Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF EDDY CURRENT SENSOR TO DETECT DEFECT ON METAL

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours

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DEVELOPMENT OF EDDY CURRENT SENSOR TO DETECT DEFECT ON METAL

DANESH S/O G.M GUNALAN

A project report submitted
in partial fulfillment of the requirements for the degree of
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DEDICATION

To my beloved my beloved lecturer and also
My family member. Not forgetting my fellow
friends

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ABSTRACT

Eddy current basically use in heavy industrial company. It is very useful to human because it can identify very small crack with precise. Besides that, many methods are practice in my industry. This method gives us precise information regarding to the material we are using. Eddy currents (also called Foucault's currents) are loops of electrical current induced within conductors by a changing magnetic field in the conductor according to Faraday's law of induction. Eddy currents flow in closed loops within conductors, in planes perpendicular to the magnetic field. The objective of this project is to detect crack and defect using eddy current sensor. After that, to create low budget eddy current testing NDT equipment. Arduino been used as a microcontroller. Through this we can measurement the eddy current with aid of the current sensor. We analyse the data and compare the result.

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ABSTRAK

Eddy current pada dasarnya digunakan dalam syarikat industri berat. Ia sangat berguna bagi manusia kerana dapat mengenal pasti keretakan yang sangat kecil dengan tepat. Selain itu, banyak kaedah yang diamalkan di industri berat. Kaedah ini memberi kita maklumat tepat mengenai bahan yang kita gunakan. Arus Eddy (juga disebut arus Foucault) adalah gelung arus elektrik yang disebabkan oleh konduktor oleh medan magnet yang berubah pada konduktor mengikut undang-undang induksi Faraday. Arus Eddy mengalir dalam gelung tertutup di dalam konduktor, dalam bidang yang berserenjang dengan medan magnet. Objektif projek ini adalah untuk mengesan keretakan dan kerosakan menggunakan sensor arus eddy. Selepas itu, untuk membuat peralatan NDT pengujian semasa eddy bajet rendah. Arduino telah digunakan sebagai pengawal mikrocontroller. Melalui ini kita dapat mengukur arus eddy dengan bantuan sensor arus. Kami menganalisis data dan membandingkan hasilnya.

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LIST OF SYMBOLS

□	-	Voltage angle
□	-	Voltage
□	-	Load
□	-	Ampere
Ω	-	Ohm
D	-	Diameter
	-	
	-	

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LIST OF ABBREVIATIONS

□□□ - Voltage
□□&□ - Gage Repeatability & Reproducibility

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CHAPTER 1

INTRODUCTION

1.0 Introduction

In this twenty centuries it almost so difficult to find affordable eddy current testing device in Malaysia. Mainly huge industry such this such aviation industry, metal manufacturing industry, welding inspection for almost everything in our main industries use this technique to detect the faulty. More than that, this project does not really use in one industry but uses in almost all industries and focus on basic eddy current techniques. This invention is made because human can't really see-through naked eyes to inspect the defect cracked material. Human eyes can't able to see small objects, their capabilities to see small through eye sight is 0.04mm. In this case human really analyse the object well. In Additive Manufacturing of Near Net-Shape Parts, Automated Defect Recognition as a Critical Element of a Three-Dimensional X-ray Computed Tomography Imaging-Based Smart Non-Destructive Testing Technique (Istvan Szabo, Jiangtao Sun, Guojin Feng, Jamil Kanfoud, Tat Hean Gan and Cem Selcuk, 2017).

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The principle of the eddy current is basically use to sense the current displacement. The eddy current creates a loop within the conductor and spreads the magnetic field. Across the conductor, the magnetic field shifts or alters. Otherwise, eddy currents would form. The electromagnetic magnet will pass the magnetic field all-over the conductor

and create eddy currents. The magnetic field have to go wide in order to complete the flow if there are any obstacles.

