DESIGN AND DEVELOPMENT
OF
WAREHOUSE MANAGEMENT SYSTEM

The Project submitted to

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Bachelor of Engineering

In

Information Technology

Guided by

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Submitted by

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2022- 2023

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SHRI SANT GAJANAN MAHARAJ COLLEGE OF ENGINEERING, SHEGAON

2022-2023

CERTIFICATE

This is to certify that **Mr. Shreyas Gawande, Mr. Prathmesh Akotkar, Ms. Rutuja Ingole, Ms. Ruchita Agrawal** students of final year B.E. (Information Technology) in the year 2022-2023 of the Information Technology Department of this institute have completed the project work entitled "**Design And Development of Warehouse Management System**" based on syllabus and has submitted a satisfactory account of his/her work in this report which is recommended for the partial fulfilment of the degree of Bachelor of Engineering in Information Technology.

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CERTIFICATE

This is to certify that the project work entitled "**Design And Development of Warehouse Management System**" submitted by **Mr. Shreyas Gawande, Mr. Prathmesh Akotkar, Ms. Rutuja Ingole, Ms. Ruchita Agrawal** students of final year B.E. (Information Technology) in the year 2022-2023 of the Information Technology Department of this institute, is a satisfactory account of his work based on the syllabus which is approved for the award of the degree of Bachelor of Engineering in Information Technology.

Internal Examiner

Date:

External Examiner

Date:

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ABSTRACT

In warehouse control, modern companies and distribution centers are overflowing with information about transporting and storing goods and services. The Warehouse Management System is a warehouse database that can work on small inventories of an organization or group. It is used to keep track of the products sold in a single store or to control the distribution of goods between several different stores. But the system only collects and stores sales data and provides low reports in a particular area at a particular time. The aim is not to control all load changes but to facilitate mind maintenance. The purpose is to reduce the pressure of monitoring rather than handling all hold renovation. The goal is to lessen the strain of monitoring instead of managing all keep maintenance. The aim of this project is to expand computer software programs on the way to allow the user to store and manipulate their statistics effectively and successfully. A WMS target is to help ensure that goods and materials circulate via warehouses in the greenest and most cost-powerful way. In warehouse management, modern companies and distribution center are overflowing with information about the transportation and storage of goods and services. Warehouse Management systems (WMS) are often used and fulfil these goals. Current work examines the program as a useful tool for finding and using a WMS. In addition, a research methodology is provided to guide upcoming research on WMS and logistics information (LIS) in general. Meanwhile, inventory management is, in general, the study of determining the structure and location of items in stock. It goes beyond the normal and deliberate manufacture and packaging of goods at different locations on the ground or at different locations in the community. It contributes to Warehouse as we see the latest technology evolve in the field. These studies may be extended from time to time to determine the correct and best practice of WMS at any given time.

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1. INTRODUCTION

1.1 Preface

A warehouse is a commercial space vital in the supply chain that is used to store finished goods and raw materials and is widely used in industries such as manufacturing and distribution. Warehouses are also synonymous with distribution centers, where products can be redistributed to retailers, wholesalers, or directly to a consumer. A warehouse management system (WMS) consists of software and processes that allow organizations to control and administer warehouse operations from the time goods or materials enter a warehouse until they move out. Warehouse management software comes in a variety of types and implementation methods, and the type typically depends on the size and nature of the organization. They can be standalone systems or modules in a larger supply chain execution suite.

WMSes can also vary widely in complexity. Some small organizations may use a simple series of hard copy documents or spreadsheet files, but most larger organizations from small to medium-sized businesses (SMBs) to enterprise companies use complex WMS software. Some WMS setups are designed specifically for the size of the organization, and many vendors have versions of WMS products that can scale to different organizational sizes. Some organizations build their own WMS from scratch, but it's more common to implement a WMS from an established vendor.[13]

Warehouses play an important role in any shipping process. The key elements required for warehouses to gain value and efficiency in the supply chain offer some reflection on current and future tensions. What is clear is that the constant changes and changes/challenges in areas such as reverse logistics, environmental security, information technology, and sharing the entire chain together are changing the ideas, roles, and responsibilities of the home. In fact, the term "distribution center (DC)" may be appropriate to represent the many activities in a modern warehouse that go beyond meeting custom needs to provide value-added services. The Inventory Management Widget is a real-time inventory management tool for businesses.

Warehouses sit at the center of producing, manufacturing, and supply chain operations because they keep all the materials used or produced in the one's approaches, from raw materials to completed items. A WMS handles many functions that permit these actions, along with stock tracking, selecting, receiving, and setting away. A computerized warehouse management system simplifies everything from inputting facts to taking inventory. The most effective warehouse system products raise your operating performance, main to extra productiveness It ensures smooth manufacturing operations by using preserving reasonable stocks of substances. It allows normal and timely delivery to customers thru good enough shares of completed products.[11]

The principle purpose of the challenge is to extensively range warehouse management device model software program applications wherein all of the facts regarding the warehouse of the corporation can be furnished. This software provides stability of the warehouse for stable data. Each new stock is created and named with the stock's receipt date and it can be updated at any time as needed based on business or income.

The project warehouse management system is a complete computer application developed in Python on the Tkinter framework based on the Turtle library. Use of code visual studio in addition to working with code. This project works with the DB browser and SQLite3. The widget only collects and adds sales data and provides low-stock notifications in a specific area in C language. The goal is to focus attention, to solve all the store's problems. Allocation Warehouse Control System is a complete computer application developed in Python time using the Tkinter framework of Pycharm Community Edition.

1.2 Statement of the problem

The Warehouse Management System is a real-time warehouse database capable of handling large inventories of an organization. This can be used to track the inventory of a single store or to manage the distribution of stock between several stores of a larger franchise. However, the system merely records sales and restocking data and provides notification of low stock at any location at a specified interval. The goal is to reduce the strain of tracking rather than handle all store maintenance.[3]

After analyzing many existing WMS, have now the obvious vision of the project to be developed. Before starting to build the application, the team had many challenges. The defined problem statement is as:

- To make desktop-based applications of WMS for small organizations.
- To make the system easily managed and can be secured.
- To cover all the areas of IMS like purchase details, sales details, and stock management.

This desktop application is based on the management of the stock of an organization. The application contains a general organization profile, sales details, Purchase details, and the remaining stock that is presented in the organization. There is a provision for updating the warehouse also. This application also provides the remaining balance of the stock as well as the details of the balance of the transaction.

Each new stock is created and entitled with the name and the entry date of that stock and it can also be updated any time when required as per the transaction or the sales is returned in case. Here the login page is created in order to protect the management of the stock of the organization to prevent it from the threads and misuse of the warehouse.

1.3 Objectives of Project

Warehousing is an important aspect of businesses that are dedicated to the place for storing goods and materials efficiently. Organizations invest in warehouse management systems that are related to importing, exporting, transporting, and manufacturing goods. The purpose of warehouses is to coordinate the necessary activities for optimal functionality of the operations. The objective of this project is to develop a Desktop Based application for a "Warehouse Management System" in order to solve the problems encountered in their current system of running and managing the business. [5]

- Warehouse Management System is directed toward owners of small to large stores and stock managers who are responsible for maintaining sufficient goods on hand in a retail or manufacturing business.
- It can scale from a single computer running both client and server software up to multiple stores and warehouses.
- The system is also capable of tracking In & Out transactions of single or multiple stores as well as also generates their billing details.
- The system generates monthly reports of sales from which a manager of a respective store would be able to know the monthly sales transaction is done. The Warehouse Management system is a Desktop application.
- To develop an application that deals with the day-to-day requirement of any production organization.
- To develop easy management of the warehouse. To handle the warehouse details like sales details, purchase details, and balance stock details.
- To provide a competitive advantage to the organization. To provide details information about the stock balance.
- To make the stock manageable and simplify the use of inventory in the organization.

1.4 Scope and Limitations of the Project

The scope of WMS functionality is extremely comprehensive, ranging from receipts and location management to picking, packing, and shipping of orders and everything in between, including inventory management.

It is software that manages all day-to-day operations within a warehouse and acts as the foundation for any other technology systems a warehouse might implement. "Warehouse Management System" (WMS) is targeted at a small or medium organization that does have many Warehouses, for those organization that has single power of authority.

Some of the Scope are:

- Only one person is responsible for assigning the details or records.
- It is security driven.
- The warehouse can be added as per the requirement.
- Stock is easily Managed.

Limitations:

- Many processes are integrated into a system - an error in one place entails errors in others.
- Risk of choosing incorrect parameters before use.
- Granting unsuitable levels of authorization to employees within the system.
- Potentially unsuccessful implementation: Like every investment, also these entail a certain risk. To avoid unsuccessful implementation, it is important to make a detailed analysis of your needs, choose a competent software house, consult your project with your employees in terms of how the application should look, as well as commit time to properly train your staff on how to use the application. Working with our clients, paying attention to each of these elements so that you get a guarantee of the success of the project.

1.5 Organization of the Project

The project is organized as follows:

- Chapter 1 gives an Introduction to the project.
- Chapter 2 gives Literature survey of the project.
- Chapter 3 provides an analysis of the project.
- Chapter 4 provides the design phase of the project.
- Chapter 5 provides how the project is implemented.
- Chapter 6 gives a conclusion with the future scope of the project.

2. LITERATURE SURVEY

2.1 Literature search and selection strategy:

To conduct the literature search and selection methodology systematically and transparently, follow the guidelines presented by Durach et al. [19]. The sample is generated through the following steps:

Step 1: Define the research scope.
According to the topic, research on integration decisions and optimization of smart warehouses is reviewed in this research. Based on the previous research, the research scope could be refined.

Step 2: Determine the required characteristics for primary studies.
Based on Step 1, the inclusion and exclusion criteria should be established to determine if an article is relevant to the review:

(1) Research related to warehouse operations management can be included.

(2) Research related to warehouse operations management can be included. Research focusing on supply chain management, inventory management, and warehouse location should be included.

(3) Research topics that are not relevant to the logistics section (e.g., data warehouse and knowledge warehouse) should be excluded.

(4) Research in English with a publication date from January 2015 to December 2020 can be retained.

(5) Research published in high-impact journals that meet all the following criteria can be included to ensure focus on the research topic:

- The journals should be peer-reviewed.
- The journals should be cited by the Science Citation Index Expanded (SCIE) or Social Sciences Citation Index (SSCI) database.
- According to the 2019 Journal Citation Reports (JCR), the journals should rank in the first quartile in the related JCR category.

(6) The research with a document type of article or review can be included.

Step 3: Retrieve samples of potentially relevant literature.
Web of Science Core Collection is used as the database in this review. Use the initial keywords set gathered from the topics of previous literature reviews as the starter of the search. The papers in the initial search results are analyzed and some keywords are extracted from the initial search result to refine the keywords list.

Step 4: Select pertinent literature.
In this step, the inclusion and exclusion criteria listed in Step 2 are applied. Relevant literature is selected and classified according to the review framework. In this way, many publications were selected.

Step 5: Synthesize literature.
Literature is synthesized and examined in the following sections.

2.2 Literature search:

Warehousing takes up between 2% and 5% of the fee of income of a business enterprise and with nowadays tremendously competitive international commercial enterprise environment organizations are emphasizing going back on assets, and hence minimizing warehousing expenses has grown to be vital business trouble. Many firms are automating their basic warehousing functions to gain the increase in throughput fees or stock turns required for their warehousing operations to be value-effective. It is far necessary to allocate warehouse sources successfully and efficiently to beautify productivity and decrease the operational costs of the warehouse. One vital region determining the efficiency of the warehouse is the dedication to the proper storage locations for probably lots of merchandise in a warehouse. Different factors affecting the storage undertaking like order selecting method, size and format of the storage system, material handling machine, product characteristics, demand traits, turnover charges, and area necessities are been substantially studied. it has been counseled that choosing appropriate garage project policies (i.e., random, devoted, or magnificence-based totally) and routing methods (i.e., transversal, go back, or mixed) for the above elements is a likely solution to enhance efficiency. diverse choice guide fashions and answer algorithms have additionally been set up to resolve warehouse operation-making plans issues. [1]

The implementation of WMS for an agency demands massive investment and a time period (numerous months) which must be justified by the advantages received after implementation. The justification entails the splendid evaluation of the present-day situation of the warehouse and warehouse operation for a specific duration tuning the WMS. The company must be organized to trade the entire system and storage. Only WMS implementations without changing processes show that does not cause cost savings or efficiency enhancement, it will only reduce mistakes due to human elements. Another issue that has exercised corporations in the latest days has been the degree of generations to utilize in warehousing operations. The choice spans from conventional warehousing –racking and shelving with a forklift or even manual operations to completely computerized systems with conveyors and automated guided vehicles (AGVs) and from carousels to robotic programs. The motives for the choice

of a specific era, degrees are not constantly clear cut and run the gamut of financial, advertising, and different factors, from the employer's photo or flexibility for future trade thru to personal perception of the appropriateness of a selected era to a selected commercial enterprise or organization [1].

As a result, of implementing WMS, the picking of items could be completed an hour after receiving goods, while picking an item after it reached the warehouse used to take weeks in the old system. Also, before the WMS was implemented, new employees needed at least one month to get familiarized with the system. With the new system, however, they only necessitate quick training before they can effectively use the system. Moreover, pickers no longer have to guess where items are located; all locations are clear and well-defined on the system. Consequently, the storing and picking processes are faster and more efficient. Furthermore, the application of the WMS led to an increase in the average number of orders handled per day and a decrease in the error ratio. Product alertness is also improved, and visibility on which product has high or low turnover with the reasons leading to that are all enhanced. Finally, the high accuracy in stock levels renders making purchasing decisions easier. As explained and discussed previously, the strategic changes that were followed improved operations and reduced costs.

The general improvement brought about can be summarized as follows:
A reorganization of roles and functions inside the warehouse was necessary to be sure that the right person is at the right place, doing the right job. The workflow became clear, allowing each person to know what tasks they should complete and how to do them in the right way. After applying the WMS, will have higher accuracy regarding the end-of-year physical stock count. By implementing this system, stock count became easy since the worker is only required to scan the barcode and enter the quantity for the system to generate a report showing the differences between stock count and stock values in the system. Also, the WMS is offering managers full visibility of costs related to warehouse operations. Reports show that the cost of each operation, the salary of each employee, and the full cost of an item (including shipping, stocking, delivering, etc.) are automatically generated and sent on a regular

basis to concerned managers. Many costs were reduced due to the integration of the expiry dates in the system leading to the appearance of alerts whenever items are close to the expiry date. The delivery process was also modified to prevent the delivery of items with short shelf life (as defined in the system). So, when delivered items have a long shelf life, returns of near expiry or already expired items are almost reduced to zero. This reduced operation costs and enhanced the company's image relative to the customers. In brief, the use of the WMS helped in organizing the work, providing full visibility of expiry dates, ensuring the accuracy of stocks, and generating reports related to products and their specifications. All of these changes led to the reduction of operating costs.[29]

The warehouse system is a key part of the supply chain and primarily aims to control the movement and storage of materials within a warehouse and process the associated transactions, including shipping, receiving putting put, away, and picking. The systems also direct and optimize stock put away based on real-time information about the status of bin utilization. Warehouse management systems often utilize Auto ID Data Capture (AIDC)technology, such as barcode scanners, mobile computers, wireless LANs, and potentially Radio-frequency identification (RFID) to efficiently monitor the flow of products. Once data has been collected, there is either batch synchronization or a real-time wireless transmission to a central database. The database can then provide useful reports about the status of goods in the warehouse. The objective of a warehouse management system is to provide a set of computerized procedures to handle the receipt of stock and returns into a warehouse facility, model and manage the logical representation of the physical storage facilities (e.g. racking, etc.), manage the stock within the facility and enable a seamless link to order processing and logistics management in order to pick, pack and ship product out of the facility. Warehouse management systems can be standalone systems or modules of an ERP system or supply chain execution suite. The primary purpose of a WMS is to control the movement and storage of materials within a warehouse – you might even describe it as the legs at the end of the line that automates the store, traffic, and shipping management. In its simplest form, the WMS can data track products during

the production process and act as an interpreter and message buffer between existing ERP

and WMS systems. Warehouse Management is not just managing within the boundaries of a warehouse today; it is much wider and goes beyond the physical boundaries. Inventory management, inventory planning, cost management; IT applications & communication technology to be used are all related to warehouse management. Warehouse management today also covers container storage, loading and unloading.

Zhimin Chen applied the association rules to the warehouse management system. When procurement staff decides to procure the goods, whose amount is less than the minimum inventory, the warehouse management system based on the association rules will obtain the association rules by analyzing data in the system. According to the association rules given by the system, the system will analyze the number of goods involved in the association rules, if the number of mice or keyboards is less than the minimum inventory or less than half of the maximum inventory, the system will give the recommended names of the goods that need to be purchased at the same time. This system will not only help procurement staff save time but also ensure sales, avoid the lack of inventory, and affect sales. The warehouse management system based on association rules has become a development trend, it will be welcomed by many procurement staff, and it can promote the further improvement and development of warehouse management. [31]

In 1971, 1982, and 1983 respectively, Miebach [5], Matson and White [4], and L. Mc Ginnio et al. [3] reviewed the operations research and material handling literature. They concluded that important gaps in the research fields existed and that most research seemed to concentrate on rather limited problems. In 1992, Goedschalckx created a WWW-page1 with an extensive list of publications. In 1996, Van den Berg [2] surveyed the literature on the planning and organization of warehousing systems.

The idea of using a smart architecture with reference to the IoT and decentralization has been widely discussed in the literature. However, the design of a reference

architecture for warehouse automation is a relatively emerging field. A summary of various works performed in this context is given below. The management of a warehouse may consist of managing the goods or products coming into the inventory, keeping track of the location of the items, and handling the check-outs of the finished goods. Data collection or data entry is one of the important aspects of warehouse management. Data can be of any form such as IDs, prices, or time stamps, and the data collection units can be barcoding scanners, RFID readers, sensors, etc. An IoT-based WMS for industries operating in the development of customized products was proposed [19].

Laxmi et al. [20] examined the use of GPS positioning for transport fleets along with RFID shipment tracking at the entrance and departure points of the warehouse. The focus of their approach was on supply chain management through the tracking and identification module. The position tracking module uses Wi-Fi, as it requires a high data rate and more transmission power, while the information from the position tracking module is received through a base transceiver station. RFID has been very popular for the segmentation, tracking, and positioning of products [21,22]. The RFID reader's information is sent wirelessly to open-source hardware and the data are stored in a central server. All modules are connected over the same network for effective data communication. All the data from the warehouse are stored within a Raspberry Pi and displayed on the front end.

The use of vehicles for transportation within the warehouse is very common. Traditionally, manually driven vehicles are used for transportation; however, as the architecture transitions toward the IoT, unmanned vehicles, robots, and conveyer belts are also being introduced. A system was developed for inventory regulation by using Unmanned Aerial Vehicles (UAVs). These UAVs help in the counting and localization of inventory. UAVs have the capacity to avoid obstacles and collisions. This reduces the need for critically planning and maintaining inventory tracks in the warehouse. To use wireless connections for these UAVs, Ultra-Wide Band (UWB) solutions using anchor nodes have been developed, whose range can be scaled using the IPv6 Routing Protocol for Low-Power and Lossy Networks (RPL) depending on

the requirements. They also designed a multi-technology, duty-cycling, time-slotted UWB MAC protocol for the optimization of power consumption by UWB radios.

Nagendra et al. proposed an IoT-based architecture for order picking that involved controlling and monitoring the inventory. The architecture included process specification and domain model specification using the product ID, location, rack, etc. Information model specification introduces information about the position of the robots, the availability of the products, the position of the products, the size of the rack, etc. Service specification provides the service of operating auto and manual modes for orders received, the identification of the location of a rack, the movement of robots towards the specified rack, and so on. The authors also described an IoT-level specification including measurement, automation, innovation, and cloud utilities, making the solution a Level-4 IoT system. Furthermore, the architecture involved device and component integration, where they mapped the functionalities of the sensors and actuators.

In any inventory management system, the location of goods is of great importance as it makes tracking easier and more efficient. A self-adaptive decision model for the inventory positioning, check-in, and check-out of the inventory and other event handling was proposed by Zhang et al. [23]. The model senses the environment, creates knowledge based on it, and trains a neural network to recognize the scenario to make a decision. The model improves itself by adjusting the knowledge base and decision-making is performed at the node level, which makes this system completely decentralized.

Similarly, Liu et al. [24] developed a strategy for logistics management for which they devised a framework consisting of three parts: IoT-enabled vehicle terminals, resource management, and dynamic optimization services. Information is obtained by identification sensors, e.g., RFIDs, wireless connectivity, etc., and is updated to the Enterprise Information integrated System (EIS) and Geographic Information System (GIS), which further provides optimal routes; this also involves tracking the inventory while loading, which is specifically based on RFIDs. This creates the first layer of the architecture, i.e., the IoT-based physical sensing layer. The second layer includes

resource management in which the real-time data of vehicles is uploaded to the GIS, and the last layer involves providing optimal paths for the logistics.

