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# Smart Stock Management Control

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**Abstract**
The recent stock management control system uses 1D and 2D barcodes which is difficult to maintain because it is not durable and reusable and also the barcodes are not rewritable. The researched based project is about managing stock using android smartphone with RFID technology system. An android application has to be developed and designed using Android Studio software where the android smartphone requires having the NFC enabled in it, so it can in-cooperate with the RFID tags to allow the data transfer between the smartphone and the RFID tag. The software prototype of the SSMC was created and tested based on different types of testing approach. And the system has zero errors visible because the approach of the programming of the application and debugging the codes ensures that the errors can be located and solved within a short period of time. The system would be more realistic if the database created is based on real time events where auto syncing is available directly to computer instead of backing up manually on SD card and transfer via wireless. Moreover the graphical user interface of the software prototype can be improved to make it more professional.

**Keywords:** Barcode, RFID, database, SD card, Warehouse Management System, Android Smartphone, Incoming and Outgoing Items.

## Introduction

In this era of modern technology, the industrial companies are becoming more systematic in every term possible but to create a systematic system for data reporting, the cost of this systems are high which causes the company to create an unfriendly report because that is where the stock management system is done manually without the help of any technology or system. The industrial affected areas are mainly in the warehouse department and the manufacturing department, the warehouse department is where the items or materials are arriving for stock purposes and later on to be used by the manufacturing department. In the manufacturing department, the manufactured items are combination of the materials obtained from the warehouse department to manufacture objects based on user's description. RFID (Radio Frequency Identification) is considered as the main technology for realizing the universal environment by providing the identity to the physical object.

For the smart stock management system which uses an Android Smartphone in the industrial companies are research based on the supply chain management, tracking system based on RFID and so on. For the barcodes part, it is seen to have more than two types of barcodes which are available on the market. For example, on types of barcodes existing are the 1D barcode, 2D barcode and etc. It is said by Flipse [1], the use of this barcode can increase the database system productivity but the limitation is that the not all system are compatible the 1D or 2D barcode, therefore in the journal researched states the advantages of radio frequency identification (RFID) technology in warehouse management system.

The database section is a main role for the reporting for both the warehouse department and manufacturing department, this is because the incoming and outgoing is analysed and evaluated on what materials have arrived for the warehouse department and what materials are used for manufacturing for the manufacturing department. In order for the database in Android Smartphone and the computer to be kept up to date from time to time the system is linked via wireless connectivity. The smart stock management system has already been in the market just recently but there a number of limitations to the system such as the database syncing via wireless connectivity between the Android Smartphone and the computer is not available. But the users can sync information using data transfer via USB. In addition, the systems introduced are costly which makes the company owner's to reconsider whether purchasing the system is worthy.

Moreover, the system can be enhanced by making the connectivity of the Android Smartphone and the computer to be connected via wireless which includes auto database syncing and reducing the cost further is considered and introduced. This system allows user to sync data manually or the system is set to auto sync every 1 minute. By doing this, the database is kept up to date not only on the Android Smartphone but also on the computer, plus these also ensure

good reporting will be done on the database for both the warehouse department and manufacturing department.

## Related Work

In this modern century, the growth of RFID is tremendously outstanding due to its setting up to be everywhere such as logistics, warehouse and etc., the RFID has an automatic identification and data capture technology where three elements are involved which is the RFID tag or chip, a reader which can emit radio signals and receive data from the tag and third element is the software where it is between the RFID hardware and enterprise application [2]. According to the authors of this journal [2], the impact and potential benefits of RFID technologies in supply chains performance were analyzed using multiple journals, articles and conference paper to further improve the system. In this research paper, numerous works on how the benefits can be evaluated is by addressing the analytic modelling, simulations, case studies and experiments and also including the reviews of the ROI (Return-On-Investment) analyses. The limitations of this journal is basically a research made overall using a number of journals, so one of the limitation is that is the source reliable and trusted, second most of the studies has only develop analytical model but the some of the models are not capable to estimate the impact of RFID. Though there is little limitation, but the results are impressive and the RFID technologies in supply chain is considered to have a good number of advantage which are traceability and visibility of products is improved, efficiency is increased along with the speed of processes, information accuracy is improved, and inventory losses is reduced.

The demands of RFID tag system in various applications has been increasing because of its benefit such as high accuracy, time saving and etc., Ping et al. in paper [3] proposed a design of passive RFID reader based on mobile phone. According to the authors, the problem faced is the use UHF RFID reader which has a frequency range of 900MHz ~ 2400MHz where the UHF can costly and the size of system makes it not easily to be brought around through the warehouse or stock inventory due to its hulking size plus it requires an external antenna for data transfer. The methodology applied in this research is a mobile phone is used as an innovation to make the system to integrate with the passive RFID reader which has the similar frequency band of the UHF which is 915MHz ~ 2400MHz. Though there is limitation towards the system in this work even after the method was applied which is the mobile phone used for the system because not all phones can support the passive RFID reader system. Thus, the results obtain was done and fulfils the authors requirement via experimentally, where the reading distance of the mobile RFID reader was 2 ~ 5cm when the maximum power of mobile phone is at 0.25W. And also the use of mobile phones solves the issue of bulky UHF, large power dissipation and portability of the system. Figure 1 show the flowchart of the mobile RFID where users can identify the goods information or receive product certification via GPRS.

