these with the concept of creation.

Teaching Asso., et al. (2021) in the title of Implementation of Automatic Cooling System for Cattle Shed and its Effect on Milk Production. In human existence, automation and robotics are very important. The northwestern region of Rajasthan experiences wide variations in temperature (around 5 degrees Celsius). The high temperatures have an impact on cattle and animal health. It reduces the amount of milk produced. Numerous initiatives have been developed to use technology, such as integrated and wireless sensors and the Internet of Things, to get out of these kinds of delicate situations. In this temperature-based cooling system for livestock and cattle farms in the western region of Rajasthan, the wireless temperature sensor uses an Arduino system to measure the ambient temperature of the cattle/livestock shed. If the temperature rises, the cooling system Fogger system activates, and if the temperature falls, the fog-ger system automatically shuts off. This device is under the control of Arduino. The temperature is also displayed on the LCD panel. The owner may also set the high-low temperature threshold setting via Bluetooth mobile connection.

N.Indumathi1.,et al. (2018) in the title of Well-organized milk distribution monitoring System based on Internet of Things (IoT). Maintaining the cold chain and preventing milk spoilage are the two main objectives of the project milk distribution monitoring system. The system's core components are data mining and the Internet of Things. Milk is typically given in cans with little supervision, which raises the possibility of milk becoming bad before it's used, particularly while it's being transported. The routing plans are initially identified using a data mining technique, after which the drivers' case-based routing plans are created. The existing sensor-based technology will be used to measure the pH of milk in order to determine its quality. The system will direct customers to the nearest milk booth where they can get refrigerated milk in order to maintain and deliver the item.

Deny Beny Kamuhanda., et al. (2023) proposed of "IoT based Milk Monitoring in Rwanda" in the project By integrating internet of things (IoT) devices into already-existing infrastructures, such as tanks, traders and suppliers will be able to centrally monitor and share information about the quantity and quality of milk, which will minimize financial loss and make it easier for food and standard institutions to remotely verify the purity of the milk that traders are selling to customers. Ineffective communication between business partners causes delays in service delivery, harms consumers' health, particularly that of youngsters, and costs milk sellers money. Through the web interface, the IoT gadget will alert the organization in control of quality standards as soon as the milk is diluted or tampered with. There is only one IoT device used for sampling.

Sabyasachi Mukherjee., et al. (2016) proposed "Design of a temperature control system using matlab for milk processing plant" In a company that manufactures food and uses milk as a main ingredient, heating milk is a common procedure. To supply milk to the downstream unit activities at the desired temperature and consistency, the temperature must be precisely controlled. It is possible to develop and manufacture a model of the heat exchanger and control loop using software instead of utilizing costly and time-consuming hardware. To tune the controller, however, this procedure requires an accurate model that considers the temperature dynamics along the whole length of the counter current heat exchanger. This research will use a CFD model to create a double-pipe heat exchanger and an experimental setup to validate the design. MATLAB (R2011a) will then be used to create a control loop that will regulate the valve to achieve the desired temperature.

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Carlos Calderon-Cordova., et al. (2018) proposed Pasteurization is a crucial step in the dairy business since it ensures the final product's flavor, yield, and quality. A temperature monitoring system is used in the project to monitor the pasteurization process in the small dairy sector. As a result, keeping an eye on the pasteurization process's temperature and duration is crucial. The quality of the final product and the security of the process operators are both severely impacted by manual monitoring. The goal of this project is to provide a portable, low-cost architecture for temperature monitoring in dairy product silos based on the prior issue. Based on the findings, a working prototype was created and assessed for the lactofino sector. The RTD sensor used in the prototype collects the data. Using an RTD sensor, the prototype gathers data, conditions it, visualizes it, and ultimately determines and notifies the operator of the process step where the dairy product is situated. When the temperature recorded by the prototype and a reference instrument were compared for evaluation, the largest absolute inaccuracy that could be found was 1° C.

Revathi R, Suganya M., et al. (2020) proposed "An Iot based Temperature Monitoring System for Industries and Transportations the Temperature" that can vary as high or low especially in Industries will cause discomfort to products and organizationThus, in order to track and measure the temperature in industries, we utilize temperature sensors. These sensors are fitted into a part that frequently causes problems because of overheating. The sensors make use of a GSM module to continuously update your personalized devices with the machine's and the environment's temperature. This project not only measures the temperature of the machinery and industry, but it also adjusts the temperature in accordance with the organization's needs by activating the nearby extinguishers or humidifiers. In the event of a serious fire, this can also transmit emergency signals to the fire department. Because these devices have a GSM module built in, they can also be utilized in transport systems to track a location and keep an eye on the surrounding temperature.

