Volume 10, Issue 7, July – 2025 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul1153

A Smart Integrated System for Milk Collection & Dispensing

Akshitha Jangam[1*]; Lakshmi Nagaraju Kojja[1*]; Aneesh Ahamad Shaik[2]

[1]Department of Electronics and Communication Engineering, Rajiv Gandhi University of Knowledge Technologies (IIIT), S.M. Puram, Etcherla, Srikakulam, Andhra Pradesh – 532402, India
[2]Department of Electrical and Electronics Engineering, Rajiv Gandhi University of Knowledge Technologies (IIIT), S.M. Puram, Etcherla, Srikakulam, Andhra Pradesh – 532402, India

Corresponding Author's: Akshitha Jangam[1*]; Lakshmi Nagaraju Kojja[1*]

Publication Date: 2025/07/26

Abstract: The dairy industry faces significant challenges in ensuring fair pricing for farmers, maintaining milk quality, and providing convenient access for consumers. Traditional milk collection systems often rely on manual testing, fixed pricing, and delayed payments, leading to financial losses and inefficiencies. This paper proposes an IoT-enabled smart milk collection and vending system that integrates real-time milk quality assessment, automated pricing, and digital transactions. The system uses sensors to analyze key milk parameters such as fat content, SNF (Solids Not Fat), pH, and temperature, ensuring transparent pricing based on both quality and quantity. A cloud-based payment system allows for instant transactions to farmers, eliminating the need for middlemen and enhancing financial security. Additionally, the system includes smart storage units with automated dispensing mechanisms, enabling consumers to purchase milk using RFID cards, mobile wallets, or UPI payments. Implementation of this system can be managed by government bodies, dairy cooperatives, or private enterprises, ensuring efficiency, transparency, and accessibility. Future advancements may include AI-driven milk quality prediction, blockchain-based payment security, and the expansion to other dairy products. This smart system has the potential to revolutionize milk collection, payment processing, and consumer accessibility, creating a sustainable and technology-driven dairy ecosystem.

Keywords: *IoT, Smart Dairy System, Milk Quality Analysis, Automated Payment, Digital Transactions, RFID-Based Vending, Milk Collection Automation, Dairy Supply Chain, Fat & SNF Detection, Cloud-Based Payment, Smart Storage, AI in Dairy, Blockchain in Dairy, Real-Time Quality Assessment, Farmer Empowerment.*

How to Cite: Akshitha Jangam; Lakshmi Nagaraju Kojja; Aneesh Ahamad Shaik (2025) A Smart Integrated System for Milk Collection & Dispensing. *International Journal of Innovative Science and Research Technology*, 10(7), 2072-2076. https://doi.org/10.38124/ijisrt/25jul1153

I. INTRODUCTION

The dairy industry is vital to the global agricultural economy, serving as a primary source of income for millions of farmers. However, traditional systems for collecting and distributing milk are plagued by inefficiencies, including manual quality testing, delayed payments, and a lack of transparency in pricing. Farmers often incur financial losses due to inconsistent methods of quality assessment and the involvement of middlemen who control the payment process. Additionally, consumers face challenges in accessing fresh and hygienic milk through reliable vending options

To tackle these challenges, we propose an IoT-enabled smart milk collection and vending system that integrates real-time quality assessment, automated pricing, digital payments, and smart storage solutions. This system ensures that farmers receive fair and instant payments based on the milk's fat content, SNF (Solids Not Fat), pH level, and temperature. By eliminating middlemen and automating transactions, the system enhances transparency and provides financial security for farmers.

For consumers, the system offers automated vending units where fresh milk can be purchased using RFID cards, UPI payments, or mobile wallets. This approach reduces reliance on traditional retail supply chains and guarantees the availability of hygienic, high-quality milk. Furthermore, the system can be implemented by government bodies, dairy cooperatives, or private enterprises, making it scalable and adaptable to different regions.

The proposed system utilizes IoT, cloud computing, and digital payment solutions to develop a sustainable, transparent, and efficient dairy ecosystem. Future enhancements will incorporate AI-based milk quality

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul1153

prediction, blockchain technology for secure transactions, and the expansion into other dairy products, such as yogurt and cheese. This paper examines the design, implementation, and potential impact of the proposed system on the dairy supply chain.

