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A SEMI AUTOMATIC ROBOTIC WELDING SYSTEM

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ABSTRACT

Technical development in robotic welding and greater availability of computer vision based control features have enabled manual welding processes in harsh work environments with excessive heat and fumes to be replaced with robotic welding. The use of industrial robots or mechanized equipment for high-volume productivity has become increasingly common, with robotized Gas Metal Arc Welding (GMAW) generally being used. Thus, sensors play an important role in robotic arc welding systems with adaptive and intelligent control system features that can track the joint, monitor in-process quality of the weld, and account for variation in joint location and geometry. The double electrode process consists of two torches: the main torch and bypass torch. In this process, arc rotation phenomenon causes increase in deposition rate and reduces the arc pressure forming shallow molten pool. This research explain about automatic robotic welding system design, development of system for various industrial aspects.

KEYWORDS: *Robotic Welding System, Sensors, Arc.*

INTRODUCTION

Welding is a technology that provides the fastest, strongest, and most economical method of joining metals. The field of welding has moved from coal-fired furnaces and hammers used for forging iron, to modern methods such as the concentrated accelerated free electrons of the electron beam process and the advantages of robots and lasers. Welding had its ancient origins in the fires of blacksmiths, who could forge two white-hot pieces of metal together with hammer blows and patience.

Preliminary, the simple definition of welding was “joining metals through heating them to a molten state and fusing them together.” With increasing progress in welding processes and techniques, the definition has had to change. It is quite true to say that the weld is stronger than the base metal. Beside the classic application areas of welding such as shipbuilding, automobile manufacturing, building construction, and pipelines, currently welding techniques are being used in more complex application fields including aircraft, space vehicles, and nuclear reactors.

Conventionally, arc welding and oxyacetylene fuel welding were two main welding techniques but currently more modern technologies are being used such as pulsed GTAW, plasma welding and cutting, submerged arc, pulsed GMAW, and electron beam and laser welding. Basically, there are two types of welding namely, fusion and non-fusion. The former is the most common and involves the actual melting of the parent metals being joined. Non-fusion welding is most commonly represented by soldering and brazing where the parent metal is heated, but not melted, and a second or “filler” metal is melted between them, forming a strong bond when all are cooled.

OBJECTIVE OF STUDY

- To understand about design and development of automatic robotic welding cell
- To know how multi wire and laser best computer vision system work on automatic welding cell
- To improve the productivity, reduce downtime with the ISO weld standard.
- To knowledge about process of reduce to manpower on the industrial environment.
- To acknowledge about improve the welding quality and the cost of production
- To safe the human life from the unhealthy environment without stop the work
- To how introducing new technology with existing welding system without replacing a hole
- To knowledge to improvised new introducing technology to the robotic welding technology to the current small, medium & large scale engineering, manufacturing, and cutting edge industries and foundry industries.

METHODOLGY

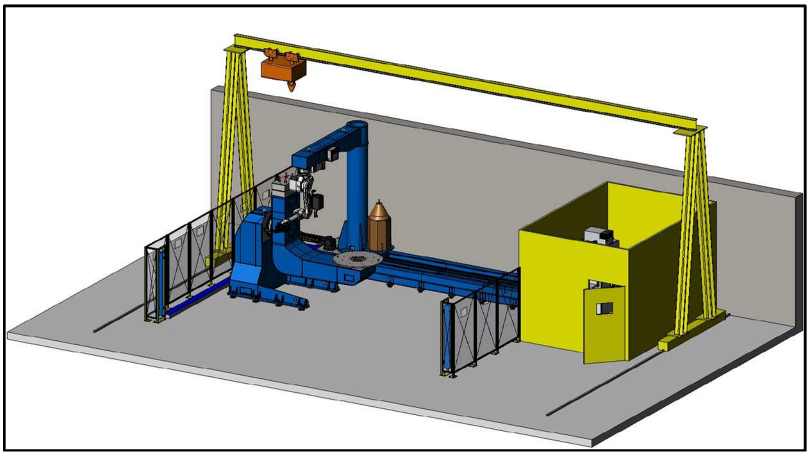


Figure 1: Welding Robot System for Side Frame and Bogie Bolster.

