REMOTE DATA ACQUISITION
USING
LOCAL AREA NETWORK (LAN)

By

SITI RAHAYU MAT SOM

FINAL PROJECT REPORT

Submitted to the Electrical & Electronics Engineering Programme
in Partial Fulfillment of the Requirements
for the Degree
Bachelor of Engineering (Hons)
(Electrical & Electronics Engineering)

Universiti Teknologi PETRONAS
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CERTIFICATION OF APPROVAL

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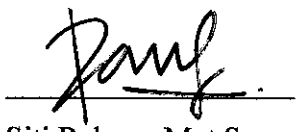
UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK

December 2007

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



Siti Rahayu Mat Som

ABSTRACT

This project is about remote control, data acquisition, data management and security system called as Remote Data Acquisition System Using Local Area Network (LAN). This system encompasses collection of information, method of transfer from the laboratory, analysis and control of the system, and display of the received information. This system has the capability to monitor and control laboratory operations in real time. By using this system, the user can control and collect data from any computer as the user login with assigned username and password using LAN in Universiti Teknologi PETRONAS. For this project, the methodology and project works are more on the design and execution works. The works related with programming the system, interfacing with LAN and the reliability and precision in the data collection and storage. The system will assist the user with systematic time management. Since both data collection and storage can be simultaneously done, this will increase efficiency as less manpower, time and energy will be utilized. It also provides the user the flexibility to use the system from any place and time.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

CAN	Campus Local Network
CPU	Control Processing Unit
DAQ	Data Acquisition
DC	Direct Current
GUI	Graphical User Interface
IP	Internet Protocol
LabVIEW	Laboratory Virtual Instrumentation Engineering Workbench
LAN	Local Area Network
MAN	Metropolitan Area Network
OLE	Object Linking and Embedding
OSI	Operation System Interface
PAN	Personal Area Network
PC	Personal Computer
PSTN	Public Switched Telephone Network
RAS	Remote Access Server
TTL	Transistor-to-Transistor Logic
UTP	Universiti Teknologi PETRONAS
VoIP	Voice Over IP
WAN	Wide Area Network
TCP/IP	Transmission Communication Protocol/Internet Protocol

CHAPTER 1
INTRODUCTION

1.1 Background of Study

All industrial processing systems, factories, machinery, test facilities, and vehicles contain thousands of mechanical and electrical phenomena that are continuously changing and not in steady state. The measurable quantities that represent the characteristics of all systems are called variables. The proper functioning of a particular system depends on certain events in time and the parameters of these variables.

Most variables must be measured with a device that converts the phenomena into a form that a human can perceive such as a visual display, a transducer for sound, or vibrations to stimulate physical sensations. The conversion devices are called transducers or sensors, and it translates the physical phenomena to electrical signals to be measured with electronic instruments. But an increasing need to record and preserve these phenomena and analyze them at a later time forced engineers to develop data recorders and data acquisition systems.

Variables may be classified in many ways, but generally there are two classifications: by characteristic and by type of measurement signal. Variables classified by characteristic include thermal, radiation, force, rate, quantity, time, geometric, physical properties, chemical composition, and electrical. Those classified by measurement signal include motion, force, electrical, and time-modulated.

Data acquisition systems have evolved over time from electromechanical recorders containing typically from one to four channels to all-electronic systems capable of measuring hundreds of variables simultaneously. Early systems used paper charts and rolls or magnetic tape to permanently record the signals, but since the advent of computers, particularly personal computers, the amount of data and the speed with

which they could be collected increased dramatically. However, many of the classical data-collection systems still exist and are used regularly.

Nowadays, data acquisition system also has been integrated with other applications such as automatic billing, online simulation, transport management, forecasting, linepack management, etc.

From the current data acquisition system applications, the student will apply four of these system applications to implement it on the Remote Data Acquisition System using LAN for the laboratory in Universiti Teknologi PETRONAS. The four applications are data acquisition, remote monitoring, data management and security system.

1.2 Problem Statement

1.2.1 Problem Identification

In Universiti Teknologi PETRONAS, the researchers or students need to do research or experimental works in the laboratory for their studies. Usually the research or experimental works are produced varying variables. As there are continuous numbers of variables has to be collected and stored, it will required a large amount of time and manpower to executes the data collection and storage of the works.

As this situation grows, it will increasing the cost, time taken and number of manpower using for this data acquisition process. A possible solution is to use Remote Data Acquisition System using LAN. This system is capable in simultaneously data collection and also remote monitoring. It helps in time management, flexibility and efficiency for research or experimental work in the laboratory.

1.2.2 Significant of the Project

Remote Data Acquisition System using LAN can collect a large amount of data or information simultaneously. This system will make the time management more systematic and can reduce the time taken for the data collection process. This system will add the flexibility to the user, which they can control and received the data or information from any computer, which connected with the LAN in Universiti Teknologi PETRONAS. In the future, it will increase the efficiency of the data collection and storage for the system.

This system will enable the integration of functions such as monitoring, safety, remote controls and management information as the experiments are running in the laboratory. The system works as the data or information are received from the hardware. Then, the data will transmit to the laboratory computer for updating and storage. The laboratory computer will connected with LAN. As the user want to do a monitoring, controlling or data acquisitioning process from the laboratory, the user just need to login to the system.

1.3 Objective and Scope of Study

1.3.1 The Relevancy of the Project

The main objective for this project is to design remote monitoring and data acquisition system, which the user can control and collect data from any computer as the user login with assigned ID and password using LAN. The system can received a large amount of data or information simultaneously by the user from a single computer. The computer must be connected to the LAN of Universiti Teknologi PETRONAS.

1.3.2 Feasibility of the Project within the Scope and Time Frame

The area and scope of the project has been narrowed down to control and data acquisition system in laboratory using LAN. This will makes sure that this project is feasible and should be completed within the allocated time frame. The focus of this project includes the basic concepts and system architecture for remote monitoring, data acquisition, data management and security system, basic concepts of Local Area Network, the fundamental of LabVIEW and related softwares, graphical programming for data acquisition, and lastly on data transmission and collection in the system.

CHAPTER 2
LITERATURE REVIEW AND THEORY

The whole concepts and idea for this Remote Data Acquisition system comes from plant automation system such as Distributed Control System (DCS) and Supervisory Control Architecture and Data Acquisition (SCADA) System. As to make this project meet the requirement for the student, the scope of the project has been narrowed to remote monitoring and data acquisition system using Local Area Network (LAN) in Universiti Teknologi PETRONAS only. This will help the student to focus on the area which gives benefits to Universiti Teknologi PETRONAS.

As been researched, this project will focus only on four areas as compared with current automation system in the market. The four areas will be the main concept and design for this project. The four areas are data acquisition, remote monitoring, data management and security.

2.1 Data Acquisition (DAQ) System

Data acquisition systems, as the name implies, are products and/or processes used to collect information to document or analyze some phenomenon [1]. As technology has progressed, this type of process has been simplified and made more accurate, versatile, and reliable through electronic equipment. Equipment ranges from simple recorders to sophisticated computer systems. In data acquisition systems consists of four elements [3]:

1. Measuring output (sensors around the vehicle)
2. Recording output signal (logger unit)
3. Uploading/accessing recorded data (telemetry system)
4. Analysis of recorded data (DAQ system software)

The four elements in this system have specific requirements which need to physically present and included in the design process for this project. Sensors to measure selected parameters must meet certain specifications and the routing of the sensor cables ensures they will not suffer from electromagnetic interference from other electronic systems. The DAQ unit (including memory) and the link from the DAQ unit to the operating platform to upload the acquired data via a hardwire cable or telemetry also must conform to requirements.

The accuracy, repetition, reliability and errors-free data is very high in all PC-based DAQ system as they are connected and operated accordingly to the practice recommendations. In DAQ system consists of many different PC technology forms for great flexibility when choosing the system. (Refer in Appendix A for further description on data acquisition system). There are five components to be considered when building a basic DAQ system [3]; transducer and sensors, signals (data or information), signals conditioning, DAQ hardware and application software.

One of important aspect in data acquisition is data transmission. Data transmission is directly related with computer networking. A computer network is two or more computers connected together using a telecommunication system for the purpose of communicating and sharing resources [3].

There are many types of network in the computer network used world wide. Below is a list of the most common types of computer networks are Local Area Network, Campus Area Network, Metropolitan Area Network, Wide Area Network, Internetwork, Internet, Intranet and Extranet. Refer to Appendix B for further explanation on Computer Network.

Usually basic network building blocks are workstations and servers. There are several types of server such as file server, print server, mail server, fax server, telephony server, proxy server, remote access server, application server, web server and backup server.

One of a type of network is Local Area Network (LAN). A LAN is a computer network covering a small geographic area, like a home, office, or group of buildings [3]. Current LAN in Universiti Teknologi PETRONAS is based on switched IEEE 802.3 Ethernet technology, running at 100 Mbit/s. Each node or computer in the LAN has its own computing power but it can also access other devices on the LAN subject

to the permissions it has been allowed. These could include data, processing power, and the ability to communicate or chat with other users in the network. Refer in Appendix C for further description on LAN. Smaller LANs consists of a small numbers of switches usually connected with each other and with one connected to a router, cable modem or DSL modem. Otherwise, larger LANs are characterized by distributing Ethernet traffic roles within the network. Each layer aggregates traffic of the layer below it and will typically maintain redundant links with switches capable of quality of service and spanning tree protocol to prevent loops and the recovery of failed uplinks.

2.2 Remote Monitoring System

Remote monitoring system is monitoring systems that enables various network monitors and console systems to exchange network-monitoring data. The remote automation technique used in remote monitoring allows Object Linking and Embedding (OLE) objects to be accessible to other users on a network. By using this technique, an object which is located on a different machine is completely transparent to the application using the OLE object.

A remote monitoring implementation typically operates in a client/server model. Monitoring devices contain remote monitoring software agents that collect information and analyze packets. These monitoring devices act as servers and the Network Management applications that communicate with them act as clients.

The biggest advantage of this OLE is because it is user friendly. The OLE system is already built in the LabVIEW main features. So as the LabVIEW programming is used as the Interfaces between the experiment and user, OLE system directly can be used by the user.

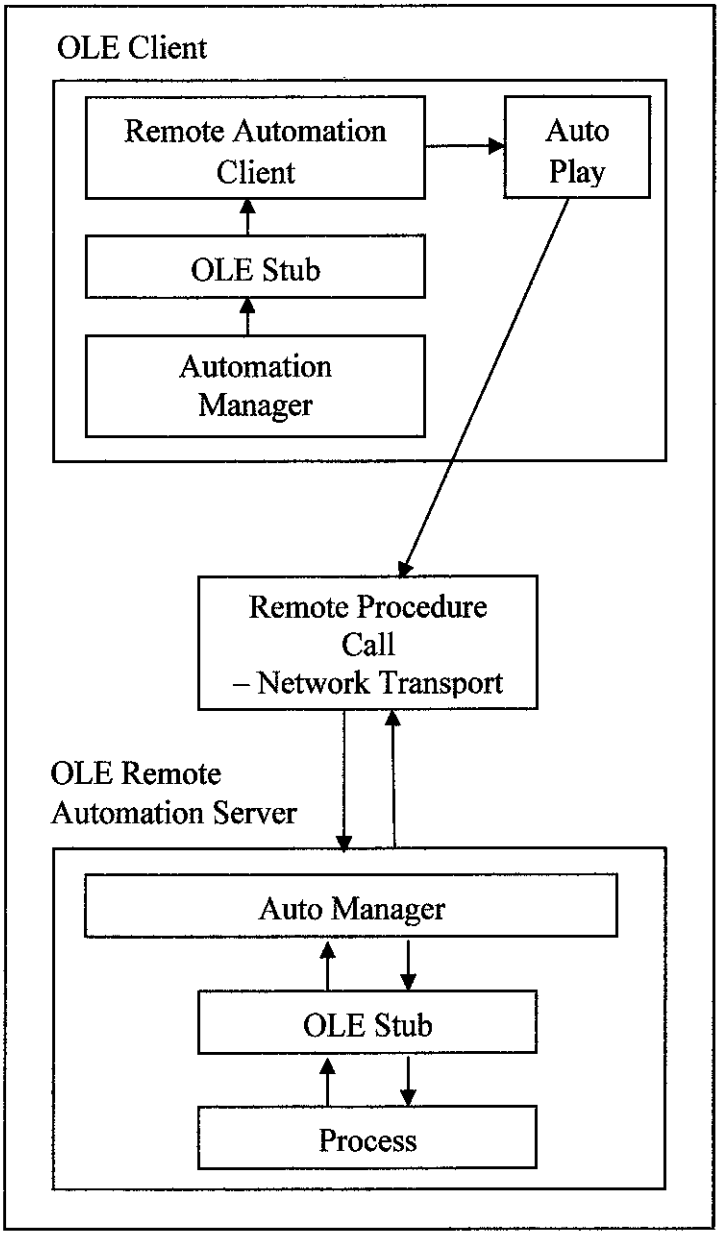

Figure 2.1 How an OLE Client Application Communicates with an OLE Remote Automation Server

2.3 Data Management

Currently, data re easily available but to make it to be meaningful requires proper management. As the data is captured by measurement unit such as sensors, the reading will be transmitter to the data logger and the data logger will save the data inside the database at the Local Disk. For the project, data management system is applied using LabVIEW data logger and stored inside the Local Disk under LabVIEW folder. From the stored data, the LabVIEW VIs will studies and do the data analysis to come out with the desired output. The flow of the data management is as shown in Figure 2.2.