Setyawan P. Sakti., et al. (2021) proposed IoT-Based Temperature Monitoring for Milk Collection Tank in Remote Area. In order to attain good milk quality, which is indicated by lower bacterial content, it is vital to monitor the temperature of the milk collection tank in the mill collection plan. Within two hours of the last fresh milk input, the temperature in the tank needs to drop below 4 °C. Real-time remote monitoring and tank temperature visualization are made possible by the Internet of Things (IoT) for temperature measurement. This study describes a low-cost Internet of Things temperature monitoring system that makes use of readily accessible electrical modules. The Internet of Things (IoT) system is built on a 2G wireless sensor network, which has a data rate and remote location. The electronic module, readily available mobile network, and cloud storage made it simple to put the Internet of Things into practice. According to the experimental findings, the designed system has a 0.14% error rate. The findings indicate that it is feasible to deploy an Internet of Things monitoring system in a remote location in order to increase data availability.

III. SYSTEM ARCHITECTURE

➢ *Hardware Components and Architecture*

The components used in this study are a microcontroller (NodeMCU). It also includes a temperature sensor(DS18B20), a lcd display(16X2), three LEDs, some jumper wires, resistors(330 ohm, 4.7k ohm), Dot PCB board, PN junction diode and a few other pieces that are required during assembly.

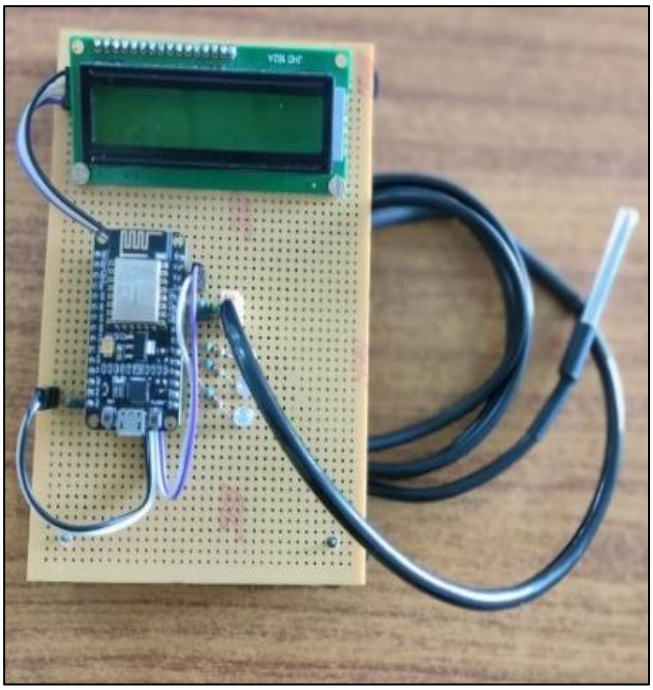

Fig 1 Picture of Prototype

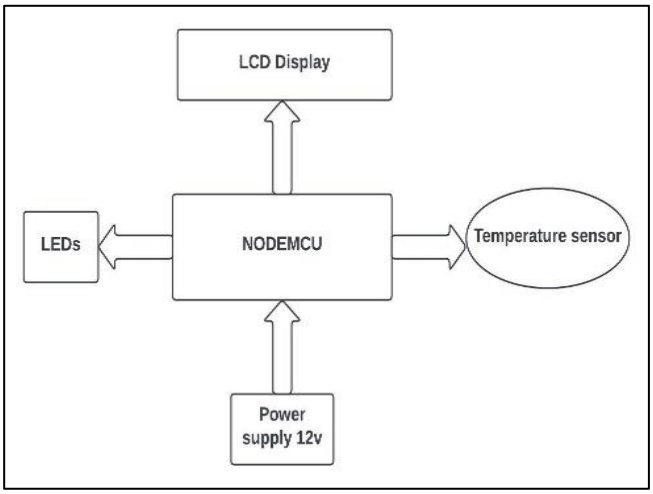

Fig 2 Overview of the Model

The power source for the prototype is 5v adapter which is constant in its current rating. Then the power requirement for the display ,leds and the temperature sensor is distributed from the micro controller.To prevent the short circuits diodes are used to maintain the polarity.Leds are connected with resistors to prevent over voltage.

