



Sales Force Mobile Application for Arpico Local Manufacturing and Distribution Sector

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ABSTRACT

The business systems in today's world have become increasingly distributed and the mobile devices have become a very important tool at the enterprise stage. Compared to traditional server-based systems, the mobile extensions bring the business environment to a new array with its capability of having a large amount of processing power. As a result of this sales forces represent both a direct link to sales and expenses of sales organizations and therefore have a high impact on companies' profitability. Therefore businesses have constantly endured the challenge of getting their field force to adopt enterprise Sales Force Automation [SFA] systems.

Richard Pieris and Company PLC having over fifty to hundred salespeople spread over the island in their Arpico Local Manufacturing and Distribution (LMD) sector, the order placing is done manually. The placement of orders is a main job in the company and due to the manual maintenance, the process is not efficient. Most of the times the customers do not get a clear picture on how much of stocks are available exactly and even the salesperson is also sometimes not so sure about it since there are many other sales personnel who are doing sales at the same time. Therefore as a result sometimes the customers are not happy with the service that is being provided since sometimes there could be orders placed but without having stocks at hand. At times like these to deliver the goods will get delayed. Sales Force Automation (SFA) and Customer Relationship Management (CRM) systems create a new platform for a business to overcome past pain-points and to manage the customer pipeline information better.

The project looks on how an SFA system can be implemented to LMD sector of the Richard Pieris & Company to achieve efficiency and effectiveness of the sales process. The Proposed system has many facilities such as order capturing at dealer level and flow the orders to company main Enterprise Resource Planning (ERP), keep track of sales force by location tracking and route planning for sales force. Furthermore, company's basic requirements are primarily centered on a mobile dashboard application that allows real-time monitoring of sales figures and Key Performance Indicators (KPIs), provide customizable dashboard views, real-time access to the latest data from the server, display information visually in the form of interactive charts and other details.

This system develops on android platform and programming languages such as PHP and Java is been used. Also for the front end scripting languages like JQuery, JQMobile & Java Scripts is also used along with MySQL database.

SFA system is mobile based because sales force can login to the system and enter sales orders from anywhere anytime even though they do not have an internet connection. To achieve this advantage it is decided to follow mobile based application.

Through the proposed solution, The Company expects to analyze better sales forecasting and improve the performance of the sales process by automating manual work and also provides fulltime control over the salespersons. The system directly helps to increase productivity and helps to provide a better customer service island wide and by localizing the system. This system is mostly useful for the sales teams who are functioning in rural areas.

DECLARATION

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge, it does not contain any material published or written by another person, except as acknowledged in the text.

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LIST OF ACRONYMS

CRM	-	Customer Relationship Management
CSS	-	Cascading Style Sheets
ERP	-	Enterprise Resource Planning
HTML	-	Hypertext Markup Language
HTTPS	-	Hypertext Transfer Protocol Secure
IT	-	Information Technology
IMEI	-	International Mobile Equipment Identity
NFR	-	Non-Functional Requirement
PHP	-	Hypertext Pre-Processor
RD	-	Re-Distribution
RUP	-	Rational Unified Process
SFA	-	Sales Force Automation
SRS	-	Software Requirement Specification
TBD	-	To Be Determined
UML	-	Unified Modeling Language
XAMPP	-	Cross-platform, Apache, MariaDB, PHP, and Perl

1 INTRODUCTION

The inception of the information technology age is associated with revolution just as the industrial revolution marked the emergence of the industrial age [1]. In this era of information technology craze, there is an increasing interdependence between an organization's ability to adapt information technology and its ability to implement effectively corporate strategies to achieve short, medium and long term corporate objectives. Organization's' strategic objectives and their business processes are undergoing important and volatile changes. The shifting winds of modification in today's business surroundings have created information systems and data technology very important parts that facilitate keep associate degree enterprise heading in the right direction to fulfill its business goals.

The consumer-oriented products and services are very competitive worldwide. Therefore companies thrive for excellence in order to win over the consumer. In doing so the companies need to look at the total value chain to deliver the best product range at the lowest cost in the quickest time. Sales and distribution is a very important aspect of a consumer-centric organization's value chain. It is sales and distribution that makes the final contact with the end consumer who is considered as the "king". Hence creating an efficient and effective sales and distribution process is imperative for the success of an organization.

Sales forces represent both a direct link to sales and expenses of sales organizations and therefore have a high impact on companies' profitability. Sales Force management has been discussed for many decades however, within creasing market competitiveness sales organizations are, more than ever, feeling the pressure to meet sales targets or grow revenues and profits. Technology advances have in the last few years allowed organizations to acquire and implement information systems capable of improving their sales teams' performance and profitability, but the labor world has evolved from the confines of the office and sales professionals now require access to colleagues, customers, and suppliers, on the go. With the advent of mobile computing devices and wireless broadband networks new automation and management possibilities arise for sales forces to improve their work even more. These developments are present in the field of sales management as some specific software have been developed to enhance selling efficiency. Notable is the Sales Force Automation application. Sales Force Automation can essentially be described as the application of information technology to support salespeople in their selling and administrative activities [2].

Richard Pieris and Company PLC embraces a rich heritage of over 85 years and is one of the largest and most successful diversified business conglomerates in Sri Lanka. With its unique and acclaimed brand identity of "Arpico", the Group which comprises 35 subsidiaries across many sectors such as Re-Distribution, Rubber, Tyre, Plantations, Plastics, Retail and Distribution, Financial Services, Insurance, Health Care, Stock Broking, Interiors, Construction, and Logistics.

Arpico Local Manufacturing and Distribution (LMD) sector of the company, distributes products island-wide through a network of distributors and dealers. The distribution channel is one of the largest in the Country, catering to over five thousand hardware & furniture outlets island-wide. The sector's product portfolio includes products such as Mattresses, water tanks, cushions and sheets, rigifoam products, PVC pipes and fittings, water pumps, CFL bulbs, wooden / panel and PU furniture, day to day consumer durables as well as industrial and domestic rubber products. It also offers industrial roller products and printing roller products on a B2B basis.

They are now planning to expand the business by adding more distributors in the rural areas to their channel. Currently, they practice a manual sales and distribution process which has many negative elements such as delays, inaccurate data, room for fraud, customer dissatisfaction to name a few. This is a big drawback for an organization when competing in the “best to market” era.

To overcome above-mentioned drawbacks, it is proposed to develop an advanced Sales Force mobile application with real-time data capturing and updating which will enhance the effectiveness and efficiency of the sales and distribution process by many leaps and bounds. Through this mobile application, the organization could go to market with its product in a much shorter time span. Also, it's could improve its documentation and report with near zero mistakes. The Mobile application will also help an organization in its decision making with accurate information in real time that will be a definite competitive advantage in the modern business world.

1.1 Problem Domain

There are about 10 Strategic Business Units (SBU) under the LMD sector such as Arpitech (Pvt)Limited, RPC Polymers (Pvt) Limited, Plastishells Limited, Richard Pieris Rubber Products Limited, Arpico Durable (Pvt) Limited, The Arpico Furniture Distributors (Pvt) Limited, etc... Richard Pieris Group uses a tailor-made in-house developed ERP (Marksys)the system to handle its all IT operations. LMD sector uses its core modules such as Sales and Distribution, Inventory, Accounts Payable, Accounts Receivable, Manufacturing, Payroll.

Even though all the facilities are provided by the ERP to handle operations internally, the main problem is they do not have a proper system to capture the orders coming from the distributors around the country. Currently, sales orders from distributors are transferred to the marketing division of respective SBU via email or over the phone. LMD sector is catering to over five thousand hardware & furniture outlets island-wide. Efforts were drawn to expand the business operations of the sector by exploring new markets to grow its geographical presence. Hence without a proper system to capture orders, all SBUs are facing lot of drawbacks.

There are about 100Sales representatives in all SBUS and they are responsible for taking orders from the distributors. Since all the orders are taken over the phone or via email, there is a possibility that the marketing division may miss out some orders. Due to this, some orders will not be converted into invoices, which will directly affect the company revenue. Since there's no system for customers to track their orders and delays in the process in middle will ultimately lead to customer dissatisfaction. Everyday sales representatives are given a route to follow but there's no record of the performance of the representatives as there is no proper system to capture those data. Also, there's no track of the inventory of customers and collections from customers are difficult to manage. Finance departments of the SBUs are facing difficulties in debtor management as well.

When the company expands its operations they need to hire more sales representatives. Commission for sales force cannot be implemented properly as well as their performance evaluations for promotions as there is no track of those data. Management of the company cannot make accurate decisions as they can't do a proper analysis of the market, products, and forecasting. Also, the management doesn't have up to date accurate data for the decision-making process.

1.2 Motivation

To overcome the above problems, the proposed sales force mobile application will be helpful. It automates the order capturing process and can plan and anticipate future demand in advance they can react immediately for their orders and speed up the process while making real-time decisions. Also, information technology and the internet are fast growing in the country.[3]

In modern trade, every business is facing challenges with the increase of competitiveness. At the moment Re-Distribution (RD) sector of the Richard Pieris Group is handling its sales orders manually. This causes several major problems and ultimately leads to a drop in sales and customer dissatisfaction. They are going to enhance their business within the next year by increasing the number of distributors around the country. Currently, most of the operations are done manually. Hence the company will not be able to cater to all distributors effectively. Therefore, it's better to start developing a solution for this matter at the mean-time. With competitiveness, they are looking for a new ordering system with new features. Considering their present situation a computerized system to track their orders and capture every sales order is a great opportunity to them. They can plan and anticipate for future demand, in advance they can react immediately for their orders and speed up the process while making real-time decisions.

1.3 Aims and Objectives

The main objective of the project is to streamline the ordering process of the distribution channel to enhance productivity and performance. The proposed system is a mobile application for the sales force in LMD sector of the Richard Pieris Group. Each and every sales representative will be given a tablet to collect orders from the distributors and then flow the orders to company ERP.

By automating this process, Company aim to keep track of the sales orders until it is converted into an invoice while maintaining accurate information about the company stock and customer stock. Furthermore, this mobile application will provide functionalities to properly manage the sales force and evaluate their performance daily. This will provide a platform where the management can make accurate and real-time decisions of their business based on the information.

Another aim is to capture offline orders. This is beneficial for rural areas. More orders can be captured in this manner; data will be synchronized to the cloud environment once the device is back online. Sales representatives will be able to communicate the order status and outstanding of the customers real time.

Objectives of the proposed system:

- Speed up the process and deliver goods to customers on time which leads to customer satisfaction.
- To maintain debtor information accurately in real time.
- Reduce paperwork and improve employee productivity by avoiding manual data gathering process.
- To enhance the productivity and performance of the ordering process and sales force.
- Link the Sales force commission depending on their performance.

1.4 Scope

The proposed mobile application ensures there is a common platform for all sales representatives to get sales orders from the customers. Each sales representative is allocated for a distributor. Therefore a tablet is assigned to a sales representative. Emi number of the tablet is assigned to a tab sequence which maps the sales representative to that particular tablet only. Since each sales representative is allocated for a distributor, item list & dealer list of the distributor will be downloaded to tablet in order to process an order.

Once the order is generated, data will be synced via cloud to the company ERP. This will provide real-time accurate information to both customers and the company by updating product information and debtor information. This application will also allow sales representatives to schedule their daily route plan.

As some distributors are located in rural areas sales force may face difficulties with the connectivity. However, this can be achieved by synchronizing data when the system goes online. The proposed mobile application will provide a dashboard to each sales representative, which includes weekly sale, collections & outstanding of customers, daily route, etc... Some other features available for the sales force are personalized push notifications for sales representatives to provide real-time information& display item catalogs to customers. The mobile application will also provide daily reports to sales force with sales information, collections & outstanding of customers. Moreover, for decision making purposes reports are available to top management such as analysis of the market, products, forecasting, debtor age analysis and performance evaluation of the sales force.

1.5 Thesis Structure

Section two will further describe the concepts such as, the impact of the Sales Force Applications to Company growth. How it benefits to increase company profitability and gain competitive advantage over competitors. This chapter includes the details about the technologies used to develop the application such as the languages, platform and the framework. Furthermore, section two has a critical review of the similar systems and the technologies which they have used to develop their applications. This has helped me a lot during building this application.

Chapter three includes the analysis and the design specification of the application such as requirement specification, functional and the nonfunctional requirements of this application. This chapter also includes the UML diagrams of the application such as Use Case diagram, Class diagram, and Sequence diagram. Finally the details about the design methodology used in this application are described here. This chapter also includes some of the interfaces.

Chapter four of the thesis describes the evaluation and testing process. This chapter is very important because it includes an interpretation of the data that has been gathered from the questionnaire which is distributed among the sales representatives. Test plan and some of the test cases which is produced for the application also displayed here.

Finally Chapter five concludes the thesis and describes lessons learned and the future works.

2 BACKGROUND

2.1 Introduction

The background chapter is mainly focused on similar systems which are currently available on the market. Its cloud-based applications for sales, service, marketing, and more, which don't require IT, experts, to set up or manage. The sales representative can simply log in and start connecting to customers in a whole new way. It offers solutions to sales representatives which gives the power of automation, accelerate the sales productivity, help to make insightful decisions with up-to-date data and it tracks agent behavior automatically as a result of the automation tracking system.

2.2 Business Background

Richard Pieris and Company PLC embraces a rich heritage of over 85 years and is one of the largest and most successful diversified business conglomerates in Sri Lanka. With its unique and acclaimed brand identity of "Arpico", the Group which comprises 35 subsidiaries across many sectors such as Rubber, Tyre, Plantations, Plastics, Retail and Distribution, Financial Services, Insurance, Health Care, Stock Broking, Interiors, Construction, and Logistics.

The Re-Distribution (RD) division distributes products island-wide through a network of distributors and dealers. It is the largest distribution channel in Sri Lanka to catering their over five thousand hardwires & furniture outlets which located island-wide.

This whole complex business network is automated by advanced ERP System called Marksys which developed by company IT division.

2.3 Overview of Current Process and Drawbacks

Currently, sales orders from distributors are transferred to the marketing division of RD via email or over the phone. Orders from the distributors and direct dealers are not captured via ERP. Hence without a proper system to capture sales orders Re-Distribution Company is facing the following problems.

- Some orders will not be converted into invoices as the orders are taken over the phone which will directly affect the company revenue.
- Since there's no system for customers to track their orders and delays in the process in middle will ultimately lead to customer dissatisfaction.
- Sales representatives are responsible for taking orders from the distributors and direct dealers. Every day they will be given a route to follow but there's no record of the performance of the representatives.
- There's no track of the inventory of customers and company.
- Collections from customers are difficult to manage.
- Commission for sales force cannot be implemented properly as well as their performance evaluations for promotions.
- Debtor management is difficult.
- Management of the company cannot make accurate decisions as they can't do a proper analysis of the market, products, and forecasting.
- As a result of the above drawbacks, the users can't get full advantage of the ERP system. It slows down the ultimate process speed which creates by ERP from both sides.

2.4 Review of similar Systems

2.4.1 SalesWorx:

SalesWorx is a mobile sales solution provided by Unique Computer Systems LLC which offers customizable customer & product information & customer visit management - a complete tool optimized for field sales professionals. [04]

This solution can be integrated into an Enterprise Resource Planning or Supply Chain Management solution via RESTful APIs and custom developed web services. Options include mobile sales order management, inventory auditing, call support, collection, returns, and signature capture and customer survey management. Unique Computer Systems offers an Application Framework for a mobile sales force, which ensures rapid application development and easy customization based on requirements.

Along with field sales, SalesWorx also addresses the planning and reporting requirements of management, through a responsive and flexible backend system, to assist them in better overseeing the performance of the mobile sales force and offers instant insight on areas for coaching individual sales performance.

This solution is compatible with iOS, Android, Windows Phone, as well as Windows Mobile. Their team is applying platform-specific best practices for both native and cross-platform development tools. For cross-platform development, they specialize in Appcelerator Titanium, and Xamarin.

They use open source technologies such as PHP, JSP, JavaScript, jQuery, JSON, HTML5, CSS for front end development and application server is Tomcat 8.5. For the back-end they use MySQL & SQLite.

2.4.2 miles | Empowering sales & marketing:

mSales, an SFA (Sales Force Automation) system, is a solution that can automate the distribution process using the profusely available mobile phones and tablets connected to their CRM (Client Relationship Management). The mSales will provide sales/ distribution staffs with the convenience of entering orders, invoicing and collecting payments via the SFA mobile app and facilitates real-time exchange of information between the field staff and corporate office. [05]

Using mSales, organizations will also be able to abstain from making manual errors, filling order copy or making tips to the office in order to submit or update orders. The automated system also allows the sales team to print invoices while on the move using a Bluetooth printer. The immediate order update leads update way to instant processing and order fulfillment which in turn leads to superior productivity, efficiency and customer service.

When combining with Negete's powerful back and system, mSales becomes the ultimate solution to any distribution or manufacturing organization. It can maintain stock/ pricing structures, obtain details reports on buying patterns or transactions and track team to see the what time and where deliveries have been made throughout the day.

The software makes your Sales Managers more efficient as they can now map out the sales teams' daily routine, from the time they pick up their inventory to, where they deliver goods / collect payments, up until the end of the day when they return unsold inventory, in turn reducing the time spent on day end activities. This leads to increased trader coverage enabling sales growth and scalability.

The mSales solution by Negete also offers better management of promotions and push strategy; area, brand or product wise thus, effectively engaged in marketing and promotional activities.