The current industrial warehouse are mostly having mutual situation where an implementation of traceability system based on RFID technology is used to overcome the lack of reliability of the on item positioning which then improves the time required for picking up the item [4]. According to Pastor et al., in paper [4], the implementation of the traceability can be used to overcome the situation but then another problem is faced where it makes the deployment of the system to be expensive. The method was by creating the client application on a Tablet with Android operating system and server application was developed using Java that is later run on Tomcat application server.

Though the system is effective and is now cheaper than previously but the limitation here would be that the forklift system takes one order at a time to receive and deliver the item. Thus, the result can be observed where the picking time of item is faster and the efficiency in executing the task is increased.

Warehouse Management System (WMS) has been in the foreign investment where it intensifies the competition in the retail industry and as a result instead of a single company the competition is transferred to the whole supply chain and its efficiency plays a vital role [5].

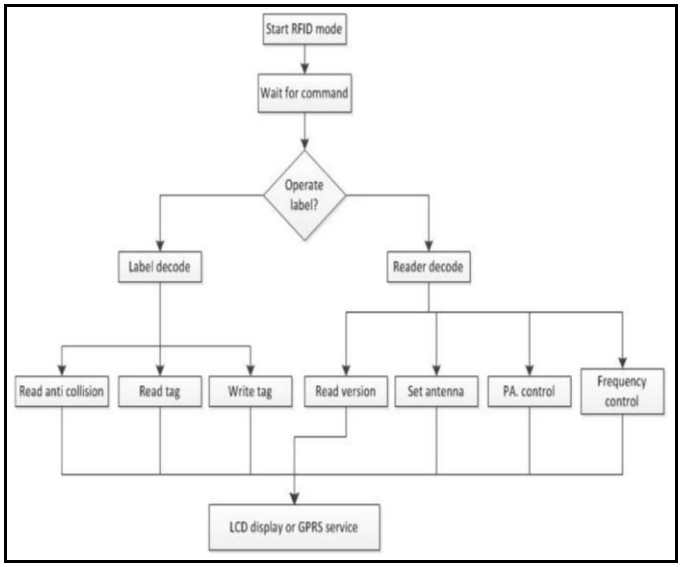


**Figure 1:** Program Flowchart of Mobile RFID [3]

According to Minbo and his research group in paper [5], the problem currently faced is that the WMS has a terminal data flaw where there is no real time data transfer or data retrieval available. Therefore, a new RFID-based intelligent warehouse management system (RFID-IWMS) was designed based on the intelligent RFID integrating the current WMS. Though, there are several limitations such as additional hardware and software components are needed to upgrade WMS to RFID-WMS and in future RFID tags will have better memory and processing speed available at an affordable price. Thus, the results are divided into few aspects of the RFID-IWMS where the service standard of the warehouse is improved, cost of warehouse operation is reduced, accuracy of the stock control is improved and inventory turnover and visibility has been enhanced. The system has been tested in real working practice and it was a success.

In this technological era, the demand of RFID has been increasing and making the systems to be enhanced and improve its efficiency on various applications using different types of RFID such as LF, HF, UHF (860-960MHz) and microwave [6]. According to this research, the problem faced is the dimension for compactness, low power and low cost

affects to create small RFID reader which can do both function which is passive and active. The methods applied to overcome the problem faced, was by doing research based on three factors, which is the receiver, transmitter and frequency synthesizer. Then a prototype was fabricated to create the UHF RFID where the chip contains passive mode, linearity- oriented passive mode and active mode. Though having the chip fabricated and making it have the entire mode does not mean it has no limitation, the limitation here would the sensitivity of the active and passive mode is high so at times the system has errors. Thus, the prototype chip was tested at a very good sensitivity for both passive tag and active tag.

The use of RFID system has been in high demand throughout the 21st century, the passive RFID tags has been used in different areas of industrial companies or shopping centres because of its easy and low-cost applicability [7]. According to Kubina and his research group in paper [7], the passive RFID has a disadvantage which is the reading range; the reason behind the disadvantages is the regulated ERP (Effective radiated power) of the reader, tag turn on sensitivity and the reader's sensitivity. In this paper, the methodology applied to the system is by using multi-reader which can easily increase the working range of passive RFID system where the multi-reader uses a constructive interference of the reader units RF waves. Although the methods have been applied in this journal, though there is limitation to the system which is the implementation of the wireless distribution of the reference frequency and control communication where less effort is needed for the installation in any environment instead of a wired distribution system. Thus, the results in this journal was proven by doing theoretical analysis on the multi-reader where it shows the tag is allowed to power-up in larger ranges when there is constructive interference of the CW reader signal which also causes an increase in the field strength at the tag position.

