

Milestone 3: Warehouse Management System

Final Project Proposal with Toy Prototype

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September 30th, 2013

1.1 System Description

Our Warehouse Management System software allows employees within a retail warehouse to better manage their inventory and reduce errors in their business. The system does this by storing all stock information on an item, including details such as price, name, attributes, and physical location within the warehouse.

The software will provide; Receivers with a simple and easy interface for adding incoming products to their inventory, Shippers with the ability to remove products for outgoing shipments, and Stock Handlers with an interface to locate and manage inventory within the warehouse. The system will have the ability to print and format reports for management, detailing internal metrics and stock within the warehouse.

By meeting the needs of each type of employee in the warehouse, this software system will be central to the efficient and successful operation of a retail warehouse.

1.2 Business Case

The modern warehouse of today is run essentially the same way that it was twenty years ago, predominantly on paper documents that are handled by a wide variety of actors. This results in lost product, missed shipments, confusion and low efficiency. Some workers are constantly working hard every day, while others take advantage of the current situation and partake in leisure activities on the job. As warehouses remain central to brick-and-mortar stores, the meteoric rise of online sales has only increased the stress and demand on the warehousing industry. It is time to develop a new and innovative way to run the world's warehouses, and disrupt their current offerings with the power of technology.

The main purpose of our electronic Warehouse Management System is to help management and staff to monitor, track, and improve efficiency with the power of data. Tools to track worker speed, stock turnover speed, and interactive stock tracking features all will allow management to better improve the efficiency of their organization, allowing them to reduce manpower and cut expenses.

This software provides functionality to integrate and organize the tasks of all members of the warehouse organization by providing a graphical user interface to easily navigate and perform tasks. Along with the management features mentioned above, Stock Handlers will receive optimized routes for gathering products for shipment, Shippers will be able to simply track and manage all outgoing shipments, and Receivers will be able to autonomously record new stock and determine immediately if the warehouse has the capacity for a new shipment.

Our Warehouse Management System provides an easy to use program to assist all members of a warehouse organization make once complicated tasks simple.

1.3 User-Level Goals for the System

We have set the following user-level goals for the system. The goals have been divided into four separate categories to match the four types of actors using the system.

Manager

The main expectations and requirements that a Manager has for the Management and Reporting System functionality of our program is to be able to:

- View information on the products in the warehouse, including name, description, item number, category, price, quantities, and location within warehouse.
- Display the shipping reports for outgoing products for a given time period (past, present or future), including date ordered, status (pending, gathered, shipped), tracking information, weight, destination, and product manifest.
- Display the purchase order report for incoming products for a given time period (past, present or future), including the date ordered, tracking information, order cost, and product manifest.
- Display statistics and metrics reports, listing the fastest selling products, slowest moving products, and the percentage of the warehouse space currently being used.
- Display employee status report, containing one or more employee's information such as name, title, employee speed (i.e. orders gathered per hour, average time to ship a shipment, average time to receive a shipment)
- Create, modify and delete shipment orders made to the warehouse.
- Create, modify and delete purchase orders made by the warehouse.

Shipper

The main expectations and requirements that a Shipper has for the Shipping System functionality of our program is to be able to:

- View a listing of all upcoming shipments.
- Assign upcoming shipments to a Stock Handler.
- Record outgoing shipment information such as tracking number and date shipped.

Receiver

The main expectations and requirements that a Receiver has for the Receiving System functionality of our program is to be able to:

- Update stock information according to received purchase orders.
- Input information of new incoming products.
- Assess if there is capacity in the warehouse for a given purchase order.
- Analyze which shipments will need to be shipped before the warehouse has enough capacity for an incoming purchase order.

Stock Handler

The main expectations and requirements that a Stock Handler has for the Stock Handling System functionality of our system is to be able to:

- Print out a list of the items required to be gathered to fulfill upcoming orders.
- Record the time of that they finished gathering the product for each pallet.
- Record any inconsistencies in stock levels, product location or product information.

1.4 User Scenarios

Use Case Name: Statistics Reporting

Level: Summary

Actors: Manager

Goal: Provide a high level view of warehouse operations, to drive efficiency gaining decision making

Activities: Analyze staff efficiency for promotion and layoffs, view turnover speed of specific products to guide purchase order and discount sales decisions, gauge warehouse stock level

Quality: high quality, fast, accurate, and reliable

Version: September 28, 2013

Use Case Name: Stock Reporting

Level: Summary

Actors: Manager

Goal: Provide in depth view of information about warehouse stock

Activities: Monitor stock levels, view stock information for all products currently or previously contained in the warehouse

Quality: high quality, fast, accurate, and reliable

Version: September 28, 2013

Use Case Name: Routing Stocking Tasks

Level: Summary

Actors: Stock Handler

Goal: Increase efficiency of navigating the warehouse for stocking tasks

Activities: Putting away stock that has been received, gathering stock for an upcoming shipment, building pallets correctly

Quality: high quality, accurate, reliable, and effective

Version: September 28, 2013

Use Case Name: Receive Purchase Order

Level: Summary

Actors: Receiver, Stock Handler

Goal: Add new stock items to the system

Activities: Recording information on newly received stock, increasing warehouse stock level to correspond to received shipments, assign Stock Handler to store the product

Quality: high quality, accurate, high ease of use, reliable, flexible

Version: September 28, 2013

Use Case Name: Send Shipments

Level: Summary

Actors: Shipper, Stock Handler

Goal: Send the items ordered for shipment from the warehouse

Activities: Remove stock from the warehouse, track pallet contents, record progress of Stock Handlers in gathering items required for shipment.

