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IoT enabled Automated Robotic Service for Warehouses

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Abstract—Thoughthe industries are well automated, automation is not well percolated among various industrial warehouses. Various vehicles, machineries are used in warehouse service under human supervision. Humans are prone to error while robots are prone to precision and response time. IoT enabled Automated Warehouse Service is a robotic solution for warehouse automation. Robotic structure incorporates the mechanical elements like chassis, wheels, etc. along with electronic elements like controlling unit, drivers, sensors, etc. The term IoT is an emerging technology which establishes the remote bridge between robot and warehouse operator and allows connecting the robot to the internet so as to command the robot. Robotic efforts will reduce the human efforts along with the efficient response time.

Keywords—automation, IoT , warehouse, robot, response.

I. INTRODUCTION

Warehouses are the storage elements of any industry.Storage quantity dependsupon the production and demand of the content. In earlier days, warehouse serviceswere managed with human as well as machine efforts. Today, e-commerce industries have well advanced warehouse services with highly adopted computerized systems along with human efforts. This requires human presence in warehousealong with continuous watch on system.We are not away from the time wherein the requirement will be to automatethe warehouses with robotic service and without on-field human involvementbutwith giving the control to humans. Internet gives the freedom to make systemremotely controllable with help of the IoT technology. The existing system that requires human efforts and their presence will be automated using a ROBOT whichwill assist the warehouse attendant.The automation using ROBOTs and the IoT technology can be clubbedtogether to attain the services in warehouses without on-field human interventions.This ROBOT will also help the customer and attendant by providing aproper database of the packages. As the ROBOT will be IOT enabled, so theattendant will be able to operate it from the places having internet connectivity.

II. LITERATURE SURVEY

The facilities involved in the operation of any warehouse can be categorized in the following two types:

*A. Warehouse Management System (WMS):*This basically involves:

- *Cranes:* The use of Cranes with Forklift mounted on it. The driver controls the Forklift movement along with driving the cranes [10].
- *Sortation System:* Sorting, routing and diverting parcels to various locations for the purposes of picking, packaging, storing, storing and shipping [9].

*B. Automation:*Automation in warehouses involves:

- *Packaging Automation:*Cartonization, carton identification, automated product placement,

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auto-bagging, product protection, packaging list maintenance, print/apply labeling, carton and bag sealing [9].

- *Automated Guided Vehicles:* Navigation software for automated guided vehicles for controlling and navigating automated guided vehicles through the layout. AVGs are capable of driving accurately in narrow aisles, positioning load in racks and on floor level with complex load handling operations. Because of this software, vehicle in the system follows a specific path by means of navigation sensors [10] [11].

The Warehouse Management System hand-over a completely automated solution for the goods storage and stock management. WMS helps in the accurate storage and intelligent management and uses fixed bins with high storage racks to store the products. Mezzanine storage system is another method of the storage of goods and packages wherein the space of warehouse is used moresystematically and precisely.Thissystem is economically viable than the other systems but it is only realizable for usage at a smaller level of operation [1].

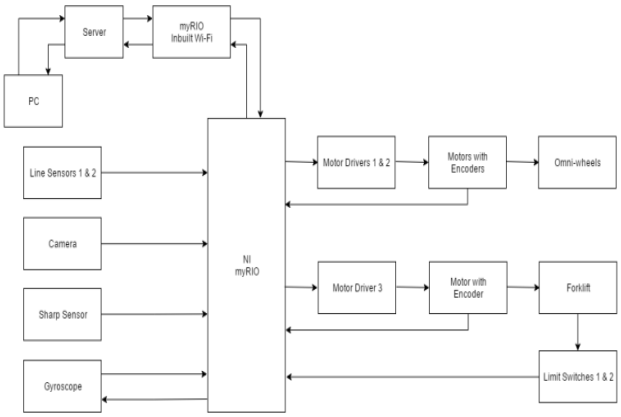

Fig. 1. Block Diagram

AS/RS is an abbreviation for Automated Storage and Retrieval System which is used for storing the goods in warehouse. By the implementation of this system, the floor space usedforwarehouse is at its maximum. In this system, the labour required during storage process is very low due to the efficient storage property which it beholds. The AS/RS is much costlier than most other systems but its accuracy, efficiency and precision is much high than the rest other system and can be used in operations at larger level [1] [9].