The WMS is considered to be one of the most effective systems to speed up the process of an organization's development [8]. According to Pulungan and his research group in paper [7], the problem faced in this paper is that the WMS focuses only on orthodox data, where the output validity is dependent on the input. Therefore, this is where the high thoroughness, accuracy, and precision come into consideration due to the demand from the supply chain managers. The method applied for this paper, creating an I-WMS consisting of five subsystems which ILS, AWS, IFS, Real-Time RTMS and IESS. Though I-WMS was applied to solve the problem faced, the system still has a limitation where it was not tested as a prototype but only proven theoretically. Thus, the results obtained theoretically shows the subsystem of the I-WMS works fine but prototype is required to further analyze the impact and effectiveness of the system.

The application of RFID in product security and tracking plays an important role to ensure the product details is well-kept and ingenuity is protected [9]. The problem faced by the authors in paper [9] is the inconsistency between the module and the wiring of the circuitry which causes short circuit. The methods applied in this journal helps to develop a Smart RFID based inventory tracking using the latest technology based from RFID which is the NFC (Near Field Communication), it use is for tracking the products being shipped. The data transfer is being done using two electronic via the NFC technology through a short range but at low speed. But there is a flaw behind this system which is the NFC breakout malfunctions due to the integration of the SD card to the mainboard. Although troubleshooting was done on the NFC but it still fails. Though with limitation, the information in the card can be read and was able to obtain details from the SD card module where this increase the safety measures of keeping its ingenuity. Thus NFC has high potential to replace the usage of barcodes the mere future to ease the process and also from being fraud by third parties on knowing the product ingenuity.

For researchers in various fields, the mobility has become an important factor where the RFID technology which is reliable, low-cost and extensively available to be used for tracking and tracing purposes through the supply chain process such as robots, vehicles and packages [10]. In this research work [10], the authors state that the problem faced is the privacy and security where the RFID tags can be attached to any package or item and it can be tracked and traced without consumer permission which is stated by the consumer protection organization and privacy advocates. Another issue faced is the data storage where the use of RFID eases the work load but increase in data growth is exponential thus it is necessary to have an economical computing resources. The method applied for this paper is the RFID-based Kanban approach which is well used in manufacturing production lines. It helps the production by being fast, accurate and real time. Furthermore, this guarantees more efficiency and effectiveness of inventory management to handle the inventory with more accuracy. But the flaw of the system is that the cost of the RFID technology can be expensive in the long run. Thus, the results shows that by implementing RFID-based Kanban the manufacturing production line will be at its best in handling the inventory management system.

The types of barcodes can cause problem to the system where it makes the system to be slow in retrieving information from the barcode on the item thus delaying the process of reporting as well. The question that suits the situation here, what type of barcode and system makes the reporting of incoming and outgoing to be fast and systematic?

From the first question created, the next would be regarding the software on the application created to capture the barcodes on the item of incoming and outgoing. And also regarding the compatibility between the Android Smartphone and the computer also is an issue for the reporting. The question that is realistic for this situation, what software is best and suitable to create this application for the Android Smartphone to be compatible with the computer for reporting purposes?

Next, for the final question that was researched is common among all the company owners which is regarding the cost of the system. The cost of the system is divided to two places, first is the system created to retrieve information and to generate a report on incoming and outgoing items, and the second part is the device used to scan the barcode of the items and the type of barcode was already mentioned in the first question. The question which suits the situation, which is the best and affordable system available in the market for stock management control?

Lastly, is there any compatibility issue between the SQLite database which is in the smartphone and the MySQL database on the computer? The question here is that, can both

the database be integrated with each other without having any errors?

The aim of this research is to use an Android Smartphone to capture incoming, outgoing using RFID technology and save the captured data into a database in SD card of the smart phone and also to be sent to a computer via a wireless communication and stored into a database of the computer. The research objectives are focused to:

1. Enhance the barcode system using RFID.
2. Create an Android application to capture incoming and outgoing items using Android developer program.
3. Develop a database that can integrate between the SQLite of android smartphone and MySQL on the computer.

## Proposed System

In this section of the study, the concept design and research methodology is considered for the ideal work flow of the research. Therefore, the proposed methodology will be in indulgence of the study proportionally with the application development.

