Journal of Mathematics and Computing Science, 12 (1): 23-40, 2026
Copyright © UiTM Press
eISSN: 0128-0767

Smart Mobile Application for Distributors: A Case Study of a Perfume Distributor

Nik Nur Ilham Rosman[1], Marina Ahmad[2*], Siti Hasrinafasya Che Hassan[3], Noorfadzilah Arifin[4], Maznie Manaf [5]

[1]Qube Apps Solutions Sdn Bhd
R&D Centre, Level 25-01, No. 8, Jalan SS21/37, Damansara Uptown, 47400 Petaling Jaya.
[2,3,4,5]Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA Kelantan, Bukit Ilmu, Machang, Kelantan, Malaysia

Authors' email: nurilham0419@gmail.com, marina170@uitm.edu.my*, hasrina581@uitm.edu.my, nfadzilah@uitm.edu.my, maznie@uitm.edu.my

*Corresponding author

Received 16 February 2026; Received in revised 20 April 2026; Accepted 11 May 2026
Available online 15 June 2026
DOI: https://doi.org/10.24191/s5b71c68

Abstract: This research introduces a novel Smart Mobile Application for Perfume Distributors (EZPD), systematically developed using the Mobile Application Development Life Cycle (MADLC) to address field distribution challenges such as unstructured paper-based records, inaccurate retail store geolocation, and uncoordinated payment collection schedules. Unlike existing enterprise solutions such as ZooM Retail & Distributor, GoSales, and SalesDiary, which primarily focus on multi-user inventory management, sales, and logistics operations, EZPD integrates three functions within a single mobile platform: Google Maps API-based spatial geocoding, centralised SQLite-based storage for invoices and receipts, and automated appointment reminders using Android AlarmManager. Black-box functional testing across ten core operational modules achieved a 100% pass rate, while a hybrid usability evaluation combining the System Usability Scale (SUS), Technology Acceptance Model (TAM), and User Acceptance Testing (UAT) ($N = 5$) yielded an overall mean satisfaction score of 4.25 out of 5.00 (85%), with the highest ratings recorded for interface design ($\mu = 4.38$) and operational usefulness ($\mu = 4.20$). Compared with conventional paper-based workflows and existing applications, EZPD demonstrates its potential to reduce manual data transcription errors, minimise navigation errors through precise coordinate mapping, and reduce the likelihood of missed collection appointments. Overall, the application provides a scalable, low-overhead framework that can potentially be adapted to other niche field-distribution sectors beyond the perfume industry.

Keywords: Appointment, database, distributors, location, mobile applications

1 Introduction

Goods distribution is a critical component of supply chain management, facilitating the physical allocation and delivery of products from manufacturers to downstream retailers [1], [2]. In field-based distribution models, such as perfume distribution, local distributors serve as vital operational intermediaries. They visit retail stores, present product catalogueues or samples, negotiate payment arrangements such as cash, bill-to-bill, or consignment, and process physical documents such as consignment notes, receipts, and invoices [1]–[3]. Despite increasing digitalisation in modern trade, many small and medium-sized distribution operations continue to rely on legacy workflows, including manual paper records, locally stored word-processing documents, and static spreadsheets [3], [4], [5]. These fragmented and unintegrated approaches introduce significant operational challenges, including

This is an open access article under the CC BY-SA license (https://creativecommons.org/licenses/by-sa/3.0/).

human error, limited real-time data synchronisation, and reduced supply chain agility [6], [7]. Recent advancements in mobile technology highlight the potential of location-based services (LBS) and digital record management to address these limitations by enabling real-time data accessibility, improving information management, and streamlining field distribution operations.

Despite the growing adoption of mobile enterprise applications, perfume distributors continue to face three major operational challenges. First, unstructured record and document management, which relies heavily on static spreadsheets and physical paper files, can result in fragmented data storage, a high incidence of manual transcription errors, and misplaced invoices or consignment notes [4], [5]. This lack of centralised record management can adversely affect the payment collection process and auditability [8]. Second, inaccurate geolocation and inefficient routing can arise when distributors encounter incorrectly identified store locations due to manual address-entry errors, outdated physical street markers, or inaccurate location pins provided by conventional navigation tools [9]. For new or temporary delivery personnel, locating dispersed retail outlets without adequate location verification may result in unnecessary travel, increased fuel consumption, and delivery delays [6], [4]. Location verification can be supported through reverse geocoding, map-based location markers, and street-level imagery. Third, inefficient appointment and payment-collection scheduling presents another operational challenge. Managing recurring retailer visits, typically structured around 15- or 30-day collection cycles, using physical planners or human memory can result in missed appointments, delayed collections, and inefficient route planning [10], [8]. Inefficient scheduling can increase transportation costs and negatively affect retailer satisfaction [8].

While commercial logistics and inventory-tracking applications are available, most primarily focus on warehouse management, inventory control, or general fleet tracking, leaving a notable gap for lightweight mobile solutions that integrate real-time location intelligence with specialized appointment scheduling and payment documentation management tailored to field distributors. To address this gap, this study presents a Smart Mobile Application for Perfume Distributors (EZPD), systematically developed using the Mobile Application Development Life Cycle (MADLC) methodology. The novelty of the application lies in its unified integration of the Google Maps API, incorporating reverse geocoding and route visualization, centralised digital record management for receipts and invoices, and an automated calendar-driven appointment notification system within a single mobile interface. The primary objectives of this research are threefold. First, to design and implement a centralised digital record management system capable of managing retailer profiles, invoices, receipts, and consignment documentation. Second, to integrate location-based services to support accurate store identification and efficient route navigation. Third, to establish an automated appointment scheduling and notification system to assist distributors in managing recurring retailer visits and payment collection schedules.

2 Literature Review

According to [11], physical distribution refers to the processes through which products are transferred from the point of production to locations where they become available to customers. Distribution plays a crucial role in a company's profitability, as the efficiency of distribution activities directly affects supply chain costs and the ability to meet consumer demand. In business economics, distribution refers to the process of allocating and delivering products to their intended recipients. According to [12] and [13], distribution system management encompasses various activities, including distribution route management and distribution channel management.

Figure 1 illustrates a typical distribution structure involving one manufacturer, one distributor, and one customer.

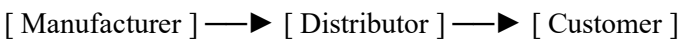


Figure 1: Relationship between Manufacturer, Distributor and Customer.

Industrial distributors serve as vital intermediaries by reselling goods while providing value-added services to enterprise clients [14]. For small and medium-sized enterprises (SMEs), traditional field

distribution relies heavily on physical store visits to establish and maintain market coverage [15]. Distributors are typically required to contact store owners, present product catalogueues, negotiate various payment arrangements, such as upfront cash, bill-to-bill, or consignment models, and process physical transaction documentation [15]. Although expanding retail coverage can increase geographic reach and product awareness, it also introduces challenges related to travel distance and route efficiency, which may adversely affect profit margins if not managed effectively [15]. Reliance on traditional physical logistics alone may limit operational efficiency and competitiveness; therefore, modern distribution operations increasingly require integrated information technology to support real-time transaction processing and effective customer data management [16].

