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DAIRYLEDGER: A COST-EFFECTIVE MOBILE APPLICATION FOR DAIRY BILLING AND ANALYTICS

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ABSTRACT
Dairy farming is vital to India's rural economy, with most milk producers being smallholders managing a few animals. However, manual billing processes, reliant on pen-and-paper and manual calculations, are time-consuming and prone to errors. Existing desktop-based solutions are costly and inaccessible to small-scale stakeholders.DairyLedger addresses these challenges with a cost-effective Android application that automates fat-based billing, organizes weekly invoices, and provides real-time analytics. Built using Flutter and sqlite, it simplifies milk procurement, reduces errors, and enhances financial transparency, empowering smallholders and milkmen in the dairy sector.
Keywords: Milk procurement, Firebase, Flutter, Deep Links

I. Introduction

Dairy farming is a cornerstone of India's rural economy, providing a primary source of income for millions of households. As the largest milk producer globally, India generates approximately 91 million tonnes of milk annually, with around 60% of this production marketed. However, milk production remains largely a small-scale activity, with most farmers maintaining only one or two cattles. These smallholders often face challenges such as low productivity, limited access to modern resources, and inefficient milk procurement systems. The milk procurement process, vital for linking farmers to larger markets, involves the collection of milk, often through milkmen, who operate on slim profit margins and rely on manual methods for record-keeping and billing.

The unorganized nature of the dairy sector, which accounts for 78% of marketed milk, exacerbates inefficiencies in the procurement and billing processes. To address these challenges, this paper introduces *DairyLedger*, a mobile application designed to modernize milk procurement billing. In addition to automating fat-based billing and organizing weekly invoices, the app can gather real-time data on milk production. This capability provides valuable insights in decision-making, improving supply chain management.

By reducing errors, saving time, and offering real-time analytics, *DairyLedger* empowers milkmen and small-scale farmers with an affordable, accessible, and scalable solution. Furthermore, the app contributes to the digital transformation of the dairy industry, promoting transparency, efficiency, and sustainability in milk procurement processes.

II. Literature

Dairy farming plays a critical role in India's agricultural sector, offering a steady income to millions of small-scale farmers and contributing significantly to the rural economy. The milk procurement process is given in the figure below.

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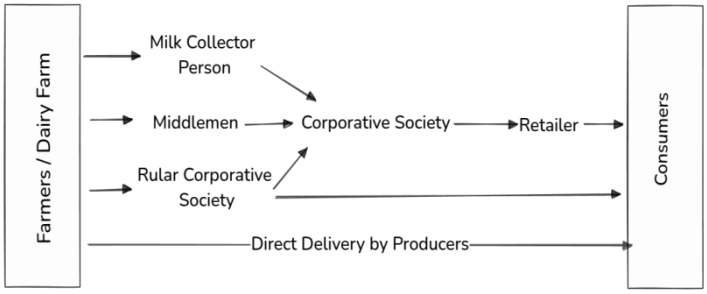

Fig. 1 The process of milk procurement

The procurement methods, are as follows:

- **Direct Delivery by Individual Producers**: Farmers located near milk collection centers deliver milk directly using their own vessels. This method is straightforward but limited to those living in close proximity.
- **Milk Collection through Cooperative Societies**: Cooperatives organize farmers into groups, ensuring fair returns and transparency. This method benefits producers but requires coordination and infrastructure.
- **Contract-Based Procurement**: Contractors collect milk from farmers at lower rates and supply it to processing plants. While it facilitates milk transport, it reduces profitability for farmers due to the presence of middlemen.
- **Organized Collection through Chilling Centers**: Milk is collected at village-level centers, tested for quality, and transported in bulk to processing plants.

The billing process in traditional systems is often manual, requiring milkmen to maintain daily records on pen and paper, which are prone to errors. Farmers receive their paychecks weekly after manual calculations of milk volume, fat content, and applicable rates. This process is time-consuming, labor-intensive, and susceptible to inaccuracies.

