Inventory Tracker for Electrical Switchboard Manufacturers

Version 1.2 2/04/2020

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Audience : Mr. Long Tran (Manager)
Dr. PJ Radcliffe (Lecturer)
Clients and Stakeholders

Justification : The document aims to provide all the key information about the Project that include Revision Information, Scope, Customer Requirements, Solution Path & description, Product Specifications, Risk Analysis Project Management and Timeline Information.

1 Executive Summary

Target Industry-
There are over Seventy Switchboard Manufacturing Companies in Australia, over twenty in Victoria with hundreds of warehouses and shop-floors. This market is ideal considering it is a billion-dollar industry with growing demand and annual growth rate of about 7.8% globally.[9]

Application Synopsis:
The Inventory Tracking App shall be developed for efficient tracking and inventory management methods to monitor, keep track of and manage various Components and C-parts items of a Typical Switchgear Manufacturing Company with multiple warehouses and factories.

The App is designed to Identify, Locate and give essential data about the components that have been misplaced in the Manufacturing Warehouses. It comes with many features such as: - barcode scanning feature that enables the user to simply scan the barcodes and extract all the data fields related to the items, GPS tracking feature enables the user locate the item's warehouse address on maps which would be helpful when there is an urgent requirement of certain items that aren't readily available at the current warehouse location. Convenient searching enables the user to enter any one primary field and access the rest of the information.

Key resource info and implications:
The Key project resources have been identified that include software skills, costs, equipment and labor fees. This application will be developed in Linux OS which is a free open source platform therefore requires a desktop(preferable over 8GB RAM) with Linux Mint operating system that will run through a bootable 150Mbps read write flash drive, Software tools include Java JDK, Android Studio IDE, Eclipse IDE and Android Emulator. The Hardware equipment required for the project would be any Android device with API above 22, Internet router to connect to Wi-Fi and Hard disks to back up all the documentation and source code. Further Resources information and Costs can be found in the Resource Management section of this Document.

Key dates:
To view the Gantt chart with all key project dates, visit project time plan section
23rd March 2020- Camera Interface implementation
6th April 2020-GPS interface implementation
10th April 2020 Advanced UI design and Implementation
20th April 2020-Database implementation
11th May 2020- Final Testing Phase
25th May 2020- Application Demonstration

Progress and Achievements.
While the application development is currently still at a preliminary phase, few major prototypes have been built to mimic the real application such as Barcode Scanner, Home screen and UI.

2 Table of Contents

3 Configuration Management

3.1 Revision Information

Version Number	Changes from earlier revisions
1.2	**Major Updates-** • GPS interfaced with application • Improved scroll down options • User Profile Button • Maps View and advanced tracking options added • Bug Fixes and Code Optimization
1.1.2	**Major Updates-** • Indoor directions will not be implemented but application will focus on GPS tracking of other factory locations with identical items. • Improved UI • GPS icon button • Bug Fixes and Code Optimization
1.1.1	**Minor Updates-** • Scan Button • Barcode Scanning • Scroll down Options • New ion additions • Bug fixes
1.0	**Initial Version-** • Basic Home Screen GUI • Action buttons

3.2 Key Referenced Documents

View the References Section to view all the Reference Documents-

- The_Guide_STUDENT_2422_2425
- Lecture_mobile_computing_2422_2425
- Lecture_databases_2422_2425

3.3 Acronyms & Abbreviations

RA   Requirements Analysis.

DP   Design Proposal.

PD   Prototype Design

DF   Data Fabrication

I/0   Input Output

EOF   End of File

SDK   Software Development Kit

Java EE   Java Enterprise Edition

IDE   Integrated Development Platform

JDK   Java Development Kit

API   Application Programming Interface

XML   Extensible Markup Language

SQL   Structured Query Language

DQL   Data Query Language

OOP   Object Oriented Programing

DML   Data Manipulation Language

FBD   Functional Block Diagram

ER   Entity Relationship

UML   Unified Modeling Language

UI   User Interface

GUI   Graphical User Interface

TOS   Terms of Service

B2B   Business to Business

B2C   Business to Customer

AMA   Ask Me Anything

PDF   Portable Document Format

WWW   World Wide Web

WIP   Work In Progress

IOT   Internet Of Things

D2D   Device to Device

GPS   Global Positioning System

NFC   Near Field Communication

Wi-Fi   Wireless Fidelity

QR code   Quick Response Code

4 Introduction, Overview & Scope

This Project targets convenient tracking of various components used in assembly and manufacturing of industrial switchgear and switchboards. The application keeps track Major Components along with 'C-parts' section too, which although are of secondary value are essential for the building of the final electrical product. Some examples include Brass Earth-bars, Insulators, switch panels, heat shrinks tubs, screws bolts nuts and washers. C-parts sections are usually very difficult to humanly keep track every day and it's hard to constantly monitor their dimensions, quantity and location as they are used in bulk every day in multiple manufacturing locations.

4.1 Product Vision-

1) Convenience-The site engineers and technicians find it quite difficult to keep track of various loosely held items and they often keep them aside or misplace. And usually end up referring through item logs and desktops to know component details. This application eliminates the use of item logbooks and desktops, one touch and all the information would be visible in the users mobile.

