ISSN (Print) : 2320 – 3765
ISSN (Online): 2278 – 8875

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 9, September 2014

Automatic Control for Storage and Retrieval System Based On PLC

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ABSTRACT: This paper is based upon use of PLCs (Programmable Logic Controllers) and 3-ph motor for the purpose of transport, store and retrieve package (automatic warehouse). A PLC system provides many benefits to control solutions, from reliability and repeatability to programmability. Currently many researches works have been done on the subject of Automatic warehouse using PLC. However their approaches seems to be more complex and cost higher. This because they always employ complex logic components which are expensive. In this research we proposed an automatic warehouse which is easy to implement and cost effective. The implementation of this system improves the efficiency of labor and the quality of manufactured products and to create conditions for the optimum utilization of all production resources. Warehouse automation is the next logical step to stay ahead of your competition and reduce your costs.

KEYWORDS: warehouse, PLC, 3-ph motor, sensors and movable rod.

I. INTRODUCTION

Automation is the use of control systems (such as numerical control, programmable logic control, and other industrial control systems), to control industrial machinery and processes, reducing the need for human intervention [1]. In the scope of industrialization, automation is a step beyond mechanization [1].

Automation greatly reduces the need for human sensory and mental requirements as well [1]. Processes and Systems can also be automated. Specialized industrial computers, referred to as programmable logic controllers (PLCs), are frequently used to synchronize the flow of inputs from (physical) sensors and events with the flow of outputs to actuators and events [1]. This leads to precisely controlled actions that permit a tight control of almost any industrial process [1].

II. RELATED WORK

There are various AS/RS systems (automated storage and retrieval systems) including pallet stacker cranes, miniload cranes and shuttles for the automatic infeed and outfeed of goods in high-bay warehouses. For example Stefano, Albeto,Jens and Juan proposed a multidimensional modelling and non-OLTP workloads which require specialized design techniques. They addressed, respectively, conceptual models, logical models, methods for design, interoperability, and design for new architectures and applications [4]. Jinxiang, Marc and Leon presented a detailed survey of the research on warehouse design, performance evaluation, practical case studies, and computational support tools. After investigating 100 papers on thewarehouse systems they came into conclusion that conclusion is that warehouse design related research has focused on analysis, primarily of storage systems rather than synthesis. While this is somewhat surprising, an even more surprising observation is that only 10% of papers directly addressing warehouse design decisions have a publication date of 2000 or later. Given the rapid development of computing hardware and solvers for optimization, simulation, and general mathematical problems, one might reasonably expect a more robust design-centric research literature [5].

The following disadvantages are involved due to this in the present scenario [3]

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- Cost of labor is high.
- The system More complexity.
- Man power requirement is high.

III. PROPOSED SYSTEM

The main objective of this system is to transport, store and retrieve packagewhich can be achieved using PLC. All the manual operations are replaced by sending signals from the PLC to the respective devices. The work of storing and retrieval of goods from various places is automatically done by a three axis movable rod setup that is controlled by the PLC.

IV. PLC HARDWARE SPECIFICATIONS

We have chosen **PLC_200** Series Programmable Logic Controllers with the following features.

Table (1) S7-200 CPU Model features [2].

Feature	**CPU 226**
Physical size (mm)	190 x 80 x 62
Program memory: with run mode edit without run mode edit	 16384 bytes 24576 bytes
Data memory	10240 bytes
Memory backup	100 hours typical
Local on-board I/O Digital Analog	 24 In/16 Out --
Expansion modules	7 modules1
High-speed counters Single phase Two phase	 6 at 30 kHz 4 at 20 kHz
Pulse outputs (DC)	2 at 20 kHz
Analog adjustments	2
Real-time clock	Built-in
Communications ports	2 RS--485
Floating-point math	Yes
Digital I/O image size	256 (128 in, 128 out)
Boolean execution speed	0.22 microseconds/instruction
Picture	

V. PLC-SOFTWARE SPECIFICATIONS

The STEP 7--Micro/WIN programming package provides a user-friendly environment to develop, edit, and monitor the logic needed to control your application [2]. STEP 7--Micro/WIN provides three program editors for convenience and efficiency in developing the control program for your application. To help you find the information you need, STEP 7--

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Micro/WIN provides an extensive online help system and a documentation CD that contains an electronic version of this manual, application tips, and other useful information [2].