For parts handling in warehouses, Schwarz et al. [25] developed a robotic arm with six Degrees of Freedom (DOF) by implementing the concepts of Industry 4.0. Object detection and semantic segmentation were used to classify the objects that were requested to complete an order. The system also involves 6D pose estimation using six degrees of freedom so that the items are picked up cautiously. This system was presented at the Amazon Picking Challenge and was highly acknowledged.

The automation of a part of a warehouse was performed by keeping a record of solid and liquid stock. The system uses an ultrasonic transducer to measure inventory, and the results are propagated to the Internet through a Raspberry Pi gateway device. However, it only focuses on the quantity of goods in the inventory and provides automatic order placement, and lacks the check-in and check-out of the items based on their Unique Identifier (UID). The flow of goods can be drastically improved by Artificial Intelligence (AI) techniques [27], as AI can possibly help in decision-making for transportation within the warehouse, the loading and unloading of inventory, and the palletized goods operations. In these papers, the IoT architectures used were categorized into two types. One was where sensors and actuators directly communicate with the server over the Internet. This type is used when there are few sensors and/or the network is slow. The other one included a gateway (such as a Raspberry Pi), which further passes on the information to the server using some IoT connectivity. [26]

Van Geest et al. [28] proposed the design of a reference architecture for a warehouse, based on architectural viewpoints. The architecture covers different sections of a warehouse and provides a detailed analysis of the subject. However, the architecture is more on the theoretical side, and the idea presented was very general, which makes it less viable for practical implementation.

As mentioned earlier, the architecture-based analysis of smart warehouses is an emerging category; hence, addressing the shortcoming of the work by Van Geest et al.

[28] and extended their work by adding more architecture viewpoints, practical testing, as well as the hardware implementation of the architecture.

After reviewing many research papers, coming across a smart warehouse that would actually help the warehouse management system in managing warehouse efficiently:

2.2.1 Literature Review Before 2015:

Given that smart warehouses have emerged in recent years, the earlier published reviews discussed less about current warehouse development and smart technologies. But the earlier reviews can still bring insights into the basic concepts related to warehouse operations management. In Rouwenhorst et al. [6] review, warehouse design problems, and models are presented at strategic, tactical, and operational levels. Gu et al. [7] present a review of warehouse operation planning based on the classification according to the basic warehouse functions, including receiving, storage, order picking, and shipping.

Gu et al. [8] provide some comments on warehouse design based on the following warehouse design problems: Overall structure, sizing and dimensioning, equipment selection, operation strategy selection, and department layout. de Koster et al. [9] stress the importance of the order-picking process. Optimization problems related to layout design, storage assignment, routing, order batching, and zoning are reviewed. Automated Storage and Retrieval System (AS/RS) has attracted much attention from earlier reviews. Roodbergen and Vis [10] provide an overview of the AS/RS literature for a range of issues, including physical design, storage assignment, batching, dwell-point location sequencing, and performance evaluation. Various models for AS/RS performance evaluation are surveyed in Gagliardi et al.'s [11] work. Analytical models and simulations are the two types of models commonly used in research.

2.2.2 Literature Review after 2015:

Recent reviews focus more on emerging warehouse technologies and new developing trends. IoT, Industry 4.0, and other emerging technologies influence the way information is exchanged in warehouses. Ben-Daya et al. [12] reveal the role of the IoT and its impact on supply chain management. Radiofrequency identification (RFID) tags are the major IoT technology studied in previous warehousing research. Manavalan and Jayakrishna [13] review IoT's role in achieving sustainable goals in supply chain management. The importance of digitalization and the influence of IoT in overall supply chain management are analyzed. The criteria for achieving business readiness for Industry 4.0 transformation are concluded.

Winkelhaus and Grosse [14] propose a systematic literature review for Logistics 4.0. The application of IoT, CPS, and other technologies related to Logistics 4.0 are summarized in the review. The rapid development of automation technology has dramatically improved the automation level of warehouse systems. In this development process, different concepts related to automated warehouses have emerged.

Boysen and Stephan [15] classify single crane scheduling problems in AS/RS from three perspectives: Layout, order characteristics, and objectives, and then survey crane scheduling problems. Jaghbeer et al. [16] present an analysis of the literature related to automated picking systems and identify and study the link between design and performance. Custodio and Machado [17] discuss flexible automation in warehouses and construct a framework for designing flexible automated warehouses. Fottner et al. [18] investigate the definition and research framework of autonomous intralogistics systems, which enable self-contained, decentralized planning, execution, control, and optimization of internal material and information flows through cooperation and interaction with other systems and with humans. A typical autonomous warehouse system is a segment of autonomous intralogistics systems.

Glock et al. [12] provide a review of technical assistive devices for manual materials handling. Their systematic literature review identifies papers that discuss assistive devices in the warehousing system. New warehouse concepts and applications have been derived in recent years. These concepts may be similar to the smart warehouses characterized.

Boysen et al. [15] surveyed relevant literature about warehouse systems for e-commerce warehouses. Warehouse systems need to cope with the requirements of e-commerce, including small orders, large assortments, tight delivery schedules, and varying workloads. The warehouse systems adopted in e-commerce warehouses are investigated in their review. Azadeh et al. (2019) reviews the developments of robotized and automated warehouse systems. Research on different warehousing systems is categorized into three categories: System analysis, design optimization, and operational planning and control. The systems identified in this review are essential for warehouse automation. The integrated models and systems are mentioned as the direction of future research for established systems.

Fragapane et al. [18] reviews the application of autonomous mobile robots (AMRs) in intralogistics and the corresponding planning and control problem. AMRs are industrial robots that evolve from AGVs and have been widely used in warehousing and other intralogistics operations.

Bartolini et al. [14] provide an exhaustive macroscopic review of green warehousing for the sustainability topic in warehouses. Existing literature about green warehousing is categorized into three macro-themes: Green warehouse management, the environmental impact of the warehouse building, and energy saving in warehousing. To some extent, the concept of smart warehouses proposed in our review may overlap technical perspectives with the abovementioned reviews. Most of the existing reviews define and classify their research scope from the technical aspect. In other words, previous studies usually focus on a specific type of warehouse equipment or technology.

In our opinion, a smart warehouse is not limited to warehouse concepts like e-commerce warehouses and green warehouses. Smart warehouses should be a broader concept that concerns leading warehouse technology and applications and intrinsic principles of warehouse operations management. This broad meaning offers a wide space for the research of smart warehouse operations management, which could be the most promising trend in warehouse management.

A novel review framework is developed based on the basic characteristics proposed above. Instead of classifying literature by technical aspect, the classification and analysis of literature in our review are based on the characteristics of smart warehouses. This classification framework provides a solution that covers both technical and operational aspects of smart warehouse operations management. This

review's main innovation and contribution is that provide a comprehensive literature review for smart warehouse operations management based on a novel review framework that reveals the existing inner links of smart warehouse operations. Expecting that the novel framework of our review could provide some new insights into smart warehouse operations management.

RFID technology has a lot of advantages, such as a simultaneous collection of large quantities of data, without any requirement on accurate counter-position, which makes the enterprise free of daily mass repeating operations. The warehouse management system (WMS) based on RFID can collect, transfer, check, and update mass data on daily frequent goods entry and delivery, thus the labor intensity will be decreased, and errors like fault scanning, miss scanning, re-scanning in the repeating manual operations can also be avoided, while the efficiency and accuracy will be improved a lot. With development of the RFID technology, reduction of costs, gradual unification of the standards, and decrease of the error rate, the effective combination of WMS and RFID will become one of the key factors to improve the competitive power of enterprises and the efficiency of the supply chain.[32]

The developed Warehouse management system is efficient and it can perform dynamic inventory updating and Real-Time search operations from the database with

the help of the robot. The implementation of this system is not bounded by a prototyping nature or laboratory setup, but it can also perform efficiently in Real-world applications. The total development and implementation cost of the developed warehouse management system is very low compared with other existing models and solutions in the marketplace. With the implementation of a user-friendly interface, the managers of any warehouse management system can easily locate the tracked product in the Warehouse without much effort and update its state. In future works, it is proposed that with more enhancements and modules this solution can be used in other areas and different other applications.[33]

According to Irina G. Fomina any production or trading is faced with the need to store their reserves or any useful stuff somewhere. This function is performed by warehouses or storage in most cases. Warehouse can be an open platform, which is used for material storage. And the warehouse also may be complex modern construction, where the goods are kept, which requires observance of certain conditions, for example, it can be frozen foods. Innovations in logistics are most often used by companies, which are concentrated in the area of e-commerce, manufacturing, and construction, these companies need to have their warehouse. And also, modern concepts are used in companies providing transportation and warehousing services. Supply Chain Management or SCM is a name of systems which are designed to manage every phase in the process of product delivery and they are needed to automate all goods movements within the organization. They can be used to satisfy the customers' needs much better and to reduce significantly the cost of procurement and logistics.

According to the study done by ARARSA BUZU KIDANE [33] Relying on the results of the study and the summary of findings, the roles of warehousing are to provide a storage facility, maintain regular supply, create time utility, minimizes risk, facilitates movement of goods, and generates employment. The study reveals that the prime reason for the establishment of warehouse management in the organization is to store the materials in a safe, quality and to provide service to the customers, and the study concludes that there is a significant relationship between warehousing management and warehouse performance. However, it is difficult to generalize that

the warehousing management of the organization under the study was providing services to the customer efficiently and effectively. Of course, some of the reasons for poor warehousing management in the organizations to provide adequate service are; lack of skilled man power, existence of poor shelves, pallets, and racks, lack of minimizing the cost of warehousing activity, lack of following the customer order, lack of giving priority for the safety of item, low level of giving attention to the accident occurred in warehouse, poor information sharing, and lack of appropriately cleaning the storage areas. Finally, as per the multiple regression analyses, the main variables that could affect warehouse performance include; receiving, storage, put away, order picking, and shipping of warehousing management. Hence, organizations are expected to enhance their warehousing management so as to gain better warehouse performance in terms of quality, response time, cost/financial, and productivity.

The inventory management gadget is an actual-time stock database capable of dealing with massive inventories of a corporation. this can be used to track the inventory of an unmarried store, or to manipulate the distribution of stock among several stores of a bigger franchise. however, the gadget simply facts sales and restocking data and affords notification of low inventory at any region at a precise c language. The aim is to lessen the strain of monitoring rather than to address all shop upkeep. The assignment inventory control system is an entire laptop-based application designed on Python era on Tkinter framework generation using Pycharm community edition. WAMP is a home Windows OS primarily based software that installs and configures Apache web server, MySQL database server, personal home page scripting language, phpMyAdmin (to manage MySQL databases), and SQLiteManager (to manipulate SQLite databases). The principle aim of the task is to broaden stock management system version software program in which all the facts concerning the inventory of the employer can be provided. it's far an intranet-based computer utility that has admin aspect to manipulate the inventory and renovation of the inventory gadget. This computer software is primarily based at the control of stock of an employer [34].

Conventionally, a warehouse is operated by manual operation such as forklift, conveyor and cart, etc. However, due to low profit caused by manual operation, automated facilities such as sorter and Automated Storage and Retrieval System (AS/RS) are widely introduced. Logistics execution software (LES) can be classified into two areas: Warehouse Management system (WMS), and Transportation Management System (TMS). Even though WMS and TMS are classified as execution software, they do not have capability to interface or control facilities in the warehouse. They rather manage order level execution. The control of automatic facilities requires control software such as Warehouse Control System (WCS), Material Flow Controller (MFC), equipment Management System (EMS) and Equipment Control System (ECS). Even though, the objectives of WMS and WCS are quite different, many software providers use those terms in the mixed ways. [35]

In general, inventory management and warehouse activity management are called by a joint name of Warehouse Management System (WMS) which is the core of enterprise's logistics management. With the acceleration of the world economic globalization process, the competition of logistic industry is becoming severe. Phylogeny of modern logistics is the process of inventory cost rate declining. Therefore, finding the way to carry through effective information management, to effectively control inventory, to optimize business process and to make use of time, space, equipment’s, human resource efficiently becomes a new and most important profit growth point, so as it reduces inventory cost and improve degree of customer satisfaction greatly. This paper develops an agile, compact, maintainable warehouse management information system which promoted its adaptation and expansibility by reengineering business logic. [36]

This system adapts itself well to the rapidly developing warehouse management. This paper designs and implements the warehouse management information system based on AOP. It turns out by practice that the design of this system can completely meet the increasing demands of complexity and accuracy in modern warehouse management. Applying AOP to WMS benefits to simplify system structure, increase agility, expansibility and maintainability, and solve some existing problems in current

WMS, for example complex structure, poor maintenance and poor expansibility, as beneficial research to improve warehouse management information system. However, how to improve system efficiency with all AOP benefits still needs further research due to AOP develop limitation. [36]

Yikun Lu & Timo Käkölä [37] conducted research in the context of the Chinese 3PL logistics services market offering services for international and domestic clients that leverage information and communication technology enabled sourcing (eSourcing) of logistics services. The research is part of a larger project that investigates various classes of information systems facilitating the end-to-end eSourcing service provisioning life-cycle for markets such as software products and services eSourcing and business process eSourcing. The eSourcing Capability Model for Service Providers (eSCM-SP) has been chosen as the reference theory of the larger research project to understand the eSourcing life-cycle holistically from providers' viewpoint and to ensure the comparability of various subprojects. eSCM-SP has been demonstrated to help various types of providers in different industries to improve their capabilities related to both ongoing, phase-specific, and engagement-specific sourcing practices throughout the eSourcing service provisioning life-cycle. The life-cycle involves three phases from the provider's viewpoint: initiation, delivery, and completion. Ongoing practices are run throughout the life-cycle to perform management functions. The three phases and the ongoing practices cover ten capability areas (e.g., knowledge management, threat management, and performance management). 3PL services are widely delivered by Chinese providers. This research investigates the end-to-end eSourcing service provisioning life-cycle (hereafter "life-cycle") using a single qualitative case study to provide a holistic, systemic understanding of the phenomenon.

Au Yong Hui Nee did a study that analyses the relationship between adoption of WMS to its impacts on business performance and competitive advantage of a regional distribution centre. In terms of business performance, the focus is placed on various competitive cores of distribution centre. WMS was found has a positive impact on companies' performance on operations management measures. To adopt the MIS,

wireless barcode embedded WMS in specific, it is necessary to have a corporate culture that supports complex operational activities. WMS implementation is crucial in bringing cost reduction at the operational level, effective management at the management level, as well as improvement of the company's competitiveness at the strategic level. Companies that manage the warehousing of their products are expected to implement WMS in order to maintain their competitive edge in the global marketplace. The impetus for the strategic use of Management Information Systems (MIS) has been highlighted as the world transits into a global village. There is growing research interest in the use of MIS as a strategic weapon by organizations. Globalization and competitive pressures have heightened the impetus for strategic use of MIS. More specifically, a Warehouse Management System (WMS) designed to introduce improvement into every aspect of a company's warehouse operations offers an organized approach to managing efficiency. Bar code data collection solutions for warehouse management system provides powerful and flexible automatic identification system that connects the shop floor to the enterprise software. [38]

3. ANALYSIS

3.1 Detailed Statement of the Problem

Problem Management is identifying, prioritizing, and systematically resolving these underlying issues. It provides the end-to-end management of problems from identification to elimination. Basically, a small-scale warehouse works with Handwritten records and as a result, increases the work of the business enterprise. The calculations are all manually performed and consequently vulnerable to errors resulting in transaction inaccuracies. Possibly, the handwritten record can be out of place or lost. The invoice is manually made, growing the work of the corporation to a quantity.

The following problems state the different modules that are worked upon:

- In this world everything is working digitally but, in many shops, all work is done manually so there is lots of time lost during the work as well the huge manpower required for every work done. To know the status of every Stock and Transaction. No other medium is available for communication with the customer and Admin.

- Doe to the manual working has not present co-ordination between the employee, organization, or customer. With maximum manpower required for different roles and responsibilities, the process and chain of working are always disturbed due to the lack of technology and irregular management system.

- Admin can't find the transaction of any particular customer in the manual generation of bills, and Admin Doesn’t know about the actual stock available in the shop. The maximum time required while dealing with such a task.

- The variation of the prices of raw materials are also analyzed with their effects on the overall working of the unit.

- The purpose of "Warehouse Management" is to ensure the availability of materials in sufficient quantity and quality as and when required and also to minimize investment in inventories.

- Inventories play a vital role in the operation of the real estate industry. The Warehouse ensures operational smoothness. In almost all organizations a substantial part of capital is invested in inventories.

- The manual maintenance warehouse information may erase or lost in a few years.

- Common warehouse problems such as redundant processes, poor facility layout, seasonality in demand, high labor costs, and inaccurate inventory information require robust systems that keep managers informed about changes and gaps that require attention.

A WMS handles many functions that permit these actions, along with stock tracking, selecting, receiving, and getting away. A computerized warehouse management system simplifies everything from inputting facts to taking inventory. The most effective warehouse system products raise your operating performance, main to extra productiveness It ensures smooth manufacturing operations by using preserving reasonable stocks of substances. It allows normal and timely delivery to customers thru good enough shares of completed products.

3.2 Requirement Specifications

In this section, we will look at the Software and Hardware required for the implementation of the project. We have divided the requirements into two parts Software requirement and Hardware requirement.

The requirements in this section provide a detailed specification of the user interaction with the software and measurements placed on the system performance.

3.2.1 Hardware Requirement:

- i3 Processor Based Computer or higher
- Memory: 1 GB RAM
- Hard Drive: 50 GB
- Monitor

3.2.2 Software Requirement:

- Windows 7 or higher
- Visual studio 2019.
- Python

3.3 Functional Requirements

Functional requirement defines a function of a system or its component. A function is described as a set of inputs, behavior, and outputs. Basically, requirements are statements that indicate what a system needs to do in order to provide the capability. Functional requirements are the features or functions of a software system to accomplish tasks. It basically explains how the system must work. They are the statements that describe what a system needs to do in order to provide a capability. A description of each major software function, along with data flow (structured analysis) or class hierarchy (Analysis Class diagram with class description for the object-oriented system) is presented. Functional requirements involve the following points listed below:

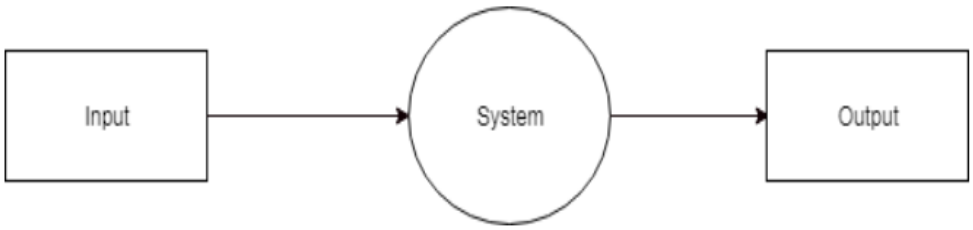


Fig: 3.3 Data Flow Diagram

3.3.1 Installation of Warehouse Management System Software:

- Click on exe file of WMS file
- Click on Install

3.3.3 Login Function

Admin Login into the system using Login ID and Password

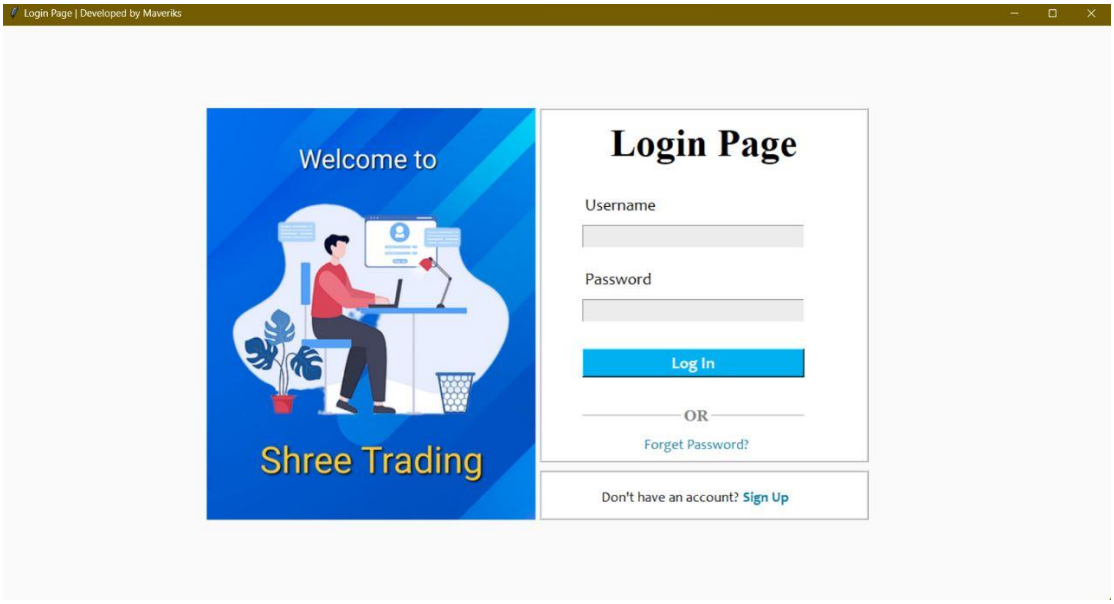


Fig: 3.3.1 Login page

3.4 Non-Functional Requirement

3.4.1 Supporting Technologies

Implementation should be feasible using technologies that are accessible to the end users.

