Annals of the University of Petrosani, Electrical Engineering, 22 (2020)

AUTOMATION OF THE WELDING PROCESS USING SOFTWARE AND INDUSTRIAL ROBOTS

ALINA DANIELA HANDRA[1], FLORIN GABRIEL POPESCU[2], DRAGOS PASCULESCU[3], MARIUS MARCU[4], NICOLAE DANIEL FITA[5]

Abstract: The most common assembly process in the industry is welding. The modern means of automatic execution of welding operations are industrial robots, specific material supply installations, special positioning devices, special work tools. With the help of industrial robots, spot welding operations can be performed and continuous arc welding in a shielding gas medium, etc. The use of software and industrial robots combats the harmful effects that occur on the human operator during welding operations, increase the productivity of companies and increase energy efficiency.

Keywords: welding, robotization, energy efficiency, automation.

1. INTRODUCTION

Sir Humphry Davy invented electric welding in 1800 when he created electric arcs between two carbon electrodes using batteries. He set a precedent for welding innovation that continues to this day [3], [13], [16].

The period 1800 to the mid-1900s brought the development of arc welding, various types of resistance welding (spot, seam, projection, butt), as well as metal inert gas welding (MIG) and tungsten inert gas welding (TIG). Since then, robotic welding has become an essential element of many industries, and friction, centrifugal, laser and ultrasonic welding have become commonplace [1], [6], [8].

Welding in Europe can be traced back to 3,000 BC, when it was a manual process of heating and hammering metal parts to join them [10], [15]. Thousands of

[1] *PhD., Assistant, Eng., University of Petroşani, handra.alina@yahoo.com*
[2] *Ph.D., Lecturer Eng.,University of Petroşani, floringabriel82@yahoo.com*
[3] *Ph.D., Associate Prof. Eng., University of Petroşani, pdragos_74@yahoo.com*
[4] *Ph.D., Associate Prof. Eng., University of Petroşani, mariusmarcu66@yahoo.com*
[5] *Ph.D., Assistant Eng.,University of Petroşani, daniel.fita@yahoo.com*

years later, manufacturers across the continent using state-of-the-art equipment to perform all types of welding.

2. SOFTWARE

One of the largest suppliers of welding equipment in Europe is ESAB, based in Sweden, established in 1904. Oscar Kjellberg started the company after receiving a german patent for stick welding, which is also known as shielded or manual metal arc welding.

This process uses an electric current to strike an arc between the base material and a consumable electrode rod.

The multiple achievements of the past, makes you wonder what the future holds for you in the field of welding.

Major equipment manufacturers and suppliers believe that the next big technological step will be the Industrial Internet of Things (IIoT), which offers the ability to use data to help welders, robots and automated equipment to repeatedly produce perfect welds.

ABB Group, a Swiss-Swedish company, has launched remote services that involve connectivity and the incorporation of knowledge into robots and other devices. Today, the company offers its Ability Connected Services program for robots to optimize their performance.

Their motto is "collaboration, simplification and digitization," says Hui Zhang, chief technology officer for robotics and automation. He believes that the ability to monitor robots in this way increases efficiency, reduces services costs, ensures service life and extends the life of assets [2], [5], [9].

In 2014, after 110 years, they turned their attention from the strict manufacture of welding equipment and consumables, to the creation of software that purchased and manages the data that customers can use to improve their productivity and welding quality [4].The Software, named, WeldCloud helps companies address challenges such as lack of skills and burdensome documentation requirements.

The development took several months, because it included extended testings on the spot and remote of system during welding, as well as a meeting with Microsoft and PTC, a provider of IoT and product lifecycle management software, in 2018, when the product has been completely revised [11]. The tests led to the reconstruction of the ESAB software using the ThingWorx tool from PTC, using Azure cloud computing services [12]. All data migration is done through the gateways provided by ESAB equipped on the welding power supplies.

The software can be used with manual, automatic and robotic welding systems that perform MIG or TIG welding. WeldCloud works with new and old ESAB equipment, as well as those produced by other suppliers, see figure 1 and figure 2.