III. Block Diagram

The block diagram of our project as shown in figure 1 consists of the following:

A. NI myRIO– The NI myRIO processor controls the movement of ROBOT, Forklift and Gripper action by controlling the respective motors [13].

B. myRIO in-built Wi-Fi– The in-built Wi-Fi of myRIO is a communication interface between the server (connected to PC) and the processor [13].

C. Server – The requirement of the customers will be loaded on the server from which the Processor will extract the requirements to be delivered.

D. Camera – The Camera Module will be mounted on the ROBOT and it will be used for Barcode Scanning.

E. Line Sensors – This will be used for enrooting the ROBOT till its required destination and properly positioning it so as to pick and place the products properly [16].

F. Sharp Sensor–This will help the ROBOT to maintain a proper and safe distance from the product shelf before picking up the product [17].

G. Limit Switches –This will help the forklift to reach at the desired position so as to properly pick and place the packages.

IV. Working Details

Physical working of ROBOT will be divided in five main objectives:

A. Taking request from the attendant- Attendant will give the requirements of the customers from a PC server to the ROBOT via the built-in Wi-Fi of the myRIO.

B. Traversing to the proper package– After receiving the input from attendant, ROBOT will traverse till the requested Package.

C. Identifying the requested Package using barcode scanning – Barcode scanning will be done by using the Camera Module which will be mounted on the ROBOT.

D. Picking up the requested Package using Forklift– Once the requested package is detected, the ROBOT will firstly align itself in a proper position so as to pick the product and then the Forklift will be actuated.The Forklift will be properly positioned as per the height at which the

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package is placed by using the encoder feedback from the motors.

E. Delivering the Package to customer properly

V. MECHANICAL STRUCTURE DETAILING

A. Robot Chassis – The Robot base is an rectangular structure which allows all direction motion along with the Omni-wheels combination. The image of the ROBOT chassis made by us is presented in Figure 2.

B. Forklift – The main purpose of the forklift is to pick up the warehouse material. The structure of forklift is a combination of rack and pinion along with support of mechanical structure. The up-down movement of forklift is controlled by the motor. The image of the Forklift structure designed in CATIA is presented in Figure 3.

