GRAPHICAL USER INTERFACE (GUI) FOR SUPERVISORY CONTROL OF COMPUTER INTEGRATED MANUFACTURING (CIM-70A) USING SCADA

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PENGESAHAN STATUS LAPORAN PROJEK SARJANA

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SESI PENGAJIAN : 2006/2007

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Graphical User Interface (GUI) for Supervisory Control of Computer Integrated Manufacturing (CIM-70A) using SCADA

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A thesis submitted
In fulfillment of the requirement for the award of the
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I declare that this thesis is the result of my own research except as cited in the references".

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DEDICATION

This is special dedicated to my beloved mother Aminah bte Sarib , my father Abu Bakar Bin Md Nor , my lovely fiancé Norasikin bte Harpan and my family for their continuous love and prayers , also to all my friends for their patient , kindness and cooperation . I wish to thanks all of you for your support during my studies in UTHM.

May God bless all of them.

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ABSTRACT

Supervisory Control system and the Acquisition Data or SCADA is generalization of effective plant monitoring and control system in meeting production needs etc. The aim of the study is to prepare a SCADA system for AS/RS, functional Mechatronics Educational Material which simulates to real-life production system. Graphical control buttons to the system will be design to perform single or multiple tasks. The software is form Citect Pty. Limited called Citect SCADA. This project will be discussed as it applied in a CIM-70A at Mechatronic Laboratory of UTHM. Designing a controlling and monitoring system not only for AS/RS but it is also a way providing up-to-date data. It will provide system operators with central or local control using clear, concise, resizable graphics pages (screens). Graphical control buttons to the system will be design to perform single or multiple tasks. In the last chapter, some methodologies for solving the problem as well as to improve the SCADA are proposed.

ABSTRAK

Sistem kawalan penyeliaan dan pemerolehan data atau SCADA adalah generasi baru kepada sistem pengawasan kilang dan sistem kawalan dalam memenuhi keperluan pengeluaran dan sebagainya. Matlamat kajian adalah menyediakan sebuah sistem SCADA untuk AS/RS, yang berfungsi sebagai bahan pendidikan Mekatronik yang mana mensimulasi sistem sebenar pengeluaran. Gambarajah direkabentuk untuk mengawal tugas-tugas tunggal atau tugas berganda. Perisian yang digunakan adalah Citect SCADA daripada Citect Pty. Projek ini akan dibincangkan sebagaimana ia diaplikasikan pada sistem CIM-70A di Makmal Mekatronik, UTHM. Merekabentuk satu pengawalan dan sistem pengawasan bukan sahaja untuk AS/RS tetapi juga satu cara menyediakan data terkini. Ia akan menyediakan operator sistem dengan pusat atau kawalan tempatan menggunakan jelas , ringkas dengan halaman-halaman grafik (skrin). Gambarajah butang-butang kepada sistem akan reka bentuk untuk melaksanakan tugas-tugas tunggal atau berganda. Di bab terakhir, beberapa metodologi untuk penyelesaian masalah serta untuk meningkatkan SCADA dibincangkan.

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LIST OF ACRONYMS/SYMBOLS/TERMS

AS/RS	-	Automatic Storage and Retrieval System station
Gbps	-	Giga bits per second
CIM70A	-	Computer Integrated Manufacturing Training Kit
DCS	-	Distributed Control Systems
GUI	-	Graphical User Interface
HMI	-	Human Machine Interface
I/O	-	Input/Output
UTHM	-	Universiti Tun Hussien Onn Malaysia
LAN	-	Local Area Network
m	-	mili
PLC	-	Programming Logic Controller
RTU	-	Remote Terminal Unit
s	-	second
SCADA	-	Supervisory Control and Data Acquisition
VMS	-	Virtual Memory System
CIO	-	Common Input/Output
COM	-	Component Object Model
DM	-	Data memory
FKEE	-	Faculty of Electrical and Electronic Engineering
IEEE	-	Institute of Electrical and Electronic Engineer
IEC	-	International Electrotechnical Commission
IP	-	Internet Protocol
GRAFCET	-	Graphe Fonctionnel de Commande Etape Transition
CRT	-	Cathode Rectifier Tube
DSP	-	Digital Signal Processing
Bps	-	bit per second

LAN	-	Local-Area Networking
CPU	-	Central Processing Unit
WAN	-	Wide-Area Networks
MT	-	Multi Tasking
TNBT	-	Tenaga Nasional Berhad (Transmission)
SAMS	-	Substation Alarm Monitoring System
MPS	-	Modular Production System
SYSCON	-	System Control of Communication Network
DMS	-	Distribution management system
EMS	-	Energy management system

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CHAPTER I

INTRODUCTION

1.0 Introduction

SCADA is the acronym for Supervisory Control and Data Acquisition. The term refers to a large-scale, distributed measurement (and control) system. SCADA systems are used in various applications in many different industries. Such as control chemical or transport processes, in municipal water supply systems, to control electric power generation, transmission and distribution, gas and oil pipelines, and other distributed processes. SCADA systems are used in various applications in many different industries. Whatever our application, SCADA will help to deliver and effective plant monitoring and control system. SCADA is a computer-based system for gathering and analyzing real time data and making suitable decisions based on the analysis (Rajesh Kumar, Syed Akif Kamal, Furqan M.Khan, 2004). For big or small applications alike, we have a flexibility to choose our own system design, confident our system will be fast, efficient, and completely scalable. It can record continuously a large amount of measurement points (channels) simultaneously; process the acquired data via powerful computing capability, and present data to the people everywhere in a graphical and real-time form.

