Supply Chain Management using Internet of Things

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Abstract - *A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products and the distribution of these finished products to customers. Supply chains exist in both service and manufacturing organizations, although the complexity of the chain may vary greatly from industry to industry and firm to firm. In this project the service is provided to customers by giving specific products or materials to particular customer or user. For providing such services to the customers there are two types of techniques are used. These techniques are Internet of Things (IoT) and Radio Frequency for Identification (RFID). Internet of thing technology is used for keeping all records related of products e.g. products delivery and updating information about products such as the cost of products, delivery date of products, products name, products delivery is to be done or not.*

Key Words: IoT, Radio Frequency Identification Module, Global System for Mobile Communication, Global Positioning System.

1. INTRODUCTION

Supply chain management is basically the flow of goods and services. It includes the whole process of goods movement, storage of raw materials, in-process inventory and good's consumption from the point beginning to end. The ultimate goal of efficient supply chain management is to reduce the inventory costs for an organization. That ultimately keep track about goods' consumption and product's availability when required. Supply chain management system is most probably used in sales and marketing.A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers. Supply chains exist in both service and manufacturing organizations, although the complexity of the chain may vary greatly from industry to industry and firm to firm.

The internet of things (IoT) is a network of objects equipped with radio frequency identification chips and similar technologies so that the objects could communicate and interact with each other. IoT represents the next evolution of the Internet, taking a huge leap in its ability to gather, analyze, and distribute data that we can turn into information, knowledge, and ultimately wisdom. IoT can be viewed as Networks of Networks. In essence, IoT can be viewed as billions of connections that will encompass every aspect of our lives. The IoT allows for virtually endless opportunities and connections to take place, many of which we can't even think of or fully understand the impact of today. It's important to put IoT maturity into perspective because of the fast pace at which it is emerging, so supply chain strategists need to be looking at its potential now.

There are three modules which are supplier, container and distributor. Supplier is used to supply the various types of products to customers or users with the help of container and distributor unit. Synchronization between supplier and distributor is performed with the help of Internet of things (IoT). Container is used for carrying products to the distributor. It is consisting of PIC18F4520 Microcontroller, Keypad, LCD, Global Positioning System (GPS), Motor driver IC, Global System for Mobile Communication (GSM) and Relay. Global Positioning System (GPS) is used for monitoring the location of container where it is and sending this information to the supplier for updating. When container reaches to supplier, supplier can access these products using password. Password is used for authentication purpose and known as Order Number (OrdNmbr). OrdNmbr will be generated by supplier and forwarded to distributor through IoT. Keypad is provided with product container to enter OrdNmbr. After matching OrdNmbr door of container will automatically open. The open and close mechanism of door is controlled by relay. The identification tag i.e. RFID is provided with every product for identification. The message of product delivery will be send to distributor regarding delivery of product as acknowledgement from distributor to supplier through GSM. The message regarding product received by supplier will be forwarded to customer through GSM.

The information of products or materials will be updated automatically through the internet so that supplier and distributor can use this information at any time for keeping the records. In today's world, all the systems operate on internet as processing of systems is becoming a faster and secure. Supply chain management using IoT satisfies the supplier and distributor requirements. Hence, to provide secure and fast delivery of products to supplier and distributor using IoT a new idea is proposed in this project. The objectives of Supply Chain Management using IoT are given below:

- To satisfy the customers' requirements.
- To increase sale of products.
- To provide better service to customers.
- To enhance visibility of product delivery along with the supply chain.

2. LITURTURE SURVEY

Supply chain Management has assumed a significant role in firm's performance and has attracted serious research attention over the last few years. A literature review reveals a considerable spurt in research in theory and practice of *Supply Chain Management (SCM)*. Combining and informing on features of Supply Management and distribution Management. This integration has resulted in the concept of extended enterprise and the supply chain is now manifest as the collaborative supply chain across intercompany borders to maximize the value across the entire supply chain. A literature classification scheme is proposed. This literature review finds that exploratory type of research is mostly preferred it is expected that with the maturity of *Supply Chain Management (SCM)* the hypothesis testing method will pick up.