2.4.3 bpm'online:

Salesforce automation with bpm'online provides the agility to change sales force automation processes on-the-go. bpm'online SFA are backed by a powerful BPM engine, which enables design, execution, and modification of business processes in real time to stay tuned to the new business environment. With the help of an intuitive visual process designer, users can easily make necessary changes to existing processes, as there is no coding required. Bpm'online sales is a cloud-based CRM system for sales force automation to drive successful customer acquisition, development and retention. The solution has a set of built-in best practice sales processes that guide sales reps step-by-step through the most effective actions to liberate sales bottlenecks and get the most out of the sales pipeline. [06]

Moreover, bpm'online's SFA software enables users to connect sales processes with the lead generation pipeline, account management, and service delivery stages to ensure a positive and personalized experience for each customer.

Main features of this solution are Field sales management and Sales forecasting. Easily manage field sales reps by scheduling their visits and using geo-tags to monitor them in real-time and evaluate their efficiency. Manage all contracts in bpm'online sales and receive orders instantly during all meetings. By using bpm'online sales forecasting tools to predict sales volume and ensure meet, and even exceed sales quotas. The sales analytics tool will help to compare indicators across various time periods to accurately forecast sales.

Application is developed in cross-platform technologies like PhoneGap, Cordova, React Native, Flutter, NativeScript, etc... Furthermore, they use open source technologies like HTML5, JQuery, CSS3, Angular JS, and Angular Material.

2.4.4 SPEC INDIA's Flagship SFA Solution:

SPEC INDIA's flagship Mobile Sales Force Automation (SFA) Solution, ZooM, is focused on mobilizing and automating the routine activities of the sales force, customer executives and the field representatives who are on the move. It is developed exclusively to connect the mobile field sales force with the corporate back office and thereby, ensure a real-time, robust and comprehensive flow of information between both the entities. The result is a complete end-to-end field force management app focusing on integrating the planning and execution of field staff activities along with the availability of business-critical information right on time. [07]

Major focus areas of this solution are Pre-sales & Order Taking, Direct Sales / Van Sales, Automation, Marketing & BTL Activities, and Customized Survey / Feedback. This solution can be ported on Android OS compatible Smart Phones / Tablets, HTML 5.0 browser compatible mobile handsets. Connectivity to the back office is through GPRS, 3G mobile internet, Wi-Fi or Blue tooth (for slip printing). It is configurable to accommodate email integration, bar code scanner, push notifications and SMS integration. Also, it gets linked to the back office or any third-party legacy system with the use of customized web services or client-side APIs.

Application is developed in cross-platform technologies like Phone Gap, Cordova, React Native, Flutter, Native Script, etc... Furthermore, they use open source technologies like HTML5, JQuery, CSS3, Angular JS, and Angular Material.

2.4.5 ZooM – Mobile Sales Force Automation:

Salesforce is the Customer Relationship Management (CRM) platform. Its cloud-based applications for sales, service, marketing, and more don't require IT experts to set up or manage — simply log in and start connecting to customers in a whole new way. Sales force application from the company Salesforce. [08]

They offer solutions to sales representatives which gives the power of automation & AI, accelerate the sales productivity, help to make insightful decisions with up-to-date data and nurture leads so they're ready to convert, then automatically route them to the right reps at the right time. Track the effectiveness of marketing campaigns, easily.

Key features of this application are Collaborate instantly, Dashboards and Reports speed decision-making with real-time views for sales, service, marketing, and business performance, Organize your day, See urgent messages and With Sales Productivity apps, can quickly see where you are in the process and what's important at each stage, with only the most urgent information at the top.

It also provides the facility to build own custom apps with the talent user have. With App Cloud Mobile and Force.com, everyone can build mobile, Lightning-ready enterprise apps. Business users click to assemble apps, workflows, and data schemas quickly — while developers gain powerful new ways to use their favorite languages and frameworks. Also can build apps with App Cloud Mobile and automatically connect them to Salesforce data, while gaining access to flexible APIs that link to external data sources.

2.5 Critical Analysis of the Similar Systems

In the above section 2.1 describes the similar systems and some of their features. This compares these features with respect to the proposed system.

Features	SalesWorx	miles	bpm'onli ne	SPEC INDIA's	ZooM	Proposed System
Mobile Sales Order	Yes	Yes	Yes	Yes	Yes	Yes
Inventory Inquires	Yes	Yes	No	No	Yes	Yes
Call support	Yes	Yes	Yes	No	No	Yes
Daily Rotes	No	Yes	Yes	Yes	Yes	Yes
Import Document	Yes	Yes	No	No	No	Yes
Advanced analytics	No	No	Yes	Yes	Yes	Yes
Backup& Restore	No	No	No	No	No	Yes
Offline Working	No	No	No	No	No	Yes

Table 2.1: Critical analysis of the proposed system & existing systems

2.6 Implementation Tools and Technologies

The latest java technologies are used to develop & implementation the proposed system which called "sales force". All relevant technologies are totally focusing on easier the job of users who have the IT knowledge within different levels. For success in this goal, the proposed system has divided into several levels by using the latest version of MVC architectural pattern what use by software engineering for a long time.

According to that vision, the proposed system has basically divided into several layers like "presentation layer, business logic layer, data layer & Database". These all layers are having a line with the MVC architecture.

As this very stable architecture, the mobile application, the front end of the proposed system is the successful process multiple business logic of multiple users and synchronizes them to cloud platform with light speed.

JSP & jQuery mobile technologies are involved within the Android platform to build up the front end of the system to give some very elegant and user-friendly UI to our users. Not only that but it gives some very fast & accurate processing power to solve complex logic of users.

The data what process by above flows to the next level to involve with the database without any stuck.

In this stage, the very famous technology for a long time called "PHP" get the controlled to synchronize this mobile data with the cloud platform. In the cloud platform, MySql database, another successful database system for a long time, have installed to sync this data with good stability.

When thinking about the security of the whole system, json technology has totally encrypted all data before flow through the system. The system login protected by MD5 cryptographic hash function and it validates within the business layer to prevent from MySql injections to the database. Every time, the data which enter by the user has not flowed to the database directly. They sync data to cloud database over a HTTPS call through the security process called security validation. Except these, basic security standards like three attempts to password, password lock, admin contact to reset the password etc also available in the system. Moreover, the IMEI number of the tablet is saved in the database under the tab user. Tab user is registered with the tab IMEI number and during the login system validates the account information.

2.7 Summary

From the origin of technology, its growth step by step for about a few decades. But it speeds up within the last few years as we cannot assume. This technological jump is mainly affected by the sales industry and it creates huge competition among companies.

So the order processing is acted the main role within this competition. Fast and accurate order system was the main factor to lead in this.

“Sale force” is successfully entered to this competition and it has given the brilliant option, which user can bring the system with him everywhere he wants. So also it's easier, user-friendly and so pretty. The user can move totally to his job part when the system handles his technological side. It is the final expectation of every user of any system.

3 Analysis and Design

3.1 Introduction

This chapter gives an overview of the entire design of the system. It consists of an analysis and design part of the system. System analysis is an important activity that takes place when a system is developed. The analysis is mainly focused on requirement gathering, fact-finding, identifying the functional and non-functional requirements and requirements specification of the system.

This chapter gives an overview of system analysis and system design. Requirements gathering and analysis is a significant practice for a successful project. The main processes of this phase include domain understanding, requirements collection, classification, structuring, prioritization and, validation. Appropriate methods and processes were engaged to carry out the analysis phase in an effective way.

The software design phase is an iterative process in which requirements gathered in the analysis are translated into a “blueprint” in building the system. Afterwards, this can be elaborated into detailed functional and behavioral requirements. The output of the design phase is the system specification.

3.2 Analyzing the Current System

To recognize the main system functionalities, it is vital to analyze the current system methodologies. Domain analysis was carried out through certain fact-gathering techniques such as interviews, observations and consulting domain experts in the domain's own terminology. At present orders are placed via phone or email. There is no proper system to capture the sales orders at the distributor level. After receiving the orders users will then feed the data to the ERP. Hence some orders will not be converted into invoices as the orders are taken over the phone and there's no system for customers to track their orders and delays in the process in middle. According to analysis following system functionalities were identified.

3.3 Requirements Gathering

Several kinds of techniques were engaged here to capture requirements from different stakeholder perspectives. The main approaches used for requirement gathering process were; interview, observation, document review, and scenarios.

Both open-ended and close ended interviews were conducted for prompt existing and also to identify new problems. Relevant documents and current system were analyzed and studied through a sampling observation methodology. Captured facts were represented using scenarios. Use case diagram of each module was designed to get a clear picture of the gathered requirements.

3.4 Problem of Existing Process and Propose Solutions

The requirements gathering phase identify the problems in the current process and following discuss the proposed solutions for relevant problems. Table 3.1 display Problems encountered and solutions

Problem	Proposed Solution
<ul style="list-style-type: none"> • All the orders taken by the sales representatives will not be converted into invoices as they were taken over the phone or email. • There is no track of the orders and cause delays in the middle of the process. • Commission for sales force cannot be implemented properly as well as their performance evaluations for promotions. • Management of the company cannot make accurate decisions as they can't do a proper analysis of the market, products, and forecasting. 	<ul style="list-style-type: none"> • The mobile application will capture all sales orders entered by the sales representative and transactions will be synchronized into company ERP real time. • The system will automatically update orders real time and keep track of the order until it is invoiced. • The mobile application will trace the visited locations and the number of orders generated by the sales rep daily basis. • The system will allow analyzing historical data patterns with report generation facility.

Table 3.1: Problem of Existing Process and Propose Solutions

3.5 Requirements of the proposed system

3.5.1 Functional Requirements

Functional requirements describe what the system should do. In software engineering and systems engineering, a functional requirement defines a function of a system or its component, where a function is described as a specification of behavior between outputs and inputs.

- **Synchronization of master files**

This application is mainly focused on generating sales orders. Therefore there are prerequisites that user should follow to make the system ready to use. For example, in order to process an order items details, customer details, user details & system generated sequences should be downloaded to the tablet.

- **Generation of sales orders & purchase orders**

Sales representatives can directly enter the orders from the distributor points. This operation caters for direct dealers as well. Direct dealers are customers who do not have a physical location. They will raise purchase orders from the application directly. Afterwards, the company warehouse will deliver the goods to the respective customer.

- **Item, Sales& Customer Inquiry**

Sales representatives can view the orders, customer details, and item details. This will enable the sales representative to view his daily transactions then and there. If the connectivity is

not there then the application will display the transactions stored in the tablet internal database. It also provides the facility to display transactions (header & details information) synced with the cloud. This application will consist of the product catalogs and leaflets to display the customers as and when required.

- **Navigation**
- **Generating best route**

Each sales representative is given a route map at the beginning of the day. Sales representative doesn't have to follow the same route given by the area sales manager, if he wishes to visit some other location which is not given in the route then, the application will re-route and always give the best route to follow.

- **Visit location update**

When the sales representative walks into distributor location, he has to update the visit location if there are no orders to be taken. The system will store the GPS location and save it when the order is placed. Hence management will be able to monitor their sales force real time.

3.5.2 Non-Functional Requirements

Functional requirements describe what the system behaviors. In systems engineering and requirements engineering, a non-functional requirement (NFR) is a requirement that specifies criteria that can be used to judge the operation of a system, rather than specific behaviors.

- **Supporting Technologies**

Sales force application implementation should be feasible using technologies that are accessible to the end-users.

- **Device Software Compatibility**

The mobile interfaces must be compatible with Android 4.4 version (Kitkat) and onwards.

3.5.2.1 Performance Requirements

The performance will be based on the Internet connection. If the internet connectivity is not present, the sales representative can carry out his daily tasks as all the details are already saved in the application after syncing master data. The user may not have to worry about their local system. Specifications of the tablet have a big impact on system performance. In order to avoid performance issues, a particular tablet model is decided to distribute to sales force.

3.5.2.2 Safety Requirement

There are possibilities of data loss due to the interruption of connection on the Internet. If the internet connection is found or not found it save in the internal database. The local system data will be automatically synced with the cloud when the internet found as a service. It's running in the background process. If the user has to work in an area where there is no internet connectivity application will automatically back up the data and send the sales representative & respective IT coordinator of the SBU via email.

3.5.2.3 Security Requirements

All the security issues will be provided by the service provider itself. And also the system will allow accessing the system using tablet IMEI no. one imei no has access to one tab and one user. It does restrict from the system.

Users are not allowed to enter and view the details without proper authentication (password protection). If the user has entered the wrong password more than twice the user account will be automatically blocked. Also, sales representatives are required to change their passwords at least every 15 days.

- **Maintainability**

This application will be deployed to the Google play store for easy maintainability. If there is a new version update available in the play store, the application will automatically pop up a notification with basic details such as app size, version number, and the updated date.

- **Usability**

Since taking orders is a manual process at the moment specially sales force staff who have less computer literacy should be able to understand the system functionality and work with the system. Therefore user-friendliness is very important for this application. Also, staff those who do not have IT knowledge can be able to interact with the system. Redundancy of entering data has been minimized in every possible way to save the time of users. Also, GUI is more preferred than the text, therefore, GUI makes an end user's job easier. The system contains images, icons, autocomplete option and buttons to understand clearly.

- **Reliability**

Reliability describes the ability of a system or component to function under stated conditions for a specified period of time. Simply it defines as the probability that a product will operate without failure for a specified number of uses or for a specified period of time.

3.6 Proposed Architecture for the System

3.6.1 Planning

This phase includes user interfaces to access the system. Plan of UI Design is shown in Figure. 3.1 &3.2.