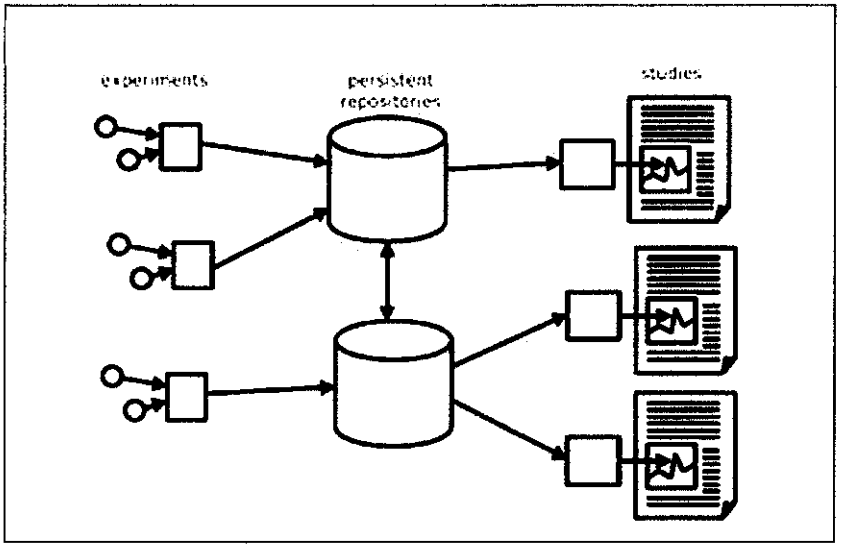

Figure 2.2 The Architecture of Data Management

2.4 Security System

Security system is the additional system will be put inside this system. Remote monitoring and operation of devices over the local network requires strict security measures for several reasons such as to protect the monitored data from being stolen, corrupted and intentionally falsified, to protect the device from malicious use (abuse) by impersonators, and to protect the device from unauthorized use, commercial or national security concerns may require steps to preserve the privacy of monitoring data.

Most of the attention focused on authentication concerns. Unauthorized operation will bring potential damage to expensive equipment. It is therefore imperative to prevent unauthorized operation of this equipment.

CHAPTER 3

METHODOLOGY AND PROJECT WORK

3.1 Procedure Identification

For this project, the methodology and project works are more on the design and execution works. The works related with programming the system, interfacing with LAN and the reliability and precision in the data collection and storage. The steps for the project works for this project are as shown in Figure 1.

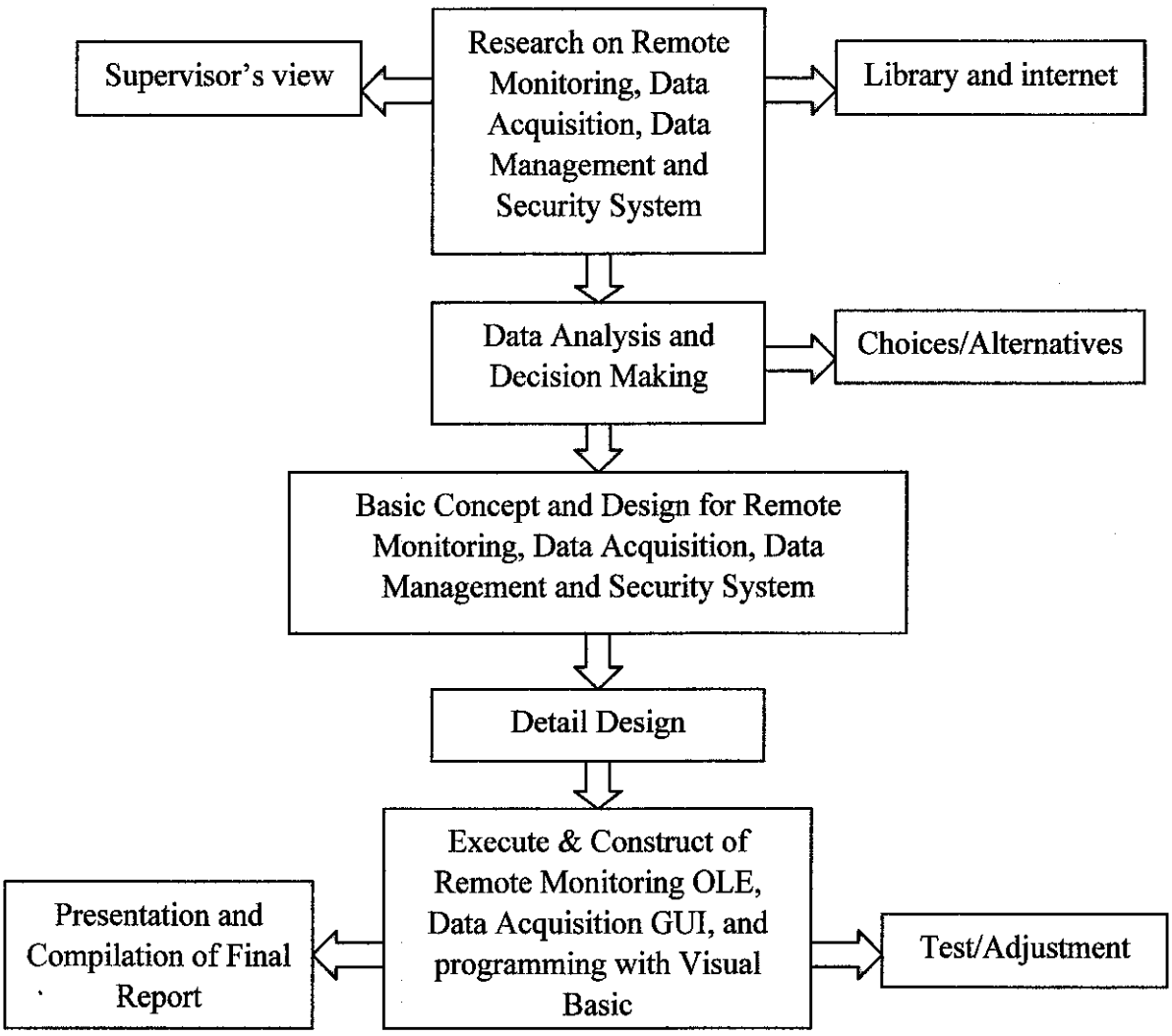

Figure 3.1 Plan Flow of the Project

3.2 Tools Required

For this project, the student has built a workstation as prototype of the project. The workstation is comprises of two computers (PCs) which the networking connection (LAN) is established between the two PCs. The workstation is equipped with all softwares and hardwares, which will be used for this project.

3.2.1 Location

Physics Laboratory
Building 19, Academic Complex,
Universiti Teknologi PETRONAS.

3.2.2 General Specifications

The specifications of the tools used in the project are as follows:

Hardware: 2 CRT Monitors
2 CPUs
PCI 6024E Low Cost Multifunction I/O
Signal Conditioning Connector Block
Thermocouple Input Module
Thermocouple (K Type)

Software: OS – Windows XP
Microsoft® Office
NI® LabVIEW 8.1
NI® DAQ 7.4
NI® Measurement and Automation Explorer (MAX)
Activity Monitor 3.92
RemShutdown (Remote Shutdown)
Microsoft® Visual Basic.NET 2005

Connection: UTP Local Area Network
100 Mbit/s IEEE 802.3 Ethernet technology

3.3 Flow of Remote Data Acquisition System

The system starts with as the user login to the system. As the login process successful, the user can directly use the system. The block diagram of flow of the system is as follow:

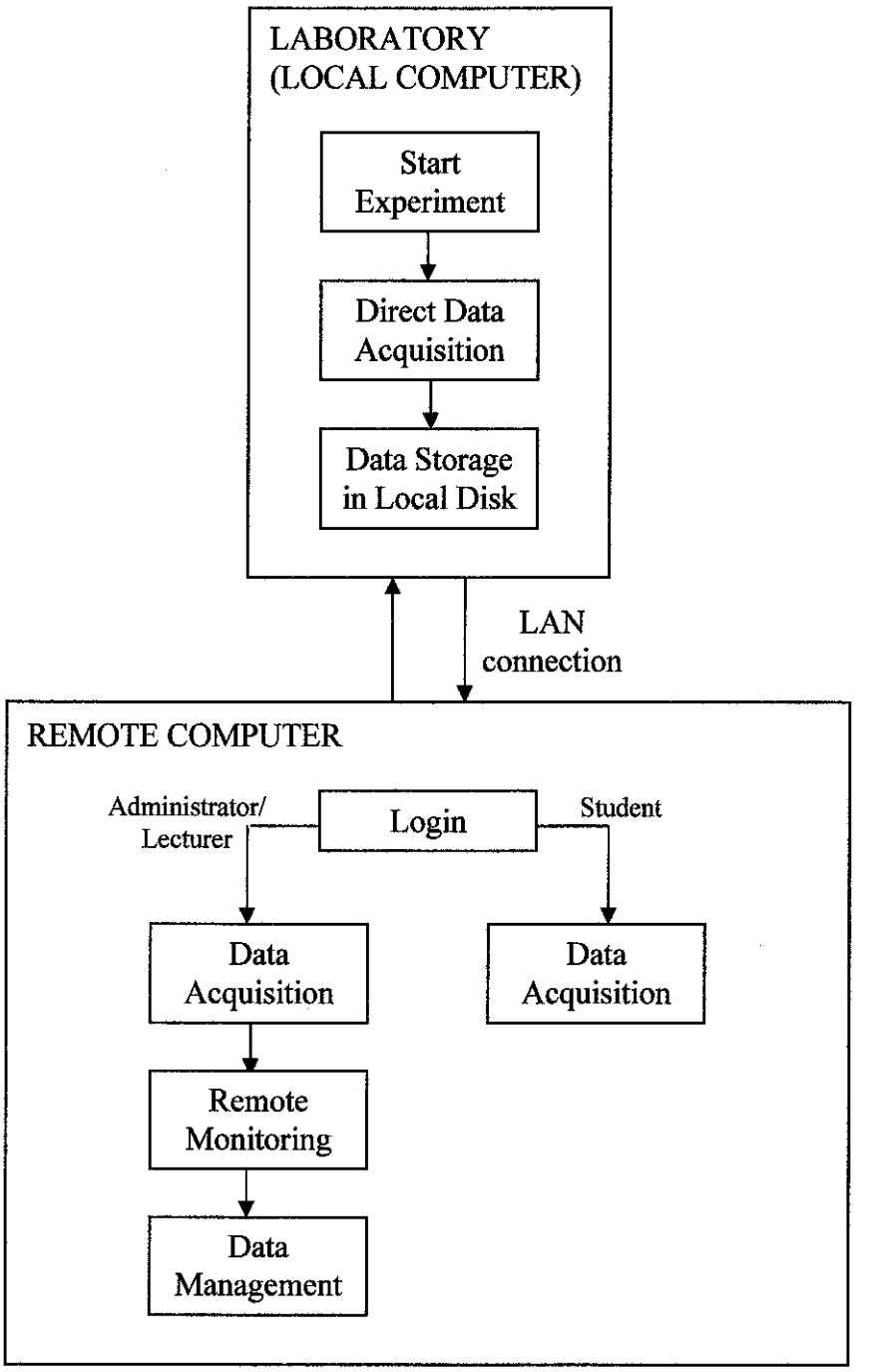

Figure 3.2 Flow of the System

CHAPTER 4
RESULT AND DISCUSSION

4.1 Prototype Development

The development of the prototype is divided with following components:

1. Security System (Login System)
2. Data Acquisition System
3. Remote Monitoring System
4. Data Management System

Before the user want to open the remote data acquisition system, the user shall login to the system with assigned username and password. This can helps to protect the computer and system from unwanted intruders. This will improve the security level of the Remote Data Acquisition System.