VI. BASIC DESIGN OF THE SYSTEM

Firstly we design a rack, the rack is subdivided into 120 cells, which are identified by the number for storage of goods. Secondly we construct a three axis movable rod setup placed between a two racks that can move along x-axis, y-axis and z-axis the 3-ph motor it can provoke this movement. Thirdly I construct an automatic monorail one for delivering of packages and the other for retrieval of the packages. The entire process of storing and retrieval of goods is automated by connecting all sensors, actuators and the other units of the system to the PLC located in the control room.

Table (2) sensors and the functions.

NO	Type of sensor	function	PLC address
1	Limits switch	End of FW motion x-axis and reference point for store load	I0.0
2	" " "	End of BW motion x-axis and reference point for retrieve load	I0.1
3	" " "	End of FW motion y-axis	I0.2
4	" " "	End of BW motion y-axis	I0.3
5	proximity switch	End of FW motion z-axis	I0.4
6	" " "	End of BW motion z-axis	I0.5
7	" " "	Column identifier of the rack	I0.6
8	" " "	Reference point for the load y-axis	I0.7
9	" " "	Load detector for storage in the rack	I1.0
10	" " "	Load detector for the retrieval	I1.1
11	" " "	Reference point for load z-axis	I1.2
12	" " "	Reference point for load z-axis	I1.3
13	Photoelectronics	Cell identifier of the rack	I1.4

Table (3) actuators and functions

NO	Type of actuator	function	PLC address
1	3-ph motor with gear box and controllable break	FW motion x-axis	Q0.0
		BW motion x-axis	Q0.1
2	" " "	FW motion y-axis	Q0.2
		BW motion y-axis	Q0.3
3	" " "	FW motion z-axis	Q0.4
		BW motion z-axis	Q0.5
4	" " "	FW monorail	Q0.6
		BW monorail	Q0.7
5	" " "	FW monorail	Q1.0
		BW monorail	Q1.1

Figure 1 illustrates the three axismovable rod and locations of the three motors that control the movement of the movable rod.by using sensors to determine the beginning and end of the motor movement in three axes were clarified sites sensors in Figure 2-3.

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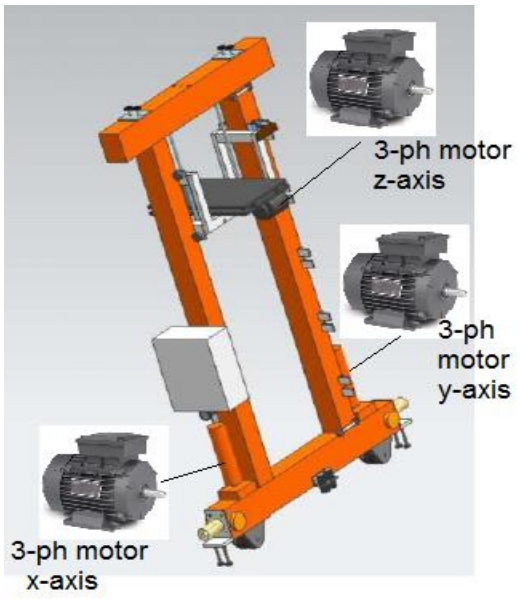