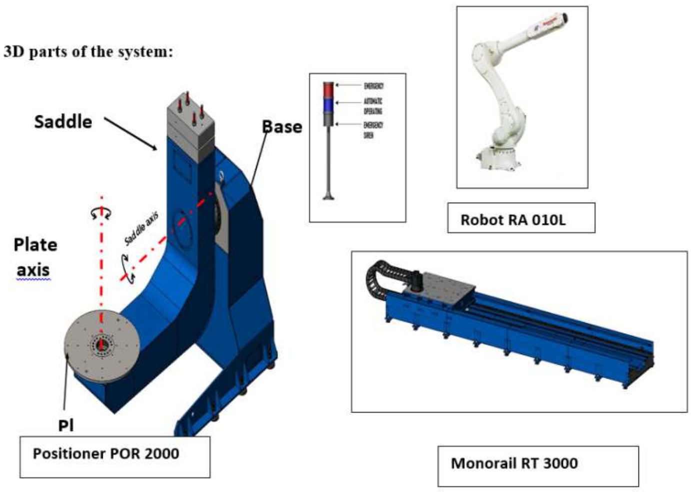
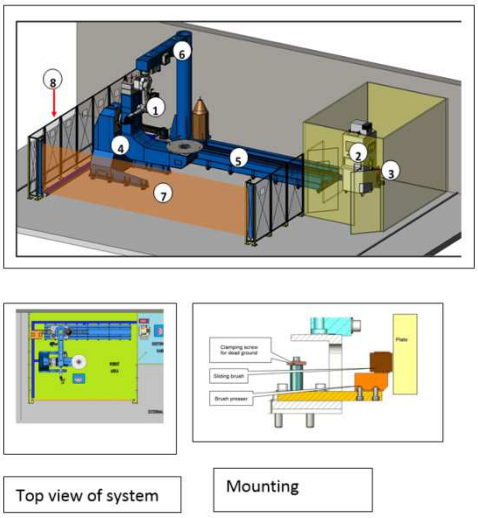


Figure 2: System 3D.



LEGEND			
1	Robot RA 010L with torch and wire feeder	5	Monorail RT 3000
2	Electrical equipment with controller	6	Robot column C-14/VK
3	Welding generator group	7	Entrance light curtain
4	Positioner POR 2000	8	Safety fences panels

Figure 3: Top View of System.

Kawasaki Controller "E 01"

It is equipped with main CPU with 32 Bit Celeron M type offering extremely fast and accurate processing.

The controller is also equipped with a system of diagnostic and breakdown research with colour LCD video that displays alarm messages.

Two serial port RS 232 C allow the connection to external PC.

One USB port allows programs saving on USB key.

A second USB port allows the connection of a Keyboard.

Two Ethernet port T-100

Simple Teaching

The design of the system has mostly considered the easiness of the use so it is equipped with: - Programming keyboard with 6, 4" colour LCD with touch panel and with menu multiple functions keys.

Programs of Machine Cycle in English Language

With clear message explaining the causes of the interruption and the action to carry out to retake the cycle. Everything shown on a back-lighted LCD video.

The specific error messages of the robot are shorten in English with identification codes reported in the errors manual, supplied with the robot.

High Quality Welding

A smooth and accurate motion can be achieved thanks to the high-resolution position encoder, maintenance-free AC servomotors, high precision backlash-free reduction units and various servo functions.

Programming and interfacing of the welding generator: There are mainly two work possibilities:

Job Mode

The full welding program is created and stored into the generator. You can create several jobs (depending on the type of welder), each one with different features (Amps, Volt, wire, diameter, burning gas, pos-gas, pre-gas, start current, end current, crater…) which may be recalled in the robot program during the workpiece programming step, both if it is carried out with self-learning mode and if it is carried out with AS language.

