AUTOMATED STORAGE RETRIEVAL SYSTEM

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MEI 2007

"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 (Control, Instrumentation and Automation)."

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THIS REPORT IS Submitted In Partial Fulfillment Of Requirements
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"I hereby, declared this thesis entitled "Automated Storage Retrieval System" is the result of my own research and design except as cited in the references.

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Date : 7/05/07

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ABSTRACT

Automated Storage/Retrieval Systems (AS/RS's) is a system that consists of storage and retrieval functions which can be operate automatically in a manufacturing facility and are widely used in warehousing and manufacturing applications. This system has many applications which include storage location assignment rules, zoning procedures, stacker movement, and incoming and outgoing queue priority and sequencing rules. Those applications were evaluated by grouping control variables and testing the significance of these variables on system performance. Among of these are automated for collectively known in the warehousing industry as materials handling systems. Typically the material handling system is used in such applications where storage density is important because of space constraints. Most systems operate in a fully automated mode with little or human involvement in the handling of material except at the controlled input and output stations to the system. AS/RS consists of storage racks, S/R machines, link conveyors, and input/output (I/O) stations. The system performance is measured throughout the capacity of the system. The service time for a transaction includes both S/R machine travel time and pickup/deposit time. This time typically depends on the configuration of the storage rack and the S/R machine specifications. The are several benefits of this system among them reduces warehouse operating costs, low storage space requirements good collection preservation, low ongoing costs and cuts cycle time by eliminating waiting time, walk, and search time for operator bringing the material.

ABSTRAK

Automated Storage/Retrieval Systems (AS/RS) berfungsi secara automatik amnya. Sistem in banyak diapplikasikan secara meluas di gudang-gudang simpanan dan juga kilang- kilang. Sistem ini mempunyai pelbagai ciri-ciri seperti tempat ataupun lokasi simpanan, zon pemprosesan, tempat barang bergerak, masukan dan juga keluaran barang mengikut turutannya. Selalunya ia dipakai atau digunakan digudang-gudang yang mempunyai pengendalian barang. Applikasi sistem ini mudah digunakan pada tempat yang mempunyai bilangan barang yang banyak masuk dan keluar disebabkan ruang yang terhad. Boleh dikatakan keseluruhan system ini adalah sepenuhnya automatik dan menggunakan sedikit sahaja penggunaan tenaga manusia pada stesyen masukan dan juga keluaran. AS/RS mengandungi ruang rak penyimpanan S/R mesin, konveyor dan juga stesyen masukan dan juga keluaran. Kapasiti pada lorong tunggal adalah balikan purata penghantaran masa mengikut jumlah jangkaan masa yang diperlukan dalam system ini. Masa juga termasuk dalam penghantaran masa S/R mesin dan juga masa ambilan. Masa bergantung pada konfigurasi rak penyimpanan dan juga spesifikasi S/R mesin. Kelebihan pada system ini antaranya ialah dapat mengurangkan operasi kos dalam gudang dan dapat mengurangkan tempat penyimpanan. Selain itu dapat mengurangkan masa menunggu pada barang yang diambil.

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INTRODUCTION

1.0 Introduction

Automation is the technology by which a process or procedure is accomplished without human assistance. It is implemented using a program of instructions combined with control system. ASRS technology is just beginning to be used in large libraries, particularly at universities, laboratory, and industrial factory. It works via a robotic "arm" that quite literally fetches materials from archival locations.

1.2 Project Objectives

Automated Storage and Retrieval Systems (often referred to as ASRS or AS/RS) refers to a variety of computer-controlled methods for automatically depositing and retrieving loads from defined storage locations. Systems of this nature have been used for years in manufacturing and warehouse facilities. There many several objectives in this project:

i) To understand the sorting mechanism system used in the industry.
ii) To learn application of sensors and construction of conveyor.
iii) To design and develop a control mechanism in proposed project

1.3 Project Scope

The project scope for execution this project are:

i. Software-Design and implementation the ladder diagram of the project into PLC (Programmable Logic Controller) to make a right sequences of the project.

ii. Hardware-Built up the mechanism system that using PLC, wiring control unit, sensor and also make a connection with computer to receive a program (ladder diagram).

iii. Combination-Design, develop and integrated hardware with PLC to make a output to storage.

