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Automatic Control Three-Dimensional Warehouse based on PLC

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***Abstract* - An automated system is increased in this globalized world. This paper is based upon use of PLC (Programmable Logic Controllers), 3-ph motor and sensors for the purpose of automatic goods handling inside the warehouse and the logistics industries. In many industries, found problem storage goods and flow tasks efficiency in warehouse because several kinds of products. Usage PLC system input line automation to helpful manufactured process accuracy and efficiency. In this research we proposed warehouse automation system 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 depends on the PLC program**

Keywords: Automatic goods handling, Warehouse automation system, 3-ph motor and sensors, PLC,

I. INTRODUCTION

Automation is the use of control systems and information technologies systems (such as numerical control, inventory control, programmable logic control, and other industrial control systems) to reduce the need for human work in the production of goods and services. In the scope of industrialization, automation is a step beyond mechanization. Automation greatly decreases the need for human sensory, mental requirements and saves time as well [1]. The 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. This leads to precisely controlled actions that permit a tight control of almost any industrial process [2].

Automatic segregation and directing of materials are controlled using PLCs. It makes use of limiting sensor, color sensor, proximity sensors for segregation and directing of the materials is controlled by using a motor and the conveyer belt depending on the instructions specified in the ladder logic in PLC. In food packaging industry PLC is mainly used for automation purpose which helps in reducing packaging time and increases the production rate as compared with the manual system [3].

Many useful researches have been done in the field of warehouse automation system. For example, Min S. Ko *et al.* [4] developed a case study to simulate and verify the PLC program for an automobile panel AS/RS. They suggested a PLC simulation using 3D models and PLC codes, which consists of real automobile manufacturing data. Senanayake and S. Veera Ragavan [5] used an optimization method to determine the optimum storage locations for the goods that will use AS/RS. They used fuzzy control system for the purpose of determining the best storage location. In this study, AS/RS's working strategies, sensor, PLC and other control components are analyzed and automation techniques are discussed. System's control structure is explained with detailed algorithms and AS/RS automation components' functions are examined. AsaadMusaab Ali Yousif [2] design and developed control system of AS/RS by simulate through PLC. Sunderesh S. Heragu *et al.* [6] modeled the AVS/RS (Autonomous Vehicle Storage and Retrieval System) and used MPA (manufacturing system performance analyzer) to examine the performance of an AS/RS. They used experimental results to show if the OQN (Open Queueing Network) methodology can be applied to analyze an AS/RS and determined MPA is a better choice to quickly evaluate alternate configurations of the AVS/RS. Rashid *et al.* [7] proposed a new design of an Automated Storage and Retrieval System using wireless communication to improve existing warehouse management system (WMS). They made the communication between PIC controller and computer by wireless technology and the motion of the system is based on three DC motors for each direction of motion X, Y and Z that is controlled by PIC microcontroller.

The main objective of the project controls the three-dimensional warehouse in goods handling with help of PLCs. The whole process is done automatically based on input signals from the PLC to the respective devices

II. HARDWARE AND DESCRIPTION

A. PLC control

We have chosen SIEMENS S7-1200 CPU 1215c series. Programmable Logic Controllers with the following features

Table 1: Profile of SIEMENS S7-1200 CPU 1215c series

Feature		CPU 1215c
Physical size (mm)		130 x 100 x 75
User memory	Work	125 Kbytes
	Load	4 Mbytes
	Retentive	10 Kbytes
Local on-board I/O	Digital	14 inputs/10 output
	Analog	2 inputs/2 output
Process image size	Input	1024 bytes
	Output	1024 bytes
Bit memory (M)		8192 bytes
Signal module (SM) expansion		8
Signal board (SB), Battery board (BB), or communication board (CB)		1
Communication module (CM)		3

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(left-side expansion)		
High-speed counters	Total	Up to 6 configured to use any built-in or SB inputs
	1 MHz	-
	100/80 kHz	Ia.0 to Ia.5
	30/20 kHz	Ia.6 to Ib.5
PROFINET Ethernet communication port		2
Real math execution speed		2.3 µs/instruction
Boolean execution speed		0.08 µs/instruction
Picture		

B. Sensor

In this system. Proximity sensor detect an object input signal transmitter for the PLC without touching it and therefore do not cause abrasion or damage to the object.

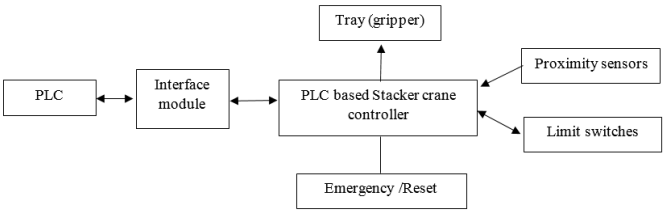

Figure1: sensor process

C. DC motor

It is use to operate the directions of the stacker crane and the gripper. The motor operation is performed using PLC and relays. Triaxial operation is performed here that is, X axis, Y axis and Z axis. Hence three motors are used to perform this operation and one for the gripper movement.