To address these challenges, technological advancements like the *DairyLedger* application streamline procurement and billing processes. The app allows for digital record-keeping, automatic rate calculations based on milk fat content, and generation of weekly bills. It also enables real-time sharing of bills and PDF exports, ensuring transparency and reducing manual errors. By leveraging such solutions, the dairy sector can improve efficiency, accuracy, and accessibility, particularly for small-scale farmers and milkmen.

III. Problem Statement

Milk procurement in India is a critical yet challenging process, especially for small-scale farmers and milk collectors operating in rural areas. Farmers often reside far from milk procurement centers, requiring milk collectors to visit their locations twice daily. Each milk collector typically manages records for 10-20 farmers, relying on manual pen-and-paper methods for daily records and billing. This approach is time-consuming, prone to errors, and inefficient, particularly during the weekly paycheck calculation, which involves extensive manual calculations.

While some applications exist to streamline these processes, they are predominantly desktop-based and prohibitively expensive for small-scale stakeholders with limited margins. Consequently, many milk producers and collectors lack access to modern, affordable solutions that could enhance efficiency and accuracy in billing and record-keeping.

The need for a cost-effective, mobile-based solution to simplify milk procurement, automate calculations, and provide real-time data insights is evident. This paper addresses these challenges by introducing *DairyLedger*, an Android application designed to modernize milk procurement billing processes, making them accessible, accurate, and efficient for small-scale farmers and milkmen.

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IV. Proposed Solution

The proposed solution, *DairyLedger*, is an Android-based mobile application designed to address the challenges in milk procurement and billing processes faced by dairy farmers and milk collectors. Unlike traditional desktop-based solutions, which are expensive and inaccessible for many rural communities, *DairyLedger* provides a cost-effective, user-friendly platform that can be accessed via smartphones, ensuring widespread adoption even in remote areas. The *DairyLedger* app is a comprehensive and user-friendly solution for streamlining milk procurement and billing processes. The following are the key features of the app:

- **Account Creation for Farmers**:Milkman can create and manage farmer accounts, keeping track of all users in the system.
- **Rate Management by Categories**: The different milk types (e.g.,cow, buffalo) can have set rates, which the app automatically applies based on the fat entered.
- **Weekly and Session-Based Billing**: Bills are organized by week and divided into morning and evening sessions for easier management of daily transactions.
- **Database Backup and Recovery**: The app ensures that all data is backed up and can be recovered in case of device failure.
- **Real-Time Bill Sharing and URL Generation**: Bills are shared instantly with farmers via the app or through a URL link for easy access.
- **Analytics and Insights**: The app tracks and shows trends in milk collection and earnings, helping users see important data in graphs.
- **PDF Report Generation**: At the end of the week, the app generates a PDF report of all bills, which can be easily shared or stored for records.

Together, these features offer an efficient, cost-effective, and accessible solution to modernize dairy operations, improving accuracy, transparency, and ease of use for small-scale farmers and milk collectors.

V. Implementation

The *DairyLedger* app is designed to simplify and automate the billing process for milk collectors and dairy farmers, with a focus on improving efficiency and reducing errors. Application is built using Flutter, the app integrates a variety of technologies to facilitate the management of milk procurement data, including user authentication, rate management, billing, and data sharing.