A Record and Data Management

Intermediaries process large volumes of business records daily, including outgoing invoices, promotional materials, retailer information, and internal sales data. Despite the widespread availability of modern computing technologies, many field distributors continue to rely on flat digital formats, such as static word-processing documents and spreadsheets, which digitize existing workflows without providing the functionality of a centralised database system. Paper-based and flat digital records remain prevalent primarily because they have low barriers to adoption, familiarity, and minimal infrastructure requirements [17]. However, these non-centralised approaches often lack dynamic data validation, effective version control, and real-time synchronisation, leaving operations vulnerable to data-entry errors, data fragmentation, and administrative delays [17]. Consequently, distribution practices are increasingly shifting toward centralised digital management platforms to enhance data integrity, accessibility, and operational decision-making [18].

B Retail Store Location Management

Optimising distribution routes is critical for ensuring timely deliveries, reducing fuel consumption, and maintaining customer satisfaction [19], [20]. High-density retail environments can present significant navigation challenges, including inaccurately pinned Global Positioning System (GPS) locations, missing address markers, and incorrectly recorded physical addresses [21]. These inaccuracies may require delivery personnel to undertake unnecessary travel or rerouting, increasing operational costs and causing schedule delays [19], [21]. The integration of interactive mapping solutions through the Google Maps Application Programming Interface (API) can help address these challenges. By utilising the Google Maps API's features, such as location search, reverse geocoding, and route visualization, distributors can resolve ambiguous address entries, verify store locations, and plan travel routes more effectively prior to dispatch.

C Appointment Management

Managing recurring client interactions, payment collection cycles, and delivery schedules requires structured task coordination. Traditional paper-based scheduling systems can result in oversights and disorganization, particularly under demanding operational workloads [22]. Modern reminder and calendar-based software solutions can improve scheduling accuracy and operational coordination. Empirical evaluations have reported that 61% of organizations experienced improvements in scheduling accuracy following the adoption of such software [23]. Automated scheduling systems can assist field personnel in adhering to predefined collection intervals, such as 15- or 30-day cycles, while reducing the likelihood of missed appointments and minimising transportation costs associated with unnecessary repeat visits [23].

D Comparative Analysis of Existing Mobile Solutions

Several mobile applications are currently available on the market. Three applications with functionalities closely related to the proposed mobile application were selected for comparison. ZooM Retail & Distributor is a mobile-first software solution designed to facilitate collaboration between distributors and retailers through real-time order management, communication, and delivery coordination. The application enables retailers to place orders directly through the platform, while distributors can view, track, and update order statuses in real time. This two-way interaction can reduce manual coordination and improve the efficiency of distributor-retailer communication. In addition to order management, ZooM provides delivery-related features that support fulfilment activities. Distributors can update order statuses from placement and dispatch through to delivery, enabling retailers to monitor order progress. Delivery personnel can also confirm completed deliveries through digital signatures, timestamps, or photographic evidence, creating a verifiable delivery record. Although ZooM does not provide comprehensive route optimisation, it supports basic delivery scheduling and retailer notifications, which can help reduce missed deliveries and improve coordination [24].

GoSales is a mobile-first Sales Force Automation (SFA) and Distributor Management System (DMS) developed by MaxMobility to streamline field sales, order management, and distribution operations across various industries. The application provides a comprehensive range of features, including real-time order booking, payment collection, GPS-based route tracking, customer visit logging, and digital invoicing. GoSales enables field agents to record orders directly from retail outlets, track daily routes, and record attendance using geotagging, thereby supporting accountability and operational transparency. Although GoSales does not provide a dedicated appointment-scheduling module for coordinating distributor-retailer visits, it supports structured visit planning and beat-route management, which can serve related scheduling and field-visit coordination functions [25].

SalesDiary is a mobile-first field sales automation application designed to help distributors and sales teams manage customer visits, order booking, and route planning. The application is designed for industries such as fast-moving consumer goods (FMCG), pharmaceuticals, and retail, and enables field agents to record geotagged attendance, track customer interactions, and execute planned sales routes efficiently. SalesDiary also supports live location tracking, visit history, and performance analytics, allowing distributors to monitor field activities and evaluate sales coverage. In addition, the application enables field agents to record orders directly from retail outlets and synchronize data with backend systems, thereby reducing manual data-entry errors and supporting more efficient delivery operations. Through these features, SalesDiary facilitates the digitization of field sales processes, enhances operational accountability, and supports structured engagement between distributors and retailers [26].

Existing platforms primarily focus on enterprise-oriented functions, such as multi-user reporting, centralised sales management, and shared retailer portals. However, based on the reviewed applications, limited functionality is available for dedicated appointment notifications specifically supporting recurring payment-collection activities and offline operation tailored to individual field distributors. The proposed application addresses these identified gaps by integrating centralised document management, precise store geolocation and route navigation through the Google Maps API, automated calendar-based reminders, and offline accessibility within a single mobile platform tailored to the needs of field distributors.

3 Methodology

To develop an effective GPS-based mobile application, the MADLC methodology was adopted. MADLC is a structured framework for mobile application development that was introduced by Intel [27]. According to [28], MADLC consists of seven phases: identification, design, development, prototyping, testing, deployment, and maintenance. This section discusses the identification, design, and development phases undertaken in the development of the proposed mobile application.

Table 1: Comparison of proposed app with existing similar app

Feature	**ZooM Retail & Distributor** [11]	**GoSales** [12]	**SalesDiary** [13]	**Proposed Solution**
Store and retail data management	Yes	Yes	Yes	Yes
Invoice and receipt management	Yes	Yes	Partial	Yes
Location-based features and routing to retail stores	Partial	Yes	Yes	Yes
Appointment and notification for collection	No	No	No	Yes
Offline accessibility	Partial	Partial	Partial	Yes
User scope and privacy	Retailer-distributor shared access	Team-based data sharing and reporting	Field team data synced to central system	Designed for individual use; full local data control

A Requirements of the Mobile Application

During the identification phase, the requirements for the mobile application were gathered based on user input. A survey was conducted by distributing questionnaires to the target users to identify their needs and expectations regarding the proposed application. Table 2 presents a sample of the identified user requirements for the mobile application.

Table 2: User Requirement Questions

Requirements	**Description**
Manage Retail Stores	• The system shall allow distributors to add new stores. • The system shall allow distributors to view a list of retail stores. • The system shall allow distributors to update retail store information. • The system shall allow distributors to view retail store information, including the store name, owner's name, phone number, address, product type, latitude, and longitude.
Manage Invoices and Receipts	• The system shall allow distributors to add new receipts and invoices. • The system shall allow distributors to view the invoices and receipts.
Manage Retail Store Location	• The system shall allow distributors to add a location to the retail store information. • The system shall allow distributors to get the latitude and longitude of the retail store. • The system shall allow distributors to view the address of the retail store. • The system shall allow distributors to obtain directions to the retail store through Google Maps.
Manage Appointment	• The system shall allow distributors to add appointments to schedule meetings with retail store owners or managers. • The system shall allow distributors to set alarms for appointments and display appointment notifications. • The system shall display a to-do list based on the selected date and scheduled appointments.

B Proposed Framework of the Mobile Application

Figure 2 illustrates the framework of the proposed application. It presents the overall system architecture, including the interactions among the distributors, mobile application, internet connection, external services, and database. Distributors can access the mobile application to create, update, and delete records as required. Newly created or updated data are stored in the database and can subsequently be retrieved by the mobile application when needed.

