CARGO TRACING AND BUSINESS ANALYSIS

Submitted in Partial fulfillment of the requirements
For the degree of

BACHELOR OF TECHNOLOGY
BY

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Under the Guidance Of
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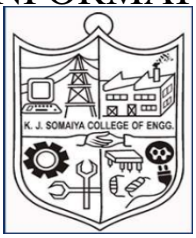

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Abstract

Industrialisation has proved to be one of the biggest factor for globalisation all over the world. The industries are growing at a faster rate, globalisation has surely increased. Due to globalisation, these industries are achieving business growth in no matter of time. The sellers are producing goods in one country and selling the same in other country, thus by making huge profits. As huge amounts of cargo is shipped everyday by different sellers, today there is no efficient system existing to track the cargo. Thus to help the seller, we are proposing a Cargo Tracing and Business Analysis System. The system basically uses RFID tags and a database. We propose method in which there will be two main check-points having both check-in and check-out processes.The RFID tags are then attached to cargo container. It can be placed in a some type of casing so that it does not get damaged. The intermediate checkpoints could vary depending on the type of cargo and number of halts of the ship. The RFID scanners at the check-out areas facilitate step by step tracing and monitoring of cargo. With this tracing system, the seller can also analyze the business growth on various parameters. We also propose the growth analysis of seller using data mining algorithms to help the seller in shipping the cargo based on the demand as well as the profit earned from them.

Keywords- RFID (Radio Frequency Identification) Tag, RFID Scanner/Reader, Arduino Board, Esp-WIFI Module.

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Chapter 1 INTRODUCTION

This chapter gives the gist of the project topic chosen. It tells about how the team got motivated about pursuing the idea and developing it as a real world project. It also speaks about the scope till which it is considered.

1.1 Problem Definition

Due to the growing trade , industrialization and globalization, large scale shipping of cargo is done , owing to increased inter country trade. As the amount of cargo, number of sellers is increasing day by day, there is also a need to update the existing system which has many discrepancies. So there is definitely a need for a System to track these shipments, prevent their loss as well as provide an automated analysis to the seller which may help them to improve their business and enhance their profits manifold.

1.2 Motivation

As we see nowadays, we have a lot of items being imported into different countries. Whether be it clothes for fashion or be it the latest technology devices, all of them are imported. With this, the cargo is being shipped everyday to different countries. The ports are busy places where a lot of different kinds of cargo loading and unloading takes place with the help of modern engineering devices. But it maybe possible that some cargo may be mishandled due to human errors. So this gave us motivation to make a system where there is efficient tracing of the cargo so that the shipments reach in time where they are intended to. With more research we came up with the idea to create a system where the seller would be benefited using extra provisions of getting business insights from our system.

1.3 Existing System

As such there isn't a well administered, automated cargo tracing system in the world right now. Currently we are using Barcodes and Barcode scanners. The major drawbacks of these are the usage of tremendous quantities of a treasured resource "paper". Along with this, specialized staff is required as the barcode is not scanned without a certain proximity.

Also damaged, folded barcode may or may not be often passed without proper authentication. The existing system does not have the following features:

- It does not notify the user,when there is a breach in the declared route of the cargo.
- Does not notify , even when the barcode is damaged hampering tracking.
- Cannot provide sellers specialized business guidance.

1.4 Proposed System

As we described some of the disadvantages in the existing system stated above, we propose a system wherein the seller could track all the shipments efficiently. The system would be consisting of the website portal wherein the seller need to register along with the details of its own. After registration seller would be authorised to use the system. The cargo shipment will be booked by the seller at the nearest area of our working. The RFID tags will be assigned to them and the load will be distributed using threshold weight for one container and also the cargo type. The tags will be well protected. Now, these tags will be assigned to unique sellers who are using the system. As the cargo passes the initial checkpoint wherein the cargo will be loaded, the system will inform the seller about the same with date and time of the check-in of cargo on the website portal. As the cargo is in transit, it passes through various checkpoints and the same updation will be notified to the user on the portal. If at all there is some mishandling at any point in journey, the scanners located at the checkpoints will help to identify those by giving some error messages. At the last checkpoint, the sellers shipment is finally off-loaded safely and then the RFID tags are removed for their reuse. The system also provides the sellers with some additional functionalities. It also helps the seller to analyze the business growth using the past data and also predict the growth for the next quarters. The system will also give suggestions about the cargo type which the seller sends to particular region. So using this he could successfully analyze the business policies and make profits.

1.5 Scope of the Project

The proposed Cargo Tracing and Business Analysis system will help the seller of the goods to trace the shipments made to different locations. As due to human errors, sometimes the shipments are manhandled and reach at wrong destination. This problem is solved by our proposed system. The project aims to provide services only to those sellers who are selling their goods to other countries. Also by analyzing the business patterns and parameters, the system aids in predicting the overall business growth.

1.6 Salient Contribution

As pointed out that the existing system used for cargo tracing was not efficient we contribute to the existing system by upgrading the system from paper barcodes to new technology of RFID. We also contribute to the existing system by giving the sellers a help in analysing his business and see the growth using our system.

1.7 Organization of Report

Chapter 1- This chapter provides us information of the project in detailed manner. It gives insights about the problem definition, the motivation why we took this as a project, the existing and proposed system with scope and organization of synopsis
Chapter 2- The chapter introduces us about the literature survey performed at the start of the project.
Chapter 3- The chapter tells about the Software Project Management Plan. It covers various topics such as Project Deliverables, the process model used, various tasks that are being carried out along with the Risk Templates, and the timetable of our project.
Chapter 4- The chapter tells about the Software Requirements Specification. It mainly covers the Requirements gathered such as functional and non functional requirements, various interfaces used, various product features and the attributes which are identified for our system.
Chapter 5- The chapter tells about the Software Design Document. It says about the system architecture used for the system, detailed analysis about the system components, and the user interface developed.
Chapter 6 - The chapter presents how the system is implemented. It gives insights about how the technology is used to develop the system.
Chapter 7- The chapter tells about the Software Test Document. It tells us about the test approach being used for testing, the test plan designed, and the various test cases mapped with their inputs and expected output.
Chapter 8- The chapter provides with the detailed Results and Analysis of the system being developed.
Chapter 9- This concludes the report and discusses the future work of the project in which ways the project could be used.

Chapter 2 LITERATURE OVERVIEW

The said chapter gives details about the literature surveyed at the start of the project. Technical papers were referred from IEEE website. Also various understandings of these papers is described in short in this chapter.

Today's world is growing at a very faster rate with the help of Technology. A lot of different industries are using the latest technology to increase their growth. Be it in Airline industry, Shipping industry, the medical industry and the list goes on. It is evident that Cargo industry is an extremely important. The number of shipments subjected to handling errors in a year can result in a huge combined loss for the seller as well as the cargo shipment company while attempting to trace the lost carton. RFID has proven to be a boon for tracking purpose and is one of the most promising, effective and feasible technology for research.[1]The system will constitute three components: Scanners, Tags and a Database system to connect the two and to store the information. The tag will be assigned a unique serial number to identify the container it is attached to. It can also store information e.g. shipment number, name of the shipment, etc. The operations will take place in Ultra High Frequency (UHF) range as it works well in dry-non-metallic environment, suitable for the application.

The method utilizes radio waves to accomplish automatic identification and collection of data from the tag. [1] The Scanner consists of the Radio Frequency module and the controller. It has another interface to communicate with the backend for passing into the database the information it reads from the tags. The backend application will then provide the user information about their shipment. RFID gathers information wirelessly using the scanners and the received data is to be managed remotely. With the information being updated automatically, users can keep a track of their shipments. A common portal accessible over the internet will enable the users to request for the tracking details.

The authorities can be informed if a shipment is found to be off-track and it can then be taken care of manually. With all these features available, the seller of the cargo also gets some additional functionalities. [2] Seller can see the business analysis with the help of this system. [2] Analysis will include to predict the profit or loss for the shipments done on quarterly basis, half yearly or yearly basis. Moreover, the seller also gets to know about the rate at which the business is expanding.

Related Work

Working and Implementation of RFIDs

RFID tags are based on the AIDC(Automatic Identification and Data Collection) which is a technology of digitally encoding data into a chip capable of transmitting the stored data with the help of a small antenna. Passive RFID tags (without a battery) depend on scanners while Active RFID (have a battery) tags can function without them. In the proposed system, we plan on making use of passive RFID tags. While active RFID tags can function on their own with the help of the battery within to transmit data, passive RFID tags depend on the scanners to function. When brought near a scanner, the coil generates just enough electric charge within the RFID tag to transmit the data in the RFID tag which is then captured by the scanner using radio signals.

Programming of RFID Scanners:

Each RFID object has its own unique identification number. This can be utilized to uniquely recognize each and every tag that is ever produced. Thus, we just need to update the database and associate the tags we give the user with their carton and other shipment details in the database, not the tag. Using technologies like windows mobile, C and .net, it is possible to manipulate information received from RFID and modify the database accordingly. The scanners can be programmed to update the location of the carton as soon as the tag associated with it is read successfully at a certain checkpoint.

Data Mining Work:

In today's data driven economy, retail businesses rely on information systems that monitor and process their daily transactions. These huge amount of data being processed on a day-to-day basis can be utilized to forecast sales for inventory management, and decision-making. There are various data mining algorithms available for use for prediction and classification. Linear regression models, Naive-Bayesian, KNN, SVM,etc are some of the algorithms available. Adaboost algorithm is one of the better algorithms used for sales prediction and classification. The algorithm is known to be capable of processing both variable and numerical values, it is quite certain that processing data, represented as facts, is faster in digital form.

This allows the algorithm to process the conditions digitally. The proposed system will also predict the profit or loss based on the previous data values. This will be done with the help of Linear Regression model. There are two algorithms which can be used for this type of prediction, the Linear Regression and the State Vector Machines. The paper discusses the comparison of the two said algorithms and suggests us to use the Linear Regression model. The time required to construct the SVM model is although less but, the accuracy of the Linear Regression model is more than that of SVM model. So we are using the Linear Regression model.

Proposed Method

The tags will be attached to the cartons after security checks. The carton information such as the owner identity, shipment details are stored in the centralized database server as well as on the tag. The scanners will have access to the internet over which they will report the data to the server. All scanners will have custom software that will process the data before sending it to the server. When the carton passes security checks, a tag will be attached to it with details preloaded on the server. Along the journey the carton will pass through various checkpoints with a scanner located at all of them. The scanner will read the tag and thus update the status of the carton as well as trigger a notification to the owner. On arrival at the destination, the user will be provided with a unique password linked with the tag. The user has to show the password and only the shipment with tags matching the password will be given to the receiver.

A.Scanning and Management at Checkpoints:

After sticking the programmed RFID tags to the cargo, it is passed through RFID Scanners. If the specifications mentioned on the tags are not confirmed by the system, the baggage is returned to its previous stage. Its tag is checked and replaced if necessary. The carton is then checked again by passing through RFID readers and the information is stored in a local server and then loaded. At the Destination, the aforementioned carton is offloaded and passed through RFID readers. The identification number of the tags read by the readers is already stored at the local server of Destination. In this way, the authenticity of the offloaded carton is checked and confirmed, avoiding loss/misplacement of the shipment. The catron passes through various checkpoints having RFID readers at each location on the conveyor belt and this will constantly inform the user about the status of his shipment.

B. Database connectivity and Users:

Once a tag is assigned to a user, he will first receive a confirmation message along with a link to monitor tracking. At the check out point, as the user reaches the destination, he will have to enter a unique identification number received by him. This number is checked by the reader and authenticated with the help of information already uploaded on main server at the arrival. We plan to implement the prototype at two locations namely check in and checkout. The performance monitoring of the proposed system is done with some people with their shipment checked in at one location and undergoing the entire process. Since our main focus is on tag generation at check in and reading ID and checking on the data on server during check out. At each and every checkpoint the user will be noticed about the status of his shipment via an email.

C: Data Mining

As per our database we would take two attributes to apply the data mining algorithms. We require the number of shipments made by the seller as well as the cost of shipment per cargo both of which will be available to us in database. Using these we will be able to calculate the total cost of cargo and apply the same to linear regression model. The model will be trained with the previous month's cargo amount and the next cargo amount will thus be predicted using the model.The seller would also be able to find out which products are going to be sold as per the market as well as as per the seasons. For that, we will require to use Adaboost algorithm. The algorithm take into consideration the product details such as the product name, the discount or anything like that if applicable, the seasonal stocks,etc and predict the class label with yes or no value. This will help in decision making policy for the business to the user.

