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DESIGN AND DEVELOPMENT OF AUTOMATED STORAGE AND RETRIEVAL SYSTEM

Syamsul Azrin Bin Kamaruddin

BEKM
(APRIL 2009)

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DESIGN AND DEVELOPMENT OF AUTOMATED STORAGE AND RETRIEVAL SYSTEM

SYAMSUL AZRIN BIN KAMARUDDIN

This Report Is Submitted In Partial Fulfillment Of Requirements For The Degree of Bachelor In Mechatronic Engineering

Faculty of Electrical Engineering
Universiti Teknikal Malaysia Melaka (UTeM)

(APRIL 2009)

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"I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Mechatronic)"

Signature : .....
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Date : APRIL 2009

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I declare that this report entitle "*Research and Development of Automated Storage and Retrieval System*" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....
Name : SYAMSUL AZRIN BIN KAMARUDDIN
Date : APRIL 2009

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To my beloved mother and father

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PENGHARGAAN

Syukur ke hadrat Allah, kerana dengan limpah dan kurnia-Nya, saya telah dapat melaksanakan Projek Sarjana Muda ini dengan baik. Saya ingin mengambil kesempatan ini untuk mengucapkan penghargaan kepada semua pihak yang telah banyak membantu saya sepanjang saya melaksanakan PSM ini. Jutaan terima kasih saya ucapkan dan moga Allah akan membalas jasa baik kalian.

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ABSTRACT

This project is to design and develop a combination of hardware and software of Automated Storage and Retrieval System (ASRS). This project was invented to be used as hardware to solving and accomplishing most of task that cannot be done by human being and also to be faster and pinch the production time. ASRS usually is used in a wide variety of material transfer applications. Basically, the machine takes a product from one spot in the first process and places it into the second location for the next process. If the process in the other location does not complete its process yet, this machine will store the buffer product into the other temporally storage. After the process is completed, this machine will retrieve the product in the storage and place it at the other location for the next process. This hardware is a prototype of ASRS for teaching and learning kit which is built in with magnetic sensor and pneumatic system. This project is a basic design and development for ASRS where it uses the peripheral interface Programmable Logic Control (PLC) as the robot brain to control all of the robot movement. The benefit from this project is it can for teaching and learning kit because the construction cost of this machine is inexpensive.

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ABSTRAK

Projek ini adalah untuk merekabentuk dan membina gabungan perkakasan dan perisian sistem penyimpanan dan perolehan semula secara automatik (ASRS). Projek ini dicipta untuk digunakan sebagai peralatan untuk menyelesaikan masalah tugasan penyimpanan barangan yang tidak boleh dilakukan oleh manusia biasa disamping dapat beroperasi dengan lebih pantas dan menjimatkan masa pengeluaran. ASRS biasanya digunakan secara meluas dalam pelbagai aplikasi penghantaran barangan. Secara asasnya, mesin ini mengambil produk dari suatu tempat dalam proses pertama dan meletakkanya pada tempat yang kedua untuk proses seterusnya. Jika proses di tempat yang kedua masih belum selesai, mesin ini akan meletakkan produk yang telah disiapkan oleh proses pertama kedalam tempat simpanan sementara. Apabila proses ditempat kedua telah selesai, mesin ini akan mengambil semula produk yang telah disimpan didalam tempat simpanan sementara dan meletakkannya ditempat yang kedua untuk proses seterusnya. Peralatan ini adalah sejenis protaip ASRS untuk digunakan sebagai peralatan pengajaran dan pembelajaran yang menggunakan sensor magnetik, dan sistem pneumatik. Projek ini adalah asas merekabentuk dan membina untuk ASRS dimana ia menggunakan Pengawal Logik Boleh Aturcara (PLC) yang berfungsi sebagai otak untuk mengawal semua pergerakan robot ini. Kelebihan projek ini adalah ianya boleh digunakan sebagai peralatan pengaajaran dan penbelajaran kerana kos pembuatannya juga murah.