With help of Python programming language and Visual Studio tool as well as SQLite3 server as database and server, and developed a desktop-based application.

3.4.2 Device Software Compatibility

The minimum requirement of WMS for devise capability is Computer System with Windows OS and minimum 1GB RAM.

3.4.3 Time Response

The application performs in a proper time constraint that typing speed, motion and obstacles in the internet. Area: Performance Efficiency. Application performance is a response time.

3.4.4 Accessibility

Warehouse Management System

The "Warehouse Management System" has an interactive user interface so that Admin or any new person can easily understand it and able to access the different features of the project.

3.4.5 Recoverability

If the System crashes due to technical or non-technical fault then all data or all record information of software store on cloud storage as daily backup.

3.4.7 Maintainability

If some error occurred during the execution of system, then the system can resolve all error by restarting or debugging of system.

3.4.8 Usability

Admin will login the system easily with username and password. After login into the system, the homepage displays. The homepage contains a simple module which can access on clicking the buttons. All module is easy to understand and easy to perform many operations.

3.5 Feasibility Study

Feasibility study is an unbiased evaluation of an App idea, conducted for the purpose of determining whether the idea is viable and worth pursuing. The feasibility study is undertaken to determine merits and demerits of each alternative and recommended system that will be most appropriate. All are feasible given unlimited resource and identified infinite, so it is essential to evaluate and estimate the advantage of one system over another.

3.5.1 Market Feasibility

- Assessment of the overall appeal to the market for the Desktop based application.
- Market timeliness: best suitable time for release
- Identification of the target audience
- Comparing with other similar competing applications

3.5.2 Economical Feasibility

- Resource cost is based on the estimated resources within the technical analysis.
- Cost of maintenance of equipment is much less.
- In economic feasibility, study about the cost of developing our system is included. The software and hardware requirement are at affordable costs. This project is economically feasible.

3.5.3 Product Feasibility

- Considering the major features of the current scope (at a high level) and evaluating if they are feasible.
- New concept: desktop-based Application is purely based on new concept
- Low Competition desktop application.

3.5.4 Technical Feasibility

- Experimental features: identify the features in the design that seem experimental in nature, such as untried or unproven technologies, techniques, perspectives, or other unique ideas.
- Technical feasibility studied the function, performance, and constraints that may prevent the adoption of another more acceptable system. This project IS feasible technically as it can run on any operating system of the computer.

3.5.5 Behavioral Feasibility

Warehouse Management System

- Behavioral Feasibility refers to the system to see whether the data input is readily available or collectable.
- This project is easily access and for understanding to people.
- System performs all functionality correctly and in a fraction of time.

3.5.6 Operational Feasibility

- Operational feasibility is mainly concerned with issues like whether the system will be used if it is developed and implemented.
- This system interacts with the user and is user-friendly and it will benefit the organization.
- The accessibility of the information will not be lost. User information will be secured and no loss of integrity.

3.6 Use Case Diagrams

The model a system, the most important aspect is to capture the dynamic behavior. Dynamic behavior means the behavior of the system when it is running /operating. A use case is a methodology used in system analysis to identify, clarify and organize system requirement. Only static behavior is not sufficient to model a system rather dynamic behavior is more important than static behavior. In UML, there are five diagrams available to model the dynamic nature and use case diagram is one of them. Now as discussing that the use case diagram is dynamic in nature there should be some internal or external factors for making the interaction.

In the Unified Modelling Language (UML), a use case diagram can summarize the details of your system's users (also known as actors) and their interactions with the system. To build one, you'll use a set of specialized symbols and connectors.

An effective use case diagram can help your team discuss and represent:

- Scenarios in which your system or application interacts with people, organizations, or external systems.
- Goals that your system or application helps those entities (known as actors) achieve.
- The scope of your system.

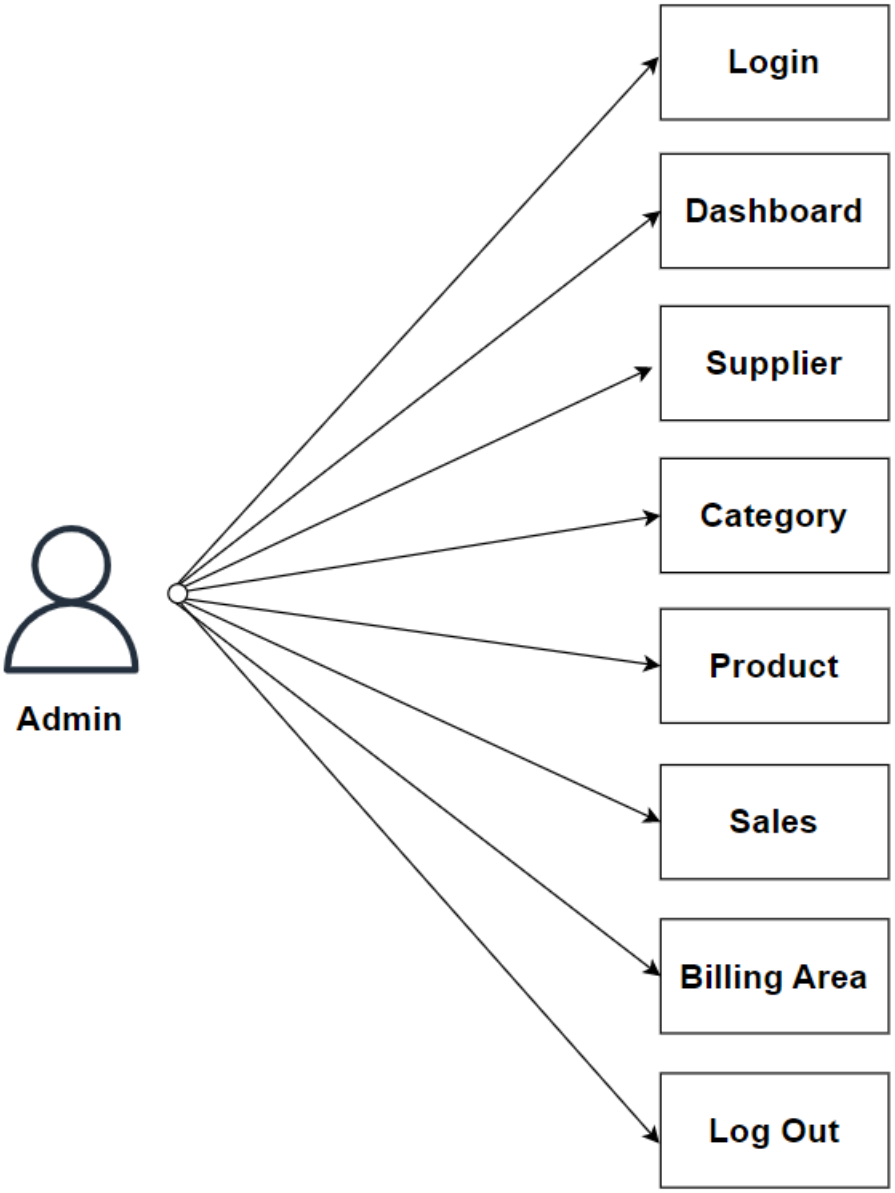


Fig: 3.6 Use case Diagram

3.7 Use Case Specification

The complete use case diagram has one actor which is Admin. The problem stated in the manual is inconsistency of records and loss of records. In the use case of inventory management system, it tries to resolve all problems occur during manual storing of records. In use case it specifies five main events occur during execution of inventory management system.

a) Login

The Login uses to access all services of inventory management system software. The stock Object contains three sub-events:

- Add New Product
- Edit Product
- Add Stock

b) Stock

The stock contains all the categorized products under sub-events:

- Add Supplier
- Sell stock
- Cancel order

c) Invoice

The Invoice Object Use for Creating Bill with four sub-events:

- Add Customer
- Add Product
- Add payment
- Generate Bill

d) Transactions

Transactions keep all data and records of payments and invoices.

- Make payment
- Invoices
- Supplier payment

e) Logout

After all process admin can logout.

4. DESIGN

4.1 Design Goals

Agile technique of modeling is used for the designing process of the complete application. Agile model believes that every project needs to be handled differently and the existing methods need to be tailored to best suit the project requirements. In Agile, the tasks are divided to time boxes (small time frames) to deliver specific features for a release. Agile methods are being widely accepted in the software world recently. However, this method may not always be suitable for all products. Here are some pros and cons of the agile mode.

The advantages of the Agile Model are as follows-

- A very realistic approach to Software Development.
- Promotes teamwork and cross training
- Functionality can be developed rapidly and demonstrated
- Resource requirements are Minimum.
- Suitable for fixed or changing requirements
- Delivers early partial working solutions.
- Good model for environments that change steadily.
- Minimal rules, documentation easily employed. Enables concurrent development and delivery within an overall planned context.
- Little or no planning required.
- Easy to manage.
- Gives flexibility to developers.

The project warehouse management system is a complete computer application developed in Python on the Tkinter framework based on the Turtle library. Use of code visual studio in addition to working with code. This project works with the DB browser and SQLite3.

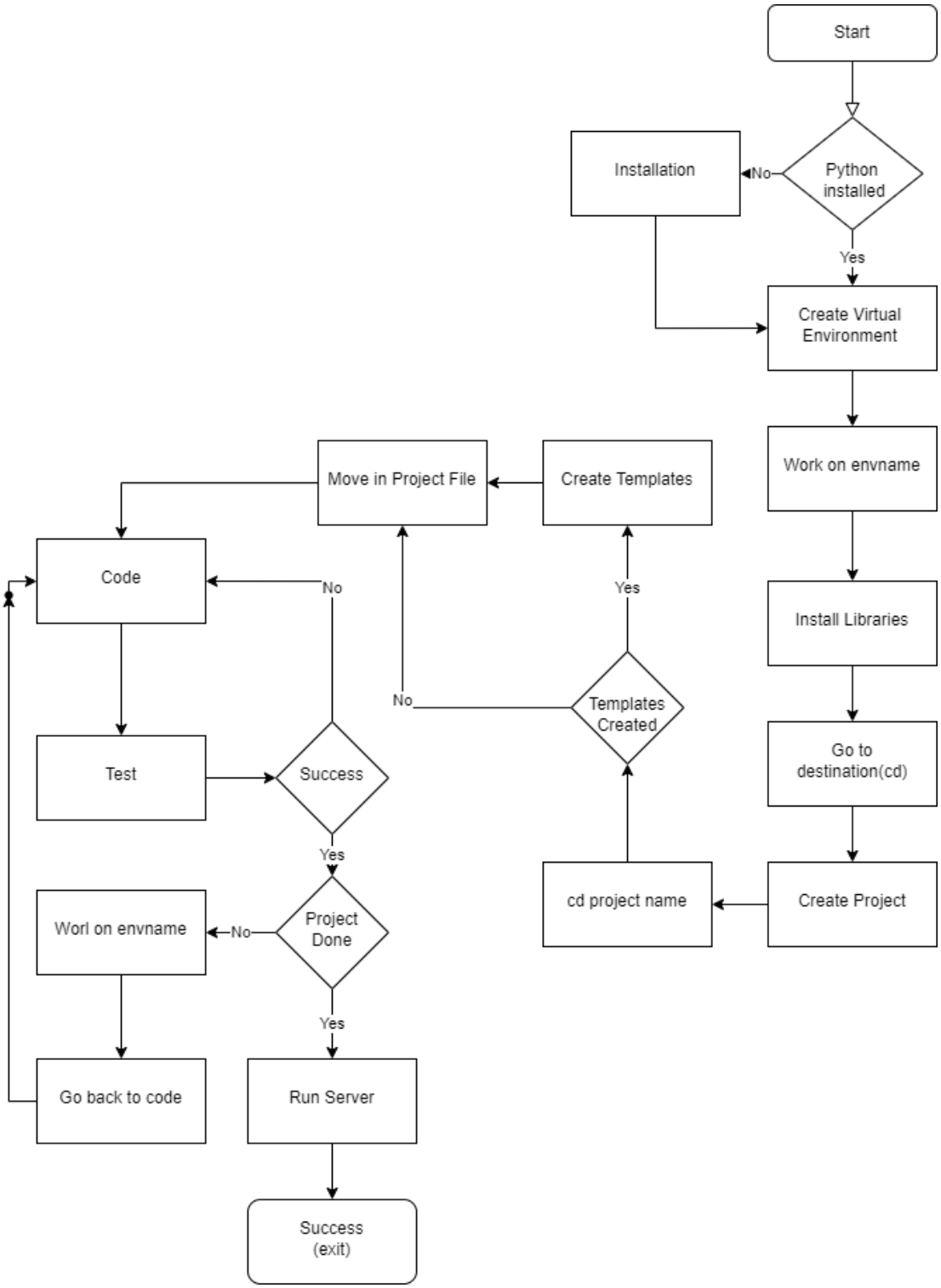


Fig:4.1 Process of Designing WMS

4.2 Design Strategy

Design is a meaningful engineering representation of something that is to be built. It can be traced to a customer's requirements and at the same time assessed for quality against a set of predefined criteria for good design. In the software engineering context, design focuses on four major areas of concern: data, architecture, interfaces, and components. The design process translate requirement into representation of software that can be accessed for a quality before core generation. Design is the process through which requirement are translated to blue print for constructing into software. Initially the blueprint depicts the holistic view of software. This is the design represented at the high level of abstraction. During various stages of system development and design following strategy have been setup for a complete architecture

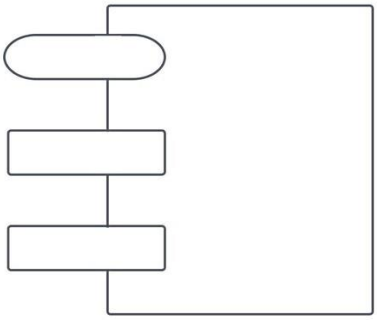
Week 1	Identifying the goal of the project & requirements of Sponsor
Week 2-5	Research and homework
Week 6	Identifying priorities
Week 7-8	Develop a plan
Week 9	Select software development tools
Week 10-15	Design and development of Dashboard
Week 16-17	Design and development of Employed Dashboard
Week 18-19	Design and development of Product Category
Week 20-24	Design and development of Product and Sales Window
Week 25-34	Design and development of Billing Area

Table: 4.2 Design Strategy

4.3 Module Diagram

Module diagrams are used to show the allocation of classes and objects to modules in the physical design of a system, that is module diagrams indicate the partitioning of the system architecture. Through these diagrams it is possible to understand the general physical architecture of a system. The two essential elements of a module diagram are modules and their dependencies. The first three icons denote files. The specification and the body icon denote files containing the declaration and definition of entities.

Specification



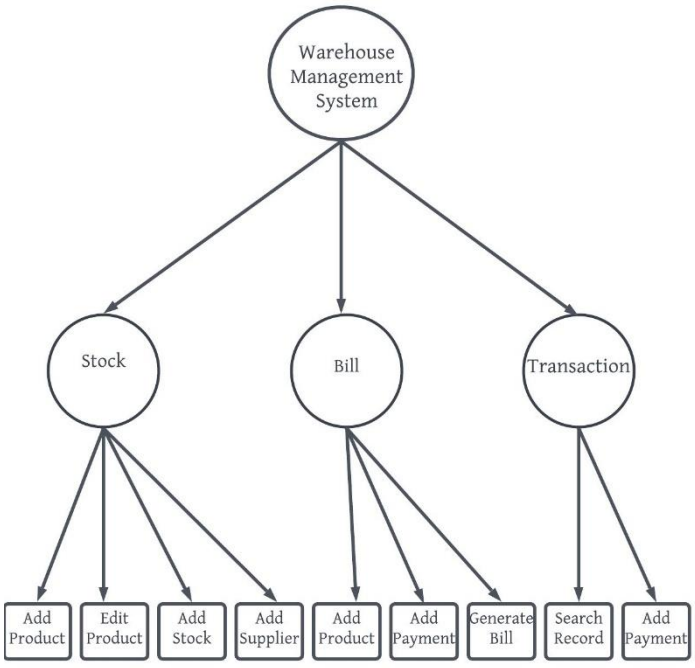


Fig: 4.3 Module Diagram

4.4 Architecture Diagram

Architecture Diagram is a graphical representation of the concepts, their principles, elements and components that are part of Architecture. Architecture is a coherent set of concepts for a structure. These concepts are often visualized at four levels of abstraction. These are:

- Conceptual Level-showing an overview of concepts.
- Logical Level showing a logical design of one or more concepts, containing at least the key elements of concepts and showing the principles of the concepts (i.e., how the concepts work).
- Physical Level - showing a component design depicting the elements.
- Implementation Level - showing the vendors and products with which the components will be implemented.

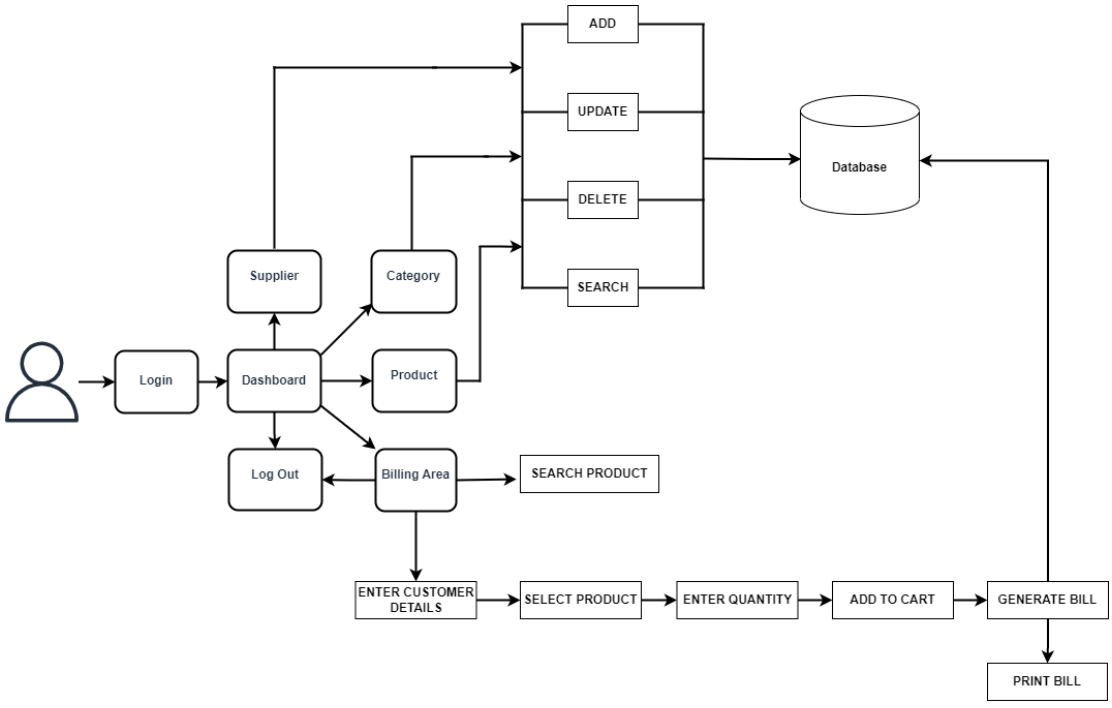


Fig: 4.4 Architecture Diagram

4.5 Class Diagram

The class diagram is a static diagram. It represents the static view of an application. Class diagram is not only used for visualization describing and documenting different aspects of a system but also for constructing executable code of the software application. The class diagram describes the attributes and operations of the class and also the constrain imposed on the system. The class diagrams are widely used in the modeling of the object-oriented system because they are the only UML diagram which can be mapped directly with object-oriented languages. UML provides mechanism to represent class members, such as attributes and method and additional information about them.

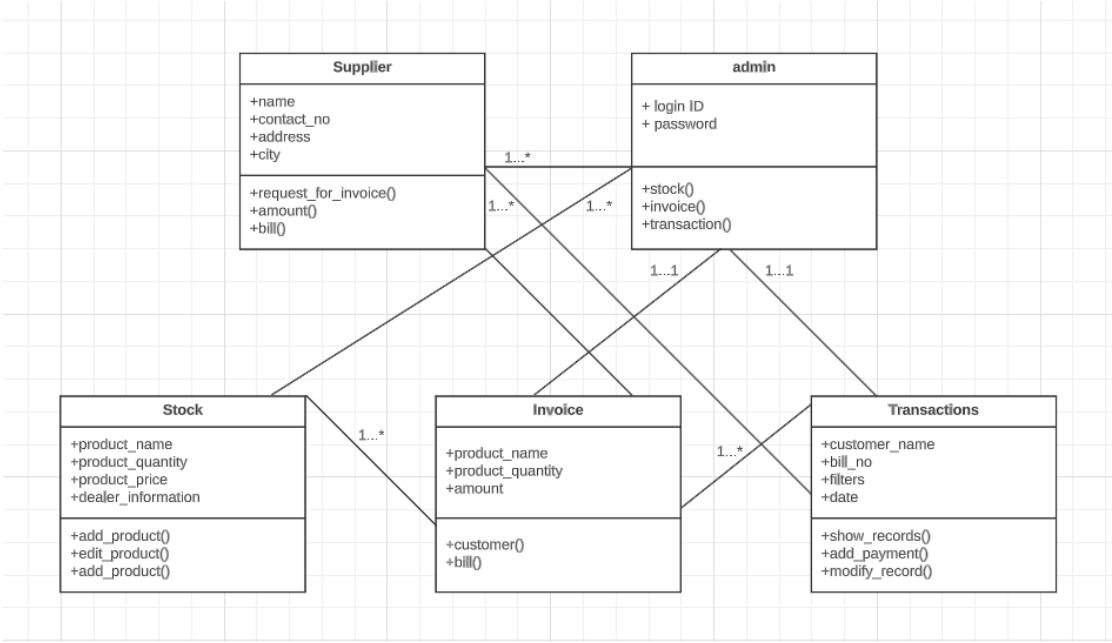


Fig: 4.5 Class Diagram

4.6 Sequence Diagram

4.6.1 UML

Unified Modeling Language (UML) is a modeling language in the field of software engineering that aims to set standard ways to visualize the design of a system. UML guides the creation of multiple types of diagrams such as interaction, structure and behavior diagrams. A sequence diagram is the most commonly used interaction diagram.