Together every components is assembled in a dot pcb board.

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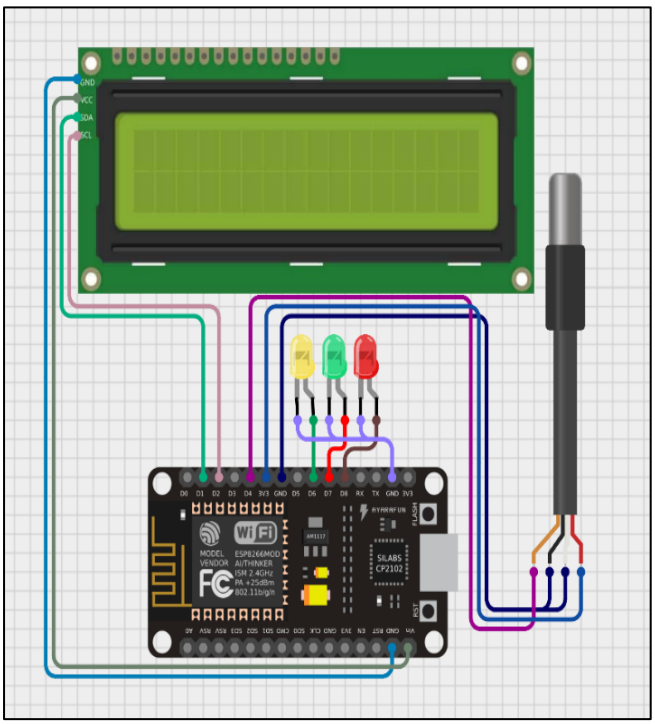

Fig 3 Circuit Diagram

➢ *Software Components*

Arduino IDE: It is an open source environment which is used to program any kind of Arduino boards.The users can directly implement the code and can directly upload the code to corresponding board with the requirement of external plugins. A C++ language variation is utilized by Arduino, together with other techniques and features to create a reliable system. The IDE composed of many libraries which can be installed as it reduces the time for the user to create a library manualy.s

IV. METHODOLOGY

The project is designed with the help of a microcontroller Node MCU to read the input values from the sensors. It will process the values make decision according statements provided. According to the sensor values the node MCU will send a SMS. The system incorporates the DS18B20 sensor to provide precise temperature readings. NodeMCU is the controller utilized in this project and it is used to control every module in the circuit. The NodeMCU board and the DS18B20 sensor are connected to create physical connections. LCD will display the temperature readings and display the status of the alert message. Blynk will also display the live readings of the medium. The LED bulb also glow to show the status of the process.

