EFFECTIVE MILK GRADING AND BILLING FOR DAIRY INDUSTRY

Project Reference No.: *47S_BE_1623*

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Keywords:

IOT, Microcontroller, Transparency in billing, Machine Learning, Model Integration, Application development.

Introduction:

The dairy industry is a vital sector of agriculture, providing essential dairy products to consumers around the world. The traditional methods of evaluating milk quality have long been mired in labour-intensive, subjective processes, often prone to human error and inconsistency. In response to these challenges, this project presents a solution aimed at transforming milk quality assessment and management through the integration of hardware and software technologies. The proposed system offers a comprehensive and automated approach to monitor milk quality in real-time, enhance billing transparency, and provide insights for optimizing production efficiency. The proposed solution consists of advanced sensors, including pH, temperature, color, and fat content sensors, meticulously integrated into a cost-effective device tailored specifically for dairy farmers. This device not only ensures accessibility but also delivers reliable and standardized data, empowering farmers to make data-driven decisions regarding milk production and quality assurance. Augmenting the hardware components is an intuitive mobile application, granting farmers and stakeholders instantaneous access to real-time milk quality data. Through this mobile application users can effortlessly monitor and manage their dairy operations, identifying trends, detecting deviations, and implementing proactive measures to uphold milk quality standards. The proposed solution incorporates transparent billing mechanisms, fostering trust and accountability across the dairy supply chain. By generating precise invoices based on objective milk quality metrics, this feature promotes equitable compensation for farmers while instilling confidence in consumers regarding the integrity of the products they purchase.

Objectives:

The objectives of the project are to

(a) Automate Quality Assessment: Develop an automated system to assess milk quality using parameters like pH, color, fat, and temperature. This technology-driven approach will replace manual methods, ensuring consistent and accurate evaluations.

(b) Real-time Information: Create a user-friendly mobile app for stakeholders to access real-time milk quality data. The app will provide detailed information on milk grade, quantity, and cost, empowering dairy farmers and processors to make informed decisions.

(c) Transparent Billing: Implement a transparent billing system that generates clear invoices based on milk quality metrics, reducing disputes and fostering trust between dairy farmers and processors.

(d) Data Analysis: Develop robust data analysis and reporting capabilities to identify milk quality trends over time. This analysis will help stakeholders optimize production processes and enhance overall efficiency and productivity.

Methodology:

(a) Data Acquisition and Sensing:

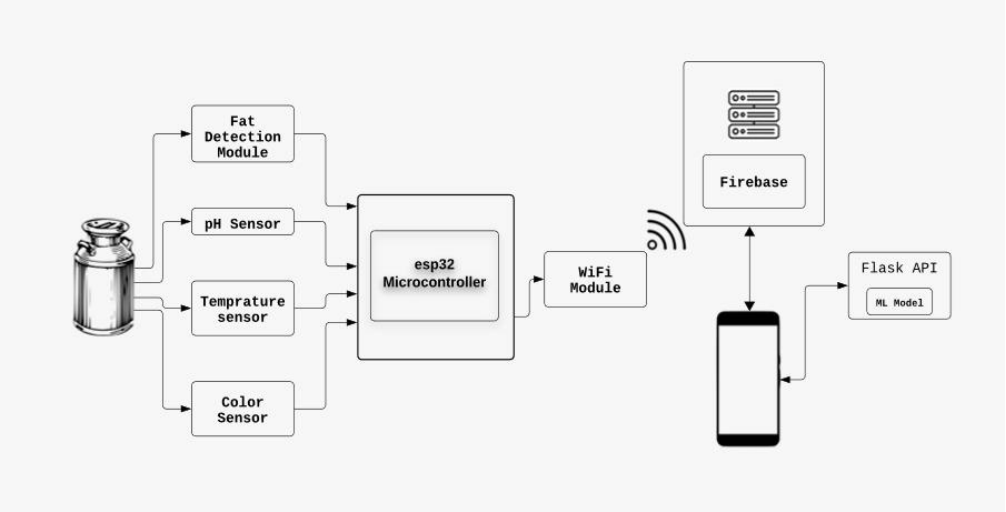
In the first phase of the project, the primary focus is on measuring the quality of milk using a combination of electronic sensors and an ESP32 microcontroller system. Several sensors, including a pH sensor for acidity measurement, a color sensor for assessing milk color, a temperature sensor for monitoring temperature, LED and LDR sensor to measure fat. The ESP32 serves as the central processing unit, responsible for acquiring data from these sensors and executing calculations to determine qualitative parameters.

(b) Quality Calculation and Grading: Assessing Milk Quality:

Using parameters like pH, Fat, and color an algorithm grades milk as A, B, or C quality. pH indicates freshness, Fat richness, and color purity. Grade A meets all criteria, while Grade C indicates deviations. This systematic approach ensures accurate milk quality assessment for informed decision-making. This data is sent to the mobile device through Bluetooth of ESP32.