Training on the actual real-life of production plant is often not possible, since the risk of a malfunctioning system would be too great and the production process would be considerably disrupted. Computer Integrated Manufacturing (CIM-70A) at Robotic Lab, UTHM allow Industrial Automation Systems of different levels of complexity involved many automation technologies such as mechanics, pneumatics, electric and electronic engineering, sensors, drives technology, PLC technology, industrial communication and computers. SCADA system falls under level 2 of control in a plant automation hierarchy.

Cell computer control and coordinate of devices in level 1 which consist of Master Conveyor. It has flexibility to change control function and communicate in real-time corresponding to devices in level 1. This level 1 encompasses devices such as, Vision inspection Station, Pin Insertion Station and AS/RS. Level 0 basically classified as automation component, such as sensors, pneumatic modules, mechatronic modules and control components.

1.1 Background of Problem

CIM-70A of UTHM's Robotics Laboratory is a Computer Integrated Manufacturing (CIM) which produces seven segment numbers from 0 to 9. The system can be control through SCADA software. The SCADA system for the CIM is control from two different windows thus used different method of communications. SCADA communicate with Master Conveyor and ASRS through COM1 and COM6 respectively. In this form, implementation of CIM system using Ethernet cannot be fully access by the user or operator. The Vision Station setting for pins location and pattern match earlier not accurate and the position of the pattern is not precise. The finished products pass through the vision sometimes not exactly same to the actual product. This project will concentrate on monitoring data status on ASRS location status let in the rack and the error massage from ASRS.

1.2 Objective

Designing SCADA for supervisory control of CIM70A system using CitectSCADA communicate with control level. It will provide system operators with central monitoring system with using clear, concise, resizable graphics pages (screens) and error alarm. To add the new value of knowledge on SCADA in term of communication, data transfer and programming for education purposed. Set up new setting for pattern recognition and location of Vision Inspection Station and data transfer from ASRS to Master Conveyor through serial communication.

1.3 Scope of Project

This project is based on some constraints listed below:

i) This project designs a SCADA system for ASRS in Robotic Laboratory.
ii) The stations included in the design are Master Conveyor Station, ASRS and Vision Inspection Station.
iii) Transfer a Data Memory from ASRS to the Master Conveyor through CIO.
iv) The process of PLCs programming of this system designed by using GRAFCET which then interpreted to ladder logic through CX-Programmer.

1.4 Thesis Layout

This thesis organized as follows: Chapter 1 explains the overall background of study. The heart of this study is presented well through this chapter. Chapter 2 explains the literature research based on SCADA system. The introduction on Computer integrated Manufacturing System (CIM-70A) in terms of operation, networking and communication explained in chapter 3.

Chapter 4 explains on the method that used through the study on SCADA. System development by using PLC represent by GRAFCET discussed in this chapter. This chapter will more focuses on SCADA software. All the method will be explain well as a future references. SCADA will be explaining perfectly plus with useful figure and graph.

Chapter 4 will explain results that reflect my problem statements as stated in first chapter. The results from the PLCs to SCADA discussed in this chapter. Chapter 5 will go through about the conclusion and recommendation. This entire thing is done after completing my dissertation references and appendices are enclosure for future reference.

CHAPTER II

LITERATURE REVIEW

2.0 Introduction to Supervisory Control and Data Acquisition (SCADA)

Patents for remote control and remote indication were filed as early as the 1890s. These very early systems were intended for either remote control or remote indication but not both. In the 1920s and 1930s various commercial systems evolved employing concepts of check-before-operate and with the capability of conveying status of multiple points. These early systems were based on electromechanical logic which largely evolved from telephone system technology.

The advent of the minicomputer in the 1960s prompted dramatic changes in the design and use of supervisory control systems. Electromechanical systems which preceded the introduction of computer-based systems were largely intended for remote control and simple indication of status. The acquisition of large numbers of status indications and analog values are not practical. The early systems were generally referred to as simply "supervisory contro1". In the late 1960s, as new minicomputer-based systems began to emerge, the possibilities for vastly increasing data acquisition became apparent, and the expression "Supervisory Control and Data Acquisition" or SCADA came into being as a more appropriate description of the system.

SCADA is a computer-based system for gathering and analyzing real time data and making suitable decisions based on the analysis. SCADA was meant primarily for remote monitoring and control function of a number of widely distributed sites. Utility industries have been heavily depending on SCADA since long. However, its form and applicability has been matured gradually over time according to the availability of new generations of software and hardware. SCADA systems can be relatively simple, such as one that monitors environmental conditions of a small office building, or incredibly complex, such as a system that monitors all the activity in a nuclear power plant or the activity of municipal water system (M A Higgs, 1999). SCADA packages are available or can be tailored for applications to many processes such as:

i) Automation system
ii) Water Supply
iii) Irrigation System
iv) Sewage lift station
v) Oil field and pipeline control
vi) Power generation and transmission
vii) automation (Energy management system or EMS)
viii) Power distribution automation (Distribution management system or DMS)
ix) System control of communication network (SYSCON)
x) Security system
xi) Early warning siren system
xii) Mass transit system, to name a few.

SCADA system falls under level 2 of control in a plant automation hierarchy. Open system or open architecture has been recognized as a key to development and maintenance of better CIM (Computer Integrated Manufacturing) systems. Figure 2.1 show the work cell architecture. Revolutions in object-oriented relational database and Workstations technology have given added power to CIM (Soumitra K. Ghosh, 1996).