Certain application features require an internet connection, particularly location-based services, alarm functions, and notification services. For location-related functions, the application retrieves location data through an internet connection to support location-based services. The Location API facilitates geolocation by converting geographic coordinates into location information and addresses through reverse geocoding. Bidirectional data communication between the database and the mobile application enables data to be retrieved from and sent to the database. This communication also supports the integration of other application services, including alarm and notification functions.

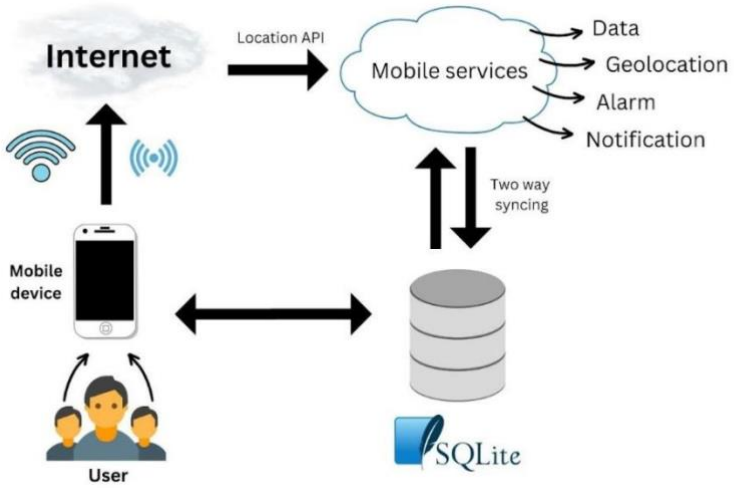


Figure 2: Mobile Application Framework

B Database Design

The database is one of the most important components of the proposed mobile application, as it stores and manages all data related to the application. The database was designed to ensure that all required information is stored systematically and can be retrieved when needed. Figure 3 illustrates the database design using an Entity-Relationship Diagram (ERD).

The Retailer table stores information such as retailer ID, store name, owner name, contact number, address, latitude, and longitude. The Collection table stores information related to retailer and product collections, including retailer ID and product ID. The Product table contains product-related information, including product ID, retailer ID, product name, price, and quantity. Each collection can be associated with an alarm that is scheduled by the user to provide a reminder. The Alarm table stores information such as alarm ID, product ID, retailer ID, store name, date, and time. Each alarm can generate multiple notifications for the corresponding retail store. The Notification table stores notification-related information, including notification ID and store name. In addition, each alarm is associated with a to-do list entry containing the relevant ID and store name.

When a user records a product collection, the transaction data are stored in the database. The recorded information includes collection ID, product ID, quantity sold, new stock quantity, collection amount, and timestamp. The database structure enables the application to maintain organised records of retailers, products, collections, alarms, notifications, and related activities.

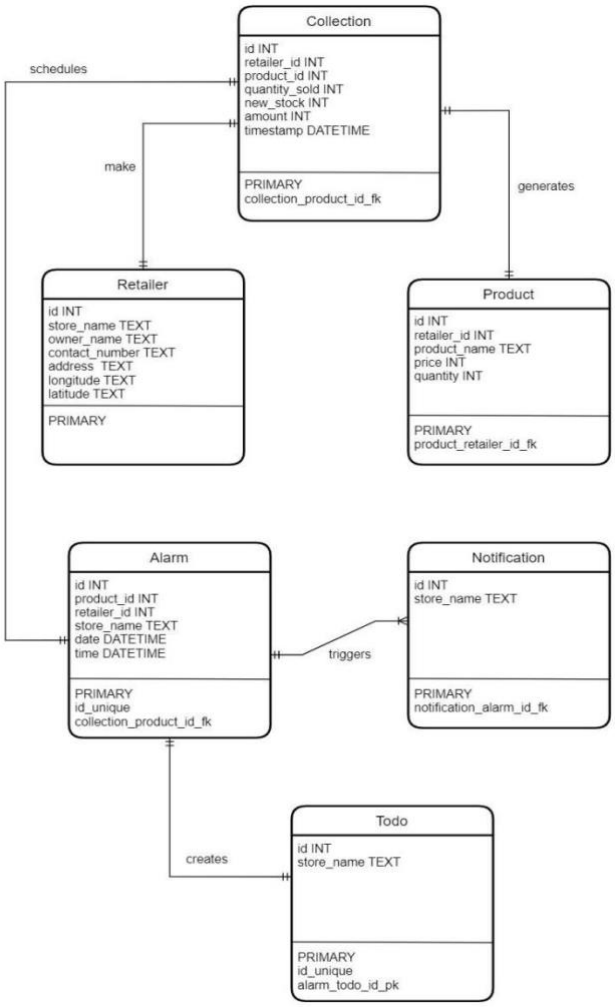


Figure 3: Database Design using ERD diagram

C Implementation and Development of Mobile Application

i. Architectural Framework and Component Design

The proposed mobile application was developed natively for the Android platform using Java within the Android Studio integrated development environment (IDE). Following a modular separation-of-concerns approach, the application codebase was organised into distinct package layers as follows:

- Models: Encapsulate domain-specific data structures and represent information related to retailer profiles, financial records, products, and scheduling events.
- Views, Activities and Fragments: Define the user interface components using XML-based layouts and provide modular screens for user interaction.
- Adapters and Utilities: Facilitate data binding between SQLite database query results and user interface list components, while also supporting application utilities and background system services.

Build dependencies and core libraries, including the Google Maps Android SDK, were managed through Gradle configuration files within the Android Studio development environment. The application was tested in virtualized Android environments across different screen densities and API levels to evaluate layout responsiveness and resource-management stability before deployment on physical devices.

ii. Data Management with Embedded Relational Engine

To ensure offline availability and local data autonomy for field distributors, data persistence was implemented using the embedded SQLite relational database engine. Database lifecycle management, including schema creation, transactional queries, and version control, was implemented by extending the native SQLiteOpenHelper framework.

- The onCreate() method initializes the relational database tables for retailer profiles, itemized invoices, receipts, and appointment records.
- The onUpgrade() method manages database schema migrations when the database version is updated while preserving existing user data.
- Data access operations use parameterized SQL queries and database cursors to reduce the risk of SQL injection and facilitate efficient retrieval of dynamic data for user interface rendering.

iii. Geolocation Services and Interactive Mapping Logic

Location-based services and interactive navigation support were implemented through integration with the Google Maps API, with API authentication configured using secured API keys within the application.

The geolocation subsystem operates using two types of geographic coordinates:

- Target Store Localization: Geographic coordinates (latitude and longitude) stored within the local SQLite database are fetched via cursor objects and processed through a spatial coordinate converter. The onLocationChanged() listener dynamically converts these spatial metrics into visual markers overlaid on interactive Map Fragments, moving the viewport camera to Centre on the destination outlet.
- Real-time User Position Tracking: The application requests system-level GPS location providers to compute real-time device positioning. Distinct visual iconography separates the user's dynamic coordinates from static store target markers, reducing spatial confusion during active field delivery and route execution.

iv. Managing Appointments with System Alarm, To-do List and Notifications

To reduce the likelihood of missed payment collections and support recurring collection schedules, the application incorporates a multi-layered background notification architecture using native Android system services.