2) Time Saving- Imagine the amount of unproductive time that goes in sorting out these items manually referring through component logbooks, data sheets, or computer desktops. This can be avoided with an organized system and convenient tracking using our mobile application.

3) Saving Money and Managing Resources-. It is estimated that 15% of the purchase cost is lost either due to misplacement or incorrect issued inventory. Many companies even with good inventory tracking systems often misplace essential components that could be reused, if in excess could be sent back to the item suppliers. This application will help the companies cut down costs and manage resources efficiently.

4) Delivery Status-The application will help the users access delivery information. If the items run low on stock the system, the user can view this information anywhere anytime. This will enable the user to place orders to the supplier and track the delivery effectively

4.2 Target Users in the Industry-

The Pie chart show the target users and their expected usage percentage. The users identified are **Fitters, Electricians, Electrical Engineers, Foremen, Welders and Inventory Supervisors.**
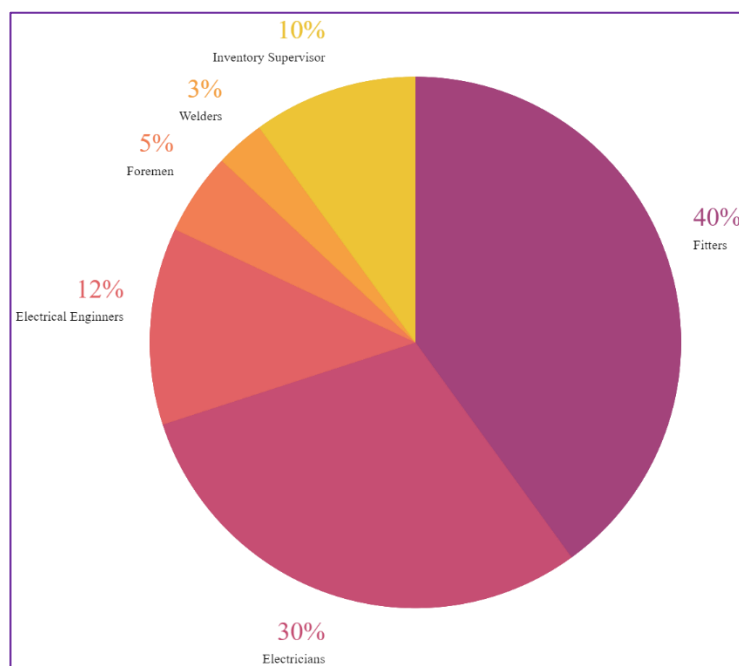
Figure 1 Pie chart showing target users

4.3   The Android System

The diagram below is to help visualize the ideas behind the application design and functionality like that of a block diagram or a mind map.
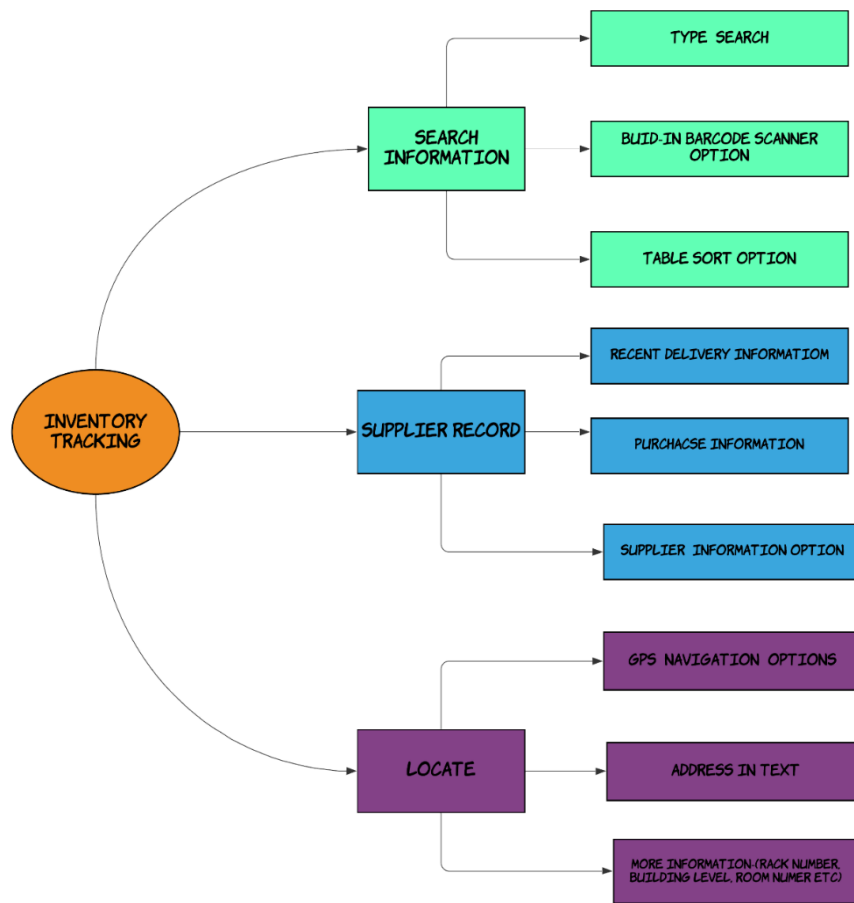
4.4 Project Scope and Priority

