# DESIGN AND DEVELOPMENT OF AUTOMATED WELDING FIXTURE

**Mohammed Ahteshamuddin[1], Venkatesh Mekala[2], Vangapalli Shameek Chandra[3], Khazi Nasiruddin[4]**

*[2-4]B.Tech, Department of Mechatronics Engineering, Mahatma Gandhi Institute of Technology, Hyderabad, India.*

---

**Abstract - -** *Welding is an integral part of various manufacturing industries and processes. Many medium and small-scale industries employ a large number of human laborers which in turn costs the company excessive capital. In developing countries like India, the competition is marked by quality, quantity, and accuracy. In earlier days attaining productivity up to the desired level was not possible due to various drawbacks such as intricate shapes and sizes, lack of skilled labor, the un-estimated quantity of wastages, scrap, human errors, and reduced accuracy.*

*CNCs have made revolutionary changes within the manufacturing sector. Welding using CNCs can reduce the drawbacks of conventional processes. The automated welding fixture proposed to be developed in this project is a type of CNC which makes use of stepper motors, sensors, actuators, transformers, a high-end microprocessor for feedback, and complete automation. A part program is written for fabricating the required profile. The program is illustrated based on labels (a kind of mode); the label mode is selected because the programming can be done assiduously. The use of (a CNC Welder) encourages companies to imbibe automation which on sustained use makes the welding cheaper, reduces human errors.*

## 1. INTRODUCTION

Welding is a process of joining different materials. The large bulk of materials that are welded are metals and their alloys although welding is also applied to the joining of other materials such as thermoplastics. Welding joins different metals or alloys with help of several processes in which heat is supplied either electrically or using a gas torch.

Welding technology has obtained access virtually to every branch of manufacturing; to name a few bridges, ships, railroad equipment, building constructions, boilers, pressure vessels, pipelines, automobiles, aircraft, launch vehicles, and nuclear power plants. Especially in India, welding technology needs constant upgrading, particularly in the field of industrial and power generation boilers, high voltage generation equipment and transformers, and in the nuclear aero-space industry.

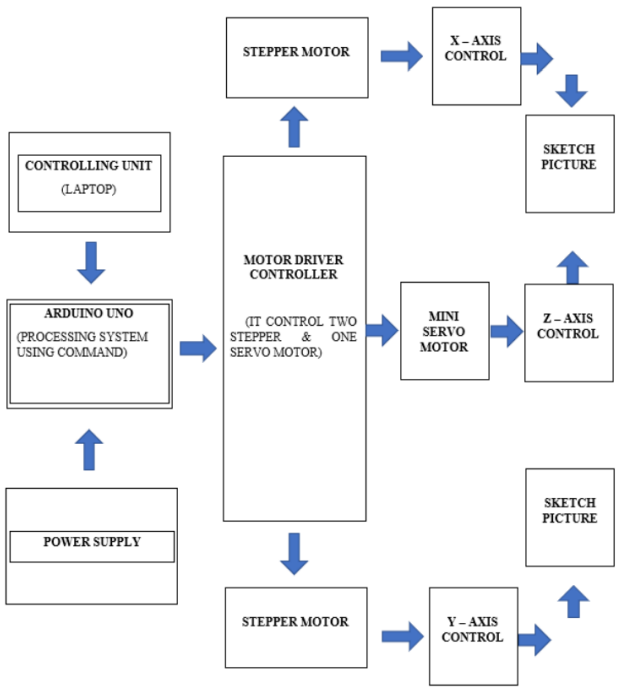
### 1.1 Theoretical background of the project

The project has been designed keeping in view the current technology and situation in India. There is a demand for trained welding fabricators in emerging companies for the welding works. Low-budget start-up companies are facing difficulty maintaining financial balance by paying a high amount to their employees. It is fact that most of the work orders require repeated work and of course, there is human error in work and also there is the possibility of wastage in infrastructure due to the errors made by fabricators in many cases. Thus, it is causing a lot for small-scale and medium-scale industries. So, it is not a smart move to waste such an important budget unnecessarily.