In this programming mode the operator shall perform the following operations:

- Recall the Job needed
- Give the start command to the generator (the robot will receive the WCR signal (arc switched on) from generator)
- Set the welding speed Define the welding path by recalling the jobs needed based on the type of joint.

References Mode

The full welding program is created and stored into the robot. In this case you can create an infinite variety of programs (one for each weld spot), each one with different features as described above.

In this programming mode the operator shall perform the following operations:

- Create the linearization table
- Through the teach interface panel you can do the following:
  - Recall the bending programs stored in the generator
  - Set the wire burning
  - Set the dynamics
  - Set the process (Standard, Pulsed, CMT, …)
- Recall the linearization table chosen
- Set Amps and Volts
- Give the start command to the generator (the robot will receive the WCR signal (arc switched on) from generator)
- Set the welding speed
- Define the welding path by setting the different parameters based on the type of joint.

Flexibility

Thanks to the particular drawing of the arm the robot can be fixed to the floor, to the wall or suspended according to the best configuration requested by the working cycle. Protection degree:arm **IP 65**

Table 1: Robot RA 10L

Discretion	Details
Model	RA 10L
Arm type	Articulated
Arm length	1925 mm
Axes number	
Axes range and max. speed	(JT1) +/-180 deg (190/deg/s)
	(JT2) + 155° ~ - 105 deg (205/deg/s)
	(JT3) + 150° ~ - 163 deg (210/deg/s)
	(JT4) +/- 270 deg (400/deg/s)
	(JT5) +/- 145 deg (360/deg/s)
	(JT6) +/- 360 deg (610/deg/s)
Payload	Kg 10
JT4 and JT5 Torque	22N x m.
JT 6 Torque	10N x m.
Repeatibility	+/-0.06 mm
Motor	Brushless C.A.
Position detection	Absolute encoder
Weight	230 Kg

Table 2: Controller E 01

Description	Details
Model:	**E 01**
Number of parallel task	5
Control Unit	Digital
Number of controlled axes	6 std
Memory type	C-MOS RAM with backup battery
Memory capacity	8 MB
External storage	2 USB Port
I/O signal	Input (WX) 32 (64/96 optional)
	Output (OX) 32 (64/96 optional)
Motion control type	Robot, Cartesian and Tool
Interpolation	Linear and circular
Operative Panel	5,7” and colours LCD video
	touch screen type
Safety circuits	Grade 4
Programming method	Self-learning with menu functions to
	guide the operator
Serial Port:	2 RS 232 C
Ethernet Port	2
Connection cables	Std. 10 mt
Controller dimensions	580 x 550 x 260 mm
Controller weight	Approximately 40 Kg
Transformer dimensions	580 x 550 x 170 mm
Transformer weight	45 kg
Ambient conditions	0°C - 45°C
Humidity	35/85% (noncondensing)
Power source	AC380/415 V ± 10%
	/50/60 Hz/3 phases/ 10 KVA

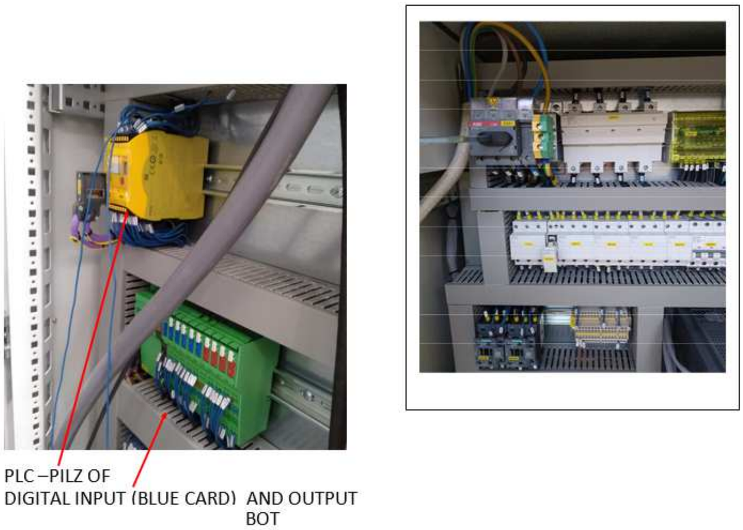


Figure 4: Digital Input (Blue Card) and Output.

