AN IMPROVEMENT TO REDUCE MISDETECTION OF ARC AND SPATTER IN WELDING PROCESS BY IMAGE PROCESSING

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SUPERVISOR DECLERATION

I admit that I have read this report and it has followed the scope and quality in partial fulfillment of requirement for the degree of Bachelor of Mechanical Engineering (Structure and Materials)

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AGREEMENT

"I agree that this report is my own work except for some summaries and information which I have already stated"

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ACKNOWLEDGEMENT

All praises to the All Mighty Allah with His permission, I managed to carry out the study with His blessings of health, opportunity, knowledge.

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ABSTRAK

Projek sarjana muda ini dijalankan untuk mengenal pasti dan mengelakkan kekeliruan antara percikan(spatter) dan sumbar cahaya kimpalan dalam sistem kimpalan robotik. Ini kerana jika terdapat kekeliruan di dalam sistem, sistem tidak akan menghasilkan kimpalan yang baik kerana garisan kimpalan akan berubah.

Dengan ini, karakter sumber cahaya kimpalan dan percikan kimpalan hendaklah dikenal pasti terlebih dahulu kemudian menggunakan perisian, Matlab, sebuah aturan baru akan dihasilkan untuk membezakan percikan dan sumber cahaya kimpalan dan secara tidak langsung, sistem robotik kimpalan akan diperbaiki.

ABSTRACT

This Projek Sarjana Muda have been conducted to determine and to avoid misunderstanding between spatter and arc welding in welding automation. This is because if there is conflict in the system, the system will not be able to produce good workpiece because the welding line will be affected.

Due to above matter, the character of arc welding and spatter will be studied. Then by using the software, named Matlab, a new algorithm going to be write to differentiate between spatter and arc welding in order to enhance the quality of welding automation welding.

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CHAPTER I

INTRODUCTION

1.1 BACKGROUND

Automation in either small or big industry nowadays is commonly been used. It can be use as arranging, conveyor, assembly, testing, packing and also as a testing method. It is widely use as it such a systematic and it is an ideal system nowhere.

In welding industry, before this, human power is needed to make a joining. But as time pass by, the skillful worker are decreasing and difficult to find. Other than that, people are now seeking a clean and more comfortable job prospectus as a welding job is quite a dangerous job. Beside, it also impossible for a human power to make a continuous welding job for the whole day. It might lead to defect and loss in quality and going to be costly later on.

To overcome this problem, engineer had come out with an idea to apply the automation technology in welding prospectus. This system able to produce such a large quantity continuously, decrease the working time and, it will increase the productivity. In term of cost, the industry need to buy the expensive automatic welding machine but when looking in the long term, it is a great saving rather than using a human power who is need to be trained. Besides, human power cannot be continuously use 24 hours per

day and seven day a week just like a machine. Time also can be save when this term is to be taken to calculate.

1.2 OBJECTIVE

The objective of this thesis is to come out with a new system in welding automation that can detect welding line and spatter. The system can differentiate which is welding line and spatter in order to decrease the percentage of line welding spoil due to cannot recognize the real welding line.

This project used to find a method that can reduce spatter effectively which can block the detection of visual inspection in automatic welding. The system is going to use the basic concept of image processing algorithm which is going to separate spatters and welding line from the welding image that have been taken from high speed camera. The complete configuration system going to apply to a automation control system of welding.

1.3 SCOPE

This study of this project will consist of:

- the literature review of the related studies
- Matlab™ software as platform to built a program
- use and modified the algorithm in image processing as a subject to detect a visual
- to be use in automatic welding
- testing of the complete program

1.4 PROBLEM STATEMENT

The new improvement in welding industry is such a glorious when research about optimization of welding speed and the welding current is successfully done.

In automatic welding, it will be in scope of welding speed, welding current and welding line. But from these specifications, even though it is correctly tune, it will still produce spatter. The problem will occur when the automation program cannot recognize between the real welding line and the spatter. Due to this, the torch will read the spatter as the next welding line and it will ruin the workpiece.

So this project will solve the image separation and image recognirion as accurate as possible by using CCD camera to capture welding image and make a program to be apply on it by using Matlab™ software.

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CHAPTER II

LITERATURE REVIEW

2.1 WELDING

There are tons of welding type exist today, such as MIG, arc, gas, tap, and many more. In this project, the type of welding that going to be discussed is arc welding.