4.6.2 Sequence Diagram

A sequence diagram simply depicts interaction between objects in a sequential order i.e., the order in which these interactions take place. One can also use the terms event diagrams or event scenarios to refer to a sequence diagram. Sequence diagrams describe how and in what order the objects in a system function. These diagrams are widely used by businessmen and software developers to document and understand requirements for new and existing systems. The sequence diagram represents the flow of messages in the system and is also termed as an event diagram. It helps in envisioning several dynamic scenarios. It portrays the communication between any two lifelines as a time-ordered sequence of events, such that these lifelines took part at the run time.

4.6.3 Purpose of Sequence Diagrams

- To model high-level interaction among active objects within a system.
- To model interaction among objects inside a collaboration realizing a use case.
- It either model's generic interactions or some certain instances of interaction.

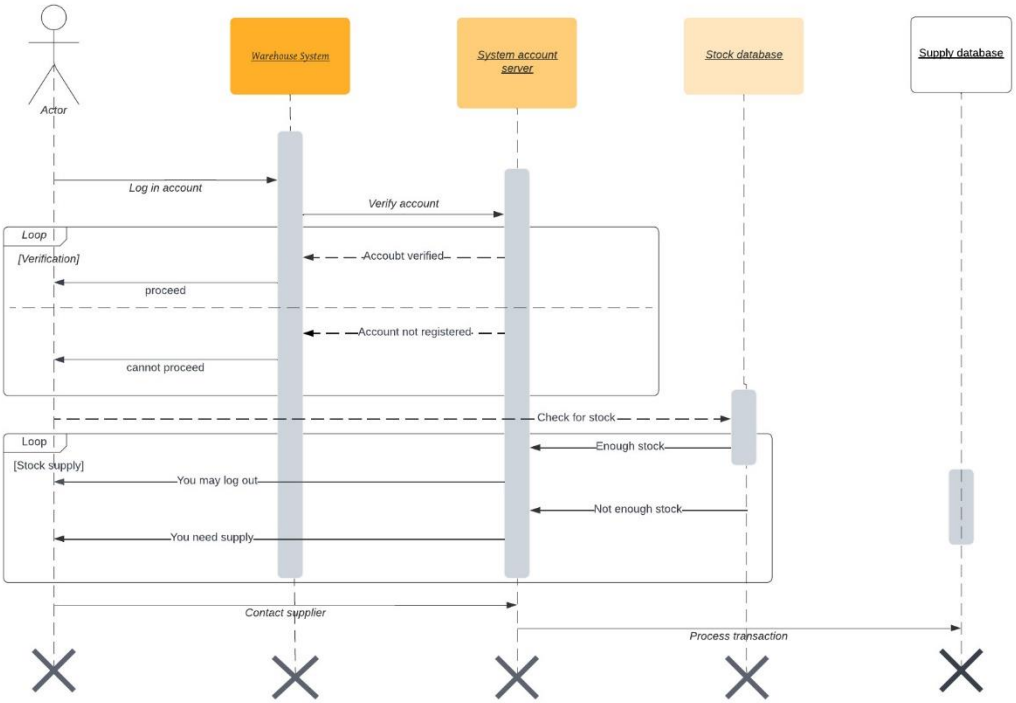


Fig: 4.6.3 Sequence Diagram

4.7 Collaboration Diagram

A collaboration diagram is a type of visual presentation that shows how various software objects interact with each other within an overall IT architecture and how users can benefit from this collaboration. A collaboration diagram often comes in the form of a visual chart that resembles a flow chart. It can show, at a glance, how a single piece of software complements other parts of a greater system.

4.7.1 Purpose of Collaboration Diagrams

- The collaboration diagram is also known as Communication Diagram.
- It mainly puts emphasis on the structural aspect of an interaction diagram, i.e., how lifelines are connected.
- The syntax of a collaboration diagram is similar to the sequence diagram; just the difference is that the lifeline does not consist of tails.
- The messages transmitted over sequencing is represented by numbering each individual message.
- The collaboration diagram is semantically weak in comparison to the sequence diagram.
- The special case of a collaboration diagram is the object diagram.
- It focuses on the elements and not the message flow, like sequence diagrams.

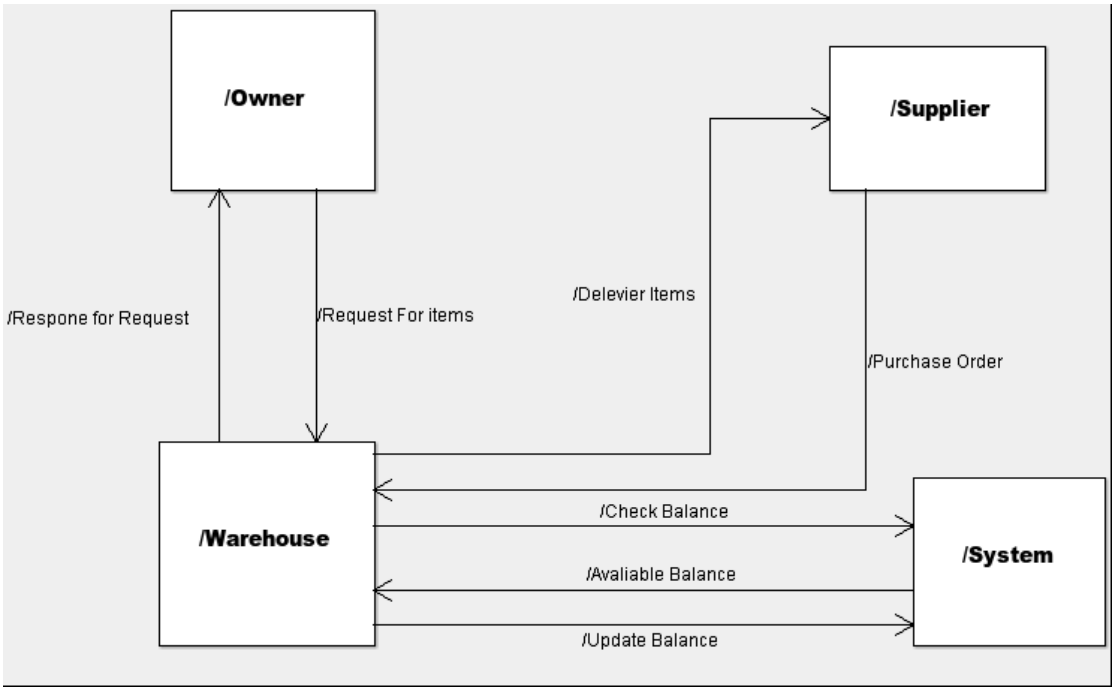


Fig: 4.7.1 Collaboration Diagram

4.8 State Chart Diagram

A State chart diagram describes a state machine. State machine can be defined as a machine which defines different states of an object. These diagrams are used to model the event-based system. A state of an object is controlled with the help of an event. State chart diagrams are used to describe various states of an entity within the application system.

4.8.1 Purpose of State Chart Diagrams

State chart diagram is one of the five UML diagrams used to model the dynamic nature of a system. They define different states of an object during its lifetime and these states are changed by events. State chart diagrams are useful to model the reactive systems. Reactive systems can be defined as a system that responds to external or internal events. State chart diagram describes the flow of control from one state to another state. States are defined as a condition in which an object exists and it changes when some event is triggered. The most important purpose of State chart diagram is to model lifetime of an object from creation to termination. State chart diagrams are also used for forward and reverse engineering of a system. However, the main purpose is to model the reactive system.

Following are the main purposes of using State chart diagrams:

- To model the dynamic aspect of a system.
- To model the life time of a reactive system.
- To describe different states of an object during its lifetime.
- Define a state machine to model the states of an object

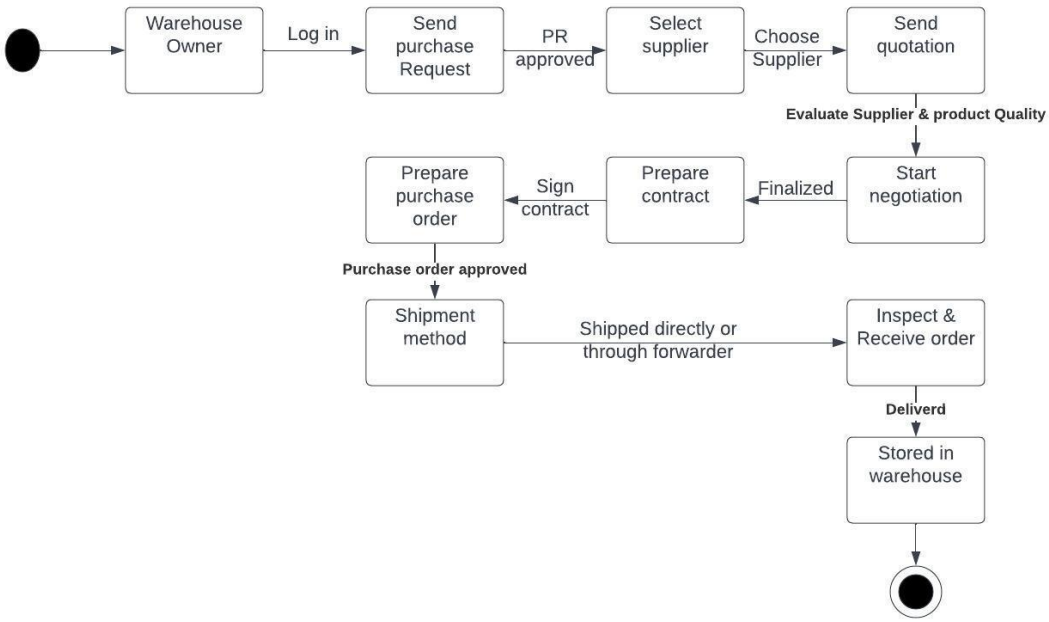


Fig: 4.8.1 State chart Diagram

4.9 Activity Diagram

Activity diagram is basically a flowchart to represent the flow from one activity to another activity. The activity can be described as an operation of the system. The control flow is drawn from one operation to another

4.9.1 Purpose of Activity Diagrams

The basic purpose of activity diagrams is similar to other UML diagrams. It captures the dynamic behavior of the system. Other UML diagrams are used to show the message flow from one object to another but the activity diagram is used to show message flow from one activity to another. Activity is a particular operation of the system. Activity diagrams are not only used for visualizing the dynamic nature of a

system, but they are also used to construct the executable system by using forward and reverse engineering techniques. The only missing thing in the activity diagram is the message part. It does not show any message flow from one activity to another. Activity diagram is sometimes considered as the flowchart. Although the diagrams look like a flowchart, they are not. It shows different flows such as parallel, branched, concurrent, and single.

The purpose of an activity diagram can be described as:

- Draw the activity flow of a system.
- Describe the sequence from one activity to another.
- Describe the parallel, branched and concurrent flow of the system

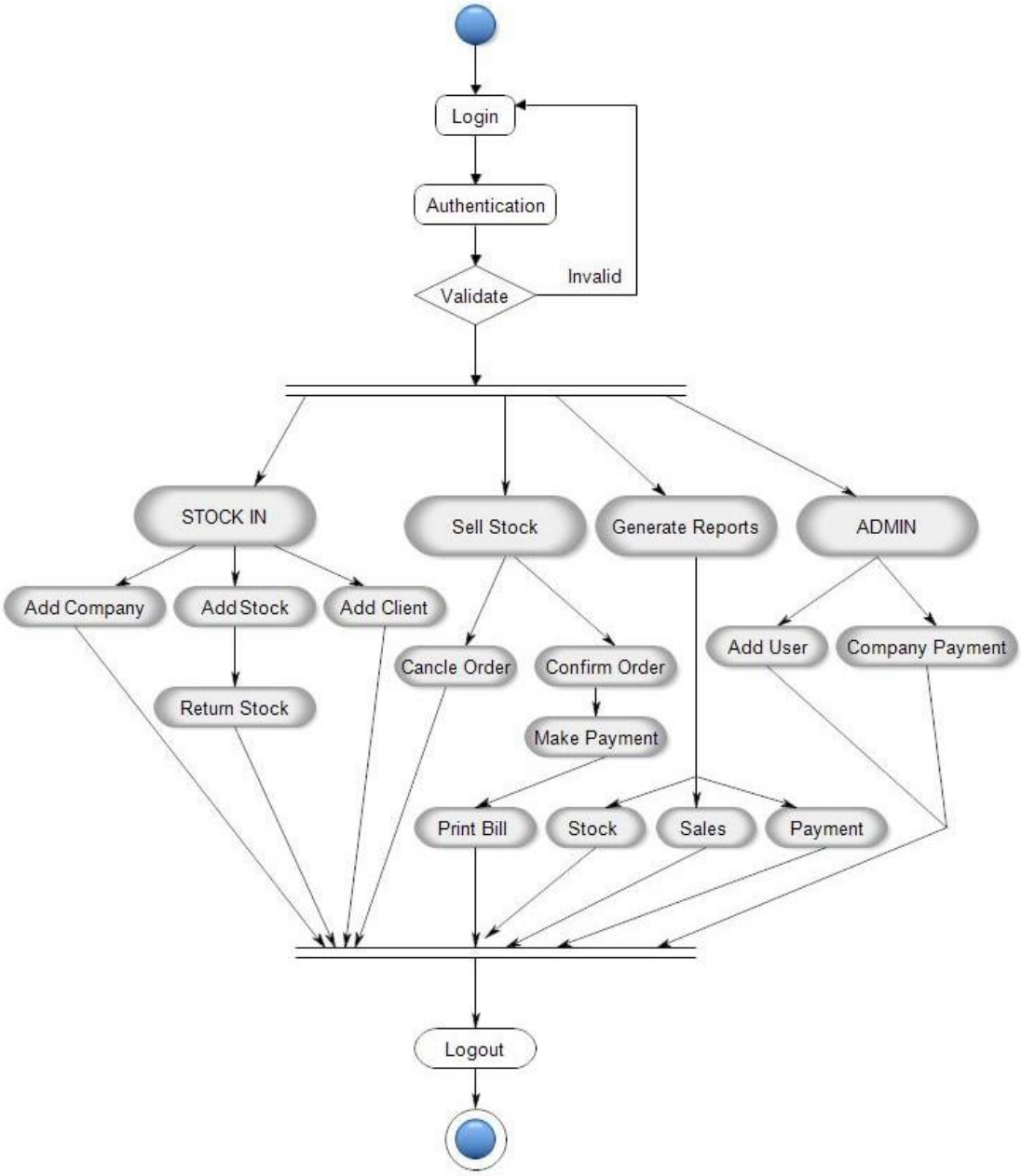


Fig: 4.9.1 Activity Diagram

5. IMPLEMENTATION

5.1 Implementation Strategy

The implementation strategy includes the use of Agile technique of modeling which is wed for the designing process of the complete application. Agile model believes that every project needs to be handled differently and the existing methods need to be tailored to best suit the project requirements. In Agile, the asks are divided to time boxes (small time frames) to deliver specific features for a release.

- Generate bills.
- Admin easily check the current status of all transaction.
- Customer didn't wait for long time.
- Supplier request for invoice.
- Problems in Time management solved.

5.1.1 Supplier

- Request for products.
- Request for Bill.
- Provide own data.
- Supply stocks.
- Pay Amount.

5.1.2 Admin

- Add Products
- Edit products
- Add Stock
- Create Invoice
- Generate Bill
- Take Amount

- Store Transaction
- Search transaction
- Add payment
- Monitor Transaction
- Add Customers
- Add Customers Data
- Add Supplier
- Update suppliers' detail

This system can also monitor incoming and outgoing goods from one or more stores and generate invoice information. The machine, which makes monthly sales analysis, will be able to understand the monthly sales from the store manager. After successful registration, someone can log in with the usage of login credentials. This could be achieved by way of using Python and its libraries together with Tkinter and Turtle. A computerized system does not ensure accuracy, but the warehouse facts are best as good as the records access that created it.

5.2 Hardware Platform Used

The hardware Platform used for any developments is key to fasten up the process of development. Devices used like computing system, memory requirement both primary and secondary are come under hardware requirements. As discussed earlier in the functional requirements about the hardware platform that have been used in the project, same are shown below normal for hardware platforms.

5.2.1 Hardware Requirement:

- i3 Processor Based Computer or higher
- Memory: 1 GB RAM
- Hard Drive: 50 GB
- Monitor

5.3 Software Platform Used

Operating System	Windows 7/8/10
Tool	Visual studio
Framework	Python
Database	SQLite3

5.3 Deployment Diagram

Deployment diagrams are used to visualize the topology of the physical components of a system, where the software components are deployed as shown in below. Deployment diagrams are used to describe the static deployment view of a system. Deployment diagrams consist of nodes and their relationships. A deployment diagram is a UML diagram type that shows the execution architecture of a system, including nodes such as hardware or software execution environments, and the middleware connecting them. Deployment diagrams are typically used to visualize the physical hardware and software of a system.

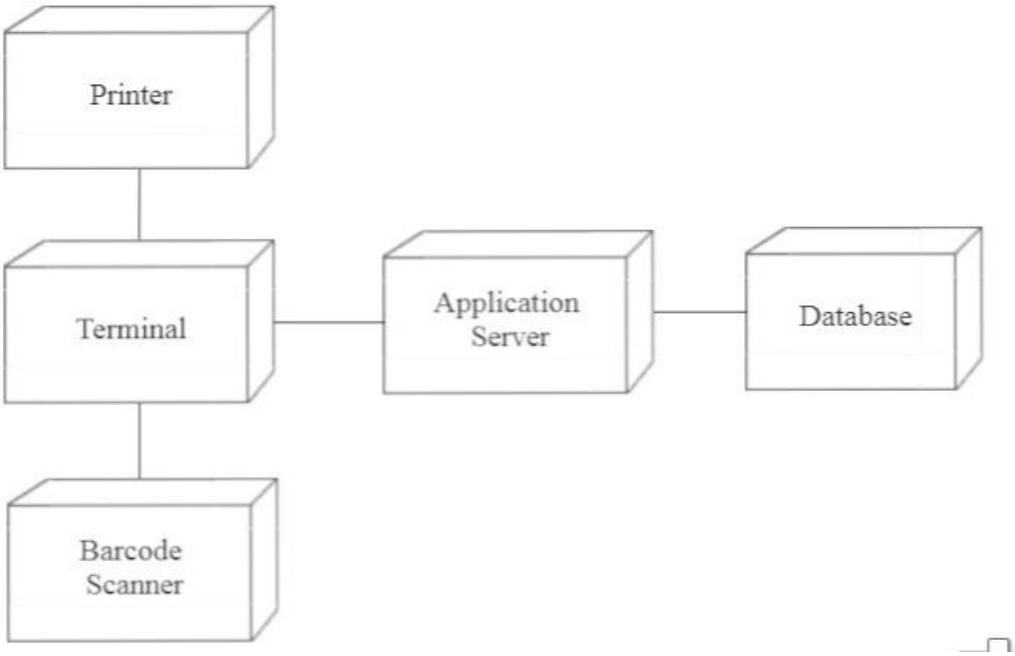


Fig: 5.3 Deployment Diagram

5.5 Testing

What is QA Testing?

QA testing is a function of software quality that assures that procedures and standards are appropriate for a project and are correctly executed. The QA team's job is to improve development and test processes so that defects do not arise when the product is being developed.

What is QC Testing?

QC testing is a function of software quality that checks that the project follows standards, processes, and procedures laid down and that the project produces the required internal and external deliverables. The QC team's job is to identify defects after a product is developed but before it is released. QC aims to identify (and correct) defects in the finished product.

QA/QC for the project shall be done by various audits, reviews and tests, Individual modules shall be test in Unit Test, Integration tests are dime when modules are integrated and System tests are done once the entire product is ready. Below are the QA and QC audit review details and frequency at which such audits reviews shall be conducted.

Sr.	Type of Review	Frequency
1	Requirements Review	On arrival of new module
2	Design Review	On arrival of design change
3	Code Review	For nightly
4	Test Case Review	On completion of new module
5	System Testing	On Integration

There six type of testing that are done in the Auto Lounge that are explained below.

5.5.1 Unit Testing

A unit test is the smallest testable part of an application like functions, classes, procedures, interfaces. Unit testing is a method by which individual units of source code are tested to determine if they are fit for use.