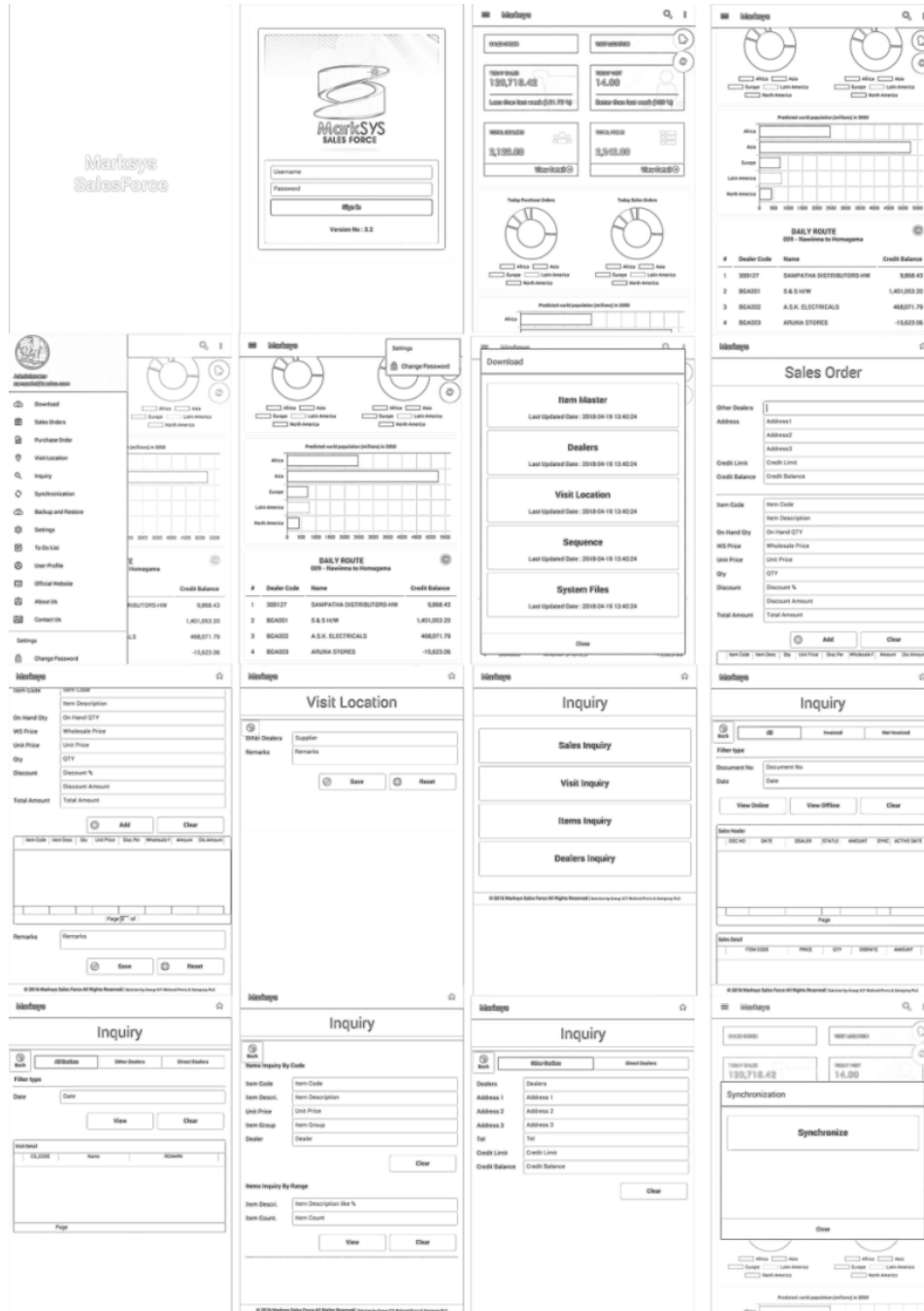


Figure 3-1: Paper Prototype - Planning Salesforce UI 1

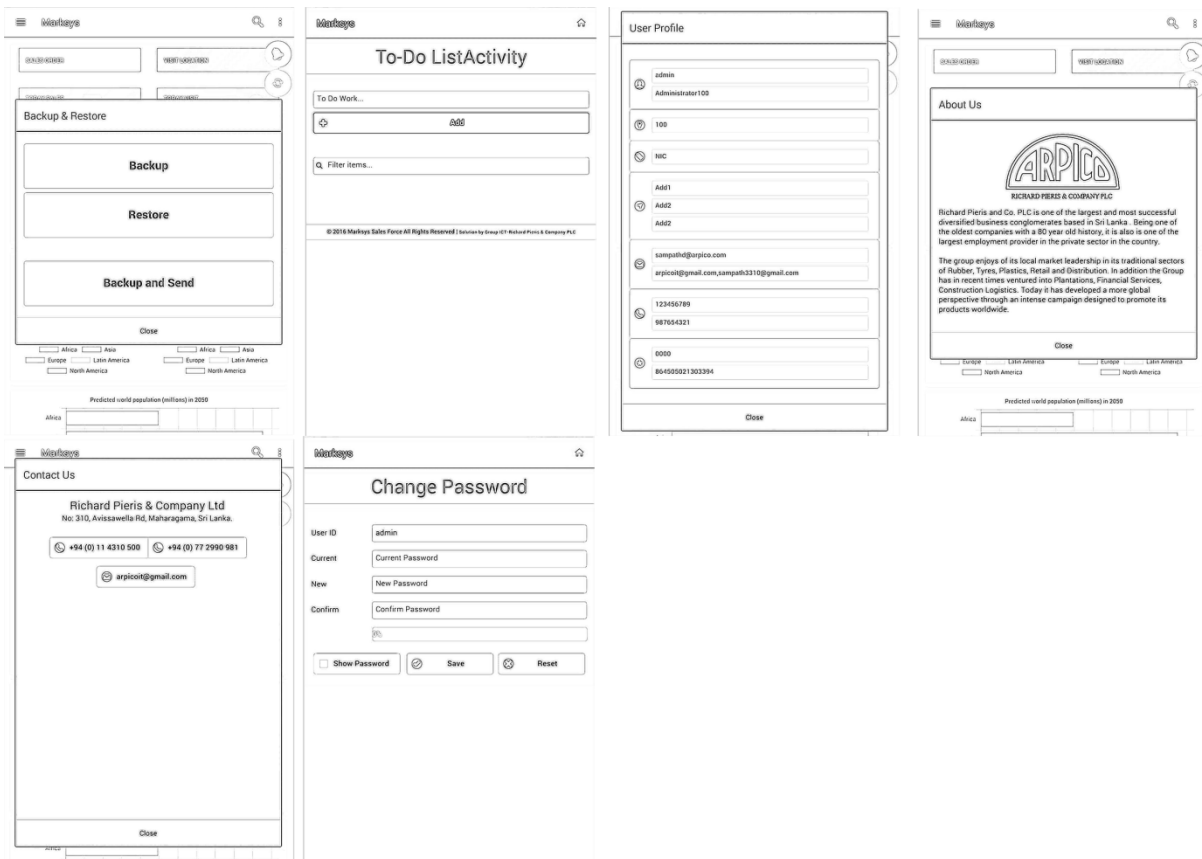


Figure 3-2: Paper Prototype - Planning Salesforce UI 2

3.6.2 Analysis

3.6.2.1 Software Requirements:

Required Software to design & implement the system.

Software Module	Requirement
Operating System	Windows
Android Version	Android (KitKat – 4.4)
PHP	PHP 5.x version
Database	SQLite & My SQL

Table 3.2: Software requirement

3.6.2.2 Hardware Requirements:

Hardware Module	Requirement
Processor	Intel 2GHz or higher
RAM	8GB or higher
Hard Disk	50GB or More Disk Space
Internet Connection	Broadband and Mobile Data Connection
Tab Resolution	8inc
Tab RAM	1GB or higher

Tab Internal Memory	8GB or more
---------------------	-------------

Table 3.3: Hardware requirement

3.6.2.3 Client Hardware and Software Requirements:

Hardware & Software Module	Requirement
Internet Connection	Data Connection (512kbps)
Tab Resolution	8inc
Tab RAM	1GB or higher
Tab Internal Memory	8GB or more

Table 3.4: Client Hardware and Software Requirements

3.6.3 Feasibility Study

A feasibility study is an analysis used in measuring the ability and likelihood to complete a project successfully including all relevant factors. It must account for factors that affect it such as economic, operational and technological.

3.6.3.1 Economic Feasibility

Economic analysis is the most frequently used method for evaluating the effectiveness of a new system. More commonly known as cost/benefit analysis, the procedure is to determine the benefits and savings that are expected from a candidate system and compare them with costs.

Since the project is developed on Android, this is a completely new technology for existing developers. Hence there is a huge learning curve is involved along with R&D. Initially, this should take into account when measuring the cost of the project. Apart from the cost of that physical asset of tabs, technical devices & expenses spent during development period should be taken into consideration secondly. These all cost must make analysis before starting the project. Finally, it must correctly evaluate the effectiveness of the project, according to cost/benefit ratio.

3.6.3.2 Cost-Based Study

However, it is important to identify cost and benefit factors, which can be categorized as Development costs and Operating costs correctly. Therefore they should take each expense one by one and value tightly to earn correct benefit after launching project. Tolerance of the cost should be minimized according to the project. They need to analyze one by one to access the value accurately in order to earn benefits of the project after launching it. Specially get the quotation for devices from the current market and compare the quality and cost wise to balance the expenses. After that consider cloud service providers for the virtual environment of the system. There were several competitors in the market and finally decide to go with Oracle cloud platform by analyzing the cost and quality of it. Less amount of cost was the major factor from both development and operating aspects to achieve higher effectiveness from the project.

3.6.3.3 Time-Based Study

This is an analysis of the time required to achieve a return on investments. For that, less development time with more accuracy is important. More time reducing with less accuracy is not worthy. The value we put on the project, both time and money will be a waste. So, the balancing of time and accuracy (bugs free) is another factor of the success of the project. Also, this accuracy brings the project to expected achievements so quickly.

Sales force was cycled between development and testing until the accuracy becomes nearly a hundred percent. By that, the project is expected to get into the full functionally level within one or two months with successful training sessions.

3.6.3.4 Operational Feasibility

Is a measure of how well a proposed system solves the problems and takes advantage of the opportunities identified during scope definition and how it satisfies the requirements identified in the requirements analysis phase of system development.

Salesforce try it best to achieve all requirements and resolve all problems within business line in the real world. Except for the requirement which can never be achieved, the proposed systems try to do it best for other all requirements. Mainly it gives direct solutions or indirect solutions for all problems in the business line. It gives more advantages to business through time, cost, security, decision making, and many more others.

3.6.3.5 Technology and System Feasibility

The assessment is based on an outline design of system requirements in terms of Input, Processes, Output, Fields, Programs, and Procedures. This can be quantified in terms of volumes of data, trends, the frequency of updating, etc... In order to estimate whether the new system will perform adequately or not. Technological feasibility is carried out to determine whether the company has the capability, in terms of software, hardware, personnel, and expertise, to handle the completion of the project.

The feasibility study helps to freeze the requirements, the scope, portability and other conclusions of the proposed Sale force. Functional and non-functional requirements are used for the analysis process. Analyze the collected information to obtain a clear and thorough understanding of the system to be developed.

3.7 User Interface Design

Designing is the most important phase of development. The design should be suitable for the process and meantime it should be user-friendly. Mobile is not like a normal computer. It can be accessed to limited resource once. It is important that we should have responsive design architecture. Standard tablet size is used across the sales force. Few interfaces designed in the application are listed below.

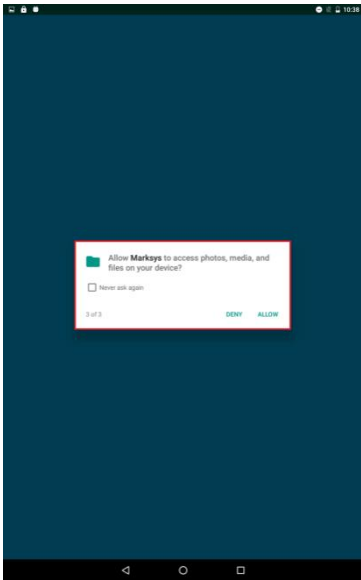


Figure 3-3: Get Permission Location

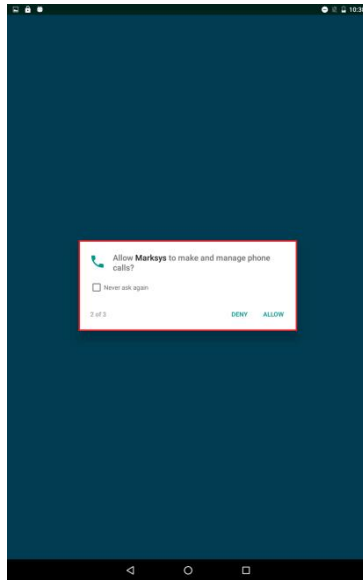


Figure 3-4: Get Permission Call

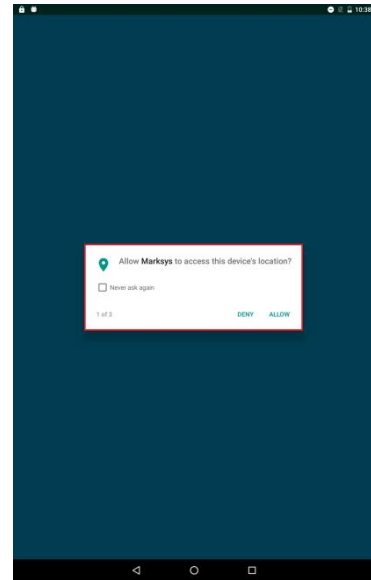


Figure 3-5: Get Permission Storage

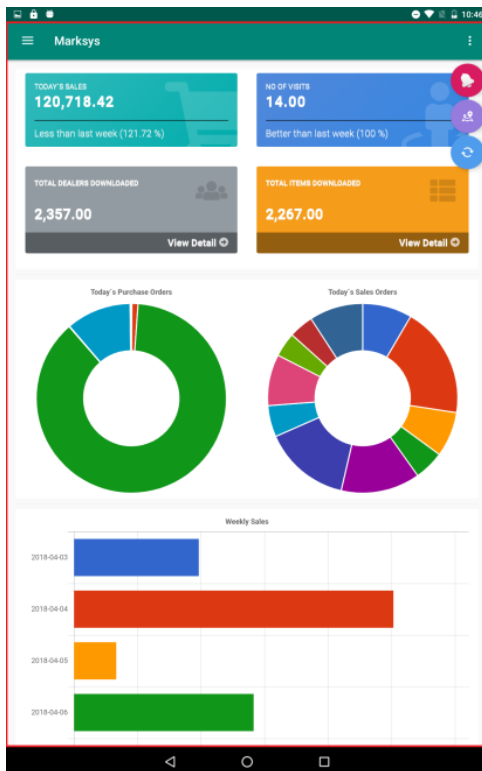


Figure 3-6: Dashboard Top



Figure 3-7: Dashboard Down

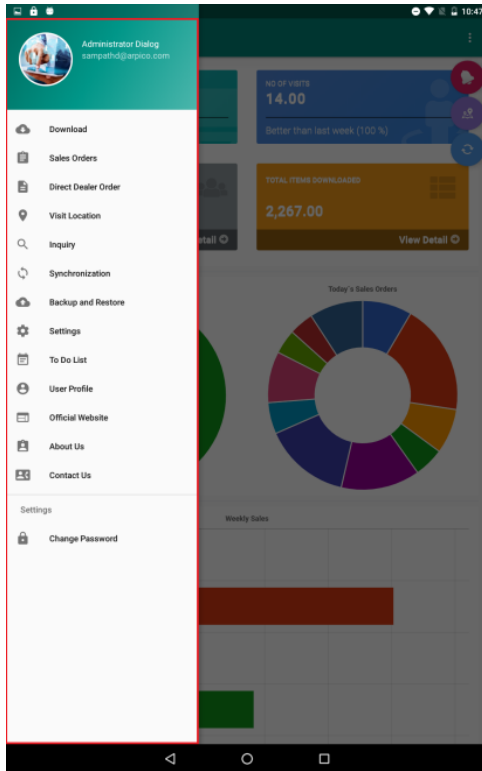


Figure 3-8: Navigation Menu

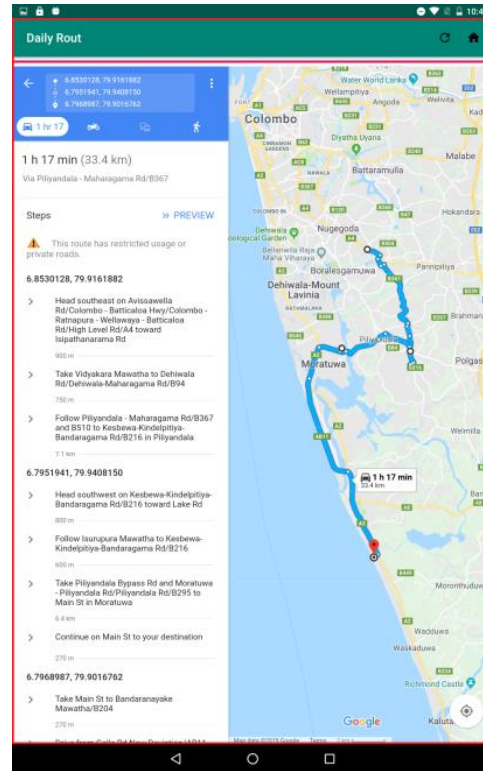


Figure 3-9: Daily Route

Initialize security & privacy settings when very first time loads the app after installation. (Figure 3.3/Figure 3.4/ Figure 3.5)

Dashboard is welcome page of system. It is not only an interface for main operations of system, but the summary of all analysis business data. User can get over roll picture about business. (Figure 3.6/Figure 3.7)

Navigation menu is main access point of system. User can access every operation from here. (Figure 3.8)

Daily route is the target map which sales representative must archived within current date. (Figure 3.9)

Please refer user manual in appendix 2 for all system functions and user navigation.

3.7.1 UML Design

The UML architecture is based on the Meta object facility, which defines the foundation for creating modeling language. They are precise enough to generate the entire application. A fully executable UML can be deployed to multiple platforms using different technologies and can be used with all processes throughout the software development cycle.[09]

The figure below shows the UML diagram hierarchy and the positioning of the UML Use Case Diagram. As you can see, use case diagrams belong to the family of behavioral diagrams (Figure 3.10)

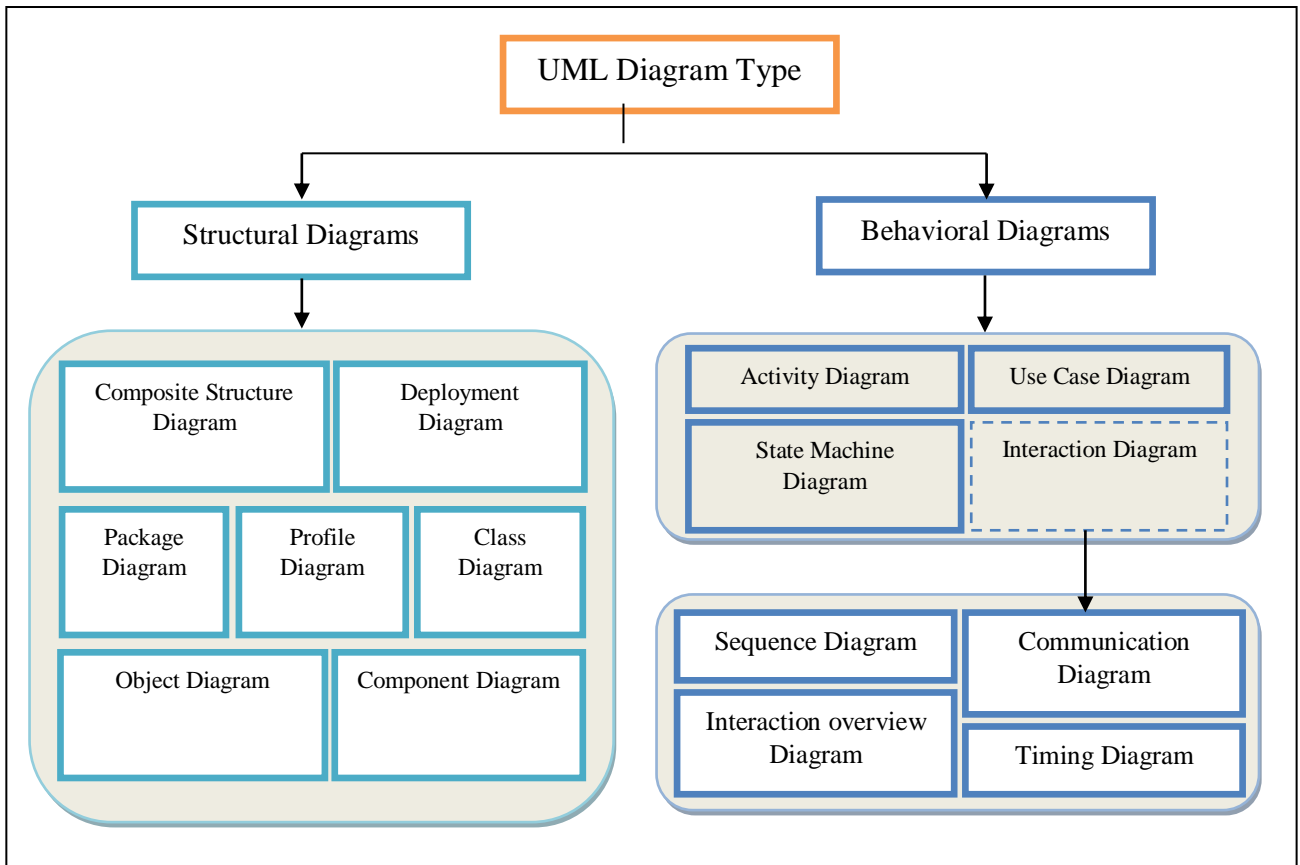


Figure 3-10: UML diagram hierarchy

3.7.2 Use Case Diagram

Use case diagrams are consisting of Unified Modeling Language (UML).[10] Graphically describes who will use the system and in what ways the user expects to interact with the system. The proposed system has two main actors such as Employer and Administrator. Use case diagram for the proposed system is shown in figure 3.11&figure 3.12.