Chapter 3 SOFTWARE PROJECT MANAGEMENT PLAN

This chapter speaks about the Software Management Plan. It provides with the details about what are the various deliverables of the project along with their submission time. It speaks of the process models followed and also the various task which will be carried out. Chapter covers the risks were identified and Sheets were prepared. Lastly, the project gantt chart is shown.

3.1 Introduction

3.1.1 Project Overview

The Software Project Management Plan Document gives details about the project deliverables, the organisation of the project and the project plan which will tell us how the project will be moving forward.The Project organisation chapter would consist of the software process model which we will be using for the whole system. It also consists of the Roles and Responsibilities along with the tools and Techniques which will be using for the project. The Management plan would be defining various tasks which need to be carried out. At last, there will be risk identification and categorization along with the impact which those risks will be having on the project. There will be risk sheets prepared with all the details of the risks.

3.1.2 Project Deliverables

Table 3.1: Project Deliverable Chart

Deliverables	**Description**	**Delivery Date**
Software Project Management Plan	A complete formal project plan, including technical and managerial processes that will be implemented in the development and delivery of the system	30/09/2018
Software Requirements Specification	A formal document detailing the functional and non-functional requirements of the system	30/09/2018
Software Design Specification	A formal document detailing the component designs as well as the relationships among components	05/10/2018
Software Test Document	Formal documentation detailing scenarios that must be followed in order to ensure that the product software is satisfactorily tested.	14/10/2018
Implementation of frontend and hardware components.	Software files to form the backbone of the system and their integration into the hardware used	14/02/2019
Final Presentation	A demonstration of the product software and a presentation of the project experience	April 2019
Black Book and CD	A full fledge report of the entire project along with all the soft copies of documents and code written to the CD.	May 2019

3.2 Project Organisation

3.2.1 Software Process Model

The process model used is Prototype Process Model Prototype is a working model of software with some limited functionality. The prototype does not always hold the exact logic used in the actual software application and is an extra effort to be considered under effort estimation. Prototyping is used to allow the users evaluate developer proposals and try them out before implementation. It also helps understand the requirements which are user specific and may not have been considered by the developer during product design.

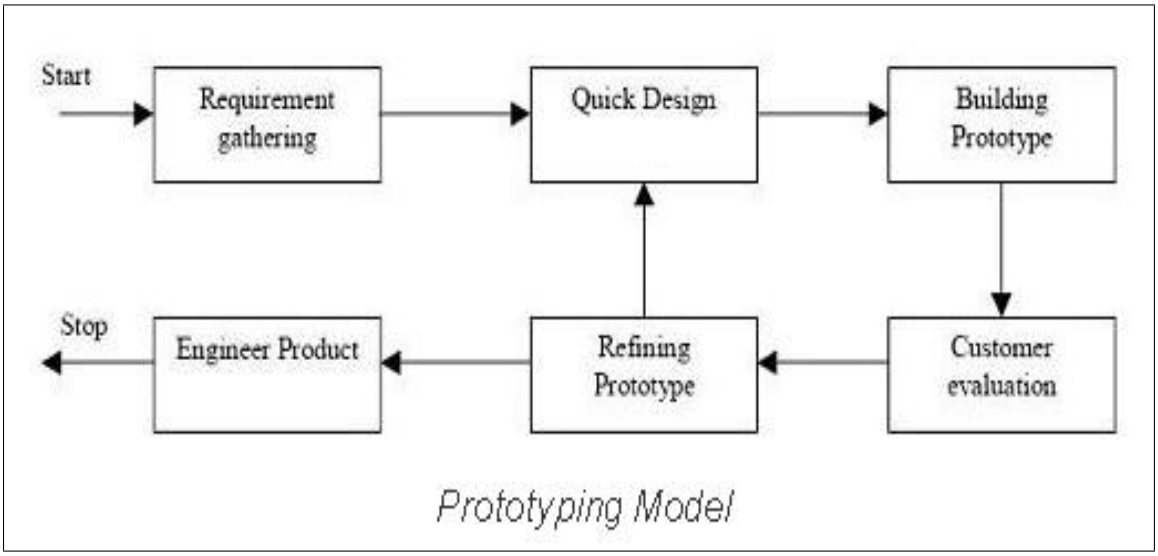


Figure 3.1: Prototype Model Diagram

3.2.2 Roles and Resposibilities

Table 3.2: Roles and Responsibilites

Roles	Responsibilities
Project Co-ordinator	Motivate the team members to perform their tasks in a organized manner Help the team in allocating deadlines
Project Guide	Works with the team to help formulate the application strategy Approves the project documents Helps the team in analysing the project from every perspective and set the goals
Project Manager	Plans, organizes, and coordinates the team project Schedules and prepares team meetings Resolves conflicts Works as a link between team members Monitors and reports the weekly status of the team Ensures that project deliverables are met
Application Designer	Designs a web application to the problem statement that satisfies the requirements Assists the Technical Writers in documenting the design
Application Developer	Develops the android application Determines the data needs for the solution Determines what hardware and tools are necessary Fixes bugs found by the Testers
Database Developer	Develops and populates Databases Ensures proper operation and interaction with entire system application
Tester	Tests all the application modules
Technical writer	Coordinates the project documents and their review by all team members Collects, proofreads, and integrates document parts Generates the final version of all the documents

3.2.3 Tools and Techniques

- LATEX for SRS, SPMP, SDD, STD.
- Gantt project for planning and to prepare the time-line chart.
- Rational rose for UML diagrams.
- Microsoft powerpoint for presentation for the users and project personnel.
- Arduino IDE(v1.8.8) for Arduino Code.
- Tex Editor - Overleaf

3.3 Project Management Plan

3.3.1 Tasks

3.3.1.1 Task 1 - Requirement analysis

Description
Definition of the different requirements which will help the users get a good gist of the project. It provides the basic understanding of the problem and nature of the solution.

Deliverables and milestones
The task provides a lis0t of the various requirements and their analysis for paving the path of design phase.

Resources needed
Effort, time and knowledge about the software.

Dependencies and constraints
The requirements must be documented , testable and related to the needs and defined to a level sufficient for system design.

Risks and contingencies
If the team does not have knowledge about the software, then it can gather the informationby communicating with the experts in that field.

3.3.1.2 Task 2 - Software requirement specification

Description
Description of the behaviour of the system to be developed and the features in the scope of the project.

Deliverables and milestones
SRS delineates the features of the project and serves as a guide to the developers.

Resources needed
Latex

Dependencies and constraints
SRS should be documented in a way understandable to other developers to identify the aspects of the system.

Risks and contingencies
There is a high amount of risk if the SRS is not well documented as the features of the system will not be clear.

3.3.1.3 Task 3 - Software design document

Description
The structure of the software to satisfy the requirements. It specifies the software structure, components, interfaces and data necessary for implementation.

Deliverables and milestones
Architecture design, data design, interface and procedural design.

Resources needed
Latex for documentation and IBM Rational Rose for designing purposes

Dependencies and constraints
SDD is developed according to the SRS, so the SRS should provide an entire overview of the system

Risks and contingencies
Risk is involved if the design does not follow the requirements . The design can be revised by proper communication among the development team.

3.3.1.4 Task 4 - System Test Document

Description
Specifies the approach that ensures that the features are adequately tested.

Deliverables and milestones
The document includes all the test cases with results done after finishing the development.

Resources needed
Latex and software test plan

Dependencies and constraints
STD should give entire description about features to be tested, amount of testing in order to save time of the testing team

Risks and contingencies
The risk is when the STD does not cover the entire system as this might cause major problem in the future which can be avoided by developing test cases for entire section wise coverage.

3.3.1.5 Task 5 - Coding and Hardware Integration

Description
Actual programming and functionalities of the application

Deliverables and milestones
The different modules and components of the system.

Resources needed
Arduino, RFID tags and sensors.

Dependencies and constraints
Coding phase depends on the SRS and SDD and should be flexible.

Risks and contingencies
Developers may have insufficient amount of knowledge.

3.3.2 Risk Table

Table 3.3: Risk assessment table

Risks	Category	Probability	Impact	Preventive measures
Server Crash	TI	10%	1	Maintain a distributed server system
Computer crash	TI	20%	3	Powerful computers capable of handling high load
Late delivery	BU	30%	2	Implementation of basic functionality first and parallelism in work
Deviation from Software Engineering Standards	PI	20%	2	Proper design standards and principles must be followed
Poor Quality Documentation	BU	6%	4	Proper understanding of the requirements
Lack of Database Stability	TI	25%	3	Update DB Structure as the traffic grows
Software failure	TI	2%	1	Maximize portability
Staff is inexperienced	ST	40%	3	Self-learning using various resources providing correct knowledge
No internet Connection	TI	10%	1	Maintain a backup hotspot/tethering service
Conflict with other traffic	TI	10%	1	Shield the high frequency signals from external noise
Failure of Scanner	TI	15%	2	Facilities of updating the database manually.
Damage of RFID	TI	5%	2	Attach the RFIDs in such a way they aren't easily accessible.

Impact Values:
1 – Catastrophic
2 – Critical
3 - Marginal
4 - Negligible

3.3.3 Risk Template-1

Table 3.4: Risk Sheet 1

Risk information sheet			
Risk ID: 1	**Date: September 30, 2019**	**Probability: 25%**	**Impact:3**
Description: The database maintained may not be stable which may lead to Database Instability.			
Refinement/Context: **Sub-condition 1:** The information gathered was misinterpreted.			
Mitigation/Monitoring: 1. Re-gather the information from the user. 2. Understand with modules are improper and correct them.			
Management/Contingency plan/Trigger: Contact the team leader and make a new increment with all the respective changes needed.			
Current status: Mitigation steps have been initialized.			
Originator:		**Assigned:**	

3.3.4 Risk Template-2

Table 3.5: Risk Sheet 2

Risk information sheet			
Risk ID:2	**Date:September 30, 2019**	**Probability:10%**	**Impact:1**
Description: The internet connection fails.			
Refinement/Context: **Sub-condition 1:** Connection fails due to fault at the ISP. **Sub-condition 2:** There is some lose contact of cables to the modem.			
Mitigation/Monitoring: 1. Contact the ISP provider and resolve the issues. 2. Fix the cable properly			
Management/Contingency plan/Trigger: Provide some alternative solution for internet like hotspot. Or make a provision for offline data storage.			
Current status: Mitigation steps have been initialized.			
Originator:		**Assigned:**	

3.3.5 Risk Template-3

Table 3.6: Risk Sheet 3

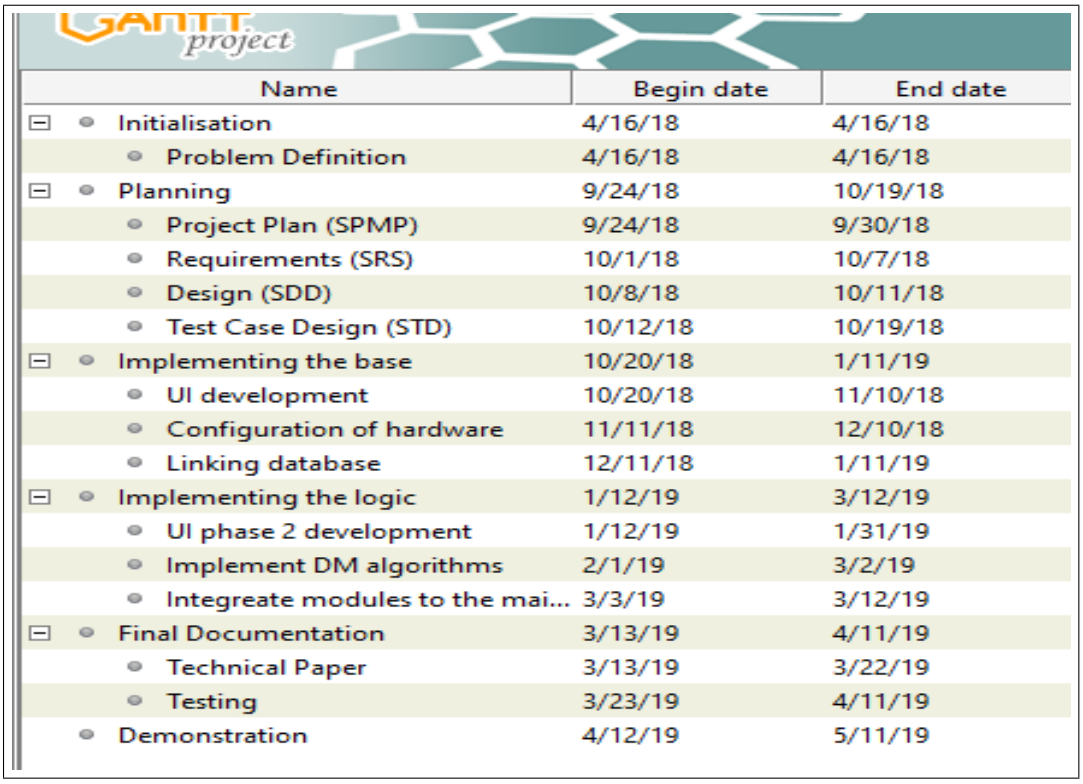
Risk information sheet			
Risk ID:3	**Date:September 30, 2019**	**Probability:15%**	**Impact:2**
Description: The scanners fail to read the RFIDs.			
Refinement/Context: **Sub-condition 1:** RFID / Scanner interface is tampered. **Sub-condition 2:** Incompatible scanner and RFIDs			
Mitigation/Monitoring: 1. Make sure the interface is clean. Check if the RFID is not damaged. 2. Try scanning the same RFID on another sensor or scan another RFID on the sensor.			
Management/Contingency plan/Trigger: Get technical assistance as soon as possible. Find out the problem location (Scanner or RFID) and take actions accordingly			
Current status: Mitigation steps have been initialized.			
Originator:		**Assigned:**	

