UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF NON-CONTACT LEVEL MEASUREMENT INSPECTION SYSTEM

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Electrical Engineering Technology (Electronic Industry) (Hons.)

By

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Electrical Engineering Technology (Industrial Electronics) with Honours. The member of the supervisory is as follow:

……

(Mr A SHAMSUL RAHIMI BIN A SUBKI)

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ABSTRAK

Projek ini berkaitan dengan kawalan Sistem Pemeriksaan Pengukuran Tahap Bukan Hubungan oleh Arduino dengan sistem pemantauan menggunakan program Java. Tujuan utama yang dirancang adalah untuk membangunkan sistem pemeriksaan untuk memeriksa ketepatan sensor tahap Ultrasonik serta mengesan ralat bagi sensor tersebut. Sistem ini direkabentuk untuk membantu industri atau bidang pembuatan untuk memeriksa sensor tahap ultrasonik juga untuk mengatasi pemeriksaan manusia. Teknologi elektronik digunakan untuk mengatasi masalah ini. Hasil diperoleh dari proses ini menunjukkan keupayaan projek dalam mengesan ketepatan sensor tahap Ultrasonik namun penemuan ini membuat kerja manusia menjadi lebih mudah dan sistem dikendalikan adalah secara automatik. Sistem ini lebih mudah, menjimatkan masa dan menyenangkan bagi pengilang yang ingin memeriksa sensor tahap Ultrasonik. Akhir sekali, projek ini dapat menyediakan tujuan keselamatan dan berfungsi untuk pembuatan dan industri untuk mengesan ketepatan sensor Tahap Ultrasonik

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ABSTRACT

This project is related to the Non-Contact Level Measurement Inspection System control by Arduino with monitoring system using Java program. The main purpose of this designed is to develop an inspection system to inspect the accuracy of an Ultrasonic level sensor as well as detecting the error for the sensor. The system are being design to help out the industry or manufacturing field to inspect the Ultrasonic level sensor as well to overcome the human inspection. The electronic technology are applied to overcome this problem. The result obtain from the process shows the ability of the project in detecting the accuracy of the Ultrasonic level sensor yet this finding makes the human works become more easy and the system is automatically controlled. The system is easier, save time and pleasant for manufacturer who wish to inspect the ultrasonic sensor. Lastly, this projects able to provide the safety purpose and serve for the manufacturing and industry for detecting the accuracy of the Ultrasonic Level sensor

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DEDICATION

To my beloved parents

All my lecturers, especially, Mr. A Shamsul Rahimi Bin A Subki and Mr. Shahrizal Bin Saat

All my friends and relatives

Millions of thanks and appreciates for their supports, encouragements, understands and inspires

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

GUI	-	Graphical User Interface
PC	-	Personal computer
IDE	-	Integrated Development Environment
LED	-	Light-Emitting Diodes
DC	-	Direct Current
AC	-	Alternate Current
UCL	-	Upper Control Limit
LCL	-	Lower Control Limit
PWM	-	Pulse Width Modulation
PCB	-	Printed Circuit Board
LED	-	Light Emitting Diode

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CHAPTER 1
INTRODUCTION

1.0 Introduction

In these modern ere, inspection system has become one of the important tool and essential part in manufacturing field. Inspection system is one of the main consideration for any manufacturer who is looking for an improvement as in the quality of the product. An automatic level inspection system able to help out or assist the human inspection where to enhance the productivity and to satisfy the customer throughout the consistency delivery of high quality product. This machine can perform repetitive task at high accuracy yet high consistency where the error in the manufacturing process are immediately detected. This inspection system able to determine the accuracy of the Ultrasonic level sensor as well as recognizing the error for the sensor yet able to generate report and graph. The level measurement inspection system will be design by using a stepper motor as an actuator to control the level and it is control by Arduino. To increase the accuracy of the stepper motor level, the U shape position sensor is added in to make sure the stepper motor is on the correct position.

Besides that, the Graphical User Interface (GUI) will be develop as an automatic report verification, and graph of actual reading and the sensor reading will be generate. This machine will run automatically where the system will start calibrating from 0 m, 0.25 m, 0.5 m, 0.75 m and 1.0 m, then the actual reading and the sensor reading will be recorded. By comparing the actual reading and the reading on the level sensor, the different of level can be calculated as well as the error. The development of this system is to improve the quality of the product, production,

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increase uptime and reduction in expenses instead of using human inspection. This system ensure that the product will meet the specifications.

