Build-a-Bot 3.0

Senior Problem Statement: Round 2

PARSEC 6.0 | 24–25 January 2026

Indian Institute of Technology Dharwad

The Handwriting Machine: Build Your Own Plotter

Background

From precision manufacturing to artistic robots, motion control lies at the heart of modern robotics. A true test of mechanical design and motion accuracy is translating digital motion logic into physical form. In this challenge, you'll bring your simulated plotter to life — constructing a compact, working handwriting robot capable of controlled 2D motion.

Objective

You are required to design, build, and demonstrate a **2-DoF handwriting robot** capable of drawing a **5 cm × 5 cm square** on a sheet of paper with an accuracy of at least **1 cm**. The system should be driven by stepper motors or servos and controlled via a microcontroller. The motion logic developed during Round 1 can serve as the foundation for your control strategy. Teams will have **24 hours** to complete this challenge.

Core Tasks

Each team must complete the following tasks within the given time frame:

- **Mechanical Assembly:** Construct a 2-DoF drawing mechanism that can move a pen in both X and Y directions. Possible configurations include:
  - Two parallel linear axes (printer-style XY plotter), or
  - A two-link arm mechanism driven by rotary joints, or
  - Radial arm mechanism.
- **Electronics Integration:** Interface your motors with the MCU of choice using the provided motor drivers. The control circuitry must be mounted safely and clearly on the provided foam base.
- **Control and Programming:** Implement firmware to control the robot's pen tip and trace the required 5 cm × 5 cm square. You may use direct motor commands, step sequencing, or any custom algorithm that achieves the target accuracy.

- **Drawing Demonstration:** Mount a pen and successfully draw the target square on a paper sheet. The pen should lift or pause at corners as needed for smooth motion.
- **Design Documentation:** Maintain a clear Bill of Materials (BoM) and provide short notes or schematics outlining your circuit, design, and control approach.

Constraints

- The drawing area must fit entirely on an **15x15cm paper sheet**.
- The drawn square must be approximately **5 cm × 5 cm** with a positional accuracy tolerance of **±1 cm**.
- Teams may only use the components provided in the part list below unless additional components are explicitly approved by the organizing team.
- The robot must be stable, self-contained, and safe to operate.

Bonus Task (Optional)

For teams seeking an extra challenge, implement an **automated printing pipeline**. Your robot should be able to:

- Interpret simple 2D image files (e.g., `circle.png`, `triangle.png`).
- Convert them into motion commands for the robot to trace the outlines automatically.

This can be achieved using image-processing scripts or G-code–like motion commands. Creativity and technical elegance in this bonus task will earn **extra credit** during evaluation.

Evaluation Criteria

Your project will be evaluated based on:

- **Accuracy:** How closely the square matches the 5 cm × 5 cm specification.
- **Design and Creativity:** Mechanical innovation and neatness of assembly.
- **Execution:** Smoothness and stability of motion, wiring, and control implementation.
- **Bill of Materials:** Clarity, optimization, and justification of used components.
- **Bonus (Optional):** Successful demonstration of automated image-to-drawing functionality.

Note: Teams Must implement the base task in order to get bonus points. Teams wont be awarded any bonus points if Base task hasn't been completed

Tentative Points Distribution

Criteria	Weightage (%)
Accuracy	30
Design and Creativity	30
Execution	40
Bonus	10

Detailed breakdown will be declared later

Submission and Demonstration

- Teams must present a live demonstration of the robot successfully drawing the target shape.
- The Bill of Materials and schematic (if any) must be submitted to the event coordinators before evaluation.
- Any additional components used must be pre-approved by the organizing team.

Resources

For guidance and reference, participants may use:

- ROS2 Humble Documentation