3.3.6 Risk Template-4

Table 3.7: Risk Sheet 4

Risk information sheet			
Risk ID:4	**Date:September 30, 2019**	**Probability:5%**	**Impact:2**
Description: RFID tag gets damaged.			
Refinement/Context: **Sub-condition 1:** The RFID tag is missing from a cargo when it reaches a scanner. **Sub-condition 2:** The tag is damaged due to weather conditions / mishandling, etc.			
Mitigation/Monitoring: 1. . Try to identify the cargo with the marking on it. 2. Wait for the user to raise a ticket when he notices that one of his cargo containers has not reached the desired destination yet. The cargo can then be linked with the ticket and the right identity of it can be found. A new RFID can be associated to it at this point and the tracing can continue as before.			
Management/Contingency plan/Trigger: Have spare RFIDs at all counters.			
Current status: Mitigation steps have been initialized.			
Originator:		**Assigned:**	

3.4 TimeTable



Name	Begin date	End date
Initialisation	4/16/18	4/16/18
Problem Definition	4/16/18	4/16/18
Planning	9/24/18	10/19/18
Project Plan (SPMP)	9/24/18	9/30/18
Requirements (SRS)	10/1/18	10/7/18
Design (SDD)	10/8/18	10/11/18
Test Case Design (STD)	10/12/18	10/19/18
Implementing the base	10/20/18	1/11/19
UI development	10/20/18	11/10/18
Configuration of hardware	11/11/18	12/10/18
Linking database	12/11/18	1/11/19
Implementing the logic	1/12/19	3/12/19
UI phase 2 development	1/12/19	1/31/19
Implement DM algorithms	2/1/19	3/2/19
Integreate modules to the mai...	3/3/19	3/12/19
Final Documentation	3/13/19	4/11/19
Technical Paper	3/13/19	3/22/19
Testing	3/23/19	4/11/19
Demonstration	4/12/19	5/11/19

Figure 3.2: Gantt Chart

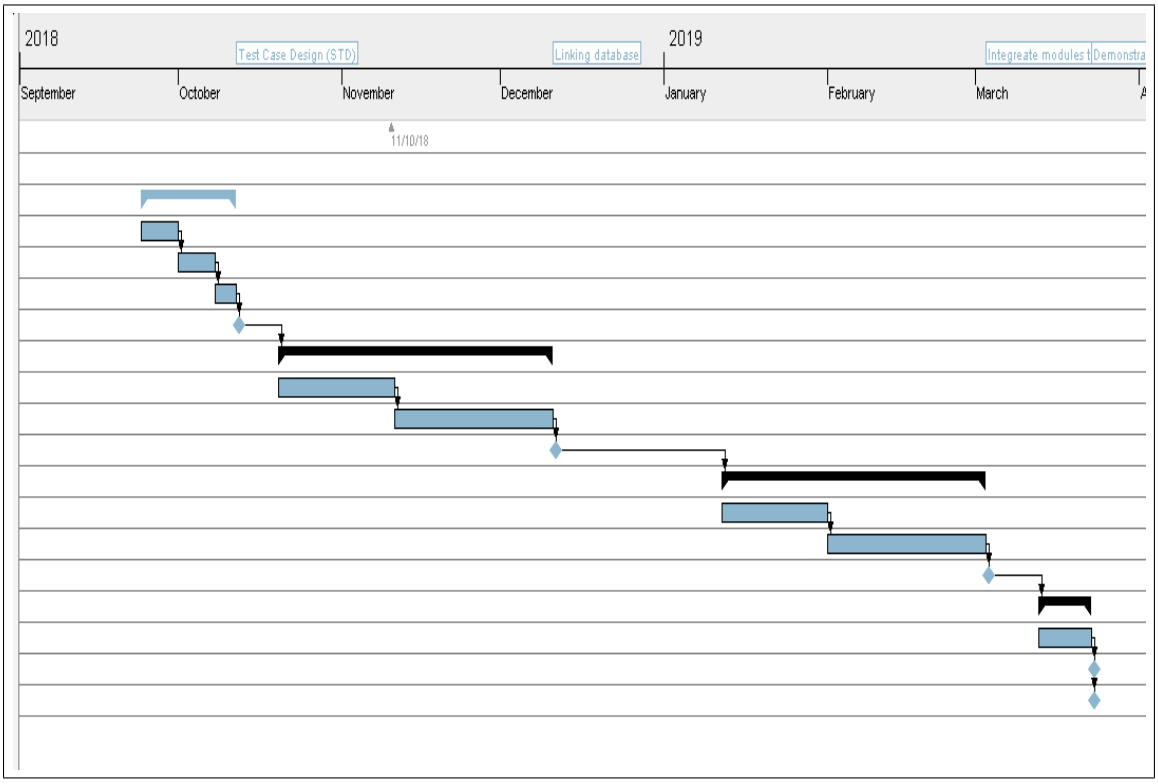


Figure 3.3: Gantt Chart

Chapter 4 SOFTWARE REQUIREMENTS SPECIFICATION

Initially,the chapter speaks about the purpose and scope of the project. It gives idea about the what interfaces are used for hardware and software. Functional and Non functional requirements are also discussed here.

4.1 Introduction

4.1.1 Purpose

Industrialization has proved to be one of the biggest factors for globalization all over the world. Due to globalization, these industries are achieving business growth at a very rapid rate. The sellers are producing goods in one country and selling the same in other, thus making huge profits. There is no system to keep a track of the goods being transported. Thus to help the seller, we propose a Cargo Tracing and Business Analysis System which helps in Goods Tracing for the seller. We also propose to make a business analysis model which will study the trends or patterns in the past records and predict the appropriate market place for the seller.

4.1.2 Project Scope

Due to human errors, at times the shipments are manhandled and reach wrong destinations. The proposed Cargo Tracing and Business Analysis system will help the seller to track the shipments made to different locations and thus using this system the errors can be handled with the help of pre-defined triggers to send notifications when a particular cargo which is expected to arrive at a checkpoint, does not arrive. Along with this, future market place suggestions will also be provided to the seller based on analysis of current trends based on previous records containing details about Shipment details, Source, Destination, Region type, Season, Date/time and so on. Furthermore, the system also helps the shipment industry to manage orders based on the profit related to particular season, destination and cargo type.

4.2 Specific Requirements

The following Sections consists the requirement which are necessary for the proposed system to function at its optimal limits without any hindrances.

4.2.1 External Interface Requirements

This section provides a detailed description of all inputs into and outputs from the system. It also gives a description of the hardware, software and communication interfaces which provides basic knowledge of the system.

4.2.1.1 User Interface

- The Cargo Tracing and Business Analysis System helps the seller of the goods to trace the cargo. For this, the seller needs to register on the website provided. First there will be a registration process which is to be followed by the seller. The registration form includes the following fields-
  - Name
  - Address
  - Contact Number (Personal and Office)
  - Country
  - Seller Registration Number
  - Email-id
  - Username
  - Password
- After successful registration, the seller will be able to log-in to the system. All the sellers who are successfully registered will be assigned a unique id which they can see in their profile. This unique id will help the seller to trace their respective cargo. As the cargo passes the checkpoints, the seller would be notified about it on the timeline of the cargo shipment. This will also be supported by notifying the user about the date and time on which the shipment has cleared that checkpoint. Thus, the user interface is simple, compact and reliable.

4.2.2 Hardware Interface

The proposed system consists of RFID tags, the scanner as the hardware for the system.The following are the hardware required for the system-

1. Rc522 RFID Scanner
2. EspNode MCU 8826 Wifi Module
3. Arduino Board or any other Uno Board
4. Any RFID Tag

The Wifi Module used in the system will be able to send data to the database of the system where all the values will get stored. The RFID tags are independent of the scanner used, so any type of the scanner can be used at different checkpoints as based on availability.

4.2.3 Software Interface

Each and every RFID tags will have their unique hex number pre included with them. The tags will generate the binary files when they are scanned by the scanner. There will be a main code written in the Arduino/ Uno Board that establishes connection and control with all the hardware modules mentioned. Both the Rc522 scanner and the Wifi module are connected with arduino with the drivers provided. These interfaces will be used for about the scanners and RFID tags. Now, the web portal will be designed by using the following interfaces.

- Server side
  - An database server and web server which will accept all requests from the client and forward it accordingly. A database will be hosted centrally using MySQL.
- Client side
  - An OS which is capable of running a modern web browser which handles requests and responses of the comunnication.
  - A web browser with the Javascript and PHP technologies enabled.
  - Android Version of Jellybean(4.1) and above would be recommended for the mobile devices.

4.2.4 Communication Protocols

As mentioned above, the scanner will be using the Wifi Module for communication between the database and the RFID tags when scanned successfully. HTTP, FTP are the communication protocols used in the system for the web portal. To connect to back-end processing with PHP JSON is useful.

4.2.5 Software Product Features

The proposed system will provide the seller with own portal to track the shipment made by the seller. The dashboard will help the seller to track all their shipment activities on one screen. This dashboard will keep updating the seller regarding all the activities at the checkpoints during the whole process.The following are the functional requirements gathered for the proposed system.

4.2.5.1 Login

The system will help the seller to login to the system to be able to trace the cargo shipment as and when required. For successful login to the portal,the seller has to enter the correct credentials for the username and password otherwise the system will throw error.

4.2.5.2 Register

Any seller form any country can register itself to the portal of Cargo Tracing. For this, registration process would require personal details like name, number, address, email, passport number to be entered by the seller.On successful registration, the seller would then be able to use our system.All the personal details are kept secured.

4.2.5.3 Filter

As there can be number of shipments made by the seller, the seller may need to segregate out some of the shipments made. To make this happen, the seller would have an option to filter the shipments based on the date of shipment, the month of shipment or the year of shipment.

4.2.5.4 View Timeline

The seller would be able to trace the shipment based on a timeline provided on the dashboard. The timeline specifies the shipment details such as the date of scanning of shipment at a particular time, the arrival time, the departure of the shipment and so on.

4.2.5.5 Scanning

At the checkpoints, the cargo shipment with RFID would be scanned at that location. The RFID scanner present at the checkpoint will trigger the database of the system after sucessful scanning of RFID stating the name of the checkpoint and the location of the same, the arrival date of the shipment and the arrival time of the shipment. The shipment would be then transfered for the further processing either to next checkpoint or it will be unloaded.

4.2.5.6 Erasing

When the shipment passes through the last checkpoint and the cargo is unloaded, the RFID tags will be erased of all the data which it collected in the whole journey from source of shipment to the destination of the shipment. These tags will be erased programmatically and all the tags will be reused again for other shipments.

4.2.6 Software System Attributes

The following are the system attributes:

4.2.6.1 Reliability

The final System will be a reliable one as it will pass through a series of testing procedures regarding the working of whole system. The trust factor of the seller relies on giving the perfect tracing of the cargo shipment along with the business analysis of the seller with high precision. The mean time of failure is very large as the deployment of web portal will be good enough to handle large requests. The probability of the system unavailability largely depends on the scanners used for RFID tags. The weather conditions mainly at port may cause hindrance in scanning and may make system unavailable for some time. Thus the rate of failure occurrence of the system is quite small.

4.2.6.2 Availability

Some times due to load on the server which is in process may malfunction. This may cause non-availability of the system. To recover from this inconsistent state, there will be checkpoints saved of the previous working and stable version of the system which will help in successful recovery of the system. The recovery phase of the system will not take long duration, so maximum of half hour would be required to recover the system to it's normal state. The scanners will be available whenever required till the continuous supply of electricity is provided.

