CowApp: Mobile Application for Livestock Farm Management Using RFID Technology

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Abstract: In the complex world of livestock farming, producers face daily tasks ranging from animal health and production management to record-keeping and documentation. Often, farmers must handle administrative tasks in addition to ensuring the welfare and performance of their animals.
The application, developed in React Native, is designed to simplify and optimize daily farm operations while ensuring mobile compatibility. It features an intuitive interface for centralized management of animal and farm data. The backend, built with Spring Boot using JPA and Hibernate, provides a robust and efficient system for data storage and processing. MySQL is used to ensure data integrity and security.
The application covers everything from detailed monitoring of animal health and production to replacing daily paper records, giving farm staff confidence that all essential information is available at any time. Additionally, through RFID technology, farmers can quickly access relevant animal data, receive notifications for medicine administration, and export information as PDF files.
In summary, the application not only simplifies data collection and management but also provides tools for informed decision-making. By generating charts and visual representations of production, health, and other key metrics, it allows for deeper analysis of livestock performance, helping farmers identify trends and make decisions to improve animal health and productivity.

1 Introduction

Livestock farming is a key sector in the Galician economy, especially in meat and milk production. In recent decades, the number of farms has sharply declined, while average farm size and output have increased IGE (2024); Ministerio de Agriculta,Pesca y Alimentacion (2023). Despite this reduction, milk production has risen by 64%, reinforcing Galician agriculture as a major contributor to the regional economy López-Iglesias (2019). This growth has been accompanied by greater automation and stricter regulations on traceability, food safety, and animal welfare Goberno de España (2003); Unión Europea (2019).

In this context, efficient information management becomes a crucial factor. Records such as veterinary treatments, withdrawal periods for milk and meat, individual animal identification, or reproductive events are mandatory and must always be available for inspection. Nevertheless, in practice, many of these processes are still carried out on paper or using digital tools that are poorly suited to the reality of small and medium-sized farms. This situation complicates decision-making and increases the risk of administrative or health-related errors.

Moreover, existing digital solutions are often designed for large-scale farms, involving high costs and technological requirements that are not easily accessible to much of the sector. Many

Galician farmers lack a simple and affordable tool capable of centralizing information and adapting to their daily routines, while offering an intuitive experience and compatibility with the mobile devices they already use.

The main motivation of this work therefore arises from the need for a practical tool that improves farm management without adding complexity or cost. The proposed solution is the development of a mobile application tailored to small and medium-sized farms, facilitating the recording and consultation of key data—such as animal health, medication administration, milk production, and reproductive events—while ensuring compliance with current regulations. The aim is to provide an innovative, accessible, and context-aware solution that contributes to the sustainability and modernization of the sector.

2 Objectives

Efficient livestock farm management increasingly relies on digital tools to reduce administrative burden, improve animal traceability, and support data-driven decision-making. In small and medium-sized farms, these processes are often manual and unstructured, hindering health and production monitoring and potentially causing economic losses or regulatory issues.

The main objective of this project is to develop a mobile application that centralizes and simplifies farm management, providing accessible, user-friendly records of key information. The app incorporates NFC/RFID identification and integrates with the official CIMAVET API to improve traceability and provide up-to-date veterinary medicine data.

Secondary objectives include:

- **Animal and health management:** centralized recording and consultation of animal information, health events, and treatments, with automatic monitoring of withdrawal periods.
- **Production and reproduction tracking:** recording milk production (distinguishing between milking shifts) and reproductive events such as matings, inseminations, and calvings.
- **Visualization and decision support:** intuitive charts and summaries for monitoring, analysis, and informed decision-making.
- **Data accessibility and reminders:** ensuring synchronized access to information and providing notifications for treatments or relevant events to prevent oversights and improve compliance.

3 System Architecture

The application is based on a client-server architecture, organized into two main components: the mobile **Frontend** and the server-side **Backend**. Both are connected to a **MySQL** database and to the official **CIMAVET** API (Ministerio de Agricultura, 2024), which provides updated information on veterinary medicines.

3.1 Frontend

The **Frontend** follows the MVVM (Model-View-ViewModel) pattern (Figure 1), ensuring a clear separation between the user interface, the presentation logic, and data management. This strategy facilitates maintenance and scalability of the mobile application, allowing changes in one layer without affecting the others. The development was carried out using **React Native**, leveraging TypeScript/JavaScript components and enabling deployment on both Android and iOS. Communication with the server is performed via HTTP requests in JSON format, using the **Axios** library.