2.1 RFID – The Best Technology in Supply Chain Management [1]
During the last decade, most organizations have implemented enterprise-wide applications and integration platforms. These implementations have delivered benefits in terms of data synchronization and information flows within the organization, and with trading partners providing valuable inputs for planning and optimization of schedules and reporting. However, automated data capture and tracking in real-time has been a major bottleneck, affecting the ability of organizations to optimize their investments in supply chain solutions. The best example of IoT is S-Parking system [1]-[2].

2.2 The role of RFID in the supply-chain: an educational case study [3]
In today's global economy, quality management of the supply-chain is a critical factor for achieving a competitive advantage for the supply-chain partners and maximizing value for the customer. *Radio Frequency for Identification (RFID)* is a proven technology that allows efficient tracking of products and their locations as they move through the supply-chain. This paper presents an educational case study that can be used in an undergraduate or graduate level supply-chain management course that addresses the role of *Radio Frequency for Identification (RFID)* in the supply-chain and the effect of *Radio Frequency for Identification (RFID)* on supply-chain quality management.

2.3 Supply Chain Management Using Cloud Based RFID Technique [4]

Cloud based **Radio frequency identification technology (RFID)** is becoming a popular area of research these days. However, no any research is there where cloud computing goes hand in hand with Radio frequency identification technology (RFID) uses. In this paper Radio frequency identification technology (RFID) is used as an important technique in cloud based supply chain management system. Main aim here is to find less expensive passive Radio frequency identification technology (RFID) in supply chain management using cloud based software infrastructure. This paper explains basic principles of Radio frequency identification technology (RFID), basics of supply chain management and cloud based supply chain management. It tries to reduce the cost of supply chain management businesses using Radio frequency identification technology (RFID) and cloud based platform.

2.4 Enhancing Supply Chain Management Using RF [4]
This paper focuses on the method with the help of which the information about the product in the organization can be accessed electronically using radio frequency identification **Radio frequency identification technology** (**RFID**) technology. The proposed Radio frequency identification technology (RFID) system uses tags which are embedded in the product through which info embedded on the tags are read by Radio frequency identification technology (RFID) readers. Data information is easily exchanged between product and the manufacturer. In the proposed system the cloud computing is attached to the Radio frequency identification technology (RFID) architecture to handle scalable Radio frequency identification technology (RFID) system.

3. PROPOSED SUPPLY CHAIN MANAGEMENT SYSTEM

The detail description of block diagram and working is given for proposed Supply Chain Management using IoT.

3.1 Block Diagram

Block diagram of this project consists of three units as shown in Fig -1, Fig -2 and Fig -3 which consist of:
- Supplier unit
- Container unit
- Distributor unit