This machine will observe the error for the Ultrasonic level sensor automatically where the human inspection system can be overcome. Thus, this type of machine will be need in the market place with high demand since it bring major advantage to the manufacturing area. The entire process flow of this project appears in the Figure 1.1

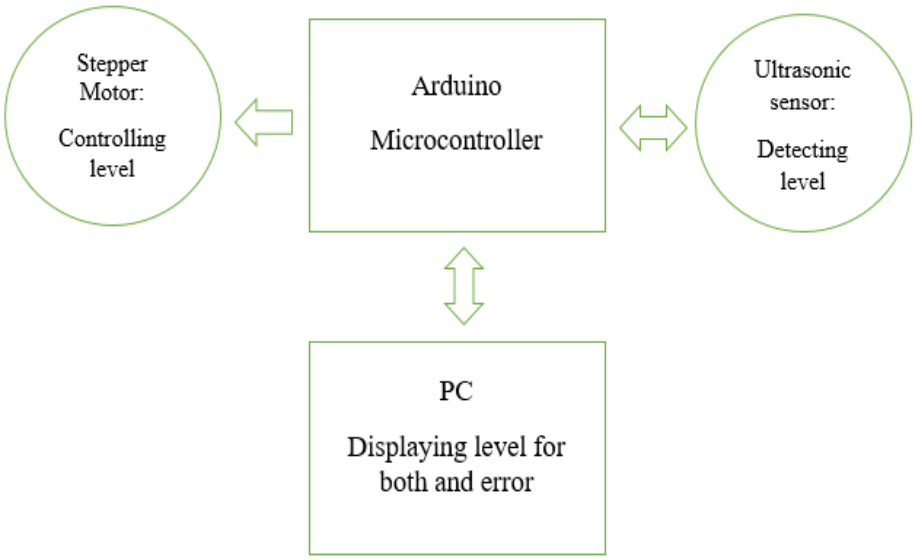

Figure 1.1: Process flow

1.1 Problem Statement

The rise in technologies has increase the production of the level measurement verification and most of it can be used in any industries which the quality control is needed. The main problem that every company having is that it has a wasteful activities to optimize the profitability of the product and services. That is why inspection system is important in manufacturing area.

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Besides that, it is used to overcome the human inspector. This is all because, human inspector cannot maintain a high level of error-trapping for long period of time. It is proven that, within 15 minutes of the start of an inspection shift, the error trapping capability of the inspector can be reduced drastically. The number of errors made will be influenced directly by the complicity of the task. That is why, human inspector bring major disadvantage such as affected by fatigue, cannot maintain long term consistency, need break and rest period from the task, can be slower than a machine and inconsistency between different inspectors [6].

In order to solve this problem, inspection system is built up to improve or secure the information obtained by the company regarding the condition of the sensor being used, the inspection system was build up to test the accuracy of the level measurement verification. Therefore, this project is being proposed where the accuracy of the Ultrasonic level sensor is test using the stepper motor. The stepper motor is act as the actuator where it control the level to be sense by the Ultrasonic level sensor. Then, the level of the stepper motor is being calculated using the formula step per inch based on the rotation. The value of the stepper motor level is then compared with the Ultrasonic level sensor. The measuring level consist of 5 levels, which start from 0m, 0.25m, 0.5m, 0.75m and 1.0m yet each of every level it consist of the U shape position sensor to make sure that the board is on the correct level. Later, the element measure is being display using the Graphical User Interface (GUI). Lastly, graph will be generated based on the stepper motor measured value and the Ultrasonic sensor measured value. This sequence is all control using the Arduino Uno and it works automatically.

The inspection system is an essential component of a critical scheme that bring manufacturing industries toward being leaner and more competitive instead of using human inspection. Inspection must be regarded as an overhead expense because it adds no direct value to the product. The product must, however be inspected to ensure that the quality remain as high as possible. A faulty product which is sold to a customer can do irreparable harm to the company's reputation. In order to improve the accuracy and efficiency of the product, this has led the attention of researchers toward development inspection system. It is important to understand that not all the system

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created equal, some may more accurate and some may not. Experience gained in the USA shows that a human being involve in visual inspection can be expected to find approximately 70% of the total errors on a task [6].

1.2 Objective

The main purpose of this project is to design and create an inspection system which can be achieve the following objectives:

1 To verify the accuracy of the Ultrasonic level sensor using stepper motor control by Arduino.
2 To design, analyse and fabricate a non-contact level measurement inspection system that able to detect the faulty of the Ultrasonic level sensor with low cost.
3 To develop a Graphical User Interface (GUI) to display the measure element and generate graph.

1.3 Scope of Work

This project is aim to develop a non-contact level measurement inspection system using stepper motor and control Arduino. It can give more efficiency in detecting the accuracy of the level sensor without human inspector. This inspection system can be used to detect the accuracy in the Ultrasonic level sensor by creating a Graphical User Interface (GUI) to automatically generate report verification, and graph of actual reading and the sensor reading will be generate as well.

