UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STUDY ON AN AUTOMATED MACHINE SIGNAL MONITORING

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Hons.)

By

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DECLARATION

I hereby, declared this report entitled “Study on an automated machine signal monitoring” is the result of my own research except as cited in reference.

Signature : …….

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Date : 24 June 2018

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfillment of the requirement for the degree of Bachelor of Manufacturing Engineering (Hons.)

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ABSTRAK

Sistem automasi mnegurangkan kerja operator termasuklah maklum balas dan sensor program. Hasilnya tergantung kepada sistem mesin tersebut melakukan kerja dari mula hingga akhir tanpa bantuan operator. Automasi ialah gabungan mekanikal, hidraulik, pneumatik, elektrik, elektronik, dan komputer. Objektif untuk projek ini adalah mengenalpasti jenis tindak balas isyarat daripada mesin automatik dan menganalisa ciri-ciri dan tindak balas isyarat mesin automatik. Kajian ini adalah untuk menyiasat kaedah yang sesuai untuk mengeluarkan tindak balas isyarat daripada mesin automatik di makmal FKP. Kerja-kerja eksperimen termasuk menyiasat tindak balas isyarat seperti getaran dan daya pemotongan menggunakan meter getaran dan dynamometer. Analisis data adalah dari segi masa domain. Hasil experiment menunjukkan robot 6 axis (arm robot) dan 'XY table' dalam keadaan yang baik. Manakala 'Parallel robot' mengalami kerosakkan dan perlu diperbaiki dan mesin 'CNC milling' perlu dipantau keadaan sebelum mengalami kerosakkan.

ABSTRACT

Automation systems eliminate the need for an operator by including feedback and sensory programs. The results is highly independent machine systems that can carry out task from start to finish, without human assistance. Automation is a combination of mechanical, hydraulic, pneumatic, electrical, electronic devices and computers, usually in combination. The objectives for this project are to identify signal response of an automated machine and analyse the behavior and characteristic of response of an automated machine. This study aims to investigate the suitable method to obtain the signal response of an automated machine at Faculty of Manufacturing Engineering laboratory. The experimental works include signal investigation of vibration and cutting force using monitoring instrument. Data analysis will be in term of time domain and the experimental presenting the behavior and characteristic of the signal response. As a result, the condition of arm robot and XY table are in good condition. CNC milling machine need to be monitored closely and parallel robot have damage occur.

DEDICATION

Only

my beloved father, Rosli bin Jonit

my beloved mother, Halijah binti Ismail

my adored sisters and brothers

for giving me moral support, money, cooperation, encouragement and also understanding.

Thank you so much & Love you all

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In the name of ALLAH, the most gracious, the most merciful, with the highest praise to Allah that I manage to complete this final year project successfully without difficult. My respected supervisor, Dr. Nur Aidawaty binti Rafan for the great mentoring that was given to me throughout the project.

Last but not least, I would to give a special thanks to my best friends who give me much motivation and cooperation mentally in completing this report. They had given their critical suggestion and comments throughout my research. Thanks to be the great friendship. Finally, I would like to thank everybody who was important to this final year project report, as well as expressing my apology that I could not mention personally each one of you.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1
INTRODUCTION

1.1 Introduction

This chapter are describing the introduction of the project. In this project, study on automated machine signal monitoring. In this chapter, it includes of project background, problem statement, objective and scope of study.

1.2 Background

Automation systems eliminate the need for an operator by including feedback and sensory programs. The results is highly independent machine systems that can carry out task from start to finish, without human assistance. Automation is a combination of mechanical, hydraulic, pneumatic, electrical, electronic devices and computers, usually in combination. Complicated systems, such as modern factories, airplanes and ship typically use all these combined techniques. The benefit of automation include labor savings, saving in electricity costs, saving in material costs, and improvement to quality, accuracy and precision.

Condition monitoring uses the selected measurement to detect change in operating data contain in the machine, to calculate the condition of a component or a machine that can be measured. This condition is a numeric expression of a component health, and can measure error

which are modeled in the calculation algorithm cause by from wear, friction, and heat dissipation and similar (Engeler *et al.*, 2017).