III. SOFTWARE PLATFORM REQUIREMENT

Siemens PLC programming software Portal V13 (including SIMATIC STEP 7 Professional V13 and SIMATIC WinCC Comfort Advanced V13)

Table 2: The computer can support software

hardware requirement	The computer with STEP 7 Basic/Professional V13 must at least meet the following requirements: ● CPU processor: CoreTM i5-3320m 3.3 GHz ● Memory: 8G or larger ● Hard disk：300 GB SSD ● Graphics resolution: minimum. 1920 x 1080 ● Monitor: 15.6"widescreen display.)1920 x 1080(● CD-ROM：DL MULTISTANDARD DVD -RW
Operating system requirements	STEP 7 Professional/Basic V13 can be installed in the following operating system (Windows 7 operating system, 32-bit or 64-bit): ● MS Windows 7 Home Premium SP1) STEP 7 Basic(● MS Windows 7 Professional SP1 ● MS Windows 7 Enterprise SP1 ● MS Windows 7 Ultimate SP1 ● Microsoft Windows 8.1)STEP 7 Basic (● Microsoft Windows 8.1 Pro ● Microsoft Windows 8.1 Enterprise ● Microsoft Server 2012 R2 Standard ● MS Windows 2008 Server R2 Standard Edition SP2) STEP 7 Professional(

IV. METHODOLOGY WORKING

- Select the location where the material is to be stored
- Press start button followed by the store button.
- If store button is pressed, sensor will sense the presence of material.
- If material is display, motor 'X' will start rotating in forward direction till the selected location and will stop.
- After that the motor 'Z' move up to material selected point,
- Once the object reaches the selected position, motor 'Y' (in/out) tray(gripper) will move to take the material
- If tray (gripper) selected object, the motor 'Z' and motor 'X' will move to AGV point.
- After arriving object position, the motor 'Z' and motor 'X' will rotate in reverse direction to handling next object position

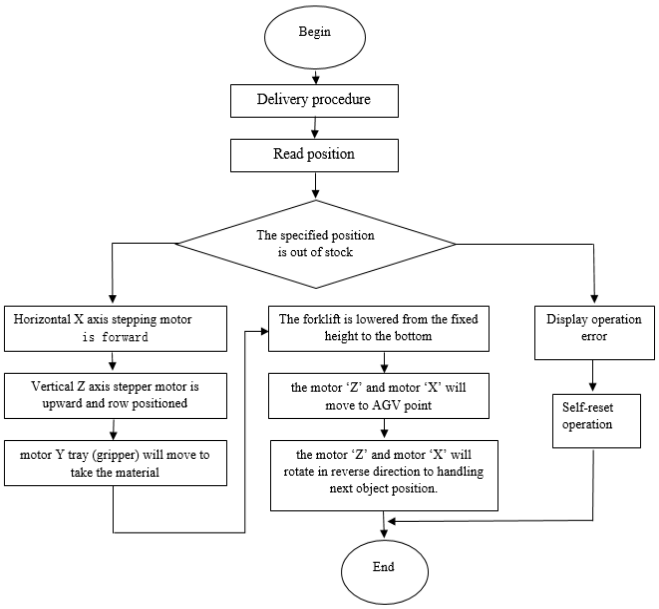

Figure2: The whole structure process

Table 3: Display configuration position devices of PLC program

Input	Signal	Description	Input status	
			ON	OFF
I0.0	CEMG	Emergency stop	effective	invalid
I0.1	PWR-ON	Power-on	effective	invalid
I0.2	EX-LIM	Palletizer overrun relay	effective	invalid
I0.3	3ELP	3-axis positive limit.	effective	invalid
I0.4	3ORG1	3 axis origin 1.	effective	invalid
I0.5	SEN1	Workpiece detection photoelectric switch on fork	effective	invalid
I0.6	3ORG3	3axis origin 3.	effective	invalid
I0.7	3EL-	3 axis negative limit.	effective	invalid
I1.0	2EL+	2 axis positive limit.	effective	invalid
I1.1	2DEC1	2 axis deceleration 1 point.	effective	invalid
I1.2	2DEC2	2 axis deceleration 2 point.	effective	invalid
I1.3	2DEC3	2 axis deceleration 3 point.	effective	invalid
I1.4	2EL-	2 axis negative limit.	effective	invalid
I1.5	1EL+	1 axis positive limit.	effective	invalid
I2.0	1DEC1	1 axis deceleration 1 point.	effective	invalid
I2.1	1DEC2	1 axis deceleration 2 point.	effective	invalid

