

# Internet Based for Computer Integration Manufacturing System

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**Abstract:** This paper has developed the computer integration manufacturing system and Internet based tele-operations. The functions of CIMS include production planning, material requirement planning, work order generation, process control, quality control, shipping planning, warehouse and inventory management and material cost accounting.[1] In this paper focuses on the automatic warehouse control and inventory management by developing the information system as well as the Internet-based integration. The system overview is divided into three parts, the mechanical system, the computer and developed software to control and manage the information and the communication system. The mechanical system consists of the warehouse machine and forklift mobile robot controlled by programmable logic controller (PLC). The computer works on many functions such as control station interfaces with PLC, managing database and inventory, and Internet server to broadcast the inventory database to users via World Wide Web and monitoring the operation on web camera. Our scheme the inventory database can be checked easily anywhere and anytime when the users connect to the Internet. In this article, the lead-time and inventory level can be reduced therefore the holding cost and operating time is also decreased.

## 1.Introduction

The concept of designing warehousing and production policies is to reduced inventory on hand and minimum lead-time as well as operating time. By using automatic control system and information technology including the Internet are bringing about the design system nearby this concept. Recently, the Internet technology is widely used in communication network by computer and other equipment such as the mobile phone, pocket PC, and customs hardware. Typically, Internet has HTML and web browser to search for any information on screen. Moreover, it has other tools for communication such as active X control, CGI (Common Gateway Interface), ASP (Active Server Page) that can be supported sending information of text, image, video and sound. At the same time the appearance of computer applied in manufacturing and business organization named Computer Integrated Manufacturing (CIM) that involves the integration of all the activities of business enterprise, operational planning functions, management functions, design, marketing and direct production control such as automatic machines, Flexible Manufacturing Cell (FMC). This paper combines the advantage of the Internet and CIM to design an automatic warehouse system based on Internet included the inventory control system.

The purpose of inventory management is to reduce the total cost of material stocks. This paper attempts to reduce inventory level during lead-time and acquisition cost. We used the inventory control model approach to develop computer software for calculating the reorder point (RP) or reorder level (ROL) and order quantity as well as recording the warehouse database.

The hardware part is constructed based on the automatic warehouse model. This model uses PLC to control the operations, the barcode system to identify type of goods or materials and the computer uses to manage database and inventory of warehousing. Further more, the computer interfaced with PLC to manipulate the warehouse control system by cooperated with Ladder Diagram programming included work as Internet web server.

## 2. Computer Integrated Manufacturing System

Computer integrated manufacturing (CIM) is the highest level of automation, and is likely to affect every department. The function of CIM generally includes two major terms: One is to use the computers and computer technology to support manufacture and design work, and the other is the computer and

computer technology to support the business management [3]. CIM includes:

- Computer control
- Computer Aided Design and Manufacturing (CAD/CAM)
- Flexible Manufacturing System (FMS)
- Management and planning functions
- Stock control and automatic warehouse
- Data handling on a plant-wide basis.

Generally, the direction of development consists of the following two major types: firstly [2][4], utilization the computer and the computer technology to promote the design capability of the product; named as CAD. Secondly, utilization the computer and the computer technology to support manufacturing automation. In recent years, computer aided design (CAD) and computer-aided-manufacturing (CAM) are integrated to be become a CAD/CAM system, and the concept of CIM is a further extension of the idea of CAD/CAM.

Since the appearance of numerical control (NC) of machine tools in the 1960s, the manual machine work started to transfer to the machine with the automatic control system. The flexibility manufacture and the appearance of CNC machine had come to a new further are since the appearance of the machine center in 1970s. In the factory, one or two CNC machine or may be some automatic equipment integrating with industrial robots can make up Flexible Manufacturing Cell (FMC), and Flexible Manufacturing System (FMS) forms with adding Automatic Guided Vehicle System (AGVS) or some automatic storage and other industrials automations such as conveyor systems which controlled by PLC into FMC. With above FMS system and a CIM system is generated. In this article an idea of CIM including the automatic warehouse system, the forklift mobile robot for transferring system, inventory management software and Internet application, the network communication is presented.