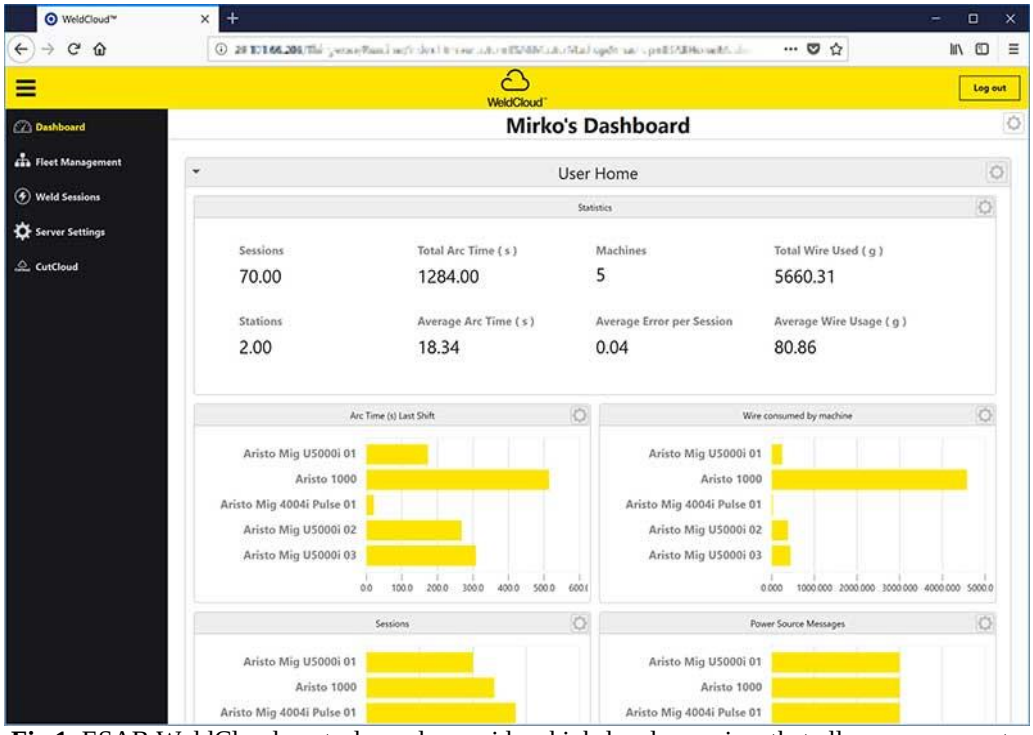

Fig.1. ESAB WeldCloud control panels provide a high-level overview that allows managers to evaluate the functionality of their welding system at a glance

