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Design and Construction of an Automatic Gas Welding System

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ABSTRACT
In the age of Automation, where human safety & comfort is the key concern, one of the most common sector of engineering remained unaltered and that is the Automation of gas welding, one of the most age old technology, is yet to be applied in industrial scale. Automation of welding requires the combination of electrical and mechanical system. The various parts used for automation of Oxyacetylene in-line gas welding comprise of Rack and Pinion, Bearing, Geared motor, Motor driver, Arduino board. As it is the model of actual system, the construction is made of wooden frame Two geared motors are used; one for feeding filler metal and other is for feeding the job. Both of the motors are controlled by micro-controller. The job is clamped on top of workbench and is fed in a controlled speed. The filler metal holder which is placed at 0^o with workbench along X-axis and slightly angled ($5\text{-}10^o$) with X -axis is also fed the filler rod in controlled way. The main working principle is as follows: The lighted up nozzle will be held over the job to be welded and when the metal will be heated up, filler rod will approach underneath the flame and will melt. The melted filler metal will drop on top of the heated metal and when cools down, the pieces will be joined. The output of the system is quite satisfactory which implicates the veraciousness of idea. The necessity of the system is with proper and accurate automation, the most commonly used welding technique will be safe for human health and production quality will increase.

Keywords - Automation, Rack and pinion system, Microcontroller, Motor driver, Gas Welding.

1. Introduction

The more mankind steps into the modern scientific world, the more men grasp the fruits of technology into their daily life. In the field of engineering the effect of adapting newer ways of doing work are much prominent. Welding and joining technologies are fundamental to engineering and manufacturing. Without the ability to make strong and durable connections between metals it would be impossible to produce the many different items we all rely on in our everyday lives – from the very large (buildings, pipelines, trains and bridges) to the very small (medical implants and electronic devices). Now-a-days there are numerous types of welding methods, which are used according to their purposes. But the pristine technology does not lose its interest through time. Oxyacetylene gas welding is still one of the most used gas welding process. The main reason behind that are e.g. equipment is relatively inexpensive and simple, mastering the technique requires is relatively easy to other methods, so implementing automation to this welding process would be a huge step forward.

2. Working Method

The system comprise of three parts. Methodology of accomplishing task of each system is briefly described below:

2.1 Work Bench:

Work bench is where the job is placed and clamped and it controls the welding speed. It produces reciprocating motion from the motor geared to the "Rack and Pinion" system. The speed of the motor is controlled by motor driver. A circuitry system connects the "motor driver" and "Arduino board". A program for the desired speed is uploaded to Arduino which can be powered either by AC line or USB cable connected with computer/Laptop.

2.2 Feeding Device:

The main mechanism of feeding is the use of friction. To facilitate this mechanism, the platform is made slightly angled (approx. 5^o) with horizontal. As motor is switched on and off in a controlled way, so when shaft will rotate, filler rod which already placed upon pinion, will receive feed. As double sided taped is used over the shaft, thus no slippage will occur when motor will pause.

2.3 Gas nozzle holder:

It is a platform which upholds the gas nozzle to a certain limit and facilitate fixation of nozzle at prescribed angle. It is stationary part of the system.

2.4 Block Diagram of Power Transmission

The total work flow can be summarized into two block diagram which are shown below in Fig.1. The first one is for the "Workbench" and the second one is for the "Filler metal holder".

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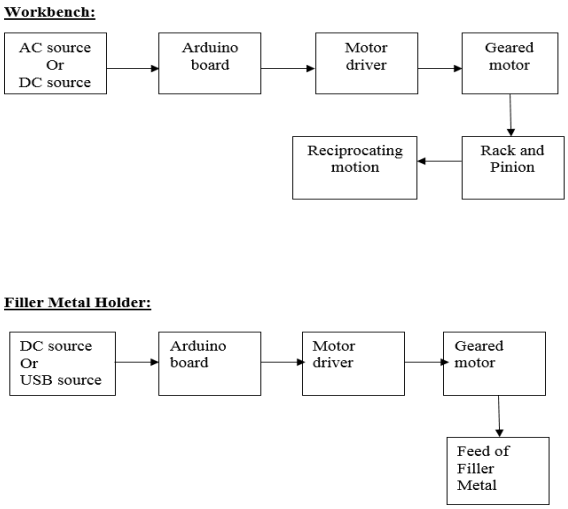