The study titled "IoT-Based Automatic Billing and Milk Quality Management System" (IRJET, 2023) proposes an innovative system that utilizes Internet of Things (IoT) technology for analyzing milk quality and managing billing processes. This system employs sensors to measure key parameters such as fat content, Solids-Not-Fat (SNF), and pH levels. The data collected is then used to automatically calculate the price based on predefined quality standards. The research highlights that integrating IoT with real-time monitoring and automated payment systems can significantly reduce fraud and enhance efficiency in dairy collection centres. Ultimately, this system promotes fair pricing and minimizes the need for human intervention in milk procurement.

Additionally, the smartAMCU (Automatic Milk Collection Unit) developed by Stellapps is an Android-based IoT device designed to capture real-time data regarding milk quality, quantity, and procurement details. This system integrates with a payment gateway, facilitating instant payments to farmers based on the quality and volume of their milk. By automating both data collection and financial transactions, the smartAMCU enhances transparency and efficiency within the dairy supply chain.

II. PROPOSED SYSTEM

The proposed system aims to automate the processes of milk collection, quality assessment, storage, and dispensing, all while ensuring fair pricing and secure digital transactions. It consists of two main components: the milk collection system for farmers and milk providers, and the milk dispensing system for customers. This system integrates IoT-based sensors, RFID authentication, automated payment systems, and real-time monitoring to enhance efficiency, transparency, and quality control.

A. Milk Collection System

The milk collection system enables farmers to deposit their milk easily while ensuring real-time quality assessment and instant payments. The process begins with authentication using RFID technology, where the farmer scans their RFID card at the collection station. The system retrieves the farmer's account details from the database.

Once authenticated, the farmer pours the milk into a collection chamber, and a weighing sensor measures the exact quantity of the deposited milk.

After measuring the quantity, the system conducts a quality assessment using IoT sensors. Various sensors analyze several parameters of the milk, including pH levels, temperature, gas emissions, density, and conductivity. A pH sensor detects the freshness of the milk, while a temperature sensor ensures that the milk remains within a safe storage range. A gas sensor identifies spoilage gases, and an ultrasonic density sensor measures the density of the milk to detect potential dilution. Additionally, a conductivity sensor helps identify adulteration, such as the presence of added water or chemicals.

Once the quality assessment is complete, the milk is either accepted or rejected based on predefined quality standards. If the milk passes the quality check, it is transferred to a storage tank equipped with a cooling mechanism to maintain freshness. If the milk fails the quality check, it is rejected, and the farmer is notified about the issue. The system then calculates the price of the milk based on both quality and quantity. Payment is processed automatically, and the amount is credited directly to the farmer's bank account.

Farmers can view the status of the milk, quantity, quality assessment details, and payment confirmation on a digital display. Finally, to complete the process, the farmer scans their RFID card again to log out of the system.

B. Milk Dispensing System

The milk dispensing system allows customers to automatically purchase fresh milk from a smart vending machine. The process begins when the customer scans their RFID card to log in. The system retrieves their account details from the database, enabling them to proceed with the transaction. After logging in, the customer can select the desired quantity of milk. The system then checks the available stock in the storage tank to ensure that the requested quantity can be dispensed.

If there is enough milk available, the vending machine dispenses it into a sterilized glass bottle. If the requested quantity exceeds the available stock, the customer will receive a notification about the shortage. Once the milk is dispensed, the system automatically calculates the price based on the quantity purchased. The corresponding amount is then debited from the customer's linked account, and a receipt is printed for reference. To complete the transaction, the customer needs to scan their RFID card again to log out of the system.

C. Integration with the Dairy Industry

To ensure smooth supply chain management, the storage tanks at collection centers are connected to the main storage tanks in dairy industries. This integration enables automated and efficient bulk milk transfers, ensuring a continuous supply of high-quality milk to processing units.

➢ *Key Components to be used:*

- *Microcontroller (ESP32):*

Processes data from sensors, handles authentication, and manages transactions. Acts as the system's brain for automation. Ensures real-time operation

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul1153

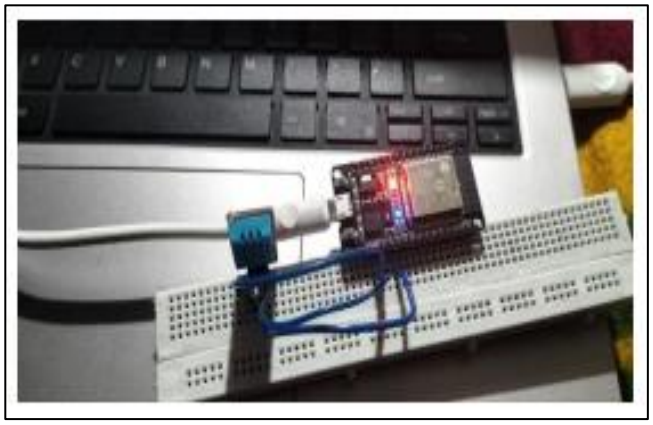

Fig 1 ESP32

- *RFID Module:*

Used for authenticating farmers and customers. Farmers log in before depositing milk, and customers use it for secure transactions. Ensures traceability and access control

Fig 2 RFID Module

- *Weighing Sensor:*

Measures the exact quantity of milk deposited by the farmer. Helps in calculating payments accurately based on weight. Prevents fraud and ensures fairness.