For the security system, login dialog box is built by using Microsoft® Visual Basic.NET. The Login System allowed authorized Lecturers and Students to used system. The authorized lecturers needed to create their User Account in the Login Dialog Box such as shown in Figure 5. The information on name, password and role for each authorized Lecturers and Students are saved in the users.xml file. From here, only authorized people can access the system.

There is difference level of access between lecturers and student. For the authorized lecturers, full accesses to the system are given. Full access is the permission to access to Remote Monitoring System, Data acquisition System and Data Management System. For the authorized students, only accesses to the Data Acquisition System are given.

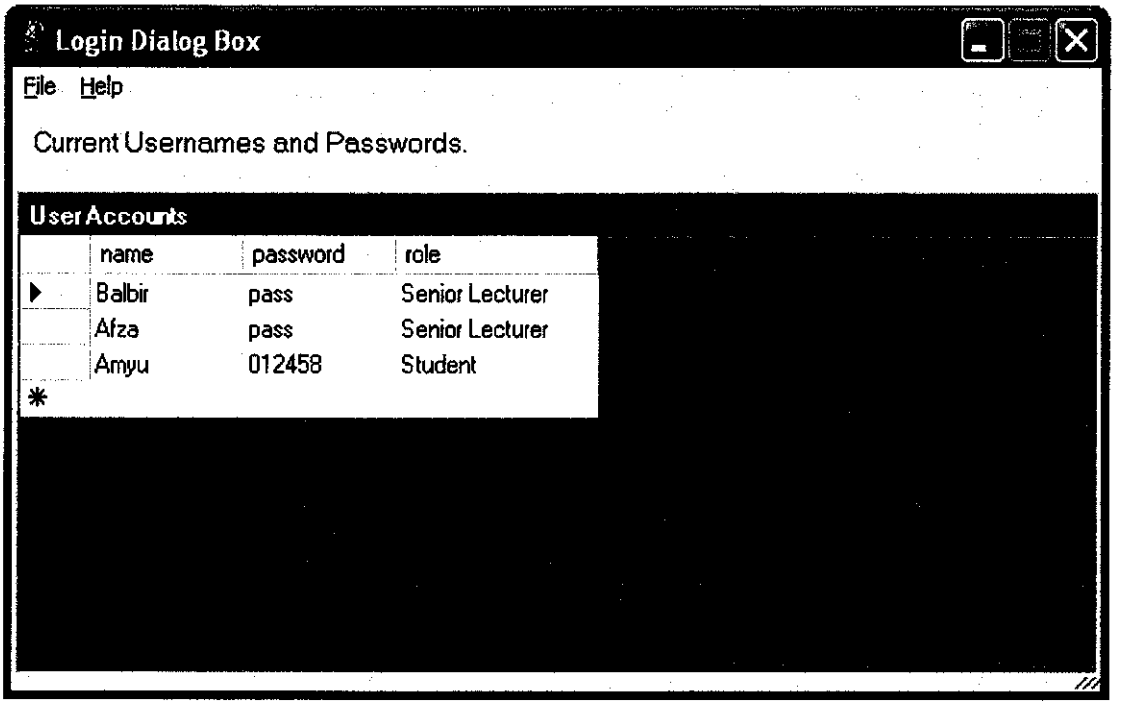

Figure 4.1 The Existing User Accounts in the Login System

The source code for users.xml is as follows:

```
<?xml version="1.0" encoding="utf-8" ?>
<users>

	<user>
		<name>Balbir</name>
		<password>pass</password>
		<role>Senior Lecturer</role>
	</user>

	<user>
		<name>Afza</name>
		<password>pass</password>
		<role>Senior Lecturer</role>
	</user>

	<user>
		<name>Amyu</name>
		<password>012458</password>
		<role>Student</role>
	</user>

</users>
```

As the Remote Data Acquisition System is running, the Login Dialog Box appeared. The user need to login with assigned user name and password. As authorized lecturer login with assigned user name and password, the Login Successful dialog box appeared. This dialog box justified that the lecturer has logged in successfully.

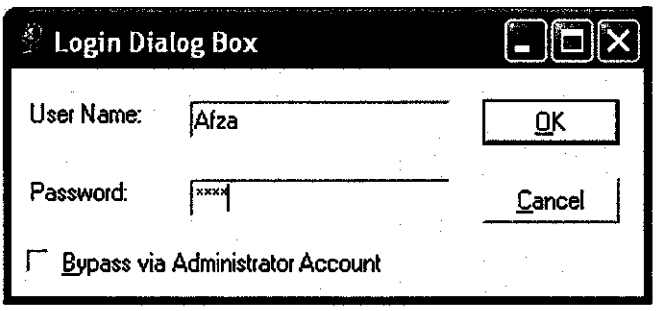

Figure 4.2 Authorized Lecturer Login

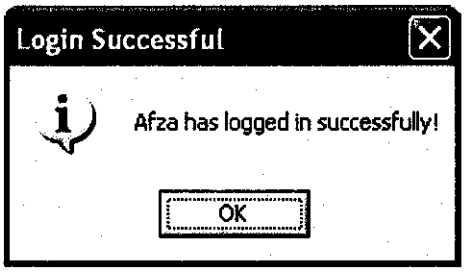

Figure 4.3 Login Successful Dialog Box of Authorized Lecturer Appeared

As authorized student login with assigned user name and password, the Login Successful dialog box appeared. This dialog box justified that the student has logged in successfully. Then after that, Insufficient Permissions dialog box appears. It gives a warning to the student that the student does not have permissions to remote monitoring the experiment.

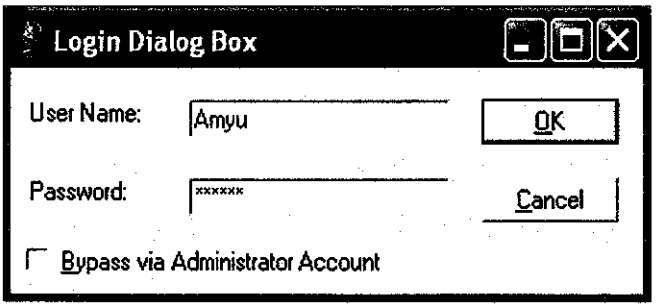

Figure 4.4 Authorized Student Login

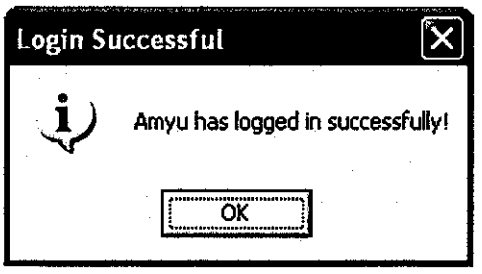

Figure 4.5 Login Successful Dialog Box of Authorized Student Appeared

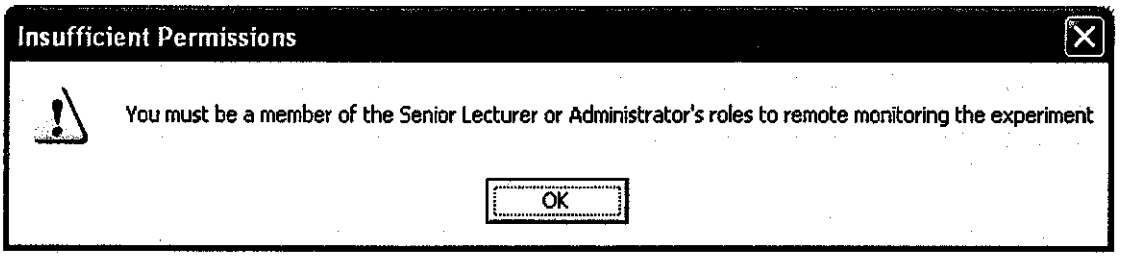

Figure 4.6 Insufficient Permissions Warning as Authorized Student Login to The Remote Data Acquisition System

If the user login with wrong user name or password, a warning dialog box appeared and ask the user to try again.

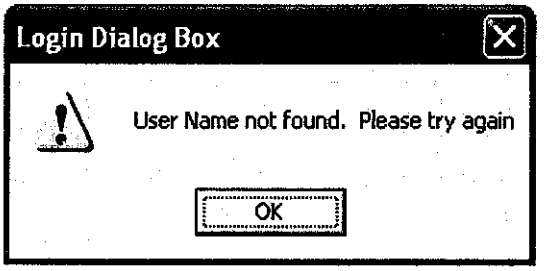

Figure 4.7 Warning Dialog Box as Wrong Username or Password Entered

As the user successfully login to the system, Program Launcher User Interface appeared. Microsoft® Visual Basic.NET is used to build the Program Launcher. Program Launcher is for integrating all four sub-systems in one menu. It is built to ensure the system is user friendly and accessible.

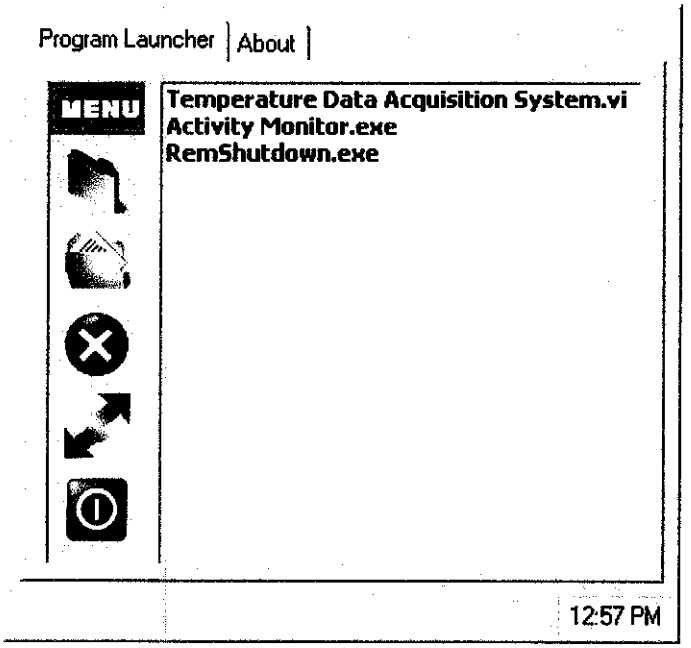

Figure 4.8 User Interface called as Program Launcher

The Program Launcher has a side menu bar, which allowed the user to open file, open folder, delete file, hide the interface to tray and exit the interface.