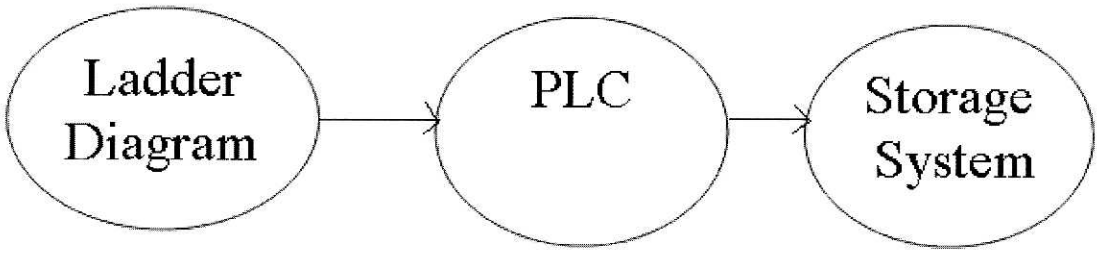


Figure 1: Project scope

1.4 Problem Statement

In real industries, those use a conventional storage used the man power for storage activities. By using this ASRS (Automated Storage Retrieval System) method, company can reduce human errors and able to prevent product from damage. One more reason for this problem is man power usually can be very slow. It can cuts cycle time by eliminating wait, walk, and search time for operator bringing the material. So, one approach to satisfy the industrial demand is to identically design and develops an ASRS system as the alternative solution to increase productivity and quality.

Figure: 1.1 overview AS/RS

CHAPTER II

LITERATURE REVIEW

2.0 Automation System

All automated systems consist of two parts that are the application (formally called the operation unit) and the control system which coordinates action of the 'application'.

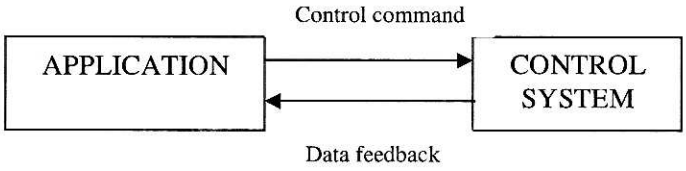


Figure 2.0: Basic structure of automated system

The application operates on the work material and the product. It generally consists of tooling and various facilities performing the production process. For example, moulds, punches, cutting tools, welding heads and marking heads. The other one is actuator that intended to drive or operate these facilities, such as electric motors to activate pumps, hydraulic cylinders to close moulds and pneumatic cylinders to drive marking heads.The control system sends orders to the application which then feeds signals back to the control system. In this way, actions are coordinated. Control systems

are based on programmable controllers or hard-wire technology depending on the system complexity.

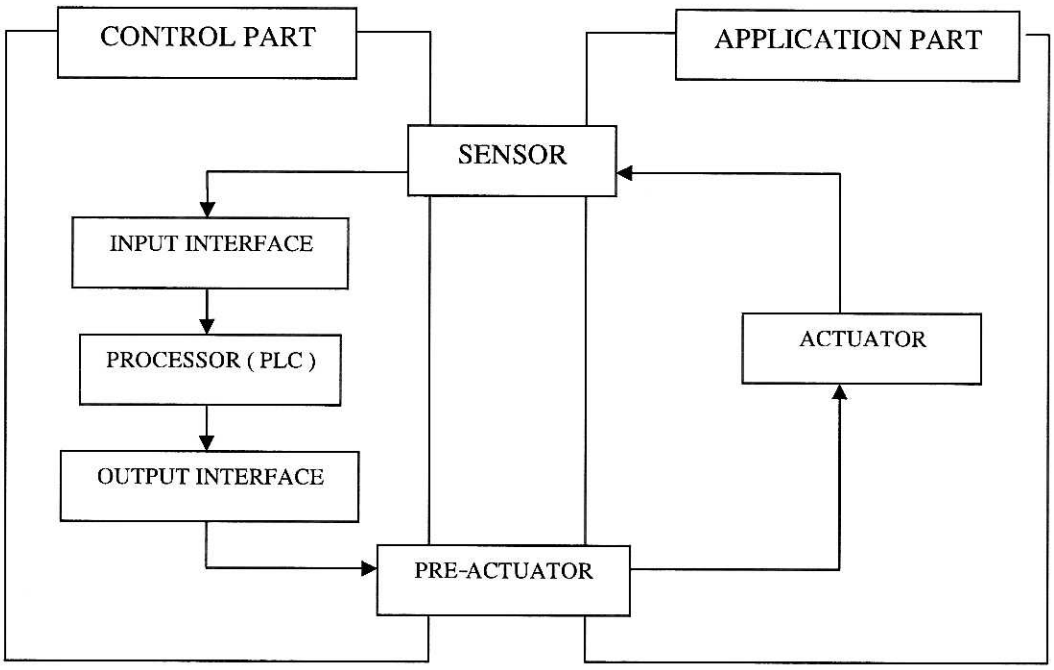


Figure 2.1 :General structure of an automated system

2.1 Automated Storage and Retrieval System

An AS/RS consists one or more storage aisles that each serviced by a storage / retrieval (S/R) machine. The S/R machines deliver materials to the storage racks for holding the stored materials and each ASRS machine got aisle one or more input /output station for materials can be delivered into storage system or moved out of the system. Pickup-and-deposit (P&D) station is a terminology in AS/RS at the input / output station. Pickup-and-deposit (P&D) can be manually operated or can be interfaced to some automated handling system such as a conveyor or an AGVS.