The design of the system is fabricate using the material that have been selected such as stepper motor, Arduino, metal plate and position sensor. The project is to design a low cost inspection system and to use Arduino as a controller to control the

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level of the metal plate using the stepper motor and verify the accuracy of the Ultrasonic level sensor.

1.4 Report Layout

This report generally explain about the design and advantage of a non-contact level inspection system. There will be five chapters that will explain more about this project.

Chapter 1 explain about the introduction of the inspection system and the objectives of the project. Besides that, the problem statement and scope of the project are added on this topic.

Chapter 2 compiles the literature review, generally on the existing projects and components that used in this project. This part concentrates on the theory of all aspects of the inspection system. Sources from journals, books, thesis and website that covering all the information connected to the project are included.

Chapter 3 describes the methodology of the project on the design and simulation part. This part concentrates on the procedure to execute the project from the primary design until the end. Strategy and time management are presented in this part. The project's ghant chart for this semester also added here.

Chapter 4 gives some prior results and discussion of the current work. This part talks about few findings and issue that being noticed during the simulation method.

Chapter 5 draws the conclusions of chapter 1 to chapter 5. The conclusion and recommendation will be concluded here.

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CHAPTER 2

Literature Review

2.0 Introduction

This chapter will discuss the method and concept that will be used in this project based on the information and the sources that obtained from books, journals and website. This section basically guides for preparing the entire report content yet the study on existing inspection system on ultrasonic also carried out in this chapter to assess the characteristics of an inspection system and to be taken as a reference.

2.1 Non-contact level sensor

In industries, sensor are widely used in detecting an object or a situation of a system. The sensor play an important role in many industry and it can be say that it is very difficult to identify the condition of certain process without the usage of sensor. For example, the sensors sense the existence of an object and it actual parameter of interest to complete various task such as for placing and picking up an object. Nowadays, the rise in technology has led toward the increase of production in different type of sensor which consist of the pressure sensor, level sensor, and temperature sensor and so on. The sensor come with two type which consist of the contact and non-contacting type where the contact type are more to detecting the change in position, force, acceleration and touch while for the non-contacting type it measure more on the presence and distance[1]. This project will cover more on the non-contact level sensor

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yet will be focus on Ultrasonic level sensing due to the main objective is to build up a non-contact level measurement inspection system.

A non-contact level measurement sensor is normally direct to a height detection of a material as in solid or liquid in a closed or open container in any industrial production [2]. The level measurement has become of the most often discussed topic recently due to it important role in various application such as food industry, pharmaceuticals, chemical industry and power generation. On the other hand, the rise in manufacturing field has led to increase the production of level measurement sensor where the reliability of the level measurement can measure the water level in certain process. Basically, there are two types of liquid measurement system that have been developed which consist of the continuous level measurement and the point level measurement, whereas the data acquisition way to measure is based on the radar, electro-mechanical, capacitance, ultrasonic and optical [3].

2.1.1 Type of non-contact level measurement

Non-contact sensor are a very important type of sensor where it detect the detail about the environment of the object. It is widely used in detecting the distance or existence of an object. It consist of 6 types of non-contacting sensor as shown Figure 2.1:

1) Ultrasonic sensor
2) Optical sensor
3) Magnetic and inductive sensor
4) Capacitive sensor
5) Air pressure sensor
6) Resistive sensor

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Figure 2.1: Type of non-contact sensor

2.2 Inspection system

An inspection system is one of the most needed part for any manufacturer. The term inspection can be review as the action of analyzing the items and whether it is meet the requirement of the design specification. This machine able to assure the good quality and reject the default product. On the other meaning, the inspection means by the poor quality product is analyses and the good quality is assured in product. The improvement in technology has updated the inspection equipment to overcome the problem that on using traditional method. This is because, the traditional method tend to increase the manufacturing lead time and increase the production cost. In addition, there is slightly delay in detecting an out of control limit. Thus the product produce is not meeting the requirement and increase the cost of scrap and rework [5].

There are two type of inspection system:

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2.2.1 Visual inspection system

The visual inspection system is one of the technique for quality control where the information is obtained and being investigate. Visual inspection normally work as a part of support of office, which it assess the gear and structure utilizing or all of the human faulty. For example, the hearing, touching, vision and smell as well as any non-specific examination. The visual inspection system tend to work with a video camera for data collection and a computer and software for data analysis [6]. The table 2.1 below list the advantage and disadvantage of the visual inspection system.

Table 2.1: The advantage and disadvantage of visual inspection system

Advantage	Disadvantage
• Can be reprogrammed off-line on another machine	• Software must be carefully implemented and choose
• Does not get tired and can work 24 hours per day	• Lighting condition must be well design and implement
• Maintain consistency of inspection	• Has no real intelligence :follow rules
• Average speed higher than human being	• Does not emulate the human inspection
• Easily adaptable to inspect different product	• Intolerant of component variation on product

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