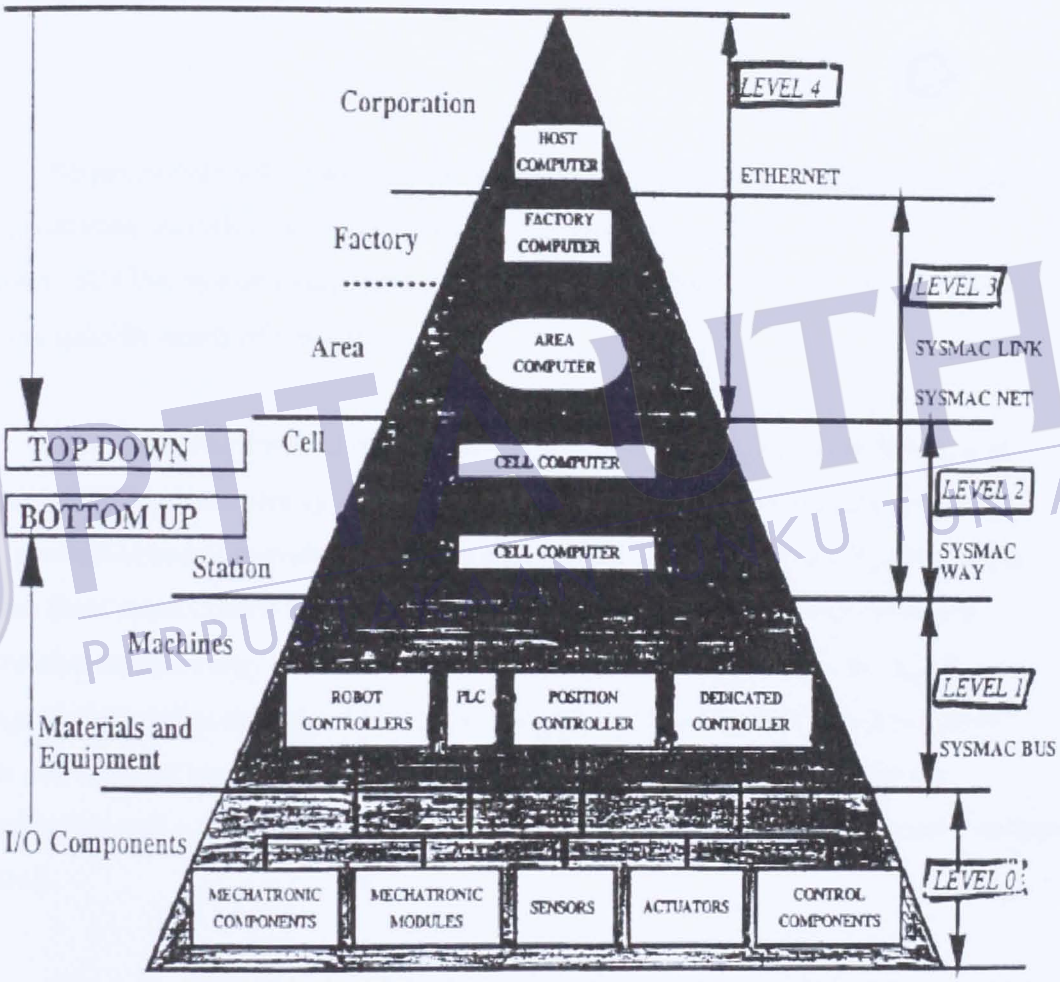

Figure 2.1: Work cell architecture.

At level 2 work cell concerns with control and co-ordination of devices in level 1. This level has flexibility to change function corresponding to devices changes in level 1. Ability to communicate in real-time to devices it controls as well to other cell controllers and higher level systems. Levels 1 encompass devices such as PLCs, vision inspection station and industrial robot. Level 0 basically classified as automation components such as sensors, pneumatic modules, mechatronic modules and control components.

2.1 SCADA Development

Requirements within the electric utility industry for remote control of substations and generation facilities have probably been the driving force for modern SCADA systems. SCADA systems recently used in many industries and, as a result, are tailored to suit the specific needs of various users.

MPS (Modular Production System) allows Industrial Automation Systems of different levels of complexity to be modeled. The MPS concept represents a radically new product-oriented manufacturing paradigm which is based on building production system from standardized machine elements. The overall objective is to provide a production methodology which will enable entire production system to be rapidly designed and configured for a wide range of consumer products with minimal delay, costs and need for specialized machinery. SCADA systems are designed for the visualization and control of process, production sequence and machines (Recep Yenitepe , 2004).

The communication rate of the high-speed Ethernet has reached l Gbps at present. With the promotion of the rate as well as the occurrence of high-speed Ethernet and the application of intelligent data exchange technology, the nondeterministic problem has been solved gradually and no long hindered the application of Ethernet in the field of industrial control. The SCADA system based on Ethernet will play a more active role in the industrial applications and become a convenient, cheap and practical scheme for the technical reconstruction in the enterprises (Yang Haijing, Yang Yihan and Zhang Dongyin , 2004).