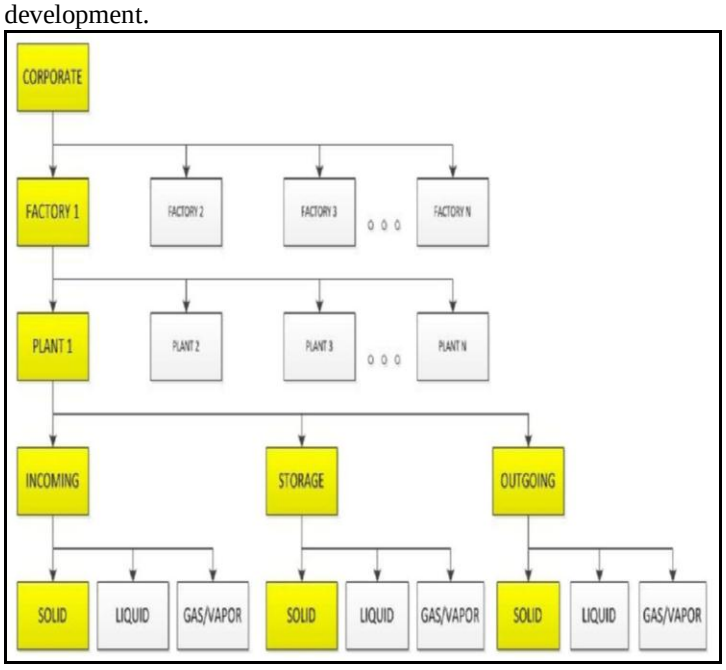


**Figure 2:** Area of Focus of SSMC

As for the proposed methodology, Figure 2 shows the area of focus of Smart Stock Management Control (SSMC) where the system will be applied to a corporate then in a corporate there can be more than one factory available then in one factory there can be more than one plant. So, it has been scoped down to Plant 1 where there is incoming, storage and outgoing where the system will mainly focus on the solid items for the time being. The system is also further elaborated using a flowchart to show the system flow and also what occurs in the incoming, storage and outgoing as shown in Figure 3.

Analysis method is also used to evaluate the system or problem area as to the right way the system works, what it does, how and how well etc. where in the justification subsection includes descriptions of the methods used in this research also how the methods are applied to the problem area.

The modification took place whilst constructing the layout of the system and creating a software prototype system is necessary to show how realistically the system works. The approached used is the software prototyping which will be used in the whole developing process for this research. Software prototyping emphasize user-oriented that is why it is a good approach that helps in clarifying user requirements. A software prototype is a model that contains all the essential elements of the object to be produced. Besides that, from the computer perspective, software prototyping is the process of the fast build a model which means the system; the model itself serves as a communication tool within the developer and user.

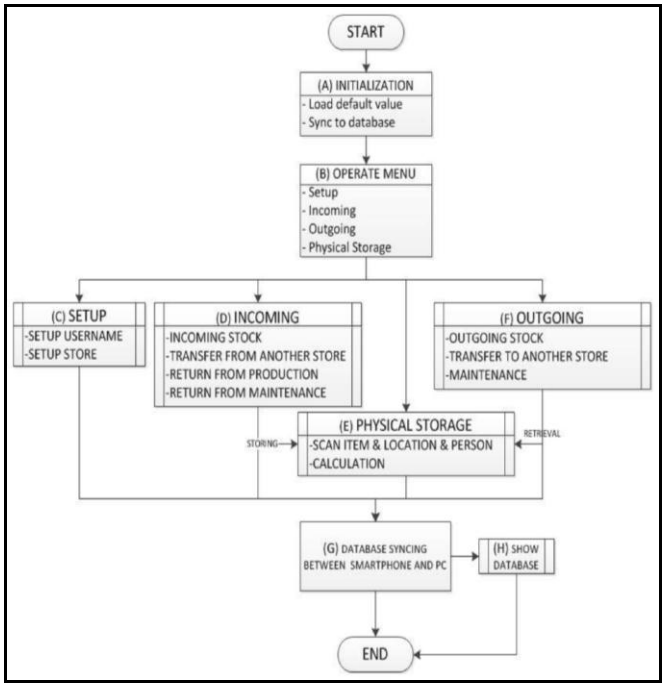


**Figure 3:** Flowchart of SSMC

The reasons of choosing software prototype as this research methodology are this warehouse system is new to the user. User would like to take part in the whole developing process. Furthermore, it is very risky if applying other methods due to the unclear requirements given by the user.

From the research, software prototyping has three key ingredients. They are quick delivery, preview of system performance, and easier communication needs. Quick delivery means the information specialists tries to provide the prototype as soon as possible. Preview of system performance allow the user input data to the software prototype and view the result on the screen just as with an operational system. By using the software prototype, user can have better understand of the developing system. Better support will be given by them as well. User might enjoy taking part in the developing process by giving more suggestion. Therefore the system can have better improvement.

The advantages of using software prototyping are better communication between the user and the information specialists. Easier determining the user needs, because user can direct interact with the real system. Software prototyping support direct users respond, if any things that do not fulfil the user needs. By using this method, opportunities for changes are increasing, but with the number of changes it also helps in reducing error and it's easier to implement the system, because the user knows what to expect from the system. Steps involved in the software prototype:

1. Identify known requirement
2. Develop a working software prototype
3. Test and revise software prototype
4. Repeat the steps until it is satisfy the user

There are two types of software prototypes. The type I prototype becomes the operational system after repeated changes based on user feedback. The type II model is a throwaway model that serves as the blueprint of the operational system. This research is not going to implement the hold system, but that is only a software prototype. The type I software prototype will be used for this research. Figure 4 shows the flowchart on creating a software prototype.