- Temporal Event Triggering: The AlarmManager system service is leveraged to schedule temporal events. User inputs from UI date and time pickers are converted into Unix epoch timestamps (in milliseconds). Unique request codes are assigned to each store to prevent conflicts between scheduled intents and notifications.
- Background Notification and Alert Pipeline: Upon reaching designated timestamps, an Intent broadcast triggers a custom BroadcastReceiver (onReceive() hook). This receiver executes an automated alert pipeline combining three distinct notification layers:
    - Visual: Generates stacked, persistent system notifications using unique notification IDs, allowing field agents to view multiple store appointments concurrently without data loss.
    - Auditory: Invokes the MediaPlayer service to stream device-default ringtones for audible alerting.
    - Haptic: Activates the hardware Vibrator service (governed by manifest permissions) for immediate sensory feedback.
- Stateful To-Do Task Generation: Event intents are parsed via Dynamic Uniform Resource Identifier (URI) parsing to instantly generate a stateful daily task checklist within the

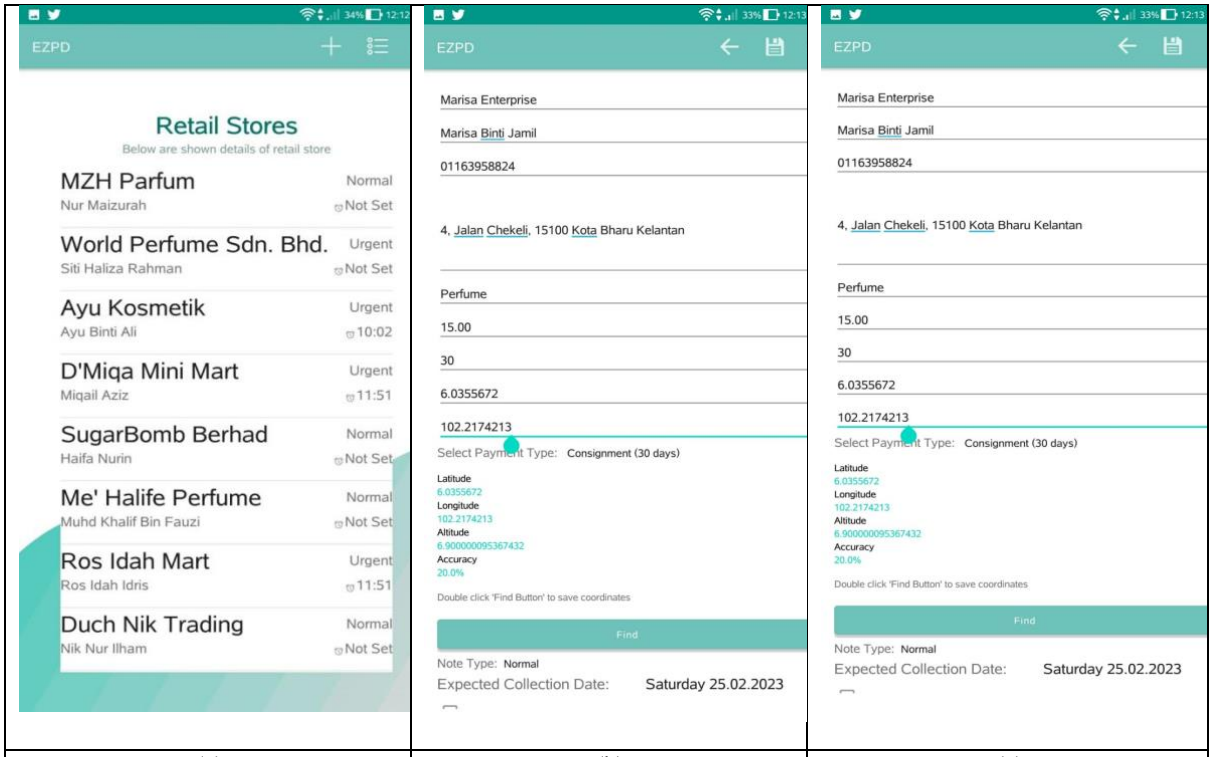
application. Once a distributor completes a retail store visit and payment collection, the task state is updated interactively, ensuring accurate progress tracking across active delivery routes.

4 Mobile Application for Distributors

This section presents the mobile application developed for field distributors.

A Managing Retail Store Data

The application's primary interface provides a dynamic list of active retail accounts, categorized by urgency status (*Normal* or *Urgent*) alongside scheduled alert timestamps (**Figure 4a**).



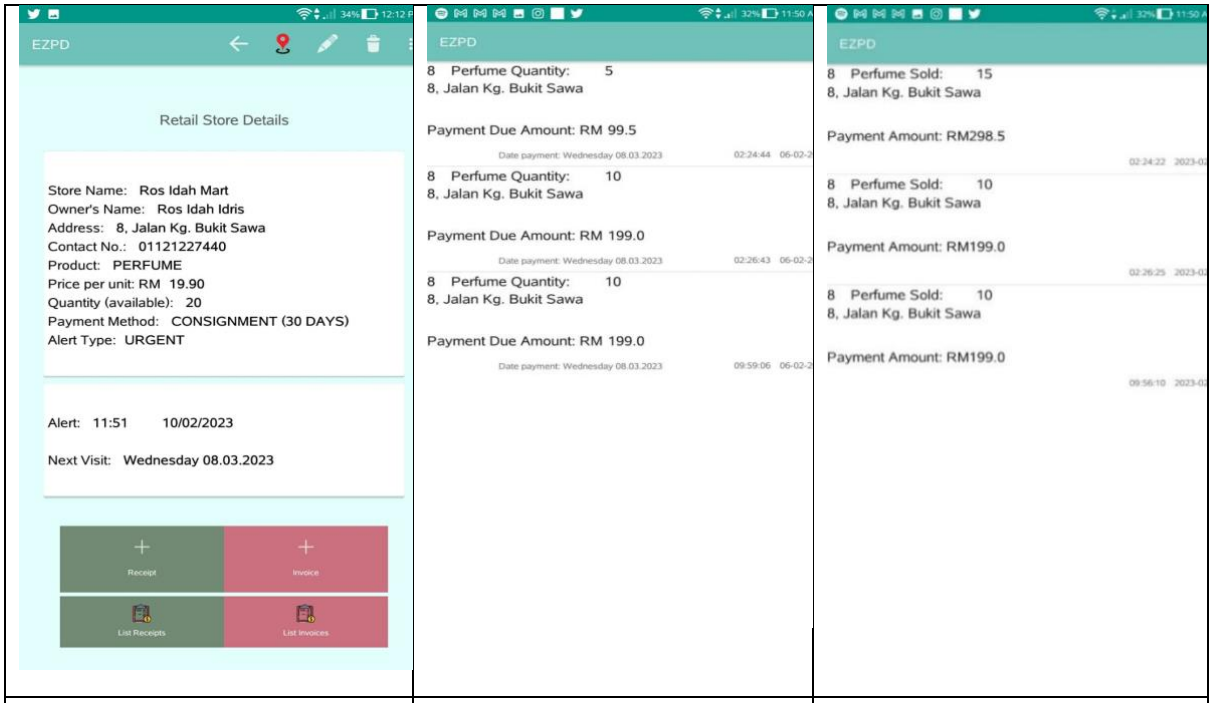
(a) (b) (c)

Figure 4: EZPD Retail Outlet Management: (a) Homepage featuring categorized store entries and active alert status; (b) Store profile entry view; (c) Dynamic GPS latitude and longitude coordinate retrieval module.