Figure 5: Lamp and Button Front Cabinet.

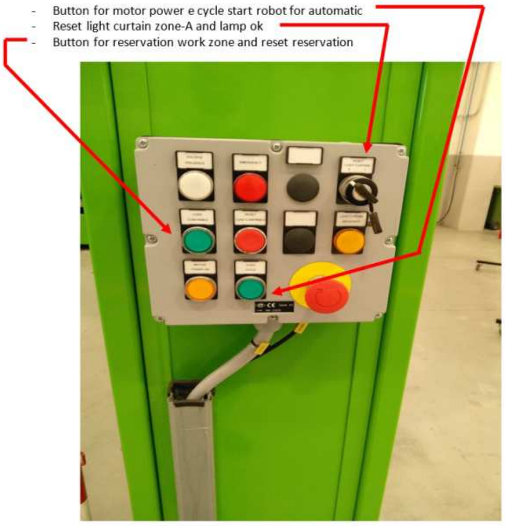


Figure 6: Pushbutton for Work Zone.

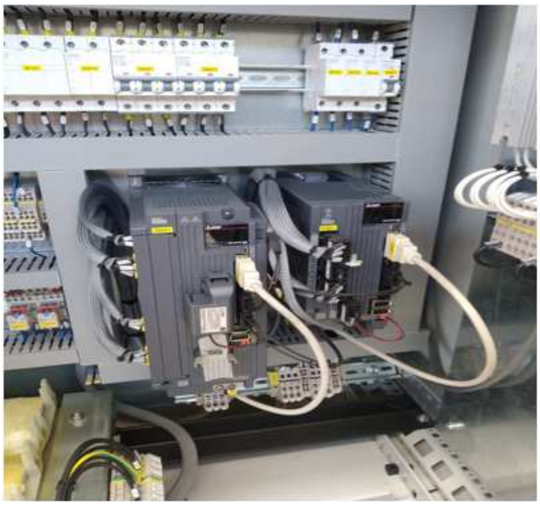


Figure 7: Drive for External Axis in the C.

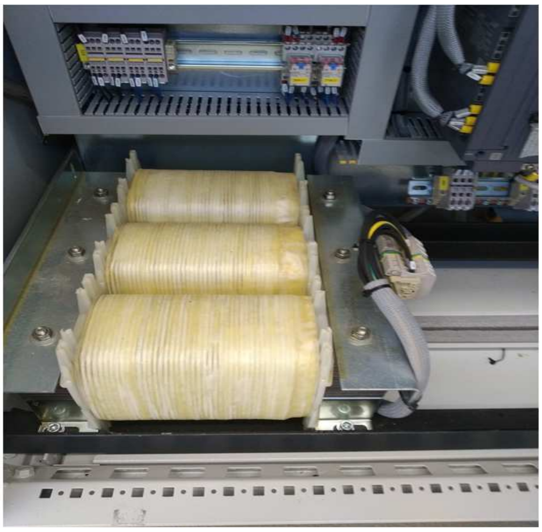


Figure 8: Transformer 400 V /210 V.

