Automated Warehouse Robots

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Abstract- **Automated Warehouse Robots are the warehouse robots that are used for transporting products from source to destination in a warehouse. The present paper provides an overview of the literature that were surveyed and published in different papers over the past few years. A comprehensive explanation of the present state of the warehouse robots is provided with a varied range of applications such as travel time estimation, collision detection, product identification etc. First the robot identifies the product. Then using a suitable optimal path, it transports the product from the source to its respective assigned shelves. This process goes on till the robot transports all the products from the source to respective shelves assigned to it. But due to increasing demands in orders of products, a new model which is more dynamic should be developed to decrease the computation time for transporting products from source to destination in a warehouse and also decrease collisions.**

This is a literature survey where we are automating the warehouse robots.

Keywords **–Warehouse Robot, Line follower, Travel time estimation, Collision detection, Product identification, optimal path.**

I. INTRODUCTION

Many E-Commerce retailers have emerged over the last few years. Retailers such as Flipkart, Amazon have huge warehouses where different goods/products are stored. The retailers will gain more if the products are stored for minimum possible time in the warehouse and delivered to customer as early as possible increasing the customer level service. These retailers have started using robots for warehouse operations to meet the largely increasing number of orders from customer. On an average, a warehouse varies from a one-stored building to a building spread across a large area. These robots are typically used for transporting products from one place to another within the warehouse. The main objective of these robots is to identify the product and transport it from the source to its preferred destination. There are many technologies which the robots use to identify products among which RFID technology, BAR-CODE scanner technology and LASER scanner are the most popular. The most important domain where the robot can reduce the travel time is by using the most optimal path possible. This is achieved by using available routing algorithms which are feasible and easy to implement which satisfies the requirements and conditions. Then the next step involves the use of simulated environment that may consist of either nodes or paths that guide robots to move from the source to its destination. Finally upon reaching the destination the robots drops the products in their respective shelves and using the optimal path the robots return to their initial position. We are trying to automate the warehouse robots. Our main aim is to optimize the minimum cost path from the packing operator to the storage shelf. Also we are trying to detect the collision between two robots and controlling the robot using mobile through Bluetooth module.

II. LITERATURE SURVEY

A. Product identification

For automating a warehouse which involves using an automated robot, the first step involves identifying the product using a suitable technology. The following papers is an overview on the technologies that are used for product identification.

In RFID Technology applied in warehouse management system[1] it includes goods receiving, warehousing, picking, matching, stock taking and withdrawing. The picking order is done by the Front end system. Back end system receives the order and checks if the collected data is matched. These data are sent to the back end system using LAN (wireless networks). This technique decreases the labor intensity. Errors like fault scanning rescanning and miss scanning are avoided. This increases the efficiency of the warehouse.

In three engineers, hundreds of robots, one warehouse [2]Product identification is done by using two cameras. One camera is placed under the inventory and another camera is placed on the floor [2] this gives the information of the location.

An RFID warehouse robot [3]uses the response of the robot while tracking the line is done quickly by placing IR sensors at the bottom of front of the robot. While lifting the robot will read the ID of the tag and move it to the destination. Using RFID reader this function is used to communicate half duplex. The RFID tag is placed above the antenna. The data is configured to serial communicated with the RFID reader. The data is sent in the Hexadecimal format to obtain the tag ID from the RFID reader. The signal received from the reader is saved at file register. The received data is checked if it is matched or not and it is displayed on the LCD. Future development using this technique can be done such as by adding database in the host computer, develop graphical user interface for controlling the robot, implementing RFID robot with wireless communication using host computer,

implementing GPS module into the RFID robot navigation system.

A robot scans the RFID [4] or barcode information through laser technique and transmits the information to the computer. A picking robot will place the box retrieved on sorter or the conveyer as per the central software. The central software will provide directions for a loading robot which will aggregate the boxes to pallet. Several robots will pick products from one or more locations and place them on a conveyer.

B. Routing methods

It is very crucial to design a routing method to deliver a multiple products to different location in a warehouse system and also it has to reroute the robot whenever there is a collision detection. Once the robot identifies the all the products it has to decide to drop the nearest product according to its present location. The best decision can be made using the Dijkstra's algorithm, which computes the shortest distance to every node [5]. When the robot drop the first product the local search is performed using the breadth first search(BFS) to increase the performance of the robot[5]. It is very difficult to find the optimal solution for the routing because total travel is dependable on warehouse environment and the layout.