During retail store registration (Figure 4b), field distributors enter essential operational information, including the store name, owner's details, contact information, product unit price, available stock quantity, and payment terms (e.g., *Consignment – 30 days*). Spatial coordinate registration is supported by the integrated Google Maps location framework (Figure 4c). The process consists of the following steps:

- Executing the coordinate fetch action invokes the device GPS hardware to retrieve real-time latitude, longitude, and accuracy metrics.
- Spatial metrics populate the coordinate fields directly, eliminating manual entry errors and establishing accurate destination nodes for downstream route generation.

To replace paper-based transaction records, the application provides modular receipt and invoice generation features that are integrated directly into individual retailer records (Figure 5).



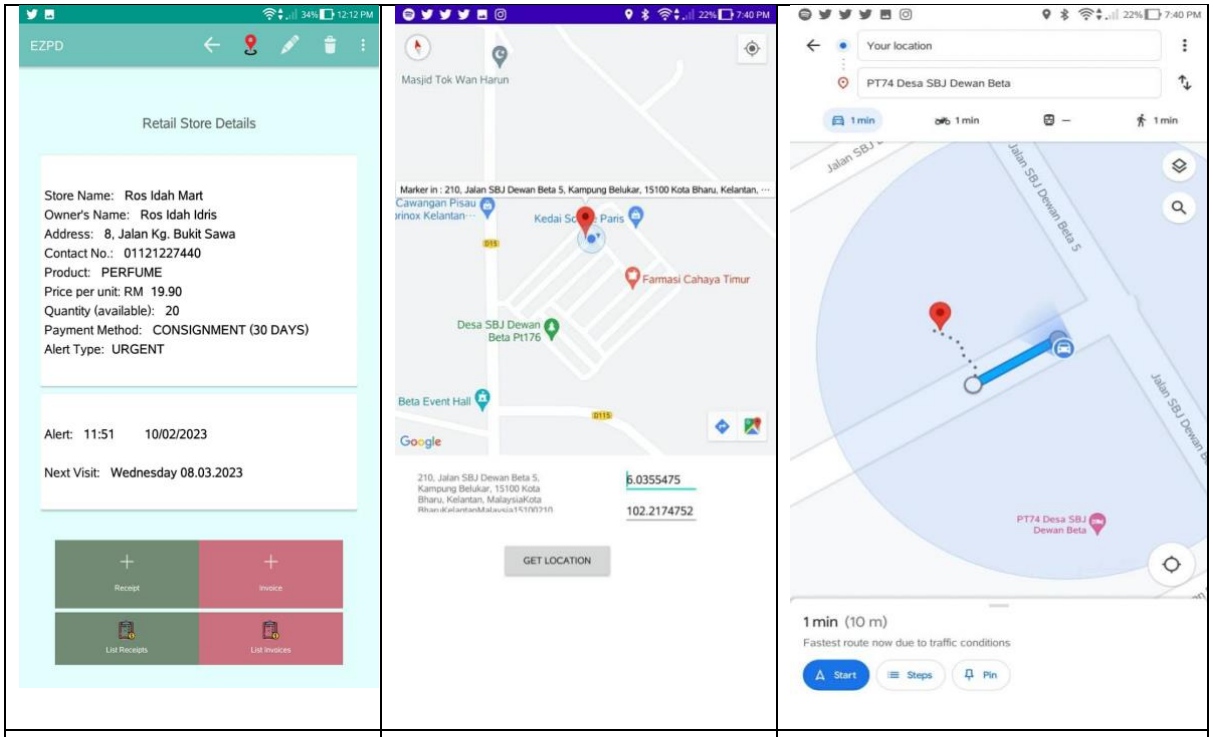
(a) (b) (c)

Figure 5: EZPD Financial Transaction Subsystem: (a) Retail store operational menu; (b) Receipt generation view; (c) Invoice generation view

- Receipt Generation: To record field sales transactions, distributors select the relevant retailer and enter the quantity of perfume sold (Figure 5a). The application calculates the total payment due based on the pre-configured product pricing and stores the transaction in the local SQLite database.
- Invoice Generation: When restocking retail accounts, distributors generate dynamic billing notes (Figure 5a), logging new inventory additions and setting future collection obligations.
- Document Ledger and Audit Trail: Generated receipts and invoices are stored in an indexed ledger (Figure 5b and Figure 5c). Distributors can audit payment histories, inspect outstanding consignment balances, and verify historical payment dates directly from field locations without an internet connection.

B Location and Routing of the Retail Store

To eliminate delivery delays caused by address misidentification and manual entry errors, the application incorporates a dedicated geolocation and route visualization subsystem (**Figure 6**).



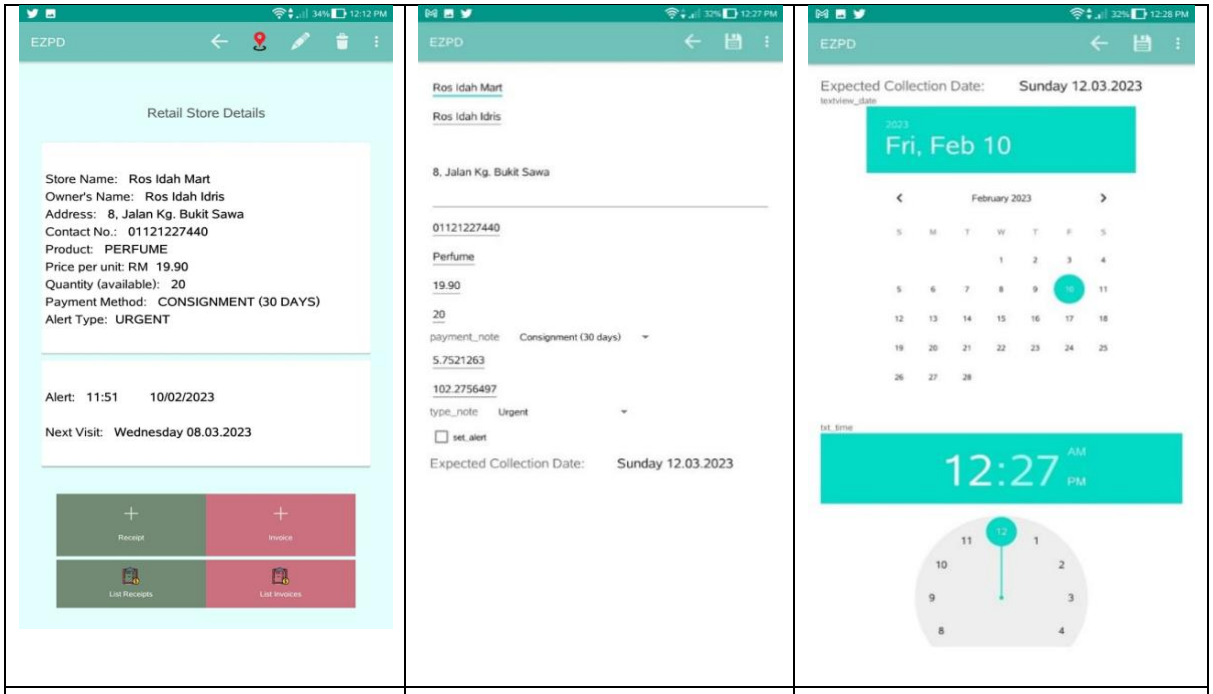
(a)	(b)	(c)

Figure 6: EZPD Geolocation and Routing Module: (a) Retail store details view; (b) Reverse geocoding interface showing the store location and coordinates; (c) Google Maps turn-by-turn navigation.