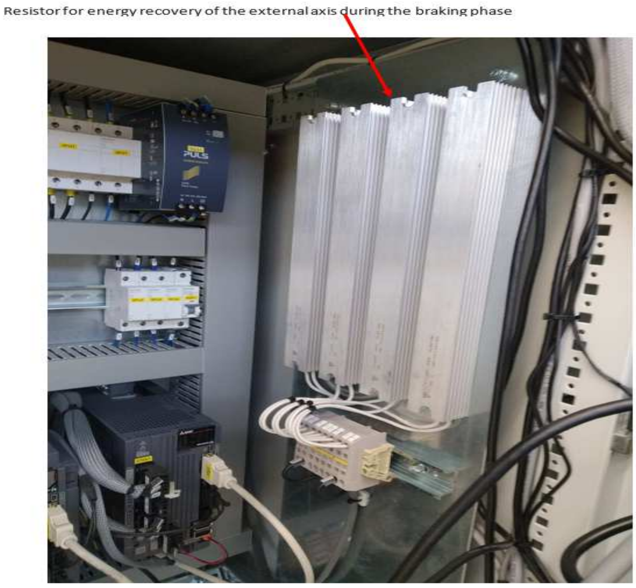


Figure 9: Resistor for Energy Recovery of the External Axis.

Figure 10: Controller Cabinet with Monitoring System.

RESULTS & DISCUSSIONS

WPS for Side Frame

Tentative schematic block diagram for Tack welding and Robotic welding for Side Frame LH and RH (1267402 & 1267460) of FIAT Bogie Side Frame is as under (or better may be provided). The Robot is required for robotic

Welding after manual tack welding stage -II .

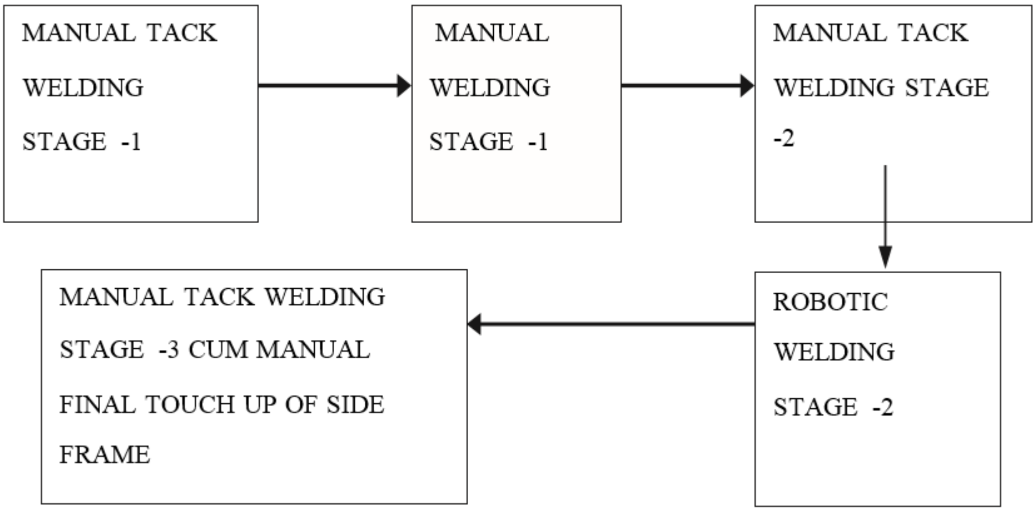


Figure 11: Welding after Manual Tack Welding Stage-II.

Component List for Tack Welding of Fiat Bogie Side Frame (1267402 & 1267460)

Table 3: Side Frame (1267402 & 1267460) Stage 1

S. No.	Drg. No.(1267402) Side Frame LH & Drg. No.(1267460) Side Frame RH Latest Alteration	Description	Quantity Per Frame in Nos.
1	**1267406**	UPPER WEB	1
2	1267452	SPRING POT	2
3	1267408	OUTER WEB	1
4	1267409	INNER WEB	1
5	1268588	STIFFNER (UPPER BOX)	1
6	1268373	STIFFNER	2
7	1267954	STIFFNER	4
8	1254690	SPRING GUIDE UPPER	2
9	1268000	STIFFNER	2

