Cargo Tracing and Business Analysis

Prof. Kiran Kumari *, Saurabh Baj †, Niyati Daftary ‖, Jayesh Gaur §, Aditya Jawalikar ¶

* † ‖ § ¶ Department of Information Technology, K.J. Somaiya College of Engineering
Email: *kirankumarisinha@somaiya.edu, †saurabh.baj@somaiya.edu, ‖niyati.d@somaiya.edu,
§jayesh.gaur@somaiya.edu, ¶aditya.jawalikar@somaiya.edu

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.

II. Related Work

A. RFID Tracing Application

In this paper [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 of this paper [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.

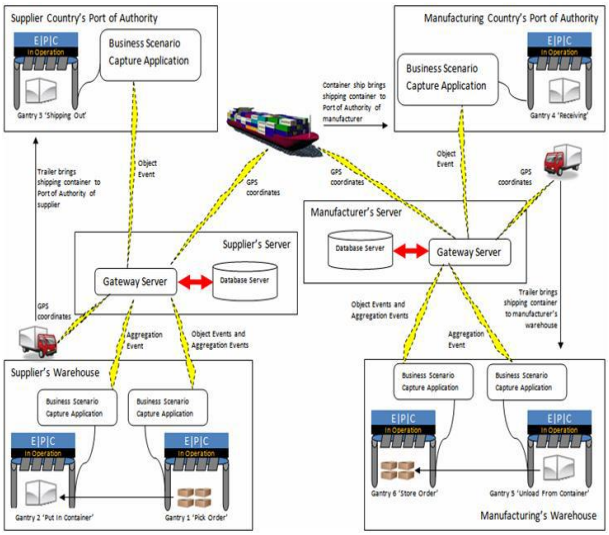

Figure 1: System Architecture

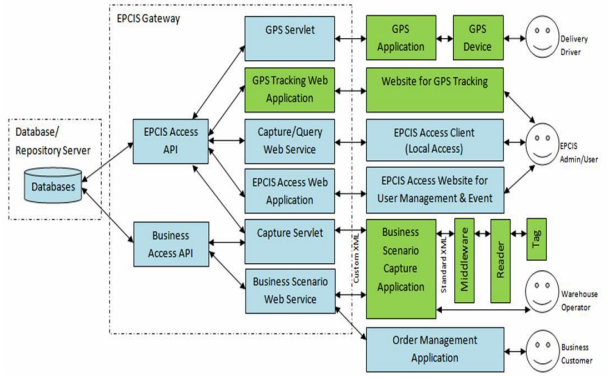

Figure 2: EPCIS solution Architecture

B. RFID tracing using J2EE platform

The technical paper written by [2], Min Li, Yang Xiao have discussed about J2EE platform for the RFID tags. The author designed the system using MVC (Model-View-Controller) design patterns in J2EE platform that uses the SSH (Struts + Spring + Hibernate) framework for building the platform. Hibernate is responsible for mapping objects to database, Struts (Web part) is responsible for displaying the functions (i.e. V work), Spring is responsible for operational control of the work (that is, C's work.) Using this framework, the system of data control, views, business logic all the peeling, the full reduced system coupling between modules, making the system maintainability greatly enhanced. Author has proposed a series of steps to make understand the business process. It is as follows-

Step 1. Retail enterprises through the WEB SERVICE send an order to the manufacturers.

Step 2. Manufacturers based on electronic product manufacturing, and order print EPC labels to every products.

Step 3. Send product manufacturer to the third party logistics, when the product after the warehouse of the export, the EPC information literacy was sent to EPCIS save for.

Step 4. Manufacturers through the WEB SERVICE to send electronic delivery notice to the third party logistics and copy to retail enterprise, the third party logistics and retailers receive electronic delivery notice.

Step 5. The third party logistics products, when product after the receipt of the entrance to the warehouse, reading and writing the EPC information was sent to EPCIS save for.

Step 6. The third party logistics send product to retail enterprises.

Step 7. The third party logistics through the WEB SERVICE to send electronic delivery notice to retail enterprises, and copy to the manufacturers, retailers and manufacturers to receive electronic delivery notice.

Step 8. Retail enterprise received products, product after the entry of the warehouse when reading and writing implement, the EPC information was sent to EPCIS for preservation.

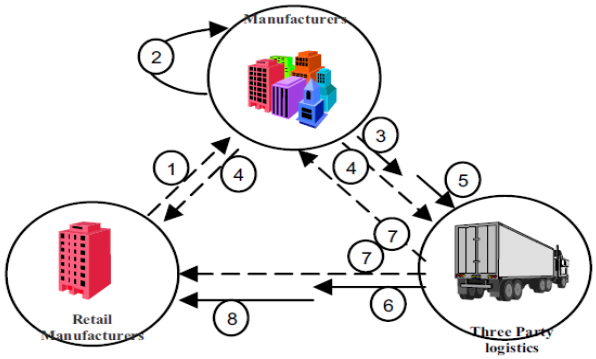

Figure 3: Business Process

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.