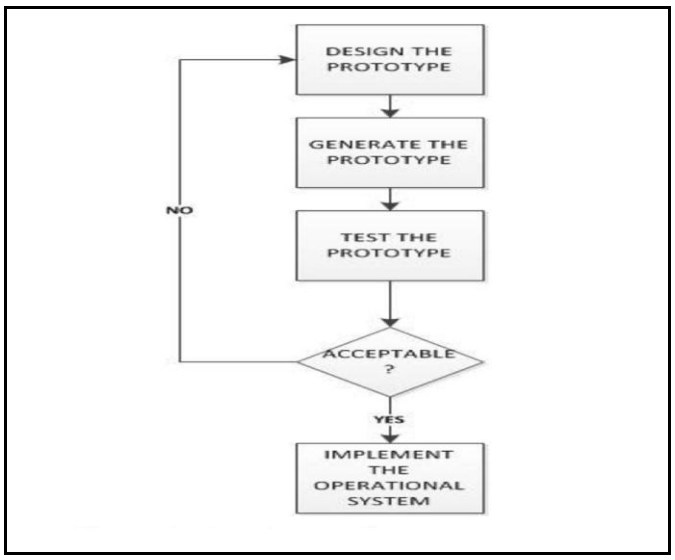


**Figure 4:** Flowchart on Creating a Software Prototype

The system design was created using the UML modelling, Figure 5 show the use case diagram of the application prototype. A use case serves to help validate the system architecture and to verify the system as it evolves during development. Besides that a use case diagram describes a set sequence, in which each sequence represents the interactions of the things outside the system (its actors) with the system itself. These behaviours are in effect system level functions that the developer uses to visualize, specify, construct and document the intended behaviour of the Smart Stock Management Control system during requirements capture and analysis. In short, a use case represents a functional requirement of the proposed system as a whole from a stakeholder or actor view.

The construction details talks regarding what the system structure is consist of; therefore it is divided to three parts which is the tag, android application and database.

Figure 6 shows the process of the data being saved into the database. There will be three activities which is being created in the application the Incoming Activity handles another 4 sub activities and the Outgoing Activity handles another three sub activities where all this activities are connected to a SQLite database within the android studio, so the Incoming Activity and Outgoing will interact with the DB Adapter which is written and provided to the system.

This DB Adapter will know how to set up and query the database where it has an internal class called the DB Helper. Then, the Android DB is where the information based on data input into the system is being stored accordingly. Moreover, through the Android DB the Database Activity can be click to check the current working tracks and its item availability.

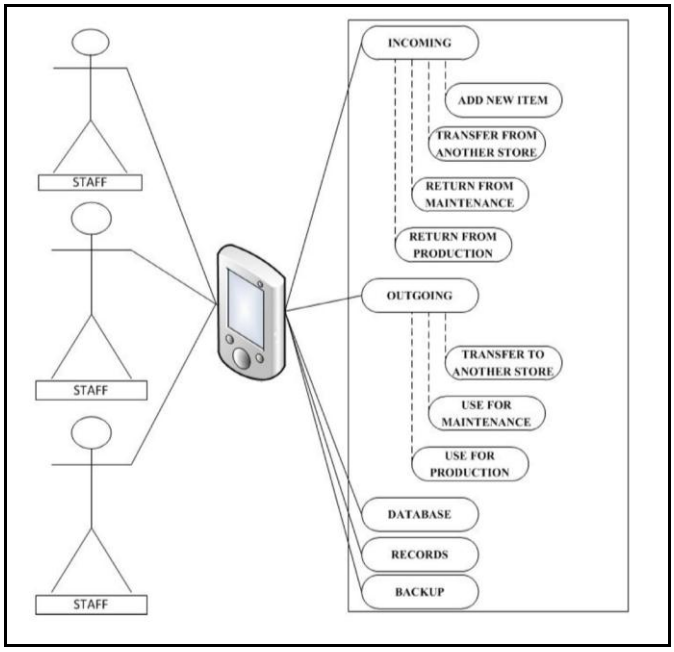


**Figure 5:** Use Case Diagram of the Application Prototype

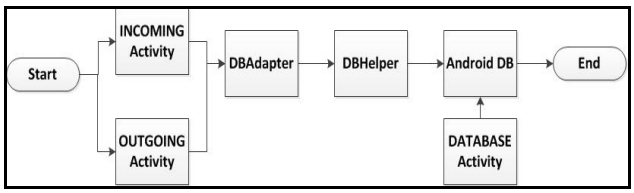


**Figure 6:** Process of the Database

## Programming

In this programming segment, it is divided into three segments which is the tag, application programming and the database programming for the system. There is no programming involved here because an outsourced application is being used to write information onto the tag. The application is called NFC Tools which can be downloaded from the Android Play Store for free.

This application is used to write, read and erase the information in the RFID tag. And upon launching the NFC

Tools ensure that the NFC is enabled on your smartphone else the application will prompt

The programming of the smart stock management control system for the application is fully based on using java programming language. For the application programming, it is entirely built on self-conceptualization programming.

The database programming of the SSMC is also done in the android studio software alongside with the application programming. A database helps to store data or information of the software prototype. Where there is no limit of storing information into the database.

## Simulation or Hardware Results

### I. Incoming

For the incoming part, based on the Figure 6, when upon clicking the Incoming button highlighted in purple box, all the incoming activity is shown which is add new item highlighted in light blue box, transfer from another store highlighted in black box, return from production highlighted in orange box and return from maintenance highlighted in light green box. Each of the button function of the incoming activity has been highlighted and match to its corresponding activity page. These activities have the same steps to be taken to add the data, so first is to click the read button for reading the item name when the tag is approach to the NFC of the smartphone, then is the quantity of the item which is keyed manually, next is to again click the read button to read the item location of the item is to be placed at, after that click the read button for the last time to attain the user identification of the person handling the adding of the stock. Lastly, after completing the filling up of all the information, click the button add data to save into the database.