Table 4: Side Frame (1267402 & 1267460) Stage 2

S No.	Drg. No.(1267402) Side Frame LH & Drg. No.(1267460) Side Frame RH Latest Alteration	Description	Quantity Per Frame in Nos.
1	LW 03246	CONTROL ARM SUPPORT RH	2
2	LW 03247	CONTROL ARM SUPPORTLH	2
3	1267533	CONTROL ARM SUPPORT STIFFNER	2
4	1267704	PRIMARY STOP	2
5	1267407	LOWER WEB	1
6	1267719	STIFFNER	2
7	1267715	HEAD BRACKET LH	1
8	1267706	HEAD BRACKET RH	1
9	1902332	SUPPORT BRACKET FOR EARTHING WIRE	2

Side Frame (1267402 & 1267460) Stage 3 for Tacking of Listed

Table 5: Components and Full Side Frame Manual Touch Up of Left Over Welding

S. No.	Drg. No.(1267402) Side FrameLH & Drg. No.(1267460) RH/Side Frame Latest Alteration	Description	Quantity Per Frame in Nos.
1	1267950/1267552	YAW DAMPER BRACKET LH/RH	1
2	1267951/1267705	ANTI ROLL BAR SUPPORT LH/RH	1
3	1267492/1267480	VERTICAL DAMPER BRACKET LH/RH	1
4	1267485	DISC	2
5	1267456	STIFFENER (ROLL STOP BRACKET)	2

All above actual components may vary in dimension up to – 10 mm, the system should be designed to accommodate – 10 mm variation. Also, robots should be capable to weld deviation up to – 10 mm (minimum) in auto mode. Side frame upper web and lower web have a tendency to spring back hence its dimension will vary.

This process is indicative for the purpose of basic understanding of bidder only. The bidder is free for modifying the process without compromising the productivity clauses and technical specification of the system.

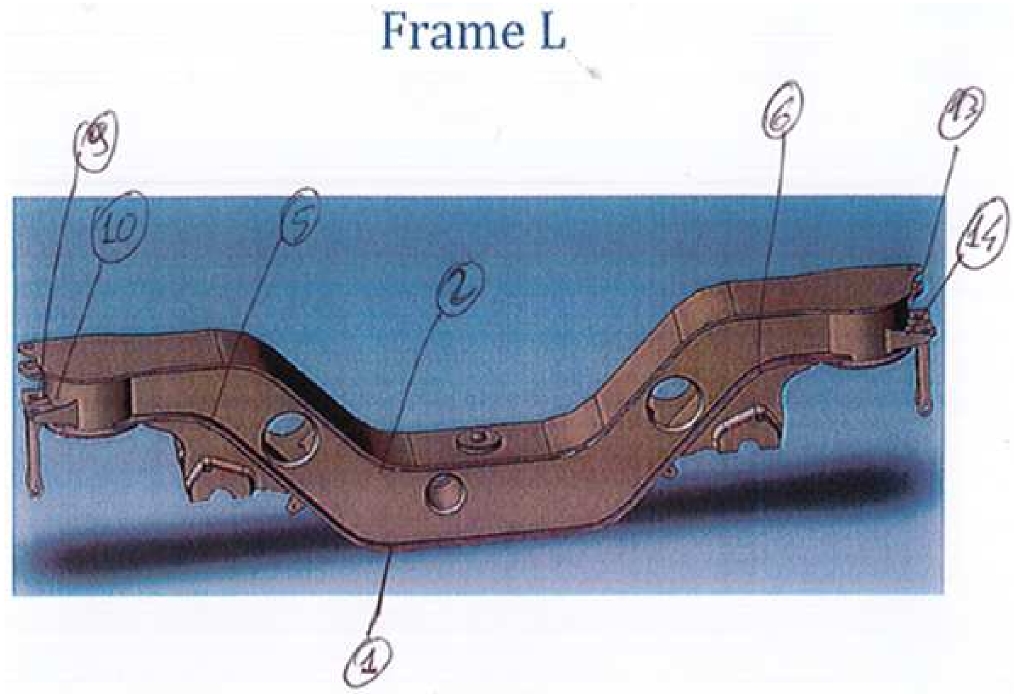


Figure 12: Side Frame Left Weld Area.

