DEVELOPMENT OF SELF DIAGNOSIS (SMART) PLANT USING SORTING PLANT

MUHD IHSAN IZZAT BIN ROSLI

BEKC

2008/2009

"I hereby declared that I have read through this report entitle "Self Diagnosis (Smart) Plant" and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Electrical Engineering (Control, Instrument and Automation)

Signature : ....

Supervisor's name : MR. AHMAD ZUBIR BIN JAMIL

Date : 12-05-2009

AHMAD ZUBIR BIN JAMIL
JURUTERA PENGAJAR
Fakulti Kejuruteraan Elektrik
Universiti Teknikal Malaysia Melaka

SELF DIAGNOSIS (SMART) PLANT

MUHD IHSAN IZZAT BIN ROSLI

A Report Submitted In Partial Fulfillment of Requirements for the Degree of Bachelor In Electrical Engineering (Control, Instrument and Automation)

Faculty of Electrical Engineering
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2008/2009

"I declare that this report entitle "Self Diagnosis (Smart) Plant" is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ……………………………………………..

Name : MUHD IHSAN IZZAT BIN ROSLI

Date : 22 APRIL 2009

Specially dedicated to

My beloved parents, sisters, brothers and friends

Thank you for the endless support and encouragement

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ABSTRACT

This project is about to develop smart plant that will embed possible fault that could occur in process plant. The fault databases have been be written using VB programming. One of the good features this system will have is that, it will shorten the time taken to identify and rectify that fault.

As to make the system become more efficient and user friendly, the Graphical User Interface (GUI) has been be developed using CX-Designer that will be utilized for data supervisory, monitoring and control system for the whole process plant that has been chose. This system will stored all the alarm history into database and can monitor current alarm that could occur in process plant.

ABSTRAK

Projek ini adalah bertujuan untuk membina sebuah sistem pintar bagi sesebuah kilang dimana ia boleh mengesan kerosakan yang mungkin berlaku di dalam sesebuah kilang tersebut. Pangkalan data yang dibina ditulis menggunakan bahasa pengaturcaraan VB. Satu keistimewaan yang ada pada sistem ini adalah seperti berikut, ia akan memendekkan masa yang diambil untuk mengenalpasti dan membetulkan sesuatu kerosakan tersebut.

Bagi menjadikan sistem ini lebih cekap dan mesra pengguna, Antara Muka Pengguna Grafik (GUI) telah dibina menggunakan bahasa pengaturcaraan CX-Designer sebagai data penyeliaan, pemantauan dan kawalan bagi keseluruhan proses bagi sesuatu operasi. Sistem ini akan menyimpan semua maklumat kerosakan didalam pengkalan data dan memantau kerosakan semasa yang mungkin berlaku didalam sesuatu proses.

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CHAPTER 1

PROJECT BACKGROUND

1.1 Introduction

A major technological challenge facing the processing industries is the need to produce consistently high quality product. This is particularly challenging in high demanding situations where processes are subject to varying raw material properties, changing market needs and fluctuating operating conditions due to equipment or process degradation. The need to provide industry with techniques, which enhance process performance, will require new methodologies to be adopted that are capable of being used across a spectrum of industrial processing operations and on a wide range of products (Simoglou *et al.*, 2000).

Modern industrial processes typically have a large number of operating variables under closed loop control. These loops used to compensate for many types of disturbances and to counteract the effect of set point change. This is necessary to achieve high product quality and to meet production standards. Although these controllers can handle many types of disturbances, there are faults in the process such as line blockage, line leakage, sensor fault, valve fault and controller fault that cannot be handled adequately. In order to ensure that process is operating at normal operating condition as required, faults must be detected, diagnosed and removed.

1.2 Objective of Project

The Objectives of this project are:

1. To create complete fault database to be embedded into to the plant

- Database will use to stored all the fault data that could occur in plant including the time and date.

2. To integrate these faults with proper GUI for effective data measurement
   - GUI will use as a monitoring system for overall process plant and as alarm event monitoring system

3. To developed databases and alarms for plant diagnosis
   - Developed appropriate data for alarm diagnosis system that will have that. Suggestion for fault elimination that will store in database.
   - Detection of malfunction equipment.

1.3 Scope of Project

The scopes of the project are:

1. To develop fault diagnosis advisory focusing on a process plant
   Consists of:
   - Location the fault occur such as Zone, Station, and others
   - Factor of the fault occur such as equipment error
   - Time the fault occur
   - How to eliminate the fault

2. Laying out the GUI in SCADA and create programming for the GUI's.

3. The faulty condition is incorporated into the process model in order to see the performance of the control charts to detect the fault(s) and to find the cause of the fault(s).

4. The results of fault detection and diagnosis are then discussed further.

5. Generation of Data.

Consists of:

- Fault data.
- Instrument data that will stored in database.

6. To verify and validate the designed fault detection and diagnosis algorithm by developing a prototype using Visual Basic (VB).

1.4 Problem Statement

Plant breakdown in manufacturing or process control is unwanted and unexpected events. The longer time spent to identify and rectify the fault will cause higher lost in production activity and this has to be treated seriously by the maintenance team. Nowadays there is a lot of kind of the system that use in each process plant to detect fault but there is no system can detect fault and come out with the suggestion to eliminate the fault.