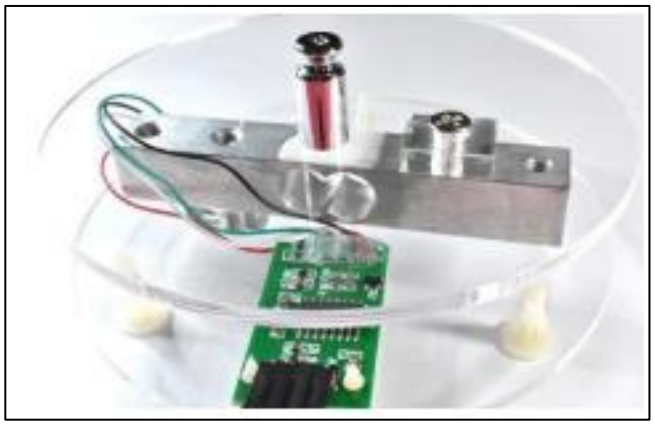

Fig 3 Weighing Sensor

- *pH Sensor:*

Determines the freshness and acidity of milk. A deviation in pH values can indicate spoilage or adulteration. Helps in maintaining quality standards.

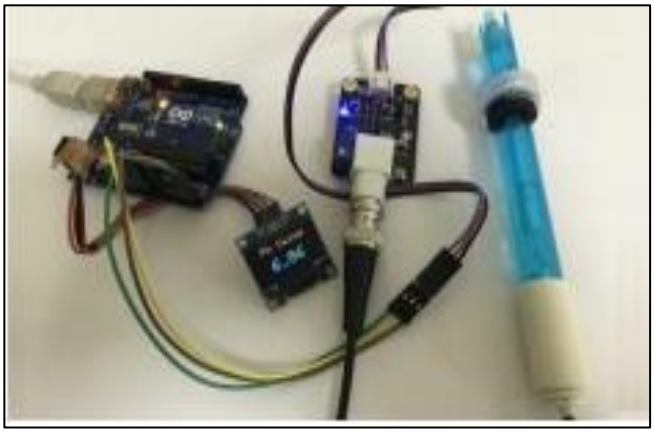

Fig 4 pH Sensor

- *Temperature Sensor (DS18B20):*

Monitors milk temperature in collection and storage tanks. Ensures optimal cooling to prevent spoilage. Alerts the system in case of temperature variations.

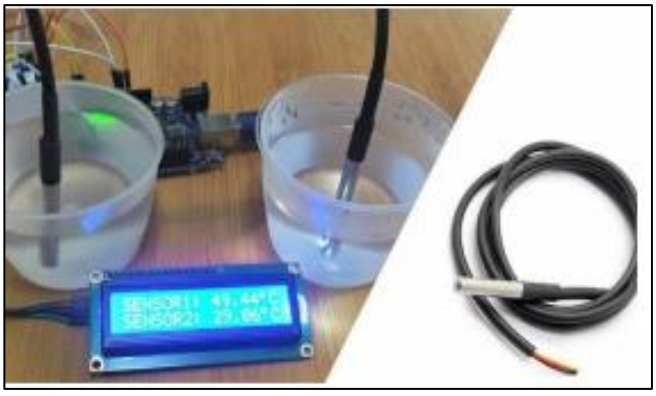

Fig 5 Temperature Sensor (DS18B20)

- *Gas Sensor (MQ Series):*

Detects gases released due to milk spoilage. Identifies microbial contamination early. Prevents unhealthy milk from being stored or sold.

Fig 6 Gas Sensor

- *Ultrasonic Density Sensor:*

Measures milk density to check for adulteration (e.g., water dilution). Ensures milk purity and compliance with industry standards. Helps in detecting fraud.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul1153

- *Conductivity Sensor:*

Detects impurities or added substances like salt and chemicals. Any variation in conductivity indicates potential adulteration. Helps maintain milk integrity.

Fig 7 Conductivity Sensor

- *16x2 LCD Display:*

Displays milk quality, quantity, and pricing details. Provides an interactive interface for farmers and customers. Enhances user experience.