Quality: high quality, accurate, high ease of use, reliable, flexible

Version: September 28, 2013

Use Case Name: Locating Stock

Level: Summary

Actors: Manager, Stock Handler

Goal: Find the location of stock within the warehouse

Activities: Locate stock for shipment, locate old stock location to store recently received stock of the same item, view map of warehouse to find location of the stock

Quality: high quality, reliable, efficient

1.5 Scope Document

The Warehouse Management System will provide all the tools necessary to run a basic, retail-scale warehouse. The following functionality will be available for each type of user:

Stock Handler

- Create printable day plans for stock to be gathering tasks
- Produce the most efficient routes that the Stock Handler should take to gather all products in a matter that will build a sturdy pallet
- Recording and monitoring of inconsistencies in stock levels
- Recording and moving items with inconsistencies in stock locations
- Track speed of each of the workers at performing tasks

Manager

- Display product information report for a set of items within the warehouse (showing one item or more) such as description, item number, category, price, quantities, location within warehouse
- Display statistics reports, listing the fastest selling products, slowest moving products, the percentage of the warehouse space currently being used
- Display shipping report for a given time period (past, present or future), including date ordered, status (pending, gathered, shipped), tracking information, weight, destination, and product manifest
- Display purchase order report for a given time period (past, present or future), including date ordered, tracking information, cost, and product manifest
- Display employee status report, containing one or more employee's information such as name, title, employee speed (i.e. orders gathered per hour, average time to ship a shipment, average time to receive a shipment)
- Create, modify and delete orders made to the warehouse
- Create, modify and delete purchase orders made by the warehouse
- Configure the GUI warehouse map to mimic the warehouse floor plan

Shipper

- Check upcoming shipments
- Assign upcoming shipments to a Stock Handler
- Record outgoing shipment information
- Track pallet contents

Receiver

- Input information of incoming products
- Check if there is capacity in the warehouse for a given purchase order
- Check which shipments will need to be shipped before the warehouse has enough capacity for a new shipment

Only the above functionality will be able to be accomplished by our system unless some key functionality is determined by test users to be required.

The estimated work time required for this project is 60 hours of planning and programming for the work unit for each team member. An additional 30 hours for each team member will be required for meetings, testing, and user interviews.

1.6 Project Plan/Rough Estimates

The following are our current rough estimates for completing the required functionality for this project. Note that these are rough estimates for the initial creation of each piece of functionality, additional iterations will certainly be required to iterate and refine the product based on user feedback. Due to the unknown nature of user suggestions, we are unable to estimate their completion time, however, it is estimated that for the completion of the coding and planning for the project will take 60 hours per team member by the end of the term.

Task	Assigned To	Rough Estimate for Completion (hours)
Stock Handler	-	-
Create printable day plans for stock to be gathered for shipment	Spencer	8
Figure out most efficient routes to take to gather all products for shipment	Matt	3
Recording and monitoring of inconsistencies in stock levels	Spencer	3
Recording and moving items with inconsistencies in stock locations	Spencer	5
Track speed of each of the workers at performing tasks	Spencer	2
Manager	-	-
Create and display product information report	Han	2
Create and display statistics reports	Han/Matt	2
Create and display shipping report	Han	3
Create and display purchase order report	Han	3
Create and display employee report	Han	4
Create, modify and delete purchase orders	Han	3
Create, modify and delete shipment orders	Han	3
Shipper	-	-
Check upcoming shipments	Xingze	4
Assign upcoming shipments to Stock Handler	Xingze	4
Record outgoing shipment information	Xingze	4
Track pallet contents	Xingze	4
Receiver	-	-
Input information for incoming products	Xingze	5
Check warehouse capacity for incoming purchase order	Xingze	5
Check shipments to be shipped to create space for incoming shipments	Xingze	5
Graphical User Interface	-	-
Create toy prototype	Sam	5
Configure GUI warehouse map	Sam	5

Move items from one section of the warehouse to another	Sam	4
Display current usage levels for each section	Sam	3
Refine user interface and menus	Sam	5
Database/Backend	-	-
Set up MySQL database to record warehouse information	Matt	1.5
Create dummy data to fill MySQL database	Matt	1
Set up Neo4j Graph Database to record warehouse layout	Matt	7
Create accessors objects to access data securely within the MySQL database	Matt	8
Create mutator objects to manipulate data in a concurrent manner	Matt	8
Set up and manage Ant build management system	Matt	10
Set up JUnit testing suite	Matt	2

1.7 User Involvement Plan

We will involve users throughout the project to ensure that our software is easy to use, error free, and most importantly, what the customer wants. This will give us the opportunity to receive feedback on which features users would like to see implemented and which features are unnecessary.