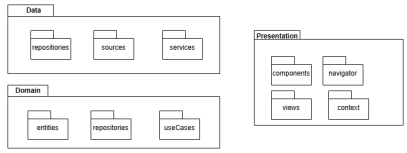

Figure 1: Simplified diagram of the Frontend architecture

3.2 Backend

The **Backend** is structured into several layers: REST services layer, business logic layer, and data access layer. This modular organization allows better scalability and maintenance, ensuring that changes in one layer do not affect the others (Figure 2). It was implemented in **Java** with **Spring Boot**, using **Spring Data JPA** and **Hibernate** for data persistence in a **MySQL** database. Dependency management was carried out with **Maven**, and system quality was ensured through unit testing with **JUnit**.

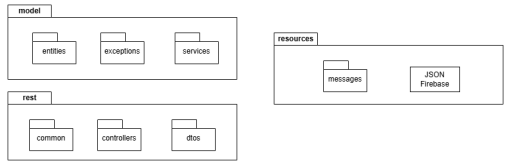

Figure 2: Simplified diagram of the Backend architecture

3.3 Integration and Communication

The system enables efficient centralization and management of information regarding animals, veterinary treatments, milk production, and reproductive events. Integration across the different layers and with CIMAVET[Ministerio de Agricultura (2024)] ensures up-to-date and consistent data, maintaining the robustness, security, and scalability required by the application (Figure 3).

The system also includes support for animal identification using NFC and RFID tags. These tags store a unique identifier for each animal, which can be read by the mobile device using its NFC reader. This integration allows the frontend to quickly access each animal's information and interact with the central database, improving efficiency in daily management and facilitating traceability without relying solely on manual data entry, while also reducing errors when consulting or adding information.

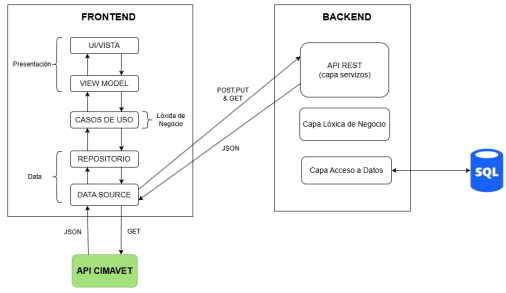

Figure 3: General architecture of the application

4 Results and Testing

To evaluate the usability and main functionalities of the application, internal functional tests were conducted, along with a preliminary validation oriented towards real-world usage. The results focus on the screens and workflows that best represent the value of the solution for farms.

4.1 Login and Animal List Screen

Access (Figure 4) is performed through a login procedure that leads the user to the list of farms and, upon selecting a farm, to the list of associated animals. This list allows viewing, searching, editing, and deleting animal records quickly and intuitively.

The animal list shows all animals in the farm with filtering and search options by identifier, ear tag, or other fields (see Figure 5), allowing access to each animal to consult or record relevant information in the daily management of the farm.

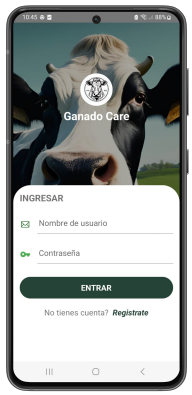

Figure 4: Login screen.

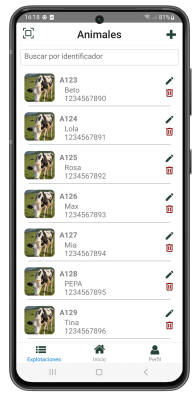

Figure 5: List of animals in a livestock farm.

4.2 Animal Detail

The animal detail page (see Figure 6) displays basic information: identifier, ear tag, name, date of birth, breed, and mother's number. It includes shortcuts to the main functions: *Medications*, *Diseases*, *Reproduction*, *Affected Udders*, and *Production*. Additionally, it shows important alerts, such as active meat withdrawal, to indicate health restrictions.

Figure 6: Example of the animal detail screen in the application (identifier, action menu, and withdrawal alert).

4.3 Interaction with NFC/RFID Tags

One of the most innovative aspects of the application is the ability to read and write NFC/RFID tags associated with animals. This functionality allows each animal to be identified quickly and individually, significantly improving traceability and record-keeping.