- Unit tests are basically written and executed by software developers to make sure that code meets its design and behaves as expected.
- The goal of unit testing is to segregate each part of the program and test that the individual parts are working correctly.
- This means that for any function or procedure when a set of inputs are given then it should return the proper values. It should handle the failures gracefully during the course of execution when any invalid input is given.
- A unit test provides a written contract that the piece of code must assure.
- Unit Testing is basically done before integration.

5.5.1.1 Advantages of Unit Testing

- Issues are found at early stage. Since unit testing are carried out by developers where they test their individual code before the integration. Hence the issues can be found very early and can be resolved then and there without impacting the other piece of codes.
- Unit testing helps in maintaining and changing the code. This is possible by making the codes less interdependent so that unit testing can be executed. Hence Chances of impact of changes to any other code gets reduced.
- Since the bugs are found early in unit testing hence it also helps in reducing the cost of bug fixes. Just imagine the cost of bug found during the later stages of development like during system testing or during acceptance testing

5.5.2 Integration Testing

In integration testing, individual software modules are integrated logically and tested as a group. A typical software project consists of multiple software modules, coded by different programmers. Integration Testing focuses on checking data communication among these modules.

The three main integration testing strategies are as follows:

- **Big Bang integration testing:** In Big Bang integration testing all components or modules are integrated simultaneously, after which everything is tested as a whole.
- **Top-down integration testing:** Testing takes place from top to bottom, following the control flow or architectural structure (e.g., starting from the GUI or main menu). Components or systems are substituted by stubs.
- **Bottom-up integration testing:** Testing takes place from the bottom of the control flow-up activities. Components or systems are substituted by the driver.

5.5.3 Functionality testing

Functionality testing is performed to verify that a software application performs and functions correctly according to design specifications. During functionality testing, it checks the core application functions, text input, menu functions, installation and setup on localized machines, etc.

The following is needed to be checked during the functionality testing:

- Installation and setup on localized machines running localized operating systems and local code pages
- Text input, including the use of extended characters or non-Latin scripts.
- Core application functions.

- String handling, text, and data, especially when interfacing with non-Unicode applications or modules.
- Regional settings defaults.
- Text handling (such as copying, pasting, and editing)
- Even applications that are professionally internationalized according to world-readiness guidelines require functionality testing. special fonts, and non-Latin scripts.

5.5.4 Smoke Testing

Smoke Testing, also known as "Build Verification Testing", is a type of software testing that comprises a non-exhaustive set of tests that aim at ensuring that the most important functions work. The results of this testing are used to decide if a build is stable enough to proceed with further testing. Smoke testing is a confirmation for the QA team to proceed with further software testing. It consists of a minimal set of tests run on each build to test software functionalities. Smoke testing is also known as “Build Verification Testing” or “Confidence Testing.”

5.5.5 System Testing

System testing is the type of testing to check the behavior of a complete and fully integrated software product based on the software requirements specification (SRS) document. The main focus of this testing is to evaluate Business / Functional / End-user requirements.

It may include tests based on risks and/or requirement specifications, business processes, use cases, or other high-level descriptions of system behavior, interactions with the operating systems, and system resources.

5.5.5.1 System Testing Main Focus Areas:

- **Hardware Interfaces:** System interfaces like software connectivity with USB port, reading DVD'S etc.
- **User Interface:** How easily system is responding to user interface for request like AJAX, call, button click, file upload, etc.
- **Install ability:** How easy the software is to get installed without much effort or knowledge needed.
- **Documentation:** How efficiently use manual is documented to use the software by end user.
- **Usability:** How easy the system software is designed so that it can be put into use by naïve user.
- **Load or stress testing:** This testing define the maximum load capacity of the system software before it could breakdown or crash.
- **Back-activity Compatibility**: If a new version of software is developed, new system should make sure that it supports all the existing interfaces and functionalities that exists in the old version and on the top of that new functionalities are supported.
- **Complex functionalities:** System is behaving as expected for complex functions like output to a file in desired format, etc
- **System Security:** System integrated as a whole is secured enough and allows intended users to access the system functionalities assigned to user.
- **Disaster Recovery/ COB Testing:** How long a system doing to take to recover from outage or disaster without impacting the continuity of business.
- **Performance Testing:** Performance testing is done to make sure system is able to withstand the unexpected loud or request without breakdown.
- **Install ability:** How easy the software is to get installed without much effort or knowledge needed.

5.5.6 Regression Testing

- Regression Testing is defined as a type of software testing to confirm that a recent program or code change has not adversely affected existing features.
- Regression Testing is nothing but full or partial selection of already executed test cases which are re-executed to ensure existing functionalities work fine.

6. CONCLUSION

To conclude, "Warehouse Management System" is a simple software, basically suitable for small organizations. Warehouse management has to do with keeping accurate records of goods that are ready for shipment. It has every basic item, which is used for large organizations. Our team is successful in making the application where one can update, insert and delete the item as per the requirement. This application also provides a simple report on a daily basis to know the daily sales. Though it has some limitations, our team strongly believes that the implementation of this system will surely benefit the organization. Warehouse management is important for keeping costs down while meeting regulations. Supply and demand are a delicate balance and warehouse management hopes to ensure that the balance is undisturbed. Highly trained Warehouse management and high-quality software will help make Warehouse management a success. The Warehouse management will be seen in the form of increased revenue and profits, a positive employee atmosphere, and an overall increase in customer satisfaction.

A warehouse management system provides many benefits. These may include real-time inventory visibility, reduced costs, error-proofing, productivity, or efficiency gains. It's true that costs vary from solution to solution depending on your needs. Warehouse Management Systems contain the functions that permit the operation of any random warehouse, as the business increase and as one moves into a faster and much more dynamic environment, there is a need to speed up processes in each and every day more demanding. Its main goal is to reduce manpower and increase efficiency as well. Warehouse complexity affects the planning and control structure through the comprehensiveness of the work that has to be done. In highly complex warehouses, feeding organizational actors with the right type of information and knowledge at the right time is difficult. It has each primary item that is used for very small organizations or any commercial enterprise, make it big or small, should remember the fact that taking suitable care of our inventory could be very crucial.

FUTURE WORK

Since this project was started with very little knowledge about the Warehouse Management System, we came to know about the enhancement capability during the process of building it. Some of the scope we can increase for betterment and effectiveness oar listed below

1. Modify user interface design.
2. Manage Stock for more than one warehouse.
3. Use of Mongo DB database for storing data on the cloud.
4. Online payment system can be added.
5. Making the system utilize in any platform.
6. Sales and purchase return system will be added in order to make return of products.
7. Lost and breakage.
8. Use of RFID technology for scanning barcode of products.

From drones to robots that collect, package and sort products without human intervention, technology and innovation will impact the warehouse of the future. Ten years from now, we may see all-electric warehouses run by an elite group of workers. The need for robots in warehouses is increasing and it is a trend that is expected to increase as technology is used. The Facts and Figures report estimates that the global robotics as a service (RaaS) market will reach approximately $44 billion by 2028, with an annual growth rate of 16.5% Warehouse renovation. For example, many companies have started using high-tech, flexible conveyor systems to optimize their multi-storey warehouse operations. Having an automated system increases speed and flow rates. Storage facilities in India are expected to double their current capacity by 2022 and nearly triple their 2015 capacity. With the increasing demand for products in Tier 2 cities, investments in the warehouse sector in India may come in the next 4 years.

Future research Smart warehouses play an important role in the future development of warehouses. In this review, we attempt an extensive review of the published research related to smart warehouses. From the contents above, the research on smart warehouses has attracted the attention of scholars, logistics, and other industries. The conclusions, future research opportunities, and limitations are listed below. Information interconnection: Interconnection is a relatively new issue in warehouse operation, which IoT and CPS bring up. IoT, CPS, and other emerging interconnection technologies enhance information interaction within the warehouse system and the entire logistics chain. From the reviewed literature, we can find that RFID is the primary IoT technology used in warehouse operations. The application of other emerging technology, such as sensors and smart things in warehouse operation, needs to be studied. IT-enabled warehouse systems could be another research direction on the system configuration level.

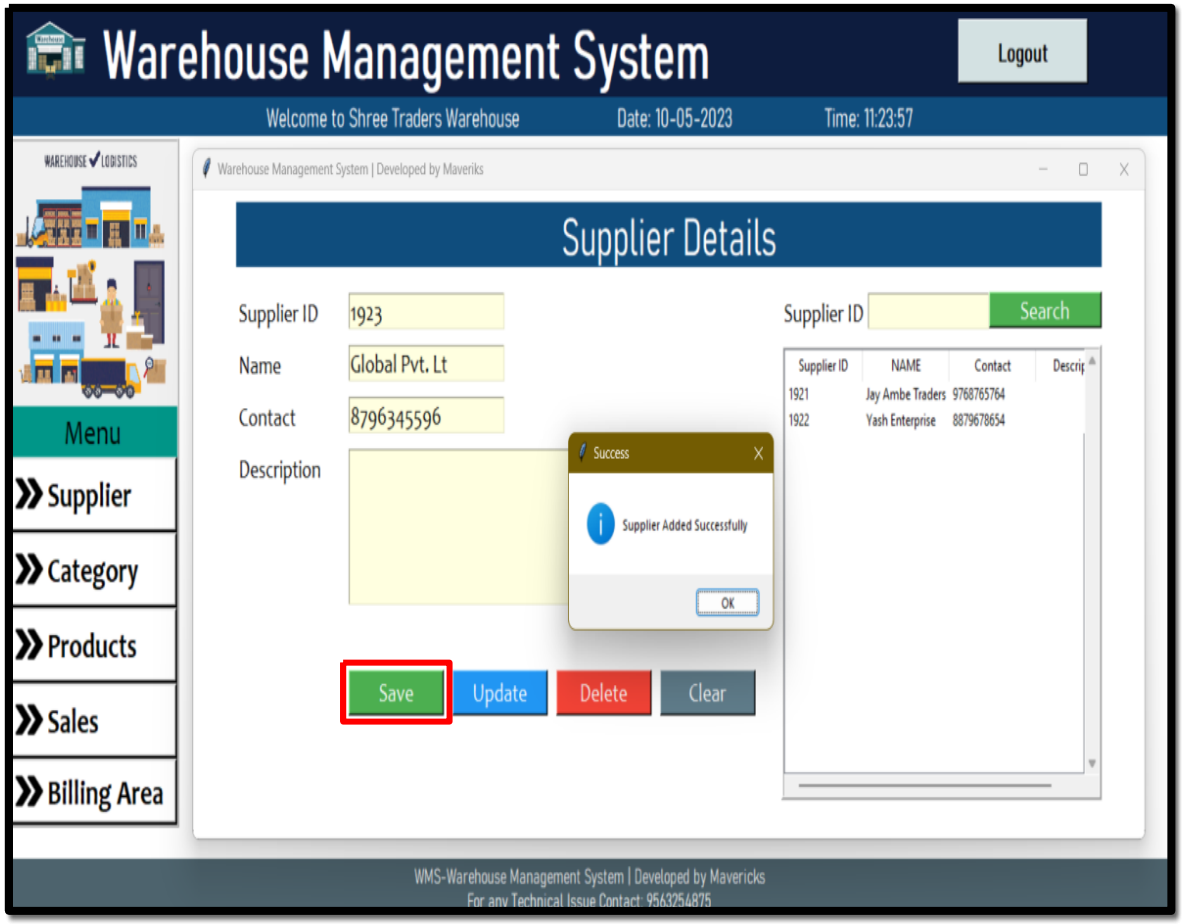
Besides, little research on warehouse operations management has been worked out considering the influence of interconnection technologies. The research on the interconnection issues of warehouse design and control has a broad foreground, for example, real-time control and dynamic decision-making of warehouse systems. Equipment automation: Several automated warehousing systems are reviewed. The deployment of these systems requires large investments and careful planning at strategic and tactical levels. In the future, systems with higher automation levels, such as various warehouse robots, will be implemented broadly and will profoundly change the operation mode. Based on the status of the warehousing industry, research on the upgrade of existing warehouse systems may need more attention.

USER MANUAL

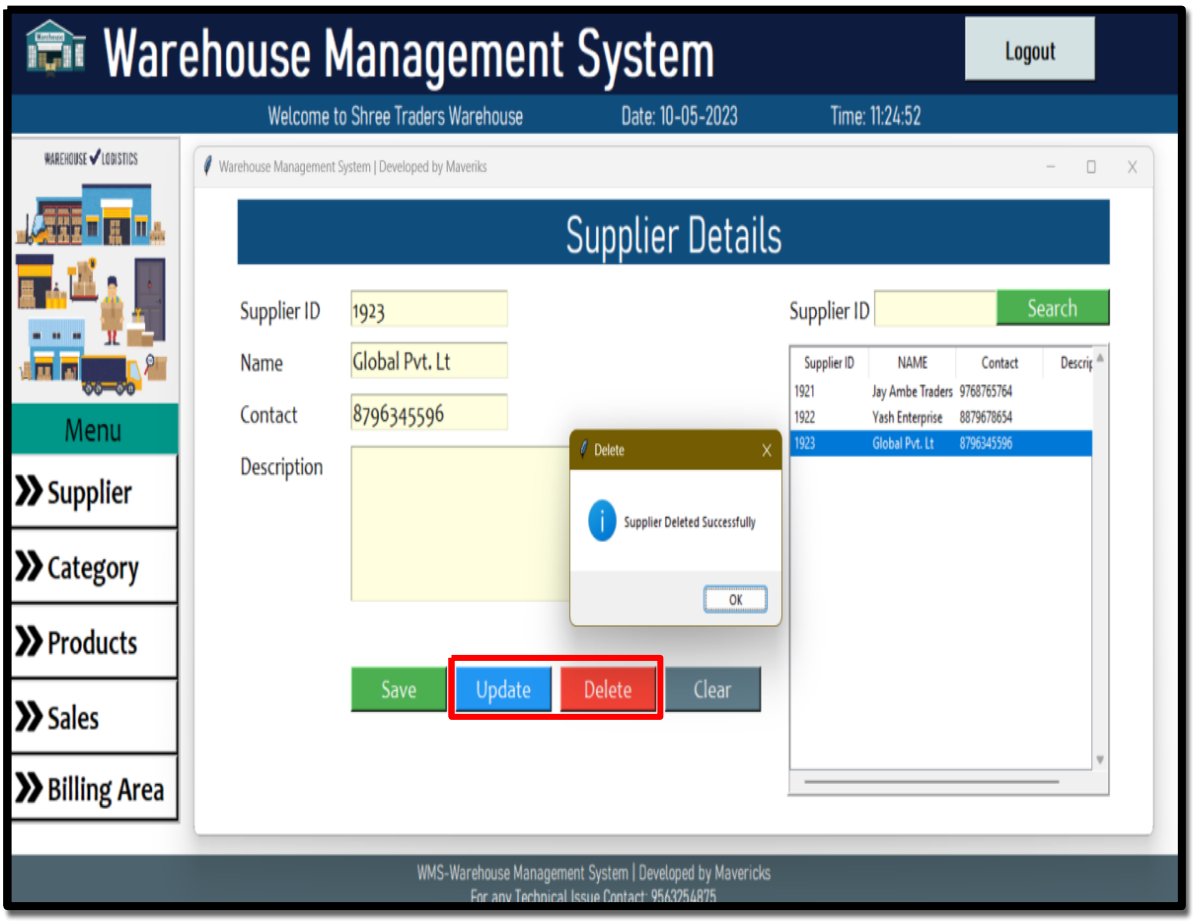
Step 1: Enter the correct credentials and click on “Log In” button to login into WMS.

Step 2: Dashboard: Showing number of Suppliers, Categories, Products & Sales. Click on "Supplier" button to view supplier details.

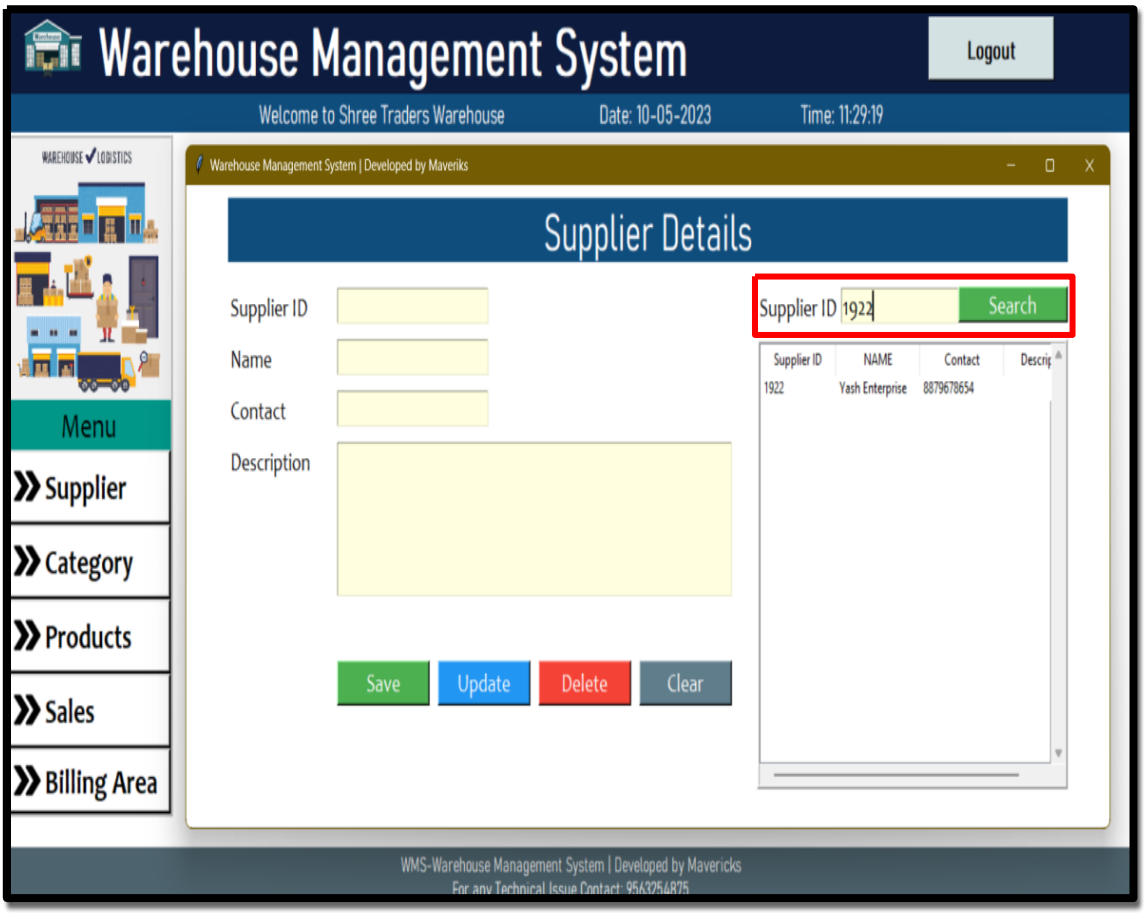
Step 3: Add Supplier: Enter the supplier details and click on “Save” button.



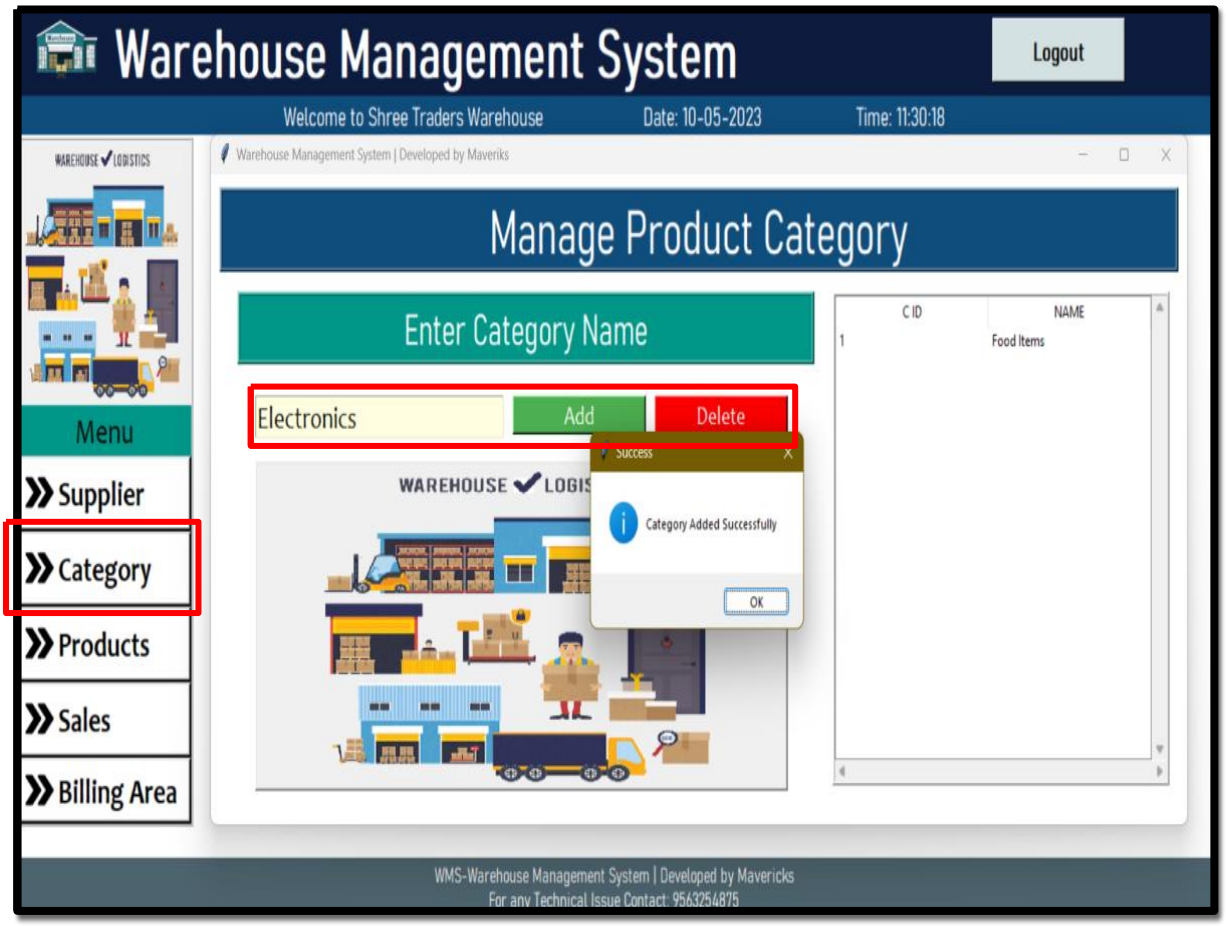
Step 4: You can also update/delete already added suppliers using "Update" & "Delete" buttons.