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I2.2	1DEC3	1 axis deceleration 3 point.	effective	invalid
I2.3	1EL-	1 axis negative limit.	effective	invalid
I2.4	U1ALM	One-axis inverter alarm	effective	invalid
I2.5	U2ALM	Two-axis inverter alarm	effective	invalid
I2.6	U3ALM	Three-axis inverter alarm	effective	invalid
I2.7	M/A	Online/stand-alone selector switch.	effective	invalid
I3.0	SQ1	Raw material warehouse position 1. Workpiece detection switch.	effective	invalid
I3.1	SQ2	Raw material warehouse position 2. Workpiece detection switch.	effective	invalid
I3.2	SQ3	Raw material warehouse position 3. Workpiece detection switch.	effective	invalid
I3.3	SQ4	Raw material warehouse position 4. Workpiece detection switch.	effective	invalid
I3.4	SQ5	Raw material warehouse position 5. Workpiece detection switch.	effective	invalid
I3.5	SQ6	Raw material warehouse position 6. Workpiece detection switch.	effective	invalid
I3.6	SQ7	Raw material warehouse position 7. Workpiece detection switch.	effective	invalid
I3.7	SQ8	Raw material warehouse position 8. Workpiece detection switch.	effective	invalid
I4.0	SQ9	Raw material warehouse position 9. Workpiece detection switch.	effective	invalid
I4.1	SQ10	Raw material warehouse position 10. Workpiece detection switch.	effective	invalid
I4.2	SQ11	Raw material warehouse position 11. Workpiece detection switch.	effective	invalid
I4.3	SQ12	Raw material warehouse position 12. Workpiece detection switch.	effective	invalid
I4.4	SQ13	Raw material warehouse position 13. Workpiece detection switch.	effective	invalid
I4.5	SQ14	Raw material warehouse position 14. Workpiece detection switch.	effective	invalid
I4.6	SQ15	Raw material warehouse position 15. Workpiece detection switch.	effective	invalid
I4.7	SQ16	Raw material warehouse position 16. Workpiece detection switch.	effective	invalid
I5.0	SQ17	Raw material warehouse position 17. Workpiece detection switch.	effective	invalid
I5.1	SQ18	Raw material warehouse position 18. Workpiece detection switch.	effective	invalid
I5.2	SQ19	Raw material warehouse position 19. Workpiece detection switch.	effective	invalid
I5.3	SQ20	Raw material warehouse position 20. Workpiece detection switch.	effective	invalid
I5.4	SQ21	Raw material warehouse position 21. Workpiece detection switch.	effective	invalid
I5.5	SQ22	Raw material warehouse position 22. Workpiece detection switch.	effective	invalid
I5.6	SQ23	Raw material warehouse position 23. Workpiece detection switch.	effective	invalid
I5.7	SQ24	Raw material warehouse position 24. Workpiece detection switch.	effective	invalid
I6.0	SQ25	Raw material warehouse position 25. Workpiece detection switch.	effective	invalid
I6.1	SQ26	Raw material warehouse position 26. Workpiece detection switch.	effective	invalid
I6.2	SQ27	Raw material warehouse position 27. Workpiece detection switch.	effective	invalid
I6.3	SQ28	Raw material warehouse position 28. Workpiece detection switch.	effective	invalid
OUTPUT				
Q0.0	RED	Tricolor lamp red	effective	invalid
Q0.1	YELLOW	Three color light yellow	effective	invalid
Q0.2	GREEN	Tricolor light green	effective	invalid
Q0.3	START	Start relay	effective	invalid
Q0.4	STOP	Stop relay	effective	invalid
Q0.5	DIS_LIM	Over limit contact relay	effective	invalid
Q0.6	ALMHL	Alarm indicator	effective	invalid
Q0.7	CMEGHL	Emergency stop indicator	effective	invalid
Q1.0	STOP_U	Inverter stop	effective	invalid

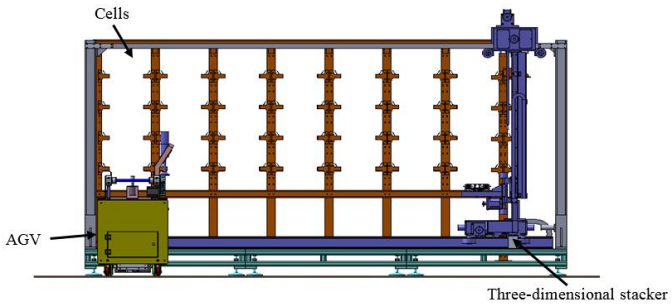

Figure 3: Three-dimensional library position regulations

V. ADVANTAGES AND DISADVANTAGES

A. *Advantages*

- This system reduces human intervention while increasing safety.
- Automatic Manufacturing process is efficiency and accuracy
- Distance time work saving

B. *Disadvantages*

- High cost investment installation
- Require engineers skilled knowledge, ability and experience
- Time in maintenance and improve are large

VI. APPLICATION

- Chemistry industries
- Vehicle factories
- Food manufacturing process industries

VII. RESULT AND CONCLUSION

we have implemented a ladder code install at PLC software to control system. After that output commands to

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configuration I/O devices. Complexity of automatic warehouse has been modeled, based on this paper purpose we achieved such as analysis, developed and control system

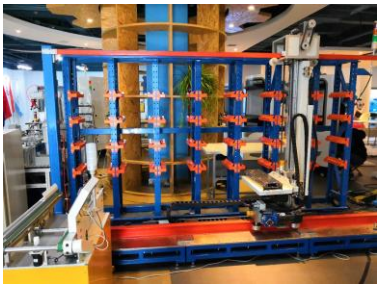

Figure 4: three-dimensional warehouse system

Figure 5: PLC control panel

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