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TABLE OF CONTENT

CHAPTER	CONTENT	PAGE
	ACKNOWLEDGEMENT	**i**
	ABSTRACT	**ii**
	TABLE OF CONTENT	**iv**
	LIST OF TABLE	**ix**
	LIST OF FIGURE	**x**
	LIST OF APPENDICES	**xiii**
1	**INTRODUCTION**	**1**
	1.1 Background	1
	1.2 Objectives	3
	1.3 Scope	3
	1.4 Benefits of the project	4
	1.5 Problem statement	5
2	**LITERATURE REVIEW**	**6**
	2.1 Literature survey and previous research	6
	2.2 Case studies 1	7
	2.3 Case studies 2	8
	2.3.1 Unit load ASRS	8
	2.3.1.1 ASRS unit load feature	8
	2.3.2 Mini load ASRS	9
	2.3.2.1 ASRS mini load feature	10
	2.4 case studies 3	11

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CHAPTER	CONTENT	PAGE
	2.4.1 Difference between single/double masted storage system & man-aboard	11
	2.4.2 Mini-load ASRS	12
	2.4.3 Unit-load ASRS	13
	2.4.4 Man-on-board ASRS	13
	2.4.5 Deep-lane ASRS	14
	2.5 Current technology	15
3	**THEORETICAL BACKGROUND**	**17**
	3.1 Introduction	17
	3.1.1 ASRS components	19
	3.2.1 Classification of transfer robot for ASRS	20
	3.2.1.1 Cartesian robot	20
	3.2.1.2 Cylindrical robot	20
	3.2.1.3 Spherical/polar robot	21
	3.2.1.4 Articulated robot	21
	3.2.1.5 SCARA robot	22
	3.2.1.6 Parallel robot	22
	3.2.2 Drive system	23
	3.2.2.1 Hydraulic system	23
	3.2.2.2 Pneumatic system	24
	3.2.2.2.1 Pneumatic logic	27
	3.2.2.3 Motor	28
	3.2.2.3.1 DC motor	28

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CHAPTER CONTENT PAGE

		3.2.2.3.2 Servo motor	31
		3.2.2.3.3 Stepper motor	34
	3.2.3	End effectors	37
		3.2.3.1 Mechanical gripper	37
		3.2.3.2 Suction cup	38
	3.2.4	Controller	39
		3.2.4.1 Programmable logic controller	39
		3.2.4.1.1 Inside PLC	39
		3.2.4.1.2 PLC operation	40
		3.2.4.1.3 PLC compared with other controller	41
		3.2.4.1.4 Digital and analog signal	43
		3.2.4.1.5 System scale	44
		3.2.4.1.6 Programming	44
		3.2.4.1.7 User interface	46
		3.2.4.1.8 Communication	46
		3.2.4.2 Microcontroller	46
		3.2.4.2.1 Program integrated circuit	48
		3.2.4.2.2 Advances in integrated circuits	49
4	**METHODOLOGY**		**51**
	4.1	Flow chart of the project	51
	4.2	ASRS flow chart	57
	4.3	Block diagram	59
	4.4	Part selection for ASRS	60
		4.4.1 Mechanical part	60
		4.4.2 Electrical part	62
	4.5	Software design	62

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CHAPTER	CONTENT		PAGE
	4.6	Hardware design	64
		4.6.1 Gear	64
		4.6.2 Gripper	65
		4.6.3 Rail (stabilizer) for cylinder	66
		4.6.4 Storage tower	67
		4.6.5 Base and sensor area	68
	4.7	Circuit design	69
		4.7.1 PLC external circuit	69
		4.7.2 PLC input devices	70
		4.7.3 PLC output devices	71
		4.7.4 Solenoid valve control circuit	73
		4.7.5 Control panel circuit	73
	4.8	wiring process	75
		4.8.1 Wiring solenoid valve	75
		4.8.2 Wiring the sensor	76
		4.8.3 Wiring the i/o of plc	77
		4.8.4 Wiring the manual controller	78
		4.8.5 Wire connection check	79
		4.8.6 Install program to PLC and testing process	79
	4.9	Budget and costing	81
5	**RESULT AND DISCUSSION**		**86**
	5.1	Simulation	86
	5.2	Actual robot operation	90
	5.3	Discussion	93

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CHAPTER	CONTENT		PAGE
6	**CONCLUSION AND FUTURE WORKS**		**96**
	6.1	Conclusion	96
	6.2	Recommendation and improvement	97
	REFERENCE		**98**
	APENDICES		

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LIST OF TABLE

TABLE	TITLE	PAGE
3.1	Comparison between basic stamp & other type of controller	48
4.1	Input devices for PLC 1	70
4.2	Input devices for PLC 2	71
4.3	Output devices for PLC 1	72
4.4	Output devices for PLC 2	72
4.5	Electrical parts price list	81
4.6	Mechanical parts price list	83
4.7	Pneumatic parts price list	84
4.5	Overall price list	85

