AN ARCHITECTURE FOR CLIENT-SERVER BASED CONTROL CHART PATTERNS RECOGNITION SYSTEM

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A thesis submitted in fulfillment of the requirements for the award of the degree of Master of Engineering (Mechanical)

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MAY 2009
ACKNOWLEDGEMENTS

I would to take this opportunity to express my sincere appreciation to my supervisor, Associate Professor Dr. Adnan Hassan. He has given a lot of advices, guidances, comments and constructive critics as well as a lot of encouragement and support in order to accomplish this study. In addition, I am also very thankful to my co-supervisor Associate Professor Dr. Abdul Samad Ismail for his guidances, suggestions and valuable support along the way to accomplish this study.

I would like to express my appreciation to my parents and family members for continuous support and care. Their support and understanding always become my motivator along the path of accomplishing this study.

Finally, thanks to all friends for their impressive, valuable helps and suggestions throughout the duration of this study.
ABSTRACT

In any industrial process, regardless of how well designed or carefully maintained it is, a certain amount of process variation will always exist. One of the commonly used methods to monitor and diagnose the process variation is Statistical Process Control (SPC) chart. Some enhancements have been made by researchers to introduce the SPC chart system with patterns recognition feature. However, these SPC chart patterns recognition systems are limited to local and standalone system. There is a need to develop a client-server based system which would enable data sharing and remote access. The purpose of this study is to develop an architecture for a client-server based control chart patterns recognition (CCPR) system. Specific focus of this study is to investigate design and development aspects of the proposed client-server based CCPR system. A suitable client-server (CS) architecture and load passing procedure are investigated. Proper selection of CS architecture and load passing procedure are crucial to ensure each functional tier can be effectively integrated, system resources can be optimized and the system workload can be fairly distributed. The selection of design parameters are based on computer simulation studies using synthetic data. Candidate designs are evaluated based on calculation time, memory, processor usage and classification accuracy. The CS architecture with load passing procedure at server tier and patterns recognition at engine tier gave the best results among the investigated alternatives. This CS architecture is able to support more users and process more data. The load passing procedure with the combination of Nelson Run Rules and EWMA test resulted in better performance compared to Run Rules and CUSUM, CUSUM and EWMA and capable to prioritize the unstable processes to access the engine tier. The proposed CS architecture and load passing procedure can be used as a guideline for the development of a client-server based CCPR system.

Keywords: Control Chart Patterns Recognition, Client-Server, Load Passing.
ABSTRAK


Kata Kunci: Pengecam Corak Carta Kawalan, Pelanggan-pelayan, Penyimbang Beban.
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CHAPTER 1

INTRODUCTION

1.1 Background of the problem

For the last ten years, business and manufacturing have shifted from local entities towards globalization entities. Quality has become one of the most important decision factors in making selection among worldwide competing products and service. To be a winner in this global competitive edge, the manufacturer needs to produce product with high quality within the shortest delivery time and lowest cost (Shariff, 2005).

There are several methods which can be used to improve product quality. One of the commonly used methods is the Statistical Process Control (SPC). SPC can be defined as using statistical techniques to improve and implement quality control. Since the introduction of SPC by Walter A Shewart in year 1920s, SPC have been widely adopted and applied in manufacturing industrial. It has been used for monitoring and diagnosis manufacturing process variation. SPC can be used to achieve process stability and improve process capability through the reduction of process variability.

Currently there are several computer aided SPC systems introduced by software vendors and researchers. These computer aided SPC systems can assist the manufacturers in automating the quality control functions. Nevertheless, these systems
still have some limitations. For example, the current computer aided SPC system only provides some basic functions such as automating the plotting of control charts. The most important part, the control chart data analysis still heavily relies on the operators and engineers. Usually, the operator and engineer are very busy with other production task and may not have sufficient time to perform analysis on the control chart data (Thompson et al., 1998).

