ARAtronics Research Center for
Opto-Mechatronics Engineering

ARAtronics Research Center,
Mechatronics Engineering Department,
Faculty of Engineering and Material Sciences (EMS),
The German University in Cairo (GUC)

Bachelor's Thesis, Term Project

Four Degrees of Freedom SCARA Robot Used for Laser Engraving

Supervisor (s): (**Assist. Prof. Dr. Eng.** Amir Roushdy) and (**Prof. Dr. Eng.** Imam Morgan)

The SCARA robot has 4 degrees of freedom which are driven by 4 NEMA 17 stepper motors and controlled using an Arduino board. We will use a 5.5W laser module which is good enough for engraving. A cool feature that we get with this SCARA robot setup is that we can have a bigger range of the Z-axis movement and so we can laser engraver taller objects. **There is a Lab Engineer from the ARAtronics Laboratory, guiding and directing the student with Assist. Prof. Dr. Eng. Amir Roushdy and Prof. Dr. Eng. Imam Morgan.**

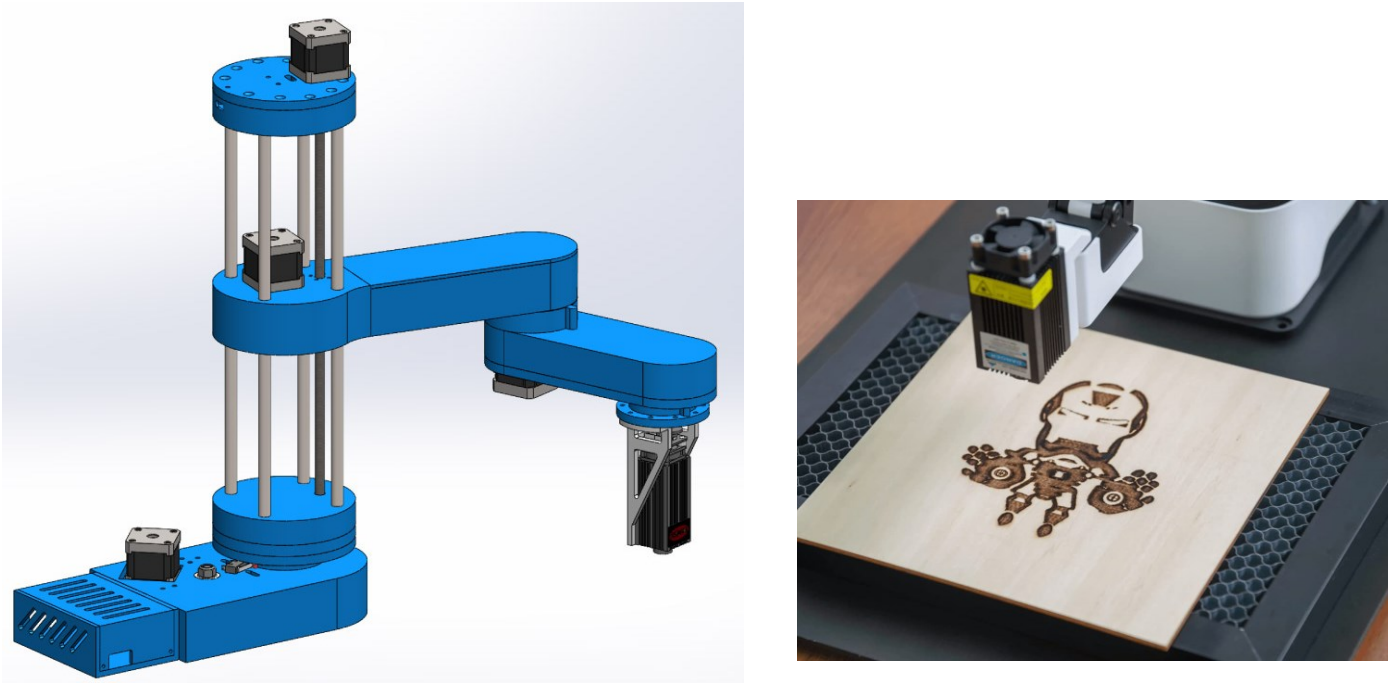

Fig.: 4DOF SCARA Robot for Laser Engraving

Project description and objective:

The working area is pretty impressive considering the small footprint of the robot. It can use the area in front of it as well as on both sides. We can actually set it up to use almost the entire 360 degrees around the robot as a working area. We can do that thanks to the open-source Marling 3D printer firmware which has options for laser engraving and SCARA robot setup. For generating the G-codes we are using yet another open-source software, Inkscape and a plugin for it called Inkscape-Lasertools. We can generate G-codes with contours only or with contours and infill from the same vector image, and we have various

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options like adjusting the laser beam, travel speed, infill speed, perimeter speed, laser on and off commands including PWM control of the laser and so on.

Research focus of this project:

- Literature review on the project should be studied properly.
- Not only, creating a software control system for the project but also the hardware.
- Experiments using the gadget and control system should be built properly.
- The outcomes must be documented.

Requirements:

- Passionate to learn more about Robotics, automation, Laser Engraving and control.
- Prior mechatronic design expertise is desired like "SolidWork".
- Enthusiasm for completing actual practical work with 3D printing staff (design fabrication and construction) and G-codes.
- Work with the open-source Marling 3D printer firmware which has options for laser engraving and SCARA robot setup.
- A method of working that is both structured and self-contained.

General tasks of the project:

- The complete design for the Robot is already exist in the ARAtronics Lab and the ARAtronics Lab Engineer will hand it to you from the first day.
- ARAtronics will support you with the CAD robot design on Solidwork. You, will adjust some parts on the design to fit with the motors and actuators in the local market.
- Fabricate the Robot using 3D printer.
- Assembly all parts of the Robot.
- Motion control study for the Robot.

Other notes:

- A weekly meeting with the advisors will be required for this project, as well as weekly progress updates (***The meeting could be more than once during the week based on your progress and based on your achievements***).
- You should to be in the Lab two days per week (***It could be more than two days based on your progress and based on your achievements***).
- All reports must be prepared in the style of a research paper.
- The outcome of this research will be published in one of the coming international Conferences and , or Journal

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