The disadvantage of human to identify the defect in metal are the reason why I had to develop this project as my final year project. Human naturally can see tiny particles at 0.04mm maximum, so human cannot see tinier than that range. This will be affecting their work that they doing it. Moreover, this project will help human to perform on their work and solve problem. From my researcher I found that eddy current sensor tools are using in industry quiet high range in price. This eddy sensors used mainly in big companies and not user friendly as well because of that specially trained people will used this sensor.

1.1 Problem Statement

Crack or defect that may happen to a metal object are the main problem to a human because when they look at through or made an inspection at the metal object, they will not see the crack to their naked eyes and its must be inspect by a machines or tools. We need a perfect tool require to inspect the crack metal.

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Firstly, the first problem to doing this project are human eyes cannot detect any crack because of human limitation. Moreover, the eddy current sensor is usually selling high price in market. Lastly, without testing, a part of the metal is in poor condition. Sometimes it's tough to tell the difference between a crack and a non-crack in metal composition.

1.2 Objective

- To detect crack and defect using eddy current sensor

• To create low budget eddy current testing NDT equipment

• To identify the value between crack and non-crack of 3 types of metal

1.3 Scope

•Tell the difference of crack and non-crack value on metal by using ESP 32

• Using copper wire to build a coil and working as a sensor

•Use 3 types of metals as a testing material

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CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter we will speak about the elaboration of the recently designed project. The literature review overviews were compiled from a variety of sources, including informative posts, reports, and other sources. Writing for this chapter were going to 3 principal themes using measurement techniques such as sort of non-destructive testing used to discover metal cracks and the coil construction.

2.1 Detect Crack using Non-destructive testing (NDT) technique

Non-destructive (NDT) is the most technique uses in some heavy industrial it is because this method doesn't harm the structure. As a result, even after the test, the piece of construction may be used. Non-destructive testing is recognized from non-destructive (NDE) this method not only measure the defect but also used to measure size, orientation and shape. Moreover, this technique doesn't reduce the strength of the object. Non-destructive testing known as composite imperfections, commonly used in our daily lifestyle. For example, radiography, ultrasonic, magnetic element, visual review, penetrant testing and eddy current are mostly used in NDT techniques. All these techniques are used to different application. There many types of method are available for NDT of strengthened, so we have to make a decision according on which techniques gives precision, good strategy and the cost. This is made to identify the properties of defect in materials or precisely to identify the position shape and size. (Aditya, Parida 2016).

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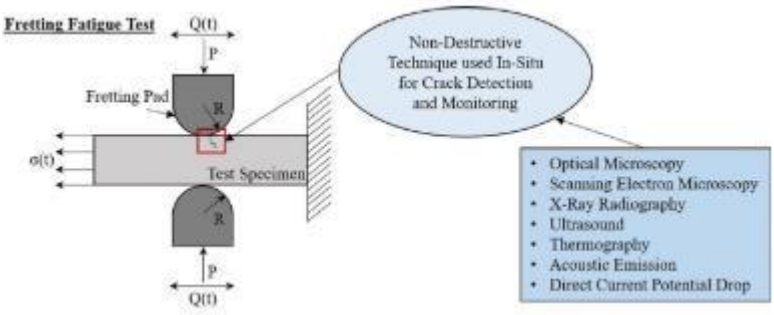

Figure 2.0 shows the advantage of Non-destructive techniques (Kong, Y Bennett, C J Hyde, C J, material and design 2020)

2.1.1 Crack detection using ultrasonic sensors

Ultrasonic sensing is one of the ways which is non damaging testing method, it basically flows the ultrasonic waves into the object or material. Uses in almost normal test applications. It uses ultrasonic pulse with frequency of 0.1-15 MHz and can go up to 50MHz.This frequency basically transmitted to the material to identify the defect on it. These can perform in various type of material. For example, steel, gold and various type of metals. Some number of manufacturing company use these techniques and utilize it on the development, metallurgy, production, car, aviation and others.