Using this value, machine efficiency can be passed in several different ways such as predictive maintenance, can be used to decrease the sum of maintenance time on the machine. This method allows for good planning of maintenance action, depend on the component condition, rather than on the maintenance cycle attached. If the maintenance is depend on the actual situation, it also decrease the amount of components, which are maintained, even healthy (Engeler *et al.*, 2017).

There are two method to monitoring tool condition such as direct and indirect methods. Direct Tool Condition Monitoring (TCM) method, such as vision and optical methods, measure the geometric parameters of the cutting tool. Direct measurement are typically very difficult or impossible to do in real-time due to continuous contact between the tool and the workpiece as well as the presence of coolant and chip. The indirect approach is achieved by correlating right sensor signals corresponding to the state of the toll wear. Tool condition is estimated from the characteristic of the signal that can be measured. Researches have used measurement of forces, vibration, acoustic emission, spindle motor and feed current to estimate the state of tool wear state. Some comprehensive studies of these works have been published (Lin and Dou, 2017).

Tool Condition Monitoring (TCM) signifies a continuous process to ensure tool cuts in surveillance during machining. To ensure effective TCM, the whole occurrence involved in machining would be investigated. Plastic deformation of work material, crack propagation, progressive tool wear, tool fracture, tool breakage, chip formation, chip breakage, chip removal, chip tangling, and process specially involved with metal cutting process (Nouri *et al.*, 2015).

1.3 Problem statement

The manufacturing industry require machine equipment in good condition and well-maintained. Intelligent machining using sensorial perception can meet this requirement (Ratava et al., 2017, Rehorn et al., 2005, Teti el al., 2010). Some studies suggest that 20% of cutting machine downtime is due to tool failure (Rehorn et al., 2005). Interviewed local industry contacts agree that tool breakage is an issue, especially in interrupted turning. The downtime cause by tool failure can be mitigated by monitoring systems despite predicting it especially difficult in disrupted cutting because of the highly variable stress causing increased tool wear (Ratava et al., 2017).

In the process of cutting metal, tool wear means failure gradually cutting tools for normal operations. In machining, the contact between cutting tool workpiece and the chip imposed pressure on the tool and cause the shape of the tool change, either gradually as tool wear fracture breakage. Plastic deformation of work material, crack propagation, progressive tool wear, tool fracture, tool breakage, chip formation, chip breakage, chip removal, chip tangling, process disruption specifically involved in metal cutting process (Nouri *et al.*, 2015). Sometimes the replacement of wearable tools may cause unpredictable damage to the machine at any time. Statistics show that in an industry about 8% of the total turnover invested in maintenance that emphasize the maintenance is one of the major industrial domain (Sudhakar et al., 2017).

Signal response from the automated machine shows the behavior of an automated machine. The method to obtain signal data from automated machine will be discussed in this project. The signal will be analyzed to suggest the behavior of the machine.

1.4 Objectives

The objective are as follows:

i) To identify signal respond of an automated machine.

ii) To analyse the behavior and characteristics of response of an automated machine.

1.5 Scope of study

The scopes of research are as follow:

i) Study on signal response on CNC milling machine, parallel robot, XY table and CAMAO 6-axis arm robot at FKP lab only.

ii) Data analysis in term of time domain.

ii) Signal response analysis suggest machine condition.

1.6 Significant of study

This study is significant to the sustainability of life machine, cost management for the maintenance and is also significant to industrial revolution 4.0 for online monitoring of the machine.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The literature review part consists of the summarizing of the project in order to get the whole data about signal, automated machine and technique monitoring condition, this will give an idea to run the project. This chapter presents related study done by previous research and will be working as a reference, to give information and guide base on journal, book and other source on the internet that could contribute to this project.

2.2 Automated machine

Within the manufacturing area there is an ever increasing demand for quality improvement and various products, as well as reducing production time and spending. This is because most global opponents, various product demand and shrinkage lifecycles. To meet the above needs, manufacturer's interest is turning increasingly shifting to automated machining systems, which there may be less dependent on operator throughout the production process. Fulfillment of automated machining systems depends relies heavily on a robust and dependable monitoring system for online and offline supervision of key machining processes (Duro *et al.*, 2016) .