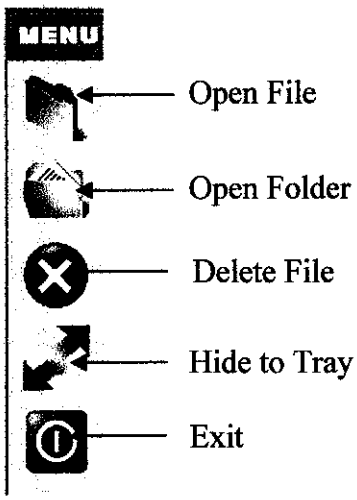

Figure 4.9 Side Menu Bar

The main feature of the Program Launcher is the Listbox. The Listbox contain the Data Acquisition and Remote Monitoring System. For Data Acquisition system, Graphical User Interface is built by using Laboratory Virtual Instrumentation Engineering Workbench (LabVIEW). The GUI is named as Temperature Data Acquisition System. For the Remote Monitoring System, two programs/softwares used, Activity Monitor 3.92 and RemShutdown. All the programs/softwares used in the Remote Data Acquisition System are listed in the Listbox of Program Launcher.

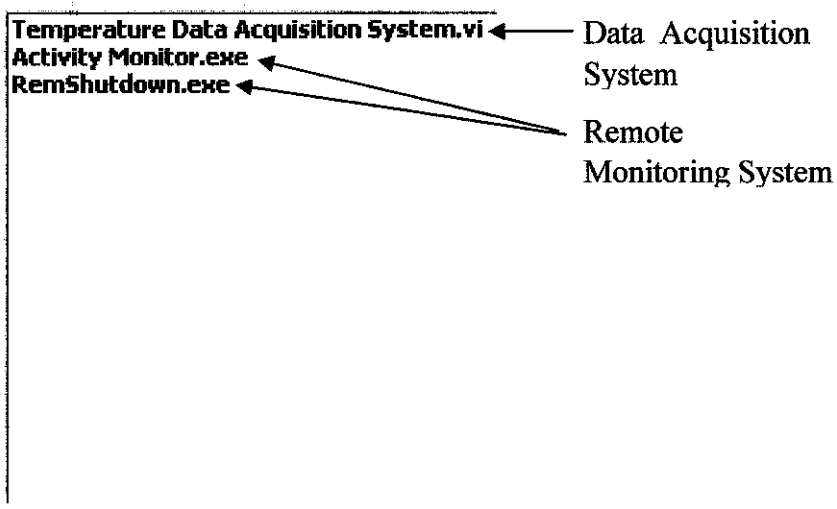

Figure 4.10 Listbox of Program Launcher

As the user want to access Data Acquisition System, the user just need to double click on the Temperature Data Acquisition System.vi. Then the Graphical User Interface from LabVIEW appeared. LabVIEW is a platform and development environment for a visual programming language from National Instruments. The graphical language is named "G". LabVIEW is commonly used for data acquisition, instrument control, and industrial automation on a variety of platforms including Microsoft Windows, UNIX, Linux, and Mac OS.

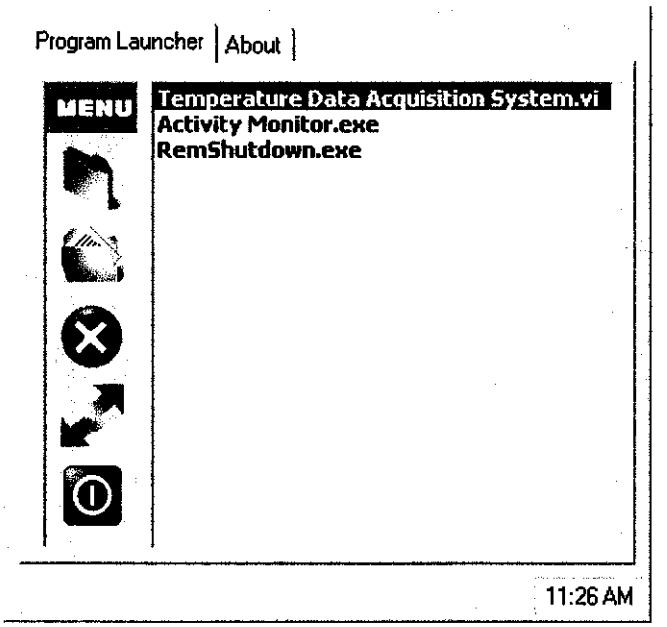

Figure 4.11 Double Click on Temperature Data Acquisition System.vi to Access Data Acquisition System

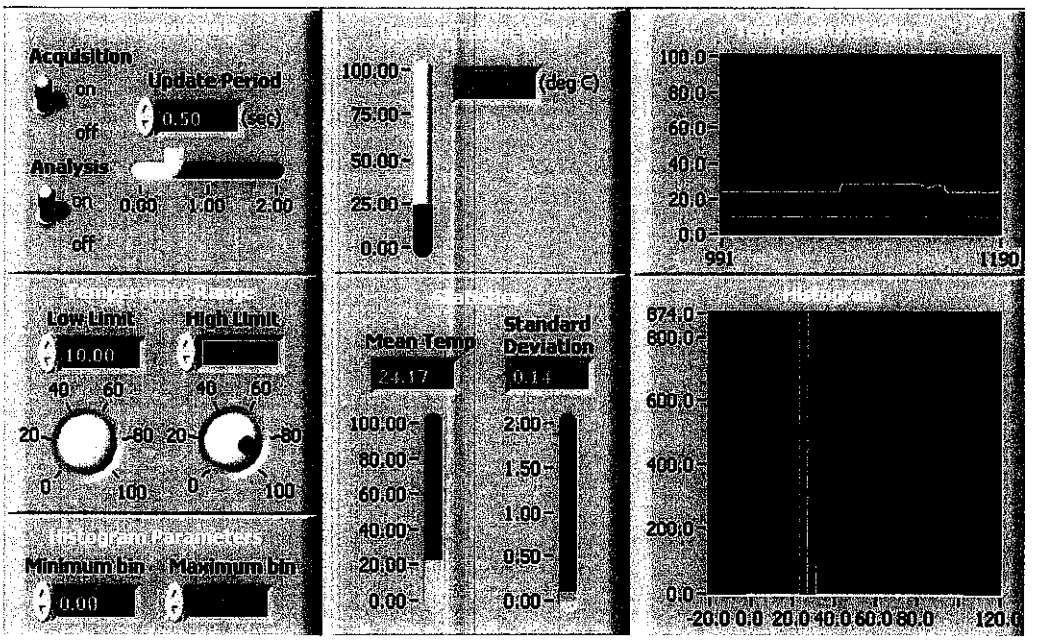

Figure 4.12 Graphical User Interface for Temperature Data Acquisition System using LabVIEW

The Graphical User Interface by using LabVIEW is the main communication and control medium between the user and the process/experiment running. It is very important to make sure that the user interface is complete and user friendly. The control systems in the interface divided to two systems; Acquisition System Control and Analysis System Control. In the interface, enhance functions and control buttons are located:

1. System Controls Panel
    - Toggle switch for Acquisition System Control
    - Toggle switch for Analysis System Control
    - Digital Controller Update Period
    - Analogue Controller Update Period
2. Current Temperature Panel
    - Digital Thermometer
    - Analogue Thermometer
3. Temperature Range Panel
    - Digital controller for Low Limit
    - Digital controller for High Limit
    - Analogue controller for Low Limit
    - Analogue controller for High Limit
4. Statistics Panel
    - Digital Indicator Mean Temperature
    - Digital Indicator Standard Deviation
    - Analogue Indicator Mean Temperature
    - Analogue Indicator Standard Deviation
5. Temperature History Panel
    - Line Graph for Temperature Versus Time
6. Histogram Panel
    - Histogram for Temperature History

The development process for Graphical User Interfaces also include with the development of block diagram of VI. In the VI, there are sub-VIs namely are Digital Thermometer.vi, Temperature Status.vi, Update Statistics.vi, Histogram+.vi and Array to Bar Graph.vi.

The block diagram is divided into two parts; Acquisition Loop and Analysis Structure. In Acquisition Loop have Digital Thermometer.vi and Temperature Status.vi. In Analysis Structure have Update Statistics.vi, Histogram+.vi and Array to Bar Graph.vi. Each sub-VI is graphical programmed to work as input and output on the Graphical User Interface of Temperature Data Acquisition System.

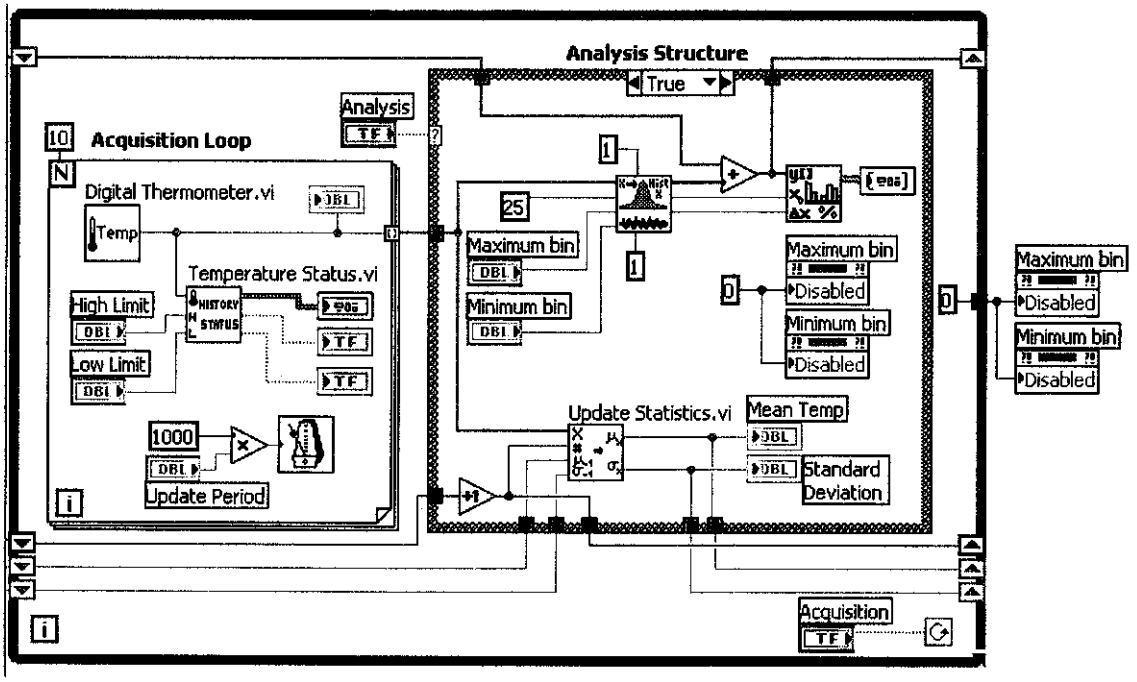

Figure 4.13 Block Diagram for Temperature Data Acquisition System.vi

From the System Controls Panel, the Acquisition and Analysis System can be turn on and off. The update period for temperature reading also can be set.

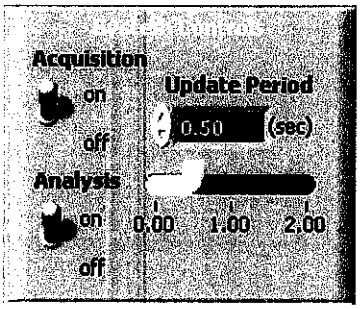

Figure 4.14 System Control Panel from Graphical User Interface

The data from the PCI 6024E Low Cost Multifunction I/O, Signal Conditioning Connector Block, Thermocouple Input Module and Thermocouple (K Type) will received by Digital Thermometer.vi. The DAQ Assistant works as data logger for this experiment.