Figure 3-11: Use Case Diagram For Employer (Rep)

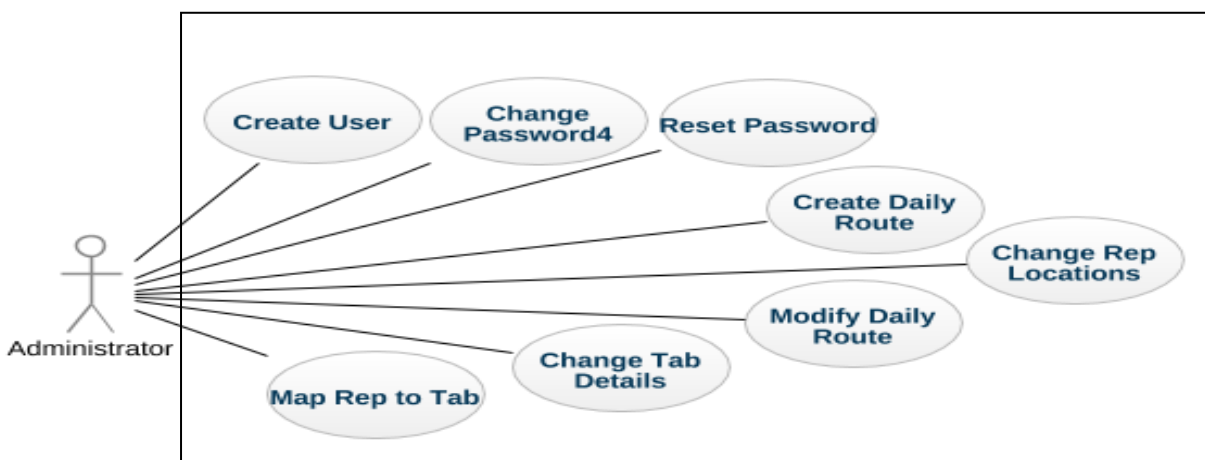


Figure 3-12: Use Case Diagram for Administrator

3.7.3 Sequence Diagram

The sequence diagram shows the sequence of messages exchanged between the objects needed to carry out the functionality of the system.[11] It is a type of interaction diagram and uses to understand the requirements for a new system. Sequence diagram for the proposed system Sales representative part is shown in figure 3.13.

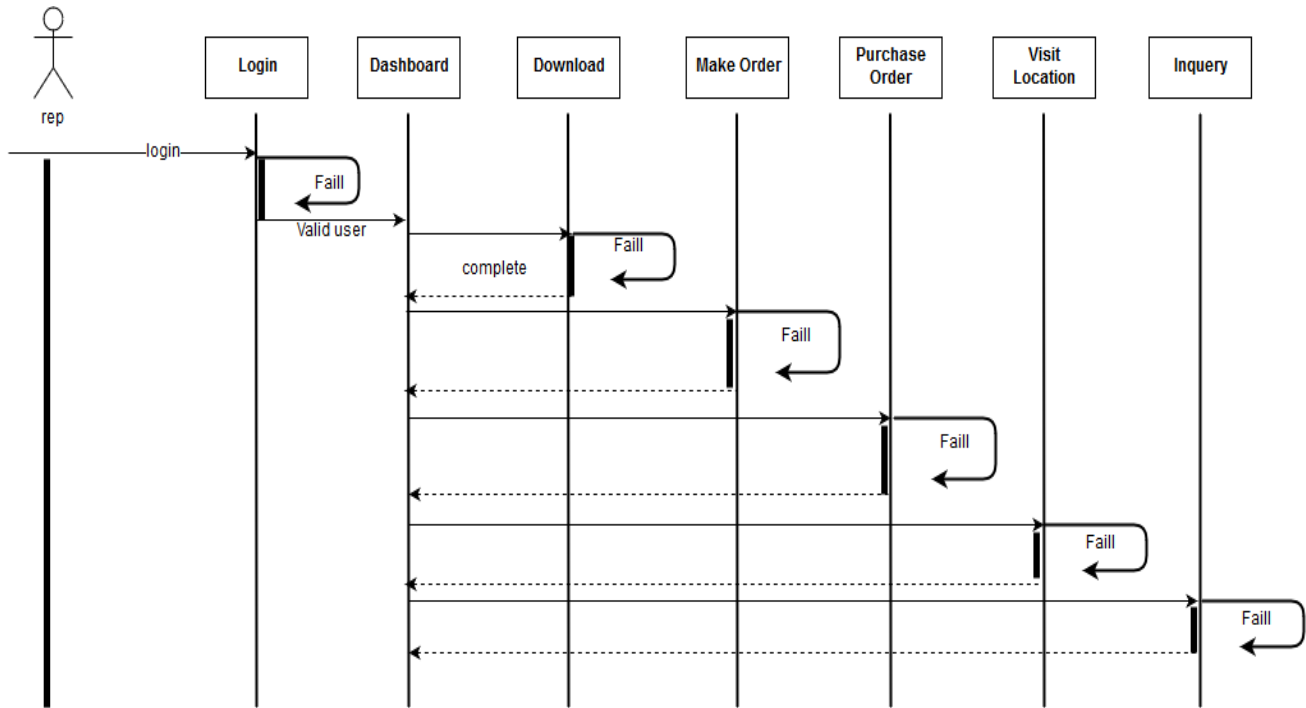


Figure 3-13: Sequence Diagram

3.7.4 Entity Relationship Diagram

An entity relationship diagram (ERD), also known as an entity-relationship model, is a graphical representation of an information system that depicts the relationships among people, objects, places, concepts or events within that system. An ERD is a data modeling technique that can help define business processes and be used as the foundation for a relational database [12]. ERD for the proposed system is shown in figure 3.14.

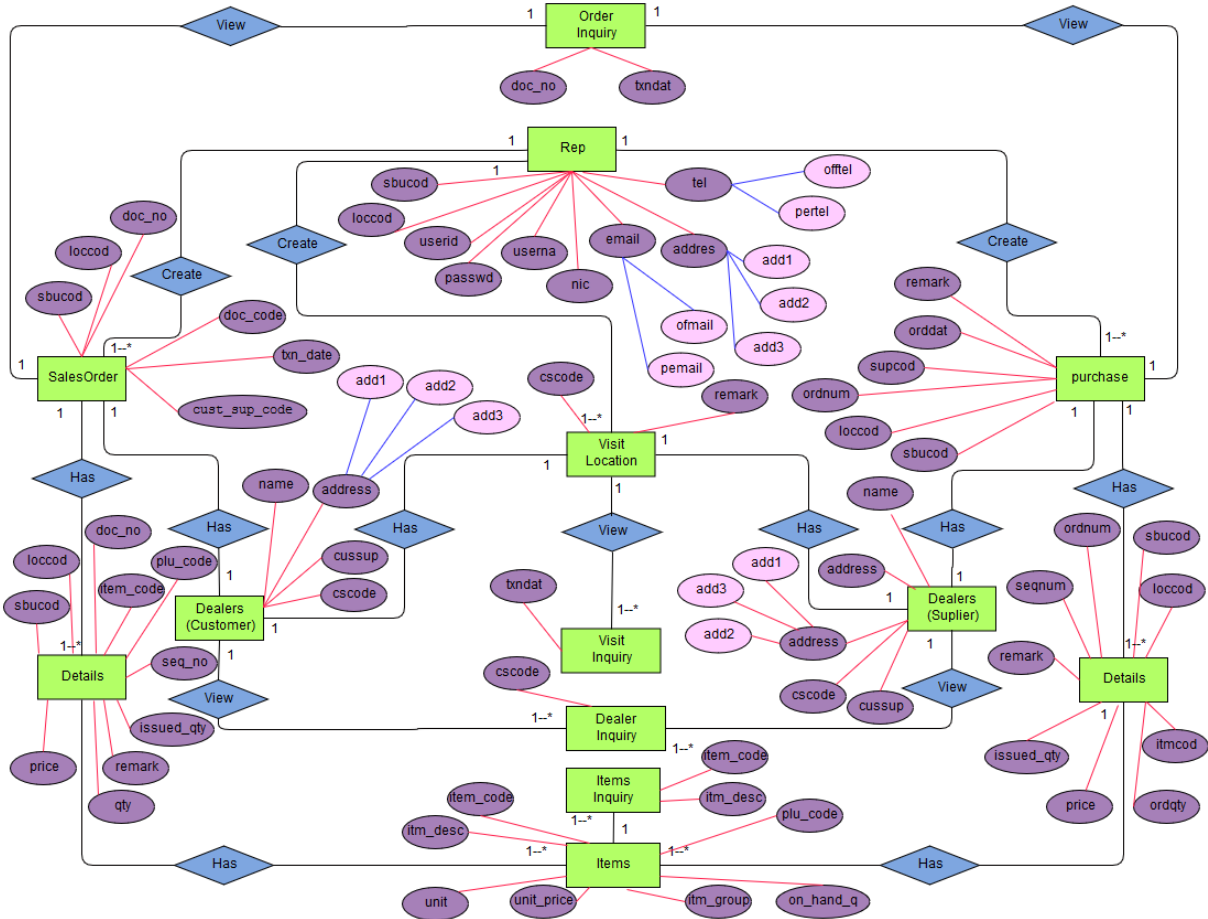


Figure 3-14: ER Diagram

3.8 Development Tools and Techniques

Tools and technologies used to develop the proposed system are shown below.

- **Android Studio [13]:** Android Studio is the official integrated development environment for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available to download on Windows, macOS and Linux based operating systems.
- **JQMobile [14]:** jQuery Mobile is a touch-optimized web framework, more specifically a JavaScript library, developed by the jQuery project team.
- **PHP [15]:** Hypertext Preprocessor (PHP) is a widely-used open source server-side scripting language created by Rasmus Lerdorf. It is specially designed for Web development and can be embedded into HTML. In here we used PHP as development language.
- **XAMPP [16]:** XAMPP is a free and open-source cross-platform web server solution stack package developed by Apache Friends, consisting mainly of the Apache HTTP Server, MariaDB database, and interpreters for scripts written in the PHP and Perl programming languages.
- **Adobe Photoshop [17]:** Adobe Photoshop is a raster graphics editor developed and published by Adobe Inc. for macOS and Windows.
- **HTML [18]:** Hypertext Markup Language (HTML) is the standard markup language for designing web pages. In here we used HTML for design interfaces.
- **CSS [19]:** Cascading Style Sheets is a style sheet language used for describing the presentation of a document written in a markup language like HTML. CSS is a cornerstone technology of the World Wide Web, alongside HTML and JavaScript.

3.9 Summary

This section mainly focuses on the analysis of the user requirements and design part of the entire system. It contains requirement gathering, find functional and non-functional requirements, software architecture design and initial diagram designs such as ER diagram and UML diagrams.

ER diagram, use case diagram and sequence diagram which are discovered in the design section.

4 EVALUATION

4.1 Introduction

This chapter gives an overview of the Testing and evaluation of the Sales Force Automation (SFA). This is a major part of the software development life cycle, which ensures that it provides the best solution to the customer. In this chapter would be explained testing techniques which are used to test this mobile application.

The testing method is basically combined with Verification and Validation. Validation refers to testing whether the system satisfies the requirements while verification refers to whether the system implements the specified functions properly. Basic goals of test evaluation are determining whether the promises about the invention by the supplier and the requirements of the customer are met on an acceptable level.

For the success of the project, it should be bugs/errors free. If it is not, it might be rejected by the customer. As well as, additional resources would be allocated to redevelop the system. So Software testing methodologies are used to identify error/bug of the system and they help to fix those errors.

Testing processes includes validation & verification. (Figure 4.1)

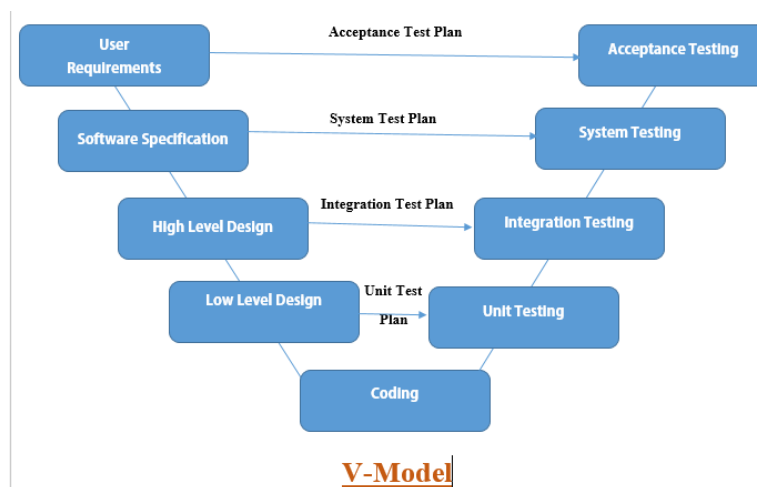


Figure 4-1: Verification vs. Validation

4.1.1 Validation

This process makes sure that the development team develops the right product by capturing customer's needs. The final solution should be satisfied with customer's given requirements.

The next challenge was the client base is not familiar with the mobile ERP environment. They do not have any ERP experience in the mobile platform. So their requirement specification was mostly compatible with the existing standard alone desktop environment. Therefore, some requirements were not practical totally.

When facing this challenge, the project specification was divided into three parts. Initially, functions which have no effect with the mobile environment were sent to production process directly.

Although in the second phase there were functionalities which need to be included in the mobile environment, those requirements were suited for the desktop environment. So it must change according to the mobile environment with a series of discussions with users.

The third part is critical and these functionalities don't take place in the mobile environment. As an example, an auto backup system of the cloud is protecting customer details automatically. So developing another backup system in SFA is not necessary. These requirements were removed from specification after explaining to the customer.

4.1.2 Verification

This process makes sure that the development team develops the product correctly. This process accesses the final product has achieved the conditions which are identified at the beginning of the implementing phase.

However, while designing the project the major challenge was to identify the requirements clearly. The main reason for this is that users change their requirements from time to time. Finally, gather all client requirements and purify them with several discussion rounds with users. By doing so, the project can prepare a validate client requirement specification successfully.

After user testing of the prepared project, the questionnaires were submitted to the client and get feedback to verification of project success.

4.2 Testing Methods in Detail

Software testing can be grouped into two categories **Static Testing** (Verification) & **Dynamic Testing** (Validation) (Figure 4.2)

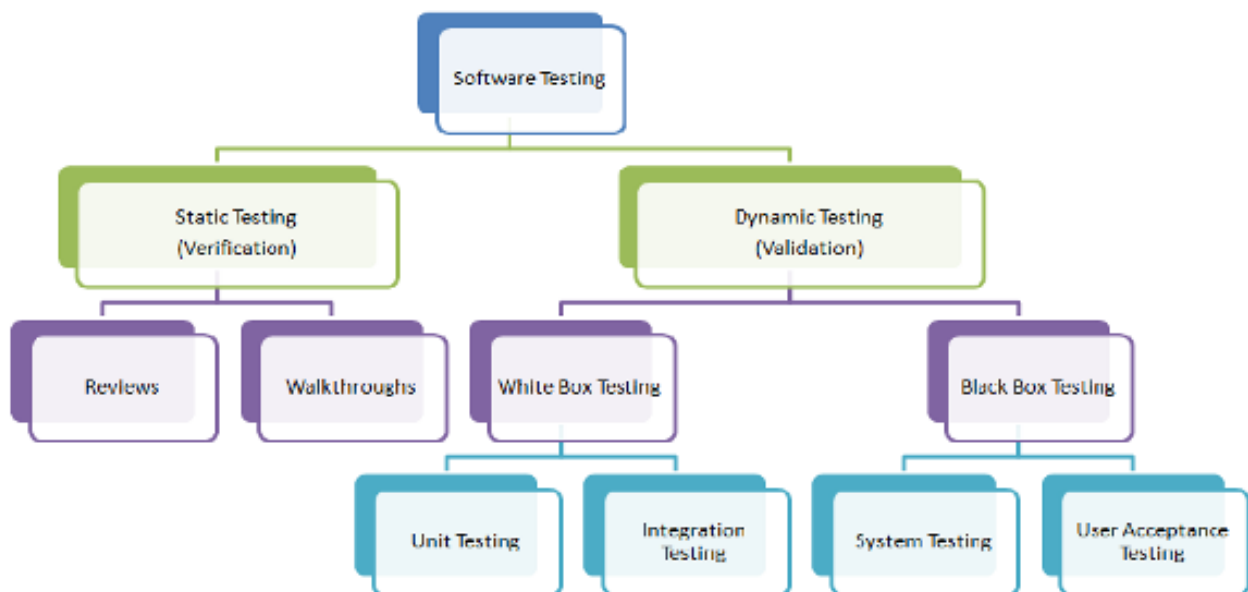


Figure 4-2: Testing Model

4.2.1 Static Testing (Verification testing)

Static testing is used to check the source code manually without executing testing codes. Also, static testing is used to find errors in requirement documents, design documents. By using those documents makes reviews and which are used to find defects and bugs. Static testing is used to improve the quality of the solution with identifying bugs and errors at the analyzing and designing phase. Therefore this is called non-executing testing or verification testing.