As noted earlier, the current computer aided SPC system are mainly based on standalone system. These standalone systems do not allow co-operation and information sharing. The accessibility of these control chart data should not be limited to the operator and engineer only. They should also be accessible to managers and customers. The control chart data can assist the manager or customer to have a better understanding on production line status and helps them in making better decision.

Beside that, the current computer aided SPC system does not allow remote access. It is only limited to one production area or factory side. The operator and engineer cannot access the status of production line remotely. Some managers and customers may not have quality engineering background. The burden of analysis the production data should not be assigned to them. The manager and customer maybe interested to know the result and status of the production line. An automated and computerized SPC system should assist them to diagnose the production line.

These are the quality control problems facing by the operator, engineer, manager and customer. So there is a need to develop a Client-Server based Control Chart Pattern Recognition (CCPR) system which would enable data sharing, remote access and intelligent diagnosis of the production line status.
1.2 Statement of the problem

Existing control chart pattern recognition systems are mainly local and standalone system. They do not provided data sharing and remote access. There is a need to enhance the standalone system towards a Client-server based control chart patterns recognition system. Several design issues need to be considered in developing such a client-server system.

The client-server based CCPR system needs to have a client-server architecture which can support multiple users simultaneously and better resource allocation. Inappropriate allocation of resources can cause certain functional tier become overloaded while the others are under loaded. An effective assignment of functional modules can enable the CCPR system to support multiple users simultaneously without additional computing resources.

Due to unique characteristics of SPC data stream, the load passing procedure as implemented in the voice and network packet system are not directly applicable in the CCPR system. A customized load passing procedure is needed for a client-server based CCPR system. Specifically, the load passing algorithm must be able to prioritize the client access based on the severity of process instability. Without a customized load passing procedure, the unstable process will have the same priority with stable process, which may result in delayed detection of unstable process data.
1.3 **Purpose and Objective of the Study**

The purpose of this study is to enhance the existing standalone control chart patterns recognition system towards a client-server based system which would enable efficient data sharing, remote access and intelligent diagnosis of production line.

The specific objectives of this study are:

i. To design a customized client and server architecture for a control chart patterns recognition system.

ii. To customize a load passing procedure for the client-server based control chart patterns recognition system.

iii. To provide a guideline for transforming the standalone system to a client-server based CCPR system.

1.4 **Scope of the Study**

Below are the scopes for this study:

i. Data stream for process variation are limited to univariate data plotted of Shewart $\bar{x}$-chart.

ii. Design and evaluation are limited to the computer simulation studies. The published and real data are used for validation.

iii. The simulation data arrive to the system with constant rate and speed.

iv. Different combination of computing resources are not taken into consideration. Fixed type and amount of computing resources are used.

v. Data encryption and network security issues are not included in this study.
1.5 Significance of the study

This client-server based CCPR system enables information sharing among different entities in the manufacturing system. By taking the advantageous of internet technology, this web-enabled system is accessible anytime, anywhere using a personal computer with Internet connection. Client-server based CCPR system makes the manager and customer feel easy and comfortable while interacting with the control chart system. The suitable client and server architecture ensures each functional tier can be successfully integrated. This architecture should be able to support multiple users simultaneously and ensure fair distribution of the system workload. With all these features, this client-server based control chart patterns recognition system could overcome the limitation of the standalone system. This study also provides a guideline for transformation from a standalone to the client-server based CCPR system.

1.6 Organization of the Thesis

This report is organized into seven chapters. Chapter 1 gives explanation on the background, statement of problem, objective, scope and significance of study. Chapter 2 presents literature review on board and focus area of the study. Techniques and technologies for the client-server based system development are presented here. Chapter 3 discusses the research methodology for this study. It begins with discussion on the problem situation, solution concept followed by the researches planning, source of data, equipment used and performance measurement methods. Chapter 4 describes the experiments and statistical analysis carried out to select a suitable client and server architecture. Chapter 5 describes the experiment and statistical analysis carried out for selecting a customized load passing procedure for the client-server based CCPR system. Chapter 6 presents the techniques and methods used for the prototype system implementation and validation. Lastly, Chapter 7 summarizes the research finding and concludes the study.
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