We have already involved users in the initial milestones for this project. Thanks to the prior experience of two of our team members (one of them with a vast range of experience in both retail and mining warehouses, the other with retail warehouse experience) we have been identifying their feedback as we outlined the project scope and initial requirements. We have used three hours of their time for this project so far, and we will continue to use their experience throughout the development cycle.

Beyond our internal users, we will start by only involving management and will require 30 minutes of their time. We will begin our user interaction with our toy prototype and a demonstration of the features we plan to implement. This will be a basic discussion of the features in the abstract. We will discuss with the user any problems they notice with the system at a high level and restructure our program accordingly. At this phase nothing is implemented, so changes can easily be made to the functionality of our system. Any change arising from these discussions will not consume very many resources.

After collecting initial input we will implement our functions with continual contact with the previously interviewed management to address if design decisions are acceptable. Each of these communications are expected to take under 10 minutes, and will allow us to further refine our system to ensure that our implementation does not deviate from the customer's needs.

To make optimal use of the employee's time we will enlist a single member of each type of employee (Shipper, Receiver, Stock Handler, and Manager) to maintain continual contact.

Once the functionality for a phase is completed we will consult that group's user. We will have the user navigate and use the completed functionality, while we observe their behavior. A short, informal, interview will take place after the usage of the functionality to determine what issues or confusion they encountered in using the product. We will use the spiral method for prototyping and iteration until all desired functionality has been addressed. The amount of time and resources required for this user involvement will range depending on the initial quality of each prototype, however, each session with the user should take approximately 30 minutes.

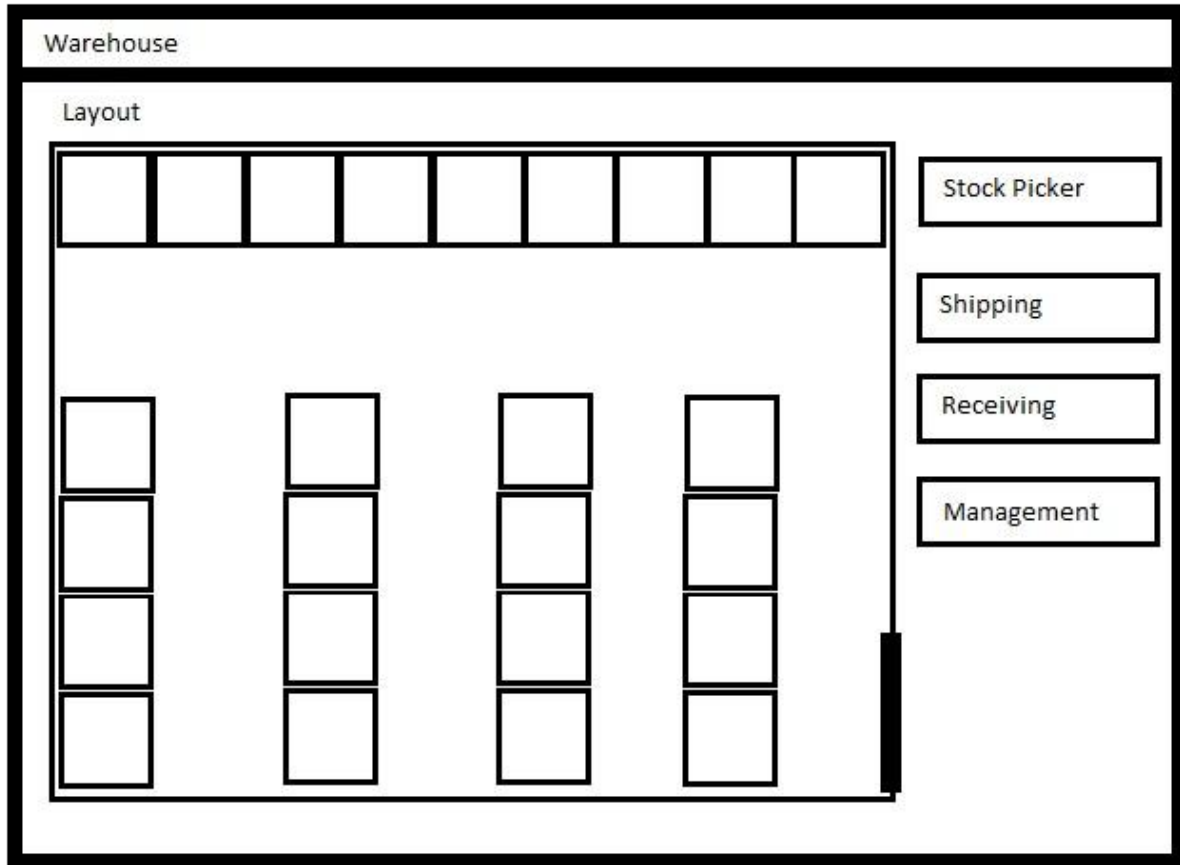
When all functionality is discussed and addressed to the satisfactory of our sample subjects, we will beta test our program with a new member of that group who is inexperienced with our software. This will ensure ease of use for many different operators and is likely to require two iterations (or spiral twice). This stage is likely to require user involvement for 45 minutes in total. At the final stage, management will be consulted for any remaining finishing touches, estimated to require 15 minutes of their time.