4.2.1.1 Walkthrough

Gather all team members of the development team and explain the project plan to them and get feedback in the question form to clear out plan.

4.2.1.2 Informal reviews

This is one of the types of review which doesn't follow any process to find errors in the document. Under this technique, the developer can review the document and give informal comments on it.

4.2.1.3 Technical Reviews

At the initial stage technical documents such as Software Requirement Specification (SRS), naming conventions, etc... Documents are shared between team members. During this review, it checks whether it is suitable for the project by finding any discrepancies in the specifications and standards followed.

4.2.1.4 Inspection

Once the production is done, the project has to hand over to the respective person who is responsible for business analyzing and information technology. This review is used to follow a strict process to find the defects which are mentioned in the formal type of review. This review goes on until the reviewer's checklist is completed.

4.2.1.5 Static Code Review

Static code review would be check syntax of the code, code optimization and coding standards without executing source code. That could be known as white box testing. This review can be done at any point during development. In the SFA project, it is important that every developer follow the same coding standards, according to industrial and company standards.

4.2.1.6 Dynamic Testing (Validation testing)

Dynamic testing is done by executing the program at the validation process. This testing is used to find the bugs/ bottlenecks of the system and fix the defects. When using dynamic testing these methods can be performed at all levels of the implementation and which can be white box testing or black box testing.

4.2.1.7 White Box Testing.

White box testing is commonly used for validation. Test cases written by newcomer developers and it guided by the senior developer for white box testing.

4.2.1.7.1 Unit Testing

The objective of unit testing is to verify that a piece of software or software component is working as expected.

The scope of unit testing covers:

- Unit of software which is a single code or multiple code units.

- Involves testing decisions, conditions, statement, and loops.

Testing multiple options in the SFA project.

1. Login screen

- Test case to check the validations of this screen is given below. It will check the empty values and the correct password for the respective user name.

User Name	Password	Validate
√	√	√
√	×	×
×	√	×
√	×	×

Table 4.1: Test Cases

2. Download Option

- Under this testing, it will check whether all data in the cloud environment has been downloaded to tablet. For example item details, customer details and previous transactions, etc...
- If the download is completed it should match with the row count in the cloud environment and carry on the rest of the project functionalities.

Test case for this menu option is shown in the figure4.3.

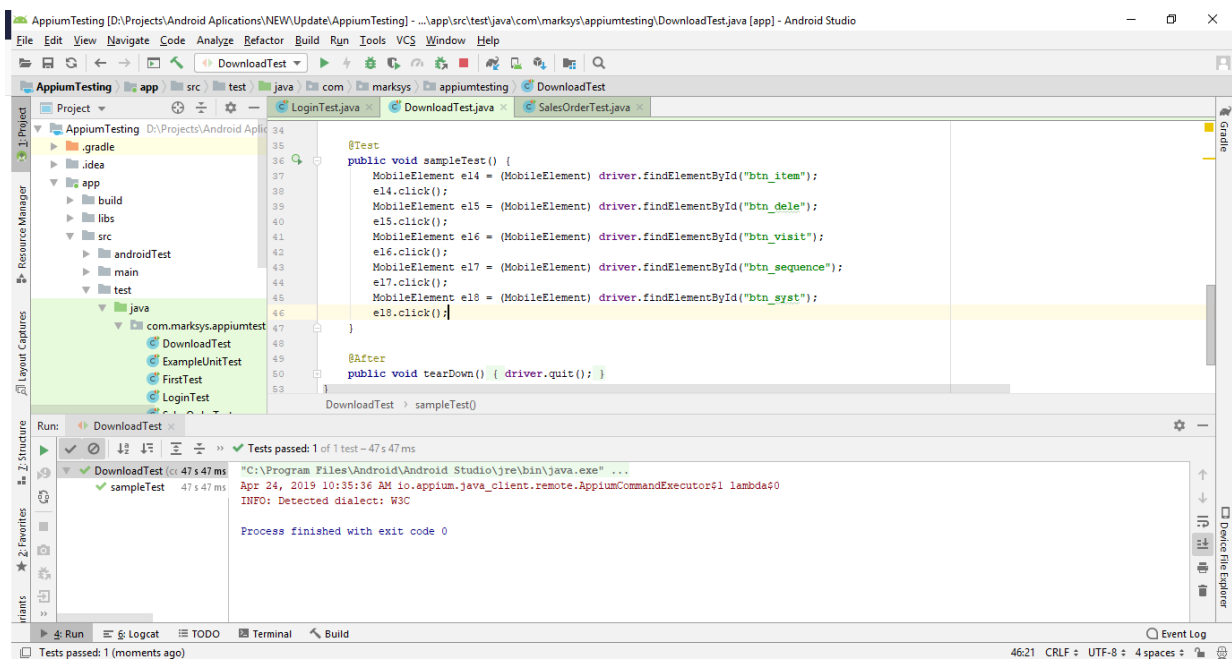


Figure 4-3: Download Test Download

3. Enter Sales Order Option

- As shown in the figure4.4 test case is written to validate the below scenarios.
 - Check if the entered dealer is a valid dealer in the system
 - Check if the entered item is a valid item in the system
 - Check the total value of the order against total price and total quantity
 - Check if the mandatory fields are not empty.

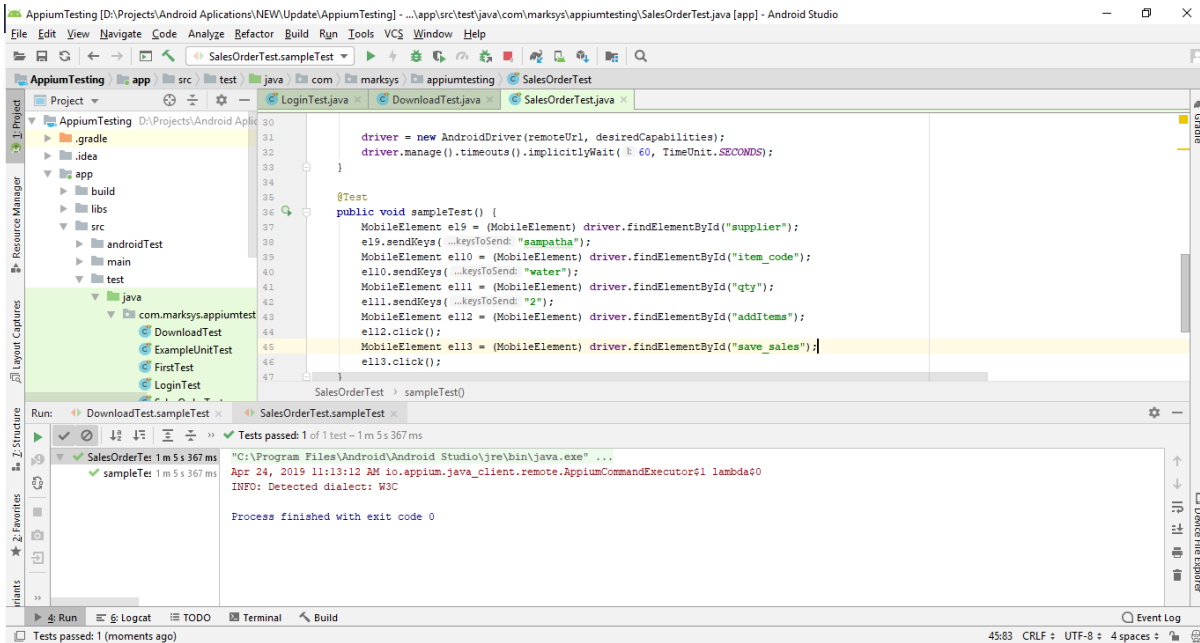


Figure 4-4: Sales Order Test Sales Order

These testing are usually done by the developer.

4.2.1.7.2 Integration Testing

The objective of integration testing is to verify that all components are working together as expected and that there is no inter-component failure.

The scope of integration testing covers:

- Testing emphasis is on the interaction between modules and interfaces.
- Covers both internal (inter-module & within module interfaces) & external interface with other applications.

In the SFA project if the download option has been completed successfully then the sales representative should be able to enter a sales order and save it without any errors. In order to save a sales order, he/she should have the relevant item, customer, and document sequence details.

4.2.1.8 Black Box Testing.

In this technique, test cases would be defined based on a system specification program. This testing can be done by system users such as sales representative, top management, etc... The testing person will check only the output against the input, therefore, no need to have knowledge of programming language.

4.2.1.8.1 System Testing

As considered one unit, the full functionality SFA system will be tested and compare with the final specification. By that, it will detect what the discrepancies are available between system and specification.

The scope of system testing includes the complete application with all interface, as well as the environment with full functionality.

The features of system testing are:

- Test the system as one unit, using the black box technique.
- The system is tested for functionality defined in the software requirement specification.
- User interface compliance is tested.

- The interfaces interacting with other systems are tested.
- Requires tests on equivalence and boundary values.
- Requires test on performance, Usability, Hardware compatibility and reliability, Security, Volume, load & stress.

4.2.1.8.2 Acceptance Testing

The objective of user acceptance testing is to test the integrity of the application by the users in the SFA environment and to ensure it meets the requirements specified in the software requirement specifications.

4.3 Testing Procedure

Software testing and implementation are iterative processes. Most of the time both stages work as simultaneous system components. The proposed system was tested while the development was ongoing. Following iterative RUP development life cycle made it possible to test Iterative increments of the software.

Structural testing techniques were followed in this phase including “white box” testing which tests “how a program/system does something”. Functional testing techniques were used, which includes “black box” testing which tests the behavior of a system or program. These techniques were exploited in different testing levels like unit testing.

The system followed the object-oriented methodology, so object-oriented testing was also carried out in this phase. Individual operations associated with objects were tested initially, followed by testing individual classes and clusters of objects, and finally test the system as a whole. User acceptance testing was completed in the client site, the participation of a few staff members.

4.4 Test Plan and Test Cases

Testing begins with the implementation; the code is reviewed while developing the stage for testing. Test plan included all phases of testing and also used as a guide for the overall testing process. Before the system implementation, the test plan was designed. A test plan includes test objectives, schedule and logistics, test strategies and especially test cases.

Test cases were created according to the designed test plan. That contains data, procedure, and expected a result and represents which use to system or part of the system run. To reduce the complexity of the testing process test cases were designed for each module independently. The following tables specify some test cases.

Manual testing method and procedures used for testing rather than automation tools and technologies. Below table tabulates some test cases for test basic functions.

Test Case ID	Test Component	Module Name	Functionality	Procedure	Expected Output
1	Login Form	Login	Invalid Login	Enter User Name & Password	Display a relevant error message
2	Login Form	Login	Valid Login	Enter User Name & Password	The current form will be closed & dashboard form will load
3	Dashboard	Notification	Check Availability	Automatically Sync	Display the notification panel
4	Dashboard	Map Route	Check Availability	Automatically Sync	Display the route allocated
5	Dashboard	Charts	Check Availability	Automatically Sync	Display charts
6	Download	Item Master	Check	Download Data	Download data from

			Availability		cloud & show total count
7	Download	Dealers	Check Availability	Download Data	Download data from cloud & show total count
8	Download	Visit Location	Check Availability	Download Data	Download data from cloud & show total count
9	Download	Sequence	Check Availability	Download Data	Download data from cloud & show total count
10	Download	System Files	Check Availability	Download Data	Download data from cloud & show total count
11	Sales Order / Direct Dealer Order	Enter Dealer	Valid Dealer	Enter a dealer name with 4 letters then autocomplete will display	If dealer name or code exists in the system it will display dealer default information
12	Sales Order / Direct Dealer Order	Enter Dealer	Invalid Dealer	Enter a dealer name with 4 letters then autocomplete will display	If no data found for the given letters it will display a relevant error message
13	Sales Order / Direct Dealer Order	Enter Items	Valid Items	Enter an item name with 4 letters then autocomplete will display	If item name or code exists in the system it will display item default information
14	Sales Order / Direct Dealer Order	Enter Items	Invalid Items	Enter an item name with 4 letters then autocomplete will display	If no data found for the given letters it will display a relevant error message
15	Visit Location	Enter Dealer	Valid Dealer	Enter a dealer name with 4 letters then autocomplete will display	If dealer name or code exists in the system it will display dealer default information.
16	Visit Location	Enter Dealer	Invalid Dealer	Enter a dealer name with 4 letters then autocomplete will display.	Autocomplete values don't exist in the system then the display relevant error message.

Table 4.2: Test Cases

4.5 Method of Evaluation

Acceptance testing of the software will be done in the evaluation process. Mainly in the evaluation process concentrate on usability, sustainability, and maintainability of the software.

Evaluation tasks a huge part in learning software, and it can provide well meaningful, useful information on the outcome of the software. And also it helps to determine the working abilities of people who undertook the analysis and development processes.

Usability

Good technical writing, like good interaction design, focuses on the user's goals. The first step in creating a usable product understands those goals in the context of the user's environment, task or workflow, and letting these needs inform the design.

User-Centered design helps to develop software's which are rich in usability. Because of this developers should and can runs acceptance tests on early stages. It will guide to accomplish interaction design and user satisfaction.

- **User-base:** Testing Software with a sample of the intended users performing a set of tasks. The goal of this is examined software supports the intended users in their work.
- **Expert-based:** Usability expert makes an assessment of software.

- **Model-based:** Expect user's formal methods to predict one or more criteria for user performance.

4.6 Evaluation of Software

Evaluating the software with a sample of users performing tasks is considered to yield the most reliable and valid estimate of software usability. The questionnaire used to evaluate the software is attached in Appendix K.

Purpose of the questionnaire is to collect information from users regarding their understanding with the developed software. In the questionnaire there are 10 properties of the system were evaluated. Evaluators were people who were going to use mobile integrated stock and restaurant management system engineer, 2 quality assurance engineer, one account clerk's, 5 staff members and 10 waiters.

4.7 Results of User Evaluation

Regarding the evaluation results of the application, the following factors are satisfied by users. Those factors are an interface and graphical view expectation, color schema, notifications facility of the system, minimum errors and improved treble shooting capacities, information about the system. Also, users appreciated securities of the system because there is a separate module to manage user privileges of the system. Furthermore, two questionnaires have been prepared to evaluate user experience. Appendix 1 shows the questionnaires.

But the user is not satisfied with the response time of application. This system has developed WPF technology and entity framework. Those technologies are consumed large memory space on random access memory of computers. Therefore some process will be modified in the future. The final result of these evaluation users is like to recommend this software to other companies.

4.8 Assumptions

The plane is based on the following assumptions, which affect the scope of testing:

- All the information and specifications given in the detailed system requirement specification accurately reflect the functional and non-functional requirements.
- The requirements are complete, accurate and are testable.
- Any change in the scope of the project will be done after impact analysis and will be accompanied by changes to the project schedule/plan.
- Usability testing will not be done as end users accept the UI documented in the detailed system requirement specification.
- Due to lack of connectivity with <Dealer's> legacy software (if any), simulators will be used for the execution of the test case. Exclusion of testing related to the interface with <Dealer's> legacy system will not affect the project.
- Test data given by <Dealer> in a predefined format will be sufficient to execute all the test cases.

4.9 Risk and Risk Management

Entry and exit criteria – Before testing, the fully implemented system module or component should release from the development and all hardware and software requirement needed to be fulfilled before the testing.

At the end when releasing the test version, QA persons should responsibility whether the tested system/ module/ component at least up to customer requirement and should satisfy all the specified conditions and functional.

Integration with the main database will be a major area of concern when coming to risk management.

4.10 Test Deliverables and Schedule

Below table describes the format of deliverables and its schedule.

Deliverable	Description	Start Date	End Date
The quality assurance test plane	This describes the overall test approach and strategy.	DD-MM-YY	DD-MM-YY
Quality assurance test case	Test case to be used for testing the functional and non-functional requirement.	DD-MM-YY	DD-MM-YY
Smoke test results – UI	Test results for Installation/ Smoke –UI after execution relevant test cases.	DD-MM-YY	DD-MM-YY
Smoke test results – Functional	Test results for Installation/ Smoke – functional after executing relevant test cases	DD-MM-YY	DD-MM-YY
Regression Test results – Functional	Test results for Regression – Functional after executing relevant test cases	DD-MM-YY	DD-MM-YY
Test Report	This summarizes the result of test case execution. It is used to understand the process of testing and the quality of the project	Produced at the end of each major code drop/major milestone deliverables.	DD-MM-YY
The workload analysis	Workload analysis model is conceptually a specialized and more complex form of a test case that relates	Produced at test planning for performance testing.	DD-MM-YY

Table 4.3: Test Deliverables

4.11 Test Strategies

Type of Testing	Yes/ No	Results
Installation/ Smoke Testing	Yes	Use manual & test automation to test. Result was success.
UI/ Usability Testing	Yes	Use different device sizes. UI & usability result was success.
Functional Testing	Yes	Functions are tested Developer & IT Officer. It result was success.
Regression Testing	Yes	Core change with under supervising.
Test Automation	No	Some test cases are implementing. Those are success.
Performance Testing	Yes	Use different device with different arias. Results are success.
Volume Testing	Yes	Used multiple devisers to connect same time & test. It was success.
Configuration Testing	Yes	Configured multiple devices it working fine.
Date & Database Integrity Testing	Yes	Cloud data sync is working fine.
End to End Testing	Yes	Sales order to invoice process doing fine.
Security Testing	TBD	Encryptions, imei no block, username & password are working fine.