4.2.6.3 Security

This feature is important aspect of our system as the system will be used world-wide. When the seller enters critical information of identity such as the Passport number, the seller license number, these values will not be directly stored in database but with the help of cryptographic algorithms such as SHA or MD5 will be applied on those values. Every care would be taken to protect the RFID from being forged or stolen. This can be implemented

by reviewing the RFID data and logs at each checkpoint.

4.2.6.4 Maintainability

The maintenance of the system is quite easy work. The web portal for the seller is easier to maintain. Any upgradation to the portal can be easily managed as there are no complex structures, API's used nor any kind of third-party services. The CSS, Javascript, PHP codes, are all developed by developers from the team so the code is easier to maintain and well readable. The system will be stable when new releases or the version of the system are rolled out.

4.2.6.5 Portability

Requirements do change with the time based on stakeholders decision. So to meet the needs of stakeholders, there will be changes made to the system. The newly developed system will easily adapt to the current working environment and there will be some functionality added to the system which will be used for reverse compatibility.

4.2.6.6 Performance

The performance of the system or to be specific the web portal will depend on internet speed. The performance of the RFID tags will depend on how well the tags are kept secured. As the weather conditions change from country to country at a particular time, the tags might get damaged. Moreover, the scanner should be placed at a location where they do not catch any moisture or not get damaged while the containers are transported. Any mishandling of scanners or tags might result in degradation of the entire system.

4.2.7 Database Requirements

The Web Portal will maintain a database which will contain all the details of the seller such as the number,name, address. The passport number and other confidential details will be kept secured. The other details of shipment such as the shipment number, the source, the destination, and also the intermediate checkpoints will also be stored to help the seller in tracing of shipment. The Authority to access the database will be given only to the administrator who will maintain the web portal. There will be another attributes which will be stored in database to keep track of the RFID unique hex values along with the other details such as timestamp and so on.

Chapter 5 SOFTWARE DESIGN DOCUMENT

The chapter gives details of the design of the whole project. It describes about the architecture chosen along with the detailed description of project components. The user interface design is also shown with the screenshots.

5.1 Introduction

5.1.1 Design Overview

This document presents the Software Design Document for the Cargo Tracing and Business Analysis project. This document gives insights about overview of the document. The requirement traceability matrix gives mapping about the requirements identified and the components in which they are fulfilled. With extensive research we chose Event driven architecture and Client Server Architecture as the architectures of our system. The system interface that is the hardware and software interfaces are mentioned in the document. Various components are described to a good extent which will help in making the system working. The document provides the description of user interface along with some of the images of the UI developed.

5.1.2 Design Requirement Traceability Matrix

Components / Requirements	Web Portal	RFID Scanner	Database
Trace Cargo	X	X	X
Business Analysis	X		X
Payment	X		
Login	X		X
Scanning RFID		X	X
Updation at Checkpoint			X
Register Seller	X		
Erasing RFID Data			X
View TimeLine	X		

5.2 System Architecture

5.2.1 Chosen Architecture : Event Driven Architecture and Client Server Architecture

An event-driven application is a computer program that is written to respond to actions generated by the user or the system. In a computing context, an event is any identifiable occurrence that has significance for system hardware or software. As such, events include both user-generated actions like mouse clicks and keystrokes and system-generated events such as program loading or IDs passing through scanners. Event-driven programming separates event-processing logic from the rest of a program's code.

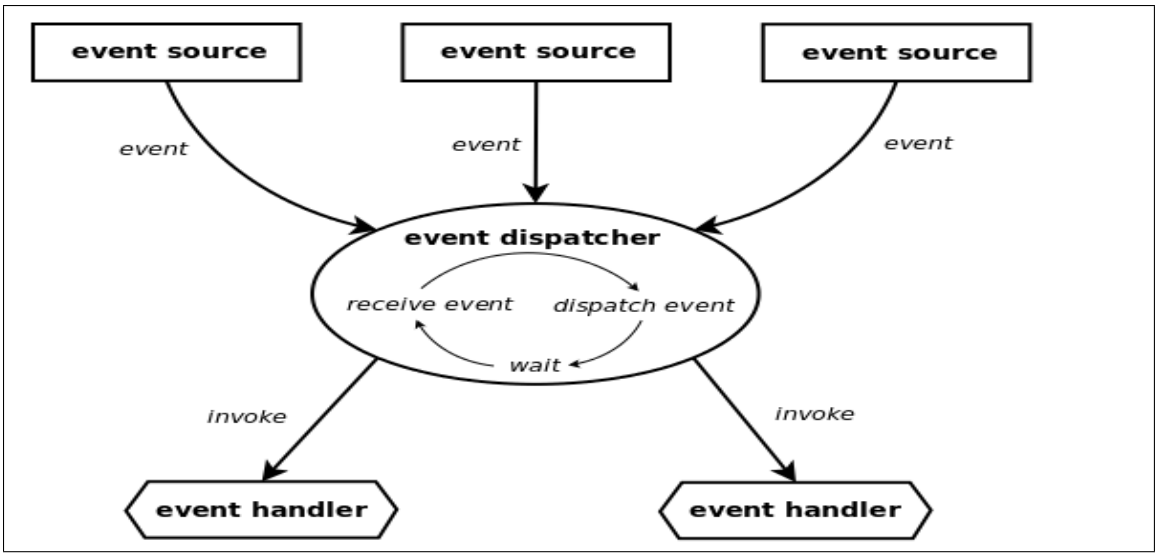


Figure 5.1: Event Driven Architecture

Client-server architecture, architecture of a computer network in which many clients (remote processors) request and receive service from a centralized server (host computer). Client computers provide an interface to allow a computer user to request services of the server and to display the results the server returns. Servers wait for requests to arrive from clients and then respond to them. Ideally, a server provides a standardized transparent interface to clients so that clients need not be aware of the specifics of the system (i.e., the hardware and software) that is providing the service. Clients are often situated at workstations or on personal computers, while servers are located elsewhere on the network, usually on more powerful machines.

This computing model is especially effective when clients and the server each have distinct tasks that they routinely perform. In our Cargo Tracing system, for example, a client computer can be running an application program for entering all the shipment related infor-

mation while the server computer is running another program that manages the database in which the information is permanently stored. Many clients can access the server's information simultaneously, and, at the same time, a client computer can perform other tasks, such as sending e-mail. Because both client and server computers are considered intelligent devices, the client-server model is completely different from the old "mainframe" model, in which a centralized mainframe computer performed all the tasks for its associated "dumb" terminals.

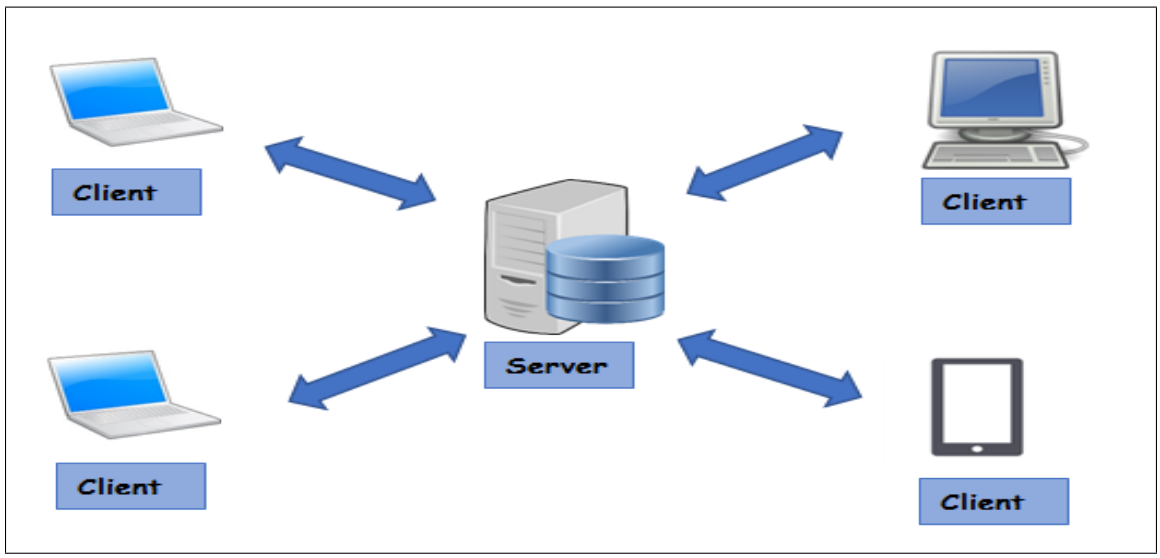


Figure 5.2: Client Server Architecture

5.3 System Interface Description

5.3.1 Hardware Interface

- The mandatory hardware requirement is a computer or an android device with basic android version of jellybean. This low specification is mainly due to the simplicity of design.
- Internet connection is a necessity.
- Decent RAM size and storage space required.
- RFID
- RFID Scanners

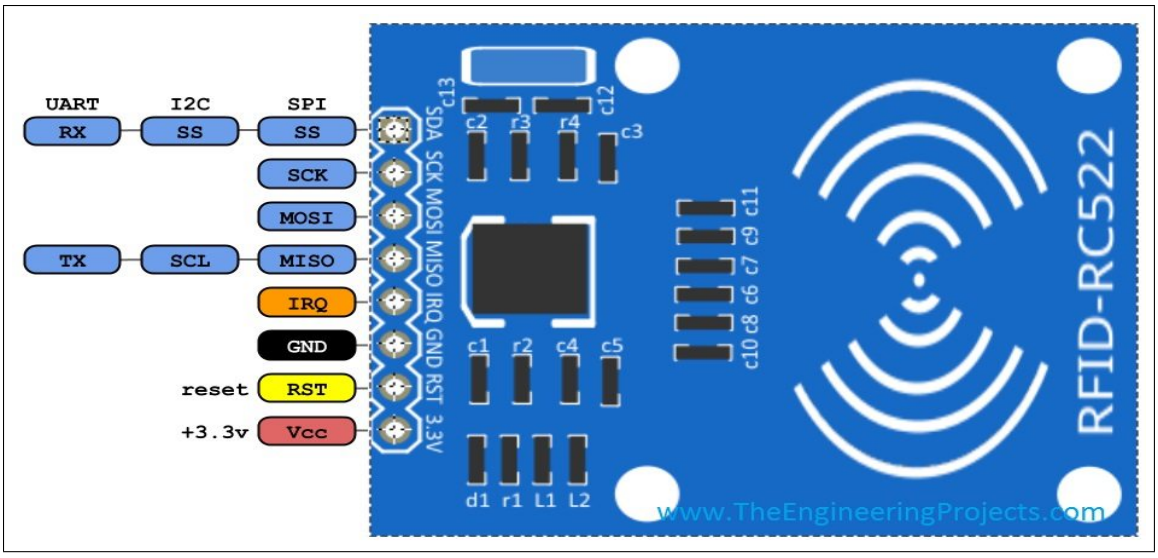


Figure 5.3: RC552 Scanner

5.3.2 Software Interface

- A web browser with minimum compatibility of JavaScript.
- An android device with minimum android version of jellybean.

5.4 Detailed Description Of Components

5.4.1 Server Connection

This component consists of php files which are downloaded locally on the hardware along with some on the server. These files help to connect with the sever and pass on the data on the server side from the client side in the form of files like text or xml. Thse files are interpreted by the server side and response in the form of JSON is given back to the client by the php files. These files also verify the data sent. Server side scripting and validation is also used.

5.4.2 Verification

Although there are php files to verify before sending the data, the software must contain verifying files for the data to be sent and received. Moreover the device must make sure that the data is sent by a human and not by any illegal practice. Basic validation also must be done separately of every data.

5.4.3 RFID tags

RFID tagging is an ID system that uses small radio frequency identification devices for identification and tracking purposes. An RFID tagging system includes the tag itself, a read/write device, and a host system application for data collection, processing, and transmission. An RFID tag (sometimes called an RFID transponder) consists of a chip, some memory, and an antenna. RFID tags in the project will be used to track shipments, assigning them user data, unique identity to each shipment for scanning and tracking purposes.

5.4.4 RFID Reader

For interacting purpose of RFID tags, we have developed our own RFID scanning mechanism with hardware: RC522 - RFID Reader / Writer 13.56MHz includes a 13.56MHz RF reader cum writer module that uses an RC522 IC and two S50 RFID cards. The MF RC522 is a highly integrated transmission module for contact-less communication at 13.56 MHz. RC522 supports ISO 14443A/MIFARE mode. RC522 - RFID Reader features an outstanding modulation and demodulation algorithm to serve effortless RF communication at 13.56 MHz.