Each time a user is involved in a consultation it will require one of the developers on our team to be present with the latest release of our software. Testing will take place in an area similar to the environment the software would be used in, in order to observe and interview the user in a realistic use case scenario.

1.8 Low Fidelity Prototypes

Our low fidelity prototypes were primarily drawn on paper, and can be viewed in the images below:

Main Screen



Provides an interactive map of the layout of the warehouse, navigation buttons on the right allow access to each of the individual users functionalities.

Ware house - Product

product

Name

Description

Category

Price

photo

← create, modify, delete

can read and write from data base

For employee status

name	title	employee	speed
Adam			
Bill			
Cathy			

Order gather per hour:

Average time to ship a shipment:

Average time to receive a shipment:

Management System

Ware house

File view help

product Listing purchase order Listing shipping Listing statistic report employee status Map

Date / /

2011/9/1 2013/9/24

Ware house

File view help

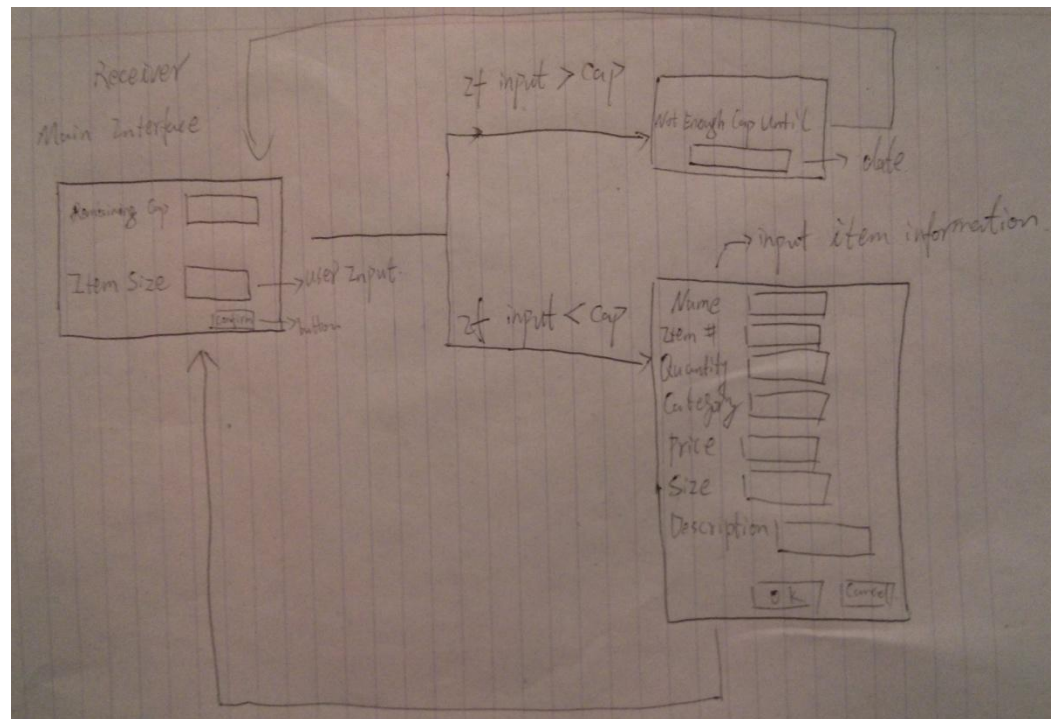
Listing type Date / /

2011/9/1 2013/9/24

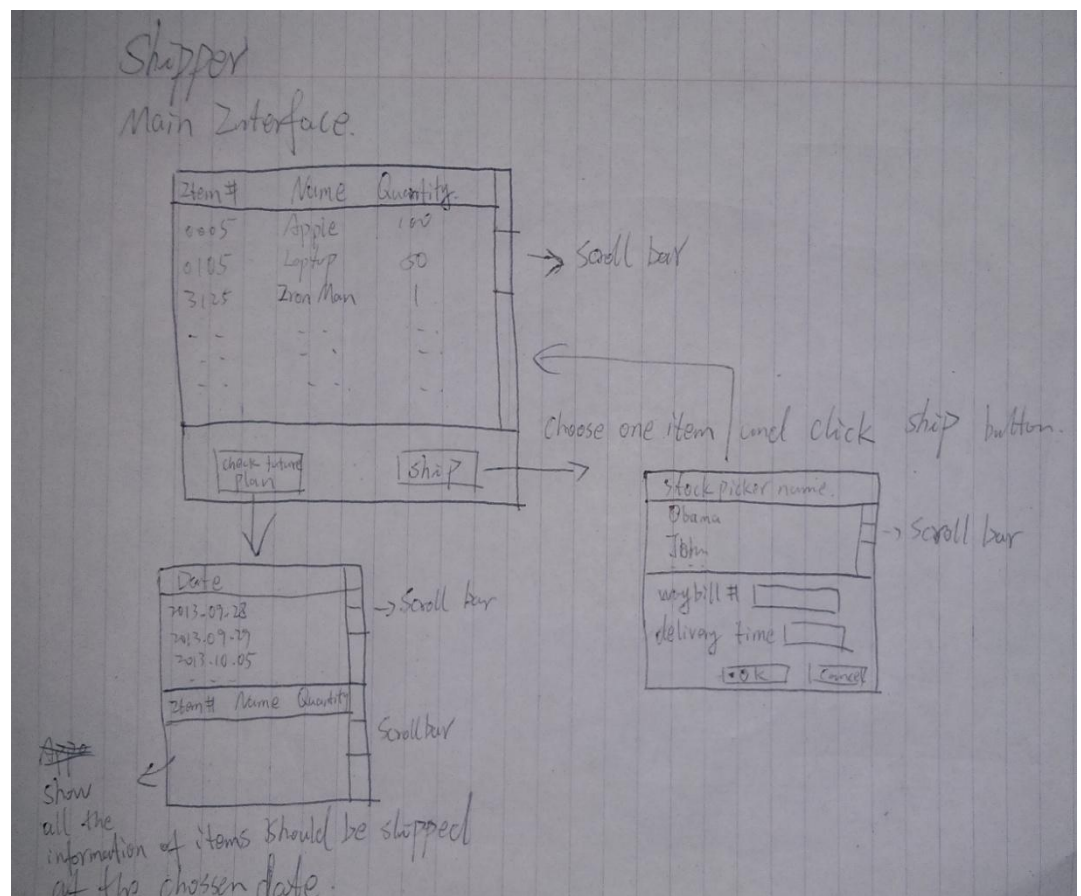
For statistic report, using tag. Just refresh tag and table

Product selling	Storage moving	percentage of warehouse space using

Receiving System



Shipping System



Stock Picker

Bill's sheets
Employee 422

Palet 1	Item	desc	Approved	Number Remaining	completed	Actual	Notes
Time start					<input type="checkbox"/>		(bigger)
					<input type="checkbox"/>		
Time end					<input type="checkbox"/>		
					<input type="checkbox"/>		
Palet 2					<input type="checkbox"/>		
Time start					<input type="checkbox"/>		

Bill

palet 1 start hour min end hour min

palet 2 start hour min end hour min

1.9 Project Management Report