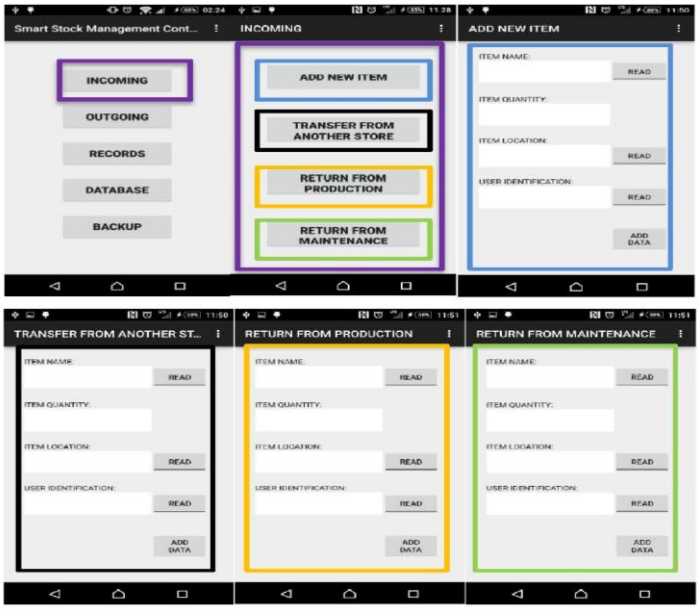


**Figure 6:** Incoming Software Prototype Display

### II. Outgoing

For the outgoing part, based on the Figure 7, when upon clicking the Outgoing button highlighted in blue box, all the outgoing activity is shown which is transfer to another store highlighted in green box, use for production highlighted in brown box and use for maintenance highlighted in yellow box. Each of the button function of the outgoing activity has been highlighted and match to its corresponding activity page. These activities have the same steps to be taken to add the data, so first is to click the read button for reading the item name when the tag is approach to the NFC of the smartphone, then is the quantity of the item which is keyed manually, next is to again click the read button to read the item location of the item is to be placed at, after that click the read button for the last time to attain the user identification of the person handling the adding of the stock. Lastly, after completing the filling up of all the information, click the button add data to save into the database.

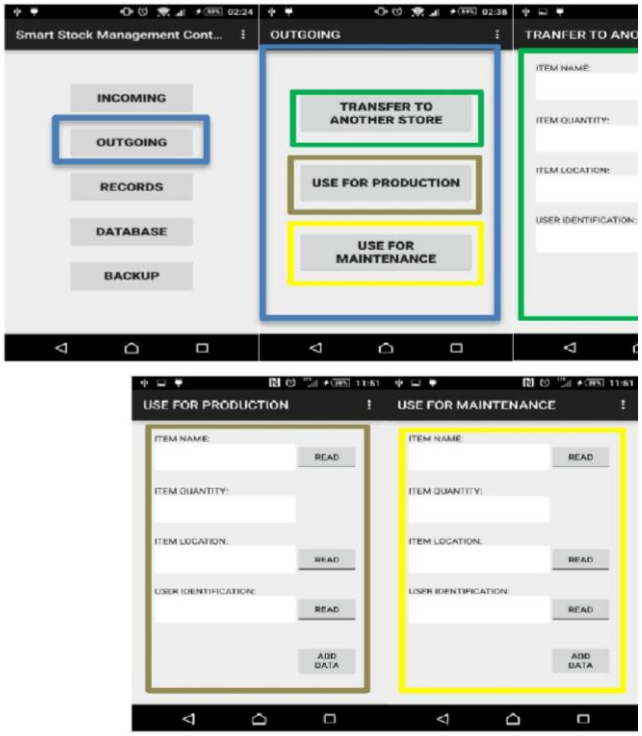


**Figure 7:** Outgoing Software Prototype Display

### III. Database

For the database part, it is divided to three different activities which are shown in Figure 8; the three parts are the records, database and backup. The records here means that it show the recent added and removed stock from the store which is also known as traceability to recent added and removed stock. The records is highlighted in the dark blue box, it is shown that all the incoming activity and the outgoing activity is used, this is to show that no error is seen during the adding and removing of the stock using the software prototype. Then, the database shows the total incoming, total outgoing and total stock where this helps in showing whether the item is running low. The database is highlighted in the red box, it is shown that all the incoming activity sums the total of screwdrivers to be 160, then the outgoing activity is run and the total screwdrivers for outgoing is 100, therefore the total stock of screwdriver is 60 which proves that the calculation made is precise.


**Figure 8:** View of Database after Adding Stock

Lastly, is the backup which means backup the database to SD card so that the database can be viewed on a computer, where the backup button is highlighted in dark green box and the ssmc.db file is also highlighted in dark green box.

After retrieving the database in the SD card to the computer, the Mozilla Firefox uses an extension called SQLite Manager, Figure 9 shows the database of the records where all the incoming activity and outgoing activity is being used for testing purpose and to check whether there is any functionality lacking of the system. In the beginning of programming the database, the prefer view of the database was landscape but due to some difficulty faced in programming the database, therefore simple list view is used to display both the records and the database.