During the last one decade, many SCADA have been developed and successfully implemented for meeting real-time monitoring system in the various field of industry. Out of these the following literature research based on SCADA system.

i.) 1998 - SCADA based control incorporated in integrated Iron and Steel Plants. Computer based systems for SCADA help to control systems operator to achieve real-time data acquisition, processing, display and control of data pertaining to large process environments (S C Bhatia, India, 1998).

ii) 1999 - Improving the supervisory control in a hydropower plant, the SCADA application was built in during the general overhaul of the hydropower plant "Miljacka" on the river Krka in Croatia. The lowest level of the execution of the controlling algorithms was on the SIEMENS PLCs S7-400. The SCADA application is the top of the supervisory control structure. The controlling application was made in the form of enclosed logical parts of the process displayed on individual control panels used for supervisory control. The communication of the SCADA application with the PLCs is realized by the communication server Applicom PC 2000 ETH, using SINEC H1 (Industrial Ethernet) protocol via fibre optics (M. Mavrin, V. Koroman, B. Borovic, 1999).

iii) .2000 - Implementation of a cost-effective and flexible system, called Substation Alarm Monitoring System or SAMS, that was developed in-house to share centralized SCADA data for operations and maintenance. SAMs can be utilized to disseminate substation information quickly and accurately. As a result, power system breakdown could be alerted promptly and restoration time could be reduced. Initial signs of equipment damage could also be detected so that corrective measures could be done at an early stage. SAMs also allows operational information to be shared among TNBT personnel. (Azlan Muhamad Sufian, Rosdi Embong, Wan Azlan Wan Kamarulzaman, Mohd. Shafik,,Mohd. Taha, 2000).

ii.) 2004 - Design and implementation of a MT (Multi Tasking) Educational MPS (Modular Production System) Unit and SCADA. Prepare a modular, functional Mechatronics Educational Material which simulates to real-life production system. Visualization of all the processes in the MT MPS Unit is also realized via InTouch 7.0 SCADA software which is possible to run, control and visualization of the system (Recep Yenitepe, 2004) .

2.2 Modern SCADA System.

In the early 1980s first SCADA were installed and since that time, the systems representing a total of three generations of SCADA architecture. The programmer has taken advantage of each of these changes to upgrade the system to capture the benefits of the improvements in the new architecture. To grasp the significance of the convergence of numerous business applications towards networks and SCADA's involvement in such, an understanding of each of these three generations of SCADA architecture is needed.

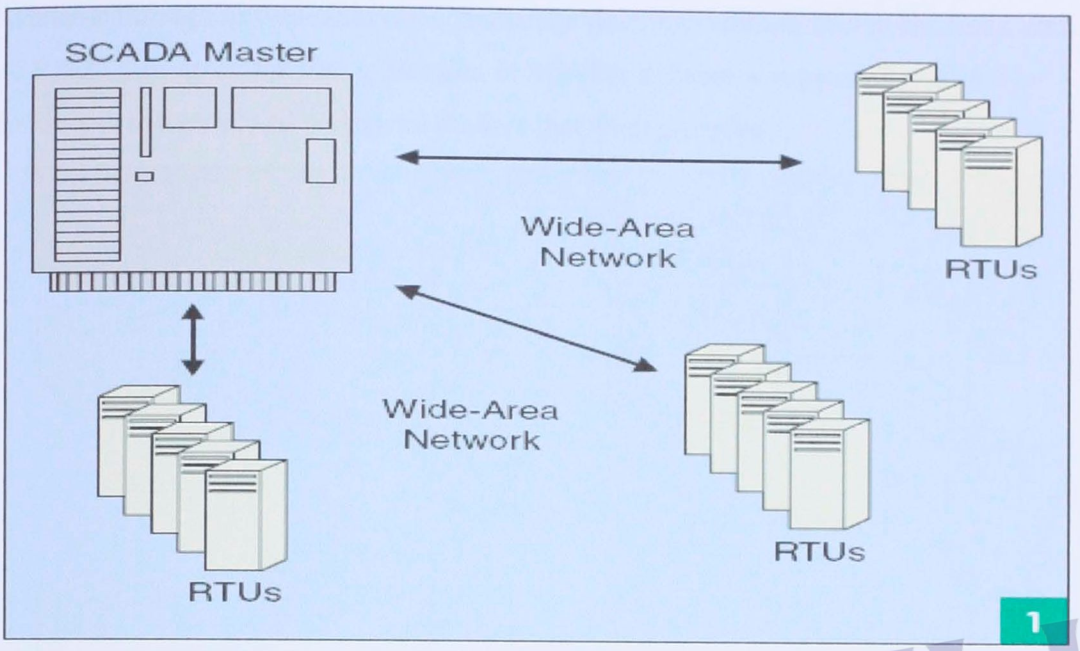

Figure 2.2: First generation monolithic

2.2.1 First Generation: Monolithic

When SCADA systems were first developed, the concept of computing in general centered on a "mainframe" system. A single monolithic system that performed all computing functions associated with a given process. Figure 2.2 show SCADA systems were standalone systems with virtually no connectivity to other systems. The wide-area networks (WANs) that were implemented to communicate with remote terminal units (RTUs) were designed with a single purpose in mind: that of communicating with RTUs in the field. The protocols in use on SCADA networks were developed by the vendors of RTU equipment and were often treated as proprietary. Connectivity to the SCADA master station itself was very limited; without network connectivity, connections to the master were typically done at the bus level via an, often proprietary, adaptor or controller plugged into the CPU backplane. Some limited connectivity to external systems was available through low-speed serial connections utilizing communication standards, such as RS-232. In short, the first generation of SCADA systems was generally limited to hardware, software, and peripheral devices that were provided.