The Bar Graph below represents application specs (X-axis) and their priority level in the scale of 0-1(Y-axis). *Search Items, Scan Barcodes, Database Connection and GPS interfaces* are the main aspects of the project that shall be prioritized and implemented. As they determine the overall functionality of the app.
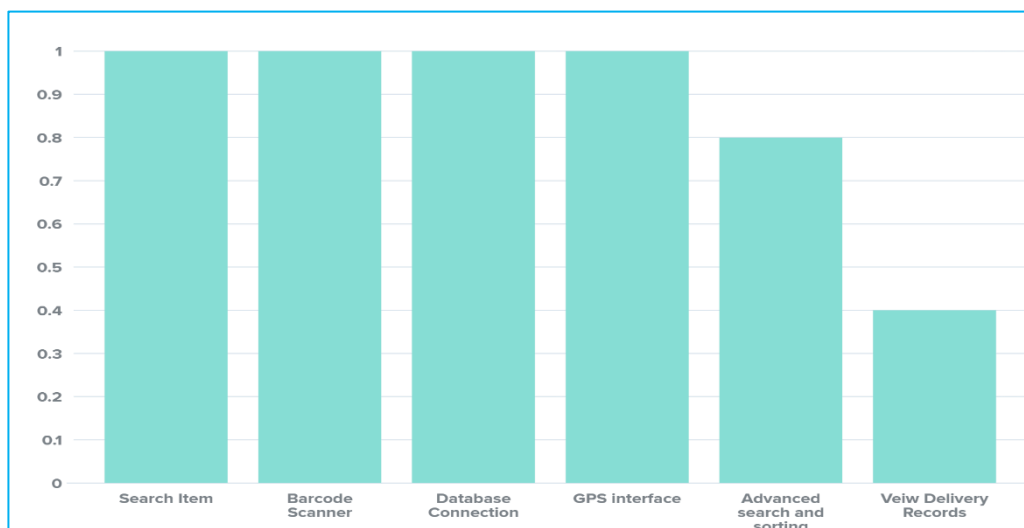
5 Key Requirements & Understandings

5.1.1 Guiding principles

5.1.1.1 **The Android Application shall be able to extract and produce essential information of items/ components from the database. Therefore, the device must have internet access (device must be connected to internet via LTE or Wi-Fi).**

5.1.1.2 **GPS feature enables tracking item's factory location including building number, rack level and directions. The application will need to access the user's location. Therefore, the user must grant permission to access to location. And the Location Services or the GPS must be turned on.**

5.1.1.3 **The Application will use the camera to scan barcodes to access the item information. Therefore, the user is expected to allow access to the camera to be able to use this feature.**

5.1.2 Requirements: -

5.1.2.1 Major Requirements-

Major Requirements	Description
View Component Data	The Android Application shall be able to give essential information of items/ components that are loosely held in the shop floor. Essential data includes fields such as 'Name', 'Serial Number', 'Quantity', 'Weight', 'Specifications (data sheet)','Price' and 'Location'
Advanced Search	The Applications is built for user convenience, one can simply extract all the essential information by simply entering any one of the main fields.
Scan Barcodes	Alternatively, the user can use the scanning option where one can simply scan the barcode of the item to extract essential data, for this the user must allow access to the camera.
Locate items that are readily available	Manufacturers usually have their items stocked up at various locations within a country and some of the items need to be moved from one location to the other. GPS feature enables tracking item's factory location including building number, rack level and directions. *Note that the user must allow the application to use the location services.*

5.1.2.2 The Operational environment-The users or stakeholder are expected to use this application where the components and 'C-parts' are located mainly factory workshops or shop floors.

5.1.2.3 Supplier Mandate Requirements-The application also stores other information such as supplier information. Supplier Information can be accessed by clicking the delivery icon, fields in it would include Supplier name, delivery status, delivery date and total costs.

5.1.2.4 Example Scenarios –

1) When there is a shortage of certain items in the manufacturing units, the application users can immediately locate the item's location and accordingly either order resources from other Warehouse locations or order directly to supplier.

2) When there's a pile of loosely held items, the user can use this application to help him identify the items which would then be segregated and stocked back into their respective racks in the storage units.

3) When components need replenishments, the user can check the notifications and view the items that are currently low in quantity and accordingly move resources from one location to the other or mandate to the supplier.

5.1.2.5 Hardware Interfaces-

- *Camera-* The Application will interface with the Back Camera of the device to scan Barcodes. Therefore, the application requires a functional camera to be able to use this feature.

- *GPS-* The application requires GPS and Magnetometer to locate items and help user navigate. Therefore, the user's device is expected to have these inbuilt sensors to use these features.

5.1.2.6 Privacy Policies and Legal Requirements-

5.1.2.6.1 *Personal Information-*The Application will not access personal information of the user other than name, email address and Company Name. The application values the privacy of the stakeholders and it is up to the user to enter their information.