Fig 8 LCD Display

- *Relay Modules:*

Control milk flow between collection chambers, storage tanks, and dispensing units. Automates the milk transfer process. Enhances efficiency and accuracy.

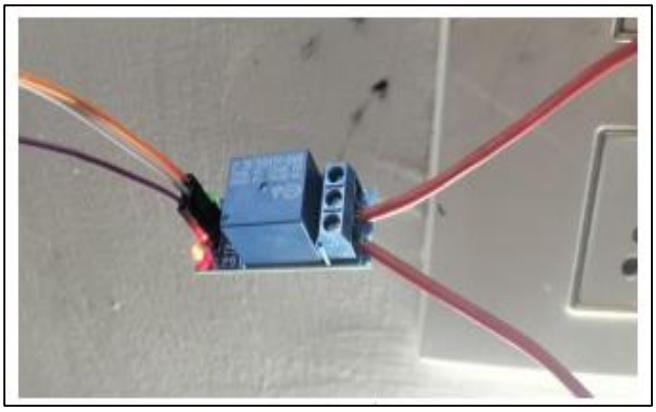

Fig 9 Relay

III. METHODOLOGY

The proposed IoT-based milk collection and vending system operates through a structured methodology to ensure automated, transparent, and efficient milk procurement and distribution.

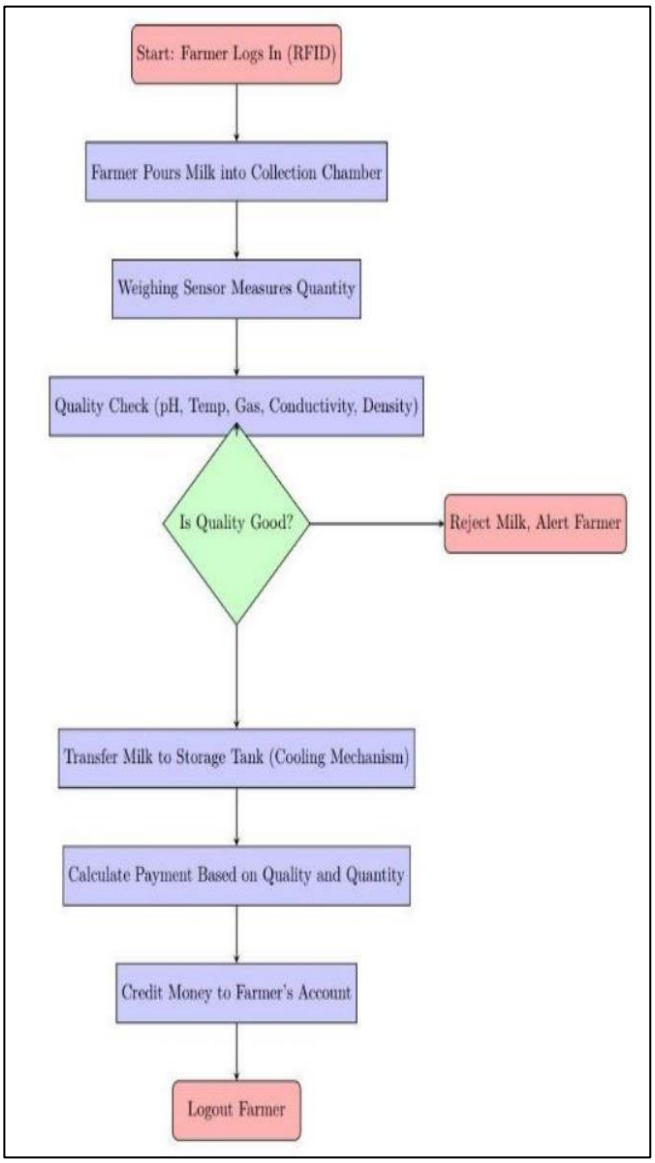

Fig 10 Flowchart for Milk Collection System

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul1153

The process begins with farmers logging into the system using RFID authentication. Once authenticated, they pour milk into the collection chamber, where various sensors—including pH, temperature, gas, ultrasonic density, and conductivity sensors—assess its quality in real-time. At the same time, a weight sensor measures the exact quantity of milk supplied. If the milk meets the predefined quality standards, it is transferred to a cooling storage tank to maintain its freshness. The system then calculates the price based on both quality and quantity, and the payment is automatically credited to the farmer's account. Before logging out with RFID, the farmer can view the transaction details, including the milk's quality, quantity, and earnings.