The CIM system structure is a Client-Server structure as shown in Fig. 1 (Business Management System, Production management, FMC, host computer and PLC network etc.) that the computers are linked together through an Ethernet Local Area Network and Internet gateway. The automatic warehouse system is used as the center of the distribution in the plant and inventory management system with Internet application.

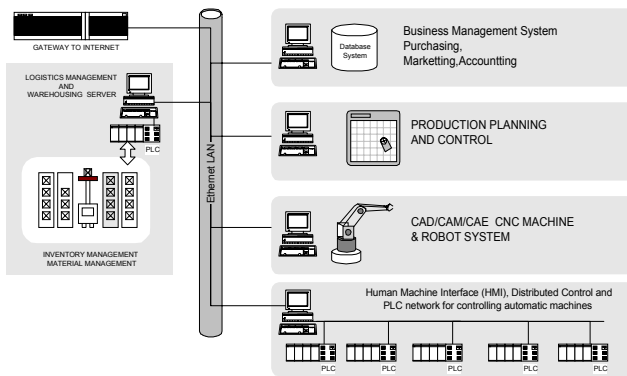


Fig. 1 CIM system structure

**3. Internet-Based Tele-operation**

The Internet becomes the most important network for communication and the biggest data storage [16][17][18][19]. It connects a million of computers all over the world giving access to communication, data, picture, videos and even real time images of distant environments. There are several factors that make the Internet an attractive medium for development of control system via Internet or Internet-based tele-operation. Firstly, the Internet has an extensive geographical reach. A several million machines are now plugged into the Internet, with the figures doubling or tripling every year. Tele-operated devices can be controlled and operated any part of this global network of computer. Secondary, the Internet is network and platform independent. This enables computers of different hardware and operating system platforms to be connected and communicate with each other over different kinds of network and physical links. This widens tele-operations development on any hardware and software platform to be shared and accessed by a significantly larger audience of computers. Thirdly, the Internet is standards-based and open. For instance, standards such as HTTP and CGI simplify the development of online application while HTML provides a means of creating consistent and open interfaces. Tele-operation application can be developed with reduced time and effort and be accessed easily from anywhere on the Internet through standard interfaces such as the Web.

**4. System Overview**

The overall system consists of the host computer connected to the Ethernet Local Area Network. The main function is to record inventory database on Windows98 operating system, Microsoft Visual Basic 6.0, Microsoft Access 2000 and SQL for managing database system. Further more this Local Area Network is linked to campus network connect to the Internet global network. The host computer also works as the Internet web server, so that any user such as supplier, dealer can get the stock information by using the Internet web browser (Internet Explorer). The web pages include graphs and numeral data of the demand rate, acquisition lead-time, reorder point and order quantity. Therefore the user in purchasing department or supplier can obtain the information rapidly. On the other word, this situation can be appropriately supported the supply chain management system and very advantageous for the production planning. Besides, this can also reduced the setup of ordering costs.

In addition, the host computer has a function to control the warehouse operations by cooperated with a Ladder programming on PLC through serial communication RS232C, the communication protocol used OMRON SYSMAC named HOST-LINK protocol. Each product or material pallets have the barcode for identifying material type, in the prototype system classified for 3 kinds of product. The barcode reader connected to PLC is used to simultaneously record the date time when the product is stored or retrieved from the automatic warehouse. The method to retrieve of material is first in and first out (FIFO). Host computer manipulates the sequence of retrieving and storing. Moreover, this system has a web camera to monitor the warehouse operations and control via Internet in order to remote control, remote maintenance and security system. Fig. 2 illustrates the system overview.

