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Automatic Continuous Robotic Arc Welding

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Abstract: **Every industry need the Welding operation. Welding is the major reclamation for automotive industry for any branch of engineering. In this era the Robotic automation systems are used in the industries to replace human work force for arc and spot welding. The most beneficial thing is the productivity is increases with high quality and high efficiency. Also there is reduction in physical damage of worker and accidents. This paper is explaining the detail of Automatic Robotic Welding for Arc Welding and Spot Welding. The Robot gives accurate output with minimum time spam and there is the no need of human presence due it has facility of giving command to complete particular number of objects to be weld.**

Keywords—Autmation,SCADA,Roboticarm

I. INTRODUCTION

Automation and robotics are two sides of coin and they plays important role in any industry. Automation or Robotics means the system works without human or very less interference of human. Automation is the technology is used for Electronics, Mechanical and Computer based system for the operation and also controls the production this is the main aspect of Industry. Mechanized assembly of machines, transfer lines, numerically controlled machine tools, feed-back control systems and robots are the parts of automation technology. And the Robotics is a form of industrial automation.

The process of joining different materials together is called Welding. The joining of two different materials or their alloys having different process like heat is applied either electrically or by using gas torch, this is Welding process. The metals and their alloys are the large bulk of material that Welded. The materials like Thermoplastics are also join by using welding.

1.1 SPOT WELDING

The Spot Welding is the process in which two metal sheet parts are merge together. The two localized points which are the two copper electrodes passing through it and produces the head that means weld.

In the Automobile industries the flam gun is used, it consist of two electrodes and for opening and closing of electrodes there is a frame. This gun provides the flam and it is commonly used in industries. In the spot welding the lot of energy is delivered in small time of period for welding, this is the best part of this type and having advantage is no extra heat is on the remaining metal sheet.

1.2 ARC WELDING

The Continuous process of welding is called as Arc Welding, it is exactly opposite process to spot welding. The large metal part which has to weld in that case arc welding is used. The air tight seal is required to join the two metal pieces. In the arc welding two electrodes produces high electric current and join the arc. The electrodes are may be rod or in the form of wires. The produced current is in the range of 100-300A and the voltage is 10-30GV.The temperature is enough high to melt the base material and join two parts together in welding process. In the Robotic Arc Welding Two types are mostly used : "Gas Metal Arc Welding" (GMAW) and "Gas Tungsten Arc Welding" (GTAW), this is also called as MIG WELDING.

Fig.1.Robotic Arm

II. LITERATURE SURVEY

For the effective use of industrial appliances there is various techniques used. One of them is Welding process. There are many research in welding field but most of the papers are based on manual welding for industrial application. But this is traditional process

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having many disadvantages like low productivity, less accuracy and also harmful for human health. These disadvantages are overcome by Robotic welding and now it's a advantages that high productivity and more accurate.

1. "Design of Spot Welding Robot" Zelun Li, paper discussed about the design of spot welding[1], Welding robot has played an extremely important role in the welding production of high-quality, high-efficiency. This paper shows the hardware structure and software of spot welding robot. The hardware design is mostly include the major modules of arm and base; the hardware design includes two parts: manual mode and automatic mode. The welding robot use PLC for control of the system and run fast and has a minimum production cycle.

2. "Arc Welding Robot Automation Systems", Beom Sahng Ryuh, paper discussed about the arc welding robot automation Robot automation systems[2] The human work force now rapidly replace by robotic automation system. This has advantage is now human force is spending more time for creating new ideas and tasks. It is ultimately change the previous process. The common use of robots are spot welding, material handling, for painting, arc welding. These all applications make the automobile industries and other industries more effective, increases the strength, quality, productivity and also beneficial in all the departments.

3. "Design, Analysis, and Simulation of a Pipe-Welding Robot with Fixed Plinth" A. Emami, this paper given information about the simulation of pipe-welding robot[3], The major asset of manufacturing the robot in industrial application is that to increase the efficiency of product and development rate of manufacturing is high, and the vast group of robot is used for welding. This information shows for pipe welding the robot simulation and analysis is in such a way that around the pipe there is fixed plinth and constant circular welding.

The robot capable of orientation for keeping electrode, speed of welding, constant distance between electrode and pipe surface all this tasks completed by robot. Hence the five linked robot is designed. This can improve the quality of welding.