5.1.2.6.2 *Account Requirement-* The application doesn't require the user's account information therefore the application would not prompt the user to login

5.1.2.6.3 *GPS-* The application will access the user's location (GPS coordinates) to help the user navigate and locate items and components, However the user can disable location services

5.1.2.6.4 *Network and Connections-*The application will require IP address and Port numbers to identify the user to access the data from the database.

5.1.2.6.5 The application will not allow any other **third-party software** including URLs or other applications to interfere while running.

5.1.2.6.6 The user is responsible for any Third-party Fees such as any access or data fees incurred from Internet providers or mobile carriers in connection with the usage of the application

5.1.2.7 Other Technical requirements-

5.1.2.7.1 The applications will be developed in Android Studio IDE. The android Studio is designed specifically for android application development built be JetBrains IntelliJ. Therefore, the application will only run on android devices. IOS devices will not be able to run the application.

5.1.2.7.2   APIs- The devices are expected to be at least above 22(Lollipop) or more for the application to run smoothly.

5.1.2.7.3   As specified earlier the device requires Wi-Fi or LTE connection to access data from the server.

5.1.2.7.4   As the application is not built from scratch. The SDKs will require third-party tools and libraries such as Google Vision API that are useful for the development and functionality of the application.

Note:- To view Other Requirements, Contradictions Wish Lists, Constraints and Assumptions visit
Appendix B section of this document.

6 Solution Description

This Section will provide information about how the application will be developed.

6.1 GUI Sample

- The images below illustrate the prototypes built so far, The GUI image figure 1 gives an initial look of the application home screen. However, it is subject to change and few elements will be edited at a later stage.
- Figure 2 shows the working of the barcode camera scanner. It scans the barcodes in fraction of a second and outputs component/item data.
- The Figure 3 shows the screen of a typical android phone(nexus) trying to extract information from the database, This will be implemented in the final application with advanced search options where the user can simply type any one of the item fields to access the rest.
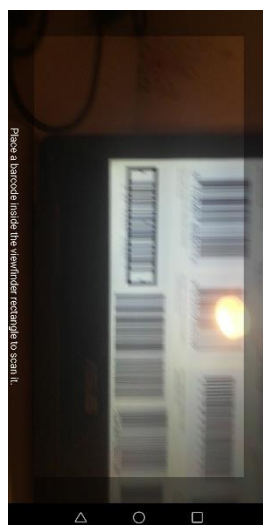

Figure 2 Home Screen   *Figure 3 Barcode Scanner*   *Figure 4 Result Screen*
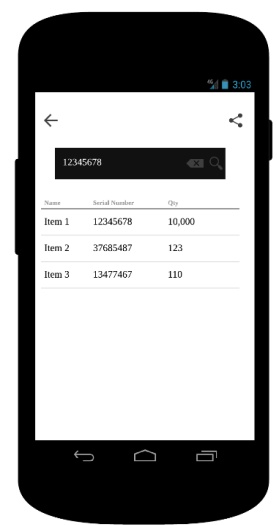
6.2 Use Case Diagram

The diagram below represents the user's interaction with the system, showing the user's connection with the use cases. The target users are Site Engineers, Technicians, Warehouse Supervisor and inventory controllers. The person interacting with the system is the target user, the uses cases are represented in yellow circles and the rectangular blue shaded background represents the overall system which contains all the application use cases.