Our detailed record of time spent on tasks for this project is included below:

Date	Who	# of Hours	Task
9/16/2013	All	1.5	Meeting to decide on project and tasks
9/17/2013	Matt Triff	0.25	Set Up GitHub Repo, added everyone
9/18/2013	Xingze Guo	1.5	Design and write early proposal of function Shipper and Receiver
9/18/2013	Rongli Han	1.5	Write management part for early project proposal
9/18/2013	Spencer Ondrusek	1.5	Design and write early proposal of function Stock Picker
9/19/2013	Matt Triff	1.5	Combined and edited Milestone 1: Early Project Definition
9/24/2013	Spencer Ondrusek	1.5	Design the GUI for the stock picker
9/24/2013	Xingze Guo	1.5	Design the GUI for Shipper and Receiver
9/24/2013	All	1.5	Discussed the Project and divided sections again
9/24/2013	Rongli Han	1.5	Design the basic GUI for management and reporting
9/26/2013	Spencer Ondrusek	1.5	Milestone 3 part 1.4
9/26/2013	Spencer Ondrusek	1.5	Milestone 3 part 1.7
9/26/2013	Xingze Guo	2	Milestone 3 part 1.3, 1.6 for Shipper and Receiver and 1.7
9/27/2013	Matt Triff	2	Milestone 3, parts 1.1, 1.5
9/27/2013	Rongli Han	2	Milestone 3 part 1.2(Business Case), 1.4and 1.8 for management and reporting
9/27/2013	Xianming Luo (Sam)	2	Design the GUI for the prototype
9/28/2013	Matt Triff	5	Prepared Milestone 3 document to be submitted
9/28/2013	Xianming Luo (Sam)	3	Implement the GUI toy prototype
9/30/2013	Matt Triff	2	Completing final edits and submission of Milestone 3 document

The risks associated with this project include feature creep (addition of unnecessary features), and inefficient planning or coordination. Due to the integrated nature of the project, certain tasks to be done by one team member are required for another team member to proceed, as such, due care and attention will be required in planning out the sequence of future tasks to ensure consistent progress.