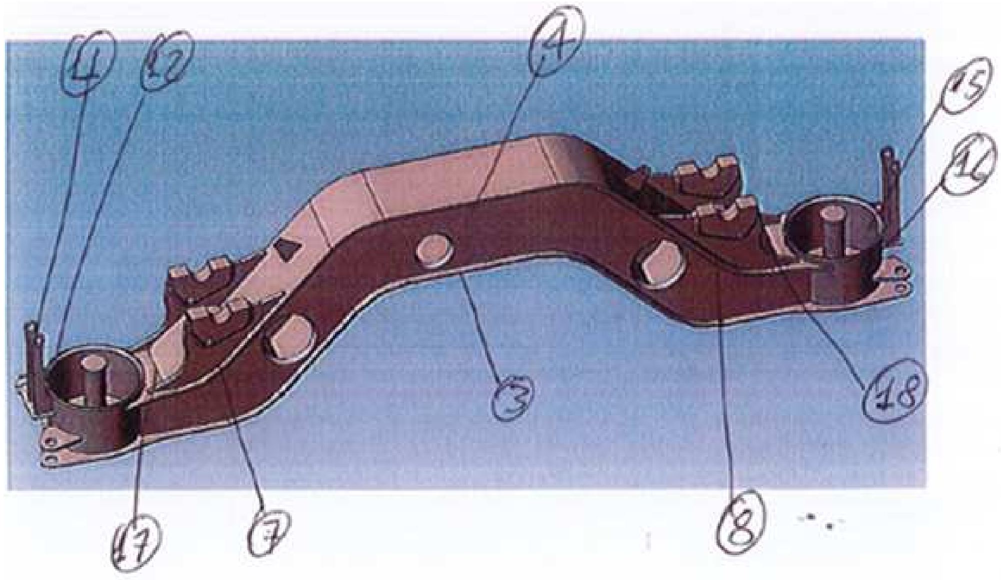


Figure 13: Side Frame Right Weld Area.

