IDENTIFICATION AND REDUCTION OF NOISE AND VIBRATION LEVEL ON REAR HANDLE OF HANDHELD TOOLS USING FAST FOURIER TRANSFORM (FFT) TECHNIQUE

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I hereby declare that I have read this thesis and in my
opinion this thesis is sufficient in terms of scope and quality for the award of
Bachelor of Mechanical Engineering (Structure & Materials) with Honor

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Date : 24 MAY 2010

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This Report Is Submitted In Partial Fulfillment of Requirements For the Bachelor of Mechanical Engineering (Structure & Materials) with Honor

Faculty of Mechanical Engineering
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MAY 2010

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"I declared that this project report entitled "Identification of Noise and Vibration Level of Rear Handle of Handheld Tools Using Fast Fourier Transform (FFT) Method" is the result of my own result except as cited in the references."

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Date : 24 MAY 2010

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DEDICATION

For my beloved father and mother,
Dearest family members and next of kin,
Lecturer and friend

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ACKNOWLEGEMENT

Assalammualaikum and Salam Satu Malaysia

Thanks to Allah, for giving me permission to complete this project. In here I would like to record my graceful thank to all the support, encouragement and inspirations that I have received during completing this project.

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ABSTRACT

Usage of handheld tool that used electricity is very wide. Tool like drill is very useful for construction work. Drills that can punch on the hard surface make that tool popular. However, usage of this tool every day will give badness for the user. Therefore, the aim of this project is to identify the areas that produce high vibration level. With suitable software, the area can be identified. The target area for this project is on the rear handle of the drill. This is because that area is the main holder for that tool. Controller would be applied in order to reduce the vibration on that tool and make the tool become more stable. Then, the suggestion for modification for the tool design would be suggested to make sure the users safety and make it the lifetime for tool longer.

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ABSTRAK

Penggunaan alatan tangan yang menggunakan elektrik amat meluas. Alatan seperti gerudi amat berguna untuk kerja-kerja pembinaan. Kesesuaiannya untuk menebuk lubang pada permukaan yang keras menjadikannya alatan yang sangat popular. Walaubagaimanapun, penggunaan alatan ini setiap hari boleh mengundang keburukan pada penggunanya. Ini kerana kesan dari getaran yang tinggi dari alatan ini akan menyebabkan pengguna mengalami sakit pada bahagian tangan. Sehubungan dengan itu, projek ini akan dijalankan bertujuan untuk mengenal pasti kawasan yang menghasilkan getaran yang tinggi pada alatan tersebut. Dengan menggunakan perisian tertentu, kita dapat mengenal pasti kawasan terbabit. Kawasan yang akan menjadi sasaran ialah di bahagian pemegang belakang alatan tersebut. Ini adalah kerana di situ merupakan tempat pemegang utama bagi alatan ini. Setelah kawasan tersebut dikenal pasti, pengawal akan diaplikasikan bagi mengurangkan getaran pada alatan tersebut dan menjadikan alatan itu lebih stabil. Selain itu, cadangan untuk pengubahsuaian rekabentuk pada alatan tersebut kemungkinan akan diusulkan bagi menjamin keselamatan pengguna dan memanjangkan jangka hayat alatan tersebut.

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LIST OF NOTATIONS

NOTATION	DESCRIPTION
a	Acceleration
c	Damping coefficient
B_{eq}	Equivalent viscous damping coefficient
ξ	Damping ratio
F	Force
f_n	Frequency
J_m	Cart motor moment of inertia
k	Spring constant
K_{cr}	Critical gain
K_D	Derivative gain
K_g	Planetary gearbox gear ratio
K_I	Integral gain
K_m	Back-Electromotive-Force (EMF) constant
K_P	Proportional gain
K_t	Motor torque constant
K_V	Velocity gain
m	Mass
M	Total mass of the Cart System
P_{cr}	Period of the sustained
Q	Q factor
R_m	Motor armature current
r_{mp}	Motor pinion radius

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NOTATION	DESCRIPTION
ω_n	Natural frequency
x	Displacement
$\dot{x}$	Velocity
$\ddot{x}$	Acceleration
η_m	Motor efficiency
η_g	Planetary gearbox efficiency

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CHAPTER I

INTRODUCTION

1.1 Background

Vibration is a phenomenon that is produced from a moving tool. A study of vibration can gives a knowledge to understand the behavior of vibrate mode. One of the vibration level is depends on the speed of tools. Vibration phenomenon could gives many benefit and vice versa. In industry, vibration is useful for their operation and for example, massaging and therapeutic application.