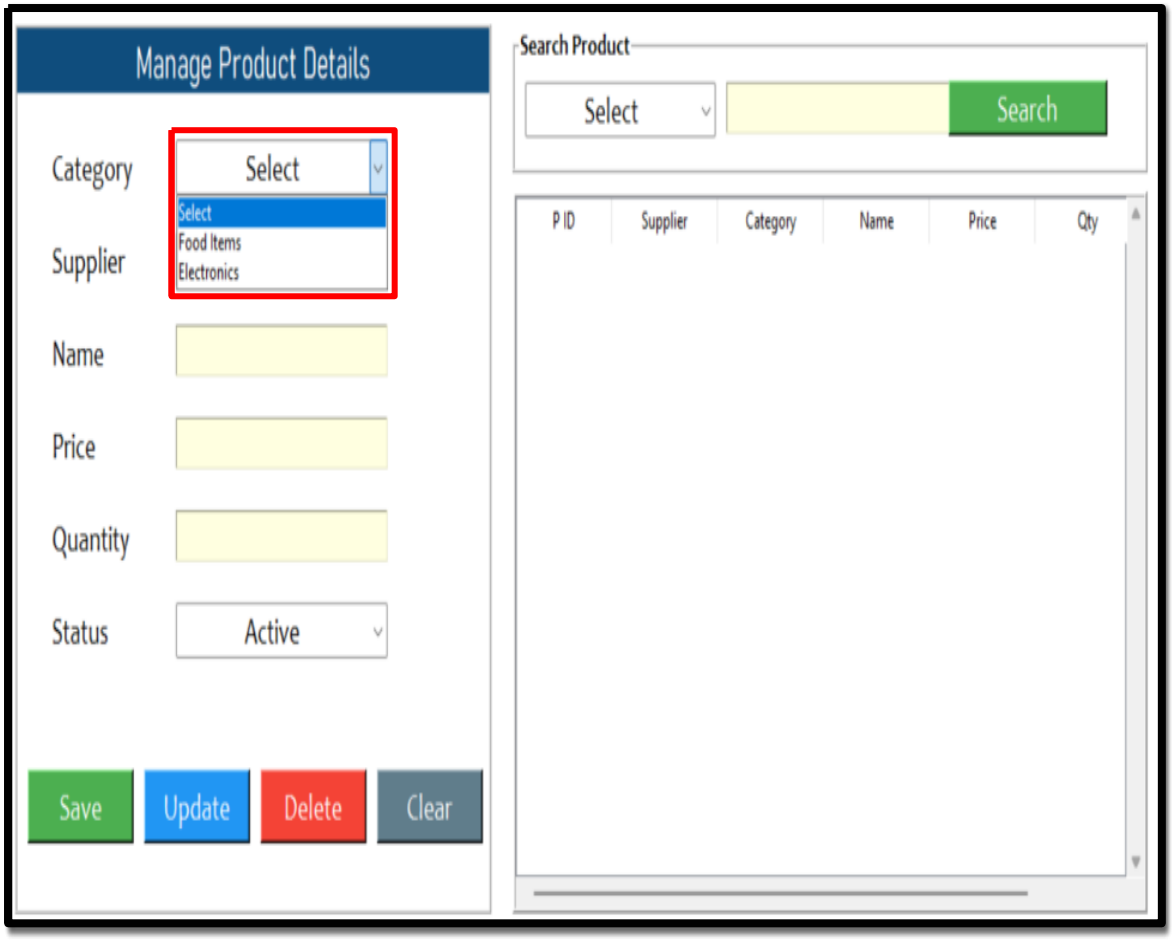
Step 5: Enter the Supplier ID and click "Search" button to search for supplier.



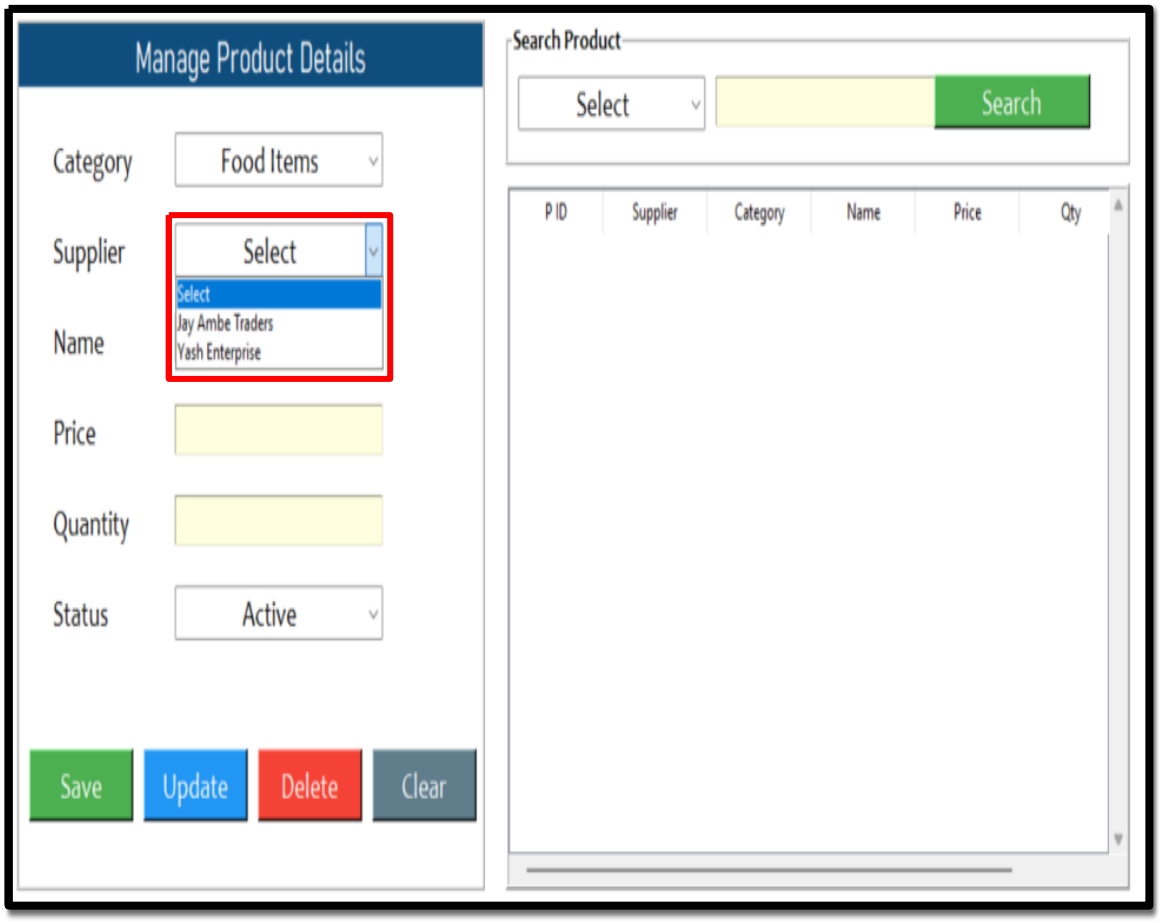
Step 6: Enter the category name and click "Add" button to add category of products, similarly select a category and click on "Delete" button to delete the category.



Step 7(a): Select "Category" from the drop-down list.

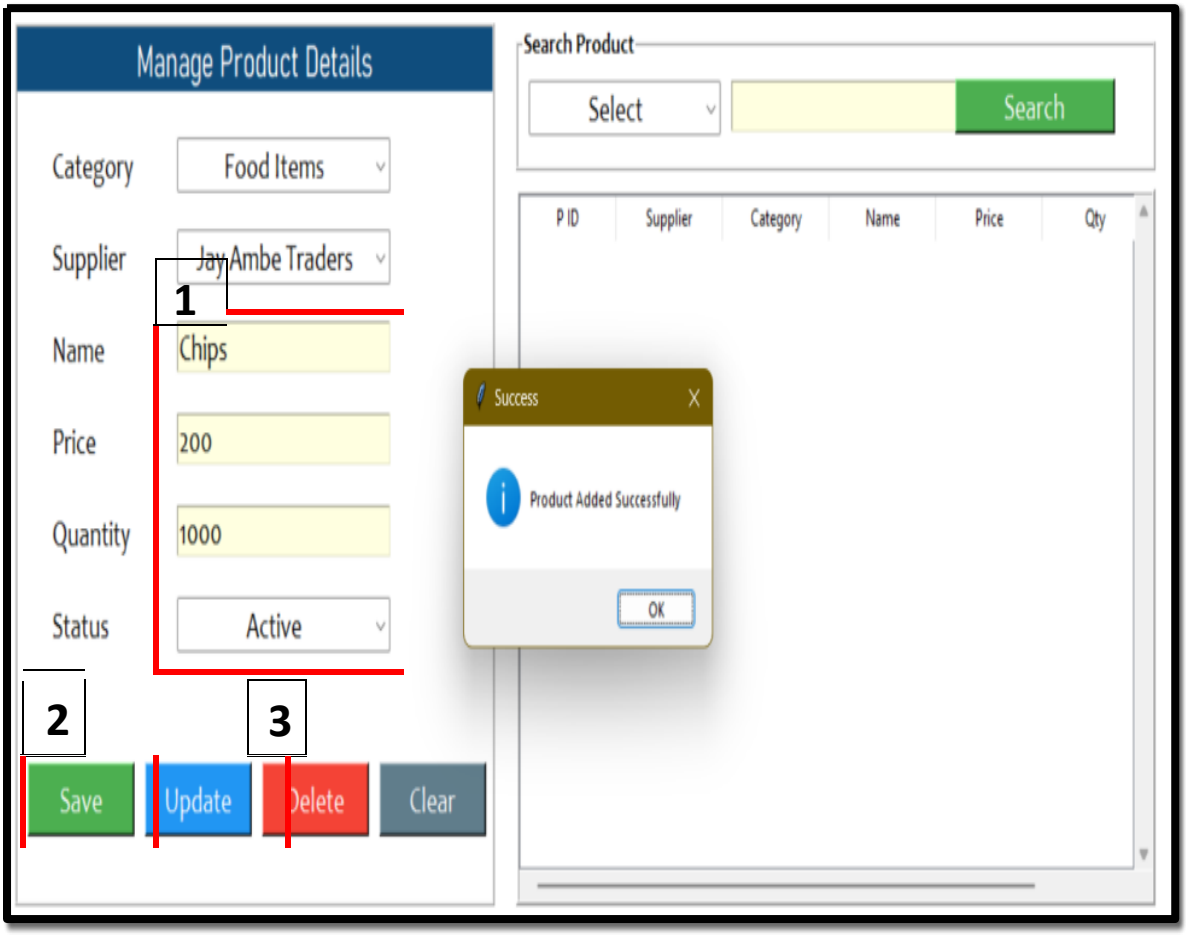


Step 7(b): Select “Supplier” from the drop down list.

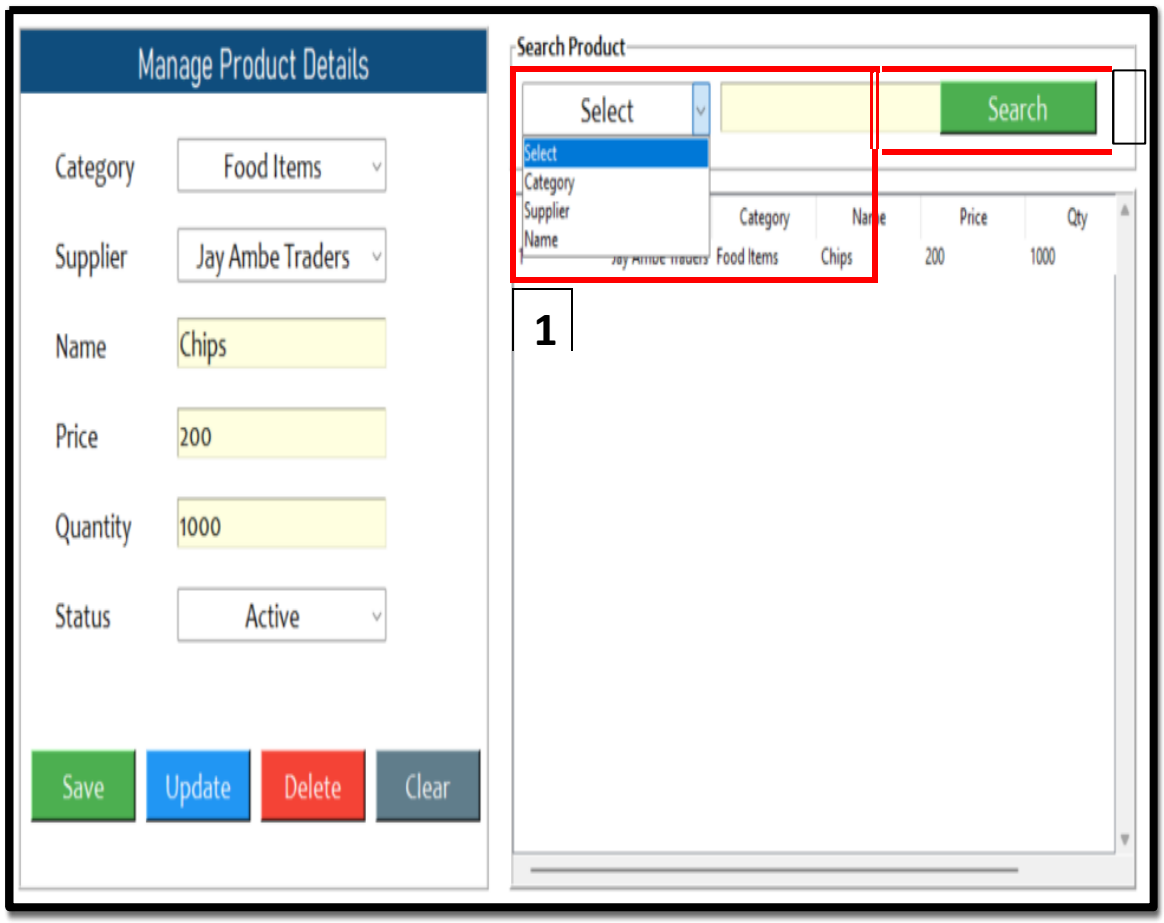


Step 7(c): ***1.*** Add other product details. ***2.*** Click on "Save" button.

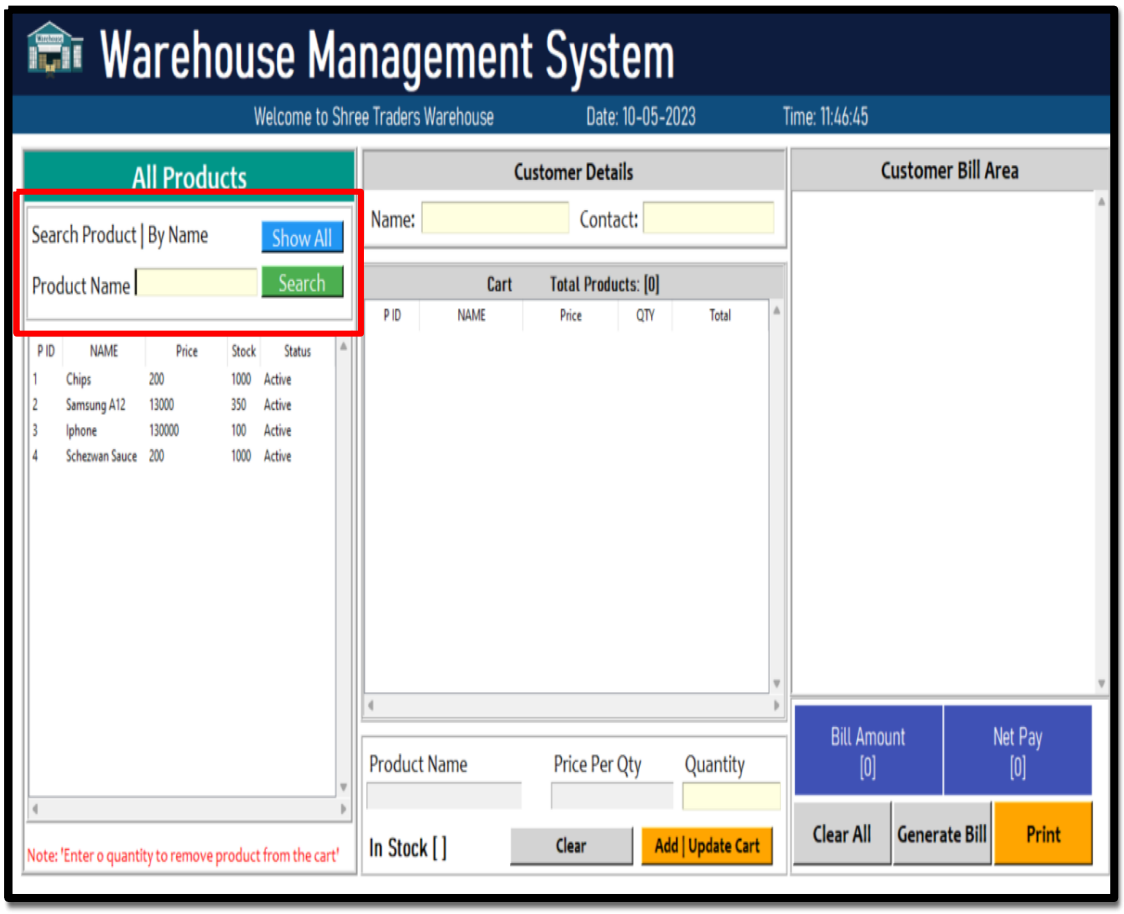
3. You can update/delete product by clicking on "Update" or "Delete" button.



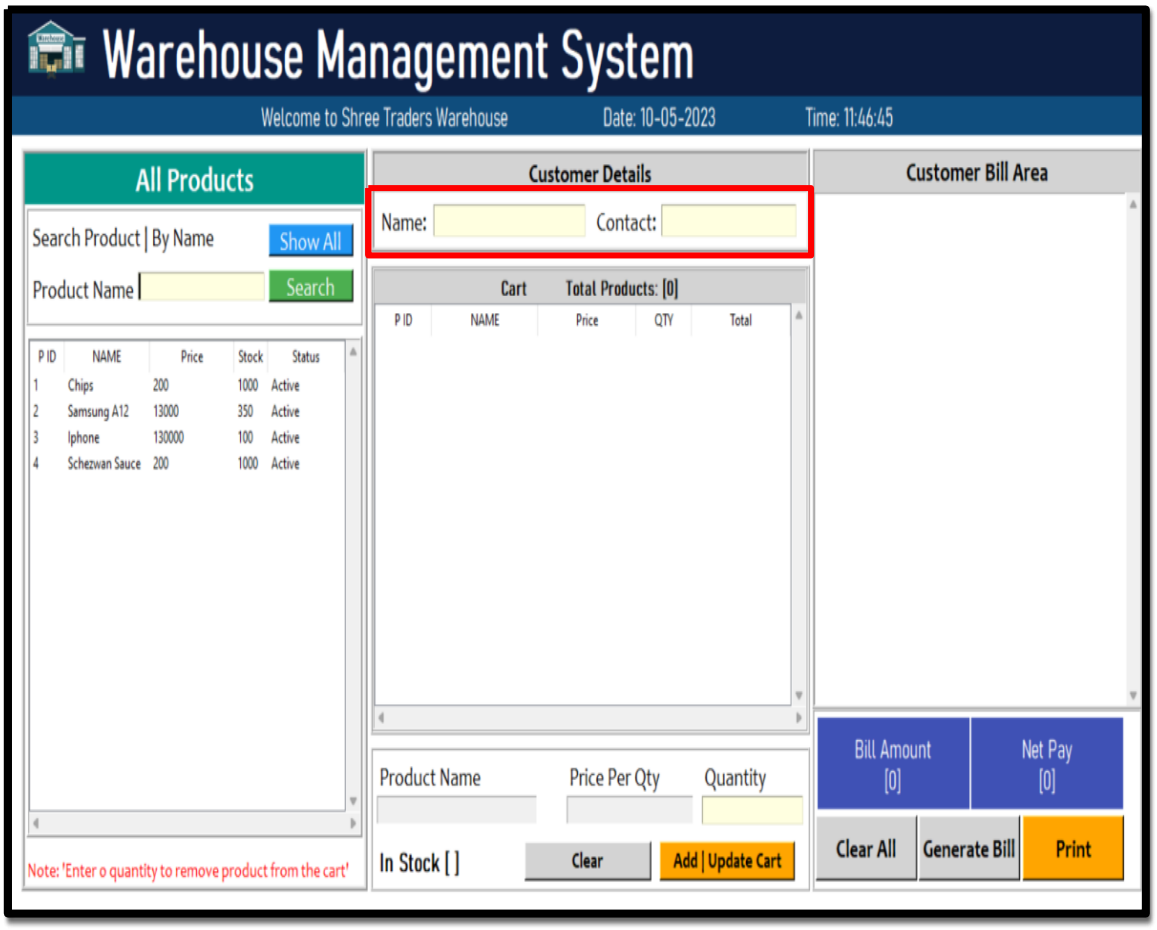
Step 7(d): ***1.*** Select any one from the drop down list. ***2.*** Enter product name & click on "Search" button.