Figure 4 *Use Case Diagram*

6.3 Block Diagram

The block diagram below is the representation of the functionality only, it does not represent all the use cases. It is meant to give a fair idea (sort of like the mind map) on how the application will function and the main ideas behind the android program. The Diagram shows both, the software and hardware aspects of the application. Note that **Scan Barcode** block and **Preview GPS map blocks** will interact with **hardware** i.e. Camera and GPS of the Android Device.
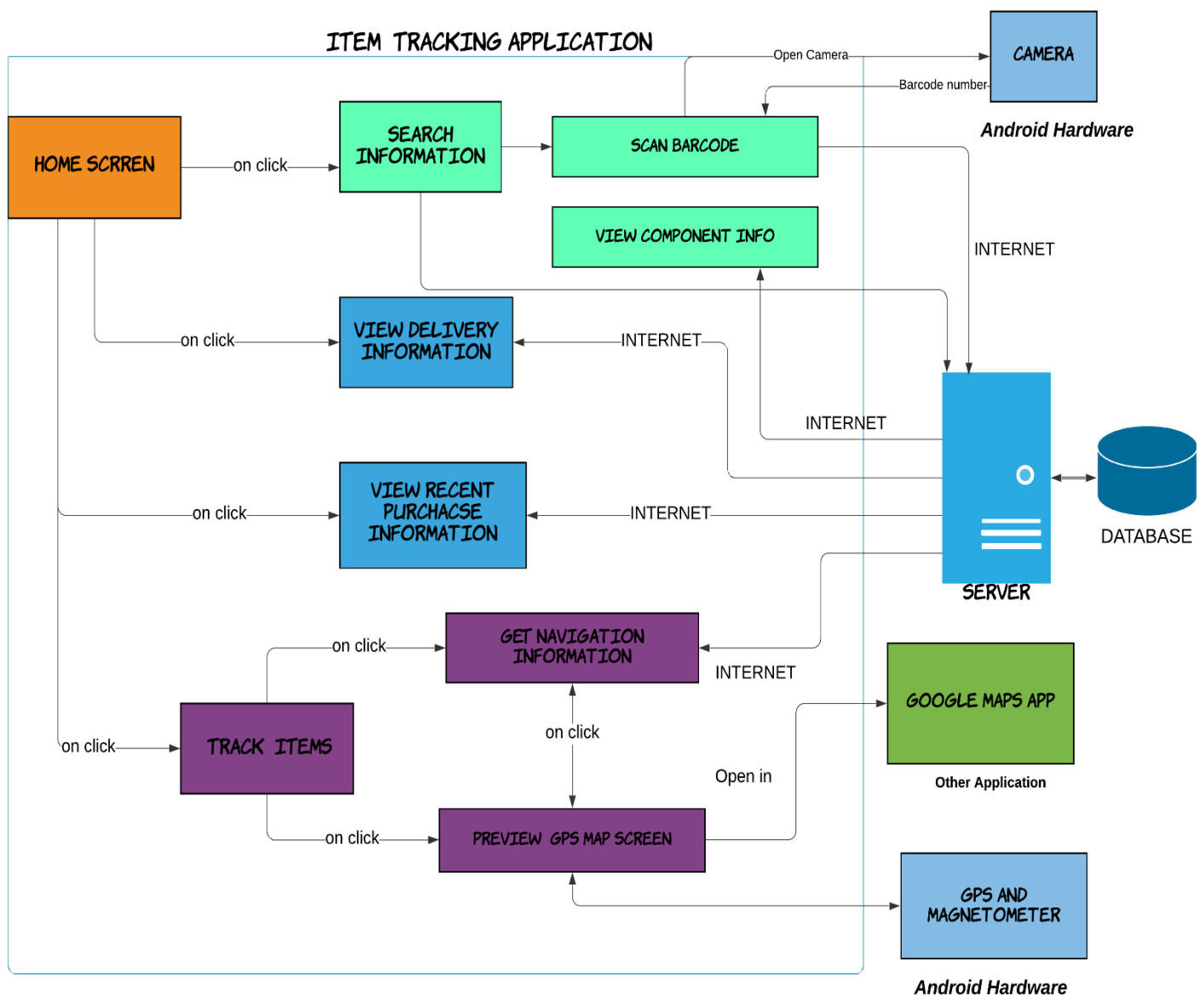

Figure 5 Block Diagram

6.4 UML class diagrams

The diagram below is an UML ER diagram, showing how the data will be stored as classes. There are six major entities that have been identified namely 'Suppliers', 'Materials', 'Technicians and Site-Engineers (or Users)','Manufacturing Unit', 'Loosely Held Items' and 'Storage Units'(Warehouse).The links between entities are the relations that have been labelled. The Supplier supplies Materials (Electrical-Components) to the Manufacturing Units and the Site Technicians. The site technicians supply assortment of items to the Manufacturing Unit for assembly. Left over items and components are sent to the Loosely held items section which are sent back to the Site-Engineers and Technicians, then the site engineers segregate and arrange the items back into the storage units.
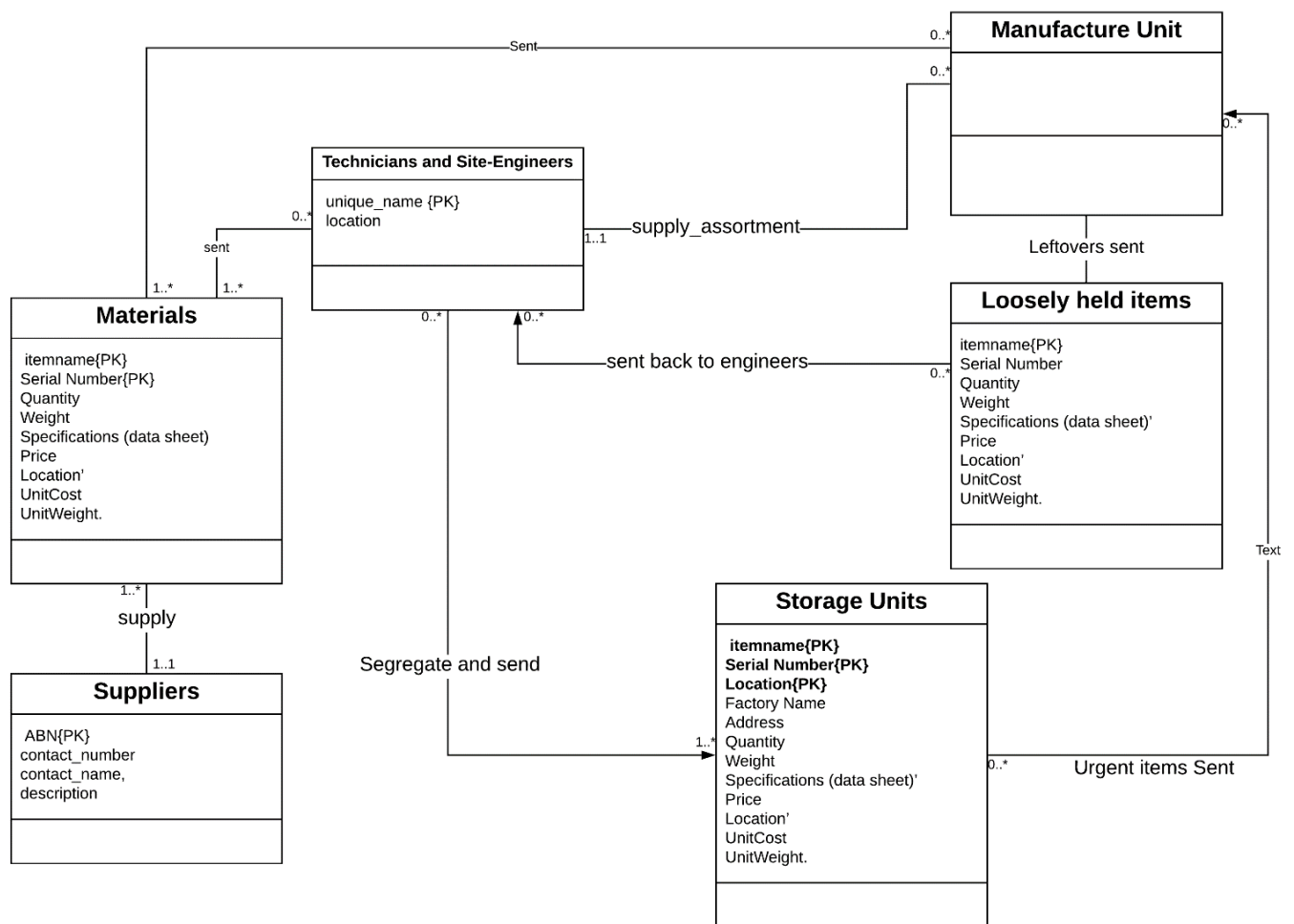
Figure 6 ER Diagram

