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Design and Implementation of an Inventory Management System Using Angular Framework

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ABSTRACT:

Inventory management is a crucial aspect of ensuring that businesses create efficiencies, decrease expenditures, and satisfy customer needs. Conventional systems of stock management (manual registers or spreadsheets) frequent inaccuracy, inefficiency, and no real-time view. This study suggests a design and implementation of an Inventory Management System (IMS) using Angular for the front-end framework and Firebase for the back-end system. Angular SPA (Single Page Application) format allows for streamlined and instant interactivity, while Firebase supplies the cloud-hosted, real time data storage, authentication and scalability. The developed system allows administrators to manage inventory, products, categories and customer information while at the same time generating reports in real-time. This study outlines the architecture of the system, the methodology, workflow diagrams and the outcomes from the implementation. After completing the testing of the application, the results indicated that difficulties with data inaccuracy were reduced, access was improved, and efficiency in decision making was improved. The purpose of this paper is to demonstrate a Inventory Management System is an accessible and scalable option for small and medium-sized enterprises (SMEs) as well as an opportunity for future integration of frameworks involving mobile and artificial intelligence within inventory management.

Keywords: Inventory Management System, Angular, Firebase, Cloud Database, Web Application, Real-Time Synchronization

Introduction:

Inventory management is important for all organizations that rely on it for their everyday operation(s). This is especially true with organizations in the retail, wholesale, and service transactional industries where inventory control processes ensure available stock levels to satisfy demand, waste reduction, and that customers are able to get what they want, when they want it. Firms using more traditional inventory management systems e.g., manual stock register, spreadsheets, have difficulties, such as human error, collating information, lack of real time updates, and inefficient report production.

With the rise of digital transformation, businesses (especially small and medium enterprises (SMEs)) are using automated, cloud-based inventory management systems. In addition to streamlining day-to-day stock management, the use of online inventory management systems allows responsive, actionable, insight for decision-makers.

This project paper details the design and development of an inventory management system (IMS) using Angular, which is a single page application (SPA) to be built using a framework developed by Google. The IMS uses a real time backend that be provided by Firebase, which also is a Google product that contains strong services, such as Authentication, Cloud Firestore, Realtime Database, Hosting, and Cloud Functions.

The objective of this work is to create a lightweight, user-friendly, and scalable inventory management solution that addresses the limitations of manual systems. The study details the system's design architecture, data flow diagrams, entity relationships, and testing results.

What is Inventory Management System?

An **Inventory Management System (IMS)** is a digital solution designed to record, monitor, and control the flow of products within an organization. It ensures that the right quantity of goods is available at the right time and in the right place, thereby reducing wastage, avoiding stockouts, and optimizing resource utilization. Traditionally, inventory was maintained through manual registers or spreadsheets, which were prone to errors, delays, and inconsistencies. With the growth of businesses and the need for real-time data, these methods became inefficient and limited in scalability.

Top roles are:

Modern IMS platforms are built using advanced web technologies and cloud-based databases, allowing seamless data access, real-time synchronization, and automated operations. They typically include modules for **product management, category management, stock monitoring, customer records, and reporting**. A well-implemented IMS improves decision-making by providing managers with accurate insights into product movement, sales patterns, and reorder requirements.

The adoption of IMS has become critical in industries such as retail, e-commerce, manufacturing, and logistics, where timely information about stock levels directly influences business performance. Cloud-backed systems, like those powered by Firebase, further enhance accessibility, security, and scalability, making them suitable even for small and medium-sized enterprises. By integrating a user-friendly Angular frontend with a real-time Firebase backend, the proposed IMS in this research bridges the gap between usability and technological efficiency.

Review of Literature

The demand for efficient, scalable, and transparent solutions to business challenges has pushed a number of searchers to work on automated inventory management systems. Some issues these studies worked on included data inconsistency, inefficient stock management, challenges of scalability, and the delay of information transfer. [1] Inventory management was historically a manual process using registers or spreadsheets. The process was time-consuming, plagued with errors, created stockouts, overstocking, and false reporting. Researchers identified the inefficient management of items and problems with stock levels as the most significant barriers on an organization's productivity and satisfaction of customers. [2]The earlier step was to move towards using database client/server applications and gain better redundancy of data storage and retrieval but still failed to account for outstanding user access and syncing provided by offline access. The next generation was to introduce web-based portals. These solutions have some performance benefits through improved access, decreased paperwork and allowed superior data entry, however, they still had weaknesses in authentication, real-time updates and would become impassive as inventories grew in sizes that did not allow for scalability. [3]The more recent research has moved towards cloud solutions where most organizations now use SaaS as a form of inventory solution that moves toward real-time collaboration and automation of organizational tasks. [4], with tools like dashboards to monitor trends, consumption and waste and maintain ease of use for data entry while anticipating demand and predictive restocking and minimizing offline entry with the help of embedded analytics. Technologies include AI and machine learning to help analyse past and future demand.Frameworks such as Angular, React, and Vue.js have been applied in management systems for building responsive web applications. Angular, in particular, has been noted for its modularity, single-page application features, and built-in data binding. Firebase has been widely adopted as a backend solution due to its serverless model, real-time database synchronization, integrated authentication, and ease of deployment. [5]Despite these advancements, most systems continue to face limitations like inadequate role-based authentication, weak reporting mechanisms, and difficulties in scaling with cloud platforms. Manual interventions are still needed in some cases to rectify inconsistencies, and the cost of third-party SaaS solutions may be prohibitive for small businesses. [6].