4. "Robotic Welding Technology", Tang Sai Hong, paper discussed about the robotic welding technology[4], Since the first industrial robots were introduced in the early 1960s, the development of robotized welding has truly remarkable and is today one of the major application area for industrial robots. Mechanized programmable tool is the main concerned of the robotic welding, known as robot, which completely automate a welding process by both performing the weld and handling the part. Robot is quite versatile therefore has been used for a variety of welding types such as resistance welding and arc

III. SYSTEM DEVELOPMENT

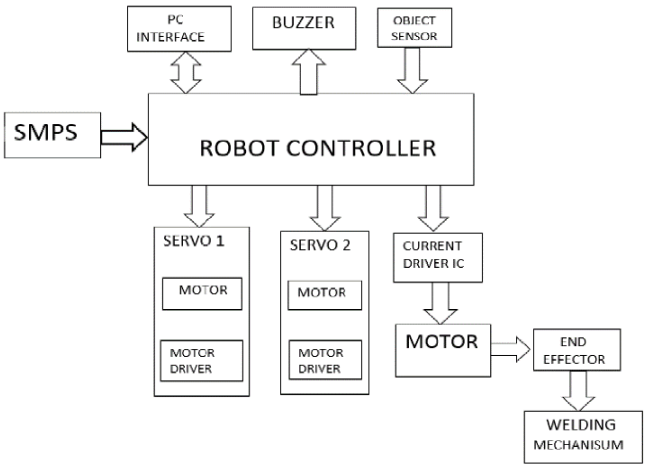

Fig. 2. Proposed System

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Above is the proposed system of our project. The components involved in our project are: robot controller, object sensor, two servo motors, buzzer, PC Interface. In the above proposed system the KPM-2 robot controller is used. It is high integrated functional computer SOC (System on Chip). It contains of integrated memory and programmable input/output peripherals. Robot controllers often operate at very low speed. They consume relatively less power. The two operation of motor Activation and Deactivation is controlled and also reads sensor signals. For sensing the object, sensor is used and sensed information is given to robot controller. The servo motor is consist of the motor and the motor driver circuit. There is no extra motor driver IC or motor driver circuit used or not required. Motor driver is used as a current amplifier, it converts the low current control signal into high is its main function.

3.1.HARDWARE

3.1.1.ROBOT CONTROLLER(KPM-02)

A robot controllers a high integrated functional computer system-on-a-chip. It consist of an integrated memory and programmable input/output peripherals. Robot controllers can be operated at very low speed. They consume relatively less power. The motor activation and deactivation operations is controlled by the robot controller and to read sensor signals.

- Controlling of 2 servo motors by Threaded processor
- Servo + USB regulated outputs
- Execution Time for 1 cycle: 1MIPS (Million Instructions per Second)

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- Parallel adder
- Connectivity to Computer

3.1.2. MOTORS (KPM-1):

To converts electrical energy into mechanical energy electromechanical device is used, called Electric Motors. Like batteries direct current source is given to electric motors as a power. To take the desired action for motor through driver circuit command given by robot controllers.

- High torque (8 Kgcm) approx.
- Double ball bearing to output shaft
- Operating Voltage: 5- 6 VDC
- Metal gears
- Current Consumption: 1000mA
- Wattage: 6W
- TEMP RANGE: -10ºC to 60ºC.
- Weight: 100 gm approx.
- Velocity: 0.14Sec/60ºC

3.1.3. OBJECT SENSOR (HC-SR04)

The sensor is used for sensing the objects and this system we are using ultrasonic sensor HC-SR04. Through the Vcc and Ground pins of the sensor the power is given +5V. The power of 5V is directly given to board pin (If available) because it consumed very less power, <15mA. The I/O pins directly connected to the robot controller, Trigger and Echo both are I/O pins. For measurement Trigger pin made high for 10us after that turn off it. To trigger ultrasonic wave this action takes at frequency of 40Hz for transmitter, and wait for the wave return to sensor. By reflecting any object wave get reflected back at that time Echo pin goes high, this time is equal to the time taken by wave to get reflected towards sensors. The echo pin goes high is measured by MCU/PU as per the information gives to sensor by time taken for wave reflected back to the sensor. By all this information the distance is measured between the object and sensor.

- Operating voltage: +5V
- Practical Measuring Distance: 2cm to 80cm
- Theoretical Measuring Distance: 2cm to 450cm
- Accuracy: 3mm
- Measuring angle covered: 15
- Operating Current: 15mA
- Operating Frequency: 40Hz

3.1.4. BUZZER:

An audio beeper also called as Buzzer is a mechanical, electromechanical or piezoelectric device. The alarm module, timers are included in buzzers and beepers. Also includes the input given by user it may be mouse clicks or keyboard. After completing welding process the buzzer will indicates by beeping.