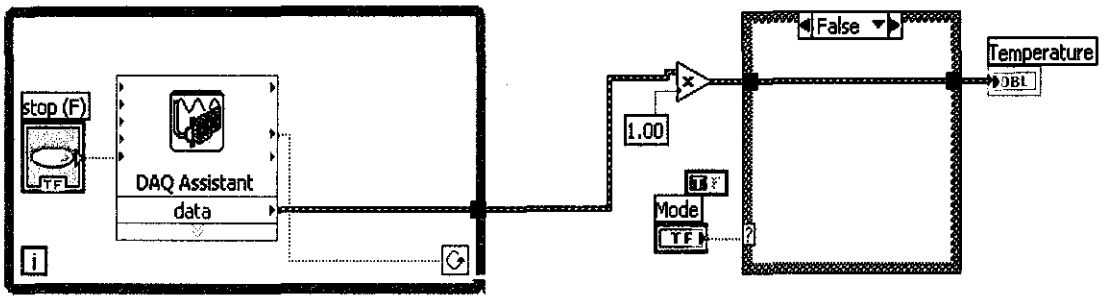

Figure 4.15 Sub-VI Digital Thermometer.vi

The DAQ Assistant need to be configure first before being applied to the sub-VI. The configuration window is as shown below. DAQ assistant will automatically detect the types of hardware connected with the 6024E Low Cost Multifunction I/O. As for this experiment, the type of the experiment is temperature. The measurement unit is thermocouple. The user needs to choose the maximum and minimum signal input range, scaled units and thermocouple type.

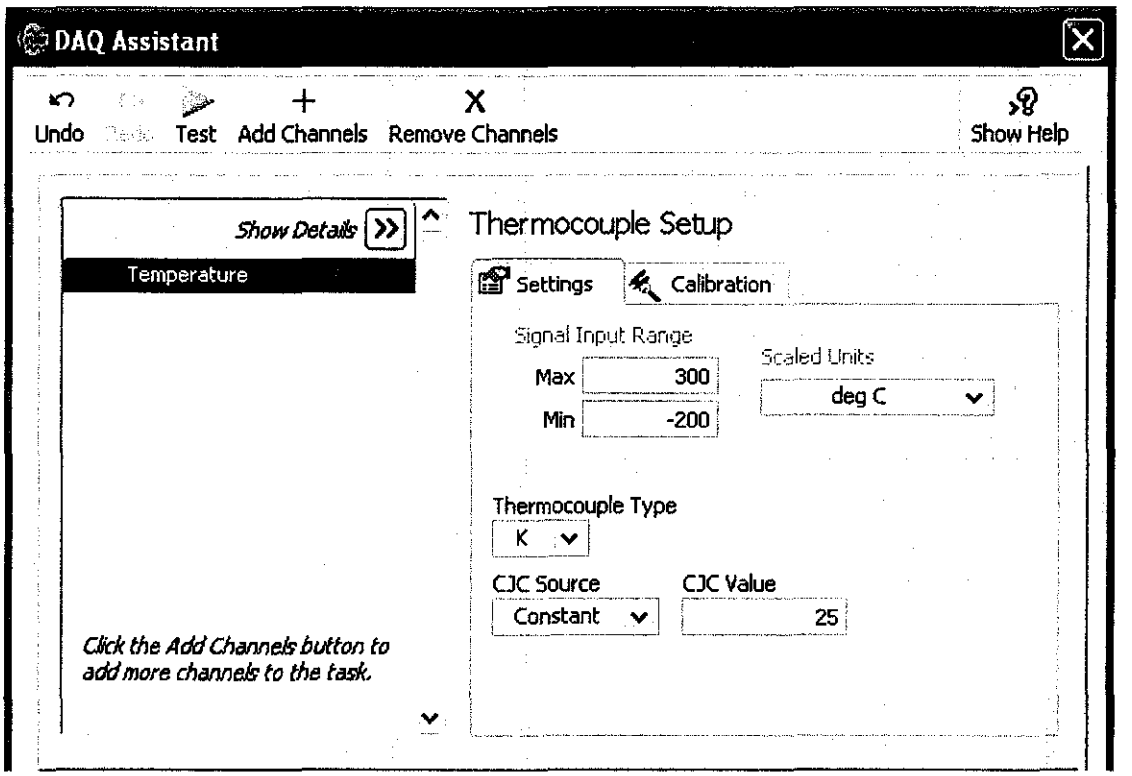

Figure 4.16 Configuration of DAQ Assistant

The user also needs to add channel to task. As for this experiment, the Signal Conditioning Connector Block is used because usually input from thermocouple is varies and very small. Signal conditioning used to stabilize the data reading and also to amplifier the very small signal. Thermocouple Input Module (SCC-TC01) is slotted in the channel ai0 of Signal Conditioning Connector Block and connected with the Thermocouple. So the channel ai0 must be added to the task of DAQ Assistant.

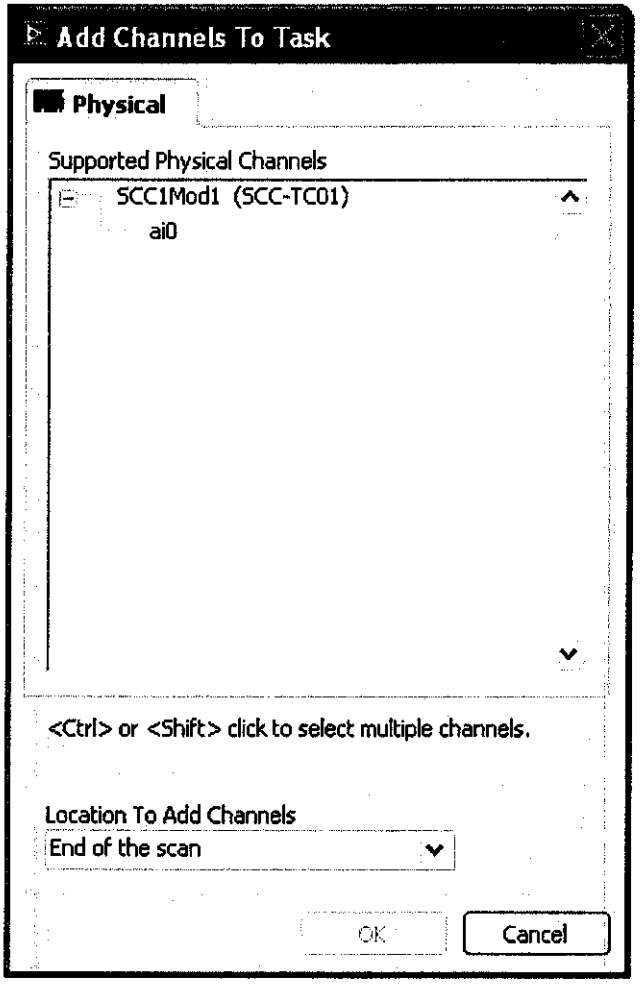

Figure 4.17 Add Channel ai0 to the Task

Data from the DAQ Assistant will go through thermometer loop. This loop is capable to change the data from degree Celsius to degree Fahrenheit. For this experiment, the unit temperature unit used is degree Celsius. The data from DAQ Assistant will be the output of Digital Thermometer.vi. The output from Digital Thermometer.vi will be input for Temperature Status.vi and Analysis Structure part. The thermometer readings also will be displayed in Current Temperature Panel.

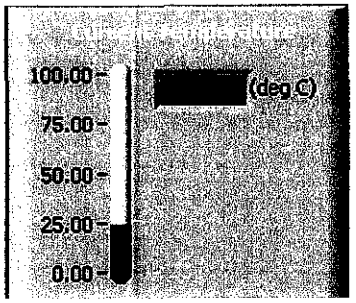

Figure 4.18 Current Temperature Display Panel from Graphical User Interface

In Temperature Status.vi, the temperature reading from the DAQ Assistant will be the input for Temperature History. The temperature readings are also compared with low and high limit temperature set at the Temperature Range Control Panel.

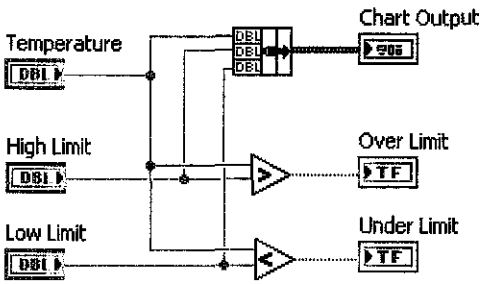

Figure 4.19 Sub-VI Temperature Status.vi

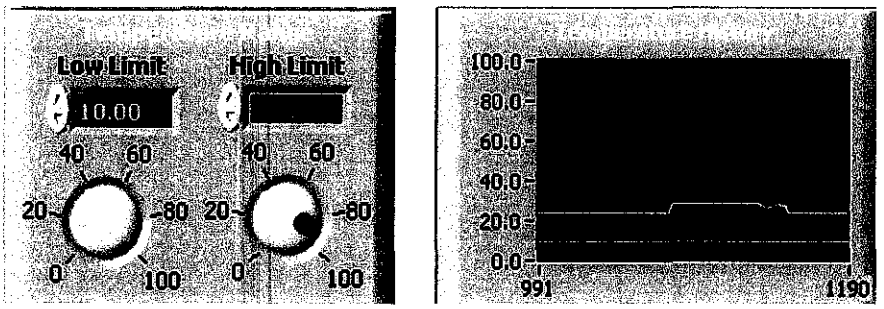

Figure 4.20 Temperature Range Control Panel and Temperature History Display Panel from Graphical User Interface

In Update Statistic.vi, the temperature readings from DAQ Assistant will be Input Array. Then by used the block function for mean and standard deviation, the value of mean temperature and standard deviation will be updated for every update period set at the System Controls Panel. The updated mean temperature and standard deviation are displayed in Statistics Panel.

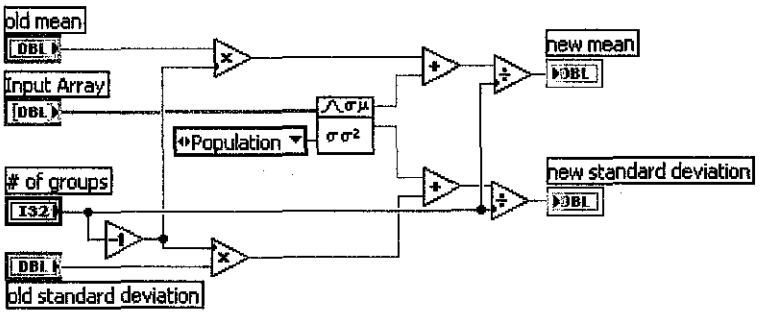

Figure 4.21 Sub-VI Update Statistic.vi

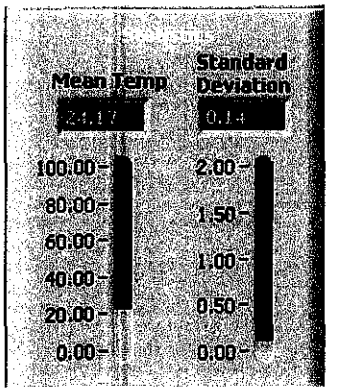

Figure 4.22 Statistics Panel from Graphical User Interface

In Histogram+.vi, the input is come from temperature reading from DAQ Assistant. This function of this sub-VI is to update for each update period set at the System Controls Panel. The output from histogram is Histogram Display Panel, where the histogram will be moving and showing the reading for certain period. The minimum and maximum bin will be used to be the range for minimum and maximum range for temperature display in the histogram. The output from Histogram, H(x) is the input for Array to Bar Graph.vi.