Figure 1: Three axis movable rod with actuators

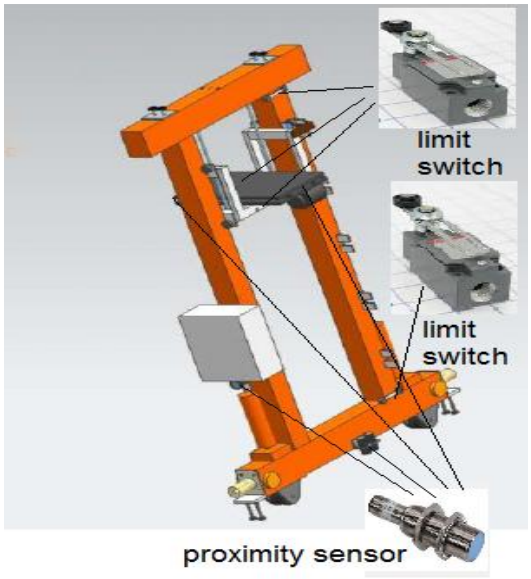

Figure 3: Three axis movable rod with sensors

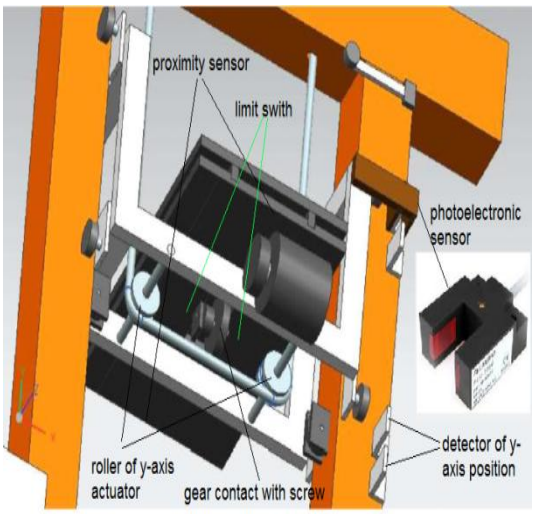

Figure 2: Three axis movable rod with sensors

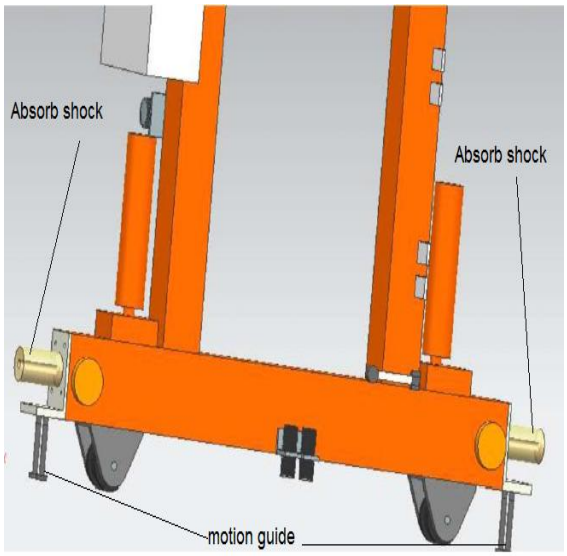

Figure 4: motion guide and absorb shock

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Figure 5 shows the final destination is divided into two racks and the rack is subdivided into 60 cells between the two racks there is a rail to allow the rod move in between it ,to storage and retrieve the goods. Figures 6-7-8 shows that the sensors control the moving of monorail and determine the end of motion for the three axis moveable rod