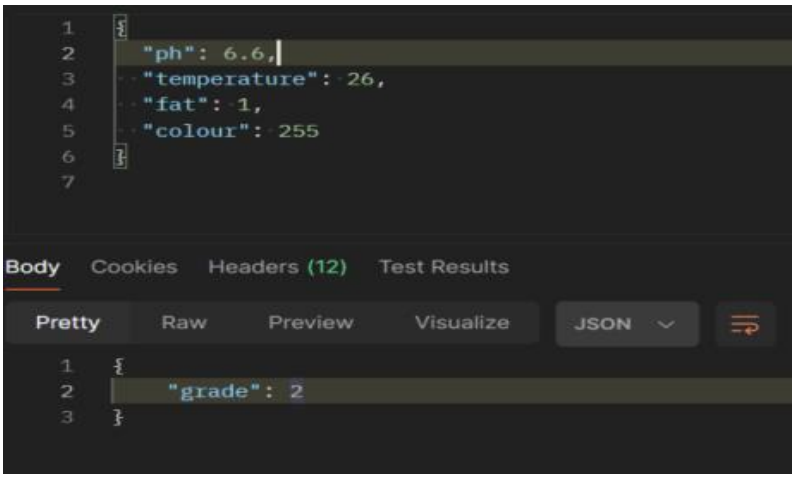
(c) Receiving, Display, and Analysis Data:

In this phase, a user-friendly mobile app is developed using Flutter, enabling easy access to real-time milk quality data sent by the ESP32 microcontroller via Bluetooth. Users can monitor pH and temperature on their smartphones. The app integrates with Firebase for data storage and management, encompassing milk quality parameters and user details. Providing comprehensive milk quality assessment, the app ensures users stay informed with timely updates.



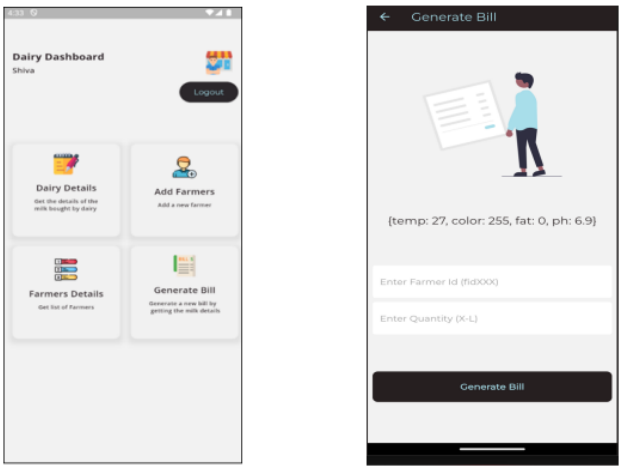
Conclusion:

The effectiveness of our milk quality assessment system, which integrates electronic sensors such as pH sensors, temperature sensors, color sensors, Light Emitting Diodes (LEDs), and Light Dependent Resistors (LDRs) for assessing various milk quality parameters.This system successfully calculates milk fat content and other quality parameters, facilitated by the real-time processing of data through a microcontroller. Additionally, our algorithm grades milk into categories such as Grade A, B, or C based on parameters indicating milk freshness, fat richness, and color purity,



Grade calculated from ML Model

ensuring objective and consistent assessment. The integration of these components, alongside a user-friendly mobile application providing real-time access to milk quality data and billing information, enhances accessibility and efficiency in dairy operations, contributing to improved productivity and sustainability in the dairy industry. The effective milk grading and billing solution for dairy industry presents a transformative solution for the dairy industry,offering advanced capabilities in milk quality assessment and management.



User Interface of the Application

By leveraging sensor technology, data processing, and machine learning integration, the system enables accurate measurement and analysis of various parameters crucial for determining milk quality, eliminating the need for manual testing and reducing the chances of errors. Integration with a mobile application provides dairy owners and farmers with convenient access to essential features such as milk transaction management and quality monitoring. The system's real-time quality display empowers immediate insights, facilitating informed decision-making and enhancing operational efficiency. The effective milk grading and billing solution for dairy industry promises to revolutionize dairy management practices, contributing to improved productivity and profitability in the industry. This can lead to a more effective and streamlined management process, ultimately benefiting both the farmer and organization.

Scope for future work:

The refinement and optimization of sensor technologies could improve the accuracy and reliability of milk parameter measurements, with a focus on additional parameters like Corrected Lactometer Reading (CLR) and Solids-Not-Fat (SNF). This enhancement would provide a more comprehensive assessment of milk quality. Additionally, the development of machine learning algorithms could significantly enhance milk quality assessment capabilities by incorporating advanced techniques for more precise predictions. These algorithms can analyze large datasets to identify patterns and correlations, leading to more accurate and reliable results.

Integration with additional dairy management features and functionalities could further expand the system's utility, catering to a wider range of user needs. This holistic approach would allow for seamless synchronization of milk quality data with other aspects of dairy operations, such as herd health monitoring and feed optimization. Enhancing the user interface and experience of the mobile application is also crucial, as it could greatly improve usability and accessibility for dairy owners and farmers. Features like intuitive design, multilingual support, and customizable dashboards can make the system more user-friendly.

Gathering insights for iterative improvements is essential to ensure that the system meets the evolving requirements and expectations of stakeholders. Regular feedback from users can provide valuable information for continuous development and adaptation. By addressing these areas of future work, the effective milk grading and billing solution for the dairy industry can continue to evolve and adapt to the dynamic landscape of dairy management. Ultimately, this will deliver greater value to users, making the system an indispensable tool in the technological advancement of the dairy industry.