Although the idea of our project is original, several projects with similar functionalities can be found. For example, Kuka an industrial robot manufactured by a German company is employed in many industries similarly TM-1400 designed by Panasonic company is also employed in various high scale industries but the fact is, these robots bear a high cost.so it is difficult for small companies to invest such a big amount in infrastructure like this. The main idea of this robot is to provide a robotic welding fixture with higher efficiency in small-scale repeated works, it can also weld complex contour works. And all this will be achieved on a very low budget compared to the existing ones. It provides a good opportunity for the industries to invest in this robot rather than pay their employees.

## 2. System design

The block diagram showing the system functionality is shown in figure




### 2.1 controller unit

It consists of a microcontroller (Arduino UNO), Its Function is to receive inputs from the controlling panel(laptop) and transmit the required data to the Motor driver controller. The motor driver receives the feedback position from the servo and stepper motors and transmits it to the microcontroller. The microcontroller gives further motion control signals to the driver controller according to the contour given by the controlling unit.

### 2.2 L293D Motor driver controller (4-axis support)

It takes input control signals from the microcontroller and controls the servo and stepper motors to move in x, y, and z directions respectively.it is responsible for maintaining appropriate power to the motors and also receives position feedback from motors.it is wholly and solely responsible for motion control of servo and stepper motors.

### 2.3 Robot driving motors

It has 2 stepper motors and 1 servo motor for driving the robot. Stepper motors are responsible for the movement of the electrode(tool) in x and y directions. The Servo motor is responsible for the z-axis movement of the electrode. The motor driver is interfaced with the microcontroller to control the robot.

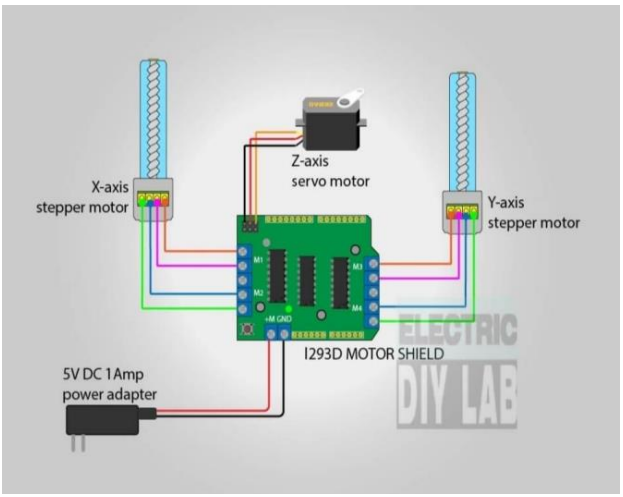
### 2.4 Tungsten electrodes

It is a non-consumable electrode.it is fixed vertically on the z-axis.it makes its motion along with the servo motor as it is attached to the servo motor. This electrode serves the purpose of welding in this robot.

## 3. WORKING MECHANISM:

This project is a CNC machine, it has two stepper motors on both the X and Y axis and a servo motor at Z-axis, an electrode is connected on Z-axis which is mounted on the Y-axis, The Z-axis is used to give up and down (depth) to the electrode. The machine welds the workpiece as per the given instruction in form of a G-code. The contour will be converted to G-code with the help of software, and then this G-code is sent to PLC with the help of Processing 3 software and the controller controls the movement of the motors with the help of a program which will be uploaded from the personal computer or manufacturer's computer unit and the machine will start welding the workpiece. The filler material can be introduced manually or automatically with the help of a motor roller.