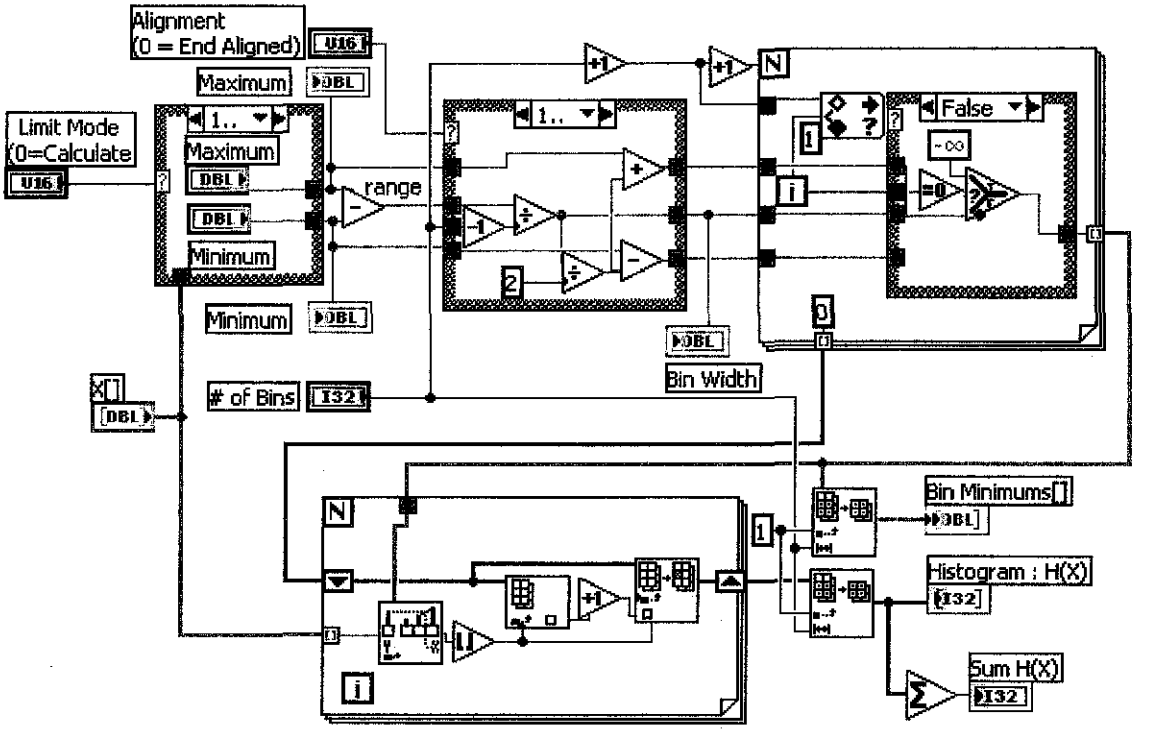

Figure 4.23 Sub-VI Histogram+.vi

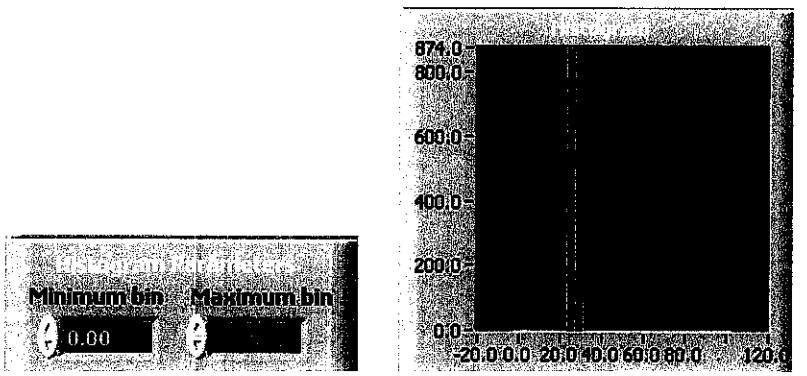

Figure 4.24 Histogram Parameters and Histogram Panel from Graphical User Interface

In Array to Bar Graph.vi, the input from H(x) is added with initialize array to get Y array. From the Y array, each point is created the four points to define the vertical bar. Then, the output from here is the input for baseline. If the baseline is to be drawn, the graph begins with the last point of the graph drawn back to the first point.

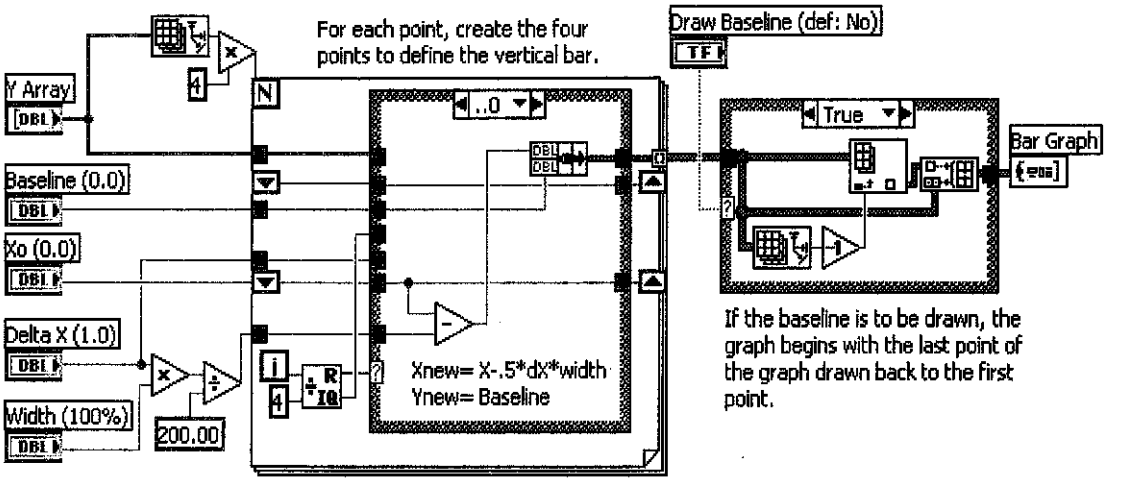

Figure 4.25 Sub-VI Array to Bar Graph.vi

For the remote monitoring system, it comprises of Activity Monitor and RemShutdown. As the two PCs are connected via LAN, the remote monitoring system can be applied. As the user want to access Activity Monitor, the user just need to double click on the Activity Monitor.exe. Then the Main Window from Activity monitor appeared.

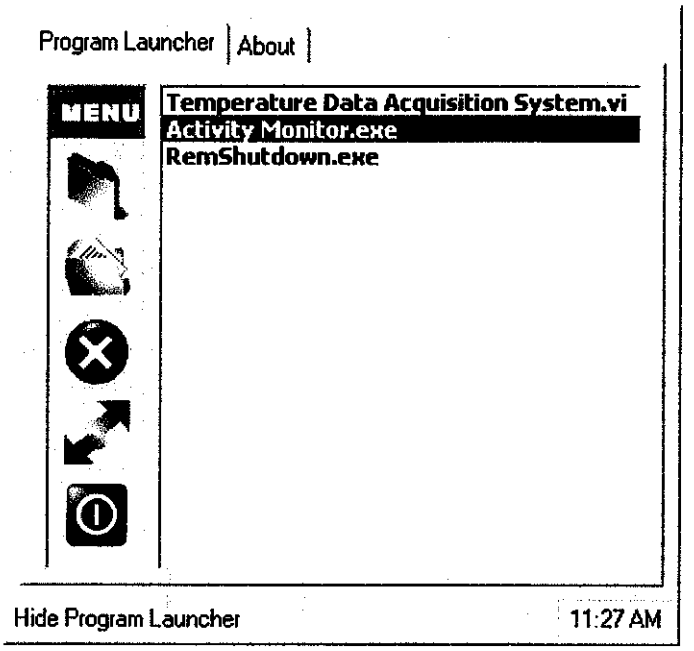

Figure 4.26 Double Click on Activity Monitor.exe

Activity Monitor is for real time monitoring of users activities on network computers. The administrators can view typing keystrokes in real time, take snapshots of the remote screen, view all running programs and monitor when user switches between

them, copy any files from remote PC, terminate processes, send instant messages and control computers remotely. The features for this program/software are:

- Real time keystrokes monitoring
- View desktop of the remote workstations in real time
- Monitor Internet surfing on the remote computers in real time
- View list of running applications, terminate any of them
- Record activity log on the remote PC
- Auto-detect computers with installed Agents on a LAN and manage computers list
- Export logs to HTML for viewing in browser with embedded screenshots
- Export logs into delimited text files in CSV format
- Copy any files, including recorded logs and screenshots from remote computers
- Schedule automatic periodical downloads of log files and their export
- Shut down or restart computers remotely, Log Off user
- Send instant messages to monitored computers
- Monitor all computers on LAN simultaneously from a single PC
- Run commands/programs on remote computers, open web sites/documents for the remote users to view
- Shut down or uninstall Agent software remotely

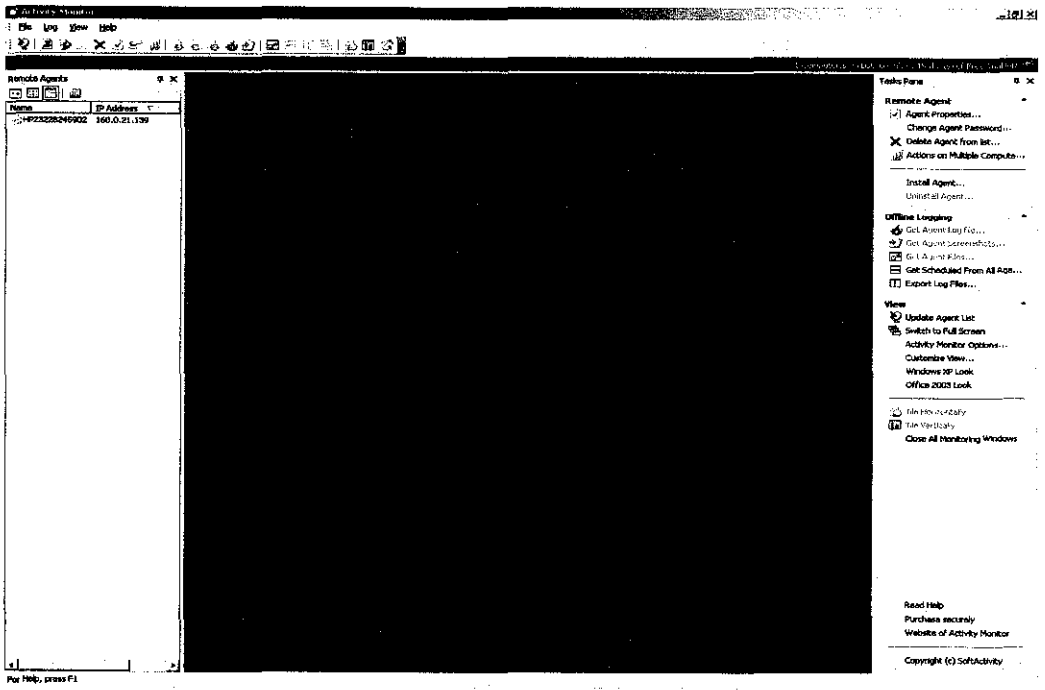

Figure 4.27 Main Window of Activity Monitor 3.92

As the user want to access RemShutdown, the user just need to double click on the Remshutdown.exe. Then the Main Window from Activity monitor appeared. RemShutdown is a software/program that it allows to program the turning off of the local PC of other remote PC in a LAN.