7 Solution Path

The section below describes the prototypes that must be implemented to achieve the final product.

#	Prototype Purpose	Details
2	UI Home Screen. (Accomplished)	Create the home screens for the product as a quick prototype (with simple functionality just looks and feel). (22^h March 2020)
1	Camera Scanner test (Accomplished)	Interface the application successfully to read/scan barcodes. (20^h March 2020)
3	GPS tracking (Work in Progress)	Configure and interface GPS within the application to track locations. (8th April 2020)
4	Data Extraction from the Database (Work in Progress)	Extract essential data from the database (20th April 2020)
5	Create tuples and store data (Work in Progress)	Collect all the required data from the switch board manufacturer and insert the data into database. (25th April 2020)
6	Advanced Search Option (Work in Progress)	Develop advanced search made for convenient search of data with sorting options. (30th April 2020)

8 Risks, Opportunities, and the Test Plan

8.1 Risk Analysis and Elimination

Major Risks	Risk analysis & risk elimination activities.
GUI Design (Solved and Eliminated)	The GUI has been designed and implemented. Thereby eliminating the risk of falling behind schedule
Camera Scanner (Solved and Eliminated)	Interfacing the camera with the application and being able to detect barcodes can be identified as risk because faulty software could result in incorrect readings. Therefore, this has been addressed and the risk has been eliminated
GPS Interface (To be Solved)	Interfacing with GPS can be tricky, and one might have to use Google vision API for the development of this aspect of the application.

Minor Risks	Risk analysis & risk elimination activities.
Database	This is a minor risk and requires SQL database to store data. The item data should be stored in the form of tuples. The insertion of the data into the tuples must be verified and any error prone data must be recognized and deleted.
Data Extraction	Interfacing the database with the android device can be a little tricky and is a risk if not addressed properly, as all the data is solely stored in the database.

Issues to be Resolved	Risk analysis & risk elimination activities.
Application Privacy Policies	Privacy policies must be ascertained to avoid any legal complications. The legal implications must be assessed and addressed.
Project Constraints and Contradictions	Project Constraints and Contradictions have been identified. Having Constraints could cause disruptions in progress. Therefore, they must be addressed and eliminated.

8.2 Testing Considerations

The Testing of the application shall be done using the emulator and real android devices, So far, the completed protypes have been tested.

Main Functionalities to be tested	Status
Item Search	In Progress
Barcode Scanning	Tested
Scroll down	In Progress
GPS Navigation and Location Accuracy	In Progress
View Delivery Information	In Progress
View Recent Purchase Information	In Progress
Open Google Maps via the App	In Progress
UI with Landscape Screen Orientation	In Progress
View Checklist menu	In Progress
Data Extraction from the Database	In Progress
Quitting Application	In Progress

- o ***Testing Resources-***The Application will be tested on the emulator and actual hardware as listed below-

  - ***Android Emulator****-* Nexus 4, Nexus 5, Pixel C
  - ***Hardware Device****-* Huawei Honor 7X

- o ***Time Requirements****-* The Testing will occur simultaneously while developing the application. But the final tests will be done 2-weeks before the project deadline (1st May 2020-15th May 2020)