Table 4.4: Test Strategies

5 CONCLUSION

5.1 Introduction

At Present context, the Information Technology has spread broadly among the regions and is used as a success factor in most of organizations. This is due to that information technology has given the advantage of better service to the organization as well as for the customers. In order to compete with their rivals and to maintain the organization sustainability, businesses are now moving towards the use of information technology as a competitive tool.

Information technology can provide a competitive advantage if it is used effectively according to the organization wants it. Throughout the years the marketing era has changed from the traditional product oriented to customer oriented marketing. Due to the competition the organizations which used to produce goods massively now moved into producing the goods in massive customized products. Failure to do so will result in losing the existence in the market. To gain business benefits and profits the company's customer base itself will not be enough but there should be a way of reducing the unnecessary costs which will incur as well. For this by having an the automated system which will do the job for the company will help the company to concentrate on more value-added services for its customers in order to gain more benefits and profits.

The sales force automation is a concept which will help the organization to handle all the sales forces which they have and also to cut down the unnecessary costs which can incur during the operations in the field. This will look into two aspects which one will concentrate on reducing costs as well as to give a value-added service to the customers by giving a fast and reliable service as well as being accurate.

This proposed application is smart enough to avoid paperwork and other manual work. The application would give complete data in real time like Generate Leads, Order creation, Accept returns, View Itinerary, View targets, Sales Reports, Itinerary Reports. Dashboards are easier to access. Information within large data sets and to analyze that information in hopes of managing performance, making better decisions and lowering overall costs.

Each organization will have its own business needs and corporate culture, identifying the proper metrics, Providing the right level of detail to end users, and making sure the information is timely a: all aspects that should be considered irrespective of the type of dashboard being deployed, keep the employees on the tasks by constantly pushing data to be on their toes, Device based Application Extensions, Data Access In the Field, Automatic Data Collection.

5.2 Problems Encountered

At the beginning of this implementation, different kind of difficulties has been faced. When gathering requirements, had to spend more time because of difficulties of contact management of the Company. Also when interviewing users of the Company have to explain many things about automated system because some of them didn't have a clear idea about the system. When discussing the system with the high-level prototype of the system, management and users had as much kind of changes. Some of the changes were implemented and some of them are refused because of those changes are not possible to implement in the application.

After that user interfaces were designed to satisfy users' requirements. After implementing the solution in the Company so many issues were faced. Because of requirement changes and user training. Especially in the report module, management asks to the change content of reports, design new report templates, etc...

After discussing with management decisions were made to make changes in the future. When accessing the application via smart phone there were some issues because of the weakness of the Wi-Fi router. So the strength of the Wi-Fi had to increase with installing suitable devices. Those changes were made by Company management as per the requirement.

5.3 Lessons Learnt

Initially, the problem that was found is a delay, order to invoicing process with the existing distribution system. Because of its very low due to the main reason of communication problem with the ordering process. As a solution to the above problem, this system is suggested. At the beginning of the project, the aim was to increase customer satisfaction through introducing an SFA (Sales Force Automation)

According to analyzed the questionnaire results, it has been providing that the suggested system has achieved the main aim. So it is clear that by the proper communication with the customer form ordering Items.

And also good experience in analyzing and design based on customer exact requirement and also working with customers. Gain knowledge about Java, XML, Google Map, and Charts. Improve knowledge about Mobile application development in Android Studio.

5.4 Future Enhancements

After implementation of this application on the SFA, some changers are identified. Because of users are requesting to improve system to minimize the day to day manual works.

As an extended version of the application, the managers & aria managers can be see real-time where the reps are right now. It tracking and update system. Show map view Dashboard in web URL or mobile dashboard.

Apart from those following changes also implemented on the system:

- Fine-tune the android application and improve the speed of the application
- Improve report module

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GLOSSARY

CSS (Cascading Style Sheet) - is a style sheet language used to describe the presentation semantics (the look and formatting) of a document written in a mark-up language.

Database - is an organized collection of data for one or more purposes, usually in digital form.

Graphical User Interface - is a type of user interface that allows users to interact with electronic devices with images rather than text commands.

Internet - is a global system of interconnected computer networks that use the standard Internet Protocol Suite (TCP/IP) to serve billions users worldwide.

JavaScript - is a prototype-based, object-oriented client-side scripting language which is dynamic? It is also considered a functional programming language.

jQuery - is a cross-browser JavaScript library designed to simplify the client-side scripting of HTML.

Objects Oriented Development - is a standard approach to software development based on objects and their instances

Structured Query Language - is a database computer declarative language designed for managing data in relational database management systems (RDBMS).

Unified Modeling Language (UML) - is a standardized general-purpose modeling language in the field of object-oriented engineering. This includes a set of graphic notation techniques to create visual models of object-oriented software-intensive systems.

Appendix A

Questionnaire 1:

1. Who are the order takers on behalf of the company?
2. Are there enough opportunities exist in the market?
3. How many sales staff do you have?
4. What's your sales hierarchy?
5. How many numbers of customers do you have?
6. What type of customers do you have?
7. What kind of problems you faced when collecting orders?
8. How many new leads did you meet during a one route visit?
9. How many new customers did you meet during a one route visit?
10. What type of reports do you use today?

Questionnaire 2:

Personal Details

Employee Name:-

Designation:-

Age (Year) 18-25 26-30 31-40 Above 40

Working (Years) 0-1 1-3 Over 5

Education Level Pass Grade 10 G.C.E. O/L G.C.E. A/L

B.Sc. M.Sc. Other

1. Do you satisfied with the interface and graphical view of the system?
 - a. Yes
 - b. No
 - c. Partially
2. Do you satisfied with the color scheme of the system?
 - a. Yes
 - b. No
 - c. Partially
3. As the user does u feel you have enough permission to access to the database?
 - a. Enough
 - b. Not enough
 - c. Should be more restricted
4. Do u satisfied with the responding speed of the system?
 - a. Satisfied
 - b. Not satisfied
 - c. Should be more speed
5. Do you feel trust in this application?
 - a. Yes
 - b. No
 - c. Some sort of
6. Do you satisfy the error and troubleshooting methods of the system?
 - a. Yes
 - b. No
 - c. Some sort of
7. How easy to understand the contents of the application?
 - a. Very Good
 - b. Good
 - c. Bad
 - d. Very Bad
8. Do you satisfied and informed about the application notifications in our product?
 - a. Yes
 - b. No
9. Would you recommend our software to others?
 - a. Yes
 - b. No

10. Any suggestions to improve this product?.....

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.....

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Date

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Signature

Appendix B

Mobile App User Guide



Sales Force Mobile App User Guide



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1 Security & Privacy

Initialize **security & privacy** settings when very first times load the app after installation.
(Figure 1/Figure 2/ Figure 3)

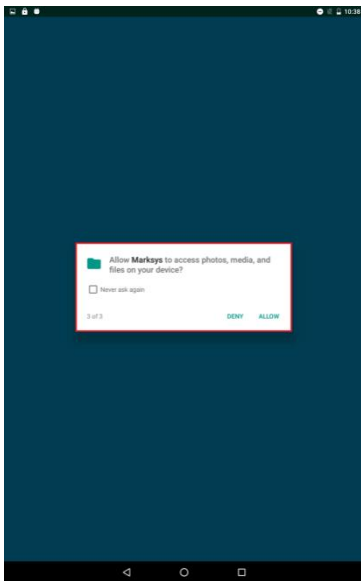


Figure 1.1 Get Permission Location

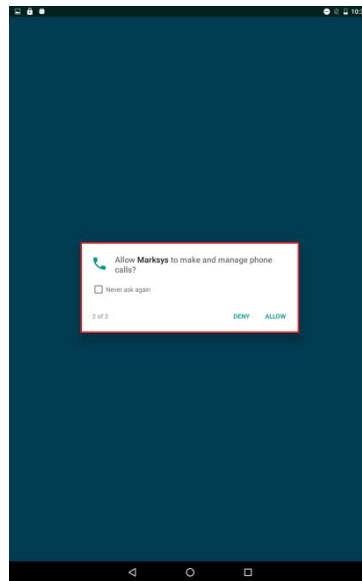


Figure 1.2: Get Permission Call

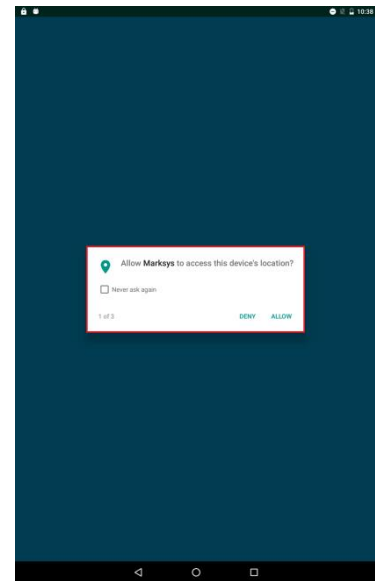
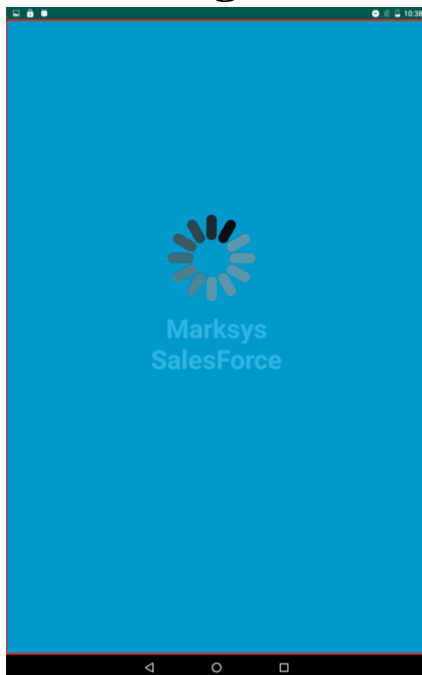


Figure 1.3: Get Permission Storage

2 Loading



2.1: Loading

Loading and initialize all components.

3 Network Connection

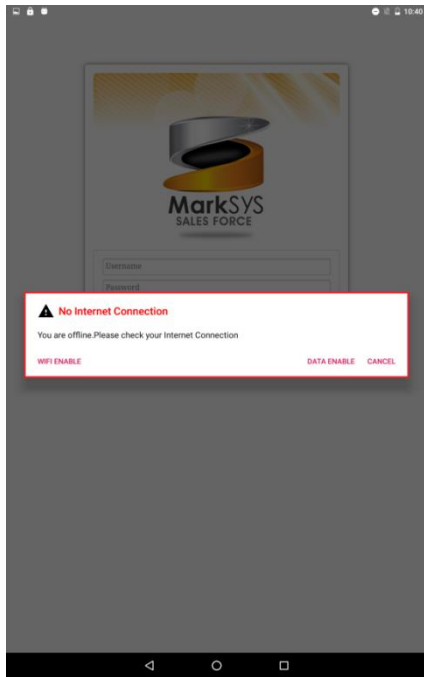


Figure 3.1: Network Connection

Setup **network connection** through Wi-Fi or Mobile data connection.

- Wi-Fi Connection: Restart the application and auto enable Wi-Fi connection. You must supply username and password by manually.
- Mobile Data Connection: Restart the application and auto enable mobile data connection. You must supply username and password by manually.

4 Version Update

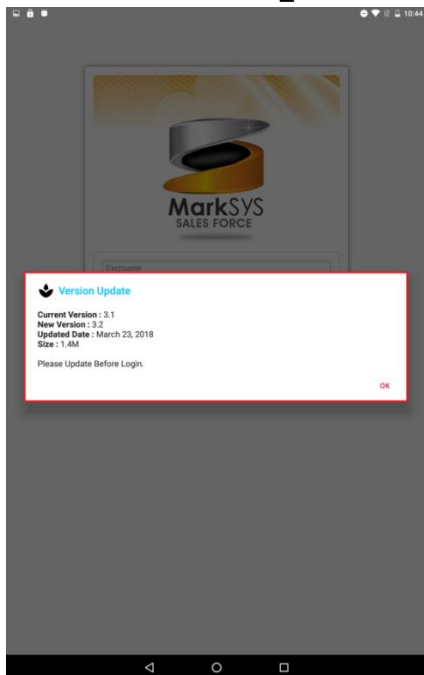


Figure 4.1: Version Update

Execute auto **version update** service and keep the current version up-to-date with Google play store. This is mandatory to continue application.

5 Login

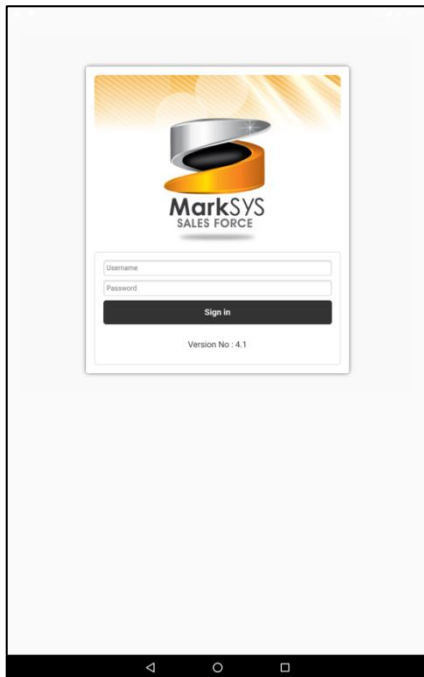


Figure 5.1: Login

Login page is entry point of Sales Force. Enter the correct credential and sign in.

Current version no also is display in below here.

6 Dashboard

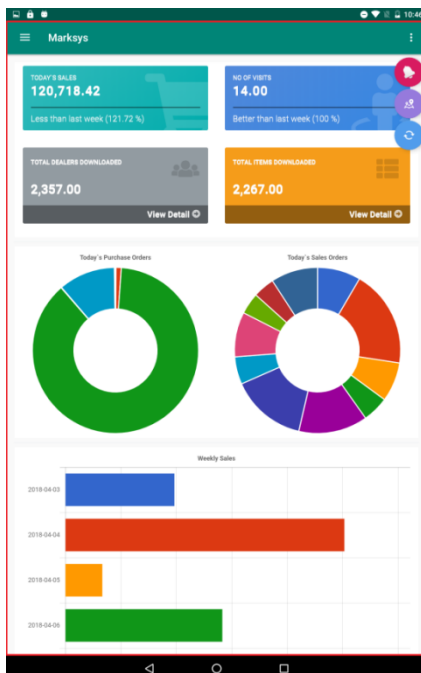


Figure 6.1: Dashboard Top



Figure 6.2: Dashboard Down

Dashboard is welcome page of system. It is not only a interface for main operations of system, but the summary of all analysis business data. User can get overroll picture about business.

Dashboard will appear following analysis data for user convinence.

- Current date total sale of user.

- Current date total customer visits.
- Downloaded dealer count.
- Downloaded item count.
- Customer wise total purchase orders.
- Customer wise total sales orders.
- Date wise weekly sale.
- Monthly Comparison of sales and purchase orders.
- Navigation of daily sales target.

7 Option Menu

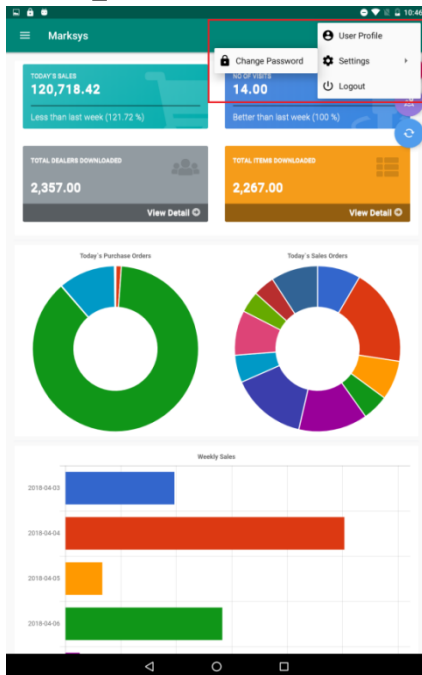


Figure 7.1: Option Menus

System set up is handling by **option menu**.

- User Profile: View all user details.
- Settings: Change and modify system handling & security settings for customer convince.
- Logout: Expire all credential and redirect to login page.

8 Notification

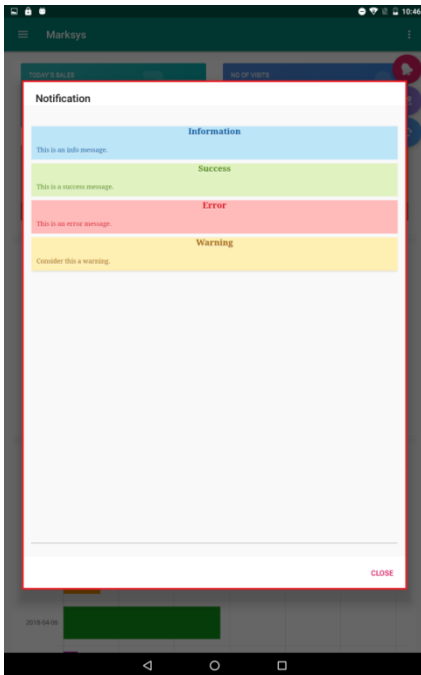


Figure 8.1: Notification

Notification indicates by four colors according to message status.

- Blue: Information messages.
- Green: Success messages.
- Red: Error messages.
- Orange: Warning messages.