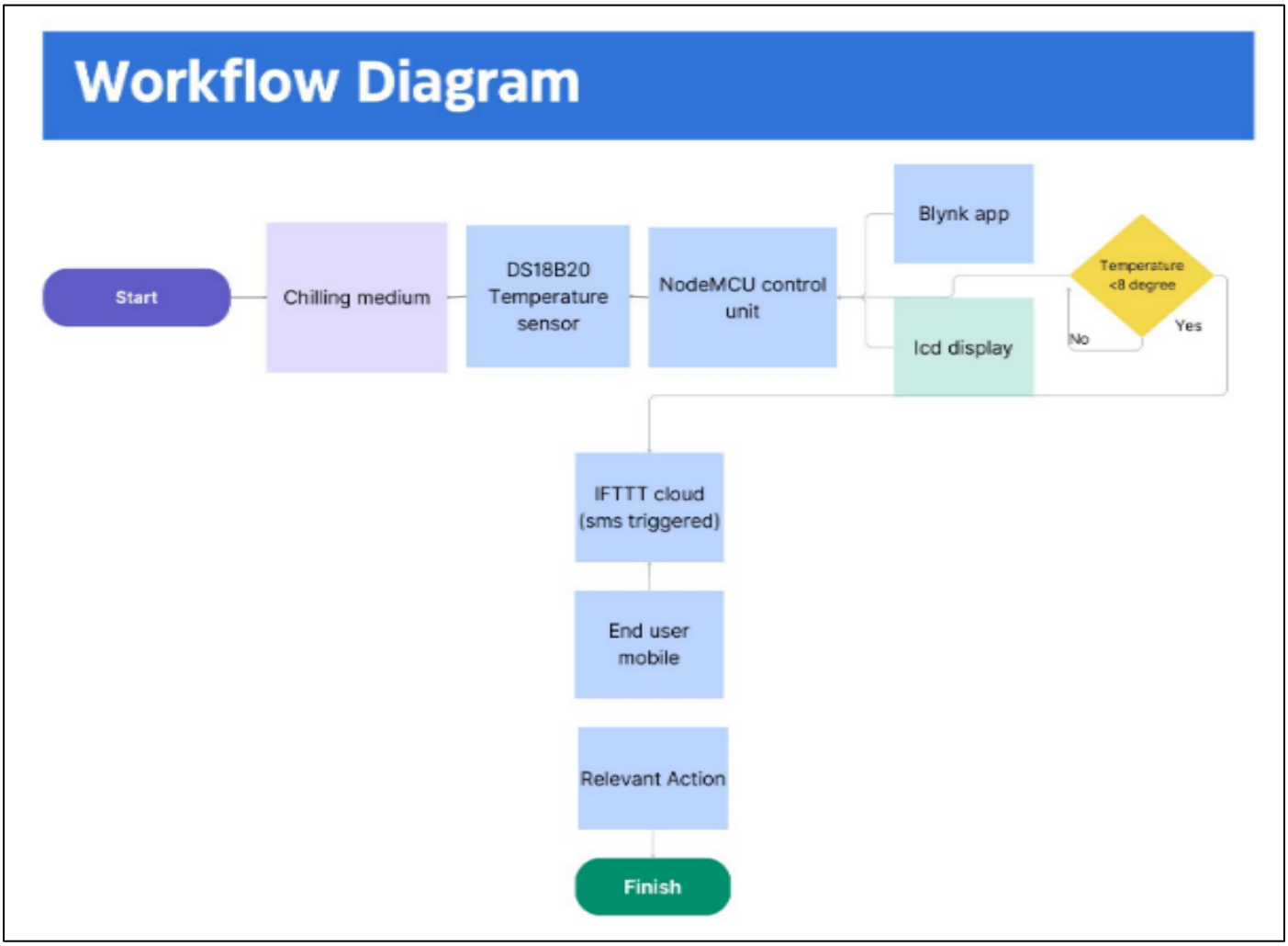

Fig 4 Workflow Diagram

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➢ *Communication Technologies*

The temperature reading is continuosly monitored by the microcontroller when it reaches above the limit an event is triggered in the IFTTT cloud platform. The live data is feeded to the blynk application where a Celcius meter shows the temperature.

- *IFTT*

The well-known web site IFTTT, which stands for "If This, Then That," enables users to construct straightforward conditional statements, or "applets," to automate a range of operations and processes across many web services and devices.

- *Blynk*

Blynk is a well-known Internet of Things (IoT) platform that lets users create and manage IoT applications through a mobile application. It offers an easy-to-use interface for remote device control and the creation of personalized dashboards.

V. RESULTS

The temperature sensor frequently transfers the temperature points to the NodeMCU board. When the temperature level is increased above 8^{0}C the alert event created in IFTTT is automatically triggered. The alert SMS will be sent to the end user one time with real time readings. If the temperature is not reduced the remainder alert is sent at frequent times of interval like 30 minutes until the user see. The temperature readings are displayed in the LCD display by using I2C module. Moreover, the led bulb glows to display the status. The RED, GREEN and YELLOW bulbs are used to indicate the current running state of the process. Red led glows when the temperature is above the required level. Green led glows when the temperature is at the required level. The user's mobile device can display the real-time readings with the Blynk app. The LCD display and Blynk app integration made up the user interface, which made the experience easy to utilize. Real-time temperature updates were visible on the LCD, and Blynk allowed remote monitoring. The chosen interface elements effectively communicated temperature information.