5.4.5 Wifi Module

For interaction purpose with our website we are using ESP MCU Node8266 module. NodeMCU is an open source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module

5.4.6 Arduino

Arduino is a basic micro-controller used to handle all the hardware components present in the system, main underlying code of basic functionality of the system like scanning of ID tags, writing of ID tags, communication with wifi module to send or receive data to/from a centralized database of a website. Arduino is an open-source computer hardware and software company, project and user community that designs and manufactures single-board micro-controllers and micro-controller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world.

5.5 User Interface

5.5.1 Description

The User will have an option initially to sign up or to log in in an existing account. Further once the user has logged in to his account they can track their shipments on the website. The user gets an option to know the possible prediction of transaction by providing basic details of the transaction. The user gets an option to manage the account where he can change his account type, edit his information, manage his security options and many more.

5.5.2 Images

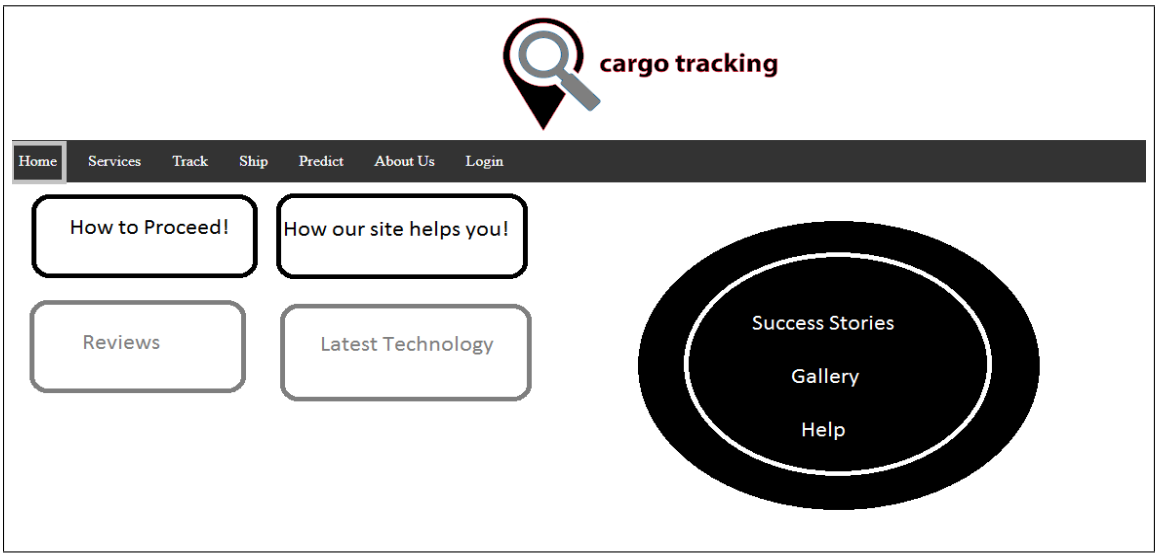


Figure 5.4: Home Page

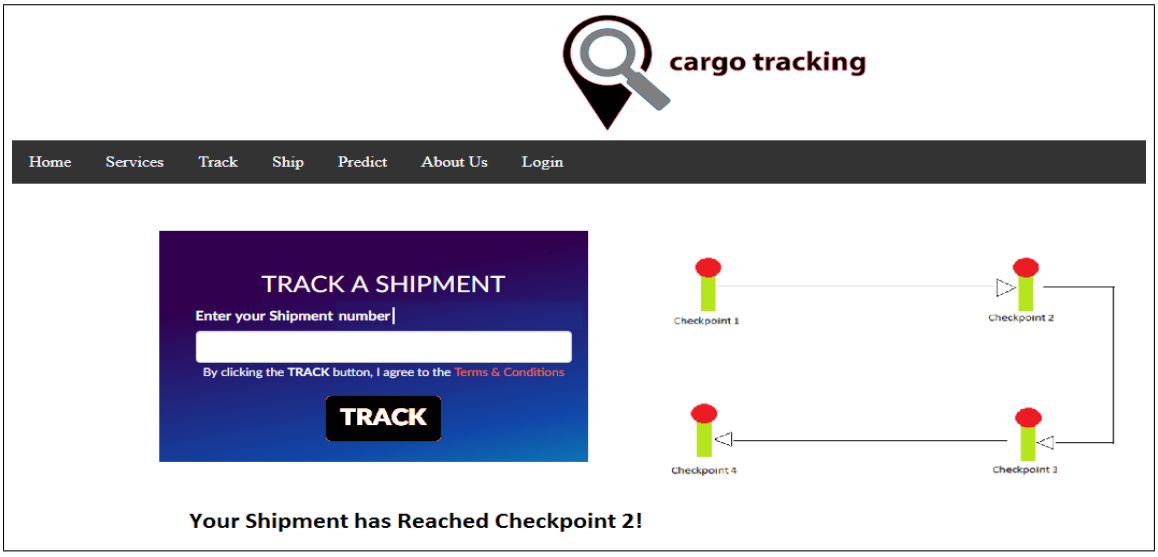


Figure 5.5: Tracking Page

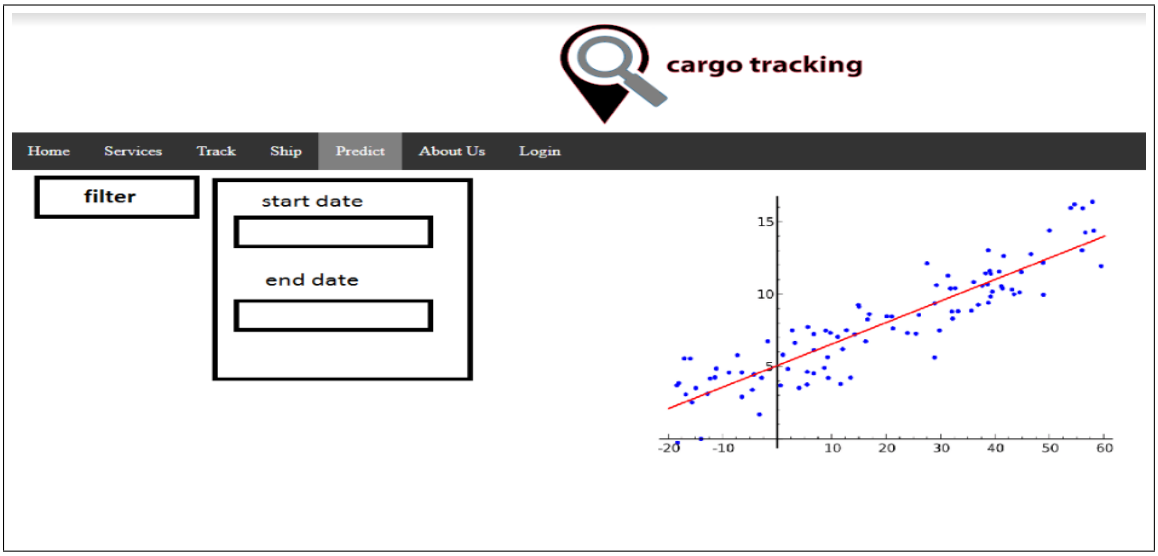


Figure 5.6: Business Analysis

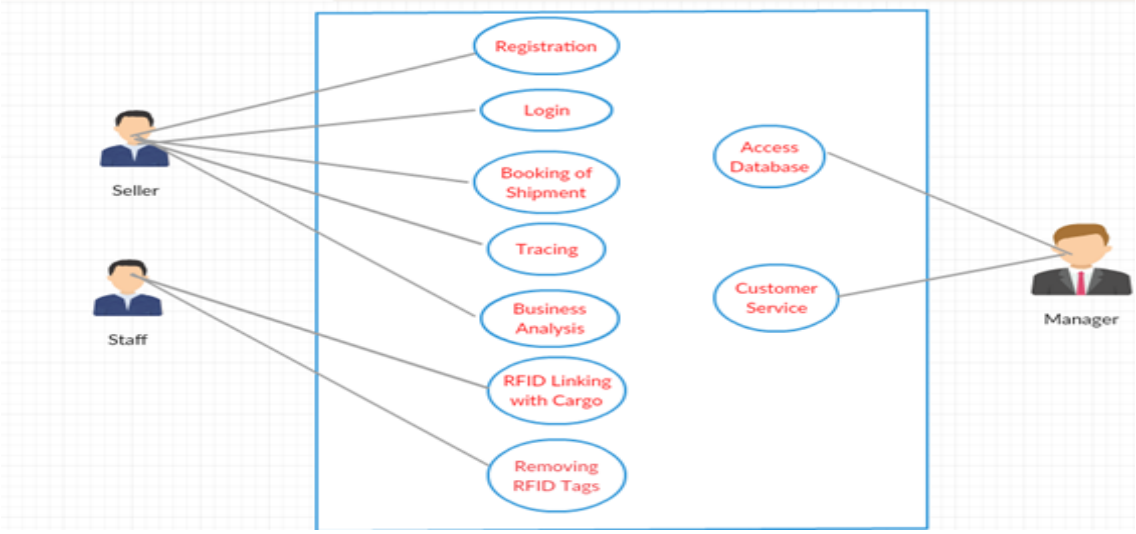


Figure 5.7: Use Case Diagram

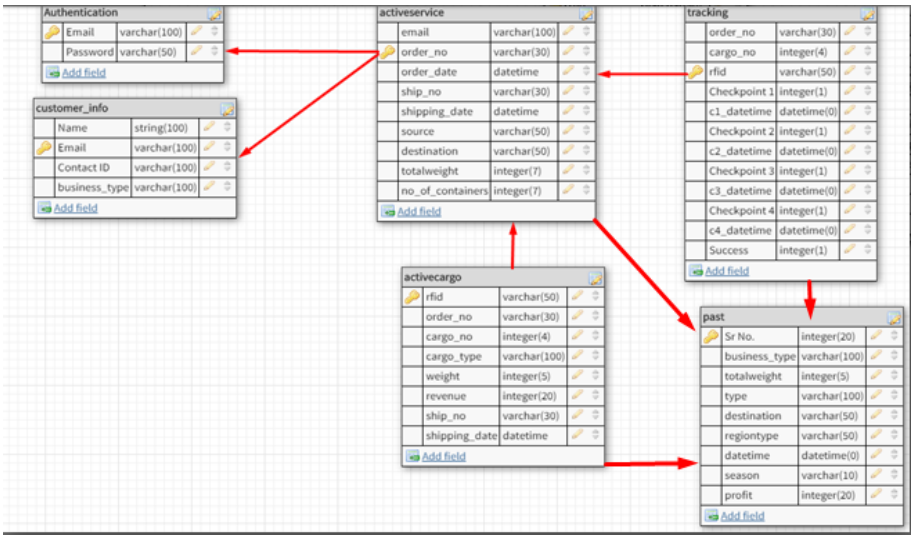


Figure 5.8: Database Schema Diagram

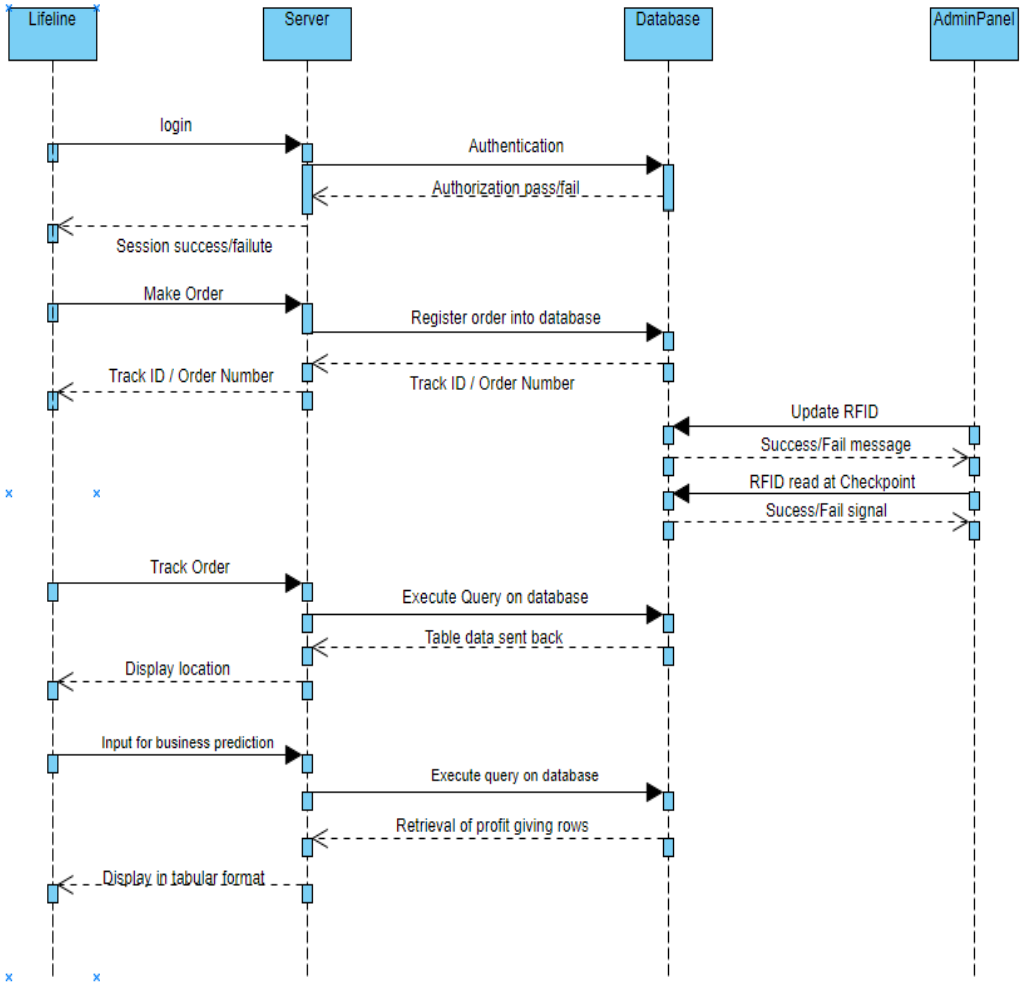


Figure 5.9: Sequence Diagram

Chapter 6 IMPLEMENTATION

This chapter presents detailed explanation about implementation of the system. This chapter focuses on the technologies used to developed this application, algorithm that have used and the various modules implemented to developed this project.