There are several types of AS/RS and the application following the principal types of the important categories of automated storage / retrieval system:

i) Unit load AS/RS. Typically is a large automated system designed to handle unit loads storage on pallets or in other containers. The system used computer controlled, and designed to handle the unit load containers.

ii) Deep lane AS/RS. Is a high density unit load storage system that is appropriate when the large quantities of stock are stored, but number of the stock type is small.

iii) Miniload AS/RS. System that used to handling small loads (individual parts or supplies). S/R machine is designed to retrieve the bin and deliver it to P&D station at the end of the aisle. Usually P&D station operated by a human worker.

iv) Man-on-board AS/RS. The system that represents an alternatives of the problem of retrieving individual items from storage. Human operator rides on the carriage of S/R machine and permits individual items to be picked directly at their storage location.

v) Automated item retrieval system. Designed for retrieval of individual items or small product cartons. Usually the items are stored in lanes rather than bins or drawers.

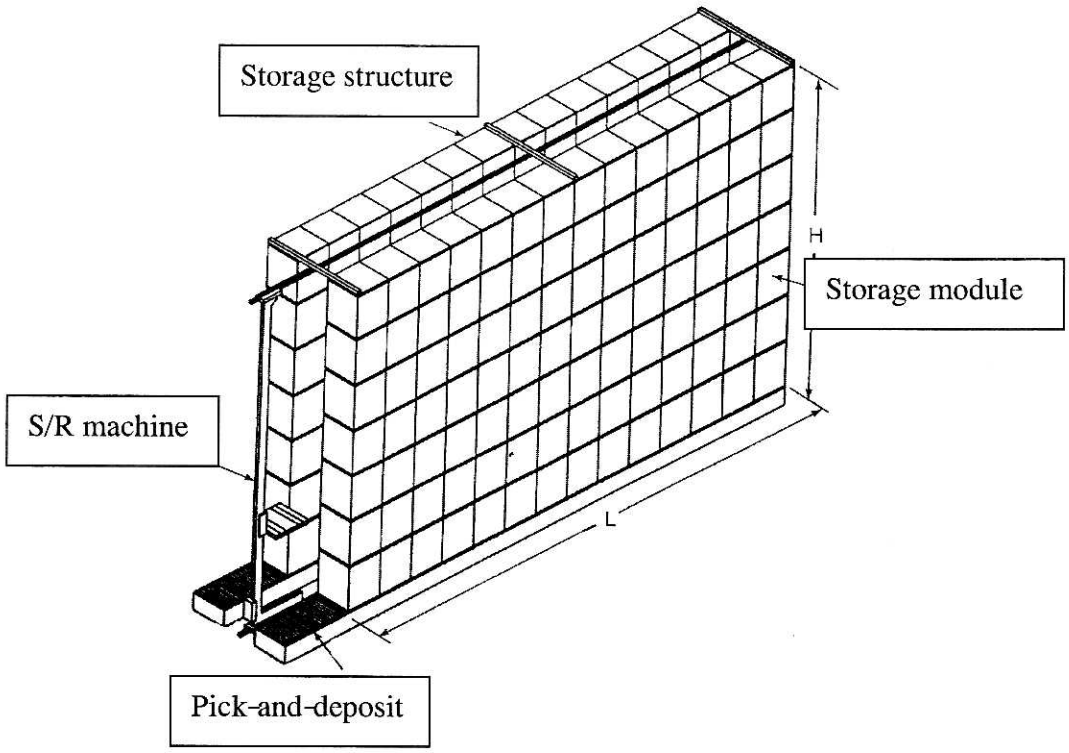


Figure: 2.2 AS/RS

An AS/RS can also store raw materials and work-in-process in field of the manufacturing. Three application areas for automated storage/ retrieval systems:

i. Unit load storage and handling
ii. Order picking
iii. Work-in-process storage system.

Unit load storage and retrieval represented by unit load AS/RS and deep-lane storage system and commonly found in warehouse in a distribution center, rarely in manufacturing. Order picking involves retrieving materials in less than full unit load quantities such as miniload, man-on-board, and item retrieval system are used in this second application. Work-in-process storage is desirable to minimize the amount of work-in-process and also to manage the unavoidably does not exist in factory.

Automated storage systems, represent an efficient way of sorting materials between processing steps, particularly in batch and job shop production.

2.1.1 Component and Operating AS/RS

AS/RS system consist several components:

i. Storage structure
ii. S/R machine
iii. Storage modules
iv. One or more pickup-and-deposit station.