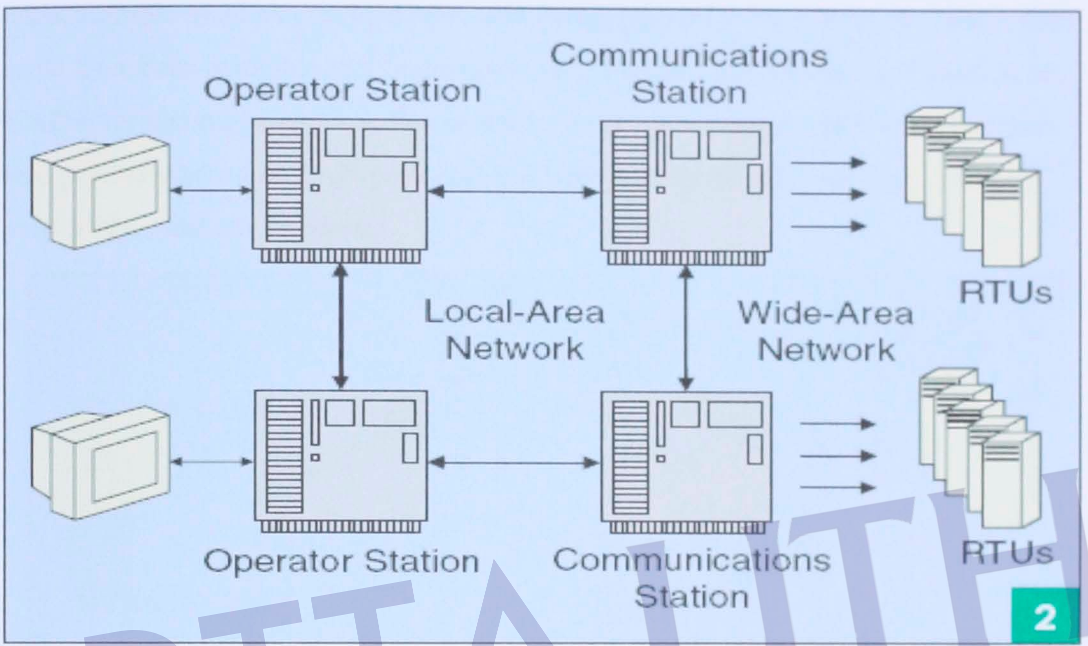

Figure 2.3 : Second generation distributed.

2.2.2 Second Generation: Distributed

The next generation of SCADA systems began to take advantage of developments and improvement in system miniaturization and local-area networking (LAN) technology to distribute the processing across multiple systems. Multiple stations, each with a specific function, were connected to a LAN and shared information with each other in real-time. These stations were typically of the minicomputer class, rather than mainframes, and were smaller and less expensive than their first generation predecessors. Some of these distributed stations served as communications processors, primarily communicating with field devices, such as RTUs. Some served as operator interfaces, providing the human-machine interface (HMI). SCADA systems, as yet, do not operate in isolation; they interface with people (operators) and processes (management) (Soumitra K.Ghosh ,1996). The distribution of individual SCADA system functions across multiple systems provided more processing power for the system as a whole than would have been available in a single processor. Figure 2.3 show the configuration of SCADA for second generation. The networks that connected these individual systems were generally based on LAN protocols and were not capable of reaching beyond the limits of the local environment.

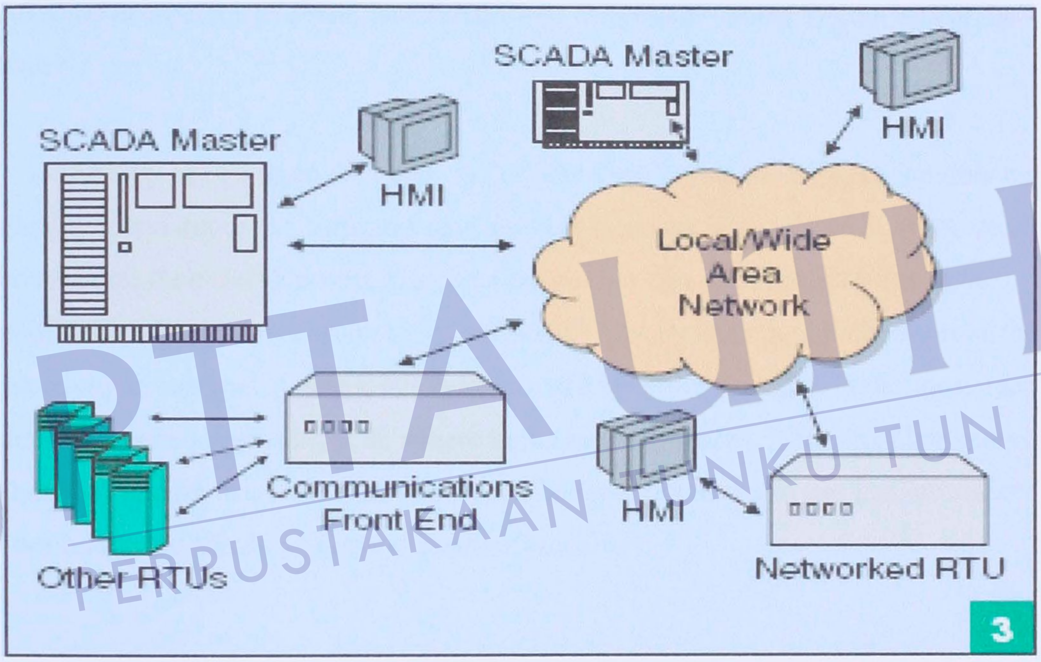

Figure 2.4: Third-generation SCADA architecture (networked).

2.2.3 Third Generation: Networked

The third generation of SCADA master station architecture is closely related to that of the second generation, with the primary difference being that of open system architecture rather than a vendor-controlled, proprietary environment. There are still multiple networked systems sharing master station functions. There are still RTUs utilizing protocols that are vendor-proprietary. The major improvement in the third generation is that of opening the system architecture, utilizing open standards and protocols and making it possible to distribute SCADA functionality across a WAN and not just a LAN illustrated at Figure 2.4. Open standards eliminate a number of the limitations of the previous generations of SCADA systems. The utilization of off-the-shelf systems makes it easier for the user to connect third-party peripheral devices (such as personal computers, printers, disk drives, tape drives, etc.) to the system and/or the network.