Technologies used:
Software Requirements:

- Arduino: The Arduino Integrated Development Environment consists a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the NodeMcu hardware to upload programs and communicate with them.
- PHP: PHP is a general purpose scripting language that is especially suited to server-side web development, in which case PHP generally runs on a web server. Any PHP code in a requested file is executed by the PHP runtime usually to create dynamic web page content or dynamic images used on websites or elsewhere. The PHP software works with the web server, which is the software that delivers web pages to the world. This process is essentially the same when PHP is installed. You request a file, the web server happens too be running PHP, and it sends HTML back to the browser, thanks to the programming in PHP.
- Javascript: JavaScript is predominantly a client-side language used to make websites with static HTML and CSS interactive. Majority of Web-browsers supports JavaScript by the means of built-in javascript engine.
- MySQL: MySQL is an open-source relational database management system (RDBMS). MySQL is used by many database-driven web applications, including Drupal, Joomla, phpBB, and WordPress.
- Bootstrap: Bootstrap is a free and open-source CSS framework directed at responsive, mobile-first front-end web development. It contains CSS- and (optionally) JavaScript-based design templates for typography, forms, buttons, navigation and other interface components.

- Latex: Latex is a document preparation system. When writing, the writer uses plain text as opposed to the formatted text found in WYSIWYG word processors like Microsoft Word. The writer uses markup tagging conventions to define the general structure of document, to stylise text throughout a document.. A Tex distribution is used to produce an output file suitable for printing or digital distribution.
- Gantt Project: GanttProject is GPL licensed Java based, project management software that runs under the Windows, Linux and Mac OS X operating systems. A Gantt chart is a type of bar chart. Gantt charts illustrate the start and finish dates of the terminal elements and summary elements of the project. Terminal elements and summary elements comprise the work breakdown structure of the project.

Hardware Requirements:

- NodeMCU ESP8266: This will act as a master for the RFID scanners to read the RFID tags. The module uses a wifi signal to connect to the database and is capable of sending http requests to interact with databases and php files.
- RC522 RFID Scanner: Acts as a slave to the NodeMCU module. RFID tags will be scanned using this device.
- RFID Tags: Physical passive RFID tags for demonstration purposes.
- Jumper wires: Forms the connection between the NodeMCU and RC522

Implementation of Tracing System

- Step 1: Placing an order
  - User logs in and places an order, sharing details about the goods he will be transporting.
  - User takes his goods to the dock to start the process.
- Step2: Assigning RFID Tags
  - The goods of the user are assigned RFID tags.
  - Database is updated and the user's order is now associated with a unique RFID Tag.
  - The employee of the transport service will attach the RFID tag and update the database using the control panel.
- Step3: Transit
  - Each checkpoint has an inbuilt scanner coded to update the order details in the database associated with the RFID it scans.

  - User can use the website to check time and location using his order ID.

- Step4: Final stage
  - User collects his goods at the destination.
  - Order details are removed from the database and stored in a separate one which is then used to train the business analysis module.
- Step5: Complaints
  - User

Implementation of Business Analysis

- Step1: Predict profit before placing order
  - User logs in to the website.
  - User enters the details of the goods he plans to transport along with other attributes defining the journey.
  - Application returns a percentage value of the profit he can make on that particular order.
- Step2: Predict alternative business opportunities
  - New sellers could get business analysis of their new plans and ventures.
  - They can easily know about which products to sell in which country and also in which seasons. The filters are user defined. It's upto the seller how to use it.

Chapter 7 SOFTWARE TEST DOCUMENT

The chapter is concerned about the testing part. It speaks about the approaches of the testing to be followed. It gives details of which components need to be tested and which not. Lastly, each test case is described and a test case table formulated describing the result of testing.

7.1 Introduction

7.1.1 System Overview

The goal of the system is to manage shipments of the customers by providing them tracking of their goods using RFIDs and also giving business recommendation to cargo suppliers based on their cargo shipment order. The system has to be up and running at all times to ensure proper updation of checkpoints and tracking. Staff should be trained enough to be able to use the scanners and update the database by scanning the RFIDs. The scanners should have uninterrupted internet connection to not cause any delay. RFIDs should be cleared from database once a particular journey is over. To ensure smooth functioning of the whole system, it is really necessary for these conditions to be met at all times.

7.1.2 Test Approach

7.1.2.1 Unit Testing

Unit testing is a method of testing that verifies the individual units of source code are working properly. The goal of unit testing is to isolate each part of the program and show that the individual parts are correct. Unit testing is simplified when a component with high cohesion is designed. When only one function is addressed by a component, the number of test cases is reduced and errors can be more easily predicted and uncovered. Here, we can test the working on scanners, mobile app connectivity, server based notifications all separately.

7.1.2.2 System Testing

Once the entire system has been built then it has to be tested against the Software Requirement Specification and System Specification to check if it delivers the features required.

System testing can involve a number of specialist types of test to see if all the functional and non-functional requirements have been met. System testing can be applied to our project when the prototype of RFID + Scanners is generated along with a sample dataset.

7.1.2.3 Performance Testing

The system should meet the performance requirements as mentioned in the SRS. The performance will be evaluated based on the response time of the GUI and the database commands. The system will also be tested based on the load (number of active users at a time) on the servers and the ability of the system to handle database stability when various transactions are taking place simultaneously.

7.1.2.4 Functional Testing

The functional requirements specified in the SRS must be met at all costs. Tests can be applied to check if the tasks supposed to be fulfilled by the system are being successfully executed. A sample cargo order can be used at it can be simulated such that the system thinks it's travelling. The end point can be studied to ensure that the functional requirements are met.

7.2 Test Plan

Each module can be tested separately to check if it works. Functional Testing, Unit testing can all be done as soon as development of a particular module is completed. The product can be tested completely when the first prototype is ready which will also verify the integration aspect of the whole system, data flow and usability.

7.2.1 Features to be tested

- Login
- Registration
- Place an order for shipment / Book shipment.
- Trace cargo using mobile app / website
- Scan RFIDs at different places using scanners as checkpoints
- Business suggestion

7.2.2 Features not to be tested

- Reset Password: Is not a mandatory functionality of the system. Can be skipped for demonstration purposes.
- Checking if all RFIDs are unique: All RFIDs are unique.

7.2.3 Testing Tools and Environment

The project consists of various modules both at the software and hardware part. Each module can be tested as and when the development is complete. Well prepared documentations of the hardware which will be used will make the testing process easier as most of the steps and working will already be described. The goal is to go step by step, gradually, making sure that the work done is correct.

7.3 Test Cases

7.3.1 Test Case: Registration

7.3.1.1 Purpose

Our system will help the sellers from all over the world to register themselves to our system. Therefore, it is necessary that the registration feature works on all kinds of devices and perform its desired functionality. As the seller tries registering, the system should not be in ambiguous state i.e. it should either register a particular seller successfully or it should display an error.

7.3.1.2 Inputs

Name, Address, Email, Phone, Seller Registration number, Passport number, DOB, password.

7.3.1.3 Expected Output and Pass/Fail Criteria

If all the input details are valid then the seller's details must be stored in the database and the seller must be directed to Login page to log to the system. If the details are not valid the web portal must show where the error have occurred along with the error fields highlighted. The test case will be passed only when all the values entered in registration form will be valid and successfully submitted. Otherwise, the test case will fail on invalid input values.

7.3.1.4 Test Procedure

Verify whether the user has input text values with no special characters and blank spaces wherever required. Also verify the code for database connectivity so that successful registration adds the seller details to the database. Check the password size with necessary security requirements.

7.3.2 Test Case: Login

7.3.2.1 Purpose

To verify the seller with correct login credentials so that seller could be authenticated successfully to use our system.

7.3.2.2 Inputs

Email, Password.

7.3.2.3 Expected Output and Pass/Fail Criteria

If the email id and password both are correct and matching with the values stored in database, the seller would be redirected to the dashboard of our system from where the seller can manage all the activities provided by the system. The test case will be passed if the values are matched with the database values and it will fail if the values are not matching the values.

7.3.2.4 Test Procedure

Check if the length of the password matches with the standard length specified. Also see whether the email id is of correct pattern.

7.3.3 Test Case: Shipment Booking

7.3.3.1 Purpose

When seller has registered to our system successfully, seller is authorised to use our tracing facility by booking the cargo on web portal. The portal would ask some details about the cargo like the quantity in tons, the type of cargo whether it is fragile glass or clothing or food kind. It is necessary to book the cargo to trace it using our system.

7.3.3.2 Inputs

Type of Cargo, Quantity, Date of Shipping, Time of shipping, source, destination.

7.3.3.3 Expected Output and Pass/Fail Criteria

If the date is available for booking along with the time slot, the cargo will be successfully booked for that seller. The test case will be passed if all the values are valid and then only the shipment will be booked successfully. The Fail Criteria will be when the seller enters insufficient details or the seller will try to book when the dates are not available.

7.3.3.4 Test Procedure

Check the maximum and minimum values of all the details to be entered whether they pass the test or not. It is necessary to check the database for the correct booking so that there is no inconsistency in the field values.

7.3.4 Test Case: Tracing

7.3.4.1 Purpose

Tracing is the main part of the system so it is necessary to make sure that the seller gets the correct details of cargo whereabouts. The updates when the shipment reaches from one checkpoint to another will be notified. It will make the seller to know the exact details of the shipment where it has arrived.

7.3.4.2 Inputs

Source, destination, date, time.

7.3.4.3 Expected Output and Pass/Fail Criteria

The system should give correct results when the shipment is in transit. Whenever the RFID is scanned properly the database will be updated and then the seller will be able to see the shipment tracing on web portal with the details such as checkpoint place, time and date. The test case will be passed when the seller will be notified about the correct details of tracing along with the date and time. On the other hand, the test case will fail when the seller will not be able to see the tracing details or incorrect details.

7.3.4.4 Test Procedure

Check if the scanning and updating of database is done properly. Check the values fetched from database and show it to particular seller. Make sure that if load comes to the database fetching values and matching to every seller is correctly done.

7.3.5 Test Case: RFID Scanning

7.3.5.1 Purpose

When the shipment arrives at the checkpoints, it is required that the RFID attached to the cargo are successfully scanned at that location. When these RFID are successfully scanned, they will trigger the database for updation of checkpoint with date and time. If it is not scanned properly or there is malfunction in scanning, the database trigger will not happen and the seller would not be able to trace the cargo at that particular location.

7.3.5.2 Inputs

RFID Tag

7.3.5.3 Expected Output and Pass/Fail Criteria

After scanning the RFID tag successfully, the database will be triggered setting the values of the checkpoint location along with the date and time of the scanning. These values will be set in the database. These will be used to provide tracing to the seller on the web portal provided. The test case will be passed when the RFID is scanned successfully and failed when scanning is failed.

7.3.5.4 Test Procedure

RFID scanning will be done manually by the staff members present at the checkpoints. The RFID will be scanned by trying at different distances from the scanner. They will also be checked for scanning at different angles from the scanner. Suppose if the RFID is broken during the transit of cargo, the broken RFID will also be tested for scanning. They will be checked if they are scanned or not.

