

			
<p><i>Blocks programming</i></p>	<p><i>D.I.E.G.O. wheeled robot</i></p>	<p><i>ARMando manipulators</i></p>	<p><i>MaraDrone UAV</i></p>

THESIS OVERVIEW

Educational robotics can make robotics, programming, and control more accessible to students, but modern robotic frameworks such as ROS2 often require a steep learning curve. This thesis aims to bridge this gap by developing a visual programming environment that allows students to control real and simulated robots through intuitive block-based programming.

The goal is to develop a **visual programming environment** for ROS2-based educational robots. The student will design a high-level block-based language (movement, sensors, control, communication) and a library of didactic activities (obstacle avoidance, line following, exploration) calibrated for the available robot platforms. Usability will be validated with a small group of students, measuring learning time, usability, and user satisfaction. The work includes testing in simulation and experiments on real hardware.

TOOLS

Hardware: differential drive robot, 4-DOF manipulator with gripper, quadrotor drone

Software & Framework: ROS2 (Humble), Blockly / Scratch 3.0, Electron, Node.js, Gazebo GZ Simulator, Python, C++, Docker, GitHub Actions

SUPERVISOR

Prof. Mario Selvaggio - mario.selvaggio@unina.it

TECHNICAL-SUPERVISORS

Dr. Simone D'Angelo - simone.dangelo@unina.it

KEYWORDS

educational robotics; Scratch; ROS2; Blockly; sim-to-real

EXAMPLES / POSSIBLE ACTIVITIES

• Track 1 – High Level Block Programming Language

Design a drag and drop interface that translates visual blocks into ROS2 commands toward existing low-level nodes. Replicate already implemented functionalities (movement, sensor reading, grasping) as visual blocks, offering a complete graphical rewrite of the robot primitives. Develop a set of custom blocks and didactic documentation, then validate usability with a small group of students.

• Track 2 – Open-Source Platforms for Education

Design and upgrade the available low-cost, modular open-source robotic platforms (aerial manipulator, rover, ground vehicle) with **standard mechanical and electrical interfaces** enabling easy combination and interchangeability of modules. Develop custom CAD, electronics, and a ROS2 stack. Validate through educational scenarios. The students will produce documented open-source kit with plug-and-play interfaces for rapid prototyping in robotics courses.

PREREQUISITES / NOTES

Recommended courses: Robotics Lab, ROS programming.

Recommended skills: Python/C++, familiarity with ROS2 (topics, services, actions).

Target degree: Master's in Automation and Robotics Engineering.

RELATED BIBLIOGRAPHY

- ROS2 Documentation – <https://docs.ros.org/en/humble/>
- Blockly – <https://developers.google.com/blockly>
- Scratch3ros – <https://www.scratch3ros.com/>