9   Project Management

9.1 Resource and Skill Acquisition-

Software Skills-	Resources	Timeline	Costs
Advanced Java Programming for Android Application Development	JDK, Eclipse IDE Android Studio, Android Emulator	*1-2 weeks*	*Free*
Database Concepts	SQL, SQL Lite	*1 week*	*Free*
OOPs Skills	JDK, Eclipse	*1 week*	*Free*
SQL Programming	SQL, Lucid chart, SQL lite	*1 week*	*Free*
Linux OS Knowledge	Linux Ubuntu, (SanDisk flash drive 128GB)	*3 weeks*	*$35*

Other Resources-

Hardware Equipment Required – Android Device-Huawei Honor 7X

Network Connectivity-For Wi-fi (Routers), or LTE

9.2 Configuration & Issue Management Plans

Back Up Plans-

Items that need back up	Backups
Project Documentation	Google Drive, Desktop Hard Disks, Hard drive and OneDrive and Hardcopy backup
Application Software	Android Device Storage, Hard drive and Desktop Hard Disk.
Source Code	Google Drive, Desktop Hard Disks, Hard drive and OneDrive and Hardcopy backup
Library and Reference Information	Google Drive, Desktop Hard Disks, Hard drive and OneDrive and Hardcopy backup
Project Visual illustrations (Graphs, Images, Diagrams)	Google Drive, Desktop Hard Disks, Hard drive and OneDrive and Hardcopy backup

Issue Tracking-All the issues or defects that have been identified will be recorded in a spreadsheet and addressed during the development and testing phases.

9.3 Cost Estimates

Since the project currently is still at a premature stage, the costs below are **rough estimates**. Note that although the project development is for a University Project Demonstration, the Labor cost have been considered according to the real market scenario, considering the costs of paying one developer for 30hrs of labor time at the current market pay rate.

i)	**Project Development Costs-**	ii)	**Notional expenses**
$	Android Studio (Free)	$	Labor time- 30hrs@$50/hr.- (AUD$1500)
$	JDK (Free)		
$	License Fees- (Free)		
$	Bootable Flash drives-$35		
$	Hardware- Android Device (AUD$250)		
$	Internet Expenses (AUD$80)		
$	Google Play Store Fees (USD$25=AUD42)		

Total Estimated Cost- AUD$ = 1,907

9.4 Time Plan

Below is the Gantt Chart with the Project timeline and activity status.

| Activity	W1 2/3/20	W2 9/3/20	W3 16/3/20	W4 23/3/20	W5 6/4/20	W6 20/4/20	W7 27/4/20	W8 4/4/20	W9 4/5/20	W10 11/5/20	W11 18/5/20	W12 25/5/20	Status
Initial Prototype & GUI													Done
Project Application													Done
App development													WIP
Barcode Scanner interface													Done
Project Proposal & GPS interfacing													WIP
Testing and Code Optimization													WIP
Database Implementation													WIP
Partial Implementation													WIP
Final Testing Phase													WIP
Final Presentation													WIP

Note: WIP-Work in Progress

10 References

Search the web to find the IEEE or Harvard referencing style and use that.

[1]Armour, B., 2020. *The Mobile App Product Requirements Document [Free Template]*. [online] Clearbridge Mobile. Available at: <https://clearbridgemobile.com/product-requirements-document-free-template/> [Accessed 2 April 2020].

[2] Programmerworld. 2020. *Design A Location Tracking App Using GPS In Android Studio*. [online] Available at: <https://programmerworld.co/android/design-a-location-tracking-app-using-gps-in-android-studio/> [Accessed 2 April 2020].

[3] Athuraliya, A., 2020. *How To Plan An App | 7 Little- Known Visual Strategies To Build An App*. [online] Creately Blog. Available at: <https://creately.com/blog/diagrams/how-to-plan-an-app-visually/> [Accessed 2 April 2020].

[4] Mohammad, A., 2017. *Mobile Tracking System Using Web Application And Android Apps.*. 1st ed. [ebook] Available at:<https://www.researchgate.net/publication/328346114_Mobile_Tracking_System_using_Web_Application_and_Android_Apps> [Accessed 1 April 2020].

[5] bardecode.com. 2020. *Image Resolution And Barcode Reader*. [online] Available at: <http://www.bardecode.com/en1/image-resolution-and-barcode-reading/> [Accessed 2 April 2020].

[6] Thinking Portfolio. 2020. *The 6 Secrets Of Good Project Resource Management*. [online] Available at: <https://thinkingportfolio.com/the-6-secrets-of-good-project-resource-management/> [Accessed 2 April 2020].

[7] Sims, G., 2020. *Publishing Your First App In The Play Store: What You Need To Know*. [online] Android Authority. Available at: <https://www.androidauthority.com/publishing-first-app-play-store-need-know-383572/> [Accessed 2 April 2020].

[8] Grønli, T., Hansen, J., and Ghinea, G. 2011. A Cloud on the Horizon: The Challenge of Developing Applications for Android and iPhone. PETRA '11: Proceedings of the 4th International Conference on Pervasive Technologies Related to Assistive Environments. ACM.

[9]2020. Global Switchgears Market By Manufacturers, Regions, Type And Application, Forecast To 2025. [ebook] VRR. Available at: <https://www.visionresearchreports.com/global-switchgears-market/24281> [Accessed 2 April 2020].