7.3.6 Test Case: RFID Erasing

7.3.6.1 Purpose

After a particular cargo arrives at the destination intended, the RFID will be collected to reuse them for other cargo shipments. These RFID need to be erased of the information collected during the whole journey. The values from the database also need to be made invalid for that particular erased RFID.

7.3.6.2 Inputs

RFID tag

7.3.6.3 Expected Output and Pass/Fail Criteria

The RFID information will be erased successfully and can be used for other tracing process. The values from the database would be made invalid after the RFID's are erased. The new RFID will not contain any information and can be reused. The testing will be passed when the information is totally erased with all the information contained in them and it will fail when either some information is present in tag or nothing is erased.

7.3.6.4 Test Procedure

Collect the RFID tags which are arrived at the destination location. These RFID tags will be then erased by the staff members present at that location. There will be manual testing of erasing and scanning done to ensure that erasing and feeding of information is done successfully without any error in the process.

7.3.7 Test Case: Business Analyzer

7.3.7.1 Purpose

After a particular cargo arrives at the destination intended, the RFID will be collected to reuse them for other cargo shipments. These RFID need to be erased of the information collected during the whole journey. The values from the database also need to be made invalid for that particular erased RFID.

7.3.7.2 Inputs

All the attributes which are needed for analysis for ourselves along with the shipment source, destination, quantity, type of the shipment, etc.

7.3.7.3 Expected Output and Pass/Fail Criteria

The analysis will be done on the values provided by database. After successful completion of the deductions and calculations on the values, the output will be provided as a graphical analysis. The graphs should be properly plotted with a good amount of accuracy. The test cases will be passed when the accuracy will be above the specified standard limit and the graphs show the correct results made by analysis. The cases will fail when the accuracy will be less.

7.3.7.4 Test Procedure

Give the model constructed different amount of values such as first give the model 60% of the values and measure the accuracy. For next iteration, provide the model with 70% of data and again measure the accuracy. Consider also the cases where there will be missing values in the dataset.

7.3.8 Test Case Table

Table 7.1: Test Cases Table

ID	Module	Input/Test Case	Expected Output	Actual Output	Result
1	Registration	Seller doesn't enter field values according to conditions	Display condition messages	Appropriate messages are displayed	Pass
2	Registration	Seller forgets to enter the required field values	Display required field values	Password field empty	Pass
3	Registration	Seller uses same password as username	Display message saying username and password cannot be same	Username and password cannot be same	Pass
4	Registration	Seller enters all the details	Successful Registration message	Successful login	Pass
5	Login	Seller enters username which doesn't exists	Display message to enter proper username	Username doesn't exist	Pass
6	Login	Seller enter wrong password	Display invalid password message	Incorrect password	Pass
7	Login	Seller enters correct details	Successful login and seller will be redirected to dashboard	Dashboard page	Pass

ID	Module	Input/Test Case	Expected Output	Actual Output	Result
8	Login	Seller checks the remember me option	Sucessfull login and credentials will be saved	Appropriate messages are displayed	Pass
9	Shipment Booking	Seller enters quantity of a particular shipment type as zero	Display error message saying quantity should at least be one	Invalid Quantity	Pass
10	Shipment Booking	Seller enters same destination and source	Display message indicating source and destination should not be same	Source and Destination cannot be same	Pass
11	Shipment Booking	Seller tries to book shipment for passed date	Notification should be made regarding the same	Date already passed!	Pass
12	Shipment Booking	Seller enters all details correctly	User will be redirected to Payment page	Payment Page	Pass
13	Tracing	Two or more shipments arrive at same time	Display shipment numbers along with the date and time	Display the shipment details	Pass
14	Tracing	Updation error in database	Display message indicating error at back end	External Source Error	Pass

ID	Module	Input/Test Case	Expected Output	Actual Output	Result
15	Tracing	RFID broken during the transit	Inform user about the problem and suggest methods to resolve the issue	Cannot trace shipment	Pass
16	Tracing	RFID scanned correctly	Seller will be able to trace shipment	Shipments details displayed	Pass
17	RFID Scanning	A broken or damaged RFID	Display error message saying RFID damaged	RFID error	Pass
18	RFID Scanning	Scanner not working properly	Display error message saying can't scan RFID	No message	Pass
19	RFID Scanning	Scanner scans RFID	Display message saying RFID scanning successful	RFID number and details	Pass
20	RFID Erasing	RFID not placed properly for erasing	Display error message RFID not placed properly	Error	Pass
21	RFID Erasing	RFID placed properly for erasing	Erase all the data stored with only RFID number remaining	Error	Pass

ID	Module	Input/Test Case	Expected Output	Actual Output	Result
22	Business Analyzer	Data from database or archived data	Calculating results and displaying	Calculated output displayed	Pass
23	Business Analyzer	Missing attributes provided as input	Display error message for missing attribute value or show nothing	Attributes missing error message	Pass

Chapter 8 RESULTS AND DISCUSSION

In this chapter, we discuss about the Results obtained from the project implemented and its discussion.

- The project guarantees a precise, hands-free implementation of a tracking/tracing system to monitor any package which is a part of a journey/transport. It solves the loss of money arising from mishandled goods in transport, which is estimated to be around 2 billion last year.
- With the help of the ”send a ticket” system, if user notices any anomaly in the path of the cargo, the user can notify the officials and appropriate measure can be taken immediately to put the cargo on track. The project can be extended to solve luggage issues in airports. It can also be used to monitor attendance by fitting sensors in doors and other entry/exit points.
- The business opportunity module suggests alternative destination, season, product type or quantity to the user depending upon his/her inputs. A list of all possible alternatives will be shown to the user based on some value he sets.
- The suggestions will be such that it gives the user more profit. This helps the users in getting a broader idea of the market while still being in business with their current system.

Chapter 9 CONCLUSION AND FUTURE WORK

This chapter speaks about the future scope of the idea presented. It tells us in what way the RFID's can be used, in which fields it could be used and in what way it could be used. The chapter concludes ny giving the benefits obtained from the project to the sellers.

As all the necessary documents and the work has been presented, the system will be surely be helpful for the sellers. We have adopted a prototype model for this project, so there will be continuous improvement of this system by taking the reviews from the sellers and by making inspections from the industry experts. This system will indeed help the sellers to trace their cargo shipments and analyze the business growth using this system. The following are the highlights of the conclusion-

- Information about Cargo location during transit is accurately available to the customers.
- The location of the shipment can be checked at all times using the order ID provided to the customers on the website.
- The data mining module of the system provides the sellers an approximate profit they will make depending on the goods they travel and the characteristics of the destination involved. It also finds new regions where the customers can sell their products based on the up to date database of goods transportation.

Future work which can be carried out on this project:

- The project can be extended and applied to airport facilities to manage their bags and lu/ggage.
- Hands free implementation can be used for checkin-checkout for employees, students, and so on. With a powerful enough sensor, even a door can act as a reader. The only drawback is that the human has to carry the RFID tag with him at all times while in the premises.
- Attendance monitoring system, Worker wage durations, detecting time of completion in races are a few other examples.

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Cargo Tracing and Business Analysis

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Abstract - Today's world is growing at a very fast rate with the help of Technology. A lot of different industries are using the latest technologies to increase their growth. Due to globalisation, these various industries are achieving business growth in no matter of time. The sellers are producing goods in one country and selling the same in other country, thus making huge profits. As huge amounts of cargo is shipped everyday by different sellers, today there is no existing system to track the cargo. Thus, to help the seller, we are proposing a Cargo Tracing and Business Analysis System. This system will help the sellers to trace their cargo by using the web portal created and also the portal will intelligently give growth rate of the seller according to the seller's profits. The system will also suggest the seller alternative destinations to send his cargo so that his profit margin increases.

Keywords- RFID (Radio Frequency Idetification), RFID scanner, RFID tag, database, cargo, GPS (Global Positioning System), J2EE (Java Enterprise Environment), EPCIS (Electronic Product Code Information Service).

I. Introduction

It is evident that Cargo industry is extremely vast. There are many shipments done everyday. The high number of shipments means a lot is subjected to handling errors and can result in a huge combined loss for the seller as well as the cargo shipment company while attempting to trace the lost cargp. RFID has proven to be a boon for hands-free application purposes and is one of the most promising, effective and feasible technology for usage at this point of time. The RFID tags will operate in Ultra High Frequency (UHF) range as it works well in dry non-metallic environment, suitable for the application. The tags are very unique in nature. These tags have been assigned a unique serial number(a Hexa-decimal valeue) which uniquely identifies the tag. The Hex number can then be converted to user-friendly unique values. By converting, we can easily assign these tags to a particular seller's container and identify it uniquely.

We will require a Database which will store the information such as destination of shipment, source, date of shipment, etc. A common portal accessible over the internet will enable the sellers to monitor the tracking details. The authorities at the ports can be informed if a shipment is found to be off-track and it can then be taken care of manually. With all these features available, the seller of the cargo also gets some additional functionalities from this system. Seller can see the business analysis with the help of this system. Analysis will include prediction of profit or loss for the shipments done on quarterly basis, half yearly or yearly basis. Moreover, the seller can also see suggestions from our system which specify alternative destination or time frame to send his goods to earn maximum profit.

The section Related Work describes about the work which is already done on RFID and it's application. It also speaks about the data mining module which we will be implementing in our system. The methodology section indicates how the system is developed and by using which technologies are used in it. It also mentions how the pins are connected in the circuit. Next comes the result part in which we have discussed about the results after successfully implementing the system. We later concluded the paper saying about the benefits the seller will get by using the system. Lastly, the Future Scope is discussed.

II. Related Work

A. RFID Tracing Application

The paper "A solution for Integrated Track and Trace in Supply Chain based on RFID GPS" [1], W. He, E. L. Tan, E. W. Lee, T. Y. Li proposed and developed a RFID based tracing application which traces the cargo shipment using GPS. A prototype is designed and developed based on proposed solution architecture for the business scenario as shown in Figure 1. They used JAVA as development language and Microsoft SQL Server 2008 Express as database.

The authors here [1] have used EPCIS standards for RFID events. Electronic Product Code Information Services (EPCIS) is a global GS1 Standard for creating and sharing visibility event data, both within and across enterprises, to enable users to gain a shared view of physical or digital objects within a relevant business context. "Objects" in the context of EPCIS typically refers to physical objects that are handled in physical steps such as products, electronics, etc. of an overall business process involving one or more organizations. The architecture proposed in the paper is shown in the Figure 2.

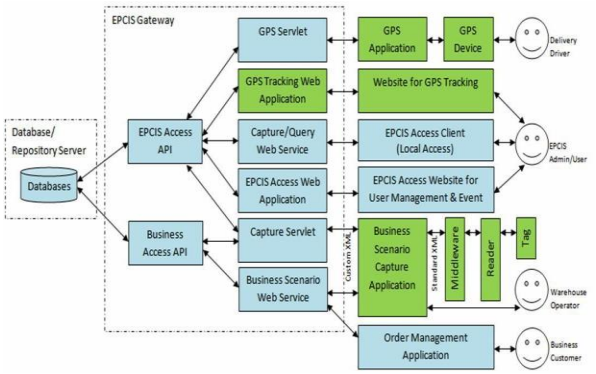

Figure 1: EPCIS solution Architecture

B. *RFID tracing using J2EE platform*

J2EE platform for the RFID Tags is discussed and conferred in Min Li, Yang Xiao [2].In this paper the author designed the system with the help of MVC (Model-View-Controller) design pattern. The SSH which stands for Struts-Spring-Hibernate framework is used by J2EE as a building platform. Mapping of objects to the database is done by Hibernate. The web part consisting of displaying functions is done with the help of Struts. The entire logic consisting of operational control of work is done with the help of Spring. The system is maintained and enhanced with the help of this framework that is the system of data control, views, business logic all the peeling, the full reduced system coupling between modules. The following are the steps proposed by the author, which helps us to understand the business process better:

Step 1. The manufacturers are sent all the retailers' details via the Web Service.
Step 2. The EPC labels are printed to all the products by the manufacturers.
Step 3. The products need to be sent from the manufacturers to the third party logistics, the EPC information was sent to EPCIS to save after the warehouse of export.
Step 4. Manufacturers send electronic delivery notice to the third party logistics via Web Services. The electronic delivery notice is then received by retailers and third party logistics.
Step 5. After the entrance of products' receipt to the warehouse, the reading and writing of the EPC information is sent to EPCIS and saved.
Step 6. The products are sent to the concerned retail enterprises with the help of third party logistics.
Step 7. The electronic delivery notices are sent to particular retail enterprises by third party logistics via Web Services. A copy of the same will be sent to retailers and manufacturers.
Step 8. Information about the products is received by retail enterprises and the EPC information is sent to EPCIS for updating and saving for future use.

