

Survey on Automatic Welding System

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ABSTRACT: Automation plays powerful role in many fields. Automation in welding has grabbed significant role in industries since last few years. This paper introduces various methods used to automate the welding process used in industries. The methods may be generalized or specific for a job depending on the requirements. The cost factor also plays a major role i.e. it will vary according to the degree of automation used in the process. A fully or generalized automatic welding process will be much more expensive than a process which welds a specific job. Thus, this paper reviews description of different algorithms for automated welding process.

KEYWORDS: Automatic welding, Seam Tracking, PLC, Robotic Arm, Arduino.

I. INTRODUCTION

Welding is a process of joining two metals in the presence of suitable amount of heat with or without application of pressure. Welding is responsible for permanent joints. Conventionally, there was manual process of welding in industries but with time in order to increase productivity, accuracy, safety and many more parameters automation was introduced and has been increasing since. Human welders have been replaced by robot welders as it gives maximum throughput as well as they have a greater accuracy. But automation in industries is expensive thus, only large scale industries are able to implement it in their plants but now-a-days it is possible to build an automated welding system of low cost by using various strategies. Various algorithms have been developed to automate process of welding in order to achieve maximum advantages.

II. SEAM TRACKING IN AUTOMATIC WELDING SYSTEM

A. Machine Vision System

Interpretation of an image of scene or an object through use of optical non contact sensing mechanics for the purpose of obtaining information and controlling processes or machines is called as machine vision.

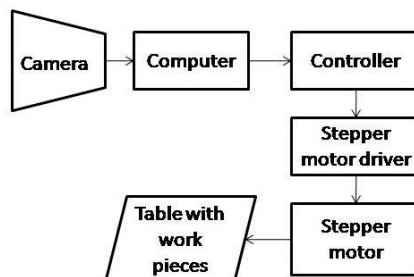


Fig. 2. Block diagram of vision based welding system

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In machine vision system camera and controller plays an important role. Camera is used to capture image of worktable with workpiece on it. After capturing of image in camera controller is used for computing position, dimension and orientation of workpiece. Then controller controls the electrode based on calculations. In this way welding can be done accurately.

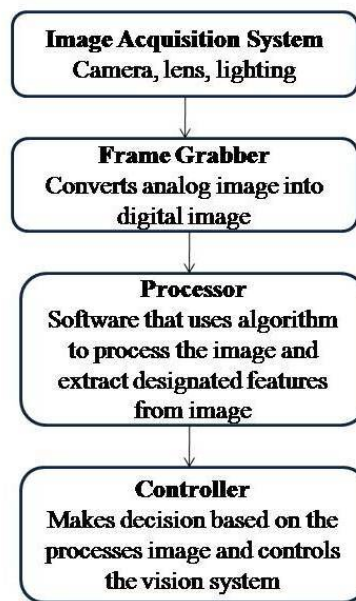


Fig. 2. Anatomy of machine vision

In workflow of system first step is to calibrate and initialize camera. Next step is to bring the electrode at initial position. After initialization of system image of scene is captured. Processor processes captured image and then position and length of the weldline is determined. Final step is to actuate the electrode, where controller guides the electrode to move along weld line and then welding is done. After completing welding, electrode is brought back to its initial position. Image processing is one of the important step in the process as controller can make decisions on based of processed image. In image processing captured image is converted into a binary image by selecting a proper threshold value. In this processing weld line is converted into black pixels and all other parts of the image are converted into white pixels.