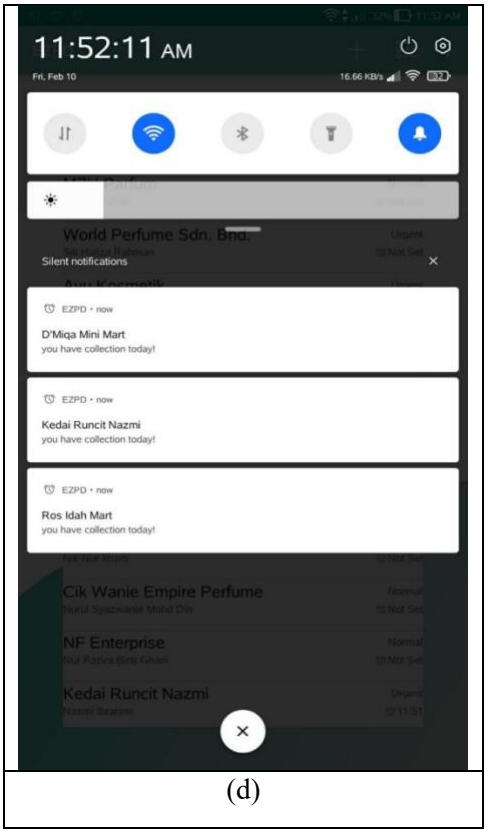
- Spatial Coordinate Retrieval: Interfacing with the location action from a store details view (Figure 6a) triggers the spatial converter module. As shown in Figure 6b, the system fetches the stored geographic coordinates (latitude: 6.0355475, longitude: 102.2174752) and uses reverse geocoding to resolve and display the corresponding physical street address (e.g., Jalan SBJ Dewan Beta 5, Kota Bharu).
- Interactive Map Pinning: The embedded Google Maps SDK Centres the viewport camera on the target outlet using dynamic visual markers (Figure 6b), allowing field distributors to visually verify the retail location prior to dispatch.
- Turn-by-Turn Navigation Launch: Selecting the route function launches the native Google Maps application (Figure 6c) with the relevant origin and destination parameters. Google Maps then provides navigation information, including route options, estimated travel distance and duration (e.g., 1 min / 10 m), and available traffic information, thereby supporting more efficient field delivery cycles.

C Managing Appointments

To resolve delays in collection cycles and prevent missed retailer visits, the application provides an automated appointment management and notification subsystem (Figure 7).



(a) (b) (c)



(d)

Figure 7: EZPD Scheduling and Notification Module: (a) Store management detail view; (b) Integrated DatePicker and TimePicker temporal input controls; (c) System notification tray presenting stacked appointment alerts; (d) Stateful daily collection task checklist.

- Temporal Parameter Configuration: Through the store modification interface (Figure 7a), field distributors configure upcoming collection windows and payment deadlines. The system presents native DatePicker and TimePicker dialogs (Figure 7b) to capture explicit calendar dates (e.g., Sunday, 12.03.2023) and time parameters (e.g., 12:27 PM).

- Background Scheduling Engine: Once confirmed, temporal values are parsed into Unix epoch milliseconds and registered with the Android AlarmManager service. To avoid intent collisions when multiple appointments coincide, the system assigns a unique entity request code to each scheduled event.

- Notification and Alert Execution: Upon reaching designated timestamps, background broadcast receivers invoke a multi-channel alert pipeline (Figure 7c). The application generates persistent notifications containing the retail store's name and collection information. Simultaneously, dynamic URI intent parsing populates these events into a consolidated daily to-do checklist, enabling distributors to track visit completions systematically across their active field routes.

5 Empirical Testing and System Validation

The operational validity of the Smart Mobile Application for Perfume Distributors (EZPD) was evaluated through a two-part empirical assessment. The first component involved Black-Box Functional Testing to verify the functionality and stability of the application's core features. The second component employed a Hybrid Usability Evaluation Framework combining SUS, TAM, and UAT principles to assess user usability, acceptance, and satisfaction.

A Functional Specification Verification

Black-box functional testing was conducted under realistic operational scenarios to evaluate the functional readiness of the application's ten core modules. Each functional module was evaluated based on predetermined input parameters, expected system behaviours, and observed outcomes.

Table 3: Result of Functional Testing

No	Functions	Expected Result	Actual Result	Result
1.	Add the new retail store	Users can enter the details of a new retail store.	The retail store is added successfully.	Pass
2.	Find the location of the new retail store	Users can get the latitude and longitude coordinates of the retail store.	Latitude and longitude coordinates are fetched successfully with high accuracy.	Pass
3.	Add and view invoices	Users can add new invoices and view all available invoices.	Invoices are added and displayed successfully.	Pass
4.	Add and view receipts	Users can add new receipts and view all available receipts.	Receipts are added and displayed successfully.	Pass
5.	Set an appointment	Distributors can set date, day and time for collecting payment and restock perfumes.	Appointment details are set accordingly.	Pass
6.	Set an alarm for the appointment	Distributors can choose to activate the alert for the appointments.	Notification will appear on the day of the appointment.	Pass
7.	View the to-do list	Distributors can view a to-do list on chosen date.	A to-do list is displayed for the selected date.	Pass

Table 3: Result of Functional Testing *cont…*

No	Functions	Expected Result	Actual Result	Result
8.	View the retail store location and route for visits	Distributors can view location of the retail store and get the route to the retail store.	A map appears with location of the retail store and route to the store from distributors' current location.	Pass
9.	Delete the retail store in to-do list after visiting	Distributors can delete the retail store from the to-do list after completing visit to the store.	The retail store is deleted from the to-do list.	Pass
10.	Edit and delete the retail store information	Distributors can update or delete the retail store information as required.	The retail store data are updated or deleted accordingly.	Pass

As detailed in Table 3, all ten core functional modules achieved a 100% pass rate. These results demonstrate that the tested functions, including data persistence, external API integration, background event handling, and transaction calculation, operated as expected. No functional failures were observed during the test cases.

B Hybrid Usability Framework Evaluation

To measure user perception and practical adoption, field distributors ($N = 5$) evaluated the application across active distribution routes before responding to a structured 10-item questionnaire scored on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

Table 4 presents the overall results of the usability evaluation, indicating a generally positive level of user satisfaction with the mobile application's design, functionality, and practicality for managing product distribution and retail store data. The User Interface Design category received high ratings for text readability (4.7) and non-distracting backgrounds (4.6), suggesting that users perceived the interface as visually clear and easy to use.

For Usefulness and Ease of Use, the scores ranged from 4.1 to 4.3, indicating that users generally perceived the application as useful for reducing manual work and minimising errors in distribution-related tasks. The Usability scores, which ranged from approximately 4.0 to 4.5, further indicate positive perceptions of the application's functionality and ease of interaction, particularly regarding button usability and the expected behaviour of its features. Overall, the findings suggest that the application demonstrates positive usability characteristics and practical potential for supporting individual distributors in managing distribution activities through a mobile-based platform.