9 Daily Route

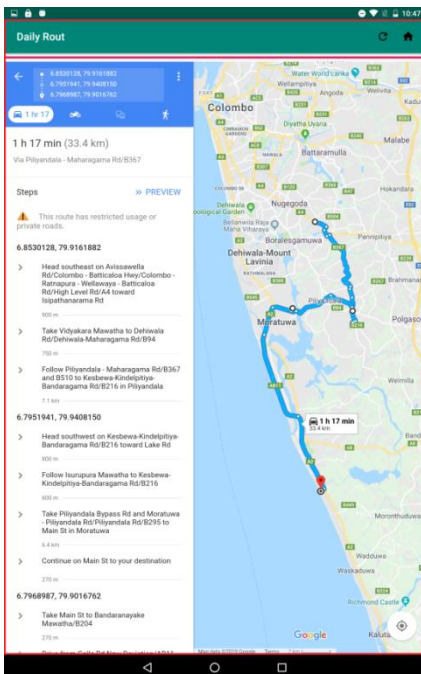


Figure 9.1: Daily Route

Daily route is the target map which sales representative must archived within current date.

This route is handled by Google map. When touch the map, It will re-route from the current location.

10 Navigation Menu

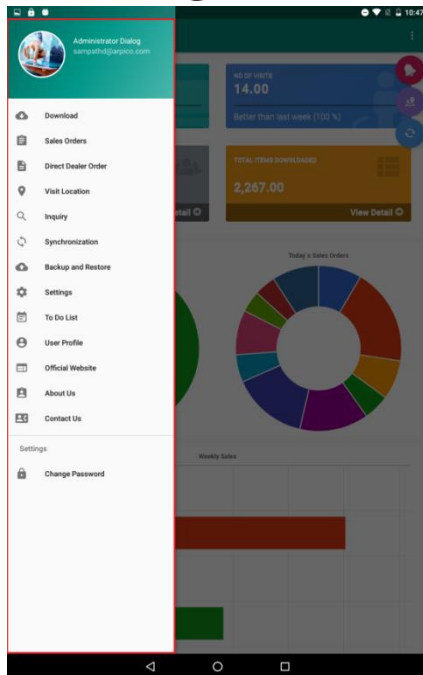


Figure 10.1: Navigation Menu

Navigation menu is main access point of system. User can access every operation from here.

Upper of navigation, the logged user name and email will display.

Bellow the user name, all authenticated options will be available as menu list.

The bottom of navigation, in the settings section there is an option to change password to user for more security purpose.

11 Download Options

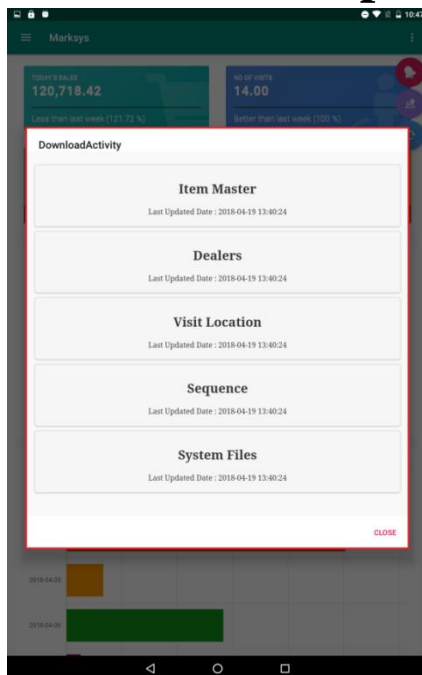


Figure 11.1: Download Options

Download all master data from cloud to local database (Android tab).

Below of each downloaded section, It will display the last synchronized date with time.

12 Sales Orders/ Direct Dealer Orders

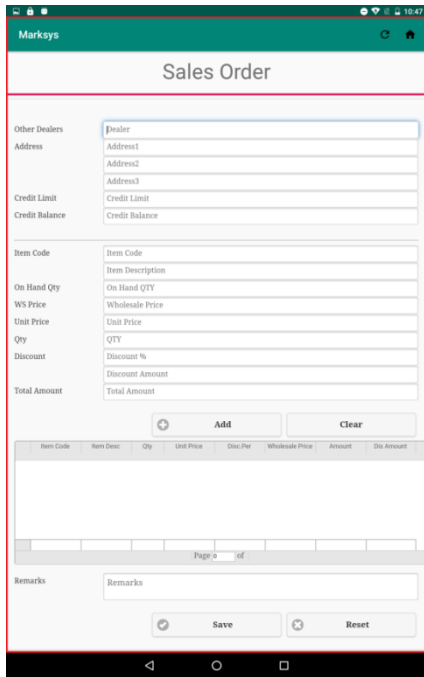


Figure 12.1: Sales Order

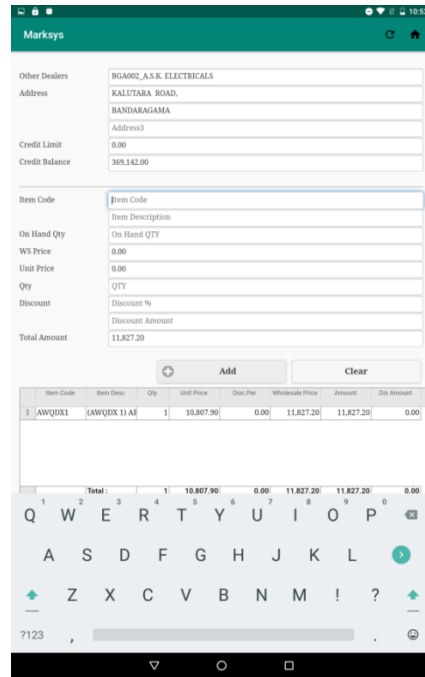


Figure 12.2: Fill Dealer Details

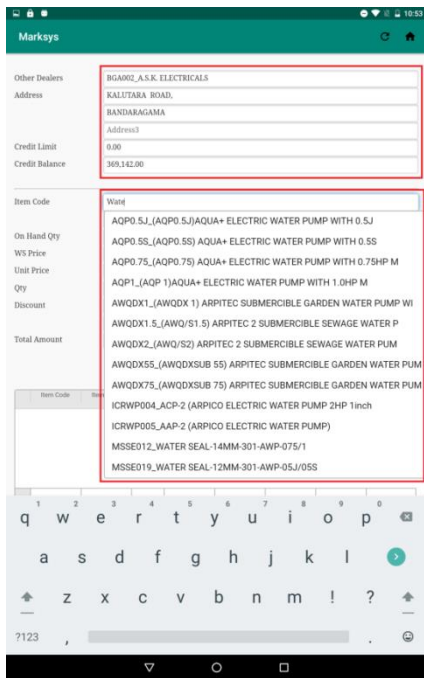


Figure 12.3: Fill Auto complete Items

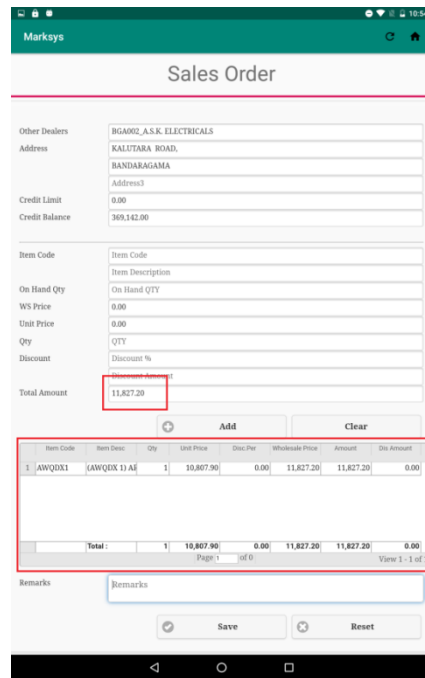


Figure 12.4: Add Data to Table & Sum

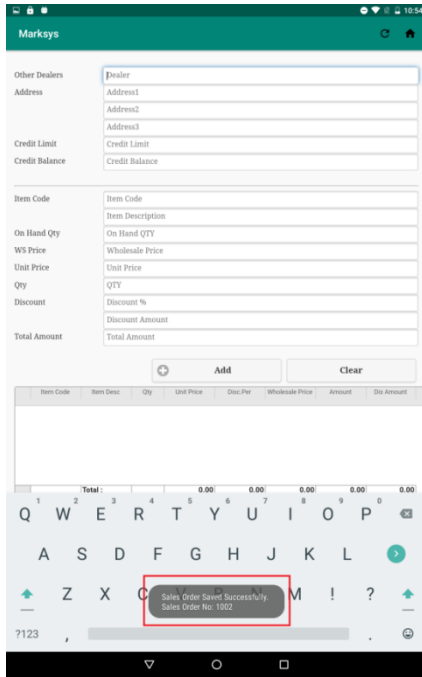


Figure 12.5: Save Sales Order with Doc. No

Process of **sales order** system.

- Select relevant type from menu.(Sales order/Direct dealer orders)
- Enter all data and add to system.

13 Visit Location

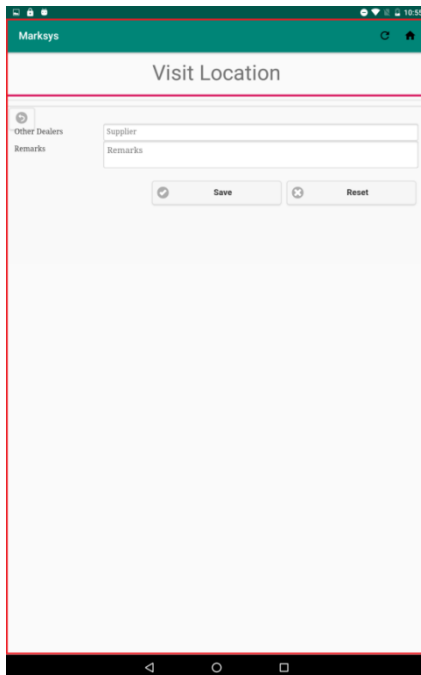


Figure 13.1: Visit location

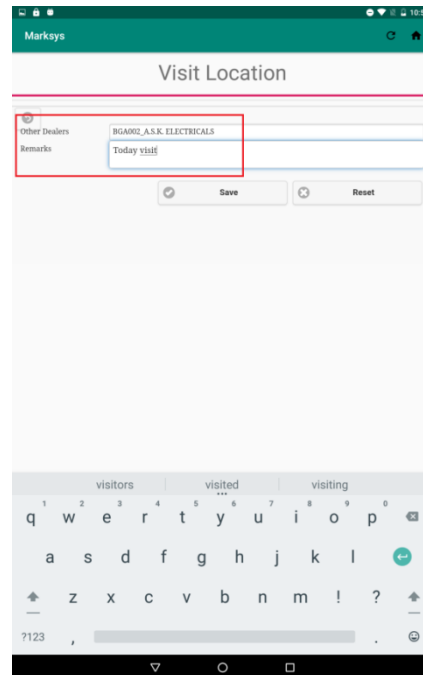


Figure 13.2: Fill Dealer

If sales representative return from dealer without any **sales order or purchase order**, then the visit location option will keep the relevant reason as a remark.

14 Inquiry

Inquiry section is many important thing of Sales Force application. It inquire total business flow and get detail for user. To optimise this detail, this inquiry section has divides to child sections as follow.

- Sales Inquiry
- Visit Locations Inquiry
- Items Inquiry
- Dealers Inquiry

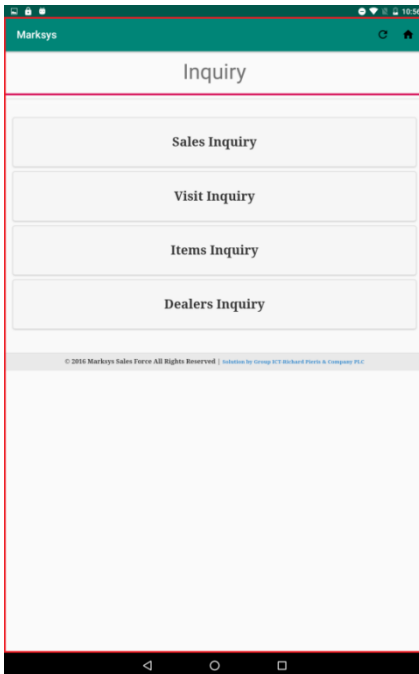


Figure 14.1: Inquiry Main Menu

14.1 Sales Inquiry

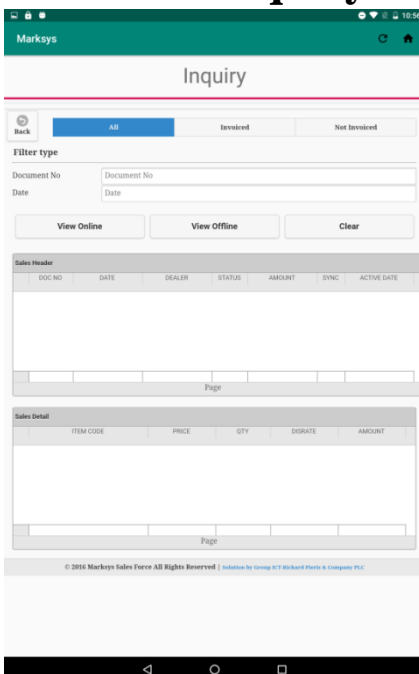


Figure 14.2: Sales Inquiry

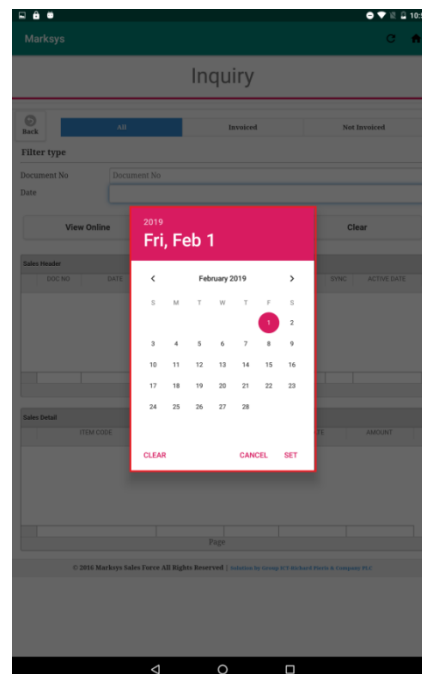


Figure 14.3: Filter Data with Date

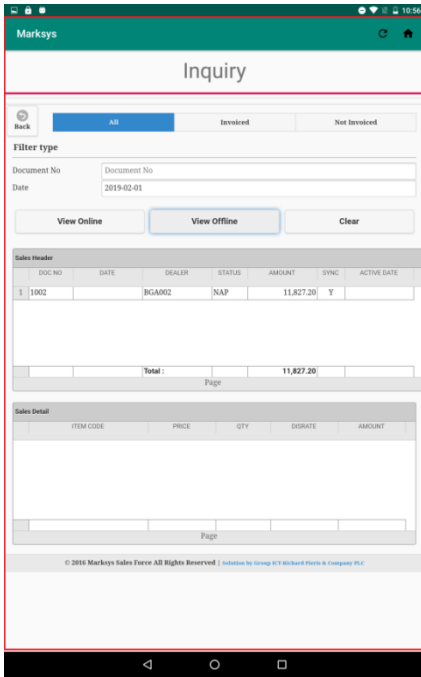


Figure 14.4: View Data Offline

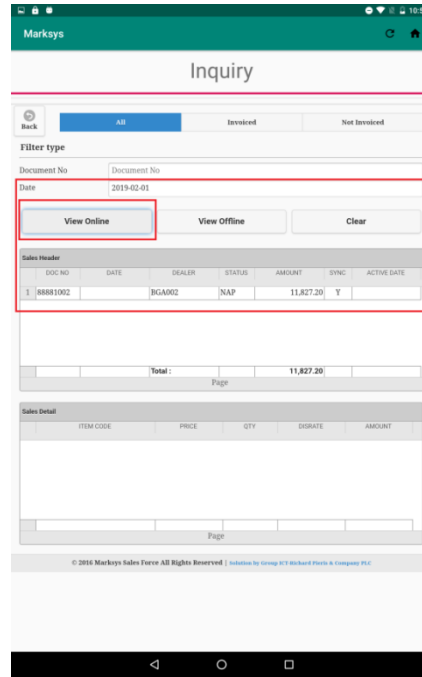


Figure 14.5: View Data Online

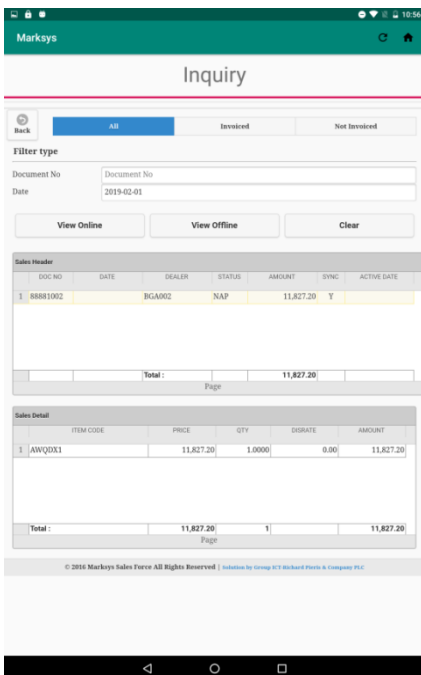


Figure 14.6: View Header Details

- Search all details of sales orders by document number and order date.
- They are categorized two type of search as online and offline.
- So also, previous orders could be search whether invoiced or not.