Fusion welding process which use electric as heat source is called arc welding. It uses heat for fusion because more effective fusion can be generated, concentrated, and controlled.

Arc in arc welding is create between an electrode and workpiece at different polarities. The arc emits electrons and positive ions from the electrode and also from the work piece. As both electrons and protons accelerate between both sources, it will produce heat and it will convert to kinetic energy as it collides.

The electrode can be use as permanent, serves solely as a source of both electrons and protons or being consumed as it will be both as energy for welding and also as a filler to the weld joint.

Welding can be separate into two groups[1]:

- nonconsumable electrode arc welding processes
- consumable electrode arc welding processes

2.1.1 Consumable electrode arc welding processes

There are six types of consumable electrode arc welding:

- Gas-metal arc welding (GMAW)
  - The consumable electrode produced arc with the workpiece made of electric circuit and provides filler to the weld joint. The wire is fed to the arc automatically by using push and pulls types.

- Shielded-metal arc welding (SMAW)
  - Metal combine is by the heat source from the heat from the electric arc that maintained the tip of flux-coated, discontinuous consumable electrode and the surface of the base metal being welded. The core wire supply current from constant power supply to the arc and provide most of the filler to the joint.

- Flux-cored arc welding (FCAW)
  - It is similar with SMAW just the gas and the flux keep in the core of a roll formed and drawn tubular wire.

- Submerged arc welding (SAW)
  - The arc and molten shielded by a cover of molten flux and a layer of unfused granular flux particles. As the electrode is buried in the flux, relatively it is clean and free of radiation of heat.

- Electrogas welding (EGW)
    - This welding process work on inert gas shield to joint enclosed with coolant, shoes and backing plants.

- Electroslag welding(ESW)
    - The energy melt the base metal and filler produce by a molten bath of slag that is resistance heated by the welding current. The arc only been use to melt the flux at the early process hen being struck at the bottom of joint.

2.1.2 Nonconsumable electrode arc welding processes

There are six types of nonconsumable electrode arc welding processes

- Gas-tungsten arc welding (GTAW)
    - The tungsten electrode is to create an arc at the workpiece which the electrode shielded with inert gas to prevent electrode from degradation.

- Plasma arc welding (PAW)
    - This type of the same with GTAW but the different is at the converging action of inert gas at the orifice of the nozzle of the torch. With these changes it has advantages at energy concentration, higher heat content, stability, welding speeds and penetration capability.

- Carbon arc welding (CAW)
    - Had been rarely been use anymore

- Stud arc welding (SW)
    - Specialized in attaching thread or unthread studs to structures.

- Atomic hydrogen welding (AHW)
    - Had been rarely use anymore

- Magnetically impelled arc but (MIAB)
    - This is a welding process that apply forging and need pressure to complete the welding and yet the rapid and clean and also reliable.

2.2 SPATTER

Consumable electrode arc welding need the molten metal from the electrode drop at the workpiece providing filler besides simply heat and melt the substrate [2]. The transfer should be transferred effectively to the point with minimal loss due to the spatter. To get better understanding before explaining of how the spatter exist, first take a look at the Figure 2.1. It is the welding arrangement and show how the spatter can exist.