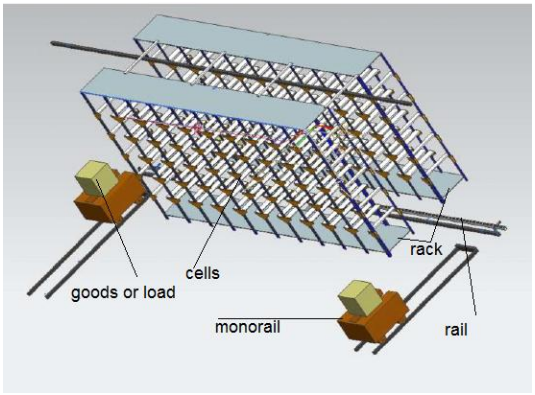

Figure 5: The racks and monorail

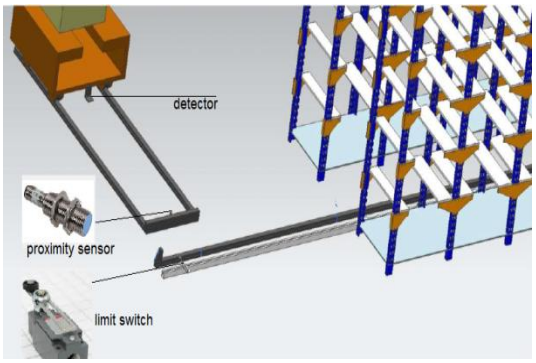

Figure 6: Sensors

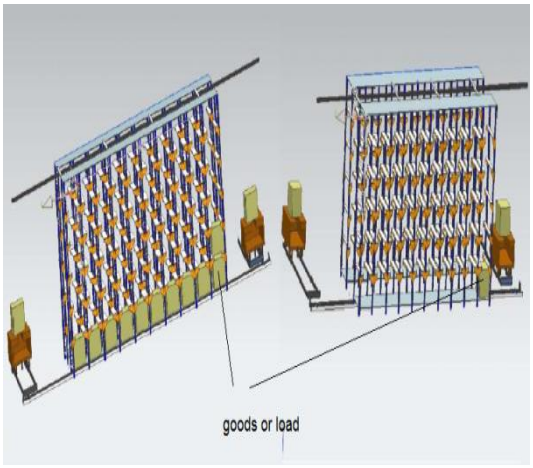

Figure 7: Goods or load

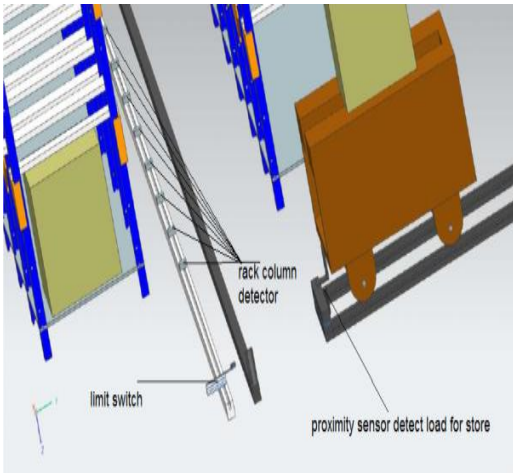

Figure 8: Sensors and detector

VII. WORKING

The working of the design can be classifiedinto two phases:

[A]. STORAGE PHASE

In storage phase, the automatic monorail delivers the package to the three axis movable rod, when it reaches to storage reference point the load detector (proximity sensor) will sense the proximity of the monorail and the sensor will go into on state. The PLC will receive the signal from the sensor and send the control signal to the movable rod alerting it to move to the storage reference point. In the storage reference point the movable rod is commanded to take the package to the final destination which is one of the cells of the rack. All this activities are performed automatically by the PLC itself.

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[B]. RETRIEVAL PHASE

The retrieval phase is the reverse process of the storage phase. In this phase another automatic monorail will arrive at the retrieval reference point without any load (package) on it. The proximity sensor will sense it, the sensor will change to on state which sends the signal to PLC alerting it about the request of retrieval. PLC will crosscheck the warehouse if there is any load enough to be retrieved. Then PLC will send signal to the movable rod to move and take the load according to first request first cell and take the load out for retrieval. Then the movable rod should move back to the retrieval reference point and release the load to automatic monorail.

VIII.SIMULATION & RESULTS

First we finish the ladder code for the control system we install it in the PLC after that we did all connection and configuration for the actuators, sensors and PLC. The system is work normally and stably without any fault figures 9-10 shows the whole system and there connections.

Figure 9: General storage system.

Figure 10: PLC and its connections

IX. CONCLUSION

Complexity of system has been simplified, by this proposal. Man power has been reduced and labor cost has been eliminated.

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ISSN (Print) : 2320 – 3765
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Vol. 3, Issue 9, September 2014

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