The literature therefore illustrates the evolution from manual and spreadsheet-based systems to web-based and cloud-based inventory systems. However, there remains a gap for a lightweight, cost-effective, and scalable system that integrates modern frontend frameworks with real-time backend support. This gap is directly addressed by the present project, which employs Angular for the frontend and Firebase for the backend to create a secure, real-time, and scalable Inventory Management System suitable for SMEs.

Methodology:

Technology Stack Overview

- **Frontend:** Angular – for building dynamic, responsive single-page applications (SPA).
- **Backend:** Firebase (Firestore Database and Realtime Database) – for secure, cloud-hosted, real-time data storage.
- **Authentication:** Firebase Authentication – for login and admin verification.
- **Hosting & Deployment:** Firebase Hosting.

User Roles

- **Admin:** Manage login, product categories, product stock, customer records, and reporting.

Features

- Authentication and secure access.
- CRUD operations for products and categories.
- Real-time updates in the inventory.
- Customer registration and management.

- Report generation for stock levels and sales.
- Dashboard-based workflow.

Existing Methodologies

Traditional inventory systems relied heavily on manual registers and spreadsheets. These methods created delays in decision-making, inconsistencies in records, and increased risk of data loss. Some organizations used standalone desktop applications with relational databases such as MySQL, but these were limited in real-time collaboration, multi-user support, and scalability Cloud-based solutions improved accessibility and reduced paperwork. However, many systems suffered from poor synchronization speed, weak authentication, and limited automation. Additionally, large-scale ERP-based inventory tools were expensive, making them unsuitable for SMEs.

Proposed Methodology Using Angular and Firebase

1. The proposed system integrates Angular with Firebase to create a lightweight, real-time inventory management platform with the following core features:

1. Client-Server Architecture – Angular provides a dynamic user interface, while Firebase acts as the cloud backend with APIs and database services.
2. Role-Based Access – Only authenticated admins can manage products, categories, and reports.
3. Core Modules:
    - Admin login via Firebase Authentication.
    - Product module with add, update, delete, and view functions.
    - Category management for product classification.
    - Customer details registration.
    - Real-time reports and dashboards.
4. Automation: Automatic synchronization of data across devices, reducing manual delays.
5. Security and Testing: Authentication through Firebase's secure login, encryption, and access control. Thorough testing ensures accuracy and reliability.

2. This methodology streamlines inventory processes, minimizes errors, and ensures real-time visibility of data

System Architecture

The system follows a **client–server model**:

- Angular handles the client-side interface and communicates with Firebase.
- Firebase Authentication secures user access.
- Firebase Firestore stores all product, category, and customer data in real time.
- Firebase Hosting manages deployment and accessibility.

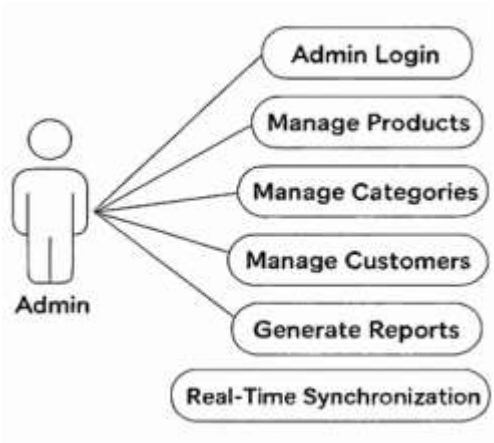

Figure 1: Admin User Use Case Diagram

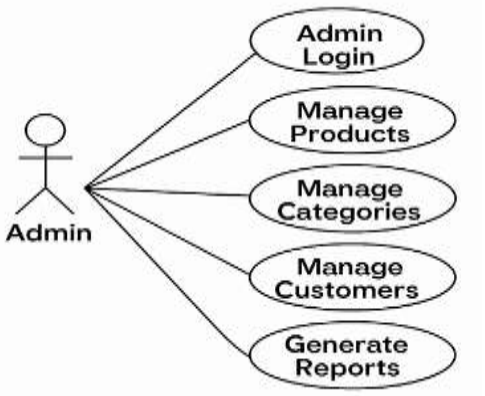

Figure 2: Admin Use case Diagram

Results

The developed system was tested in a simulated environment with sample data. The following outcomes were achieved:

- Real-time synchronization of inventory data across multiple devices.
- Accurate CRUD operations with zero duplication.
- Faster product entry and updates compared to manual records.
- Positive user feedback on ease of use and dashboard clarity.
- Scalable performance as dataset size increased.