1.10 Project Plan

The following table contains a summary of all tasks that have been completed thus far, as well as all tasks that will need to be completed for the next milestone. For a detailed listing of all tasks completed thus far, refer to section 1.9.

Task	Assigned To	Rough Estimate for Completion (hours)	Status
Meet to discuss Milestone 2	All	1.5	Completed
Complete Milestone 2 Tasks	All	6.25	Completed
Meet to discuss Milestone 3 Tasks	All	1.5	Completed
Complete Milestone 3 Tasks	All	25	Completed
Meet to discuss presentation of project	All	1.5	Not Started
Create presentation	All	6	Not Started
Meet to discuss Milestone 4 tasks	All	1.5	Not Started
Complete requirements gathering	Unassigned	5	Not Started
Move use cases to “User Goal” level	Unassigned	4	Not Started
Preliminary Software Design	All	4	Not Started

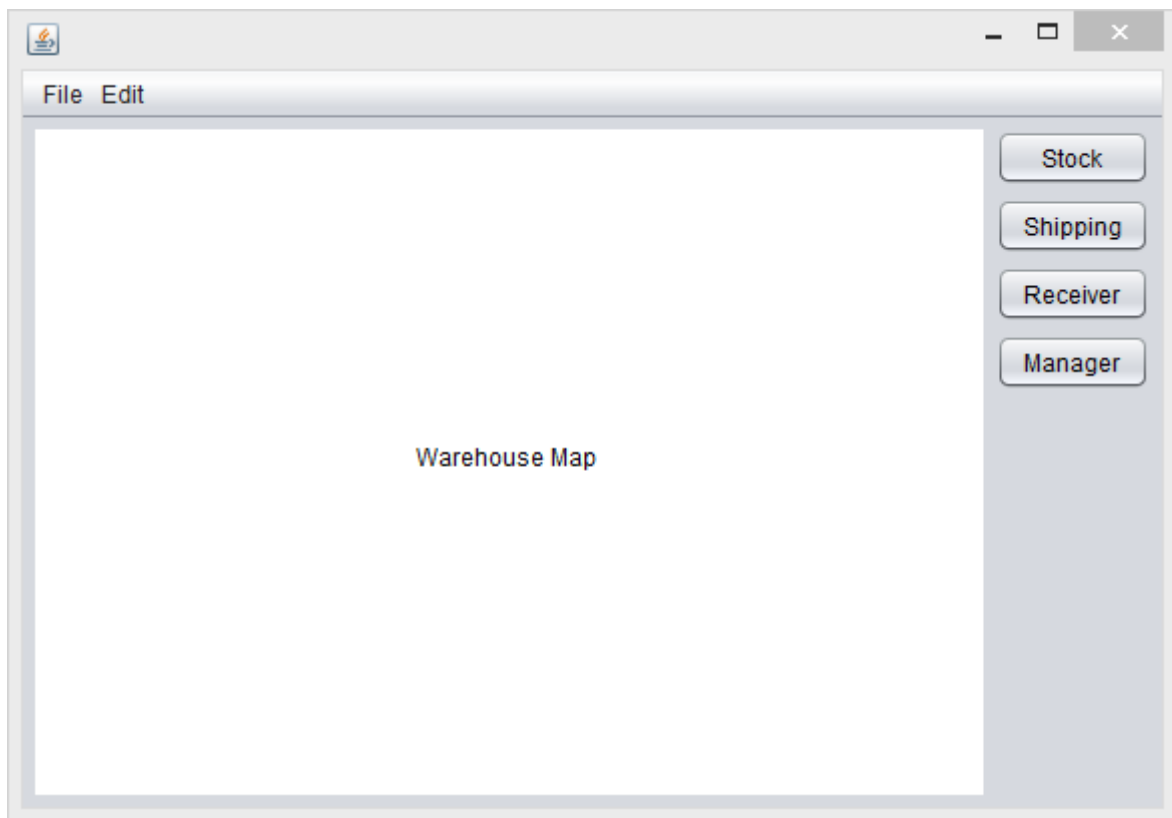
1.11 Toy Prototype

We have included a toy prototype with our submission for this milestone, to run the toy prototype, extract the included file “group02-toyPrototype.tar” and navigate to the extracted “dist” directory.