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LIST OF FIGURE

FIGURE	TITLE	PAGE
1.1	ASRS mini load storage buffer for order picking and fulfillment	2
1.2	ASRS using transfer robot	2
2.1	ASRS loading unit	7
2.2	Mini-load unit	12
2.3	ASRS unit-load	13
2.4	Man-on-board asrs	14
2.5	Deep-lane asrs	15
2.6	Storing book using asrs	16
3.1	ASRS 36-Storage unit	18
3.2	ASRS robot templates & parts on conveyor	18
3.3	Cartesian robot	20
3.4	Cylindrical robot	21
3.5	Spherical/polar robot	21
3.6	Articulated robot	22
3.7	SCARA robot	22
3.8	Parallel robot	23
3.9	Principle of hydraulic drive system	23
3.10	Element of a basic pneumatic system	24
3.11	DC motor	28
3.12	A simple dc motor	29
3.13	Servo motor	31
3.14	Feedback system	32
3.15	The relationship between the pulse width & the rotor position	32

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FIGURE	TITLE	PAGE
3.16	Stepper motor	34
3.17	Operation of a stepper motor	35
3.18	Gripper	37
3.19	Suction cup	38
3.20	Inside a plc	40
3.21	The steps are continually processed in loop	40
3.22	A PIC 18f872040	47
3.23	Intel 8742, 8-bit microcontroller	49
4.1	Flow chart for PSM 1	51
4.2	Transfer robot base	54
4.3	Transfer robot mechanical part	54
4.4	Flow chart for PSM 2	55
4.5	ASRS operation flow chart	57
4.6	ASRS operation flow chart (continue)	58
4.7	Block diagram of ASRS	59
4.8	5/2 way 4 port solenoid valve	60
4.9	5/2 way single port solenoid valve	60
4.10	Mechanical part	61
4.11	Electrical part	62
4.12	Electrical part in solid works design	63
4.13	Mechanical part in solid works design	63
4.14	Combination of electrical and mechanical	63
4.15	Joining gear and rotary cylinder	64
4.16	Pneumatic gripper	65
4.17	Main of robot stabilizer	66
4.18	Storage tower	67
4.19	Base and sensor allocation	68

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FIGURE	TITLE	PAGE
4.20	Programmable logic control	69
4.21	Circuit diagram for control panel	74
4.22	Wiring for solenoid valve	75
4.23	Storage tower wiring	76
4.24	Wiring process for magnetic sensor	77
4.25	Wiring manual controller	78
4.26	Wire connection check	79
4.27	Interface with computer using rs232	80
4.28	CX-programmer software	80
5.1	Storage 1 push button is pressed	87
5.2	ASRS robot rotate 90^0 clockwise	88
5.3	ASRS robot extend	88
5.4	ASRS robot retract	89
5.5	ASRS robot rotate 90^0 counter clockwise	89
5.6	ASRS robot's DOF	90
5.7	Robot operation when storage 1 push button is pressed	91
5.8	Robot operation when return push button is pressed	92

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LIST OF APPENDICES

APPENDIX TITLE

A	Project Planning Gantt chart
B	Body development process
C	ASRS body design
D	Wiring drawing
E	PLC program

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Automatic Storage and Retrieval System are used in a wide variety of material transfer applications. Basically, this machine takes a product from one spot in the manufacturing process and places it into a storage location and it will retrieve the product if needed. Automated Storage and Retrieval Systems (ASRS) are typically used in applications where there is a very high volume of loads being moved into and out of storage where storage density is important because of space constraints, and where no value adding content is present in this process. They are used widely in both Manufacturing and Distribution operations to hold and buffer the flow of material moving through the process to the ultimate end user. Most systems operate in a fully automated mode with little or no human involvement in the handling of material except at the controlled input and output stations to the system. This results in extremely high inventory accuracy. The advantages of these systems are numerous. ASRS provide users with increased inventory control and tracking, including greater flexibility to accommodate changing business conditions. Indeed, these systems are comprised of modular subsystems that can be easily replaced to minimize downtime and extend the service life of the overall system. AS/RS systems also reduce labor costs, lowering necessary workforce requirements, increasing workplace safety, and removing personnel from difficult working conditions (such as cold food storage environments).