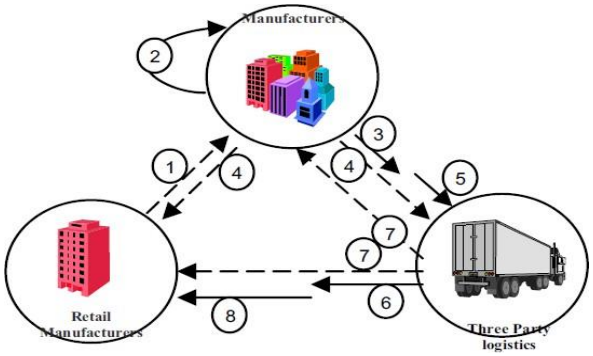

Figure 2: Business Process

C. *Data Mining Algorithm*

The authors Meraj Nabi, Abdul Wahid sescribe about the various data mining algorithms [4]. Logistic Regression, Naive Bayes, Decision Trees and Random Forest are the algorithms compared. The dataset on which these algorithms are implemented is of Diabetes. The data is divided as 70% and 30% of which 70 is for training and 30 is for testing. The results indicate that Naive Bayesian preforms well with accuracy of 76.52%. Thus we are selecting this algorithm to implement on our dataset.

III. METHODOLOGY

RFID tags are based on the AIDC(Automatic Identification and Data Collection) which is a technology of digitally encoding data into a chip capable of transmitting the stored data with the help of a small antenna.As we have both hardware and software part of the project

we have adopted two design architectures. For software part we have used Client-Server architecture and for the hardware part we have used Event-Driven Architecture. Both these architectures are shown in the diagram below.

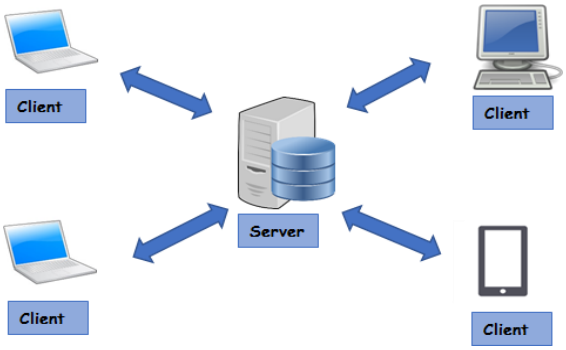

Figure 3: Client Server Architecture

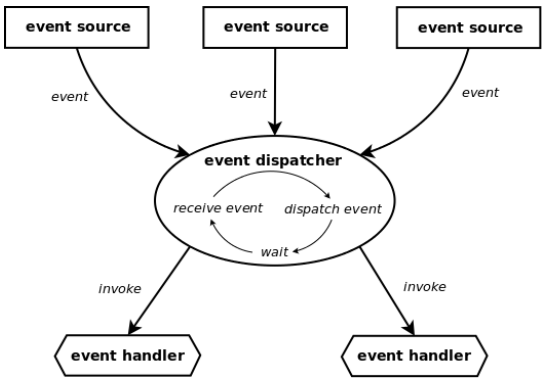

Figure 4: Event-Driven Architecture

We programmed the RC522 Scanner and uploaded code successfully using Arduino. We can also use Nodemcu 8266 for uploading the code to the scanner. A circuit which will be used on-site is shown in the following figure-

The code scans the RFID tags and transmits the unique id(Hexadecimal number) along with date and time recorded to the database using the NodeMcu Wifi Module installed. The tags will be attached to the cargo containers after security checks. The cargo information such as the owner identity, shipment details are stored in the centralized database server and the unique tag id will be associated later when the tag is attached to the shipment. The scanners will have access to the internet over which they will report the data to the database located on server. The pin connections are shown as below-

Node Mcu It is basically a SoC (System on Chip). The database is then populated with all the details of the

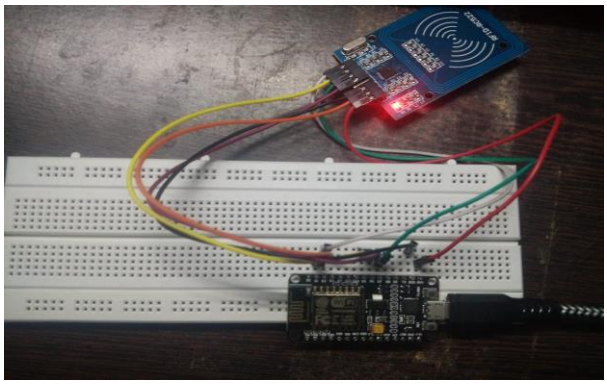

Figure 5: Circuit

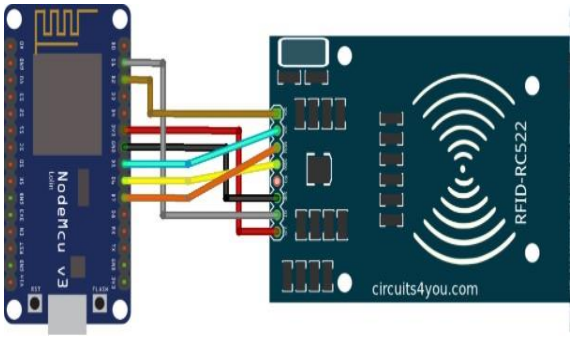

Figure 6: Pin Connections

shipment which passes through the various checkpoints. After attaching the programmed RFID tags to the cargo, it is passed through RFID Scanners. The pin connections If the specifications mentioned on the tags are not confirmed by the system, the shipment is returned to its previous stage. The tags are checked and replaced if necessary. The identification number of the tags read by the readers is already stored at the local server of Destination. In this way, the authenticity of the offloaded cargo is checked and confirmed, avoiding loss/misplacement of the shipment. At the checkout point, as the user reaches the destination, he will have to enter a unique identification number received by him. This number is checked by the reader and authenticated with the help of information already uploaded on main server at the arrival. All this can be understood graphically by the system architecture. The system architecture is as follows-

Our database consists of eight columns. But we would require five to six attributes to apply the data mining algorithms because other columns such as Weight, Date and Time are not necessary. Naive Bayesian is the algorithms used for training the dataset.[4] A model was thus built using the attributes Cargo Type, Cargo, Season,

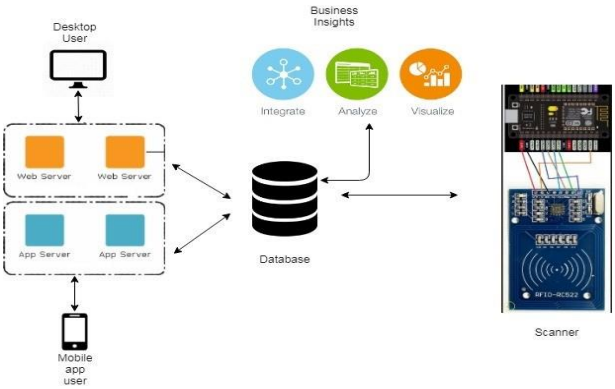

Figure 7: Architecture

Country and Region Type. All the requirements, the type of shipments made by the seller as well as the cost of shipment per cargo, the region type, the continent type and the profit percentage of which will be available to us in database. With the help of the data available with us and gaining data after the system is working we will predict the profits to the seller based on various attributes mentioned.

As seen in the architecture, sellers first will use desktop/smartphone to register on our web portal. This web portal will send the data to the database which will securely store all the information. The business logic parts of Tracing, Shipment Booking and Prediction will all be done by the server. This server will be connected to the RFID database which will update the necessary fields to indicate the tracing. So, in all the tracing part will be then sent back to the sellers dashboard along with any other request sent by the seller.

IV. Results and Discussion

We successfully built the system which helps the seller for tracing the cargo. The naive bayesian algorithm was successfully applied and the profit was predicted. The web portal will be thus used as an interface between the sellers and the whereabouts of cargo. The response time of the system is good and as expected. The system is built bug free and there are no errors whatsoever. Some of the web portal images are given.

Figure 8: Home Page of Web Portal

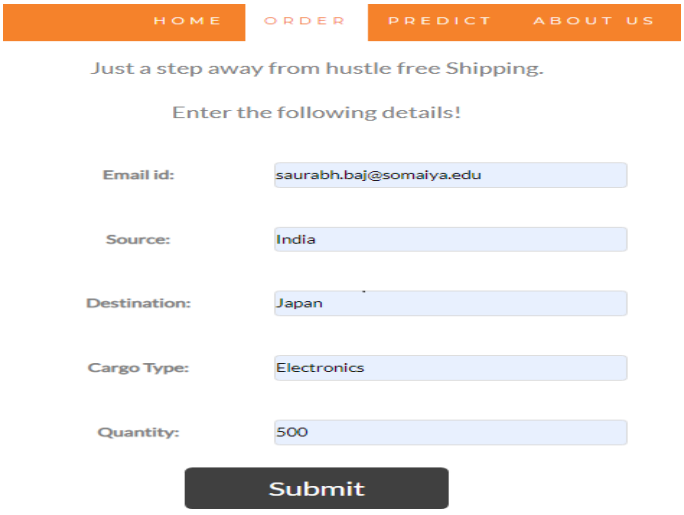

Figure 9: Order Page

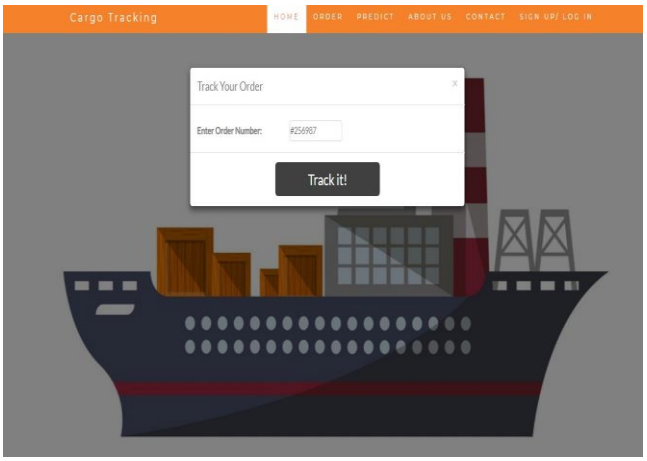

Figure 10: Tracing Page

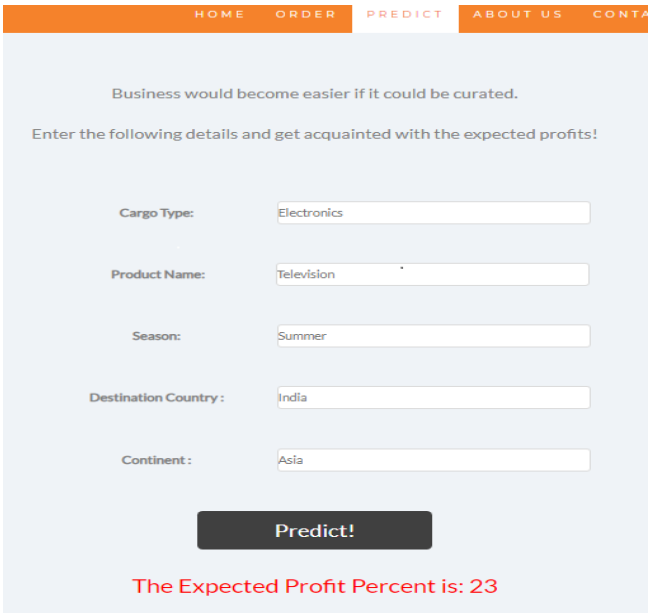

Figure 11: Profit Prediction

The entire system will surely help the sellers to trace the cargo. As the usage of this system will increase, it will slowly slowly replace the existing system with this improvised and seller friendly system.

V. Conclusion

As our system tackles the problem the sellers are facing primarily, the tracing is very accurate. Sellers can easily trace their shipments by using the order number given to them while booking the shipment. The data mining module of the system will surely help the sellers to increase their profits and also to find new regions where they can sell their products. As this is prototype system, there will be changes incorporated to it by taking the feedback of the sellers provided from web portal. The system could easily replace the existing system where Barcodes are used and no tracing is provided. The system surely benefits the sellers all over the world.

VI. Future Scope

The system successfully establishes a hands free tool to monitor the goods of transportation. The project can be extended and applied to airport facilities to manage their bags and luggage. A broader vision will be seeing this system in other applications besides tracking. This hands free technology can be perfectly used as check in-check out portals for students, workers and so on. With a powerful enough sensor, any door can act as a reader. The only drawback is the human has to hold some RFID tag with him at all times while in the premises. Attendance, Worker wage durations, detecting time of completion in races are a few other examples.

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