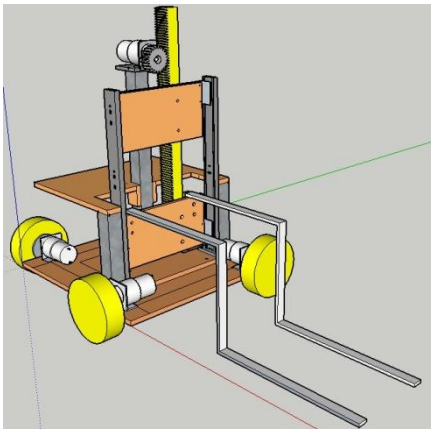


Fig. 2.Isometric View of designed ROBOT

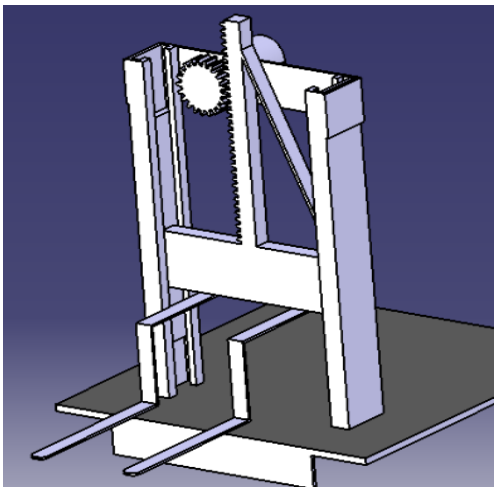


Fig. 3. Forklift Assembly

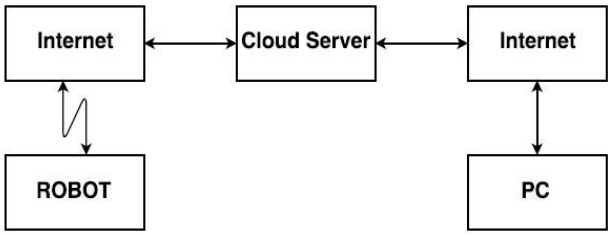
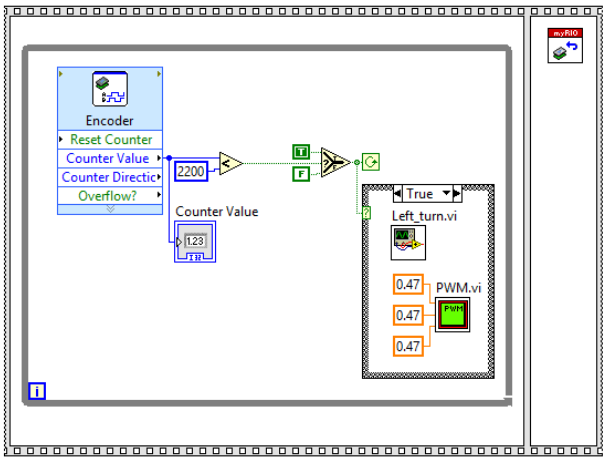
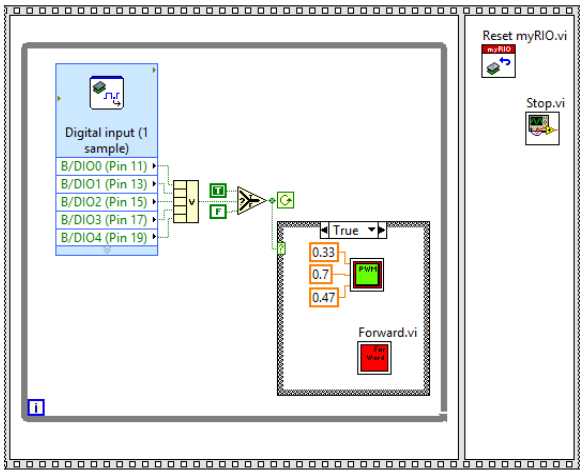


Fig. 4.Connection between ROBOT and PC system



(a) Code Example 1



(b) Code Example 2

Fig. 5. LabVIEW Code Examples

VI. CLUBBING OF ROBOT AND IOT

The built in Wi-Fi of the myRIO allows the ROBOT to connect wirelessly to the internet through whichit can communicate to the cloud server. The cloud server is accessed

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bythewarehouse operator which gives instruction to the ROBOT regarding the product to be picked.The connectivity will be as shown in Figure 4.

VII. Graphical Codes

Few examples of LabVIEW based Graphical codes are represented in Figure 5.

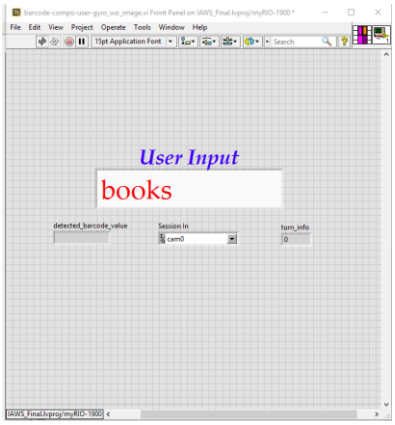

Fig. 6.Input from user

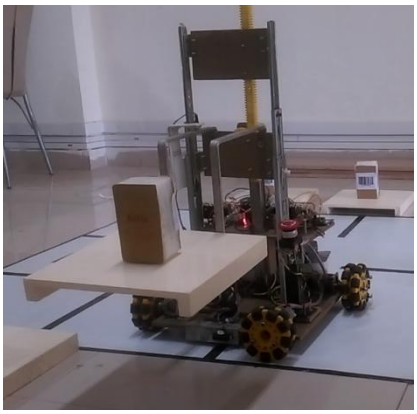

Fig. 7.Picking Up the object

VIII. Results

As per the requirement of our project we have successfully built the four wheeled chassis for the robot structure which can move in all the directions. We have designed, implemented and successfully tested the power distribution and motor driver circuitry for the project. We have simulated the mechanical structure of Forklift in the CATIA software and also manufactured it. Based on the input from the user our system can pick up the product and deliver it properly which we specified in Figure 6 and Figure 7.

IX. Conclusions

This project is something that the existing system demands. Mechanical structure plays an important role in the proposedssystem. More stable the structure more will be the system's accuracy. In accordance to the work done by us till today, we found the implementation of this idea to be practically feasible. In today's world of automation, this project can not only prove to be another step further towards automation but is also a step which can be accounted with the DIGITAL INDIA motto.

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