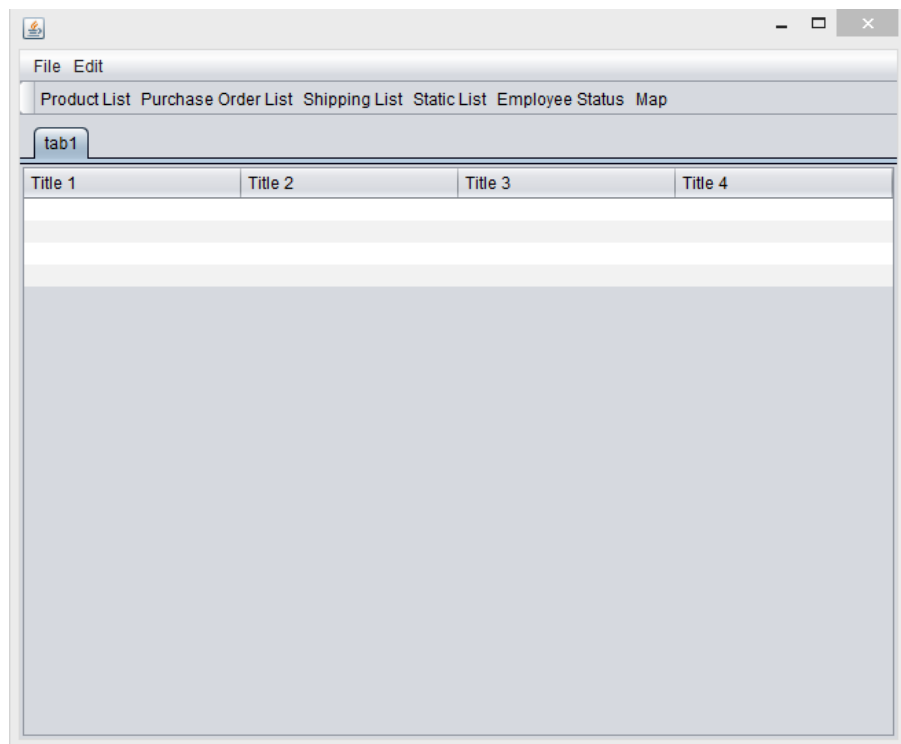
The prototype can be started by either double-clicking on the ‘Warehouse.jar’ file, or by using the command line to run ‘java -jar “Warehouse.jar”’.

Included below are screenshots of the running toy prototype.