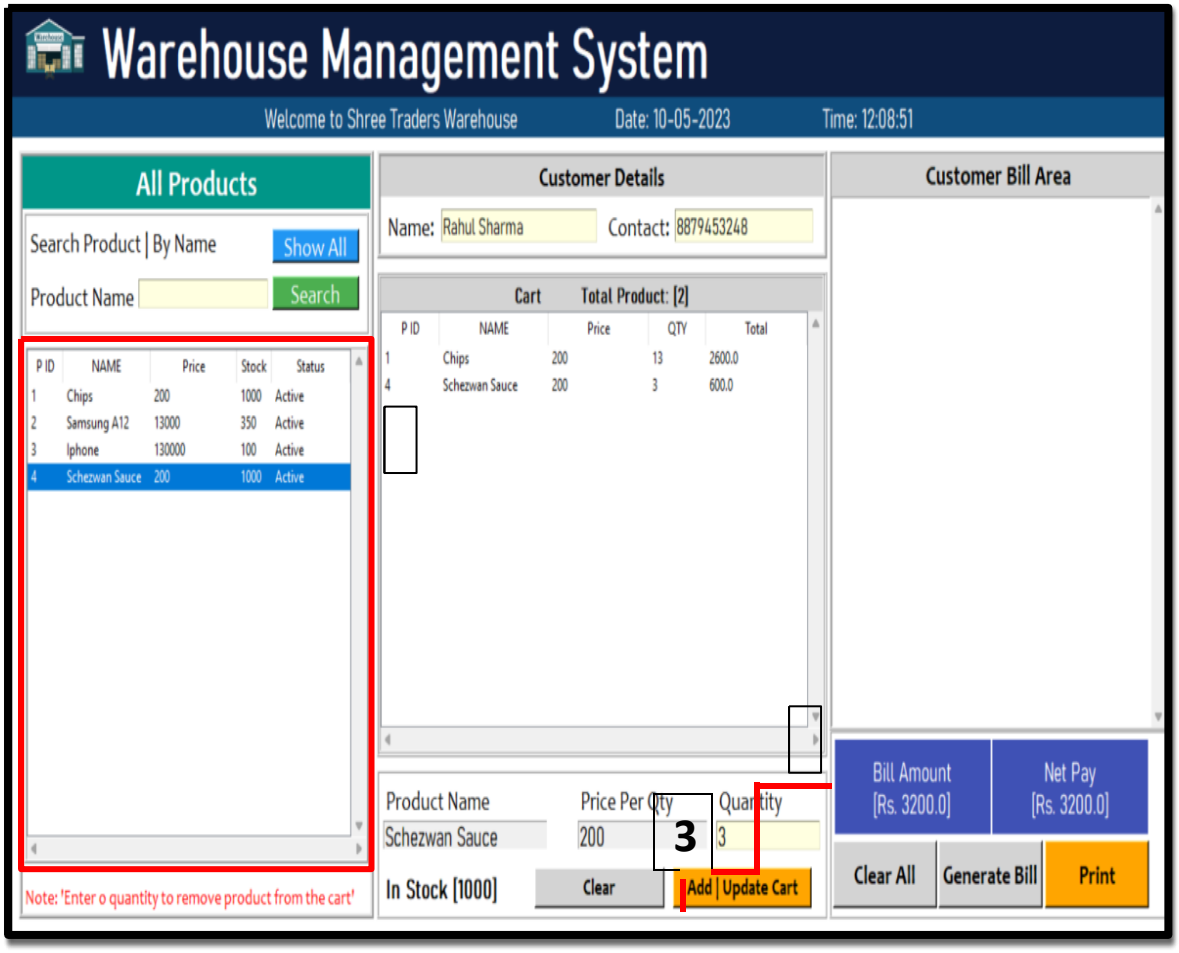
Step 8: Enter product name and click on “Search” to search available products.



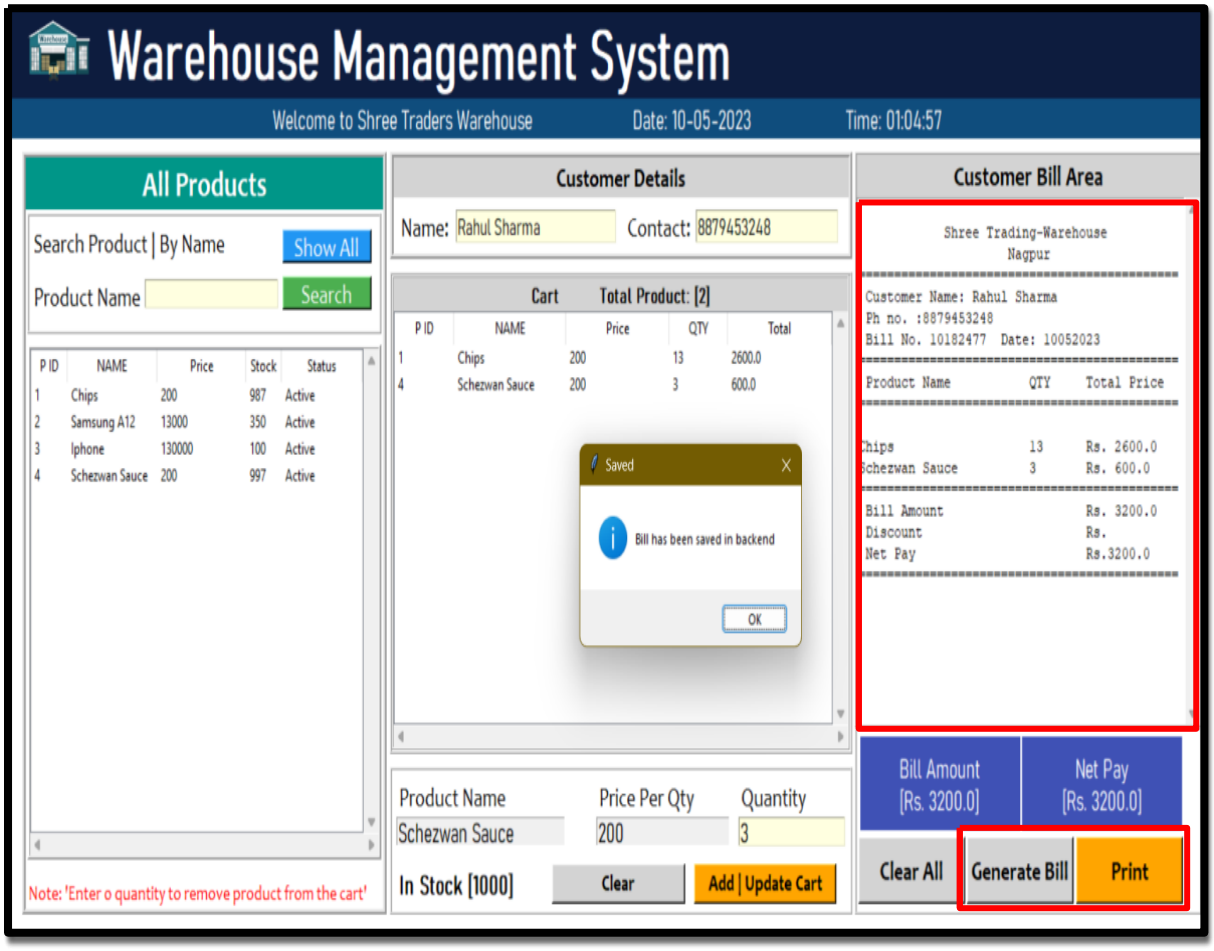
Step 9(a): Enter customer Details



Step 9(b): ***1.*** Select the product. ***2.*** Enter the quantity. ***3.*** Click on "Add | Update Cart" button.



Step 9(c): Click on "Generate Bill" button to save the bill & click "Print" button to print bill.



Step 10: Click on “Logout” button to exit the system.

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38. Warehouse Management System and Business Performance: Case Study of a Regional Distribution Centre Au Yong Hui Nee ESH Department Hoya Electronics Malaysia, 01000 Kulim, Kedah Tel: 04-4033118, Fax: 04-4033108 E-mail: ayhn@yahoo.com (2014)

DISSEMINATION OF WORK

Paper 1

Title - Design And Development of Warehouse Management System

Author - Shreyas Gawande, Ruchita Agrawal, Rutuja Ingole, Prathmesh Akotkar.

Publisher – Vidhyayana An International Multidisciplinary Peer-Reviewed E-Journal

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Design And Development of Warehouse Management System

Shreyas Gawande, Ruchita Agrawal, Rutuja Ingole, Prathamesh Akotkar, A.K. Shahade

Department of Information Technology

Shri Sant Gajanan Maharaj College of Engineering

Shegaon, India

Volume - 8, Issue - 5, April - 2023 | Page 1

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Abstract: *In warehouse control, modern companies and distribution centers are overflowing with information about transporting and storing goods and services. The Warehouse Management System is a warehouse database that can work on small inventories of an organization or group. It is used to keep track of the products sold in a single store or to control the distribution of goods between several different stores. But the system only collects and stores sales data and provides low reports in a particular area at a particular time. The aim is not to control all load changes but to facilitate mind maintenance. The purpose is to reduce the pressure of monitoring rather than handling all hold renovation. The goal is to lessen the strain of monitoring instead of managing all keep maintenance. The aim of this project is to expand computer software programs on the way to allow the user to store and manipulate their statistics effectively and successfully. A WMS target is to help ensure that goods and materials circulate via warehouses in the greenest and most cost-powerful way.*

I. INTRODUCTION

Warehouses sit at the center of producing, manufacturing, and supply chain operations because they keep all the materials used or produced in the one's approaches, from raw materials to completed items. A WMS handles many functions that permit these actions, along with stock tracking, selecting, receiving, and setting away. A computerized warehouse management system simplifies everything from inputting facts to taking inventory. The most effective warehouse system products raise your operating performance, main to extra productiveness It ensures smooth manufacturing operations by using preserving reasonable stocks of substances. It allows normal and timely delivery to customers thru good enough shares of completed products.

The principal purpose of the challenge is to extensively range warehouse management device model software program applications wherein all of the facts regarding the warehouse of the corporation can be furnished. This software provides stability of the warehouse for stable data. Each new stock is created and named with the stock's receipt date and it can be updated at any time as needed based on business or income. The project warehouse management system is a complete computer application developed in Python on the Tkinter framework based on the Turtle library. Use of code visual studio in addition to working with code. This project works with the DB browser and SQLite3.

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II. LITERATURE REVIEW

Warehousing costs make up 2% to 5% of a company's revenue. In today's competitive global business environment, organizations are focused on recovering assets, so reducing the cost of goods has become an important business. adding shipping costs or product rotation to make their products more profitable. An important factor in determining the efficiency of the warehouse is the careful selection of storage space for large volumes of goods in the warehouse.[8] In-depth research is conducted on the various factors affecting the storage industry, such as selection options, sizes and models, materials, products, required features, replacement costs, and regional needs. A suitable station (e.g., random, custom, or beauty-based) and routing method (e.g., Various selection models and response algorithms have also been established to solve warehouse business problems.[8]

Another problem that has plagued the company lately is the number of generations used in the warehouse business. Options range from traditional products – from materials to robots, which use forklifts and even work on racks and racks – to all computer systems using conveyor belts and automated guided vehicles (AGVs). Motivations for choosing at a given time are not static and may differ from the image of the employer or changes in the future market as well as financial, advertising, etc. business or organization [8].

Miebach [12], Matson and White [11], and J\1cGinnis et al. [12] analyzed research activities and data transfer data. They concluded that there were significant gaps in the research and that most studies focused on issues of other limitations. In 1992 Goedschalckx created page 1 of WWW with many publications. In 1996, Van den Berg [10] searched the literature on planning products and companies.

III. CURRENT SYSTEM AND PROPOSED SYSTEM

2.1 Current System

Basically, a small-scale warehouse works with Handwritten records and as a result, increases the work of the business enterprise. The calculations are all manually performed and consequently vulnerable to errors resulting in transaction inaccuracies. The possibility is that the handwritten record can be out of place or maybe lost. The invoice is manually made, growing the work of the corporation to a quantity.

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2.2 Proposed System

This system can also monitor incoming and outgoing goods from one or more stores and generate invoice information. The machine, which makes monthly sales analysis, will be able to understand the monthly sales from the store manager. After successful registration, someone can log in with the usage of login credentials. This could be achieved by way of using Python and its libraries together with Tkinter and Turtle. A computerized system does not ensure accuracy, but the warehouse facts are best as good as the records access that created it.

IV. METHODOLOGY

This project is completely Python primarily based using crucial libraries i.e., Tkinter and Turtle alongside SQLite3 and DB browser.

Since the turtle module uses Tkinter as the image base, it provides the turtle image primitives in object-oriented and process-oriented.

Tkinter is the usual GUI library for Python. Python when blended with gives a fast and clean way to create GUI programs. Tkinter offers a powerful object-oriented interface to the Tk GUI toolkit.

By means of using functionalities, the system offers all styles of options to the consumer for work.

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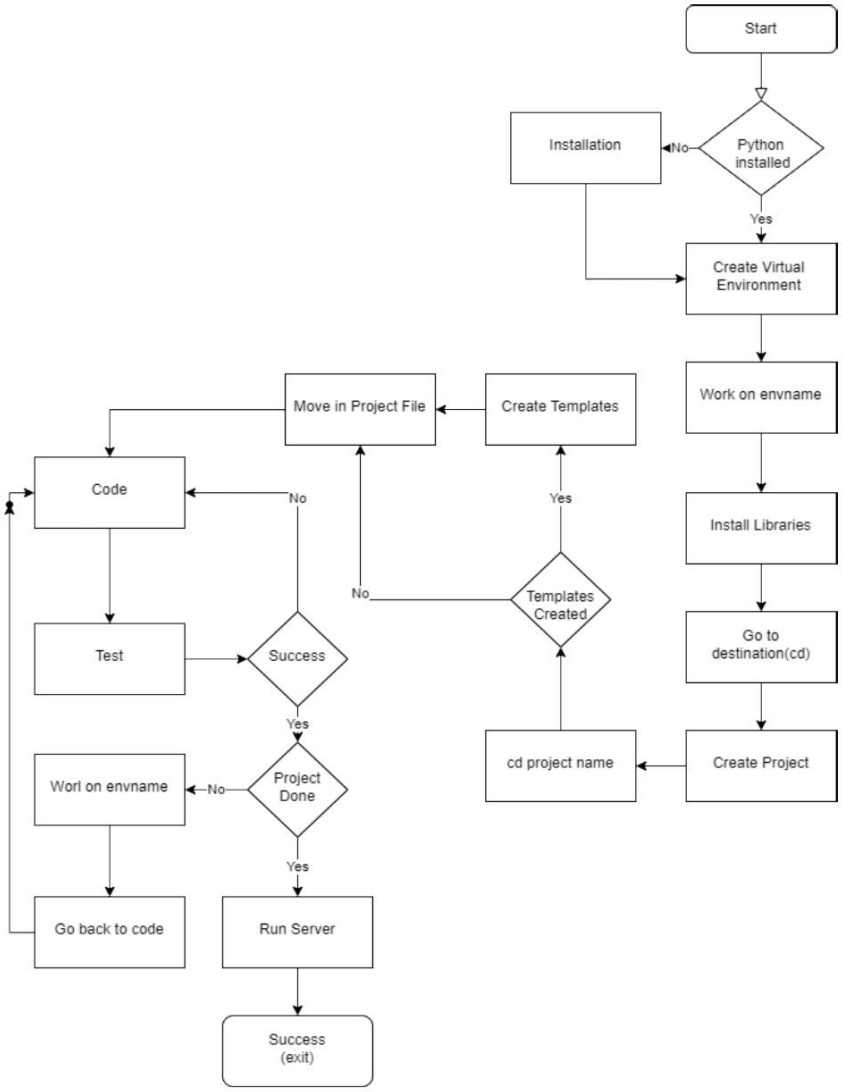

Fig 1: Flowchart of Process

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V. RESULTS AND SCREENSHOTS

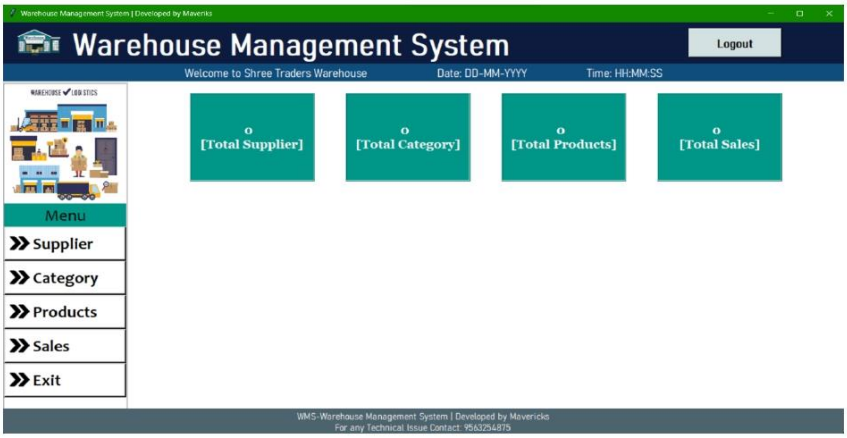

Fig 2: Dashboard

A dashboard is a monitoring tool that displays real-time performance data that the system uses proactively for management. It gives a piece of total information related to warehouse stocks, employees, and sales.

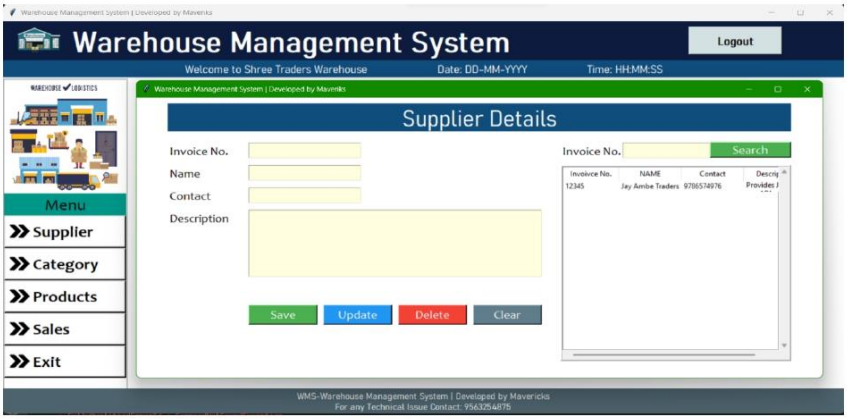

Fig 2: Supplier Page

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This page keeps the records of suppliers and the product the person is providing. It keeps detailed descriptions so that the information can be used as per need.

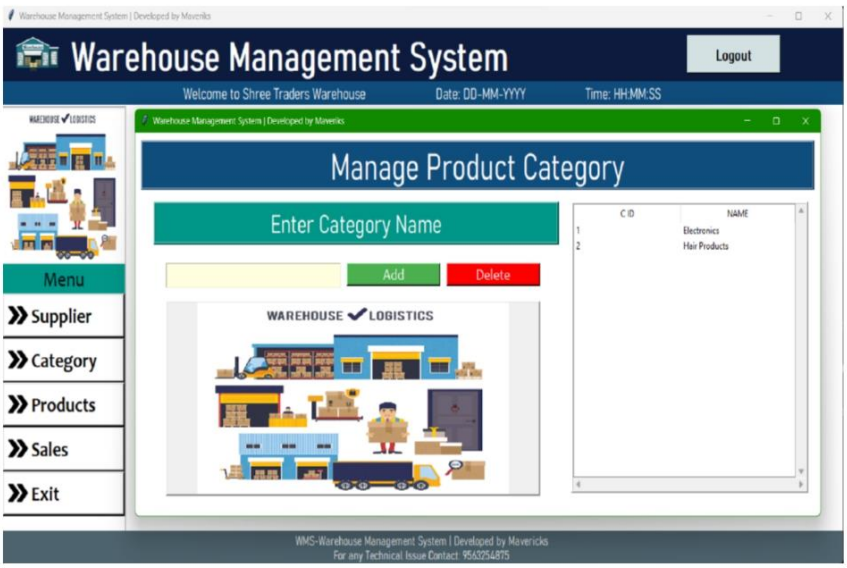

Fig 4: Category Page

The category page contains all records of products and their sales. It sits above the product page. It helps in navigating products to a particular category or group so that users can easily find the stocked item they are looking for.