The vending system allows customers to log in using their RFID cards. Customers can specify the desired quantity of milk, which is then dispensed from a storage tank through a flow sensor that ensures accurate measurement. The system automatically deducts the corresponding amount from the customer's account, and a thermal printer generates a receipt for the transaction. The details of the transaction are displayed on an LCD screen for confirmation, and the customer logs out after completing the purchase.

The storage tanks are linked to a central dairy processing unit, ensuring efficient milk management. Additionally, the entire system incorporates IoT technology for real-time monitoring, secure digital transactions, and automated quality control. This significantly reduces the need for human intervention and enhances overall operational efficiency.

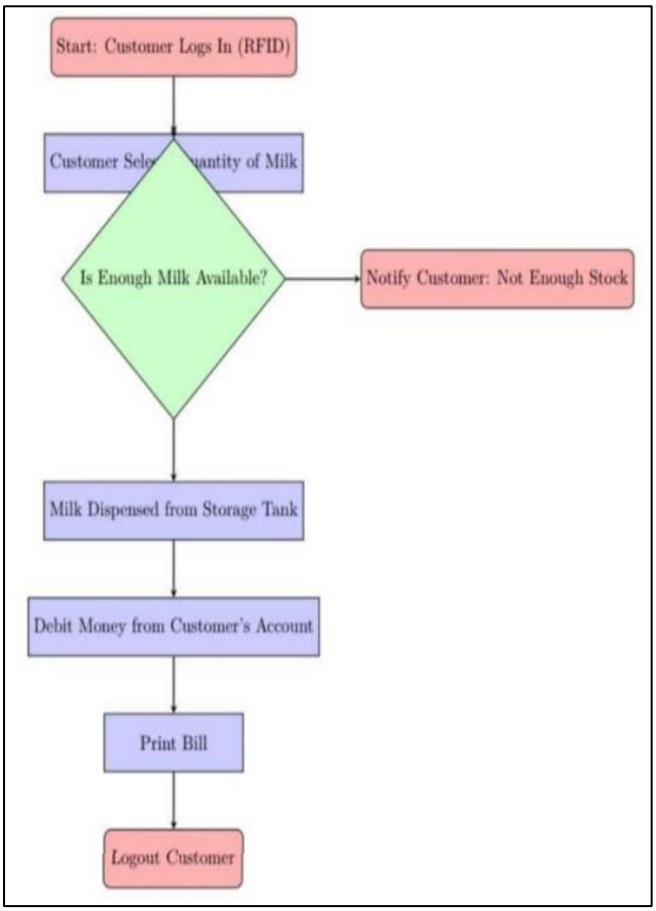

Fig 11 Flowchart for Milk Dispensing System

IV. CONCLUSION

The proposed IoT-enabled Milk Collection and Dispensing System guarantees a fair, transparent, and efficient dairy supply chain by incorporating automated quality assessment, digital payments, and smart storage mechanisms. This system removes middlemen, ensuring that farmers receive instant and equitable payment based on the quality and quantity of the milk they supply. By utilizing real-time sensors, the system identifies milk adulteration and spoilage, ensuring that only high-quality milk reaches consumers.

FUTURE SCOPE

Future advancements in this system will focus on enhancing biometric authentication. Power efficiency can be improved using solar-powered backups and intelligent battery management for uninterrupted operation.

REFERENCES

[1]. IoT-Based Automatic Billing and Milk Quality Management System, *International Research Journal of Engineering and Technology (IRJET), 2023.*
[2]. IoT-Based Automatic Milk Collection Unit (AMCU) *"SmartAMCU by Stellapps: An IoT-Based Milk Procurement and Quality Monitoring System," Stellapps, 2023".*
[3]. Sharma, P., & Verma, K. (2020). *"Application of IoT in Smart Dairy Farming and Automated Milk Collection Systems," IEEE Transactions on Agriculture and Food Processing.*
[4]. Singh, R., et al. (2021). *"A Sensor-Based Approach for Automated Milk Quality Analysis and Adulteration Detection," Elsevier Food Science Reports.*
[5]. Digital Payment and Smart Vending Machines Zhang, L., et al. (2021). *"RFID and Digital Payment Integration in Smart Vending Machines: A Case Study in Dairy Retailing," Springer IoT Journal.*
[6]. Gupta, M., & Nair, A. (2022). "Smart Cooling Systems for Milk Storage Using IoT Sensors," International Conference on Smart Agriculture & Dairy Technologies.
[7]. Choudhary, D., & Mehta, P. (2023). "Solar-Powered IoT-Based Dairy Systems for Rural Implementation," Journal of Sustainable Agricultural Innovations