CHAPTER I
INTRODUCTION

1.1 Background

One of the most common machining processes applied in the manufacturing industry is the turning process. The turning process is a machining process aims to change the shape of a material by cutting the surface of a rotating workpiece using a single-point cutting tool. The tool moves linearly along the axis of rotation to reduce the mass of material with cylindrical geometry[1]. The turning process can be divided into conventional turning and CNC based on its mechanism.

In the conventional turning process, a lathe is operated manually by an operator with special skills. The manual operation of this lathe has several weaknesses i.e. the quality of machining product depends on the skill of the operator, lack of measurement accuracy, need a long time to set the machine, the cutting speed depends on the operator's experience, and the quality of the resulting product must be checked regularly[2]. Meanwhile, a maximum cutting rate is required to obtain an optimum production process while still paying attention to machining capabilities. In other words, the feed rate must be set at a certain optimum speed and it always has to be under allowable speed. This objective cannot be realized if the operator does the process manually [3]. To overcome these weaknesses, it is necessary to have a control system to adjust the feeding motion on a lathe to maintain the cutting force. Retrofitting conventional lathes to control the feed rate is needed in order to optimize the production process, increase efficiency, increase product accuracy and quality, and reduce production costs.[4].

In the turning process there are several cutting parameters i.e. cutting speed, feed rate, cutting time, spindle rotation, cutting depth, and cutting force. [1]. In this study, the cutting force parameter of the lathe to be controlled is the horizontal cutting force caused by the feed rate. Mihajlo opovic et.al [5] states that the calculation of the cutting force component in the machining process is crucial in determining the power

required, dimensional accuracy, shape accuracy and surface roughness, vibrations, tools and other supporting equipment. Based on research conducted by C. J. Rao et al [6] , there is a significant effect between the cutting force and feed rate on the surface roughness quality of the lathe. Research conducted by A. K. Rakhit [7] about the effect of cutting forces on the surface texture of the lathe process also shows a non-linear effect between cutting forces on surface roughness. This is caused by the vibration response in the tool system and the workpiece during the turning process.

B. Turasiramarao has researched on detecting cutting forces using a dynamometer [8]. The dynamometer used consists of a strain gauge accelerometer connected to the data acquisition system. This research can detect several forces that act during the lathe process. However, no such control system controls feed rate and cutting force. Naveenkumar [9] has also researched on cutting forces using various cutting tool nomenclatures, but the detection results did not reach the cutting force control stage.

Research on cutting force control was conducted by Tae-Yong Kim using the adaptive controller method [10]. The cutting forces on the x, y and z axes are indirectly calculated from the current usage read by the AC feed-drive servo motor. However, this study could not show how much cutting force is detected and controlled simultaneously.

So, in particular, research on the detection and control of the cutting force of a lathe need to be developed. Therefore, this final project has conducted a study on the detection and control of cutting forces on lathes using fuzzy control logic. Fuzzy control was chosen to convert linguistic language to automatic control language and have a more accurate data input [11].

1.2 Objective

This final project research aims to obtain a control and detection system of cutting force on a lathe using Arduino uno microcontroller based on fuzzy programming logic.

1.3 Outcome

The benefit obtained from this study is that it can be used to optimize the productivity of turning process and facilitate further development for machining control applications based on fuzzy logic control.

1.4 Problem Limitations

Problem limitations in this final project are

a. The parameters controlled are cutting force and feed rate.

b. Maximum cutting load read by sensor is set to be 500 gr.

c. The workpiece material is a composite with fiberglass reinforcement.

d. It is assumed that no deflection occurs on the workpiece.

1.5 Report Outline

The systematics of writing this final project consists of five chapters. Writing begins with CHAPTER I which contains an introduction. This chapter discusses the research background, objective, outcome, problem limitations, and report outline. In CHAPTER II, the supporting theories related to research are described which are taken from various books, articles, and other sources. CHAPTER III is a methodology that contains problem identification, tool design, installation and implementation of testing, and research flow diagrams. CHAPTER IV contains results and discussion. The last CHAPTER V is the conclusion of the final project.