Smart Inventory Management System using Weighting Scales

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Abstract— Inventory is a batch of physical goods in large quantities which are stored by companies for efficient supply of goods to end users. Based on a preliminary survey with companies which store and sell products use technologies such as RFID and manual human intervention. We came across the lack of shelf-level item tracking, real time tracking in addition to cost effectiveness. In this paper, we have implemented a new approach for easier inventory management. The paper discusses about shelf-level inventory tracking system for products by using weighing scales. It allows the user to access the inventory details in real time along with essential notifications. The inventory can also be tracked from anywhere via the internet.

Key words: Inventory, Real-Time Tracking, Shelf-Level Item Tracking, Inventory Management System, Cost-Effective, Weighing Scale

I. INTRODUCTION

In businesses, most of the functions are interlaced and connected to each other with key aspects like supply chain management, logistics and inventory management forming the backbone of the business delivery system. Inventory management helps company determine the health of the supply chain as well as impact the financial well-being of the organization. Every organization therefore constantly tries to maintain optimal inventory curbing on the wastage due to their traditional policies at service level such as tracking of inventory by humans. Inventory is always dynamic and requires constant, watchful assessment of external and internal factors and control through planning and review.

II. INVENTORY MANAGEMENT

A. Defining Inventory

Inventory [1] is an idle stock of physical goods that contain economic value, and are held in various forms by an organization in its custody awaiting packing, processing, transformation, use or sale in a future point of time. Any organization which is into production, trading, sale and service of a product will hold stock of various physical resources to aid in future consumption and sale.

B. Different types of Inventory

According to Management study guide (MSG) team, [2] Inventory of materials occurs at various stages and departments of an organization. An organization holding inventory of raw materials and consumables [3] required for production also holds inventory of semi-finished goods at various stages in the plant with various departments. Both the raw materials and finished goods, [4] those that are in transit, form a part of inventory depending upon who owns the inventory at that particular juncture. Finished goods inventory is held by the organization at various stocking points or with dealers until it reaches the market and end customers. In the paper, we discuss the system implemented to manage the inventory with the organization, shortly before it reaches to customers

C. Inventory Management

Inventory management [2] is a science predominantly about specifying the shape and percentage of stocked goods required at different locations within a facility or within many locations of a supply network to precede the regular and planned course of production and stock of materials involving activities such as maintaining the optimum amount of each inventory item. In this paper, we are trying to achieve this using weighting scales. The objective of inventory management is to keep a track of the stock-out, uninterrupted production, sales, managing the prices to prevent hoarding during time of disaster. For many companies' inventory is the largest item in the current assets category, inventory problems can and do contribute to losses or even business failures and that is why waste reduction is of utmost importance and hence, we are trying to minimise it with our system

III. LITERATURE REVIEW

A. The Pros and Cons of RFID in Supply Chain Management

In the paper by Michael, K, & McCathie. L [5] they highlight key problems of existing technologies such as RFID

- While RFID has a greater number of benefits than its predecessor, the bar code, it currently comes at a price that many businesses still consider prohibitive
- RFID is presently a costly solution, lacking standardization, it has a small number of suppliers developing end-to-end solutions, suffers from some adverse deployment issues
- An Accenture survey found cost to be one of the two primary barriers to the implementation of RFID Reports on the current cost of RFID tags vary.
- However, they all find common ground in noting that the current cost of tags is too high to justify tagging all items. This is why most companies mandating the use of RFID are focusing on tagging pallets and cases, as opposed to item-level tracking, which is years away

This [5] paper gave us insight regarding the lack of item-level shelf tracking, which we have implemented in this paper. Further, the paper helped us understand the need for cost effectiveness along with improving the economic benefit of the system.

B. Adaptive inventory management using RFID data

In the paper by C. Saygin[6] we see a comparative study of RFID usage[7] companies and how they try to establish efficiency. The paper helped us to understand the cost constraint and its overall impact. It also helped us understand the need for item-level shelf tracking of each product in a shelf

– Limitations include the inaccuracies of product identification throughout the product life cycle, the daunting and difficult task of actually tracking the product, and uniquely identifying each part rather than product type

The emphasis of the research is directed towards improvement of processes directly related to product handling, storage and exchange; including product reorder, product receipt and put-away, product recount, replenishment, and reverse logistics

IV. SYSTEM OVERVIEW

A. *Basic Working*

The prototype is a proof of concept of using a weighing scale for tracking the number of products. It is done by calculating the number of products on a shelf using the total weight on the weighing scale and the known weight of each product. The product in the inventory is first placed on the scale, the microcontroller then initializes itself, thereafter simultaneously calibrating it. The product is placed on the weighing scale made using a load cell. The load cell consists of strain gauges in a balanced Wheatstone's bridge configuration. The weight applied on the load cell generates strain in the gauges and the Wheatstone's network is disturbed. The strain generated is directly proportional to the load applied. The change in the load cell network is given as analog signal to the differential inputs of HX711, where it is amplified and converted to digital data via 24-bit Analog to Digital Converter. This digital data is sent in serial form using I2C protocol to microcontroller. The microcontroller calculates the weight of product on shelf in grams and sends the weight on each scale via USB to the Smart Inventory Management System (SIMs) software on a computer. The entire database is updated to a cloud server in real time which allows remote access via internet.