- This buzzer is from PS series which having high performance and piezoelectric elements are employ unimorph and this is developed for various circuits for easy incorporation.
- They consume low power in comparison with electromagnetic units.
- These buzzer have both musical tone oscillator and buzzer for external excitation, they are specially designed.
- They can be used with automated inverters. Moisture resistant models are also available.
- Both-sided adhesive tape is installed easily and it is prepared the lead wire type (PS1550L40N)

3.2 SOFTWARE

Human-machine interaction, is the field of industry where the communication between the user and machine takes place. For controlling of the machine the interaction between the machine and the human is the one of the important goal of industry and for making operational decisions feedback from machine to operator plays important role. People interact with a machine is the user interface system. Hardware (physical) and Software (logical) are the two components of user interface. For different systems user interface plays major role in

- The manipulation of system is allowed to user by Inputs
- The effects of the user's manipulation to the system is allowed by the Output

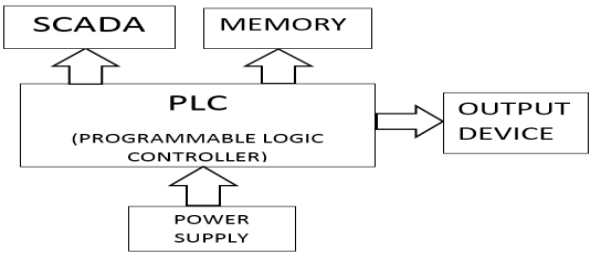

Fig.3. Software Design

The interface between the programming language and model of automatic welding robot is needed. For that selection of programming language and completion of model is important. The main and important part of the project is interface between hardware and software. The interfacing is based on the trial and error method, by removing the errors final movement of robot should be set with software. The movement of robot is very safe and it can not be harmful for the operator.

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Here we are using PLC (programmable logic controller). Based on the program, sensor input and actuator operation based on input that is output system is continuously monitor by using the PLC. SCADA is the control system architecture, it is the interface between computer or PLC and machinery or process plant. The SCADA can continuously observed the process commands such as set point changes as per that system shows the process status on screen of computer.

IV. WORKING PROCEDURE

In this project, the GUI on computer screen contains block in which we have to put total number of objects to be weld, then by pressing start button the start command given to the robot. Robot having two servo motor: motor 1 (M1) and motor 2 (M2), after receiving start command M1 for rotating base of robot rotate in downward direction and start the welding gun, then M2 which for controlling arm of the robot start moving in the semi-circle direction. After completing the arc, signal given to controller and it will stop the welding gun. Then M1 move the robot in upward direction and hold the arc in initial condition. At the same time message display cycle completed..

This process is continuously repeated until all the given number of objects to be completed. Once all object weld then buzzer indicated the task is completed. The object sensor is used for sensing the objects, and if there is no object present then robot will come back to its original position.

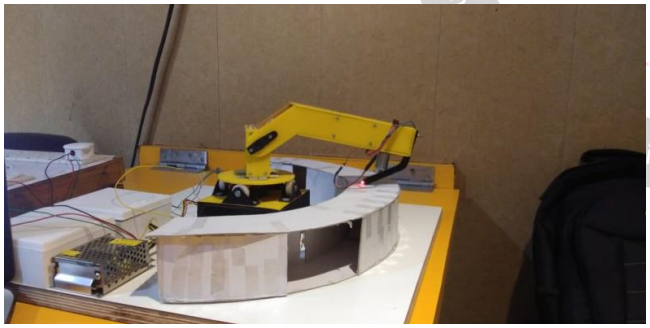

Fig. 4. Robotic arm welding

V. WORK FLOWDESIGN

For the Robotic Welding following figure shows the work flow design. To start the welding first initialized the compute then press the start button on computer screen. This startsignal send to the robot until robot received the start signal wait for it. After that enter the total number of objects to be weld. Simultaneously robot received thesignal and start moving in downward direction. Then it will wait for the command, by giving start command the welding gun is started and robot moves for welding. After completing the arc, it will stop the gun and move in upward direction. In this way the first object is weld. This same action is continuously done for multiple time to complete the given number of object. Once robot completed all the object it will give indication through buzzer. And wait for next command.