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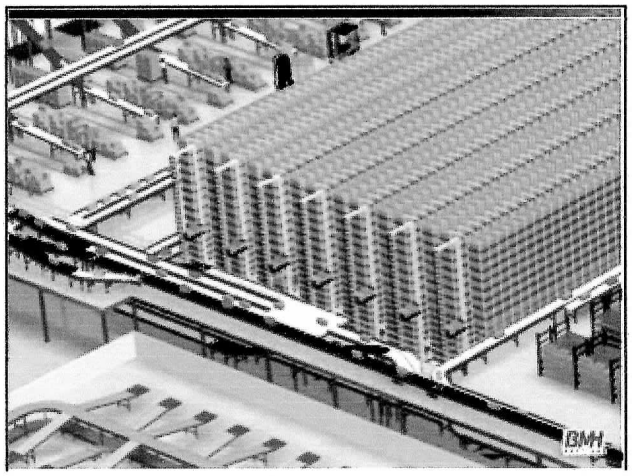

Figure 1.1: ASRS mini load storage buffer for order Picking and fulfillment

Figure 1.2: ASRS using transfer robot

The typical ASRS using transfer robot can only perform its function within its work cell as being shown in figure 1.2. If a different shape of material is being used, the end effectors of the robot had to be changed as well to suit the material its handling.

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1.2 OBJECTIVES:

In manufacturing industries, the Automatic Storage and Retrieval System is invented to be used as hardware for solving and accomplishing most of task that cannot be done by human being and also to be faster and pinch the production time.

For this project the main objective is:

i) To implement the concept of ASRS operation.
ii) To design and develop the hardware for ASRS.
iii) To design and develop the software for ASRS using the Programmable Logic Control (PLC).
iv) To integrate the combination of pneumatic and electrical system.

1.3 SCOPE

In order to design a successful Automatic Storage and Retrieval System, scopes are required to assist and limit the development of the project. The scope should be identified and planned to achieve the objective of the project successfully on the time. The scopes for this project are:

i) To design a program that controls the robot movement using an OMRON PLC
ii) To design and fabricate the mechanical structure for the robot consist of pneumatic actuator.
iii) To load and unload the box dimension 75mm x 55mm x 50mm.

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1.4 BENEFITS OF THE PROJECT

AS/RS benefits include:

- Bringing material to the operator cutting cycle time by eliminating wait, walk, and search time.
- Reduces work-in-progress inventory. Better inventory accuracy and better responsiveness to need result in reduction or elimination of "safety stock" in the overall inventory model. This has the net effect of inventory reduction.
- Dramatically increases operator productivity. The "Part to Picker" model of order fulfillment is 3 to 5 times more productive that having the picker travel to the part to complete the fulfillment.
- Provides real-time inventory control with instant reports. With near 100% accuracy and real time information about the inventory on hand, achievable commitments can be made to your customer – as opposed to "best efforts promises".
- Improves product quality and productivity. Real time information, faster response to a need, physical protection, and traceability of material access all contribute to a better process where time can be spent on improving the quality of the process instead of on expediting material to a point of use.

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1.5 PROBLEM STATEMENT

This Automated Storage and Retrieval System is being designed for the production process. Usually the storage of the products is being carried out using man power and if the storage process is repeated for a period of time, it can cause injuries to the operator while lifting the product and sometimes the operator will make a mistake due to misplace the product. By using this particular robot, the operator will no longer has to store the product manually thus preventing injuries and increasing the efficiency of the work. Operator will make mistakes once in a while .In the industrial world, the industry cannot afford to take that kind of mistakes. Every mistake is costly whether in time, money, and material. So a prototype of ASRS system that can be used as a teaching and learning kit is vital before developing the actual ASRS system.

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CHAPTER 2

LITERATURE REVIEW

2.1 Literature Survey and previous Research

Now days, many research about Automated Storage and Retrieval Systems (ASRS) had been done to improve the storage system in warehouse or industrial sector. Automated Storage and Retrieval Systems offer incredible pick and put cycle times along with more accurate inventory management. A basic ASRS system is comprised of one or more aisles, each having a robotic crane to retrieve from and store product in the racks on either side of the aisle. The use of a robotic crane allows racks to be built several stories high over almost any length, providing more storage density than almost any other storage solution. The cranes also bring the materials to the operator which virtually eliminates wait, walk and cycle times. ASRS systems can also handle a variety of materials, from small bins of parts up to entire pallets of materials, with fast cycle times and high precision.

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