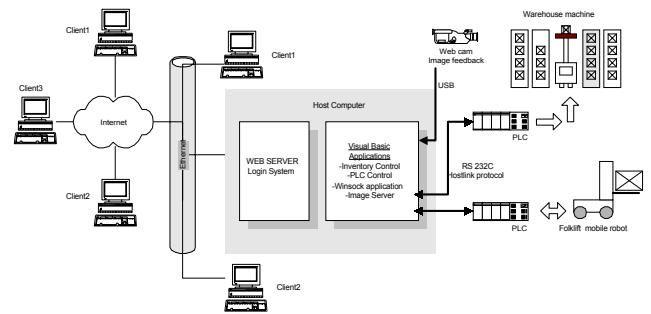


Fig. 2 The system overview

**5. System Design**

**5.1 Computer network and communication systems**

The accurate and rapid communication is very important in business and industrial management system. It can increase the efficiency of the production, throughput and higher profit. The business and industrial organization include several departments. Each part necessarily uses the communications associated their operations for example, production department needs to know the material inventory on hand and purchasing department has to order material from supplier. Consequently, the setup of good Management Information System (MIS) such as network system, databases, searching data system and security system, will be a significant tool and associated the production planning and business decisions correctly.

**5.1.1 Web server and Camera system**

Web server system designed to work on Microsoft Windows operating system (Windows98 by personal web server or Windows NT), which composes of basic service system 3 parts; (1) Login Service. (2) System Manager Service. (3) Visual Basic applications. Web server system depends on standard of client-server for requesting the services including 3 main parts;(1) Client is who ask for service. (2) Network System.(3) Server is who gives the service. Camera system has a web camera for monitoring the warehouse operations and control via Internet in order to remote control, remote maintenance and security system to make sure that automatic arranging machine works step by step as programmed. We can see both Client and Server as we can know that machine can move correctly as ordered or not or program that bring to use with this camera is more important. In general web camera can be able to catch the changing picture faster than 30 frames per second. However exacting of computer system including the size of that subject will set it up. In this article, we use Microsoft Visual Basic 6.0 to developed program by using

OLE link to NetMeeting program, which working on custom platform and it can be used immediately by input the IP. Address.

5.1.2 Computer programming and interfacing

In this research, we applied the MIS with automatic warehouse machine and computer programming and network. [5] In part of computer programming consists of inventory management, database system and interfacing with the automatic warehouse controller.

5.2 Database management

The computer programming is developed from Microsoft Visual Basic 6.0 that created statements, numeral data to be the relation database performed to tables and charts. It can be linked to a variety database system such as Microsoft SQL server, Oracle, Microsoft Access, which used UDA technology (Universal Database Access). The UDA can link to many kinds of RDBMS (Relational Database Management System) and it can create OLEDB (Object Link Enable Database) in order to access to any information that not specified only data from tables. It is to instead the JET Engine that can be accessed only data inform table. This paper used Microsoft Access 2000 and SQL language cooperated with Microsoft Visual Basic 6.0 to manage the database. Furthermore, we have designed Graphics User Interface (GUI) and input data by barcode system for easily operating. Typically, the barcode reader is equipment to input data automatically instead only entered data by keyboard in order to reduce mistake and operating time. In this system, the barcode reader has output in numeral and alphabet following the ASCII code, it can support all standard such as 2 of 5, 3 of 9, UPC and EAN. The reading code is identified the type of material, in this prototype system divided material in three types. The database between computer and warehouse can be able to exchange through communication port it will be presented in next topic.

5.3 PLC interfacing function

This part of computer programming is present the communication between host computer and PLC. The communication system is RS232C serial communication, which used asynchronous protocol of OMRON SYSMAC named Hostlink protocol. The host computer must first compose command block to read or write data in PLC's memory and then sends it to PLC via RS232C after that waiting to receive the response block for requested information and acknowledge the command. When the users need to order material they can order via software platform by select type of material and then the software is going to send command by FIFO arrangement of position in storage rack to retrieve the material from warehouse. Moreover, the database of storage machine (data on PLC) will be reviewed and exchanged to be the same data by computer through communication port every scan-time (0.5 ms) and update inventory database also. The information such as available space, position of material, date and time are recorded to computer database.