Comparison Table:

Feature	**Manual System**	**SQL/Basic DB Systems**	**Proposed IMS (Angular + Firebase**
Data Handling	Paper-based	SQL Based	Real-time Firestore (NoSQL)
Authentication	None	Basic Password	Firebase Authentication
Access Control	None	Limited	Role-Based(Admin)
Transparency	Low	Medium	High(real time updates)
Scalability	Not possible	Limited	High (cloud-hosted firebase)

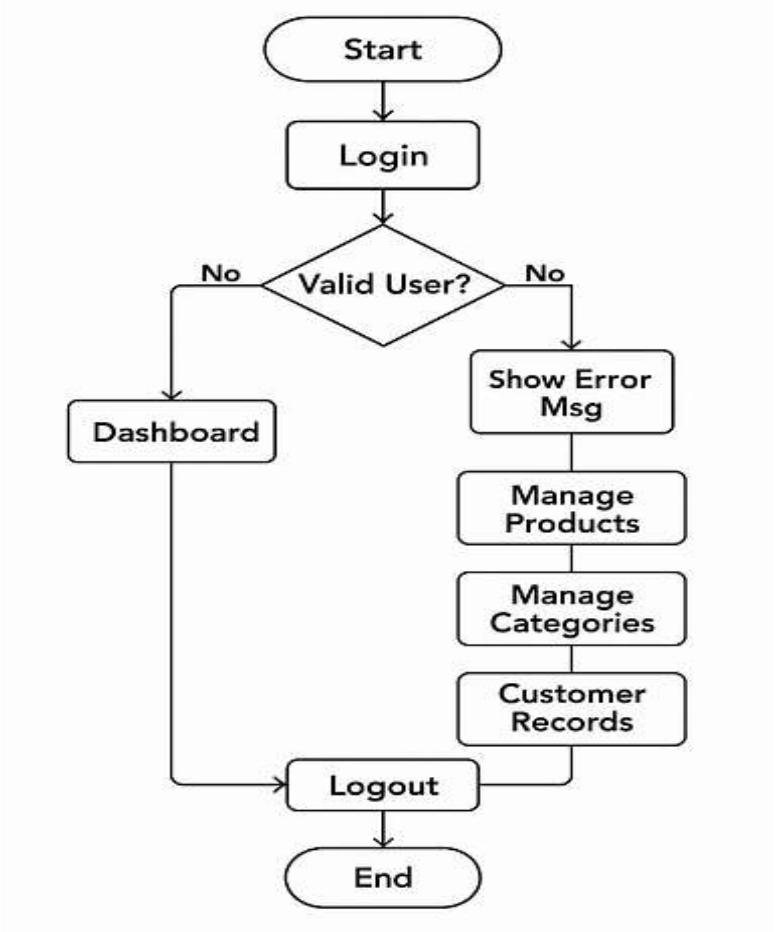

Figure 3: Flowchart

Advantages of Using Angular + Firebase in IMS

- **Full-stack integration** with minimal server-side maintenance.
- **Angular SPA** ensures fast and responsive UI.
- **Firebase Realtime Database** provides instant synchronization of updates.
- **Built-in Authentication** offers secure login with minimal configuration.
- **Cloud Scalability** ensures that the system can expand without additional infrastructure.
- **Low Cost** compared to traditional ERP systems.
- **Easy Deployment** through Firebase Hosting.

Conclusion:

The Inventory Management System developed with Angular and Firebase efficiently addresses the challenges of manual inventory processes. It provides a centralized, real-time, and scalable platform for managing products, categories, customers, and reports.

Testing confirmed that the system significantly improves accuracy, efficiency, and user satisfaction compared to manual and SQL-based methods. With Firebase's cloud hosting and real-time updates, the IMS is a **cost-effective solution for SMEs** seeking automation.

Future Enhancements may include:

- Mobile application integration.
- Barcode/QR scanning for product entry.
- AI-based demand forecasting.

- Multi-role user support beyond admin (e.g., staff, auditors).

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