➢ *Analysis Table*

Table 1 Analysis Table

TIMINGS	TEMPERATURE OF MILK	TEMPERATURE OF WATER
Before cooling(At the time of arrival)	27^{0}C	1^{0}C
After cooling	5^{0}C	3^{0}C
After 1 hour	5.5^{0}C	5^{0}C
After 2 hours	6^{0}C	7^{0}C
After 3 hours	6.5^{0}C	9^{0}C
After 4 hours	7^{0}C	11^{0}C
After 5 hours	8^{0}C	13^{0}C
After 6 hours	9^{0}C	15^{0}C

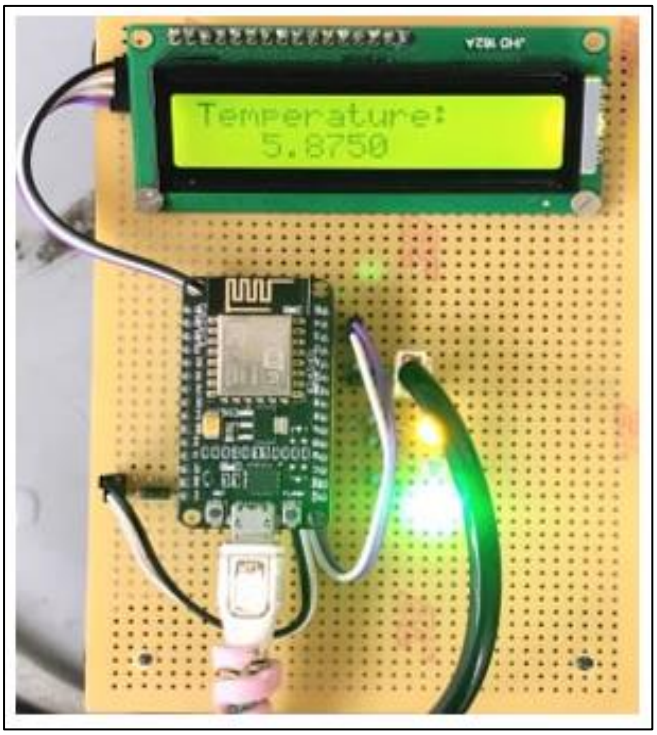

Fig 5 Required Reading and Led Status

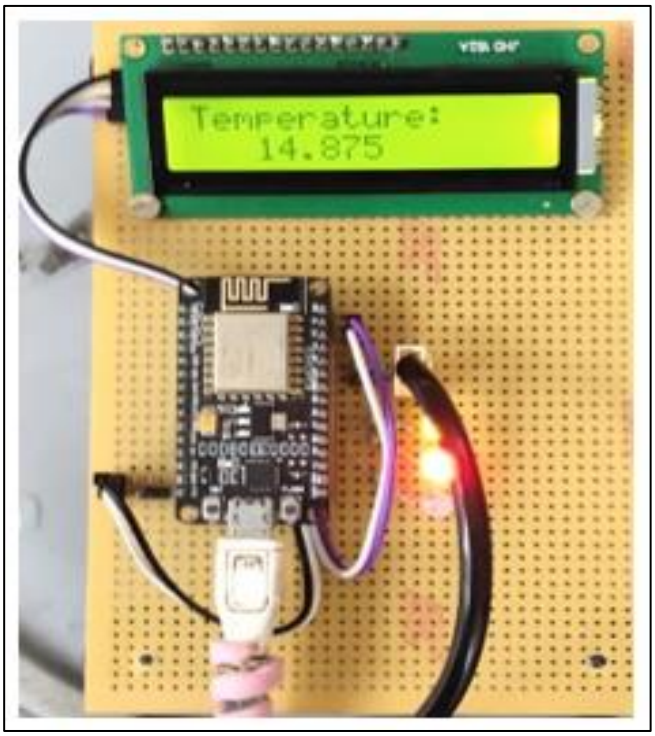

Fig 6 High Reading and Led Status

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The figure 5 represents the reading which is in the required level.So the green led shows that the reading level is normal.The figure 6 shows that the reading is high than the required level and the red led is got turned on.

VI. CONCLUSION

The results affirm the successful implementation of an IoT-based temperature monitoring system for the chilling process in the dairy industry. The combination of hardware components, connectivity, and user interface elements contributed to a robust and user friendly solution. The insights gained from testing lay the foundation for further enhancements and applications in temperature-sensitive industries. Future improvements may include calling mechanism, additional sensors, enhanced power management, and more sophisticated alerting mechanisms.

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