5.4 Automatic warehouse

The hardware systems of the automatic warehouse include a storage frame an automatic guide vehicle. Fig. 9 shows the automatic warehouse. The storage rack is made by iron material and has 24 cells to store goods. The automatic guide vehicle consists of 3 set of induction motor for driving 3 axis of mechanical system, each induction motors are driven by inverter to control speed and direction, which Programmable Logic Controller (PLC) manipulates them. The position control uses

the rotary encoder to feedback pulse signal for locating position. The rotary encoders are coupled to mechanical part of the horizontal axis and vertical axis, they have 360 pulses per revolution output, which employed to generate pulse signal to Hi-speed input module of PLC. They are adopted with high-speed counter function on PLC. In the shuttle part have limit switches to be input device of PLC, however the limit switch still necessary for all axis in order to set origin and protection. This part using PLC OMRON SYSMAC C200HS [21] to adopt as the control system of the automatic warehouse. In the part of forklift mobile robot it use PLC OMRON SRM1-C02, which has remote, input output to control the operations. The communication system between the master and slave is COMPO bus that is one type of serial communication system, through the twisted pair with long distant. Because of it is conveniently to wiring, so that we selected it to be the mobile robot controller. The mobile robot consists of DC motor and gear set to drive forward and reverse, DC motor and mechanic for steering and DC motor to drive the fork including photo sensor and limit switch. The interfacing can be done by link module OMRON-LK201 as the communication unit between the host computer and both PLC [20]. Through the link module the control center enable to get data directly from the data memory of PLC and cooperate with the Ladder programming.

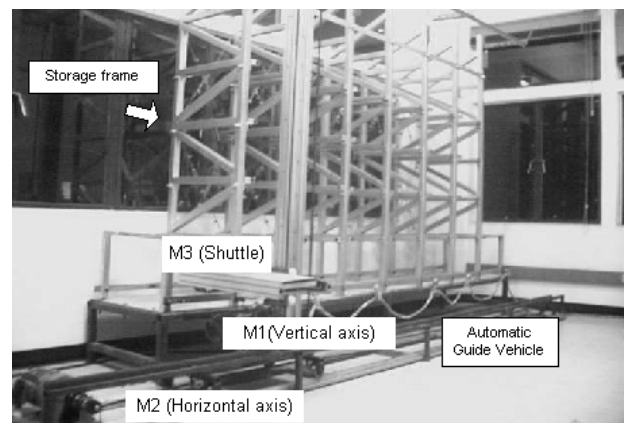


Fig. 3 The automatic warehouse

6. The experiment

The storage cells in automatic warehouse have 4 rows and 6 columns, each of position can be defined as two-dimensions array variable. There are three types of material (Type1, Type2 and Type3) which divided zones for storing follow as: Type1 stored at column 1<sup>st</sup> and 2<sup>nd</sup>, Type 2 stored at column 3<sup>rd</sup> and 4<sup>th</sup>, Type 3 stored at column 5<sup>th</sup> and 6<sup>th</sup>. Each zone will start the storage from row 1<sup>st</sup> to row 4<sup>th</sup> respectively to arrange FIFO queuing system. The operation of storage mode starts with users command the forklift robot to pick up the material pallet and then moved pass the barcode reader after that the host computer will consider to define warehouse's position by type of product. The operation of retrieval mode start with users request material by selecting material type from host computer and the stack crane will move to retrieve material for earliest storing it can notify date and time also. The motion of vertical axis and horizontal axis are independently and simultaneously and stop at their position then the shuttle part will operate. For the Internet applications the users must have password to login system and they can

check inventory information on Web pages, In the part of tele-operation users have to download software, which developed by Visual Basic in order to control and monitoring system.

### 7. Conclusion

This design system has combined the automatic machine in factory automation systems, computer network and information technology by using the Operations Research (OR) method. The operations and control of automation system can be reducing mistake and manufacturing lead-time and increasing performance as well as reliability of the production systems. The applications of Internet and information technology can be saving time and economizing cost for communications. Especially, this system we aim as to reduce ordering cost, setup cost and also lead-time that effected to reduce holding cost too. This conceptual design suitable to support the JIT system (Just-In-Times), Supply chains and logistic management that has more important role for changing in industries nowadays.

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