

1. Introduction

1.1 Background

Sales forecasting plays a pivotal role in the retail industry by enabling businesses to anticipate customer demand, optimize inventory, streamline procurement, and enhance operational planning. Accurate forecasting reduces the risk of overstocking or stockouts, thus improving profitability and ensuring customer satisfaction. In large retail enterprises, advanced forecasting systems are often part of integrated enterprise resource planning (ERP) platforms, supported by dedicated analysts and machine learning specialists. However, this is far from the reality faced by small and medium-sized retail businesses.

Many small-scale retailers, particularly those operating traditional or informal stores, lack the financial, technical, and human resources to adopt such complex systems. These businesses form the backbone of local economies and contribute significantly to employment and economic stability in developing regions. Yet, their operations are often hindered by guesswork in managing inventory levels, relying on past experiences and manual records to estimate future demand. Such approaches are prone to human error and cannot adapt to fluctuations caused by seasonality, holidays, local events, or broader economic trends.

While modern cloud-based tools and artificial intelligence offer unprecedented opportunities for retail analytics, they are typically geared towards large enterprises. The software interfaces may be overly technical, the pricing models prohibitive, and the platforms themselves are often designed with desktop or web-first experiences in mind. Mobile platforms, which have become central to daily life, particularly in regions where mobile penetration exceeds PC access, are underutilized in this domain. According to [7], small retailers frequently find themselves excluded from the benefits of digital forecasting tools due to the complexity and inaccessibility of existing solutions.

The lack of accessible, intuitive, and affordable tools for small retailers to perform sales forecasting is a key barrier to their digital transformation. An effective solution must leverage platforms that are already familiar to users, like Android smartphones, and incorporate lightweight yet powerful forecasting algorithms that do not require expert intervention. As emphasized by [6], deploying intelligent forecasting through simple user interfaces on mobile platforms can democratize access to advanced analytics.

This project addresses this need by proposing a mobile application that allows users to input or upload historical sales data and generate accurate demand forecasts using embedded algorithms. By focusing on usability, affordability, and portability, this research aims to empower small retailers with data-driven insights. The objective is not merely to introduce new technology but to create an inclusive tool that fits seamlessly into existing business routines. In doing so, it contributes to closing the digital divide in retail and promoting smarter inventory management among underserved segments.

1.2 Significance of the Study

This study is significant for several reasons:

- **Technological Inclusion:** It enables small business owners—many of whom lack desktop computing resources or analytical backgrounds—to harness AI-driven forecasting tools via their Android devices.
- **Data-Driven Decision Making:** With visualized predictions and algorithm choice (ARIMA or RNN), users can compare forecasts and adopt strategies that align with their sales patterns.
- **Embedded Machine Learning:** The use of Chaquopy to run Python code natively in Android applications eliminates the need for backend servers, enhancing accessibility even in low-connectivity areas.
- **Practical Retail Empowerment:** The app supports inventory planning, seasonal adjustment, and reduces loss due to overstocking or missed sales.

By focusing on usability and real-world utility, this research contributes not only to the academic exploration of mobile-integrated AI, but also to practical solutions for retail communities underserved by traditional enterprise tools.

1.3 Problem Statement

Small and medium-sized retailers often face significant barriers to implementing effective sales forecasting tools. While large enterprises benefit from sophisticated systems and expert analysts, smaller businesses typically lack the resources or access to such infrastructure. This discrepancy is exacerbated by the dominance of web-based or desktop forecasting tools, which may be prohibitively complex or expensive for smaller businesses. Most importantly, the absence of tailored, mobile-friendly forecasting solutions forces many small store owners to rely on intuition or manual tracking, leading to poor inventory planning,

missing sales opportunities, and excess stock. Without a practical and affordable mobile application, small retailers are left without reliable means of anticipating customer demand. This lack of forecasting capabilities hinders their ability to operate efficiently and grow sustainably in an increasingly competitive retail environment.

1.4 Research Objectives

This research aims to design and implement a mobile-based forecasting solution tailored specifically for small-scale retail environments. The goal is to integrate ARIMA (AutoRegressive Integrated Moving Average) and Recurrent Neural Network (RNN) models within an Android application, offering intuitive access to forecasting for non-technical users. The application will allow users to input or upload monthly sales data and generate predictions for the upcoming 1, 2, and 3 months. By leveraging accessible platforms such as Android and incorporating lightweight machine learning capabilities via Chaquopy, this research seeks to bridge the gap between modern forecasting techniques and practical, real-world retail needs. Furthermore, this study aims to compare the performance of ARIMA and RNN in terms of accuracy and responsiveness, thereby enabling users to make better decisions based on their data trends. Through this implementation, the research contributes to the democratization of data-driven forecasting for small and medium businesses.

1.5 Scope and Limitations

This project focuses exclusively on implementing two forecasting algorithms: ARIMA and RNN. The application is developed for Android using Java, with Chaquopy enabling Python script execution. Forecasting is based on historical monthly sales data, with a minimum of 12 months required for meaningful predictions.

The application's interface is kept simple and functional, prioritizing ease of use over advanced configuration features. It is intended for single-user environments and does not support multi-store management or external data integration beyond the user-provided sales input. Furthermore, the predictive accuracy is dependent on the quality and consistency of historical sales data. External variables such as promotions, economic shifts, or competitor actions are not factored into the forecasting logic. These simplifications are intended to maintain the app's practicality and suitability for non-technical users, although they may limit the precision of forecasts in more complex retail environments.

1.6 Methodology

- **Frontend Development:** Android UI built using Java, following a user-centric design approach with clear navigation and lavender-accented elements for visual appeal.
- **Backend Forecasting:** Python scripts executed via Chaquopy embedded in the app, enabling native integration of time-series algorithms within the Android environment.
- **Data Management:** Firebase Firestore is used to store structured product sales data and prediction outputs, organized hierarchically for efficient retrieval.
- **Forecasting Logic:** ARIMA is applied for linear, trend-stable sales data, while RNN is used for sequences showing nonlinear or fluctuating patterns. Each algorithm produces predictions for the next 1, 2, and 3 months.
- **Evaluation:** Predictions are displayed and can be used to compare to future data manually that then can be used as metric to calculate future predictions.

This structured methodology ensures that the application remains technically robust, scalable for additional features, and simple enough for end-users with minimal technical knowledge to operate effectively. The process from design through evaluation is carefully aligned with the core objective of equipping small retailers with practical forecasting capabilities. By combining mobile technology, embedded machine learning, and cloud storage, the system offers a compelling model for accessible digital transformation in retail forecasting.

1.7 Research Benefits

This research benefits:

- Small retailers by offering a practical tool to predict sales trends and make informed business decisions.
- Researchers and developers by demonstrating a lightweight integration of AI models in mobile environments.
- The academic community by contributing to applied research in mobile AI, forecasting, and digital inclusion.
- Future developers by providing a reference architecture that integrates Java, Python, and Firebase in a real-world retail scenario.

1.8 Thesis Organization

This thesis is organized into six chapters:

- **Chapter 1 – Introduction:** Describes the background, problem formulation, objectives, and significance of the research.
- **Chapter 2 – System Analysis:** Explores relevant literature, forecasting algorithms, and system requirement analysis.
- **Chapter 3 – System Design:** Details the system architecture, use case modeling, and database structure.
- **Chapter 4 – Implementation:** Presents the development process, technologies used, and app functionality.
- **Chapter 5 – Testing:** Evaluates the application's performance, usability, and forecasting accuracy.
- **Chapter 6 – Conclusion and Future Work:** Summarizes the findings, discusses limitations, and outlines suggestions for future improvements.