As they have moved to "open" or "off-the-shelf" systems, SCADA vendors have gradually gotten out of the hardware development business. This allows SCADA vendors to concentrate their development in an area where they can add specific value to the system—that of SCADA master station software. Open systems do greatly improve the connectivity to external systems, but there can still be interconnection limitations, even with systems or equipment that all adhere to the same standards. "Islands of automation" are not very uncommon where the elements of automation probably are just interfaced but not integrated (Zhihao Ling and Jinshou Yu, 2001).

Important issue in the real-time SCADA system is its robustness to unpredictable component faults. In the adversarial industrial manufacturing environments, the component malfunctions during system operations are unavoidable. Especially for computationally expensive real-time systems, failures of sensors, microprocessors, and actuators are inevitable under the heavy duty. Therefore, it is highly necessary to design fault-tolerant SCADA systems, which are capable of self-repairing and self-recovering from the fault condition without much performance loss.

CHAPTER III

COMPUTER INTEGRATED MANUFACTURING

3.0 Introduction to CIM-70A

In order to design the SCADA integrated with CIM-70A, we should know deeply about the system which we want to build. It is actually a policy guideline or basis to the study of a more detailed system. CIM-70A system is thus located at Robotics Laboratory, Faculty of Electrical and Electronic Engineering; UTHM also shown in Figure 3.1 .This system consists of:

i) Station-1 (Pin Insertion Station).
ii) Station-2 (Plate Insertion Station).
iii) Automatic Storage and Retrieval System (AS/RS) Station.
iv) Conveyor System Station.
v) Vision Inspection Station.

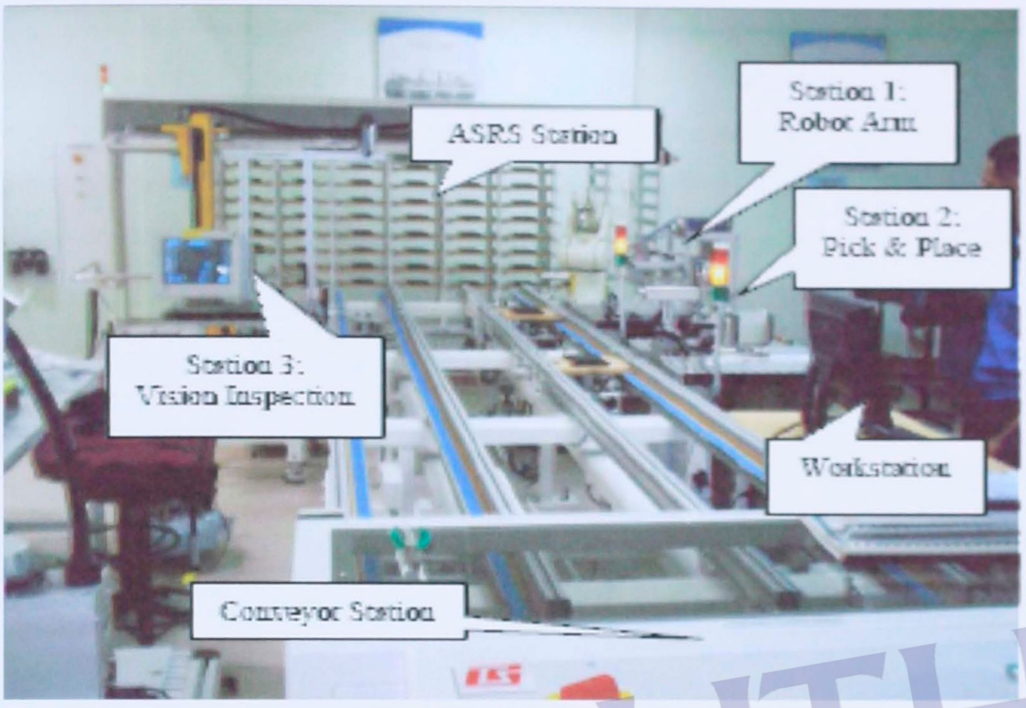

Figure 3.1: Computer Integrated Manufacturing System (CIM-70A)

3.1 Station-1 (Pin Insertion Station)

Station-1 consists of two sub-stations: pin feeder part supply, and pick and place robot arm. The structure of the station-1 illustrated in Appendix A. Pin feeder part supply is merely constructed by 2 cylinders with special mechanism and design which are able to provide pins to be picked by Pick and Place robot. The pin insertion process is done by Kawasaki FS02N-C001, a six degree of freedom articulate robot arm which is controlled by C70F-A00l controller. Kawasaki robot is indeed, based on C programming language written using KCWin software. Meanwhile the location of pins insertion is set by user using C programming.

There is a significant in communication between Station-l PLC and the C Series Controller. In order to execute a program in the C Series Controller, Station-l PLC must trigger the controller through a specific input point of the controller. Once triggered, the C Series Controller will read the inputs for program selected and therefore execute a program corresponding to the number selected to the particular program. The outputs from C Series Controller such as "robot running", "robot pick position", "robot error" and "robot home" are used by the PLC to control pin feeder robot as well as the conveyor system. Numbers to be produced in production line is thus set at SCADA software.