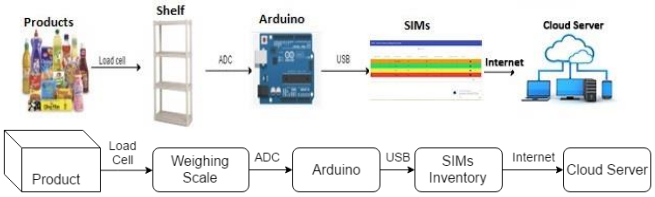

Fig. 1: Block diagram of Inventory Management System

B. *Algorithm*

Each weighing scale would be installed in a uniquely numbered shelf and rack which contains specific product. As the weight of all products on the shelf is same, the total weight on the scale can be used to calculate the total number of products currently present on the shelf. The functioning of the system is as follows:

– Step 01: Start the SIMs software and select the COM port
– Step 02: Give product information (Shelf Number, Rack Number, Product ID, Product Name, Maximum Products and Product Weight) to SIMs application.
– Step 03: Add products to the respective shelf
– Step 04: Strain is induced in the load cell which generates a differential analog voltage at the two terminals of the strain gauge
– Step 05: Analog data obtained from Step 04 is amplified and converted to digital data using HX711
– Step 06: Data obtained from step 05 is further processed using Arduino UNO to calculate the weight in grams and is sent to SIMs software serially via USB port
– Step 07: SIM system is so designed that using the data from step 06 and step 02 it calculates the exact number of products present on shelf and displays it on the screen.
– Step 08: The entire inventory database is synchronized with a cloud server which is used to access the SIMs software from anywhere via the internet.
– Step 09: If number of products are less than the set threshold then SIMs notifies and sends an email to the user.
– Step 10: Step 02 to step 08 are repeated.

V. RESULTS AND ADVANTAGES

A. *Results*

The purpose of the SIMs application is to be able to get information by shelf-level item in real time which is tractable. Other than this, the system developed is economical compared to the existing process such as RFID by a significant amount. Different parameters have been set for the system, based on which real time notifications are sent to the end-users. There is even an out of stock alert that is sent as a message to the end-users when the stock is less than 15% of the maximum products specified on a given shelf. The notifications and real time updates of the inventory is easily accessible from any of the devices that can be connected to the internet. The system as a whole is cost effective, fair and reliable that saves the need for having manual human intervention.

B. *Advantages*

Advantages of the system developed are shelf-level item tracking to monitor each item in a shelf. The use of 24-bit ADC helps to increase sensitivity of the system and eliminates the need of manual human intervention. The developed inventory management system is cost effective compared to existing technology such as RFID by a considerable amount. The system uses load cell which helps to increase accuracy of tracking each item accurately along with the ability to alert with notifications via email in case of stock-out or 15% maximum shelf specified item limit. Products can be added, deleted, searched and sorted as per convenience and capability of real time status of the inventory accessible via internet.

VI. CONCLUSIONS

By means of this project we implemented shelf-level item tracking in real time with cost effectiveness. This system introduces a new way of managing the inventory system by using weighing scales. Parameters such as real time status of inventory are continuously displayed and can be accessed from anywhere via internet. This will take the overall inventory management to a different level. All the important parameters required for active monitoring like product name, products ID, product weight, number of products, shelf and rack number are continuously display. The prototype model developed successfully satisfied the objectives. The system developed is highly reliable, fair and cost effective also saves

time and manpower of the company. It is reliable and fair because all the shelves are actively monitored throughout the day and notification is sent immediately in case the levels drop below the defined threshold. The system is cost effective as it reduces the manpower needed to a large extent and also provides remote access via the internet. The project successfully demonstrated the possibility of using weighing scales for tracking products in real time. It automatically calculates the number of products on a shelf and also provides remote access along with notifications for low level of inventory.

VII. FUTURE SCOPE

The future implications of the proposed system are very promising considering the amount of time and resources that it saves. The system can be upgraded to include thin application specific pressure pads to replace the weighing scales. Adding Text message alerts in addition to the email notifications will further ease the access to inventory information. The current system can also be bundled with the billing system to verify the products depleting from the shelves and being paid for at the billing counters. This would effectively monitor shop lifting activities. Adding secure login facilities for the website so only authorized people have access to the information. Using Artificial Intelligence, the requirement of products can be predicted as per the time of the year and an order can be sent to the manufacturers automatically.

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