Output on Time Operation by System

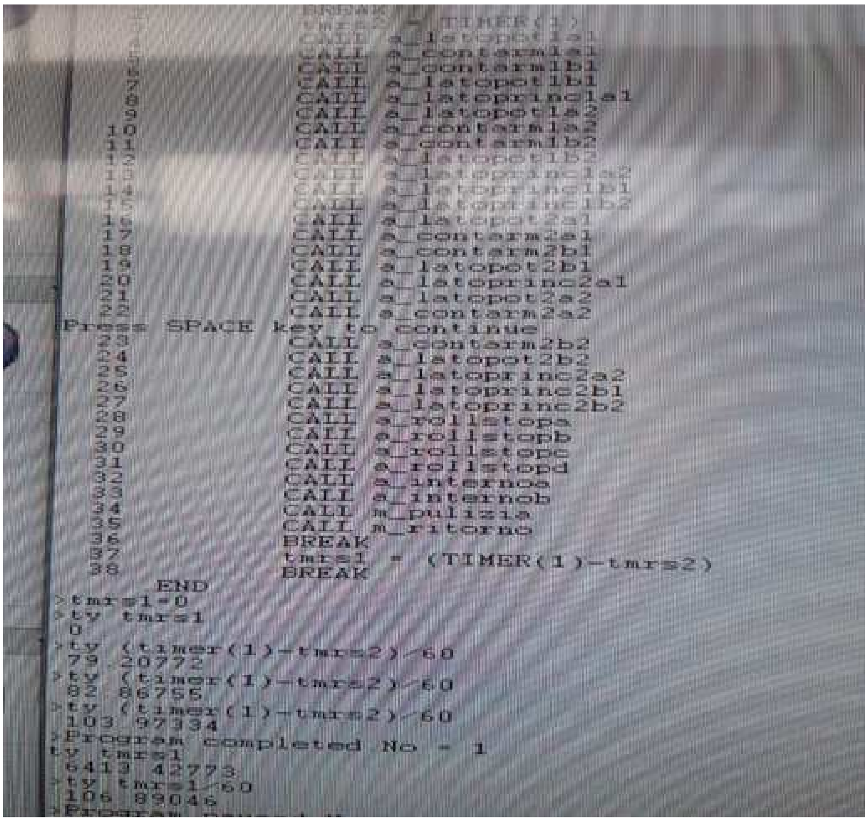


Figure 14: Output on Time Operation by System.

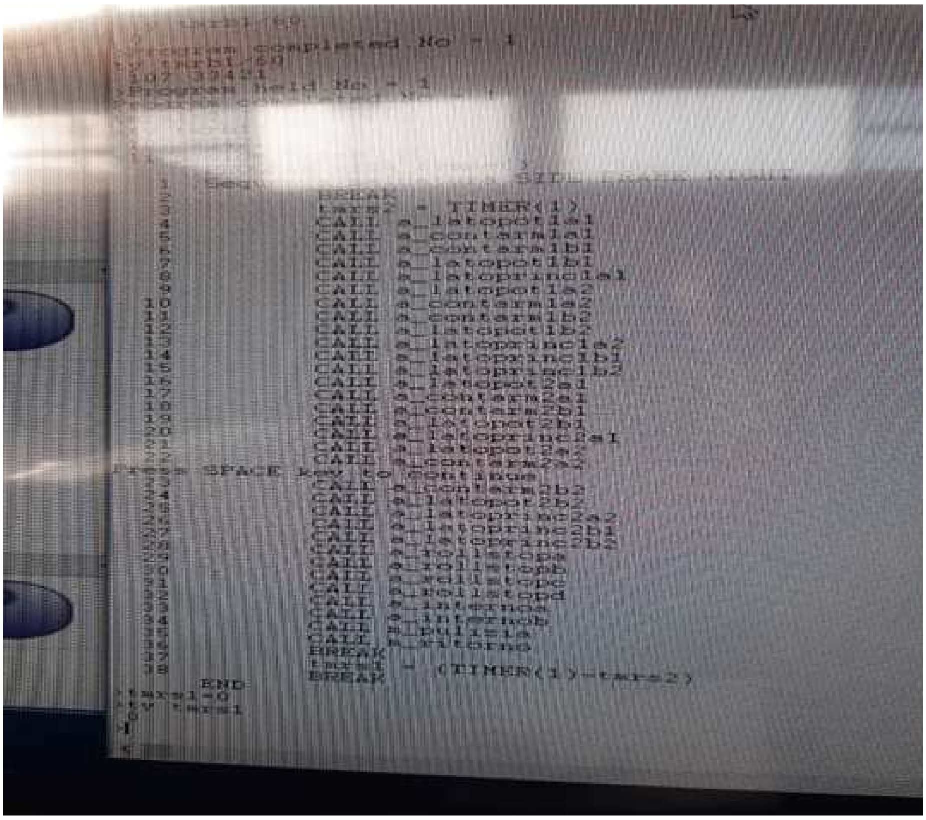


Figure 15: Output on Time Operation by System.

Table 6: Productivity of Components on Robotic Welding

Sl. No.	Thickness	Component Description	Drawing No.	No. of Pieces to be Welded/ Shift Individually
1	12 mm	Side Frame (Left)	1267402	02
2	12 mm	Side Frame (Right)	1267460	02
3	10 mm	Bogie Bolster	1267420	02

CONCLUSIONS

Robotics and sensors, together with their associated control systems have become important elements in industrial manufacturing. They offer several advantages, such as improved weld quality, increased productivity, reduced weld costs, increased consistency of welding, and minimized human input for selection of weld parameters, path of robotic motion and fault detection and correction.

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