14.2 Visit Inquiry

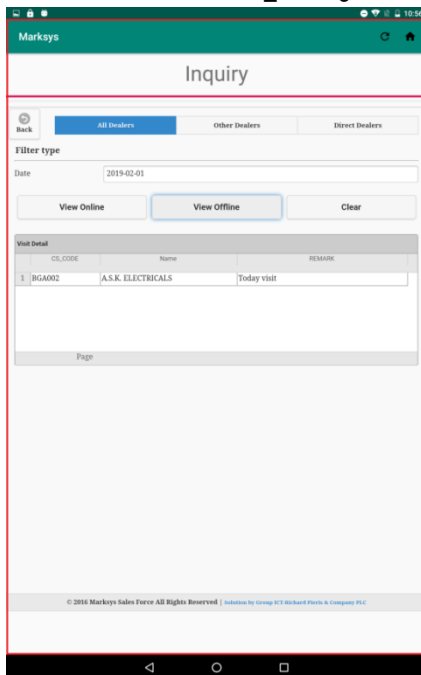


Figure 14.7: View Visit Locations

- Locations which user was visited can be inquired by this.
- There are two type of category as online and offline. If user is in online, then the inquiry is synchronized with current visited locations. Otherwise it will show till the last online time.
- There are two types of options as “Direct dealers” and “Other dealer” for filter the inquiry for user convenience.

14.3 Item Inquiry



Figure 14.8: Item Inquiry by Code

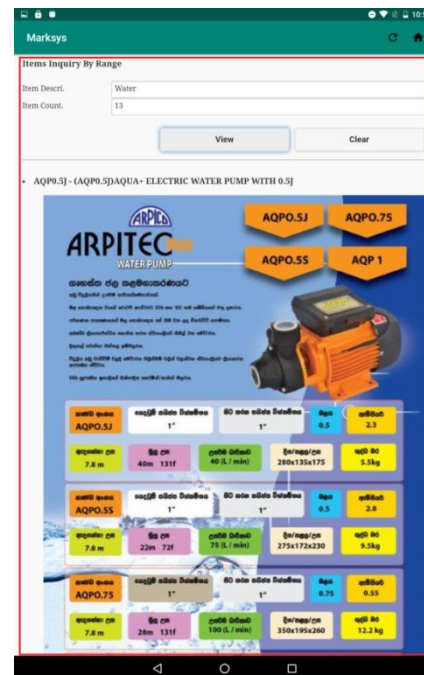


Figure 14.9: Item Inquiry by Description

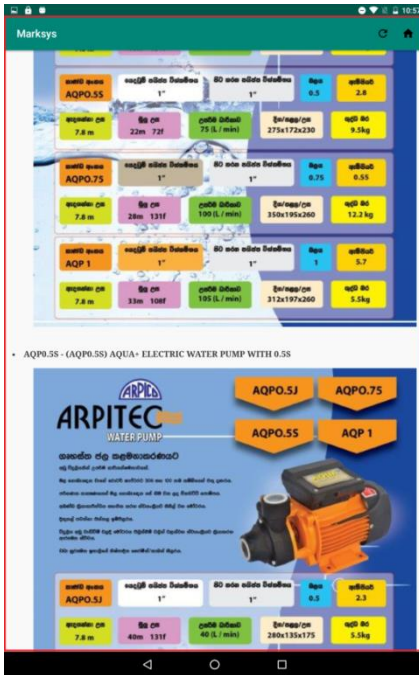


Figure 14.10: Item Inquiry by Description List



Figure 14.11: On touch Item Image

- **Item inquiry** has design under two category. User can inquire items via code or description.
- When using item code, user can view item details and leaflet of relevant item.
- When description inquiry mode, by using part of item description, user can view relevant items and leaflets as search result list.

14.4 Dealer Inquiry

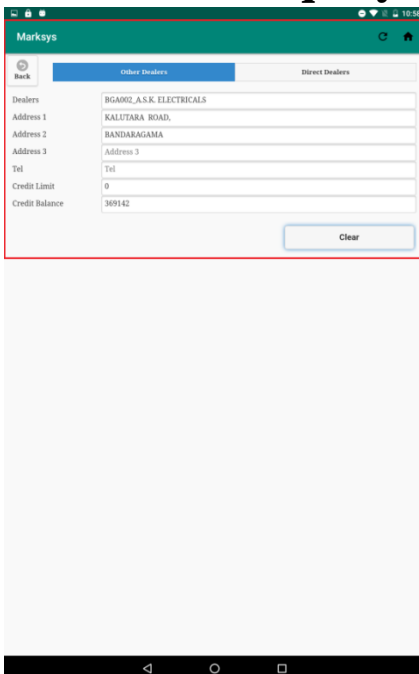


Figure 14.12: View Dealer Information

- All dealers details are can be search under two types of categories as direct dealers and other dealers.

15 Synchronize

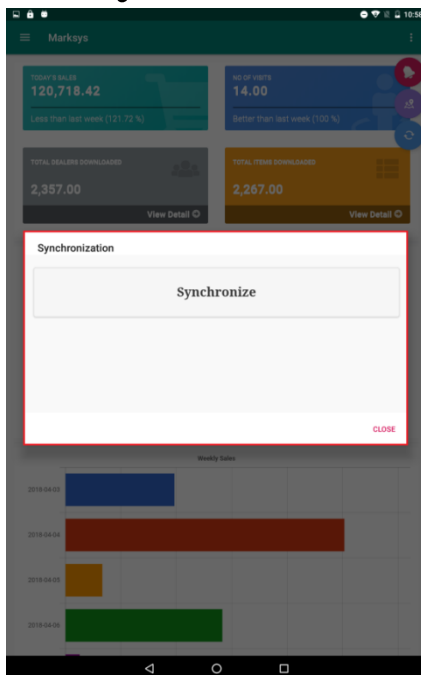


Figure 15.1: Manual Synchronize

- Under the sudden situation of auto synchronize failure, user can execute **Synchronize** process manually.

16 Backup & Restore

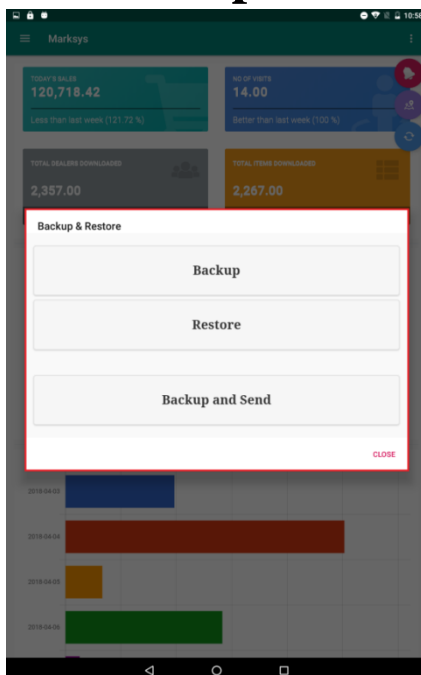


Figure 16.1: Backup & Restore

- **Backup:** Backup the current database to internal storage after confirmation message.
- **Restore:** Restore the last backup database from internal storage after confirmation message.
- **Backup & Send:** Backup the current database and email it to predefine email address within system file. User can't change this address manually.

17 Setting

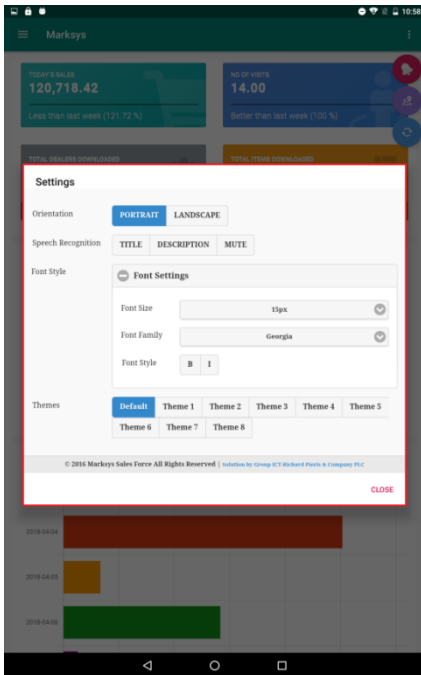


Figure 17.1: Custom Settings

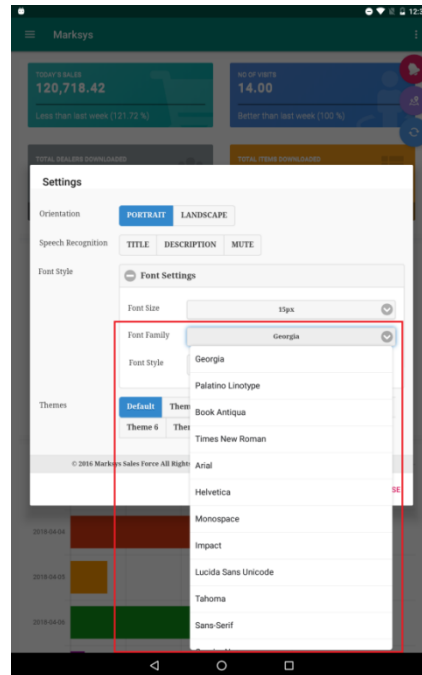


Figure 17.2: Change Font Family

- Application them and settings can customize according to user favorites.

18 To-Do list

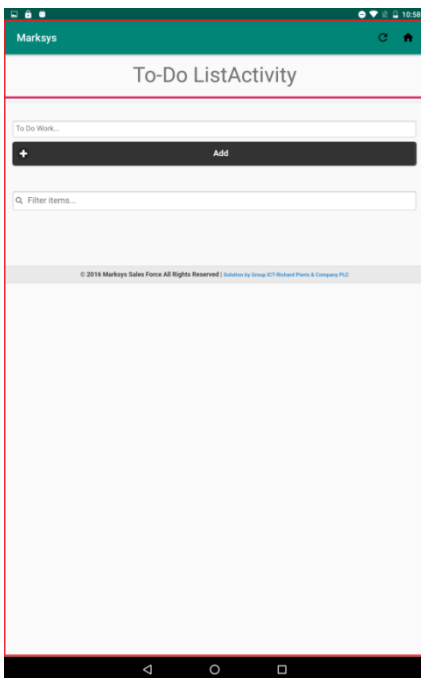


Figure 18.1: To Do List

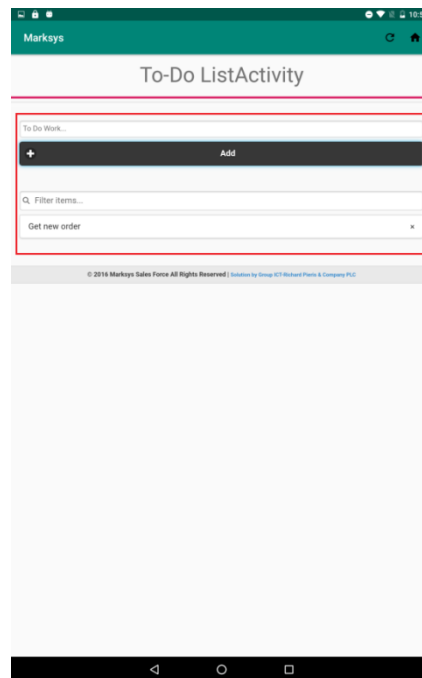


Figure 18.2: Add To Do Note

- Add, modify and delete daily jobs as a list for manage daily work load.
- It can be mark when completed task, and filter also as further functions.

19 User Profile

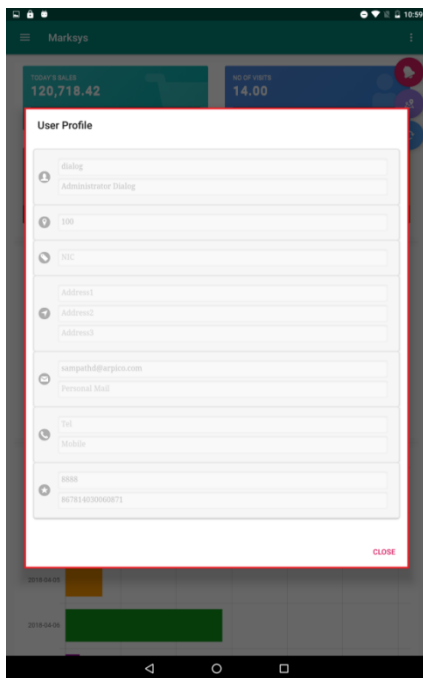


Figure 19.1: View User Profile

- View user profile as read only option.

20 Official Website



Figure 20.1: View Official Web Site

- Navigate to official web site for further details.
- It will popup information message, when network connection shall not available.

21 About Us

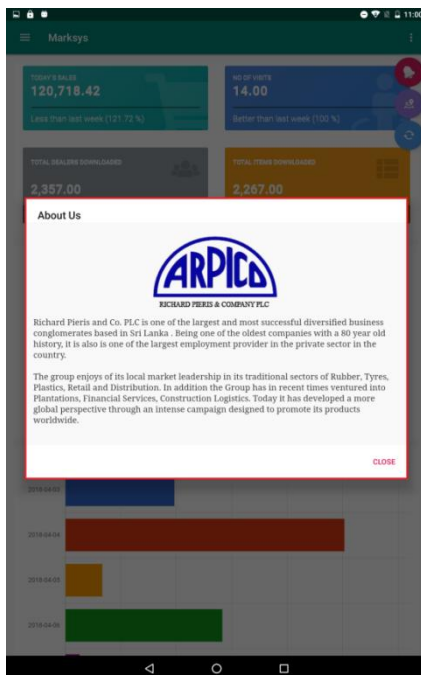


Figure 21.1: About Us

- Show the vision, mission and brief history about company.

22 Contact Us

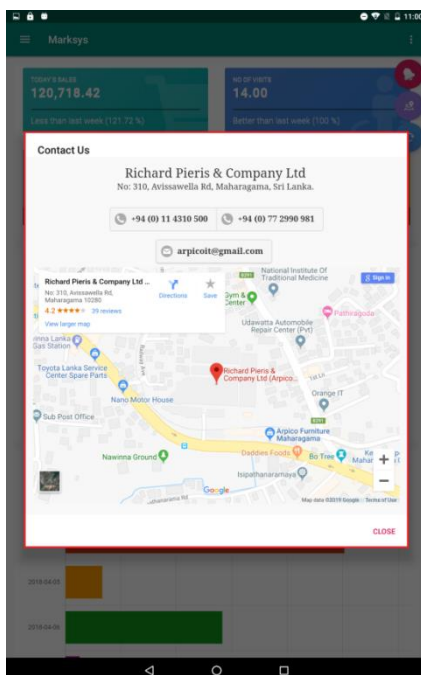


Figure 22.1: Contact Us

- **Contact us** will connect user with company directly.
- Further user can connect company & developer via phone line & email through.
- For visitors, **Google** route map to **Richard pieris head office** also view to search location details.

23 Change Password

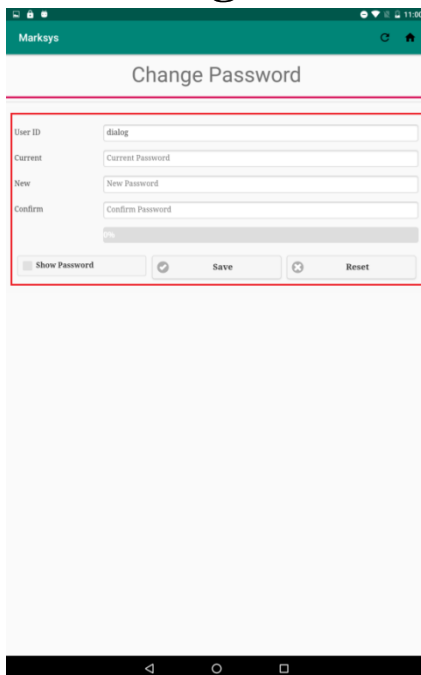


Figure 23.1: Change Password

- Change login user password and save.

24 Exit

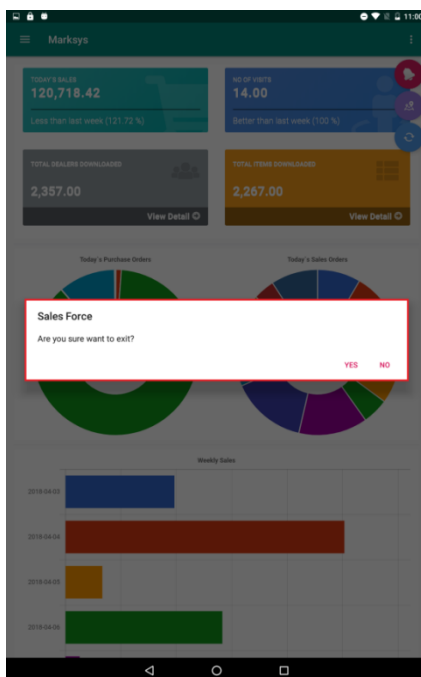


Figure 24.1: Exit By Option Menu

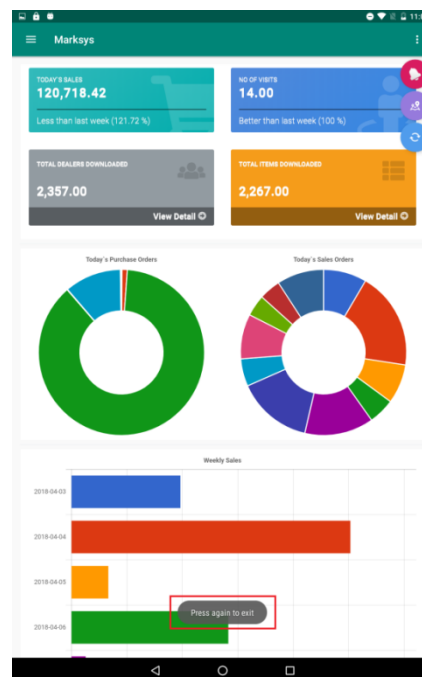


Figure 24.2: Exit By Back Press

Logout can be done by two ways

- Menu Options -> Logout
- Double touch of default android back space.