The image is then complemented and to remove the noise in an image morphological operations are performed. In this way to reduce weld line to single pixel skeleton of image is obtained using image processing and all pixel information gathered is given to controller so that it can control the electrode accordingly. Due to use of image processing system becomes flexible.[1]

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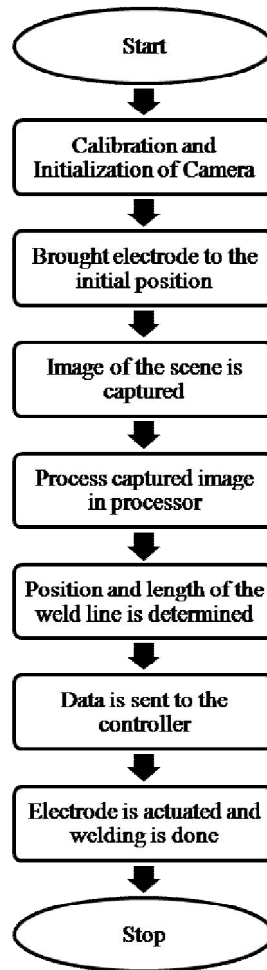


Fig. 3. Workflow of the system

B. Weld tracking Based on Artificial Vision

In this algorithm welding system based on laser vision technique is explained. The design can run in a low performance computer, and off the self-components (webcam and laser). For the automation of welding processes in heavy industries, a laser-stripe system is presented in this paper.

Capturing an image is first step in this algorithm; these images contain the information about the laser projected onto the work-piece. Then images are filtered to remove noise. Webcam takes images every 250 milliseconds so that it can obtain information about the welding groove. The next step is shape recognition. Image processing algorithm is used for analysing and interpreting the image. Shape recognition is followed by filtering of data to eliminate noise. Here in this paper median filter is used for filtering because best results can be obtained using median filter. As webcam is located ahead of the welding head there is distance between webcam and the welding head, So there is time difference between the moment at image is captured and time at when the image corresponds to the groove below the welding head And hence before the final actuation takes place we need to recalculate coordinates of the welding head After Data Recalculation Algorithm is implemented algorithm for final actuation takes place. This system is very flexible as even when the welding gap geometry strongly varied or is distorted by noise still system can perform satisfying seam tracking.[2]

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C. Welding Path Motion Programming

Motion is specified by input image files to simplify interactions between an engineer and a robot when setting up the autonomous operation. Automated code is generated which orders the welding tip to move along the path specified by the input bitmap image which is transmitted via internet by the remote computer vision system.

The process of extracting the information from the binary image mainly takes place using the Algorithm which mainly works on two steps namely tracing and arc approximation.

1.Tracing step: A Binary image of the original coloured image is obtained and the desired contours can be specified using black and white colours which is done by an engineer during the adjustment of the technological chain remotely using the computer vision system, thus with the help of Moore-Neighbour tracing algorithm an array is formed with all the coordinates of the neighbour black points of the input binary image.

2.Arc Approximation step: all the coordinates obtained from above step can be used for point to point welding but if the number of coordinates is large then it causes overloading of the controller also the speed of the welding arm decreases as the robot reconfigures its position at each reference level. Thus to overcome this problem arc approximation technique is used, which considers the movement along an arc considering only three points to increase the speed and decrease the code size

III.PLC BASED AUTOMATIC WELDING

A. For Circular weld track

It consists of an algorithm which is used to automate a welding process in which a knuckle bracket is welded on a circular shaft of the shock absorber. The PLC is used as a controller. It basically consists of three main blocks: SPM (Special Purpose Machine) Block, Control Block and HMI (Human Machine Interface) Block.