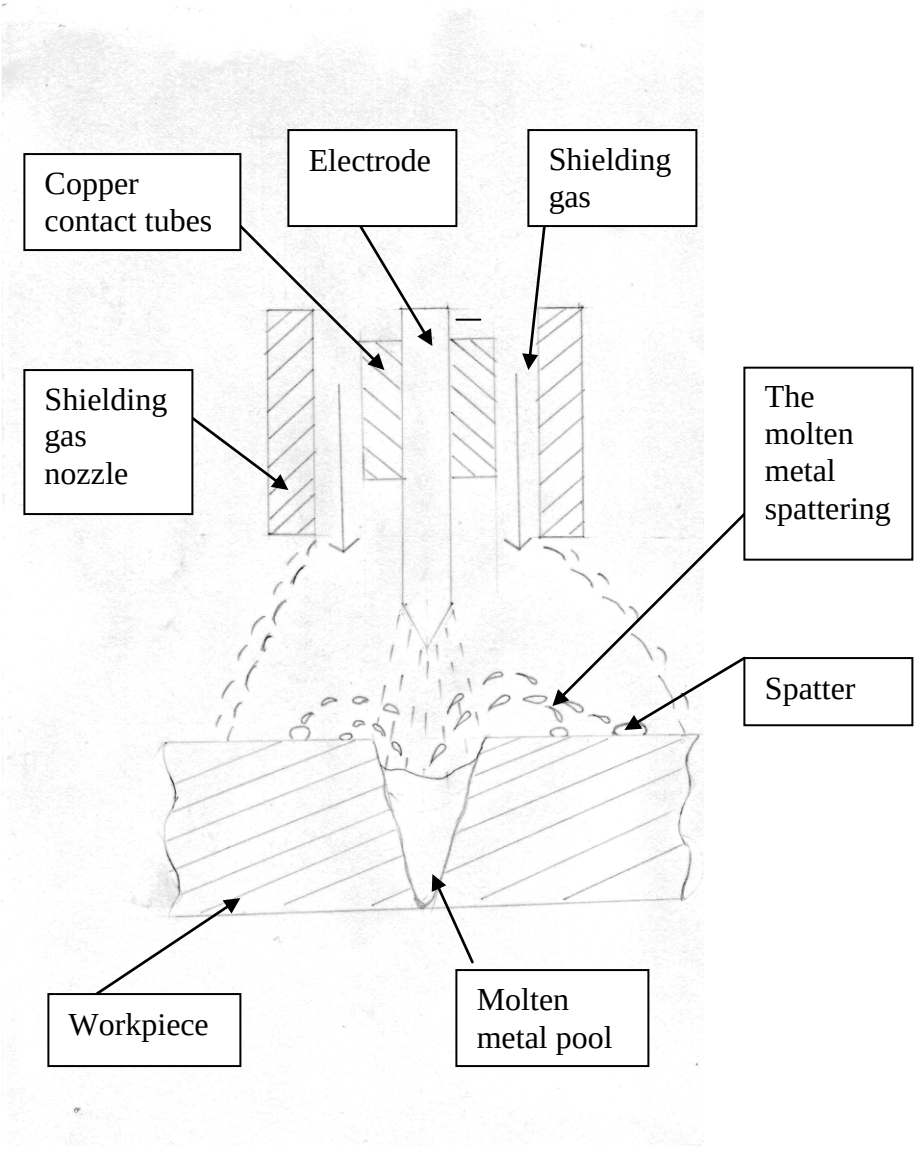

Figure 2.1: Schematic diagram of GTAW and phenomenon of spatter happen

Spatter simply can be classified as molten metal from the consumable electrode that fails to drop in the weld pool and spatter around the workpiece. In figure 2.2, is the example of spatter existence at the motorcycle chassis. It label there which the welding line and which is spatter for clearer image of what is spatter.

Spatter can exist for some factors. One of the factors is related to ampere and voltage. It can happen when the voltage is too low for the wire or gas combination. Besides, it could be also happen if the ampere supply too high. When this happen, the arc electrode too cold and the electrode will stub and this will make it droplet and it will spoil if it drops at the workpiece.

Besides, by using some type of gas in gas-metal arc welding (GMAW) such as CO_2, it will increase the energy but it will create more spatters even tough the cost will be reduced.

Other than that, spatter generated from MIG and MAG are classified as it were generated when the short circuit released, droplet in arc contact to the pool time is way to quick by the time short circuit happened. By the expansion and explosion gas, and also when the gas released from the weld pool, the spatter will also been created.

Spatter is troublesome as it will[3]:

- Stick to work piece and tool.
- loss of material from the arc and weld
- Disturbing the welding wire and welding line.

Therefore, it is very important to remove the spatter from the workpiece that adhered the surface for in term of cosmetic reasons, fitting, and also degrade fatigue resistance.