2.2.1 CNC milling machine

The use of intelligent systems expanding in the manufacturing industry to monitor the operation of computer numerical control (CNC). Many approaches had been proposed to achieve tool monitoring and certain of them had been well adapted to industrialized applications. The increasing popular approach is to analyse the acoustic emission (AE) obtained from machining cutting operation. Although its advantages, AE based systems is not considered to be truly reliable because (a) their sensitivity to AE is created via sources other than tool and workpieces which may be picked up by the sensor and confuse the signal processing task, (b) the need to adjust the signal amplification depending on the process to be monitored., (c) the sensitivity of AE measurement to sensor location and cutting parameters, and (d) constrained related to the practical implementation of a microphone in an industrial setting, such as directional consideration, frequency respond, and environment sensitivity (Denkena and Lepper, 2015). Figure 2.1 shows a CNC milling machine.

Figure 2.1: CNC milling machine.
(http://www.cadcamengineering.net/cnc-milling-machine-configuration/)

2.2.2 Arm robot

High-speed machining is quite a new application of industrial robotic since previously they had been in particularly used for part handling and welding. (Kochan, 2004). As follow form related study (Chen and Dong, 2013), the machining segment constitute less than 5% of the entire industrial robots market, but the share is continuously growing. So, alternative of conventional CNC machines through more competitive industrial robot turns into more and more attractive. For that reason, the paper proposes a comparison analysis for typical industrial robots used in machining application (Denkena and Lepper, 2015).

The use of industrial robot can reduce the amount of cutting volumes and allows the most useful cutting force to cut off when performing machining task. Robot are cheap compared to conventional machine tools however to compete with them is not enough. The important purpose for their poor positioning accuracy is their low and dynamic stiffness because their high joint compliance and long arms (Denkena and Lepper, 2015). Figure 2.2 shows an arm robot.

Figure 2.2: Arm robot. (Ambiehl, Pashkevich and Mines, 2016)

2.2.3 Parallel robot

Currently used for pick and place operations, parallel robots are capable to perform trajectories much faster and with better precision than serial ones. High acceleration are then required and, no matter of the good stiffness properties of the parallel links, the robot end-effector may be subject to unwanted vibration after accomplishing its stop position, compromising as a consequence, the robot cycle time. Given that these vibration prevent the accurate positioning of the end-effector at the stop positions, it's far at these specific points that active control is needed. Such active vibration control is then investigated, following the method adopted by way of mean of piezoelectric actuators. A non-located architecture is addressed, considering accelerometer placed on the end-effector for the output data and piezoelectric patches glued along the robot arms as actuators (Douat *et al.*, 2013). Figure 2.3 shows a parallel robot.

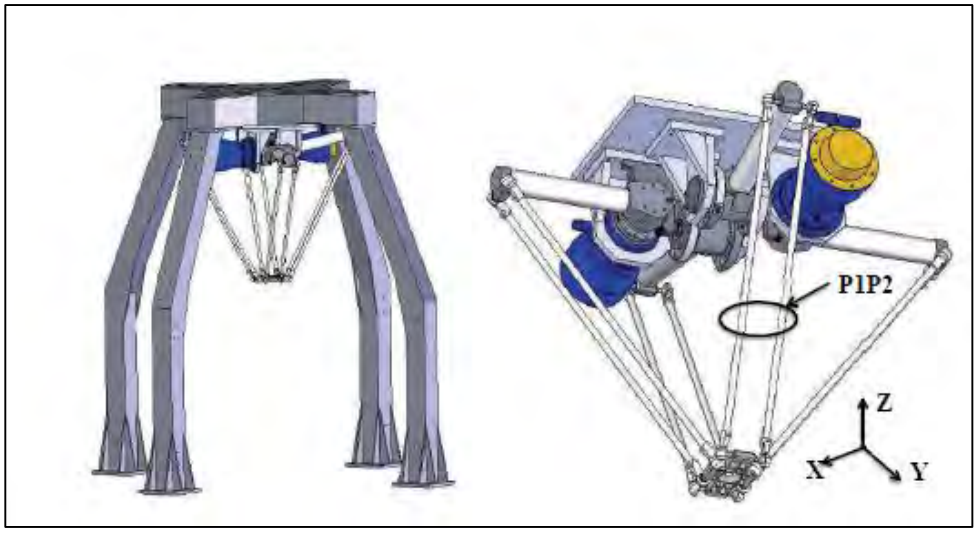

Figure 2.3: Parallel robot. (Douat *et al.*, 2013).