Fig. 1: Block diagram

3. Models & Solidworks Drawings:

Fig. 2: Workbench

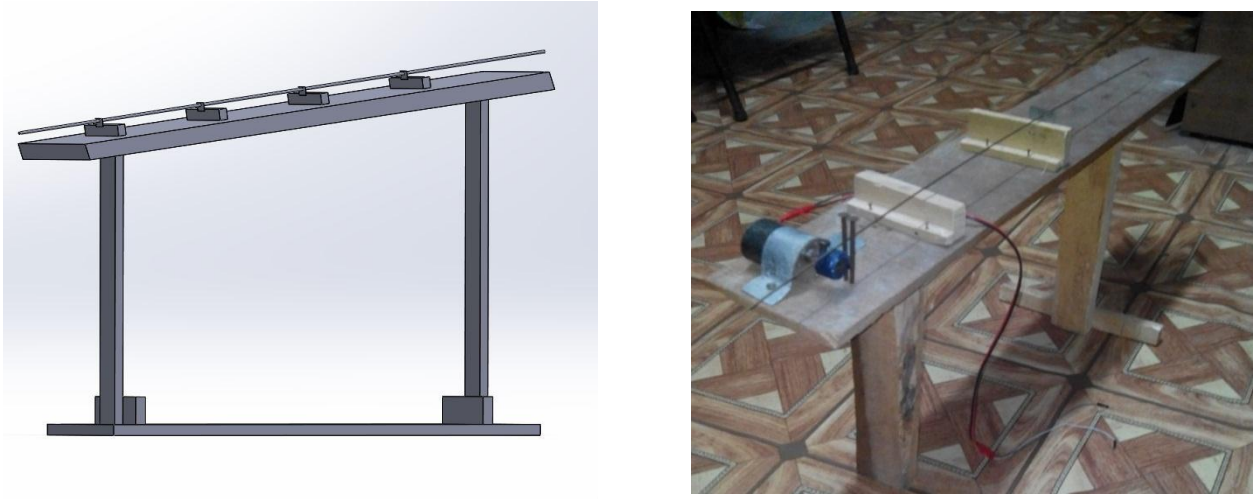

Fig. 3: Filler Metal

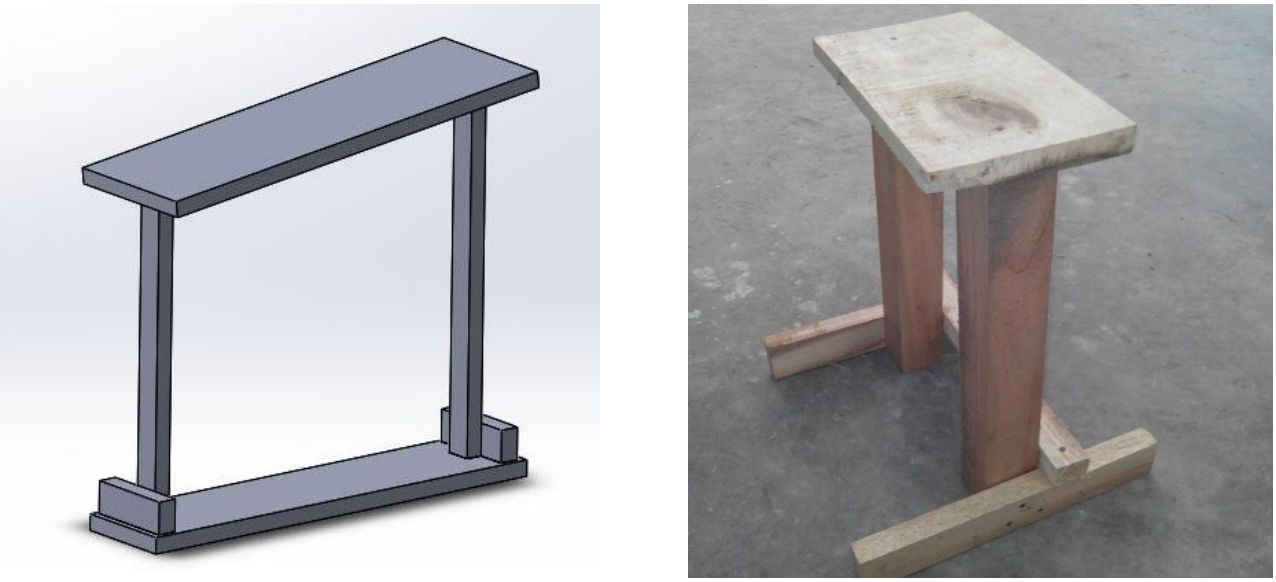

Fig. 4: Gas Nozzle

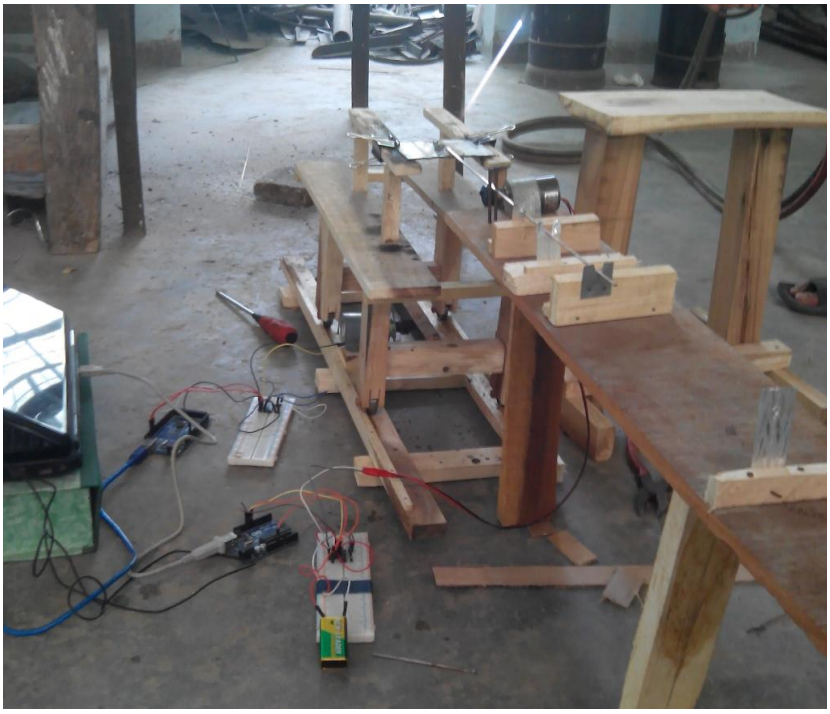

Fig. 5: The Entire System

4. Testing of System:

The workbench geared motor speed = 1.9538 mm/sec
The filler metal holder geared motor speed = 4 mm/sec
Workbench pause time = 5 sec
Workbench run time = 4 sec
Filler metal pause time = 6 sec
Filler metal run time = 2 sec
Thickness of metal = 13 gauge = 0.072 inch = 1.828 mm
Filler metal material = Brass
Tested job length = 76.2 mm
Welding Speed = 1.2 mm/sec

Fig. 6: A butt welded workpiece

5. Conclusion

The performance testing shows that, the system is quite feasible. The system proves that the idea is flawless. As there is no gauge or metering system to control the flame precisely, so various facts come into play in actual practice. The system can adequately weld two pieces of metal which satisfy the objectives of the project. The sole purpose of this project is the auto-mechanization of gas welding using the components which are being used from the very beginning. After successful completion it can be concluded that

1. All the dimensions are based on designed value.
2. Rotational speed was converted to linear motion for convenience.
3. There was no clash between teeth of Rack and Pinion.
4. Only straight line welding can be done with the model.
5. Various types of job have been tested to prove its feasibility.
6. The performance of the system is quite satisfactory for different jobs.

The modification of the system does not finished with the end of the project. The future scopes of improvement are

1. To control the flow of flame, a solenoid valve can be attached with the nozzle, which can be powered from Arduino.
2. A filler rod melting powder reservoir can be attached.
3. A frame may be created which enables different types of joints as well as Lap joint and Butt joint.
4. Modification of Filler Metal Feeding device may be done which enables holding of filler metal of different sizes and shapes.
5. Modification of filler metal feeding platform can be done which will help the vertical lift of the filler metal for proper adjustment.

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