Supplier Unit-
Supplier unit consist three parts like RFID module, MAX232 and database in computer. RFID tag is connected to all products and product is identified by reading RFID tag number with the help of RF module. All records like product ID (tag number), and information regarding delivery to distributor (like timing and date of dispatch and delivery) is stored in database. The database is updated using Google-Spreadsheet. Synchronization
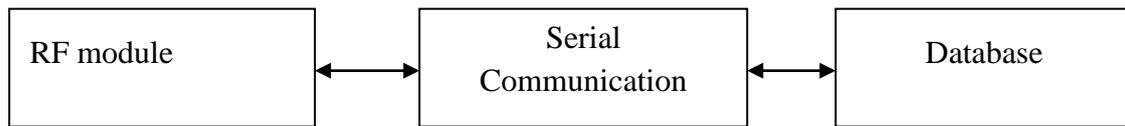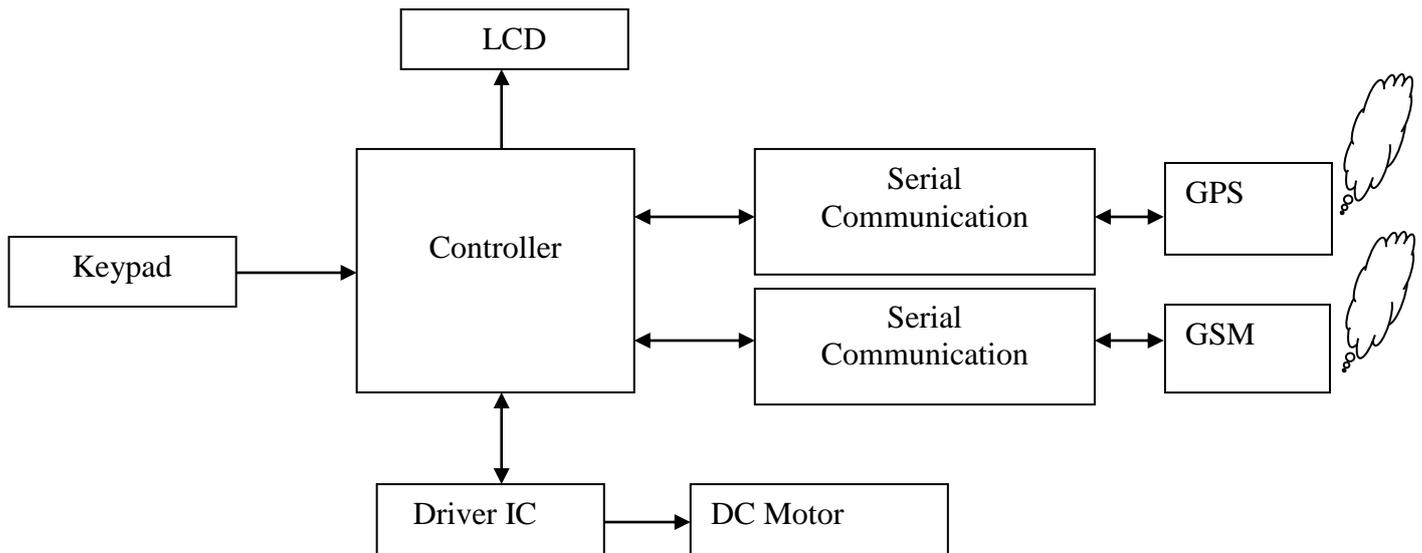
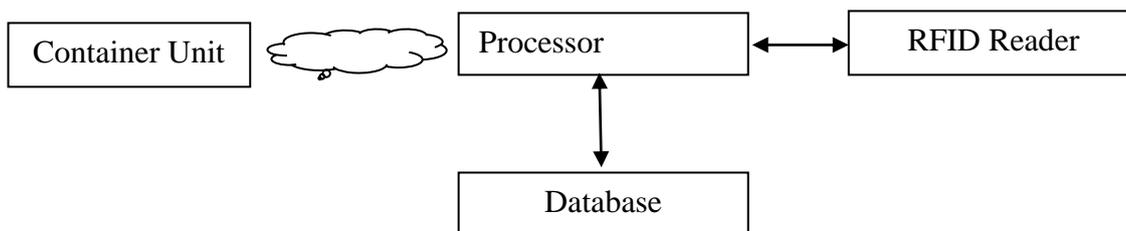**Fig -1**: Supplier Unit

Fig -2: Container unit

Fig -3: Distributor Unit

between supplier and distributor is performed with the help of ***Internet of things (IOT).*** It is just like Google or cloud computing.

Container Unit-

Container unit contains components which are Microcontroller, Global System for Mobile (GSM) communication, Global Positioning System (GPS), LCD, Keypad, Motor driver Integrated Circuits (ICs) and Motor. Keypad is used to enter the password given by supplier to distributor using. By entering correct password the container door is open otherwise display incorrect password on LCD. Motor driver IC is used for driving the motor in clockwise and anticlockwise direction to open container door. The position of container is monitored

using GPS. This location tracking message is send to the supplier as well as distributor through the GSM.

Distributor Unit-

Distributor unit consist of Processor, RFID Reader and Database. The information of product available in container is verified using processor. This information of product regarding delivery is updated on Google-Spreadsheet and forwarded to supplier. The procedure is given in detail as below.

- Create random password send to the distributer.
- Confirm the password which is entered by distributor and sent by constrainer and Keep record of delivery.
- If doesn't match send alert NO MATCH wrong distributor.