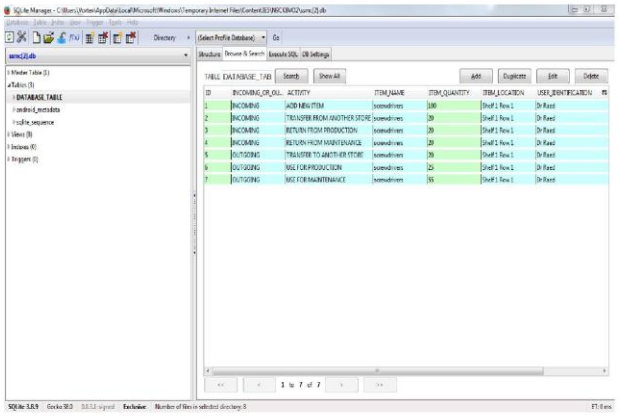

**Figure 9:** Database been viewed on Mozilla Firefox SQLite Manager

## Testing

### I. System Testing

In this system testing, there is different types of testing which are system interface, system behaviour, system feedback, it is tabulated and shown for each type of system testing. Table 1 shows the system interface testing where the interface of the application is tested for any errors or fault in interface and the results are shown.

Table 2 shows the system behaviour testing where the behaviour of the application is being tested for any problems or unwanted activities and results are shown.

Table 3 shows the feedback testing of the application, where in the android programming language it is known as a "Toast" and it can be seen the programming codes in the Appendix. The feedback testing is to verify whether is there any message or statement appear if an activity is being clicked or completed.

**Table 1:** System Interface Testing

| System Interface Behaviour | Always | Most of the time | Some of the time | Never | Comments |
|---|---|---|---|---|---|
| Does the system provide a suitable layout design? | | ✓ | | | |
| Is the click button action consistent? | ✓ | | | | |
| Is the activity responsive? | ✓ | | | | |
| Is the text box consistent? | ✓ | | | | |

**Table 2:** System Behaviour Testing

| System Behaviour | Always | Most of the time | Some of the time | Never | Comments |
|---|---|---|---|---|---|
| Does the application display a prompt for certain action? | | ✓ | | | |
| Does the application respond to the user action all the time? | ✓ | | | | |
| Does the application allow re-correction of any error done by the user? | | | | ✓ | |
| Does the application allow to type in values? | ✓ | | | | |
| Does the system crash? | | | | ✓ | |

**Table 3:** System Feedback Testing

| System Feedback | Always | Most of the time | Some of the time | Never | Comments |
|---|---|---|---|---|---|
| Does the system provide good feedback in a consistent way? | | ✓ | | | |
| Is the feedback appropriate to the action done? | ✓ | | | | |
| Does the feedback give a clear message to user? | | ✓ | | | |
| Is there any graphical image provided on the message box? | | | | ✓ | Only message is displayed. |

## II. Unit Testing

Unit testing is to breakdown the system into small parts and to test the function and process of each part of the system. Table 4 shows the unit testing for main activity of the android application. The task of each button was shown in the table and the testing is success for each of the button.

**Table 4:** Unit Testing for Main Activity Task

| Main Activity Task | Action List | Action | Result | Comments |
|---|---|---|---|---|
| Buttons | Incoming | Open another activity | Success | |
| | Outgoing | Open another activity | Success | |
| | Records | Trace and Track | Success | |
| | Database | Display Calculated Data | Success | |
| | Backup | Store data to SD card | Success | |

Table 5 shows the unit test plan for the incoming task of the application. The task in the incoming activity are add new item, transfer from another store, return from production and return from maintenance. The tasks of each incoming activity are using the similar button functions therefore the possibility of having error here is less. Therefore, it shows the success rate for the incoming task is 100%.

Table 6 below shows the unit test plan for the outgoing task of the application. The tasks in the outgoing activity are transfer to another store, use for production and use for maintenance. The tasks of each incoming activity are using the similar button functions therefore the possibility of having error here is less as well. Therefore, it shows the success rate for the incoming task to be 100%.

**Table 5:** Unit Testing for Incoming Task

| Incoming Task | Action List | Action | Result | Comments |
|---|---|---|---|---|
| Add New Item | Item Name | Scan RFID tag | Success | |
| | Item Quantity | Input value | Success | |
| | Item Location | Scan RFID tag | Success | |
| | User Identification | Scan RFID tag | Success | |
| | Add Data | Add to database | Success | |
| Transfer From Another Store | Item Name | Scan RFID tag | Success | |
| | Item Quantity | Input value | Success | |
| | Item Location | Scan RFID tag | Success | |
| | User Identification | Scan RFID tag | Success | |
| | Add Data | Add to database | Success | |
| Return From Production | Item Name | Scan RFID tag | Success | |
| | Item Quantity | Input value | Success | |
| | Item Location | Scan RFID tag | Success | |
| | User Identification | Scan RFID tag | Success | |
| | Add Data | Add to database | Success | |
| Return From Maintenance | Item Name | Scan RFID tag | Success | |
| | Item Quantity | Input value | Success | |
| | Item Location | Scan RFID tag | Success | |
| | User Identification | Scan RFID tag | Success | |
| | Add Data | Add to database | Success | |