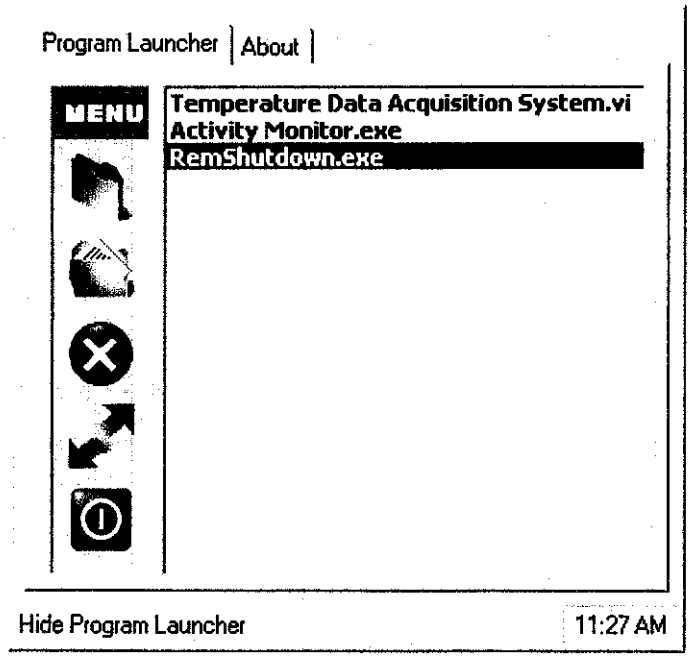

Figure 4.28 Double Click on RemShutdown.exe

RemShutdown can shutdown the PC as the command from the user such as stated below:

- After one established time period
- To a specified hour
- To a hour specified of a particular day
- When a program in execution finishes

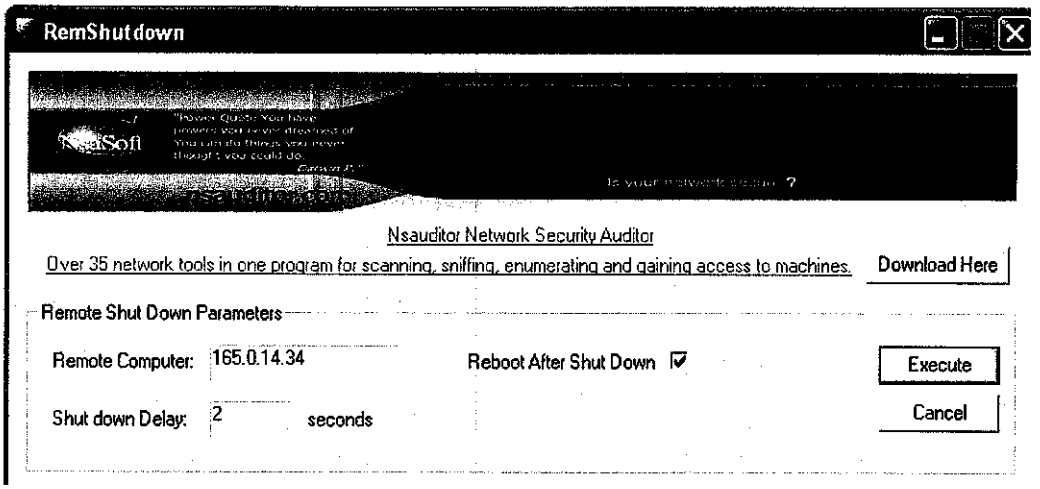

Figure 4.29 RemShutdown (Remote Shutdown)

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 Conclusion

At the end of semester, the prototype of Remote Data Acquisition System using LAN was successfully developed, which encompasses collection of information, method of transfer from the laboratory, analysis and control of the system and display of the received information. Function of this system is to integrate functions like monitoring, safety, remote controls and management information as the experiments is on going in the laboratory. For the data acquisition system, the program/software use is Laboratory Virtual Instrumentation Engineering Workbench (LabVIEW). For remote monitoring system, the programs/softwares still in experimental process are Activity Monitor and RemShutdown (Remote Shutdown). The system gives many advantages and benefits for the user as the system helps for systematic time management in simultaneously data collection and storage, increases efficiency as less manpower, time and energy used and gives flexibility to the user to use the system from any place and time as long as the user is connected using LAN.

5.2 Recommendations

For future development, the Remote Data Acquisition System can be applied not just using Local Area Network but also using Internet, wireless connection and Bluetooth. The Graphical User Interface for Data Acquisition also can be upgraded and designed for more advance function and more user friendly. As for login system, additional of database on the system for stored user details will upgrade the security of the Login System. The system also can be integrated with Window NT as the login system in UTP based on this system. The system also can be developed with more systematic data management system.

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APPENDICES

APPENDIX A

DATA ACQUISITION SYSTEM

PC Based Data Acquisition Equipment

Early, expensive mainframe computers were used extensively for gathering multiple channels of data, primarily in large industrial or scientific applications. They were seldom used in small projects because of their relatively high cost. But the introduction of small rack-mounted minicomputers that developed in the 1960's and later desktop personal-type computers that housed microprocessors and proliferated in the 1970's justified their use for smaller projects. Soon, DAQ plug-in cards (as well as hundreds of other types of plug-in cards) for these small computers were a common means to collect and record data of all types.

Plug-in cards for computers did not always perform to the user's expectations, however. Internal noise from rotating devices such as drives and electromagnetic and electrostatic noise from the computer's internal bus structure often interfered with the measured variable, particularly in data acquisition cards. Isolation and shielding have helped to solve the problem in most cases, but many DAQ manufacturers also provide signal conditioning and signal processing circuits in small, stand-alone, shielded enclosures. The separate box provides isolation by distance, expansion for hundreds of channels, and portability with laptop computers that desktop personal computers with plug-in cards don't possess.

All PC-based DAQ systems will record extremely accurate, repeatable, reliable, and error-free data provided they are connected and operated according to the manufacturer's recommended practices. These practices include selecting the correct sensors for the application, the proper wire and shielded cable; capturing the signals in proper magnitude, range, and frequency; and paying close attention to grounding and shielding – particularly eliminating ground loops. Additional items include choosing the correct impedance and using doubled-ended (differential) inputs instead of single-ended where possible. The environment should also be considered, especially for extremes of ambient temperature, shock, and vibration. And herein lies the major goal of this publication – to inform users of the most needed recommended practices based upon a fundamental knowledge of the internal workings of DAQ system instrumentation.

DAQ systems come in many different PC technology forms for great flexibility when choosing the system. There are five components to be considered when building a basic DAQ system:

- Transducers and sensors
- Signals
- Signal conditioning
- DAQ hardware
- Driver and application software

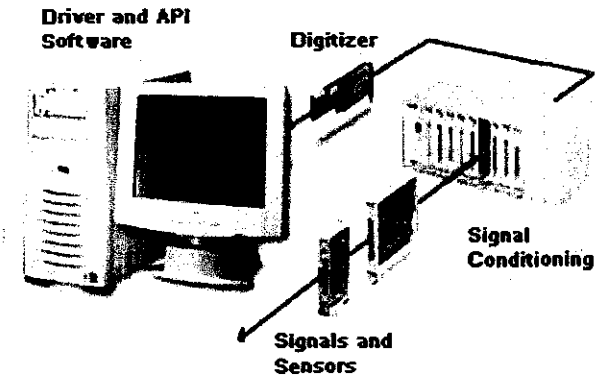

Figure 6.1 Data Acquisition System

6.1 Transducers

DAQ begins with the physical phenomenon to be measured. This physical phenomenon could be the temperature of a room, the intensity of a light source, the pressure inside a chamber, the force applied to an object, or many other things. An effective DAQ system can measure all of these different phenomena.

A transducer is a device that converts a physical phenomenon into a measurable electrical signal, such as voltage or current. The ability of a DAQ system to measure different phenomena depends on the transducers to convert the physical phenomena into signals measurable by the DAQ hardware. Transducers are synonymous with sensors in DAQ systems. There are specific transducers for many different applications, such as measuring temperature, pressure, or fluid flow. Table 1 shows a short list of some common transducers and the phenomena they can measure.

Table 6.1 Phenomena and Existing Transducers

Phenomena	Transducer
Temperature	Thermocouples Resistive Temperature Devices (RTDs) Thermistors
Light	Vacuum Tube Photo Sensors
Sound	Microphone
Force and Pressure	Strain Gauges Piezoelectric Transducers
Position and Displacement	Potentiometers Linear Voltage Differential Transformer Optical Encoder
Fluid	Head Meters Rotational Flowmeters
pH	pH Electrodes

Different transducers have different requirements for converting phenomena into a measurable signal. Some transducers may require excitation in the form of voltage or current. Other transducers may require additional components and even resistive networks to produce a signal.

6.2 Signals

The appropriate transducers convert physical phenomena into measurable signals. However, different signals need to be measured in different ways. For this reason, it is important to understand the different types of signals and their corresponding attributes. Signals can be categorized into two groups:

- Analog
- Digital

6.2.1 Analog Signals

An analog signal can be at any value with respect to time. A few examples of analog signals include voltage, temperature, pressure, sound, and load. The three primary characteristics of an analog signal include level, shape, and frequency (Figure 3).

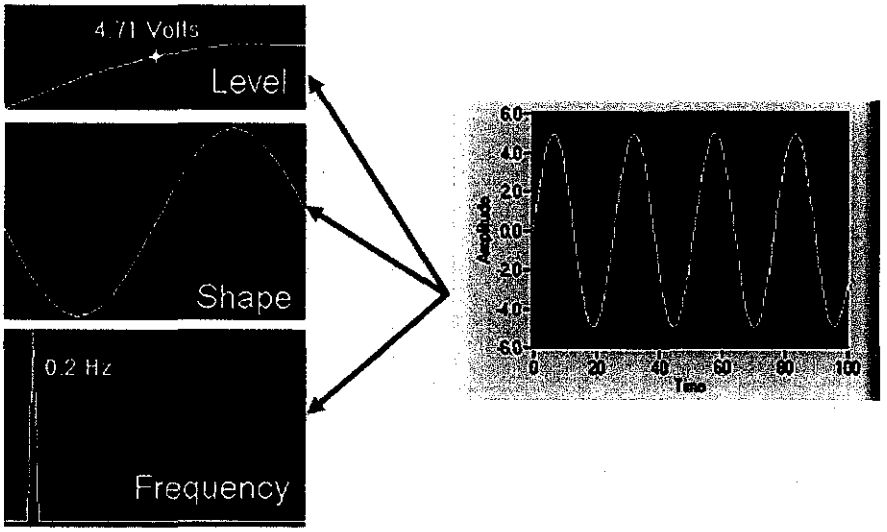

Figure 6.2 Primary Characteristics of an Analog Signal

Level

Because analog signals can take on any value, the level gives vital information the measured analog signal. The intensity of a light source, the temperature in a room, and the pressure inside a chamber are all examples that demonstrate the importance of the level of a signal. When measuring the level of a signal, the signal generally does not change quickly with respect to time. The accuracy of the measurement, however, is very important. A DAQ system that yields maximum accuracy should be chosen to aid in analog level measurements.

Shape

Some signals are named after their specific shape - sine, square, sawtooth, and triangle. The shape of an analog signal can be as important as the level, because by measuring the shape of an analog signal, you can further analyze the signal, including peak values, DC values, and slope. Signals where shape is of interest generally

change rapidly with respect to time, but system accuracy is still important. The analysis of heartbeats, video signals, sounds, vibrations, and circuit responses are some applications involving shape measurements.

Frequency

All analog signals can be categorized by their frequency. Unlike the level or shape of the signal, frequency cannot be directly measured. The signal must be analyzed using software to determine the frequency information. This analysis is usually done using an algorithm known as the Fourier transform.

When frequency is the most important piece of information, it is important to consider including both accuracy and acquisition speed. Although the acquisition speed for acquiring the frequency of a signal is less than the speed required for obtaining the shape of a signal, the signal must still be acquired fast enough that the pertinent information is not lost while the analog signal is being acquired. The condition that stipulates this speed is known as the Nyquist Sampling Theorem. Speech analysis, telecommunication, and earthquake analysis are some examples of common applications where the frequency of the signal must be known.

6.2.2 Digital Signals

A digital signal cannot take on any value with respect to time. Instead, a digital signal has two possible levels: high and low. Digital signals generally conform to certain specifications that define characteristics of the signal. Digital signals are commonly referred to as transistor-to-transistor logic (TTL). TTL specifications indicate a digital signal to be low when the level falls within 0 to 0.8 V, and the signal is high between 2 to 5 V. The useful information that can be measured from a digital signal includes the state and the rate (Figure 4).