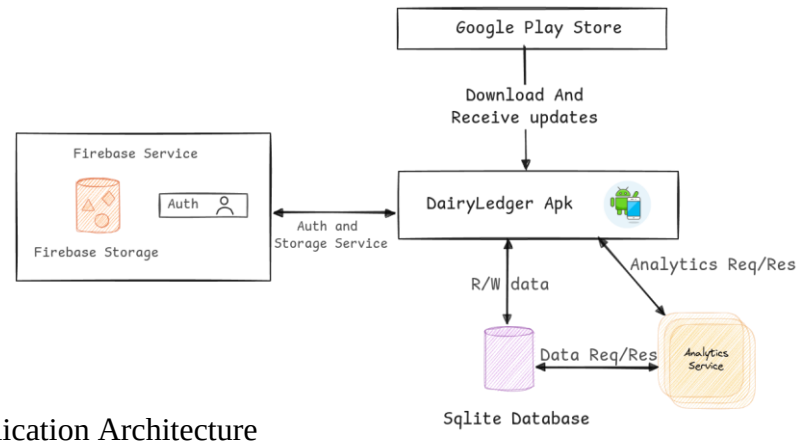

Fig. 2 Application Architecture

The image depicts the architectural design of the DairyLedger application. It illustrates how various components interact to provide a seamless user experience. The application is distributed through the Google Play Store, where users can download and receive updates. The DairyLedger Apk, runs on Android Devices and interacts with Firebase services for user authentication and data storage.

Firebase also serves as the platform for analytics, tracking user behavior and app performance. Additionally, the application utilizes a local Sqlite database for efficient data storage and retrieval, ensuring smooth operation even in offline scenarios. Thisarchitecture demonstrates a robust and scalable solution for the DairyLedger application.
The application navigation workflow and application states is described in below figure

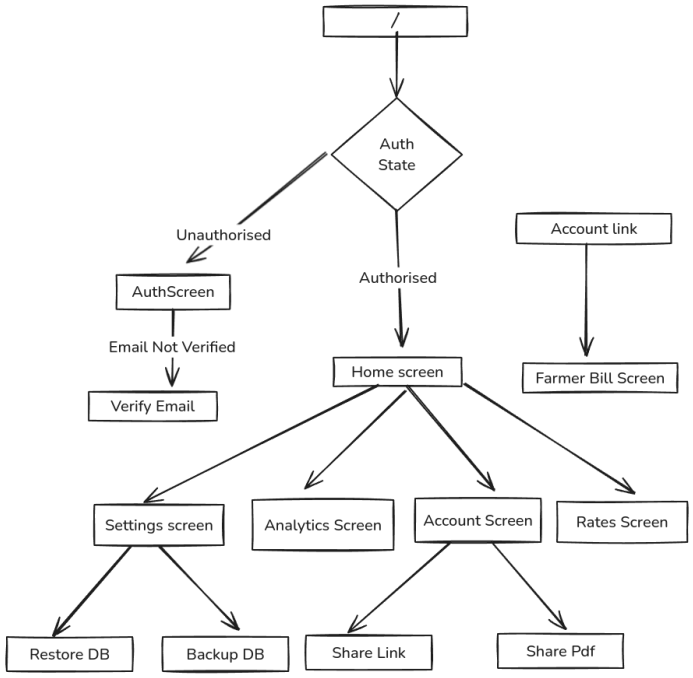

Fig. 3 Application user flow and navigation

The flowchart depicts the user flow within a dairy management application, commencing with user authentication. Unauthorized users are directed to the authentication screen, while authorized users gain access to the central hub - the Home Screen. From this point, users can navigate to various sections: Analytics Screen: Offers insights into dairy farm data, such as milk production trends and financial performance. Account Screen: Displays account details, enabling users to manage their accounts. Rates Screen: Provides information on milk rates and pricing. Settings Screen: Allows users to customize application preferences and includes options for database restoration and backup. Furthermore, the Home screen facilitates account linking, enabling users to manage multiple accounts within the application. Both the Account and Rates screens offer options to share information via links or PDFs, promoting collaboration and information sharing. This flow chart provides a comprehensive visual representation of the user's journey within the application, highlighting the various functionalities and navigation paths available.The breakdown of applications features details and implementation is given below

Account Creation : The app allows middlemen to securely create and manage accounts for milk collectors using Firebase Authentication for registration and login.Farmers Account creation to manage the accounts and bills

Key Libraries Used:

- firebase_auth: Manages user authentication and account creation for milkmens.
- firebase_core: Initializes Firebase services for authentication.
- sqflite : To manage the farmers account and their data related to billing and rates for the milk categories.
- firebase_ui_auth : Provides the UI for the authentication of milkmens

Rate Management : Milkmens can set and manage rates for different milk categories like cow and buffalo, with rates stored locally in a SQLite database, ensuring accurate billing based on fat content.
Key Libraries Used:

- sqflite: Stores rate data locally in SQLite databases.