## 4. OVERALL CIRCUIT DIAGRAM:

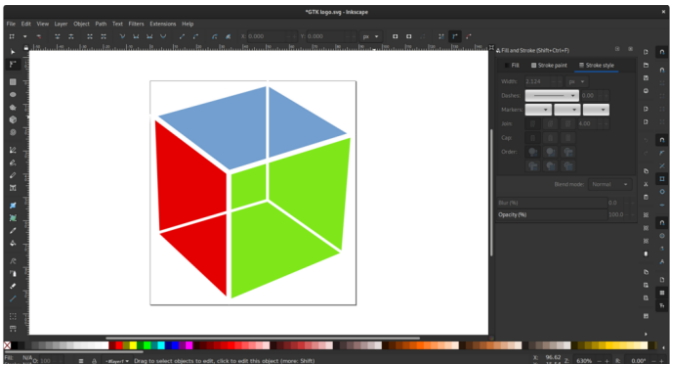



Arduino UNO is used as the brain of CNC machine, as we know the stepper motor used in CNC machine is not easy to control so here, we are using L293D (CNC Driver Shield) to control the movement of our stepper motors along with the servo motor. Stepper motor consists of 4 wires, it also has two coils which means a set of two wires from one coil, So the set of two wires are connected to the Driver Shield, same is done with another stepper motor. Remove the Yellow jumper and connect the wiring as per the circuit diagram. Also connect the servo motor at Servo 1 terminal of CNC Motor Driver Shield, in this way the wiring of CNC welding using Arduino UNO is completed.

Tungsten electrode along with its transformer is connected to supply power separately independent of the main circuit.

**5. Software's used**

INKSCAPE



Inkscape is a free and open-source vector graphics editor used to create vector images, primarily in Scalable Vector Graphics (SVG) format. Other formats can be imported and exported. Inkscape can render primitive vector shapes (e.g., rectangles, ellipses, polygons, arcs, spirals, stars, and 3D boxes) and text. These objects may be filled with, patterns, radial or linear color gradients and their borders may be stroked, both with adjustable transparency. Embedding and optional tracing of raster graphics are also supported, enabling the editor to create vector graphics from Figures and other raster sources. Created shapes can be further manipulated with transformations, such as moving, rotating, scaling, and skewing.

PROCESSING 3

Processing is a free graphical library and integrated development environment (IDE) built for the electronic arts, new media art, and visual design communities to teach non-programmers the fundamentals of computer programming in a visual context. Processing uses the Java language, with additional simplifications such as additional classes and aliased mathematical functions and operations. It also provides a graphical user interface for simplifying the compilation and execution stage.

Arduino ide

The Arduino IDE (Integrated Development Environment) employs the program to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program. Arduino is open-source software that is mainly used for writing and compiling the code into the Arduino Module. It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process.

**6. CONCLUSIONS**

In the latest field of technology concerning welding and machining, CNC Welding have huge success. Due to its improved weld quality and increased weld output, it can be used for precision welding of complex joints to automatically repair components in the industry. But due to its high equipment expense, it's been outnumbered by other advanced welding equipment like electron beam welding.

**6.1 Future scope**

1. It can be developed into laser engraving, printing, or cutting robots.

2 it can also be developed as a multi-function manipulator by changing its end effectors.

**REFERENCES:**

1) Girhe, Puja, Shubham Yenkar, and Arpita Chirde. "Arduino Based Cost-Effective CNC Plotter Machine." International Journal of Emerging Technologies in Engineering Research (IJETER) 6.
**2)** 2 (2018): 6-9. 2) Ahmed, B. J. S. A. A. "Design and Analysis Mini CNC Plotter Machine." (2018).
**3)** 3) Hong, Tang Sai, Morteza Ghobakhloo, and Weria Khaksar. "Robotic welding technology." Comprehensive materials processing 6. February (2014): 77-99.
**4)** 4) Bahrami-Samani, Mehrdad, et al. "Design and analysis of a welding robot." 2006 IEEE International Conference on Automation Science and Engineering. IEEE, 2006.
**5)** 5) Perzylo, Alexander, et al. "SMErobotics: Smart robots for flexible manufacturing." IEEE Robotics & Automation Magazine 26.1 (2019): 78-90.
**6)** 6) Manorathna, R. P., et al. "Feature extraction and tracking of a weld joint for adaptive robotic welding." 2014 13th International Conference on Control Automation Robotics & Vision (ICARCV). IEEE, 2014.
**7)** 7) Bharath, V. G., and Rajashekar Patil. "Solid modeling interaction with sensors for virtual reality welding." MATEC Web of Conferences. Vol. 144. EDP Sciences, 2018.
**8)** 8) Details about Arduino from "https://en.wikipedia.org/wiki/Arduino" & "https://www.arduino.cc