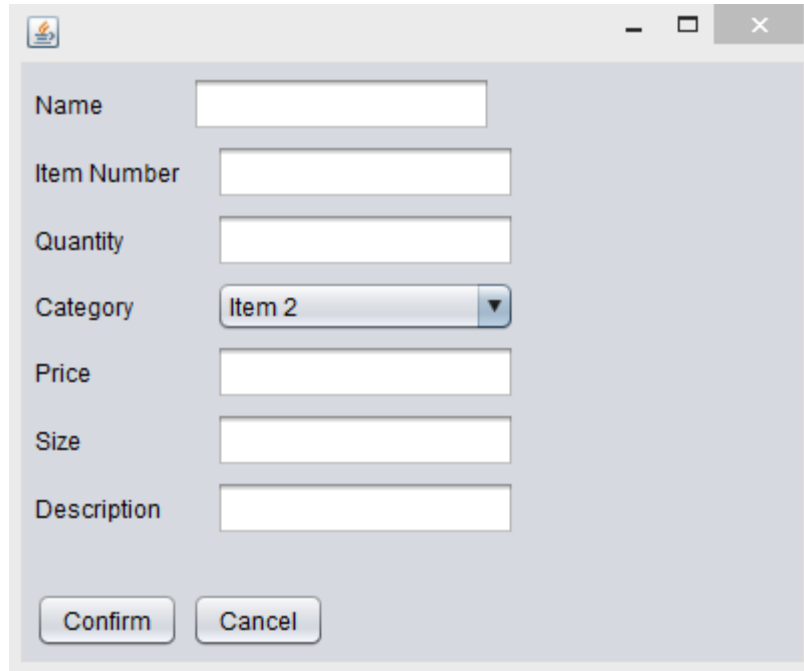
Main Screen



Management System



Receiving System

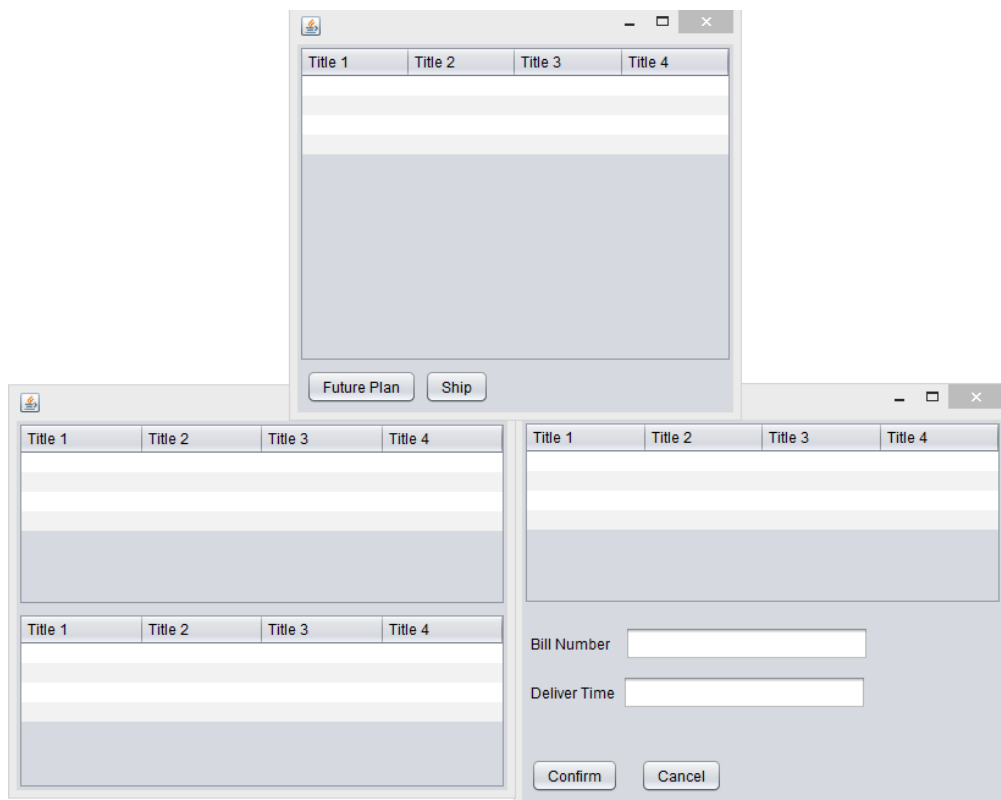


A dialog box titled "Receiving System" with a standard Windows-style title bar (minimize, maximize, close buttons). The dialog contains several input fields and a dropdown menu:

- Name:
- Item Number:
- Quantity:
- Category: (dropdown menu)
- Price:
- Size:
- Description:

At the bottom, there are two buttons: "Confirm" and "Cancel".

Shipping System

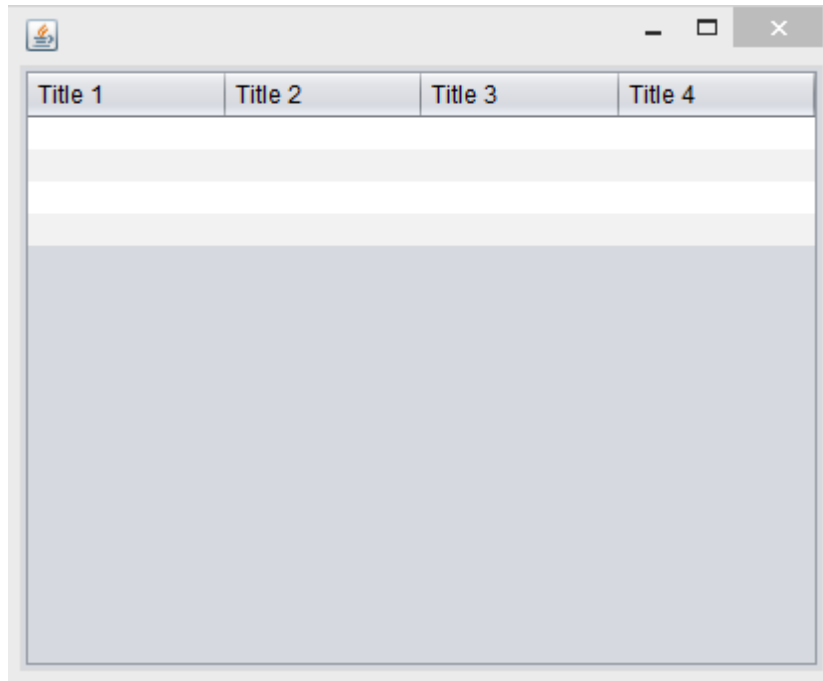


Three overlapping dialog boxes titled "Shipping System" are shown. The top dialog has a table with four columns labeled "Title 1", "Title 2", "Title 3", and "Title 4". Below the table are two buttons: "Future Plan" and "Ship".

The bottom-left dialog also has a table with four columns labeled "Title 1", "Title 2", "Title 3", and "Title 4".

The bottom-right dialog has a table with four columns labeled "Title 1", "Title 2", "Title 3", and "Title 4". Below the table are two input fields: "Bill Number" and "Deliver Time". At the bottom are two buttons: "Confirm" and "Cancel".

Stock Handler



1.12 Glossary

Stock – A product or item that can be bought by customers

Stock Handler – An employee, who puts stock items inside the warehouse when they have arrived for storage, and gathers stock items for shipment when they have been purchased

Pallet – A wooden platform for placing products on, commonly used in a warehouse to bundle products for shipment and moving the products using a forklift

Forklift – A machine with a “fork” on the front, can be used to lift heavy pallets high into the air

Shipment – A pallet that will be sent via truck to its destination

Purchase Order – A pallet containing products that have been ordered by the warehouse

Shipper – An employee who plans and prepares shipments to be sent to the purchaser

Receiver – An employee who records and tracks all incoming shipments to the warehouse