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There is project based on ultrasonic sensors, this project created to detect crack on the railway track. This ultrasonic sensor can detect 3 major part such as blowholes and porosity in metallic pipes. The ultrasonic sensor works on the principle of wave reflection. By observing the time interval between reflected beams, the flaw can be observed. The GPS module and the ultrasonic sensor are used to determine the distance and exact position of the crack. GSM are basically a best communication to used. After locating the crack, a message with the split area is sent to the nearest station. This system is simple to use in activity and is useful for sunshine and midnight break exploration. (Nagdevte, Zakir, Muley, & Shelar,

2017). Besides that, previously some projects were made used this sensor and the technique was to investigate a wave using a amplification test through the path that included surface waves with a low recurrence. Moreover, impedance of multiple directed waves provokes perplexed sign comprehension, the results of the initial analysis of plates were dependent on thickness (Titus, 2016).

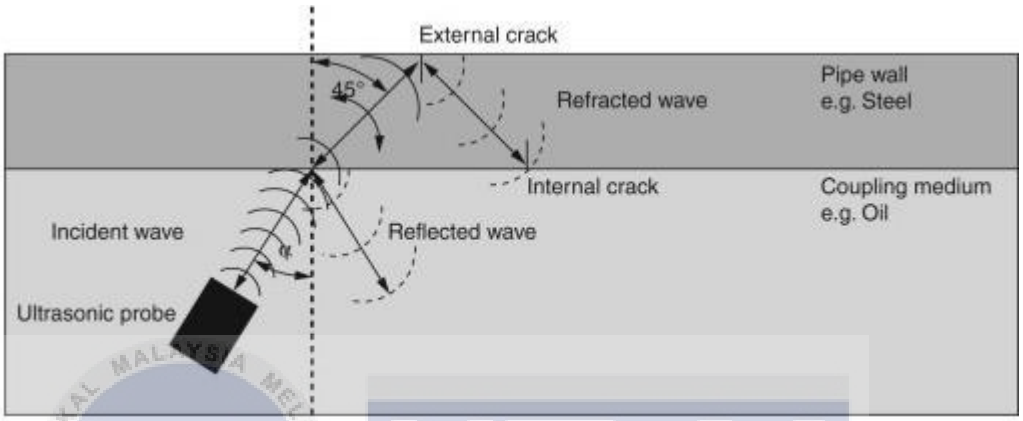

Figure 2.1 shows the ultrasonic testing for crack detection (S. Brockhaus, ... D. Storey, in Underground Pipeline Corrosion, 2014)

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2.1.2 Using Radiography to detect crack

This radiography develops to detect fine cracks in concrete. To inspect materials for installed imperfections, this method used a high recurrence rate, radiation emitted with a low amplitude emitted by a radiation source. Application to the analysis of material substances paved the way for modern radiography's development and advancement. The goal of radiographs is to identify the distribution of shortages or other assistant discontinuities in the inspection.

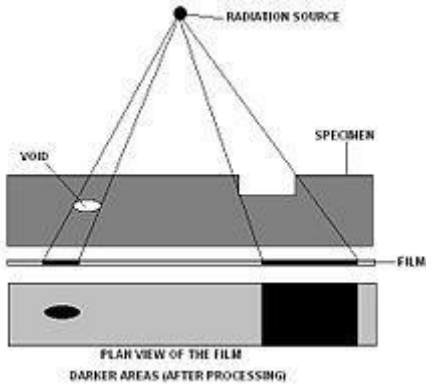

Figure 2.2: The view of radiograph testing

Radiographic analysis has a few drawbacks. Radiant moves in horizontal lines from its origins, catching the film at almost perfect boundaries. This makes competent experimenting with sophisticated computations impossible. Similarly, the data to be acquired from a radiograph or plate is differential preservation of radiation observed in thickness contrasts. Data loss or inaccuracies are common since these depth evaluations must be coordinated in all kinds of reasons perpendicular to the orientation in which the radiation is released a trip. Instrumentation (Instrumentation, 1980)

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2.1.3 Use image processing to evaluate defects

This automated identify crack and the defect through image processing is one of the best techniques using all over world today. This technique is more important for the NDT combine with the comprehension of the evaluate. Example can be with light. There will be easy to detect image-based defect in NDT. After this all the measurement record as aphoto, some of the defect can be identified, for example shape and size of the defect and also uneven lighting and etc.