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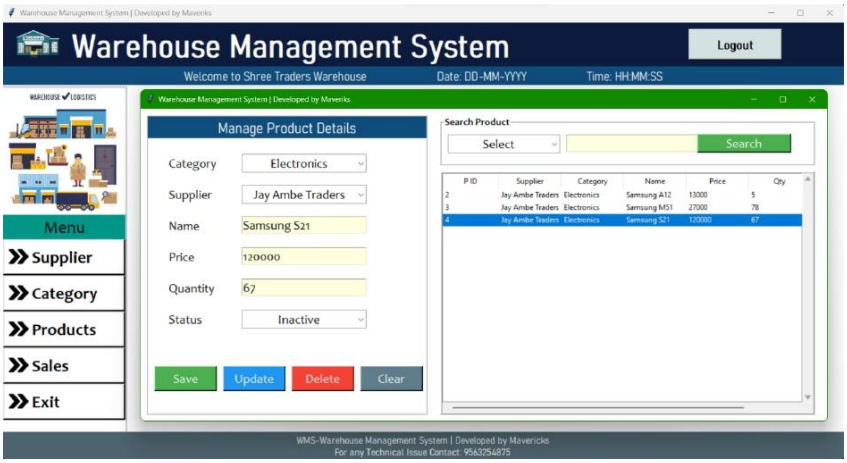

Fig 5: Product Details

Product details can be obtained from this page. User can fill up the records and get a detailed view of stocked item

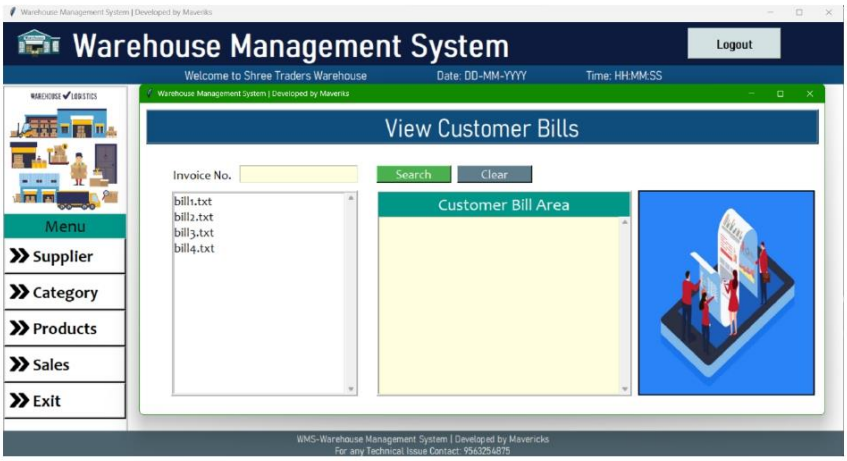

Fig 6: Bills

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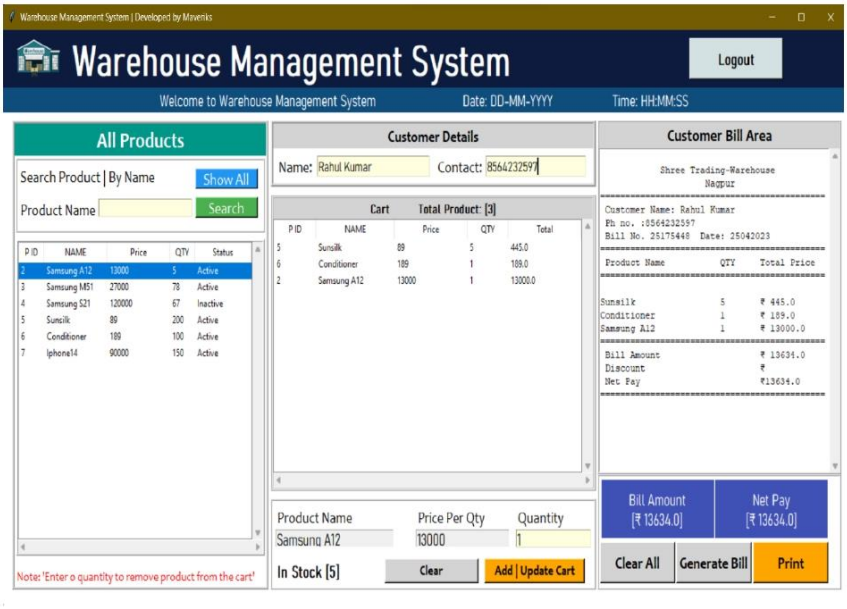

Fig 7: Billing Area

In this way, the results after designing the warehouse management system are shown above.

VI. CONCLUSION

Concluding, this is the basic software for small agencies to keep their products in take look at. This system facilitates the user to keep track of all transactions and keep facts with minimum errors. The warehouse is controlled to a specific degree with invoices. A warehouse management system makes the entirety of inputting data to take inventory easier.

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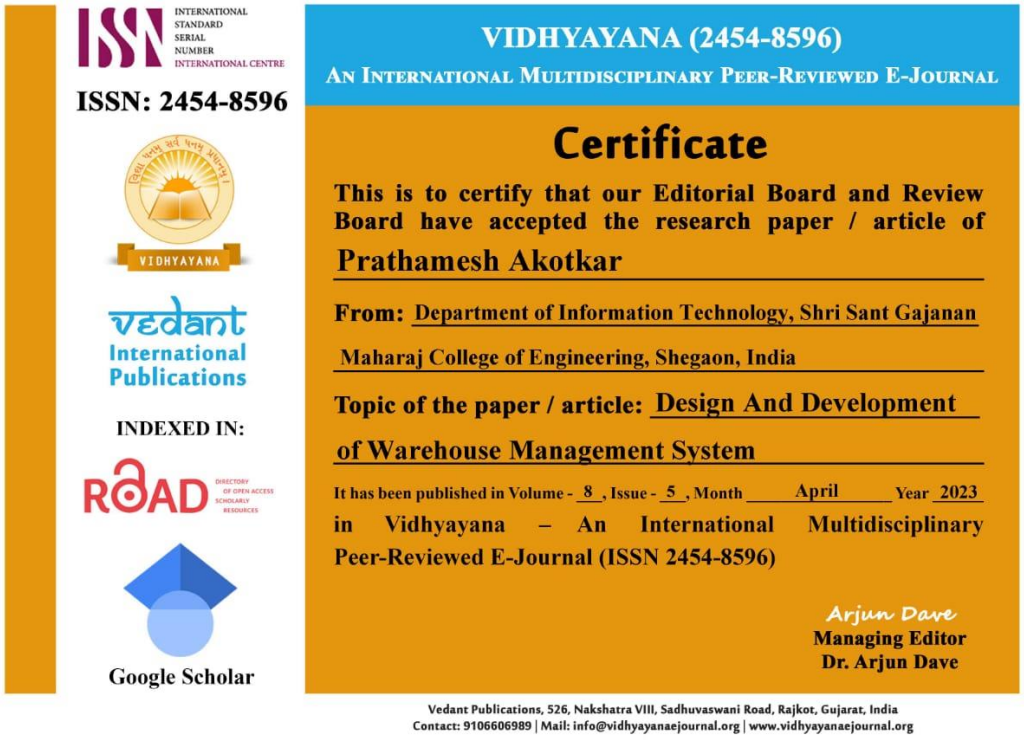

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Topic of the paper / article: Design And Development of Warehouse Management System

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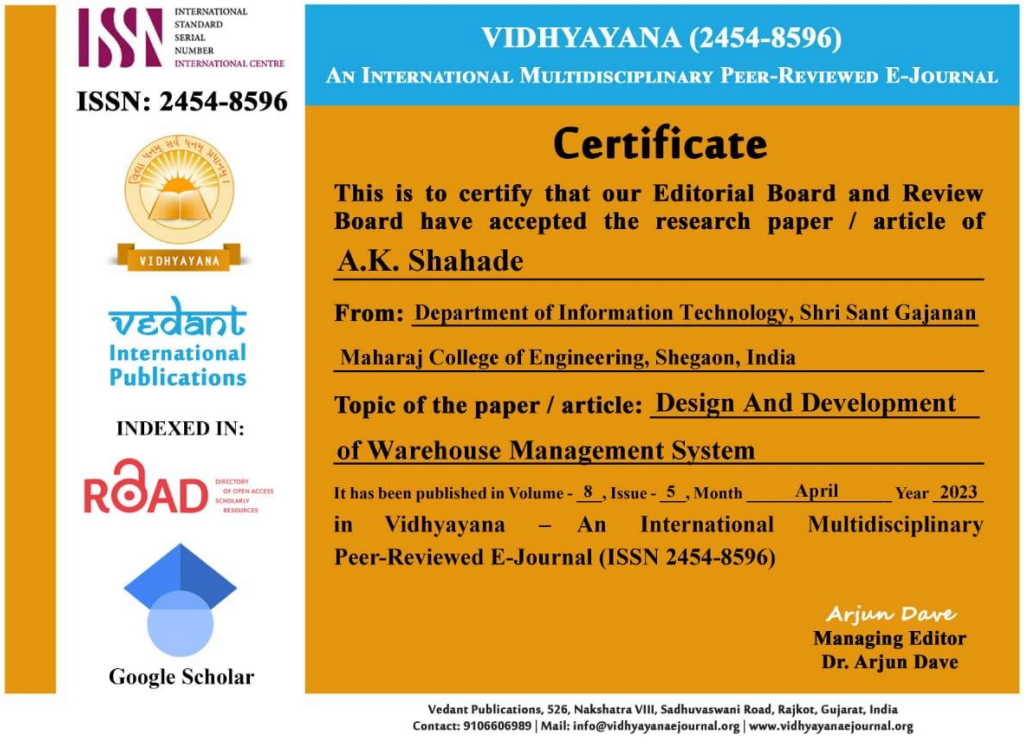

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Paper 2

Title - Review of Warehouse Management System

Author - Shreyas Gawande, Ruchita Agrawal, Rutuja Ingole, Prathmesh Akotkar.

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Review of Warehouse Management System

Shreyas Gawande, Ruchita Agrawal, Rutuja Ingole, Prathamesh Akotkar, A. K. Shahade
Department of Information Technology
Shri Sant Gajanan Maharaj College of Engineering, Shegaon, India

Abstract: *In warehouse management, modern companies and distribution center are overflowing with information about the transportation and storage of goods and services. Warehouse Management systems (WMS) are often used and fulfil these goals. Current work examines the program as a useful tool for finding and using a WMS. In addition, a research methodology is provided to guide upcoming research on WMS and logistics information (LIS) in general. Meanwhile, inventory management is, in general, the study of determining the structure and location of items in stock. It goes beyond the normal and deliberate manufacture and packaging of goods at different locations on the ground or at different locations in the community. It contributes to Warehouse as we see the latest technology evolve in the field. These studies may be extended from time to time to determine the correct and best practice of WMS at any given time.*

Keywords: Warehouse Management Systems, WMS Implementations, Inventory management system, supply chain

I. INTRODUCTION

A warehouse management (WMS) is a software solution that offers visibility into a business' entire inventory and manages supply chain fulfillment operations from the distribution center to the store shelf. The following year in 1975, J.C. Penney created the first real-time WMS. This was a game-changer. With warehouse stock software that updates stock inventory in real-time, J.C. Penney reduced time spent looking for a product that wasn't there and focused efforts on other areas to grow their business.

Research Background: Warehouses play an important role in any shipping process. This article will discuss the key elements required for warehouses to gain value and efficiency in thesupply chain and offer some reflection on current and future tensions. What is clear is that theconstant changes and changes/challenges in areas such as reverse logistics, environmental security, information technology, and sharing the entire chain together are changing the ideas, roles,and responsibilities of the home. In fact, the term "distribution center (DC)" may be appropriate to represent the many activities in a modern warehouse that go beyond meeting customneeds to provide value-added services. The Inventory Management Widget is a real-time inventory management tool for businesses.

Warehouses sit at the center of producing, manufacturing, and supply chain operations because they keep all the materials used or produced in the one's approaches, from raw materials to completed items. A WMS handles many functions that permit these actions, along with stock tracking, selecting, receiving, and setting away. A computerized warehouse management system simplifies everything from inputting facts to taking inventory. The most effective warehouse system products raise your operating performance, main to extra productiveness It ensures smooth manufacturing operations by using preserving reasonable stocks of substances. It allows normal and timely delivery to customers thru good enough shares of completed products.

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The widget only collects and adds sales data and provide slow-stock notifications in a specific area in C language. The goal is to focus attention, to solve all the store's problems. Allocation Inventory Control System is a complete computer application developed in Python time using the Tkinter framework of Pycharm Community Edition. WAMP is software

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based on theWindows operating system that installs and configures Apache web server,MySQL database server, personal text editor, phpMyAdmin (for managingMySQL databases), and SQLite Manager (for running SQLite databases).

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Warehousing costs make up 2% to 5% of a company's revenue. In today's competitive global business environment, organizations are focused on recovering assets, so reducing the cost of goods has become an important business. adding shipping costs or product rotation to make their products more profitable. An important factor in determining the efficiency of the warehouse is the careful selection of storage space for large volumes of goods in the warehouse. In-depth research is conducted on the various factors affecting the storage industry, such as selection options, sizes and models, materials, products, required features, replacement costs, and regional needs. A suitable station (e.g., random, custom, or beauty-based) and routing method (e.g., Various selection models and response algorithms have also been established to solve warehouse business problems.

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III. FUTURE SCOPE

From drones to robots that collect, package,and sort products without human intervention, technology and innovation will impact the warehouse of the future. Ten years from now, we may see all-electric warehouses run by an elite group of workers.

The need for robots in warehouses is increasing and it is a trend that is expected to increase as technology is used. The Facts and Figures report estimates that the global robotics as a service (RaaS) market will reach approximately $44 billion by 2028, with an annual growth rate of 16.5%. Warehouse renovation. For example, many companies have started using high-tech, flexible conveyor systems to optimize their multi-story warehouse operations. Having an automated system increases speed and flow rates. Storage facilities in India are expected to double their current capacity by 2022 and nearly triple their 2015 capacity. With the increasing demand for products in Tier 2 cities, investments in the warehouse sector in India may come in the next 4 years.

IV. SPECIALTY

A warehouse specialist is an executive stocking and warehouse management role for a retail or a department store. Some of the duties of warehouse specialists typically have been:

- Conducting make certain warehouse counting processes to ensure a shipment's accuracy.
- Assess and lead stock rotation procedures.
- Drafting store warehouse space usage.
- Maintaining inventory storage space in the store's warehouse
- Communicating with management about inventory problems that come if products are misplaced or damaged within a loading.
- Led and maintained reservoir records using a warehouse management software system.
- Effective Labour
- Traceable Materials
- Optimized Supply Chain

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- Internal Automation Benefit
- Effective Shipment Management providing better Customer Service
- Ongoing Improvement
- Inventory Visibility

Benefits:

- Optimized space and lower Operating Expenses Warehouse management systems optimize warehouse flow by analysing the best use of floor space based on the task and material characteristics. In the WMS implementations, the use of space and floor plan analysis is used to determine how space should be best used and provides opportunities for reducing waste – waste of premium floor space and waste of time for locating products. This will also lessen potential costs resulting from excessive material movement, time-consuming placement, and retrieval. By considering the best locations to store products, as well as materials or equipment, a warehouse can lower its operating expenses.
- Using a warehouse management system will also provide visibility of accurate, real-time inventory levels. This enables a company to more securely estimate supply and avoid backorders, which leads to more satisfied customers.
- Materials can be easily traced with warehouse management systems using lot, batch, and serial numbering. Lot/batch numbers indicate the group in which materials were made, and the serial number identifies an item specifically. By use of WMS inventory tracking as previously noted, the ability to match specific lot/batch or serial numbers with incoming receipts and outgoing shipments allows for full traceability. This ability to trace materials lowers any potential redundancy, enables accurate inventory planning and allocation, and provides current retrievable information for either future traceability, service maintenance, or recall situations.
- A warehouse management system optimizes a warehouse's internal operation which can then extend to the broader supply chain. Within the warehouse, a WMS streamlines the entire warehouse process from inbound receipts to outbound deliveries improving operational efficiencies and reducing costs. Warehouse staff achieves fast and accurate shipments by reducing or eliminating unnecessary or non-productive activity. These savings in time and cost coupled with improved processes and information can then be passed along to internal and external partners enabling them to improve their own operations. For example, improved inbound receiving reduces delivery times, enabling delivery partners to better leverage their equipment and resources and shippers to better manage inventory levels. Improved data can reduce risk and increase reliability, benefiting shippers, suppliers, and customers. Data can be shared and leveraged back to an ERP or to a customer, as well as to a TMS (Transportation Management System). The product can arrive to its final customer more quickly while allowing the partners upstream to improve planning. Inventory fulfilment service can be aligned to inventory management; enabling optimized operations while reducing time & inventory carrying costs.

V. CONCLUSION

A warehouse management system provides many benefits. These may include real-time inventory visibility, reduced costs, error-proofing, productivity, or efficiency gains. It's true that costs vary from solution to solution depending on your needs. Warehouse Management Systems contain the functions that permit the operation of any random warehouse, as the business increase and as we move into a faster and much more dynamic environment, there is a need to speed up processes in each and every day more demanding. Its main goal is to reduce manpower and increase efficiency as well. Warehouse complexity affects the planning and control structure through the comprehensiveness of the work that has to be done. In highly complex warehouses, feeding organizational actors with the right type of information and knowledge at the right time is difficult. It has each primary item that is used for very small organizations or any commercial enterprise, make it big or small, we should remember the fact that taking suitable care of our inventory could be very crucial.

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This is the basic software for small agencies to keep their products in take look at. This system facilitates the user to keep track of all transactions and keep facts with minimum errors. The warehouse is controlled to a specific degree with invoices. A warehouse management system makes the entirety of inputting data to take inventory easier.

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SPONSORSHIP AND COMPLETION LETTER

SHREE TRADING COMPANY

(PERFECT SOLUTIONS IN WAREHOUSING & TRANSPORTATION)

OFFICE ADDRESS: PLOT NO.02,AMARAVATI ROAD NEAR NAGAR PARISHAD, SHIVAJI NAGAR, WADI NAGPUR – 440023.

PHONE NO.:- 99606 95638 / 8975966774

E-MAIL ID:- umashree987@gmail.com

DATE :- **25-08-2022**

To Whom it may concern

Students Name: 1) Shreyash Gawande

2) Ruchita Agrawal

3) Rutuja Ingole

4) Prathmesh Akotkar

Of SSGMCE, IT Department

Shree Trading Company agrees to pay all expence for the above-named student of SSGMCE. The sponsorship includes, but is not limited to, development of project/software maintenance of software/services.

Project Name:- Warehouse Management System

This sponsorship will cover the student beginning on **August 2022 to March 2023**.

Sponsorship Amount - **Rs. 8000/-**

Contact Person:- Santosh N..Ghorpade

Company Name :- Shree Trading Company

Address:- Wadi, Nagpur

Pin Code:- 440023

Country: India

Email:- umashree987@gmail.com

Contact Name:- Santosh Ghorpade

SHREE TRADING COMPANY

PROPRIETOR

Sincerely,

Name and Sing of Contact Person

SHREE TRADING COMPANY

(PERFECT SOLUTIONS IN WAREHOUSING & TRANSPORTATION)

OFFICE ADDRESS: PLOT NO.02,AMARAVATI ROAD NEAR NAGAR PARISHAD, SHIVAJI NAGAR, WADI NAGPUR – 440023.

PHONE NO.:- 99606 95638 / 8975966774

E-MAIL ID:- umashree987@gmail.com

DATE :

Project Completion Certificate

To Whom It May Concern:

This is to certify that, the below mentioned students of Fourth Year, Department of Information Technology, SSGMCE, Shegaon, have successfully completed the development of a project named as "Design and Development of Warehouse Management System" for Santosh Narayan Ghorpade under the guidance of Prof. A. K. Shahade.

Student Names:

1) Ruchita Agrawal

2) Rutuja Ingole

3) Prathmesh Akotkar

4) Shreyas Gawande

We state on record that, these students have worked on the development of this project from date 30/08/22 to date 30/03/23. We appreciate and value their efforts towards the completion of project. They have successfully developed this application as per the expectations and achieved all the mentioned objectives.

We also appreciate the continuous mentoring by Prof. A. K. Shahade for his continues mentoring and valuable suggestions to the students during development of project.

Thanking You,

Santosh N. Ghorpade,

Shree Trading, Wadi, Nagpur.

SHREE TRADING COMPANY
PROPRIETOR

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