**Table 6:** Unit Testing for Outgoing Task

| Outgoing Task | Action List | Action | Result | Comments |
|---|---|---|---|---|
| Transfer To Another Store | Item Name | Scan RFID tag | Success | |
| | Item Quantity | Input value | Success | |
| | Item Location | Scan RFID tag | Success | |
| | User Identification | Scan RFID tag | Success | |
| | Add Data | Add to database | Success | |
| Use For Production | Item Name | Scan RFID tag | Success | |
| | Item Quantity | Input value | Success | |
| | Item Location | Scan RFID tag | Success | |
| | User Identification | Scan RFID tag | Success | |
| | Add Data | Add to database | Success | |
| Use For Maintenance | Item Name | Scan RFID tag | Success | |
| | Item Quantity | Input value | Success | |
| | Item Location | Scan RFID tag | Success | |
| | User Identification | Scan RFID tag | Success | |
| | Add Data | Add to database | Success | |

Table 7 below shows the unit test plan for the database task of the application. The tasks in the database activity are records, database and backup. The tasks of each database activity are using different button function. It is states that when creating application build the front end first as fast as possible once completed then the user can handle the back end design which takes much more time because of its complexity of handle the data being obtained from the from end design. Therefore, the programming for database is done at the very of the software prototype build up. And the unit testing which has been done for the database task in Table 7 shows the rate of success to be also 100%.

**Table 7:** Unit Testing for Database Task

| Database Task | Action List | Action | Result | Comments |
|---|---|---|---|---|
| Database | Records | Show database for traceability and tracking | Success | |
| | Database | Show the total quantity of the items | Success | |
| | Backup | Save to SD card | Success | |

## Conclusion

As a conclusion, the system is enhanced by using RFID technology instead of barcodes. The advantage of using RFID technology is that it can be rewritten or modified as needed where the data in the tags can be changed from time to time and the barcodes can never be changed once it is printed onto the label. Moreover, the durability and reusability of the RFID tag will make the system to last longer with increasing the cost of changing the RFID tags most of the time. Thus, the enhancement here allows the data input to be more systematic, accurate and easy.

Moreover, the system was tested and showed in detail on how useful the system is and the efficiency of the system and also how the system can assist the worker to do stock reporting fast and eliminate paper errors which usually cause losses to the companies when checking the inventory. The stock management system also increases the productivity and accuracy, reduces cost and time for stock reporting and deploys flexibly.

## References

[1] Flipse, Marcel. "Altering and Improving Kiva.", 2011.
[2] SARAC, A., ABSI, N. & DAUZERE-PERES, S., "A literature reviews on the impact of RFID technologies on supply chain management," International Journal of Production Economics, 128(1), 77-95. (2010).
[3] PING-CHUAN, Z. & GUO-FENG, M., "Design of passive rfid reader based on mobile phone," 2010 Second International Conference on Networks Security Wireless Communications and Trusted Computing (NSWCTC), Vol. 2, pp. 446-449, 2010.
[4] PASTOR, Y., ANGEL, M., GARCIA HIGUERA, A., GARCIA ANSOLA, P., & GONZALEZ SERNA, J. G., "*Application to a warehouse environment of a tracking system based on RFID and free software*,". In RFID SysTech 2011; 7th European Workshop on Smart Objects: Systems, Technologies and Applications; pp. 1-7, 2011.
[5] MINBO, L., SHENGXI, G., GUANGYU, C., & ZHU, Z. *A*, "*RFID-based Intelligent Warehouse Management System Design and Implementation*," 2011 IEEE 8th International Conference e-Business Engineering (ICEBE), pp. 178-184, 2011.
[6] NAKAO, S., NORIMATSU, T., YAMAZOE, T., OSHIMA, T., WATANABE, K., MINATOZAKI, K., & KOBAYASHI, Y., "*UHF RFID mobile reader for passive- and active-tag communication*," 2011 IEEE In Radio and Wireless Symposium (RWS)., pp. 311-314, 2011.
[7] KUBINA, B., SCHUSSLER, M., MANDEL, C., MAUNE, H., MULLER, D., ZIROFF, A., & JAKOBY, R. *A*, "*coherent multi-reader approach to increase the working range of passive RFID systems*," In RFID-Technologies and Applications (RFID-TA), 2012 IEEE International, pp. 350-355, 2012.
[8] PULUNGAN, R., NUHROHO, S. P., EL MAIDAH, N., ATMOJO, T. B., HARDO, P. D., & PAWENANG, P., "*Design of an Intelligent Warehouse Management System.* Information Systems,", 2013.
[9] YA'ACOB, N., GOON, M. E., MIKAIL, M., NOOR, H., ZIKRUL, M., YUSOF, A. L., & IDRIS, A., "RFID (NFC) application employment on inventory tracking to improve security," In Wireless Technology and Applications (ISWTA), 2014 IEEE Symposium, pp. 176-181, September, 2014.
[10] GHELICHI, A., & ABDELGAWAD, A., "A study on RFID-based Kanban system in inventory management", IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), pp. 1357-1361, December, 2014.