3.2 Station-2 (Plate Insertion Station)

Station-2 performs plate insertion onto the pallet which has been inserted by pins. This plate avoids undesired object to fall onto the pallet. The plate is transparent. This is to make sure that the finished product can be inspected by vision camera. This station also consists of pneumatically driven cylindrical robot arm, container bins, ejector, vacuum sucker module, Z-axis block, and R-axis block which are illustrated in Appendix A.

The ejector is made from a pusher attached to a pneumatic cylinder. Its function is to push the base block out from the container bin. Each will push one bearing out in every cycle. If container bins is empty, the station will be in a stop mode until the user replaces a new plate. The vacuum sucker module has two vacuum suckers to pick plastic cover, which is generated using vacuum valve. This pick and place station has three axes block which are X-axis, Y-axis and R-axis. X-axis and Y-axis block move up and down by pneumatic cylinder. Its function is to pick up or place the plastic plate. R-axis block rotates 180° degree and transfers the plastic plate from container bin to conveyor.

3.3 Conveyor System.

There are three run modes for the conveyor system; namely free running mode, production mode and demo mode. The mode can be set by the HMI software, as illustrated in Appendix A. For free running mode, the stations are not activated. This means that the pallet has free flow along the conveyor belt. Timer is used to stimulate the station operation time. In the production mode the product is run in full cycle depending on the product quantity keyed by user. In demo mode, there is no quantity target, which means that the stations will still run until the container bin is empty.

3.4 Automated Storage and Retrieval System (AS/RS).

Figure 3.2: Structured of AS/RS with symmetrical axis.

3.4.1 AS/RS Structure

An automated storage and retrieval system (AS/RS) is a computer controlled automated material transporting system which is used to transfer material from one place to another. In this system configuration AS/RS is assigned as a Slave 0. There are 64 pallets on the AS/RS rack. The X-axis consists of eight columns labeled from A to H while Y-axis consists of rows labeled from 1 to 8. Figure 3.2 shows the structure of the AS/RS. The pallet will be retrieved one by one by putting the pallet on the conveyor. In this system AS/RS works as below.

i) Collects the finished pallet from production line.
ii) Delivers the empty pallet to conveyor.
iii) Fills and empty pallet storage system.

3.4.2 AS/RS Human Machine Interface.

HMI software, which is developed using Borland C++ Builder, is used to communicate with AS/RS. Unfortunately, the programming is being disabled by the programmer to avoid modification done by the user. AS/RS communicate with HMI through RS-232 cable by using COM port 6. The software allows the use to configure the AS/RS before running the production. Pallets status at rack can be set through HMI software. If communications over Ethernet is realized in this system, real-time monitoring data at AS/RS will have limited HMI only. Thus, SCADA only communicate with Master PLC's using COM 1.

3.5 Serial PLC Link Networking Configuration

This CIM-70A is a multiple PLC which is linked up through RS422/RS485 networking. Each station uses one of its serial ports for link up. Converter CJ1W-CIF11 is required to convert from RS-232C to RS-422A. AS/RS using CJIM-CPU23 PLC controller and the other station using CJIM-CPU13. CJ1M-CPU23 has 640 I/O points compared to CJ1M-CPU13 which only has 320 I/O points. Figure 3.3 shows CIM-70A system configuration where OMRON PLC controller is linked by RS-422A cable via built in RS-232C port.

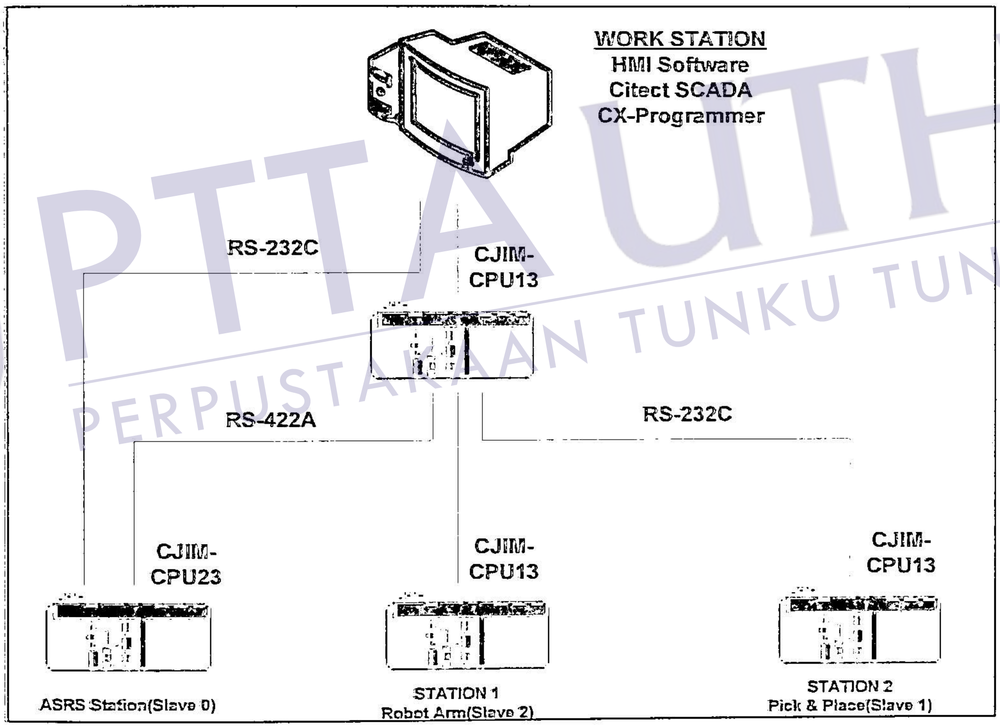

Figure 3.3: CIM-70A system networking

3.5.1 Serial PLC link Setup

Serial communications is the process of sending data one bit at one time, sequentially, over a communications channel or PLC. This is in contrast to parallel communications, where all bits of each symbol are sent together. The serial communication works by each PLC which writes data to the allocated CIO memory area (10 words maximum). This setting specifies the number of words per node in the Serial PLC Link Area to be used for Serial PLC Links. Serial PLC Link Area for CJ1M CPU Units memory area structure is assigned from CIO 3100 to CIO 3189. These words are allocated for use with the Serial PLC Link, for data links with other PLCs. Spare addresses for Serial PLC Link can only be used in the program, the same as the Work Area.