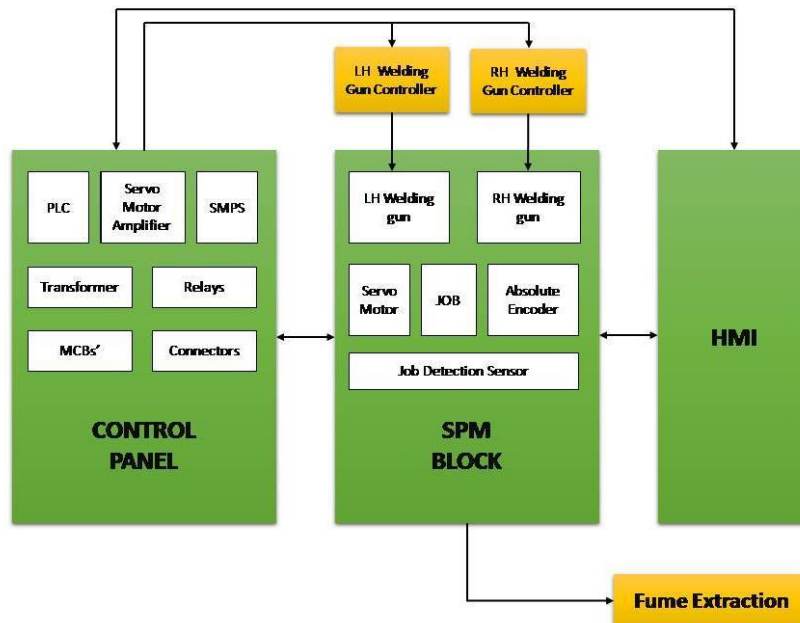


Fig. 4.Architecture

SPM Block consists of job, left and right welding guns, servo motor, absolute encoder and job detection sensor. The job is placed in the SPM Block and a job detection sensor is used to sense the presence of the job. The servo motor is connected to the job and it is used to rotate the job as per requirement. The absolute encoder counts the number of rotations of the shaft. There are two modes: Auto and Manual mode. In the manual mode, the operating parameters can

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be set manually using HMI and it can be used for system testing purpose. While in Auto mode, everything is done automatically. The job placed is detected by the job detection sensor, then the PLC controls the guns and they start moving forward. The servo motor starts rotating the job and this rotations are monitored by the encoder and send this information to the controller. When the required angle is reached the process is terminated and the guns move to their initial position.[4]

B. For Linear Track

The process of welding the bus body frame is automated in order to increase the production as well as reduce the safety issue. The robot mostly takes a linear path for welding by using PLC and FANUC program. Also, the strength of the weld produced by this method is more than that achieved by manual arc welding process. MIG welding is used to achieve so. The robot is placed near the bus body frame and the servo motor is programmed such that the weld-gun moves along the weld path. As the motion required is linear, the rotary motion of the servo is converted into linear using a rack and pinion setup. The welding gun along with feed wire unit inside it is placed at a distance of 1.5mm away from the frame. A pneumatic pump is used to push forth and back the welding gun from the frame.[5]

Advantages:

1. Increased production.
2. Less time consumption.
3. Better safety.
4. Improved and consistent quality
5. Increased productivity
6. Reduction in consumables
7. Less man power is requires

Disadvantages:

1. Complexity is high.
2. Can be used only for specific job Designs.

IV. MULTIPURPOSE ROBOTIC ARM

This topic includes design and construction of a robotic arm similar to a human arm which can be used for various purposes such welding, gripping spinning, etc. The Arduino Uno R3 is the controller used to control the motion of the arm. Servo motor and stepper motor along with L298D driver is used to rotate the arm. A sonar sensor SR04 is used to detect the position of the object to be operated. [6]

The algorithm is as follows:

- I. Scan the position
- II. Get the position
- III. React according to the position
- IV. Take to the destination
- V. Return to the initial position

Advantages:

1. Servo is used for functioning and hence the arm can be rotated from 0° to 180° . By coding the arm can be rotated with any angle between 0° to 180° .

Disadvantages:

1. With increase in load the current consumption increases. Thus, the power required will increase.

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V. CONCLUSION

This paper represents different approaches for automation in welding. Some algorithms presented above are capable of performing welding on any type of a job and some of them are for specific job. Systems which are designed for generalized welding has complex algorithm as it has to take into account all the parameters such as dimension, position and orientation etc. Large investments are required to build such systems. To build system for specific job we don't require such complex algorithm and such systems are inexpensive as compared to generalized robot welder. Digital image processing plays an important role in automatic welding system, it helps in seam tracking.

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