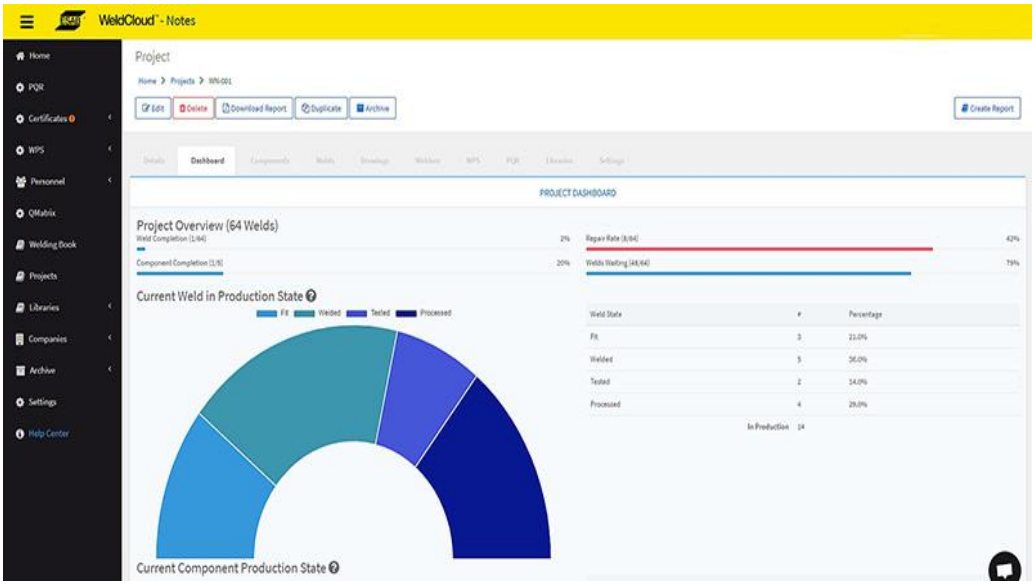

Fig.2. WeldCloud Notes monitors weld production blockages and provides a complete weld traceability dashboard that keeps track of each weld and component of a project

There are three benefits to WeldCloud for manufacturers:

1. The first is productivity and can really help companies that focus on Kaizen and operate LEAN. The recorded data allows managers to determine arc-time efficiency by department, shift, welding asset and time. They can quickly see whether or not a work cell meets availability requirements and can recognize other welding performance trends [14], [17].

2. Documentation, thanks to the Notes function of the software. Managers can now record all welds and components in a project, including base metals, welders, and filler metals. They can also create the welding procedures used in a project and generate a document that contains all this information.

3. Maintenance of the machine park. Managers can determine exactly how active each energy source is for welding on the production line and can find out the use of the source over its lifetime. They can also schedule all WeldCloud-compatible machines in their fleet to send service alerts to maintenance personnel [18].

3. ROBOTS AND WELDING

In 1969, General Motors Corporation built a robotic spot welding line, served by 38 industrial robots for welding the car body. The benefits of introducing these robots into the industry include control and productivity management and the obvious creation of product quality, see figure 3.

The welding robots used today are more technologically advanced and more loaded than ever. However, they must be properly integrated into the factory platform to achieve the desired results.

A German manufacturer of precision gearboxes and, has recently connected all 60 of its robots to the platform. According to Sven Sparmann, site manager for maintenance, repair and overhaul at KOKI, the platform allows him and other managers to accurately assess the performance of the entire KOKI robot fleet, as well as identify and correct underperforming robots. In addition, ad hoc repair tasks can be planned and executed quickly based on real-time data [17], [18].

Fig.3. Industrial robot used in welding operations

Other german manufacturers, including BMW and Daimler AG, are relying on the PRC7000 series controller from Bosch Rexroth to improve their resistance to spot welding. The controller comes in 600 and 1,600 amp versions, both with adaptive control algorithms that ensure repeatable and high quality welding of aluminium, steel and other materials with different thicknesses [7], [18].

The controller has an open system architecture with integrated application layer and electric servo-gun functionality. An integrated web server facilitates the operation of welding and diagnostics via smartphones and tablets. State-of-the-art electronics improve energy efficiency.

4. CONCLUSIONS

We are at the beginning of the 4th industrial revolution. Although the general attitude so far has been to fear that robots and software will steal our jobs, it has been shown that companies that use this software have increased productivity by about 25 percent, while significantly reducing the time required to document monthly data of welding and performing preventive maintenance (from hours to minutes). Income from productivity has increased, and labor costs related to quality documentation and preventive maintenance have been reduced.

A few reasons to use industrial robots:

- Reducing operating costs – In just a few words, robots can work without light and heat, thus optimizing electricity and heat costs.
- Improving the quality and consistency of products - robots do not get tired, are not distracted by external events, can repeat operations without making mistakes.
- Reduction of waste and increase efficiency - robots are not doing mistakes.
- Improved working conditions for humans - robots can replace humans in heavy or dangerous areas.
- Reduction of staff fluctuations and the difficulty of recruiting staff.
- Reduction of capital costs - inventory, work in progress.
- Space saving in high value production areas - robots can work from different positions, thus helping to save workspace.

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