As illustrated in **Figure 8**, cross-category analysis reveals strong user acceptance across all three operational dimensions:

- **User Interface Design ($\mu = 4.38$):** Achieved the highest domain rating. Exceptional feedback on text legibility (Q3, $\mu = 4.70$) and background visual layout (Q2, $\mu = 4.60$) confirms that the visual design minimizes cognitive load during field use. The lower relative score on interface clarity (Q1, $\mu = 3.90$) indicates an opportunity for minor layout simplification in future iterations.

- **Usefulness and Ease of Use ($\mu = 4.20$):** High ratings for error reduction (Q5, $\mu = 4.30$) and overall field utility (Q7, $\mu = 4.30$) confirm that replacing legacy paper logs with localised cloud persistence provides tangible operational benefits for field agents.

- **System Usability ($\mu = 4.18$):** Strongly anchored by intuitive button design and control responsiveness (Q9, $\mu = 4.50$), demonstrating that core interactions are easy to execute without requiring extensive user training.

Table 4: Mean Score for Each Question

Category	Item	Mean Score	Interpretation
User Interface Design	Q1	3.9	Users generally find the interface understandable, though there may be room for slight improvement in clarity or layout.
	Q2	4.6	Strong agreement that the background design is unobtrusive and supports usability – this is a well-optimized visual element.
	Q3	4.7	Excellent readability: users are highly satisfied with the clarity and legibility of text in the app.
Usefulness and Ease of Use	Q4	4.1	Users agree the app helps eliminate manual processes, though some may still rely on hybrid methods.
	Q5	4.3	Strong perception that the app improves efficiency and accuracy in retail data management.
	Q6	4.1	Users feel confident managing tasks via mobile, though some may desire desktop or multi-device support.
	Q7	4.3	High usefulness rating; users find the app genuinely supportive in their daily distribution tasks.
Usability	Q8	4.0	Users are generally satisfied with available features, though some may expect additional tools or refinements.
	Q9	4.5	Very positive feedback on button design and usability – this is a strength of the interface.
	Q10	4.1	Users are broadly satisfied with the app's capabilities, indicating good alignment with expectations.

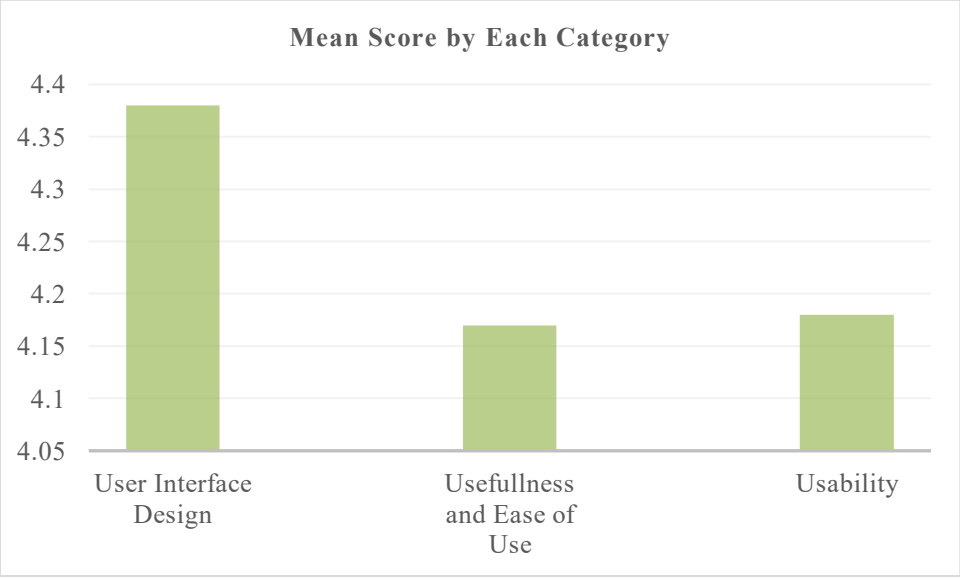


Figure 8: Mean Score for Each Category

6 Conclusion

This research introduced the Smart Mobile Application for Perfume Distributors (EZPD), a localised field-distribution solution developed using the MADLC methodology to address operational challenges in niche distribution environments. Traditional field-distribution practices that rely on paper-based documentation, static spreadsheets, and manual route planning can contribute to data-entry errors, fragmented records, and inefficient delivery operations. By integrating local SQLite database storage, Google Maps API-based location services, and an automated AlarmManager appointment and notification system within a single mobile platform, the study demonstrates the feasibility of digitising and streamlining key field-distribution activities without relying on complex enterprise-level infrastructure.

The functional reliability and practical utility of the proposed application were evaluated through a two-phase assessment framework. Black-box testing achieved a 100% pass rate across the ten core operational modules, including invoice and receipt generation, geographic coordinate retrieval, reverse geocoding, navigation, and background notification alerts. Furthermore, the empirical usability evaluation, conducted using a hybrid SUS-TAM-UAT framework ($N = 5$) yielded an overall mean score of 4.25 out of 5.00 (85%), indicating a positive level of user satisfaction. High ratings were also recorded for User Interface Design ($\mu = 4.38$) and operational usefulness ($\mu = 4.20$). These findings demonstrate that the integration of location-based services with automated payment-collection and appointment-scheduling functions can support more efficient field-distribution workflows, reduce reliance on manual administrative processes, and assist distributors in managing recurring collection schedules.

A Academic and Industrial Contributions

- Architectural Integration: Contributes a lightweight application architecture that unifies document management, location-based mapping, and calendar scheduling into a single mobile engine tailored for field intermediaries.
- Operational Efficiency: Demonstrates how embedded spatial geocoding and temporal background alerts can help reduce navigation errors and missed payment-collection appointments.

B Future Work and Scalability

While the current implementation successfully serves individual perfume distributors operating in offline environments, future research will investigate the scalability of the system through the following enhancements:

- Cloud Synchronisation and Multi-User Dashboards: Integrating real-time cloud synchronisation using Firebase or RESTful APIs to support dynamic data sharing between multi-agent field teams and central managers.
- Automated Route Optimisation Algorithms: Implementing the Traveling Salesperson Problem (TSP) optimisation routines to dynamically order daily multi-destination store visits for minimal fuel consumption.
- Cross-Industry Domain Adaptation: Extending the underlying database and workflow architecture to support other niche, field-based consignment industries such as pharmaceuticals, cosmetics, and specialty food distribution.

Acknowledgements

The authors would like to express their gratitude to the Universiti Teknologi MARA (UiTM) Kelantan Branch for its support throughout this research.

Conflict of Interest Statement

The authors declare that they have no personal, commercial, or financial conflicts of interest related to this research.

Author Contributions

The first author was responsible for the development and implementation of the mobile application. The second author contributed to the Abstract, Literature Review, and Methodology sections. The third author contributed to the Results section. The fourth author contributed to the Conclusion and References sections. The fifth author was responsible for manuscript formatting, proofreading, and editing. All authors reviewed and approved the final manuscript.