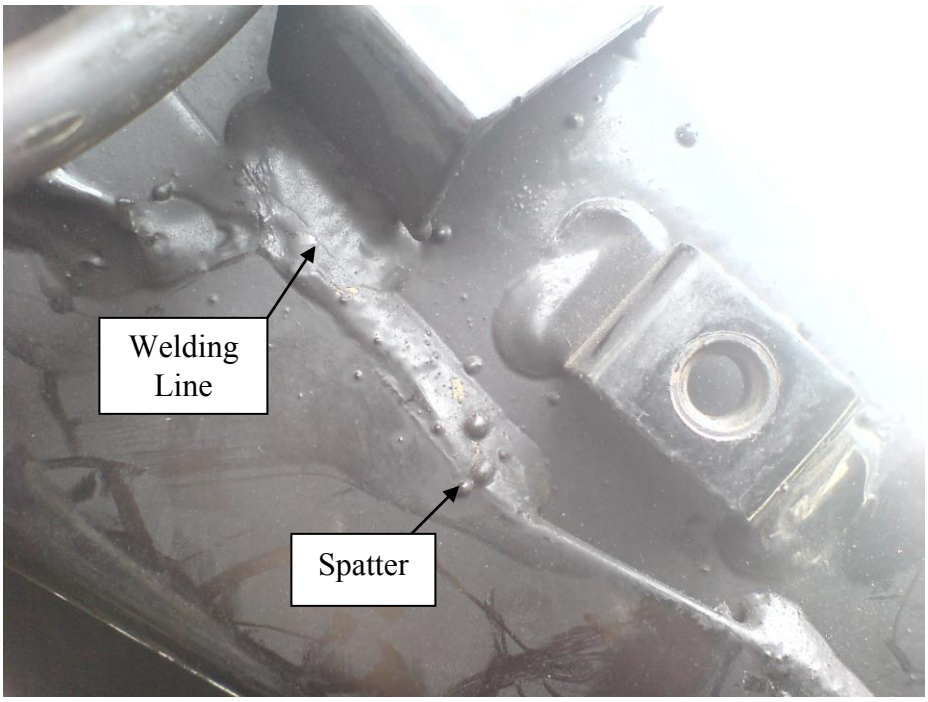

Figure 2.2: Picture of welding at motorcycle chassis have spatter

2.3 MATLAB

In this project, the software that used to do the algorthm for image processing is Matlab.

MATLAB actually stand for MATrix LABoratory. It is a software for high performance numerical computation and visualization providing with interface environment, tons of functional to be use in technical computation, graphics, and also animation [4].

With high level programming language, Matlab still easier then to be compared to other software like C++ and Fortran because it does not need to declare the variables, specified the data and allocate the memory.

It provides suitable usage in algorithm development, data visualization, data analysis, and numeric computation. MATLAB is a basic language block which is based on matrix and the fundamental data type is an array. This MATLAB almost do not have to declare the dimensions of matrix because the built in functions are optimized for vector operations.

Therefore, this software is going to be use for this final year project that going to separates and defines some objects in images as it also widely use in image processing, signal, control design, and also test and measurements[5].

Besides that, it is suitable to use for algorithm development and data visualization. Which are suit with this project process. Other than that, it also contains data analysis, and numeric computation.
Basically, built in function of MATLAB can be divided into four groups:

- Graphics
- Computation
- External interface
- Toolboxes

For MATLAB basics, it can be divided into few parts[6]:

- Matrix declaration which cover simple declaration, null matrix, scalar and vector matrix, and also random and identity matrix.
- Matrix arithmetic are addition, subtraction, multiple, and division.
- Matrix manipulation which involve address individual element, complete row and column address.
- Saving and loading data.
- Concept of function and m-files
- Concept of path

2.4 IMAGE PROCESSING

Image processing basically is a signal processing image. The input and the output of the image processing may become an image or a characteristic or a parameters. As in MATLAB, there are 2-dimensional and 3-dimensional, in this image processing, it usually do in 2-dimensional signal and then it will be process by using signal processing method.

Image processing is widely use in this world[7]. For example, these are few that been use using image processing, through out nowadays:

- automatic visual inspection system
- remote sensing scene interpretation
- biomedical imaging techniques
- robotic arm welding
- robotic arm
- face detection camera
- security system

One of the built in functions in MATLAB is toolbox and among the toolboxes functions, there are one of it called image processing toolbox.

This toolbox comprehensive set of reference standard algorithms and graphical tools for image processing, analysis, visualization and algorithm development. It can perform image enhancement, feature detection, noise reduction and image segmentation and registration and also spatial transformation [8].

It includes ICC-computational colour, high dynamic range, and gigapixel resoulution. Besides, this toolbox will explores the image, examines the pixels, adjusting