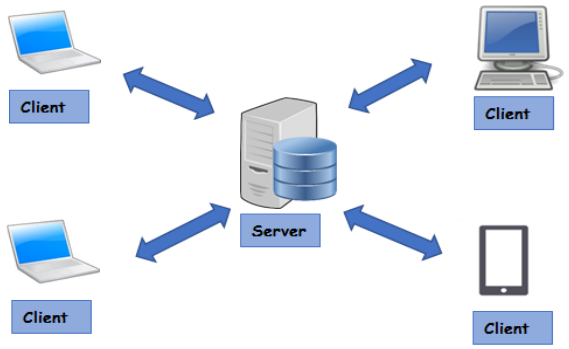

Figure 4: Client Server Architecture

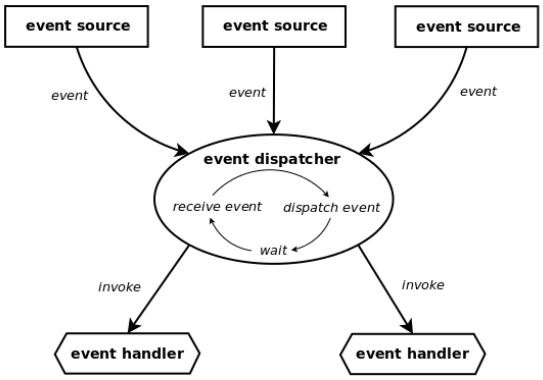

Figure 5: Event-Driven Architecture

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-

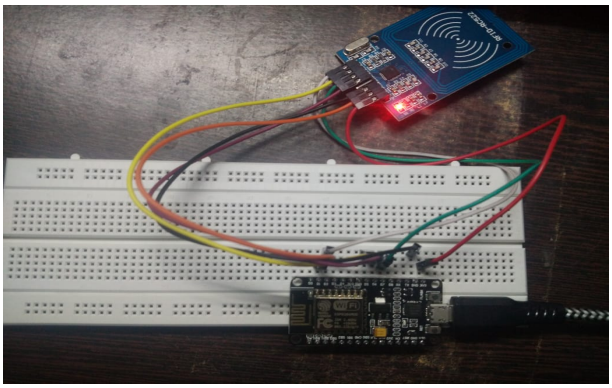

Figure 6: Circuit

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-

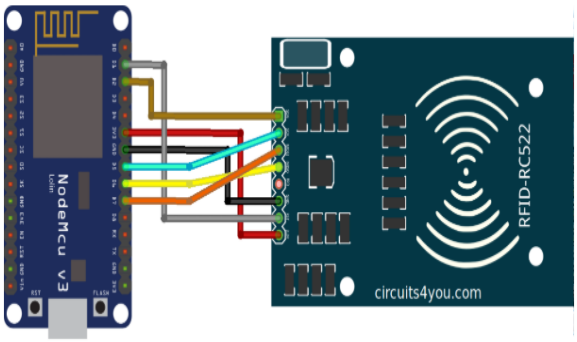

Figure 7: Pin Connections

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

As per our database we would require four to five attributes to apply the data mining algorithms. Naive Bayesian is the algorithms used for training the dataset. A model was thus built using the attributes Cargo Type, Cargo, Season, 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

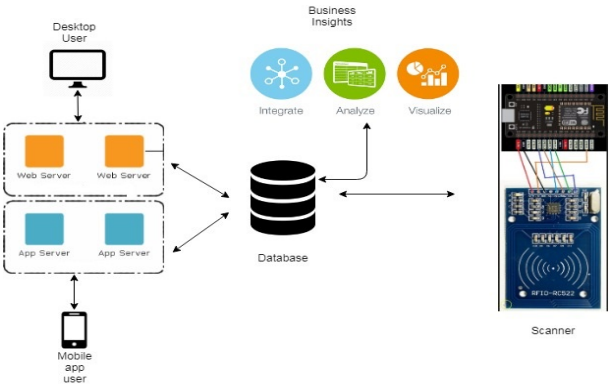

Figure 8: Architecture

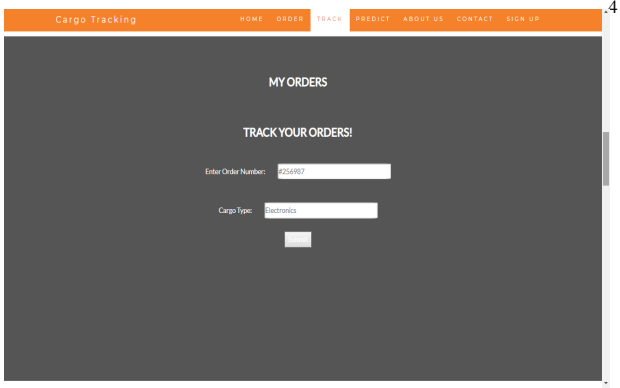

Figure 9: Tracing form

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. Naive Bayesian algorithm can be understood as per the pseudo code-

Pseudo Code:

1) Inputs
   - Dataset D and class labels.
   - The target data and sample data.
2) Output
   - Predicted output for target class.
3) Steps
   - A Tuple C belongs to a class if and only if

$$P(C(i)|X) > P(C(j)|X)$$
$$1 <= j <= m \quad j \neq i$$

   - Use Bayes Theorem as -

$$P(C|X) = P(X|C)P(C)/P(X)$$

   - Sample X is therefore assigned to class Ci if and only if -

$$P(X|C(i)).P(C(i)) > P(X|C(j)).P(C(j))$$
$$i <= j <= m \quad y \neq 1$$

IV. Result and Conclusion

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.

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. 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.

References

[1] W. He, E. L. Tan, E. W. Lee, T. Y. Li, *"A solution for Integrated Track and Trace in Supply Chain based on RFID GPS"*

[2] Abdul Hamid M. Ragab, Abdul Fatah S. Mashat, Ahmed M. Khedra, *"A comparative Analysis on Linear Regression and Support Vector Machine "*, 2016 Online International Conference on Green Technologies.

[3] Min Li, Yang Xiao, *"RFID-based Tracking and Tracing Information Platform of Logistics"*, 2014 IEEE Conference of Anthology

[4] Sklearn Sample Datasets https://scikit-learn.org/stable/modules/classes.htmlmodule-sklearn.datasets