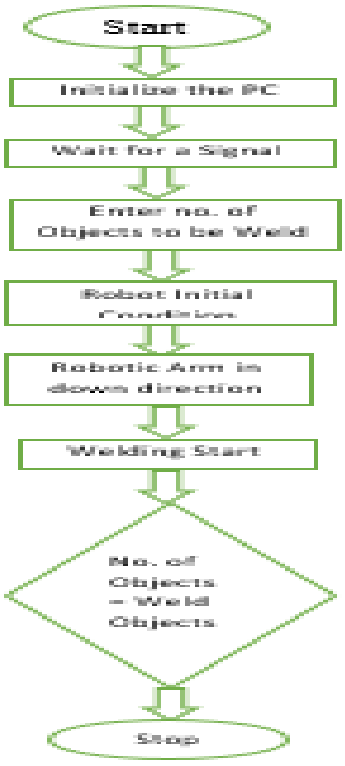

Fig.9 Flowchart

VI. RESULT

Following are the result step by step:

1. Welding operation Start:

Initially start the computer and enter the total number of objects to be weld. Then by pressing the start button robot will goes in down wards direction. Below figure shows the first operation of the welding robot. As per we set the angle of robot depending on the metal shape, robot goes to that position. The computer screen shows the message welding cycle start.

Fig.5. Starting of Welding Operation

2. Welding Gun ON:

After goes robot in down wards direction the welding gun start. Then the heat is start producing to electrodes and at the same time robot motor 2 start

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rotating and welding of metal is start. As per below figure the object is in the semi-circular shape, robot will move in that direction. The message shown in computer screen is Welding gun ON.

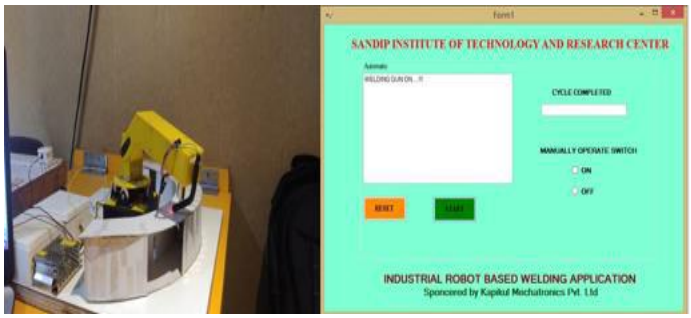

Fig.6. Welding Gun ON

3. Welding Gun OFF:

As we set the welding gun operation time depends on the dimension of the metal the gun will stop automatically. The is welded and computer shows the message that welding gun OFF.

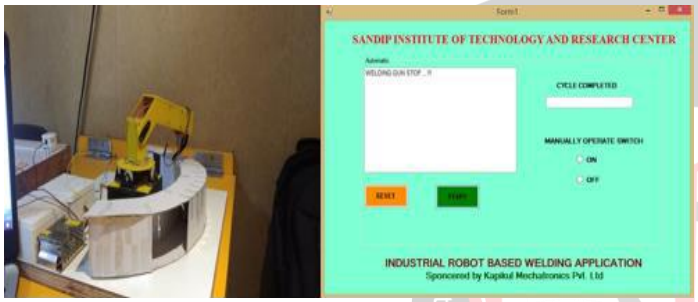

Fig.7. Welding Gun OFF

4. Cycle completed:

Once the welding gun OFF, robot will move in upward direction, here motor1 is operated. Then robot will again come on its original position with operation of motor 2. After reaching to its original position, computer shows the message cycle completed. This process is continuously repeated till the entered number of objects to be weld. Following figure shows the operation of software with computer screen.

Fig.8. Cycle Completed

VII. CONCLUSION

The value of robotics in industries is that the Productivity is increases with high quality and more efficient product. Also the human efforts are less but quality and quantity is high. Robots are flexible and capable of completing a variety of tasks without tantrum also give consistency in work. There is reduction in the physical damage of workers due to welding. These are the reasons to believe that automatic welding is beneficial for productivity and quality. It is not just improving standard of living but also improving the quality of life. Other than the welding application the robotics. This system is very helpful for the same type of objects to be weld. Because once you set the no of objects then there is no need to check in between the process, it will indicate after completion of all the jobs. If there is any problem during the process the welding will stop and pop shown in screen. In the continues arc welding we can set the robot as per the dimension of metal. If metal is not a rod and having any shape then we can set the robot as per dimension. Weld some part then stop welding change robot angle and again start welding.

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