References

[1] A. A. Tubis, K. Grzybowska, and B. Król, "Supply chain in the digital age: A scientometric–thematic literature review," Sustainability, vol. 15, no. 14, Art. no. 11391, 2023. doi: 10.3390/su151411391.

[2] [2] J. T. Mentzer, W. DeWitt, J. S. Keebler, S. Min, N. W. Nix, C. D. Smith, and Z. G. Zacharia, "Defining supply chain management," Journal of Business Logistics, vol. 22, no. 2, pp. 1–25, 2001. doi: 10.1002/j.2158-1592.2001.tb00001.x.

[3] A. Rey, E. Panetti, R. Maglio, and M. Ferretti, "Determinants in adopting the Internet of Things in the transport and logistics industry," Journal of Business Research, vol. 131, pp. 584–590, 2021. doi: 10.1016/j.jbusres.2020.12.049.

[4] [1] C. L. Garay-Rondero, J. L. Martínez-Flores, N. R. Smith, S. O. Caballero Morales, and A. Aldrette-Malacara, "Digital supply chain model in Industry 4.0," Production Planning & Control, vol. 31, no. 11–12, pp. 887–933, 2020. doi: 10.1080/09537287.2019.1631468.

[5] D. Ivanov and A. Dolgui, "A digital supply chain twin for managing the disruption risks and resilience in the era of Industry 4.0," Production Planning & Control, vol. 32, no. 9, pp. 775–788, 2021. doi: 10.1080/09537287.2020.1768450.

[6] K. Govindan, D. Kannan, T. B. Jørgensen, and T. S. Nielsen, "Supply Chain 4.0 performance measurement: A systematic literature review, framework development, and empirical evidence," Transportation Research Part E: Logistics and Transportation Review, vol. 164, Art. no. 102725, 2022. doi: 10.1016/j.tre.2022.102725.

[7] V. Silva, A. Amaral, and T. Fontes, "Sustainable urban last-mile logistics: A systematic literature review," Sustainability, vol. 15, no. 3, Art. no. 2285, 2023. doi: 10.3390/su15032285.

[8] S. Lauenstein and C. Schank, "Design of a sustainable last mile in urban logistics—A systematic literature review," Sustainability, vol. 14, no. 9, Art. no. 5501, 2022. doi: 10.3390/su14095501.

[9] M. Bertolini, G. De Matteis, and A. Nava, "Sustainable last-mile logistics in economics studies: A systematic literature review," Sustainability, vol. 16, no. 3, Art. no. 1205, 2024. doi: 10.3390/su16031205.

[10] R. Bekker, B. Bharti, L. Lan, and M. Mandjes, "A queueing-based approach for integrated routing and appointment scheduling," European Journal of Operational Research, vol. 318, no. 2, pp. 534–548, 2024. doi: 10.1016/j.ejor.2024.05.038.

[11] A. Sasi, T. Subramanian, and S. K. Ravichandran, "Systematic literature review on Industry Revolution 4.0 to enhance supply chain operation performance," in Proc. Int. Conf. on Computers and Management (ICCMB), 2022, pp. 173–179. doi: 10.1145/3512676.3512705.

[12] M. Hussain, W. Javed, O. Hakeem, A. Yousafzai, A. Younas, M. J. Awan, H. Nobanee, and A. M. Zain, "Blockchain-based IoT devices in supply chain management: A systematic literature review," Sustainability, vol. 13, no. 24, Art. no. 13646, 2021. doi: 10.3390/su132413646.

[13] R. Bahrini and A. A. Qaffas, "Impact of information and communication technology on economic growth: Evidence from developing countries," Economies, vol. 7, no. 1, Art. no. 21, 2019. doi: 10.3390/economies7010021.

[14] S. Zhang, Q. Yu, S. Wan, H. Cao, and Y. Huang, "Digital supply chain: Literature review of seven related technologies," Manufacturing Review, vol. 11, Art. no. 8, 2024. doi: 10.1051/mfreview/2024006.
[15] M. Wronikowska et al., "Systematic review of applied usability metrics within usability evaluation methods for hospital electronic healthcare record systems," Journal of Evaluation in Clinical Practice, vol. 27, no. 6, pp. 1403–1416, 2021. doi: 10.1111/jep.13582.
[16] P. Vlachogianni and N. Tselios, "Perceived usability evaluation of educational technology using the System Usability Scale (SUS): A systematic review," Journal of Research on Technology in Education, vol. 54, no. 3, pp. 392–409, 2022. doi: 10.1080/15391523.2020.1867938.
[17] P. Kortum, C. Ziegler Acemyan, and F. L. Oswald, "Is it time to go positive? Assessing the positively worded System Usability Scale," Human Factors, vol. 63, no. 6, pp. 1029–1041, 2021. doi: 10.1177/0018720819881556.
[18] Y. Liu, X. Lu, G. Zhao, C. Li, and J. Shi, "Adoption of mobile health services using the unified theory of acceptance and use of technology model: Self-efficacy and privacy concerns," Frontiers in Psychology, vol. 13, Art. no. 944976, 2022. doi: 10.3389/fpsyg.2022.944976.
[19] S. Srirojanakul and P. Kamkankaew, "Investigating the endorsement of the technology acceptance model for mobile banking: The case of Lampang Province, Thailand," Journal of Management, Economics, and Industrial Organization, vol. 6, no. 2, pp. 28–47, 2022. doi: 10.31039/jomeino.2022.6.2.3.
[20] Y. Tian and T. J. Chan, "Predictors of mobile payment use applications from the extended Technology Acceptance Model: Does self-efficacy and trust matter?" SAGE Open, vol. 14, no. 4, 2024. doi: 10.1177/21582440241292525.
[21] Google Developers, "Geocoding API documentation," Google Maps Platform. [Online]. Available: https://developers.google.com/maps/documentation/geocoding. Accessed: Sep. 22, 2026.
[22] Android Developers, "Schedule alarms," Android Developers. [Online]. Available: https://developer.android.com/develop/background-work/services/alarms. Accessed: Sep. 22, 2026.
[23] Android Developers, "AlarmManager," Android API Reference. [Online]. Available: https://developer.android.com/reference/android/app/AlarmManager. Accessed: Sep. 22, 2026.
[24] Android Developers, "Schedule exact alarms are denied by default," Android Developers. [Online]. Available: https://developer.android.com/about/versions/14/changes/schedule-exact-alarms. Accessed: Sep. 22, 2026.
[25] Zoom, "ZooM Retail & Distributor," Zoom. [Online]. Available: https://www.zoom.com/en/industry/retail/. Accessed: Sep. 22, 2026.
[26] MaxMobility Pvt. Ltd., "GoSales—Mobile sales force automation and distributor management system," MaxMobility. [Online]. Available: https://www.maxmobility.in/products/gosales.php. Accessed: Sep. 22, 2026.
[27] SalesDiary, "SalesDiary—Field sales automation app," SalesDiary. [Online]. Available: https://salesdiary.com/. Accessed: Sep. 22, 2026.
[28] T. Vithani and A. Kumar, "Modeling the mobile application development lifecycle," in Proceedings of the International MultiConference of Engineers and Computer Scientists (IMECS 2014), vol. 1, Hong Kong, Mar. 2014, pp. 596–600. [Online]. Available: https://www.iaeng.org/publication/IMECS2014/IMECS2014_pp596-600.pdf. Accessed: Sep. 22, 2026.