Weekly and Session-Based Billing System : The app organizes billing into weekly cycles and separate morning and evening sessions, where the fat content entered by milk collectors determines the total bill using predefined rates.
Key Libraries Used:

- sqflite: Stores weekly and session-based billing data.

Backup and Recovery of Database : The app provides backup and recovery functionality, allowing users to save and restore their billing records in case of data loss or device failure.
Key Libraries Used:

- sqflite : Stores local database.
- path_provider : Provides access to device storage for backup files.
- share_plus : Share the database file to another location

Real-Time Bill Sharing via Deep Links : Firebase storage to store the data and the farmers can access the data using the deeplink implemented in application
Key Libraries Used:

- Firebase_storage: To store the data on cloud so farmers can access it
- Go_router : To implement the deep links for the farmers data screen

PDF Report Generation: At the end of each week, the app generates a PDF report summarizing milk collection, and payments, which can be shared with farmers for transparency.
Key Libraries Used:

- pdf: Generates PDF reports from the billing data.
- share_plus: To share the pdf with farmers

Routing and Navigation: The app uses GoRouter for managing navigation between different screens, providing seamless routing and better control over the app's flow.
Key Libraries Used:

- go_router : Manages routing and navigation within the app.

Data Analytics: Application uses fl_charts package to draw the charts to analyse the trends and sqlfile to access the required data.
Key Libraries Used:

- fl_chart : To draw the charts using which we can analysis the tends
- sqflite : To query the required data that is used for the analysis

These features collectively provide a comprehensive solution for streamlining milk procurement and billing processes while ensuring transparency, accuracy, and ease of use for both milk collectors and farmers.

VI. Result

The DairyLedger app has successfully streamlined the billing and record-keeping process for milk collectors and small-scale farmers in rural India. By digitizing weekly billing cycles, managing rates for different milk categories, and facilitating real-time bill sharing through deep links, the app has improved efficiency and reduced errors compared to manual methods. Additionally, the app allows for the generation of detailed PDF reports at the end of each week, providing transparency and better tracking of earnings and payments.

The app has been made available on the Google Play Store, making it easily accessible to rural users. The results from early adoption indicate a significant reduction in time spent on billing, as well as improved accuracy and faster communication between milk collectors and farmers. You can access the app here.

https://play.google.com/store/apps/details?id=com.dairyledger.app

VII. Impact

The DairyLedger app has had a positive impact on the dairy sector by reducing the challenges associated with manual billing and record-keeping. It has provided an affordable and accessible solution for milk collectors and farmers, especially in areas where traditional desktop-based applications were impractical. By automating rate management, billing, and report generation, the app has saved time, minimized errors, and increased operational efficiency.

The app's ability to share billing data in real-time has fostered transparency and trust between farmers and milk collectors. The analytics feature has empowered users with valuable insights into their earnings and milk collection trends, contributing to better decision-making. The app's adoption is likely to continue growing, further transforming the dairy sector by fostering digital literacy and offering a scalable solution to rural communities.

VIII. Conclusion

The DairyLedger app represents a significant step toward modernizing the dairy farming process in India, addressing long-standing issues of manual record-keeping and inefficiency. By leveraging mobile technology, it provides a cost-effective and scalable solution for milk collectors and small-scale farmers. The app not only simplifies the billing process but also offers added features like real-time bill sharing, PDF report generation, and analytics, making it an all-encompassing tool for managing dairy transactions.

The widespread adoption of this app could lead to greater financial transparency, higher efficiency, and improved livelihoods for millions of rural farmers. As the app evolves and more users embrace digital solutions, DairyLedger has the potential to become a cornerstone of rural digital transformation in India's dairy sector.

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