In the past, control community has succeeded using alarm and interlock systems in removing regulatory control from hands of human operators. These systems have performed in an automated manner aided by computer due to the complicated plant operation and led to great progress in the quest for higher productivity, process safety, process efficiency and profitability. Poor control or process disruption might lead to plant shutdown and such situations are expected to be solved by human operators with the assistance of an alarm system. If correcting abnormal events is fully reliance on human operators, they might tend to make erroneous decisions and take actions which make matters even worse. Literature has shown that most industrial accidents are caused by human errors and these abnormal events have significant economics, safety and environmental impacts [4]. Hence, fault detection and diagnosis is one of the means for process safety management to aid the operator in improving the process operation. Abnormal events could occur due to several factors such as the broad scope of the diagnostic activity that include a variety of malfunctions - process unit failures, process unit degradation, and parameter drifts and so on. Prolonged situations such as in the case of instrument failure or any rupture of pipeline could result in disasters, forced shutdowns, or at least higher operating costs from sub-optimal plant operation and it could not be avoided unless the failure is promptly detected and accomplished in time with corrective actions. Thus, it is the purpose of diagnosis to detect any fault and give advice to personnel in taking action which caused by failure of the control system. This entire activity is called Abnormal Event Management (AEM), a key component of supervisory control [5]. In the area of plant-wide control at the supervisory level, the process fault detection and diagnosis system plays a key role. Foreseeable, the important of supervisory system and the potential of computer to provide closer supervision and better information of process safety by monitoring critical parameters and, when circumstances warrant it, initialling and carrying out a safe shutdown.

The other problem is the conventional system only allows a single workstation to monitor this system and there is no fault monitoring system that came with fault elimination suggestion. So, all the data management can't proper from conventional system.

Due to the problems stated, the best solution for this problem is to design the SCADA system (Supervisory and Data Acquisition) for the system that will equip the GUI (Graphical User Interface) by using CX-Designer and Fault Diagnosis system that will came with fault elimination suggestion by using a Visual basic platform . By using this system, the fault can be easily detected.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Nearly 35 years, process fault detection and diagnosis has been an active area of research. There are variety of techniques to develop fault detection and diagnosis system. Malfunctions of plant equipment, instrumentation and degradation in process operation increase the operating costs of any process industries. More serious consequences are gross accident such as explosion. Effective monitoring strategy for early fault detection and diagnosis is very important not only from a safety and cost viewpoints, but also for the maintenance of yield and the product quality in a process. This area has also received considerable attention from industry and academia alike and many researchers have been conducted and many industrial applications exist.

2.2 Techniques in Fault Detection and Diagnosis

This section will give a brief explanation on the need for formulation of efficient fault detection and diagnosis method, the definition of fault, noise and also the various techniques of fault detection and diagnosis.

2.2.1 Fault Definition

In general, fault is deviations from the normal operating behaviour in the plant that are not due to disturbance change or set point change in the process, which may cause performance deteriorations, malfunctions or breakdowns in the monitored plant or in its instrumentation. Himmelblau (1978) defines a fault as a process abnormality or symptom, such as high temperature in a reactor or low product quality.

2.2.2 Types of Fault

Generally, one has to deal with three classes of faults [5]. The first type of fault, parameter failures, arises when there is a disturbance entering the process from the environment through one or more independent variables.

The second type of fault, structural changes, refers to changes in the process itself. They occur due to hard failures in equipment. Structural faults result in a change in the information flow between various variables. An example of a structural fault would be failure of a controller. Other examples include sticking valve, a broken or leaking pipe.

The third type of fault is malfunctioning in sensors and actuators. Gross errors usually occur with actuators and sensors. These could be due to a fixed failure, a constant bias (positive or negative) or an out of range failure [5]. In a chemical process, some instruments provide feedback signals which are essential for the control of the process [5]. A fault in one of the instruments could cause the plant state variables to deviate beyond acceptable limits unless the fault is detected promptly and corrective actions are accomplished in time.

2.3 Supervisory Control and Data Acquisition (SCADA)

2.3.1 Introduction

In this project SCADA will be used for a graphical user interface to monitor process plant model. SCADA is an acronym for control and data acquisition [1]. SCADA stands for Supervisory Control and Data Acquisition. As the name indicates, it is not a full control system, but rather focuses on the supervisory level. As such, it is a purely software package that is positioned on top of hardware to which it is interfaced, in general via Programmable Logic Controllers (PLCs), or other commercial hardware modules [1].

Contemporary SCADA systems exhibit predominantly open-loop control characteristics and utilize predominantly long distance communications, although some elements of closed-loop control and/or short distance communications may also be present. Systems similar to SCADA systems are routinely seen in factories, treatment plants and etc. These are often referred to as Distributed Control Systems (DCS). They have similar functions to SCADA systems, but the field data gathering or control units are usually located within a more confined area. Communications may be via a local area network (LAN), and will normally be reliable and high speed. A DCS system usually employs significant amounts of closed loop control. The size of such plants can range from as few as 10 to several 10 thousands input/output (I/O) channels. However, SCADA systems evolve rapidly and are now penetrating the market of plants with a number of I/O channels of several 100K [2].

Telemetry is usually associated with SCADA systems. It is a technique used in transmitting and receiving information or data over a medium. The information can be measurements, such as voltage, speed or flow [2]. These data are transmitted to another location through a medium such as cable, telephone or radio. Information may come from multiple locations. A way of addressing these different sites is incorporated in the system.

Data acquisition refers to the method used to access and control information or data from the equipment being controlled and monitored. The data accessed are then forwarded onto a telemetry system ready for transfer to the different sites. They can be analogue and digital information gathered by sensors, such as flow meter, ammeter, etc. It can also be data to control equipment such as actuators, relays, valves, motors, and etc [2].

The SCADA program has a user configured database which tells the software about the connected instrumentation and which parameters within the instruments are to be accessed [2]. The database may also hold information on how often the parameters of the instruments are accessed and if a parameter is a read only value (e.g. a measured value) or read / write, allowing the operator to change a value (e.g. an alarm set point).

The parameters of the instrument being accessed are normally split between analogue (numeric) and logic (digital). When running, the SCADA software continuously updates its own database with the latest analogue and digital values collected from the