11 Appendices

11.1 Appendix A

11.1.1 Application database connection
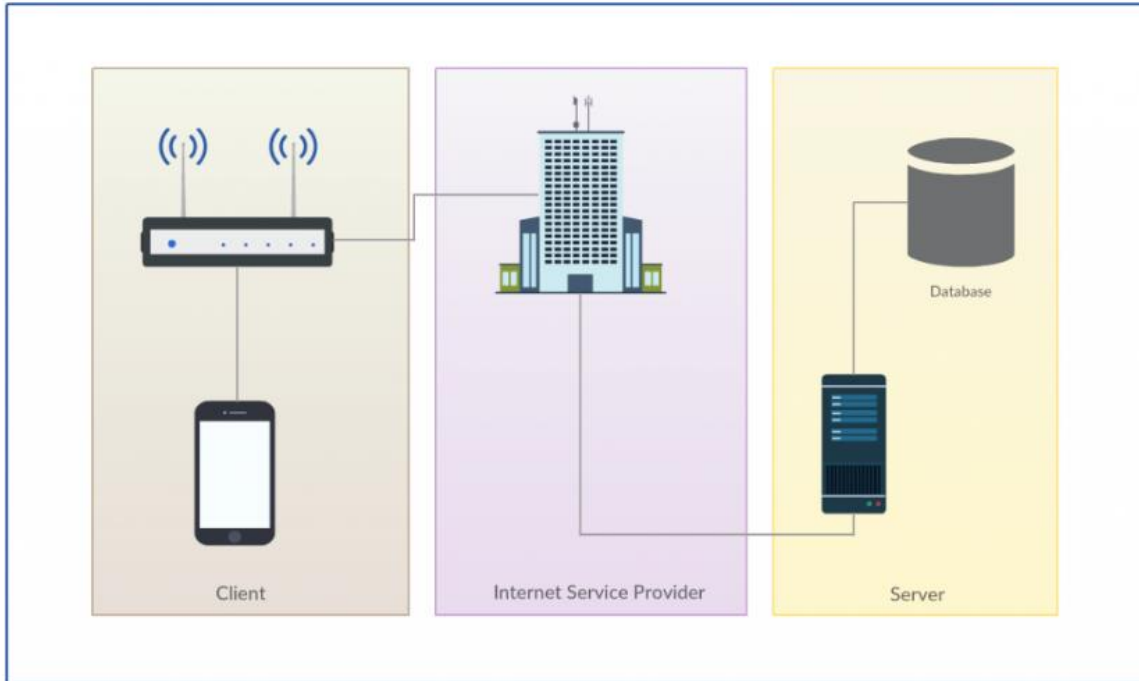
Figure 7 *Client-Server Relationship*

11.1.2 List of Few Switchgear Manufacturing Companies in Victoria, Australia

A-Line Swtichboards Pty Ltd
Advanced Controls Pty Ltd
Allro Switchboards
Custom Switchboards
DaRa Switchboards
DRC Switchboards
F & I Industries
Fordham Electrics
HP & CP Australia Pty Ltd
Kaytee Pty Ltd
Trivantage
Lai Switchboards Australia Pty Ltd
Medallion Electrical Services Pty Ltd
S J. Electrics Victoria

11.2   Appendix B

11.2.1.1 Maintenance, Bug Fixes and Updates

11.2.1.1.1 If there are any bugs in the application for example data duplication or misreading from the scanner, the user must immediately notify the developer. The developer shall fix it in at least 2-3 business days

11.2.1.1.2 There would be random maintained checks to monitor the application functionality and investigate any security issues

11.2.1.1.3 There may be updates every 3-4 months where the developer might add new features, improve UI, remove random bugs and optimize software, enhance user experience etc. The update version of the application can be installed at play store or the developer might send the updated version downloadable link to the stakeholders.

11.2.1.2 Contradictions:

- In very rare circumstances there may be duplications of data in the database and the user might get incorrect data. In these circumstances the Inventory controller or the Warehouse supervisor must immediately contact the application developer.

- The user can only view but cannot edit the data in database via the application, only the developers have the rights to access the database and update contents. However, the inventory supervisor can request the developer to update the data tuples in cases where new items have been added or if there are any errors while viewing the tuples.

11.2.1.3 Wish list:

- *Live delivery Tracking*-Tracking live delivery from the supplier.
- *Indoor navigation*- Navigate through indoors guiding and directing user towards the item location.
- *Automated order*-Automatically order items when the stocks run low and need replenishments.

11.2.1.4 Few Major Constraints-

- The application will only work in android devices
- The application supports API's above 22 or more.
- The mobile device must have a decent camera. As per the standard requirement the camera must at least have 2 pixels-4 pixels per element to scan barcode effectively.
- The magnetometer and GPS of the mobile device should be fully functional.
- The data readings in some circumstance might be incorrect if the company's data files have errors.
- We are limited to 45hrs development labor per week and any bug fixes will at least take 2-3 business days to fix

11.2.1.5 Few Main Assumptions

- The application will be launched in play store.
- The application will only need Wi-fi speeds up to 2mbps
- Application will be updated every 2-3 months
- All the application users are on android operating system with at least 22 API.

**************************** END OF DOCUMENT ****************************