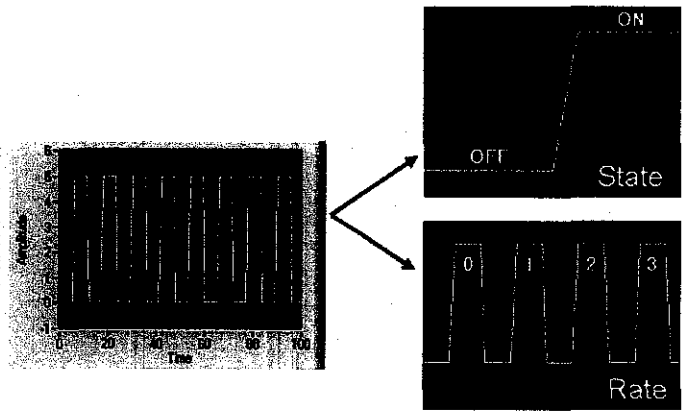

Figure 6.3 Primary Characteristics of a Digital Signal

State

Digital signals cannot take on any value with respect to time. The state of a digital signal is essentially the level of the signal - on or off, high or low. Monitoring the state of a switch - open or closed - is a common application showing the importance of knowing the state of a digital signal.

Rate

The rate of a digital signal defines how the digital signal changes state with respect to time. An example of measuring the rate of a digital signal includes determining how fast a motor shaft spins. Unlike frequency, the rate of a digital signal measures how often a portion of a signal occurs. A software algorithm is not required to determine the rate of a signal.

6.3 Signal Conditioning

Sometimes transducers generate signals too difficult or too dangerous to measure directly with a DAQ device. For instance, when dealing with high voltages, noisy environments, extreme high and low signals, or simultaneous signal measurement, signal conditioning is essential for an effective DAQ system. Signal conditioning maximizes the accuracy of a system, allows sensors to operate properly, and guarantees safety. It is important to select the right hardware for signal conditioning. Signal conditioning is offered in both modular and integrated forms (Figure 5). Signal conditioning accessories can be used in a variety of applications including:

- Amplification
- Attenuation
- Isolation Bridge completion
- Simultaneous sampling
- Sensor excitation
- Multiplexing

6.4 DAQ Hardware

DAQ hardware acts as the interface between the computer and the outside world (Refer Figure 6 for the examples of DAQ hardware). It primarily functions as a device that digitizes incoming analog signals so that the computer can interpret them. Other data acquisition functionality includes:

- Analog Input/Output
- Digital Input/Output
- Counter/Timers
- Multifunction - a combination of analog, digital, and counter operations on a single device

APPENDIX B

COMPUTER NETWORK

7.0 Basic Computer Network Building Blocks

7.0.1 Computers

Many of the components of an average network are individual computers, which are generally either workstations (including personal computers) or servers.

7.0.2 Types of Workstations

There are many types of workstations that may be incorporated into a particular network, some of which have high-end displays, multiple CPUs, large amounts of RAM, large amounts of hard drive storage space, or other enhancements required for special data processing tasks, graphics, or other resource intensive applications. (See also network computer).

7.0.3 Types of Servers

The following lists some common types of servers and their purpose.

File Server

Stores various types of files and distributes them to other clients on the network.

Print Server

Controls and manages one or more printers and accepts print jobs from other network clients, spooling the print jobs, and performing most or all of the other functions that a workstation would perform to accomplish a printing task if the printer were connected directly to the workstation's printer port.

Mail Server

Stores, sends, receives, routes, and performs other email related operations for other clients on the network.

Fax Server

Stores, sends, receives, routes, and performs other functions necessary for the proper transmission, reception, and distribution of faxes.

Telephony Server

Performs telephony related functions such as answering calls automatically,performing the functions of an interactive voice response system, storing and serving voice mail, routing calls between the Public Switched Telephone Network (PSTN) and the network or the Internet (e.g., voice over IP (VoIP) gateway), etc.

Proxy Server

Performs some type of function on behalf of other clients on the network to increase the performance of certain operations (e.g., prefetching and caching documents or other data that is requested very frequently) or as a security precaution to isolate network clients from external threats.

Remote Access Server (RAS)

Monitors modem lines or other network communications channels for requests to connect to the network from a remote location, answers the incoming telephone call or acknowledges the network request, and performs the necessary security checks and other procedures necessary to log a user onto the network.

Application Server

Performs the data processing or business logic portion of a client application, accepting instructions for operations to perform from a workstation and serving the results back to the workstation, while the workstation performs the user interface or GUI portion of the processing (i.e., the presentation logic) that is required for the application to work properly.

Web Server

Stores HTML documents, images, text files, scripts, and other Web related data (collectively known as content), and distributes this content to other clients on the network on request.

Backup Server

Has network backup software installed and has large amounts of hard drive storage or other forms of storage (tape, etc.) available to it to be used for the purpose of ensuring that data loss does not occur in the network.

7.0.4 Types of Networks

Below is a list of the most common types of computer networks.

Local Area Network (LAN)

A network that is limited to a relatively small spatial area such as a room, a single building, a ship, or an aircraft. Local area networks are sometimes called a single location network.

Note: For administrative purposes, large LANs are generally divided into smaller logical segments called workgroups. A workgroup is a group of computers that share a common set of resources within a LAN.

Campus Area Network (CAN)

A network that connects two or more LANs but that is limited to a specific (possibly private) geographical area such as a college campus, industrial complex, or a military base.

Note: A CAN is generally limited to an area that is smaller than a Metropolitan Area Network

Metropolitan Area Network (MAN)

A network that connects two or more LANs or CANs together but does not extend beyond the boundaries of the immediate town, city, or metropolitan area. Multiple routers, switches & hubs are connected to create a MAN.

Wide Area Network (WAN)

A WAN is a data communications network that covers a relatively broad geographic area and that often uses transmission facilities provided by common carriers, such as telephone companies. WAN technologies generally function at the lower three layers of the OSI reference model: the physical layer, the data link layer, and the network layer.

Types of WANs:

Centralized - A centralized WAN consists of a central computer that is connected to dumb terminals and / or other types of terminal devices.

Distributed - A distributed WAN consists of two or more computers in different locations and may also include connections to dumb terminals and other types of terminal devices.

Internetwork

Two or more networks or network segments connected using devices that operate at layer 3 (the 'network' layer) of the OSI Basic Reference Model, such as a router.

Note: Any interconnection among or between public, private, commercial, industrial, or governmental networks may also be defined as an internetwork.

Internet

A specific internetwork, consisting of a worldwide interconnection of governmental, academic, public, and private networks based upon the Advanced Research Projects Agency Network (ARPANET) developed by ARPA of the U.S. Department of Defense – also home to the World Wide Web (WWW) and referred to as the 'Internet' with a capital 'I' to distinguish it from other generic internetworks. (Inaccurate) synonyms for the 'Internet' also include the 'Web' or, in a more comical sense, the 'Interweb'.

Intranet

A network or internetwork that is limited in scope to a single organization or entity or, also, a network or internetwork that is limited in scope to a single organization or entity and which uses the TCP/IP protocol suite, HTTP, FTP, and other network protocols and software commonly used on the Internet.

Note: Intranets may also be categorized as a LAN, CAN, MAN, WAN, or other type of network.

Extranet

A network or internetwork that is limited in scope to a single organization or entity but which also has limited connections to the networks of one or more other usually, but not necessarily, trusted organizations or entities (e.g., a company's customers may be provided access to some part of its intranet thusly creating an extranet while at the same time the customers may not be considered 'trusted' from a security standpoint).

Note: Technically, an extranet may also be categorized as a CAN, MAN, WAN, or other type of network, although, by definition, an extranet cannot consist of a single LAN, because an extranet must have at least one connection with an outside network.

Intranets and extranets may or may not have connections to the Internet. If connected to the Internet, the intranet or extranet is normally protected from being accessed from the Internet without proper authorization. The Internet itself is not considered to be a part of the intranet or extranet, although the Internet may serve as a portal for access to portions of an extranet.

7.0.5 Classification of Computer Networks

By network layer

Computer networks may be classified according to the network layer at which they operate according to some basic reference models that are considered to be standards in the industry such as the seven layer OSI reference model and the five layer TCP/IP model.

By scale

Computer networks may be classified according to the scale or extent of reach of the network, for example as a Personal area network (PAN), Local area network (LAN), Campus area network (CAN), Metropolitan area network (MAN), or Wide area network (WAN).

By connection method

Computer networks may be classified according to the technology that is used to connect the individual devices in the network such as HomePNA, Power line communication, Ethernet, or Wireless LAN.

By functional relationship

Computer networks may be classified according to the functional relationships which exist between the elements of the network, for example Active Networking, Client-

server and Peer-to-peer (workgroup) architectures. Also, computer networks are used to send data from one to another by the hardrive

By network topology

Computer networks may be classified according to the network topology upon which the network is based, such as Bus network, Star network, Ring network, Mesh network, Star-bus network, Tree or Hierarchical topology network, etc. Topology can be arranged in a Geometric Arrangement

By services provided

Computer networks may be classified according to the services which they provide, such as Storage area networks, Server farms, Process control networks, Value-added network, SOHO network, Wireless community network, XML appliance, Jungle Networks, khadar network, etc.

By protocol

Computer networks may be classified according to the communications protocol that is being used on the network. See the articles on List of network protocol stacks and List of network protocols for more information.

APPENDIX C

LOCAL AREA NETWORK

8.1 Introduction

A local area network (LAN) is a computer network covering a small geographic area, like a home, office, or group of buildings. Current LANs are most likely to be based on switched IEEE 802.3 Ethernet technology, running at 10, 100 or 1,000 Mbit/s, or on IEEE 802.11 Wi-Fi technology. Each node or computer in the LAN has its own computing power but it can also access other devices on the LAN subject to the permissions it has been allowed. These could include data, processing power, and the ability to communicate or chat with other users in the network.

The defining characteristics of LANs, in contrast to WANs (wide area networks), include their much higher data transfer rates, smaller geographic range, and lack of a need for leased telecommunication lines.

8.2 Technical Aspects

Although switched Ethernet is now the most common data link layer protocol (OSI 7-Layer Model), and IP as a network layer protocol, many different options have been used (see below), and some continue to be popular in niche areas. Smaller LANs consist of a few switches typically connected to each other and with one connected to a router, cable modem, or DSL modem. A traditional model of access, distribution, and core switches was popularized by Cisco Systems and has been in use for many years.

Larger LANs are characterized by distributing Ethernet traffic roles within the network. Each layer aggregates traffic of the layer below it and will typically maintain redundant links with switches capable of quality of service and spanning tree protocol to prevent loops and the recovery of failed uplinks.

Used for basic data or program sharing functionality, the humble LAN has served as a catalyst for the indispensable role the intranet has come to play in modern government departments and businesses. The LAN-based intranet has been a large contributor to the productivity increases in western economies during the early part of the 21st century. Initial implementations of LANs tended to revolve around the type of computers and devices attached to the LAN, and to the permissions they would be granted. Modern considerations include a carefully planned intranet strategy - to comply with legislative and other responsibilities - content management software, accessibility, scalability, audit requirements, document and information control and integration with telephone systems.

LANs may have connections to other LANs via routers and leased lines. Traditionally, the network connecting two or more LANs is referred to as the WAN

(Wide Area Network). Recently, service providers have begun to offer additional services to link LANs together. These technologies, such as Metropolitan Area Networks (MANs), and MPLS/VPN services have diversified the standard model of interconnecting sites. There are also methods of connecting LANs together through the use of Internet connections, VPN software or hardware, and 'tunneling' across the Internet using VPN technologies.

Topology, protocols and media (The cables, like CAT5, or radio waves that connect devices in the LAN) are the characteristics that differentiate LAN.