Vibration with higher level such as earth quake has a potential to make a lot of destructions. High rise building and low rise building would collapse and people will be killed. Vibration produces on machine or engine would give a worse result for the performance. Vibration and noise occurs when the tool start the operations. Noise is unwanted sound and can be classified as pollution. This study is necessary in order to find the way to reduce the vibration in the control system by using stability method.

Usage of hand powered portable machines nowadays is very popular among the builders. This is because hand drill is very useful in order to simplify a hard works such as in engineering fields. When talking about hand powered portable machines, the current issues that always questioned and argued are how safe these machines to human body in term of physical and internal. Apart from other issues concerning the operator safety, one of the main sources of problems usually produced by power tools is the transmission of vibration to the hand and arm.

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1.2 Objectives

Objectives for this study is to determine the area that occur the highest noise and vibration on the rear handle of the handheld tool by carrying out the Fast Fourier Transform (FFT) method. This study also provides the solution to reduce the vibration using controller and give an extra suggestion for the tool design.

1.3 Scopes

The scopes of this study are:

a. This study is not involved the motor of the tool. The forces that come from the motor will be neglect.
b. Noise and vibration response are only limited to x and y-axis/direction.
c. Knowledge of using Fast Fourier Transform (FFT) is not necessary.
d. Comparison between Fast Fourier Transform (FFT) method and Operational Deflection Shape (ODS) method by referring the result.
e. Using PID controller in order to reduce the vibration of the tool and try to make comparison with other controllers such as P controller, PI controller, PD controller and PV controller.

1.4 Problem Statement

This project would study the vibrations that occur on the handheld tool. Using Fast Fourier Transform (FFT) and Operational Deflection Shape (ODS), this experiment would identified the area which is highest level of vibration is occurred. Vibration from the tools will be analyzed using the vibration analysis. The solution for reducing the vibration level will be discussed.

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1.5 Project Outline

Chapter 2 is the literature review for this project. This chapter will describe the theory of vibration and others. All materials that used in this project will completely explain to give more understanding about this project.

Chapter 3 would describe the method and procedures that used for vibration testing. This chapter includes the study of vibration analysis, Fast Fourier Transform (FFT) and Operation Deflection Shape (ODS) experiment method, MATLAB test, the setup and procedure of the experiment.

Chapter 4 is includes the analysis from the FFT graph and the location that give high vibration level will be determine. Analysis from FFT results will lead to find the natural frequency, spring and damper coefficient.

Chapter 5 is the implementation of controller into the system. The controllers are likes PID controller, P controller, PI controller, PD controller and PV controller. Those controllers will be applied with the same system using the Ziegler-Nichols Method.

Chapter 6 is includes the stability of the system after application of each controller. The results will be comparing between each other in order to find the best controller.

Chapter 7 is the conclusion and recommendation of this project. This chapter will concludes all results discussion, decision and also recommendation for the future work to further this study.

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CHAPTER II

LITERATURE REVIEW

2.1 Introduction

In this chapter will describe the theory of vibration and others. All materials that used in this project will completely explain to give more understanding about this project.

2.2 Theory of vibration

Vibration is undesirable, wasting energy and creating unwanted sound or noise. For example, the vibration motions of engines, electric motors, or any mechanical device in operation are typically unwanted. Such vibrations can be caused by imbalances in the rotating parts, uneven friction, the meshing of gear teeth, etc. Specific designs usually minimize unwanted vibrations.

Vibration also consider as the transfer between the kinetic energy and potential energy. It means the vibration system has the storing and release energy. Hartog et.al argued that vibration refers to mechanical oscillations about an equilibrium point. The oscillations are in periodic such as the motion of a pendulum or random such as the movement of a tire on a gravel road. Vibration is occasionally desirable. For example the motion of a tuning fork, the reed in a woodwind instrument or harmonica, or the cone of a loudspeaker is desirable vibration,

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