InBatching orders in warehouses by minimizing travel distance with genetic algorithms [6] proposed the genetic algorithm (GA), GA based optimization algorithm will give the efficient solution to all the batch structure and the warehouse layout. In this approach, the estimation of travel distance is not required to be calculated in advance. The genetic based algorithm which is alternatively known as Generic Algorithm Based Batching Method (GABM), directly minimizes the total distance travelled by the warehouse robot.

The routing decision for the multiple product to store is also done by the travelling salesman problem (TSP) [7]. The objective is to minimize the total distance travelled by the robot must be least. The TSP in the warehouse is special because of the aisle structure of the possible travel paths. In this TSP all the locations will be covered source to multiple destination and at last the robot will come the initial position where the tour is started.

The TTL [8] method which will eliminate the robot crawling and collision problems.It has three parts in which, Abstract Transition System (ATS) is used to model the warehouse environment as collision free environment, and Linear Temporal Logic (LTL) formula is used to compute the total distance of the task. Then combining the ATS and the Buchi automaton translated from the LTL formula, a Minimum cost Task Decision Algorithm is computed to obtain the task decision for the warehouse robot.

C. Simulated Environment Path

There are two possible ways by which the automated warehouse robots can determine the path to be traversed. [9]. LINE FOLLOWER-Line follower is an autonomous robot which follows either a visible black line in white are or a white line in black area. Robot must be able to detect particular line and keep following it. For special situations such as cross overs where robot can have more than one path which can be followed, predefined path must be followed by the robot. [10]. GRID/NODE FOLLOWER-A grid follower is basically a line follower with a modified code which helps it in traversing a grid. The Robot will be a simple line follower with additional sensors for finding nodes in the grid. A Node is basically an intersection between two lines. So there will be some sensors for line following and some sensors for node detection**.** The nodes will then direct the robots to move towards a particular direction in order to reach the destination.

In a simulated environment, we have nodes to guide robots from a source point to a destination point. We use three different color of nodes: blue, red and black. The blue nodes are station nodes. Here each robot starts and delivers items. The red nodes are nodes for robot travel. The black nodes are item nodes. Robots are represented by square shapes with numbers. The diamond shapes indicate items that are required by some station. Robots can only move one node at a time.

Amazon uses a robot that has a camera facing upward that reads barcodes on the products. Another camera is located at the bottom of the robot which views barcodes on the floor. This location information helps the robot place the product at correct destination.

D. Distribution of Products

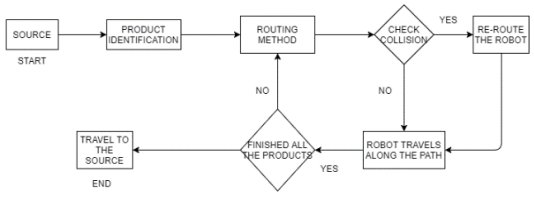
Once the products reach the source side of the warehouse, we need to decide in what order we are going to distribute the products to the robots. There are two methods for the distribution process: [11].FCFS (first-come first-serve)-FCFS is a very straight-forward method. The product that arrives first has to be delivered first. However, in this batching method large number of batches are created. The more number of batches may incur more shifting cost of batch. [12].GABM (GA-based batching method)-In GABM the batches are generated in a random manner. GABM lead to a considerable improvement compared to the straight forward FCFS strategy. The proposed GABM not only forms less number of batches, but also reduces the travel distance.

We can also consider two other strategies for collecting items: [11].Individual Collection- In this, for every station one robot is assigned. This robot will be in charge of collecting all items associated to the station.[12].Collaborative Collection- In this method, there is no specific assignment. All robots can collect items for all stations

III. PROPOSED SYSTEM

The aim of our proposed project is to make an automated warehouse robot that transports a product from source to destination in a warehouse. The robot is initially present at the

source waiting for the orders. If there is any product that should be transported then the robot identifies the product using RFID technology. Once the products are correctly identified, all the products are placed on the holder attached to the robot. Then using an optimal routing algorithm, the robot starts moving towards the destination of the first product by following the line using the PID algorithm, Here we use the QTR 8RC IR sensor to follow the line. If there is a collision during the transportation process then the robot automatically re-routes itself to reach the destination in the best path possible using the same routing algorithm. The robot repeats this process until all the products are dropped in their respective shelves. Finally after dropping all the products, the robot returns to its original position.



IV. CONCLUSION

In this project, we proposed an optimal task decision method to help the warehouse robot make an optimal task decision with minimum cost. Case studies have been done to demonstrate the feasibility and optimality of this method. In the future, we will try to extend the proposed method to multiple robots and dynamic environment field, experiments in real environment will also be investigated.

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