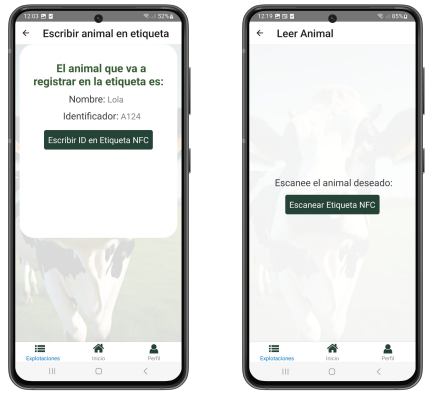

Figure 7: Left: writing information to an NFC/RFID tag. Right: reading an NFC/RFID tag.

Interaction with these tags offers several advantages, including immediate access to an animal's data without manually searching the list, the ability to update information directly on the tag or synchronize it with the central server, and increased accuracy and efficiency in daily farm management.

4.4 Medication Search Integrated with CIMAVET

The search interface queries the official CIMAVET API (Figure 8), allowing searches by name or registration number. Once a medication is selected, the system automatically extracts withdrawal times (milk, meat, or both) and calculates the corresponding suspension dates based on the administration date, displaying these restrictions in the animal's detail view.

Additionally, the user can specify the different doses or administrations the animal will receive, including dates and frequencies(Figure 9). According to the configuration, the application generates automatic reminders for upcoming doses and alerts related to withdrawal periods, ensuring compliance with health restrictions and facilitating correct treatment management.

All this information is stored in the system and can later be consulted when viewing medications associated with each animal. Furthermore, it is possible to generate a PDF per medication (Figure 10) summarizing treatment details and withdrawal times, facilitating administrative procedures or health inspections.

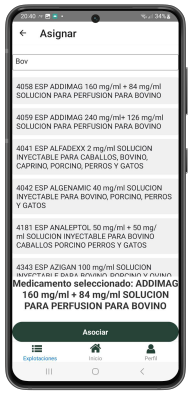

Figure 8: New disease screen

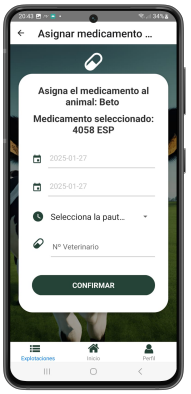

Figure 9: Assign medication screen

Figure 10: Medication PDF export screen

4.5 Data Visualization for Decision Support

The application includes a visualization section with evolution graphs(Figure 11), for example: milk production, number of treatments per month, or health incidents. These graphs assist decision-making and medium-term farm management.

Figure 11: Example of the graphs screen for decision-making support.

4.6 Preliminary Validation

The system underwent functional testing in the development environment, and its interface was validated through informal usability tests with a collaborating farmer. The feedback obtained allowed adjustments to navigation flows and improved alert clarity.

Furthermore, a small-scale pilot was initiated on a collaborating farm to collect real usage records and evaluate system behavior in productive environments. This pilot is in an initial phase; future publications will present quantitative information on the pilot implementation, such as reduced administrative errors, compliance with withdrawal periods, and improvements in production management.

5 Conclusions and Future Work

This article presents the main conclusions of the study, as well as potential avenues for improvement and future development.

5.1 Conclusions

The project resulted in a functional and intuitive mobile application for livestock management in small and medium-sized farms. The solution integrates current technologies that optimize livestock management, enhancing efficiency, farm control, and traceability through NFC/RFID. All defined use cases were successfully implemented, validating the feasibility and usefulness of the application in its intended context.

The application allows centralized recording and consultation of relevant information, including animal management, veterinary treatments, milk production, health history, and interactive graphs. This integration facilitates informed decision-making and supports more efficient and sustainable farm management.

5.2 Future Work

Although the application meets its primary objective, several opportunities exist for enhancement and expansion:

- Incorporation of advanced search tools with filters to facilitate analysis of specific data.
- Bulk import of animals using external files to improve data entry efficiency.
- A financial module to record and analyze milk or livestock sales.
- Integration of Artificial Intelligence (AI) techniques for predictive analyses on diseases, milk production, and management optimization, supporting proactive decision-making.

These enhancements could increase the scalability, utility, and innovative value of the application, reinforcing its impact as a tool for small and medium-sized livestock farms.

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