The link words are limited to 10 words due to limitations in speed and compatibility. If the default is set, the number of words will automatically be 10 (A hex).The detail setting for serial PLC link memory for each CIM-70A's PLC is as listed in Table 3.1 below.

No.	Unit Number	Station	CIO Memory Area
1	Master	Conveyor System	CIO3100-3109
2	0	AS/RS	CIO3110-3119
3	1	Robot Arm	CIO3120-3129
4	2	Pick & Place	CIO3130-3139
5	-	Spare	CIO3140-3189

Table 3.1 : CIO memory area for each CIM-70A's PLC

This setting specifies the highest Polled Unit number that can be connected in Serial PLC Links. CIM-70A completes link method shown in Figure 3.4. The system can be connected to maximum 7 stations for future expansion. The standard settings for communication settings are 1 stop bit, 7-bit data, even parity, 2 stop bits and 9,600 bps.

The maximum setting for communication is only 9,600 bps. The setting must be the same for all of the Polled Units and the Polling Unit using Serial PLC Link.

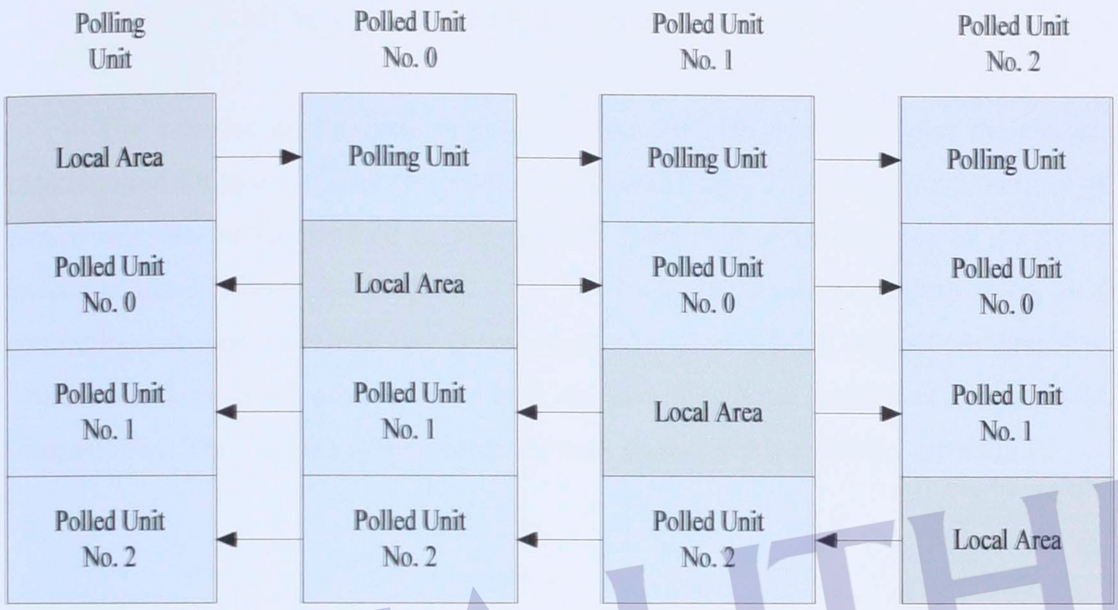

Figure 3.4: Complete link method of CIM-70A system

3.5.2 The Serial PLC Link Area

The Serial PLC Link Area contains 90 words with addresses ranging from CIO 3100 to CIO 3189. Words in the Serial PLC Link Area can be used for data links with other PLCs. Therefore, if there are new stations to be added, it can directly connect to socket and assign with unused CIO address. Serial PLC Links exchanges data among CPU Units via the built-in RS-232C ports, with no need for special programming. The Serial PLC Link allocation is set automatically by means of the following PLC Setup settings at the Polling Unit. Bits in the Serial PLC Link Area can be easily force-set and force-reset by user.

i) Serial PLC Link Mode
ii) Number of Serial PLC Link transfer words
iii) Maximum Serial PLC Link unit number

The increase in the cycle time will be the I/O refreshes times plus the refresh time required for specific Unit functions. CJ1M CPU Units: 0.7s x maximum number of data words sent or received (0 to 500 words). There will be an increase of the event execution times when Host Links or 1: N NT Links are used. Multi-drop refers to a connection between more than two devices operation of an RS-232 compatible interface; while multi-drop "work-around" have been devised, they have limitations in speed and compatibility. The detailed system setup for each station is described in Appendix B.

3.6 Vision Inspection Station.

Vision Inspection Station consists of KeySense camera integrated with DSP chip, teach pendant and monitor. Figure 3.5 above shows the structure of this Vision Inspection Station. The camera has digital video output that links to CRT monitor. This station inspects the product through the image captured. In addition, it also compares the image kept in program with the present image. Thus, there are several ways to process the input namely by, pattern, object, distance, pitch, circle, angle and area.

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