Storage structure is the rack framework made from steel which supports the load contained in the AS/RS. The rack structure must sufficient strength does not deflect due to the loads in storage or other forces. The rack structure may also support the roof and siding of the building in which the AS/RS resides. Another function is support the aisle hardware to align S/R machines and includes guide rails at the structure.

S/R machine is used to accomplish storage transactions, delivering loads from input station into storage, and retrieving loads from storage to output station. To perform this, AS/RS must be capable to horizontal and vertical travel in rail system that mounted on S/R machine.

The storage modules are unit load containers of the stored material. These include pallet, steel wire baskets and containers and plastic tote pans. There are generally made to standard size that can be handling automatically and also designed to fit in the storage of the rack structure.

Pick-and-deposit station is where the loads are transferred into and out of the AS/RS. Generally located at the end of the aisle by the external handling system that

brings loads to the AS/RS and takes load away. Pickup stations and deposit station may be opposite or combined at the same location. A P&D station must be compatible with both the S/R machine and the external handling system.

Computer controls and programmable logic controllers are used to determine the location and guide the S/R machine to its destination.

2.1.2 Engineering Analysis of AS/RS

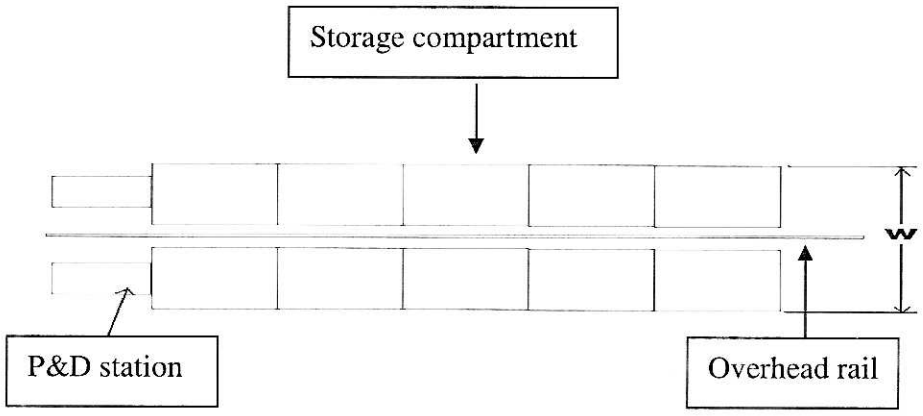
For sizing the AS/RS rack structure, the total storage capacity of one storage aisle depends on how much storage compartments are arranged horizontally and vertically in the aisle. This analysis can be used for analyzing traditional storage facilities, such as pallet racks and bulk storage.

$$\textbf{Capacity per aisle} = 2\, n_y n_z$$

N_y = number of load compartments along the length of the aisle

N_z = number of load compartments that make up the height of the aisle

2=constant, accounts for the fact that loads are contained on both side of the aisle



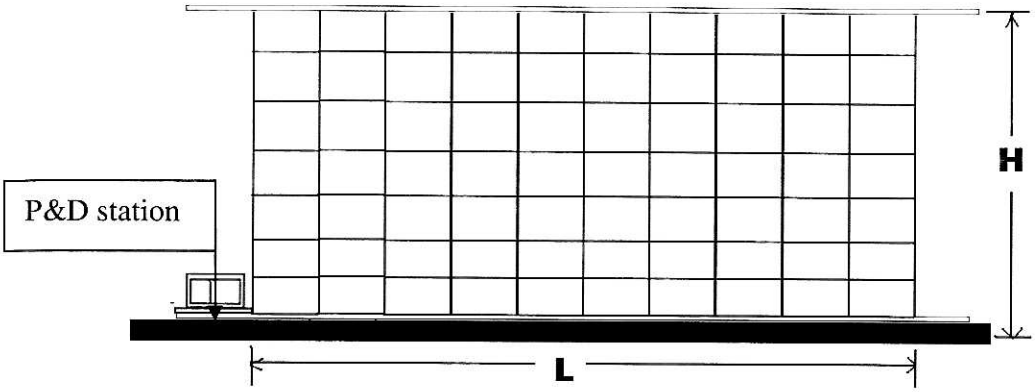


Figure: 2.3 unit load automated storage/retrieval system

The standard size for compartment and the compartment dimensions for aisle must be assumed and also it must be larger than the unit load of the dimensions.

$$W = 3\,(x + a)$$
$$L = N_y\,(y + b)$$
$$H = N_z\,(z + c)$$

x and y =the depth and width dimension of a unit load

z = the height of the unit load

W, L, and H are the width, length, and height of one aisle

For an AS/RS with multiple aisles, W is simply multiplied by the number of aisle to obtain the overall width of the storage system.

2.1.3 AS/RS Throughput

System throughput is defined as the hourly rate of S/R transaction that the automated storage can be performing. This is involves depositing a load storage or retrieving a load into storage or retrieving a load from storage. A dual cycle