4. FLOWCHART

The flowcharts of the proposed Supply Chain Management system for supplier, container and distributor unit ate shown in Fig -4, Fig -5 and Fig -6 respectively.
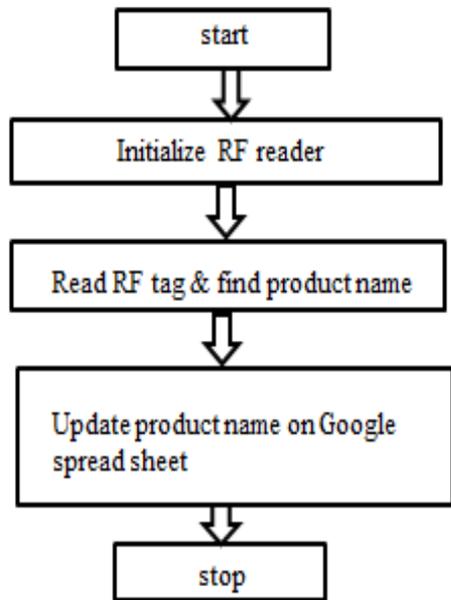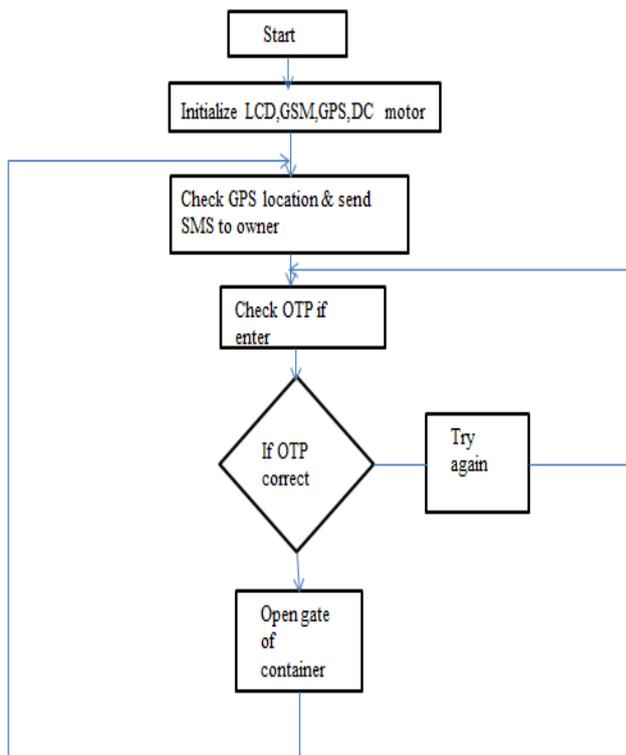

Fig -4: Flowchart of supplier

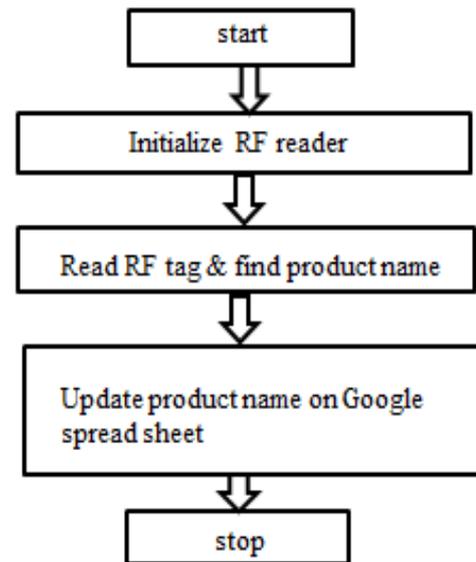**Fig -5:** Flowchart of container

Fig -6: Flowchart of distributor

5. RESULTS AND DISCUSSION

The results of three units are discussed in detail as follow.

5.2.1 Supplier hardware unit

The supplier hardware unit is shown in Fig -7. In this unit, RFID reader is used to read the RF tag which is connected to product under delivery and each device has a unique tag ID. This tag information is uploaded in the GOOGLE spread sheet through the internet and for this python software is used. For example the RF tag of mobile is "450041890984".

5.2.2 Container hardware unit

The container hardware unit is shown in Fig -8. Keypad is used to enter the password. By entering correct password the container door is open otherwise display incorrect password on LCD. GPS is used to monitor the position of container and track the location. This location tracking message is send to the supplier as well as distributor through the GSM. Motor driver IC is used for driving the motor in clockwise and anticlockwise direction.

5.2.3 Distributor hardware unit

The distributor hardware unit is shown in Fig -9. In distributor unit Raspberry pi is used. This is the wireless unit, by using the putty and VNC viewer software the one fixed device IP address is set. Through the IP address the synchronized communication is performed between supplier and distributor.
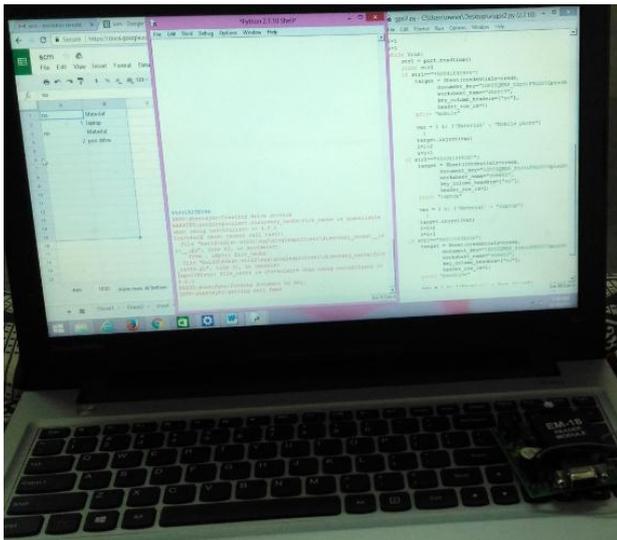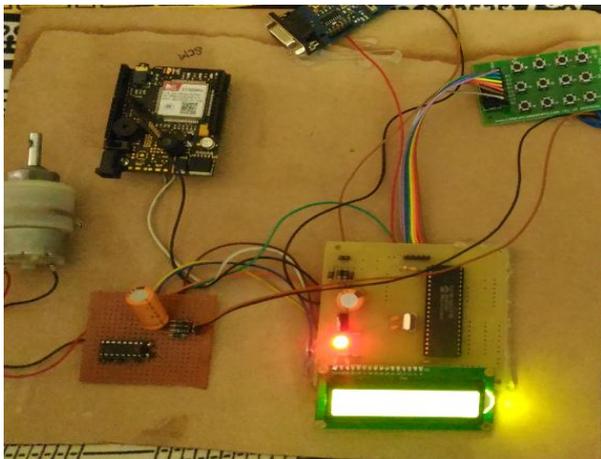
Fig -7: Supplier hardware unit

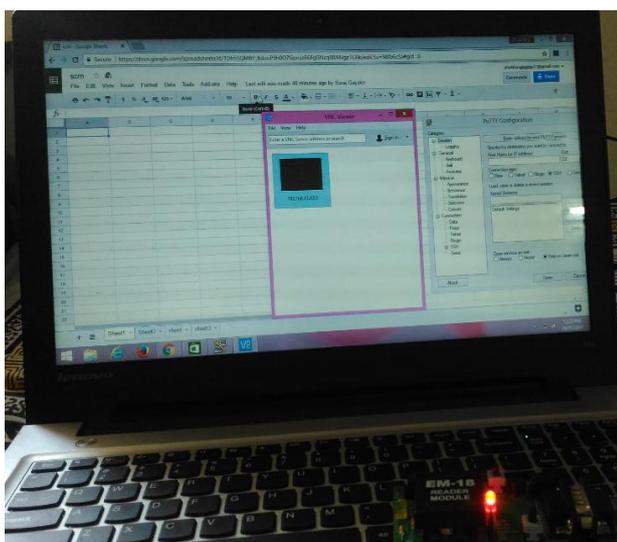**Fig -8:** Container hardware unit

Fig -9: Distributor hardware unit

6. CONCLUSIONS

RFID technology and the impact on the supply chain can be significant, from the combination and execution to the profit and challenges that faces today. There is no doubt that companies can grow with the use of the technology and its contribution to the next era in supply management. The challenges and issues can be overcome, if more growth is completed within the technology. One object is sure after implementation of the Supply Chain Management using IoT is to stay and the effect it had on the supply chain will contribute to our future economy. This work can be extended to send message to the particular customer by giving the knowledge about corresponding products or materials which have sent from supplier unit with the help of GSM module which is to be used in the distributed unit.

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