

Design and prototyping new platform for MSE 110 labs using Arduino MCU

Status:	Filled
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Project Description

Background

With the advancement in hardware and software technologies, there is a need for an alternative platform to replace the current robotics kit, LEGO Mindstorms EV3. The new platform exposes students to up-to-date hardware (MCUs, sensors, and actuators) and software (Python and/or Embedded C), and improves students' opportunities in learning fundamental sections of an advanced robotic system.

Although EV3 is a powerful device, being portable enough to be integrated on a LEGO robot, it:

- is powered by the ARM-9 processor and runs on the Linux OS, where the design inside cannot be accessed by students;
- uses ROBOTC programming language, of which the application is presently limited in real world;
- **works with** 4 different sensors (touch, colour, gyro, and ultrasonic), and 2 types of motors (medium and large), if Educational EV3 is used. Therefore, students are limited to those sensors and actuators that come with LEGO EV3 kit.

Specific Goals

This project aims to design and develop a robot to substitute EV3. While maintaining the original goals defined by learning objectives for a first-year course, the development of the custom-designed robot would help students to:

- become familiar with a more widely used programming language in industries and academics, such as Python and/or Embedded C;
- have a deeper understanding of MCU by being able to access the actual and popular MCU inside, such as STM32 family, Raspberry Pi, or Arduino;
- experience a wider range of sensors and actuators, and parts and/or components actually available in the market;
- enhance creativity with more opportunities to come up with new and different designs.

For long-lasting usability, the new robot is desired to feature:

- including hardware (MCU, sensors, actuators), software, and mechanical design;
- broken parts replaceable with available items in the market;
- more room to add different parts or designs, if necessary, especially when the source code and related documents are developed from scratch. Thus, the new robot can perform projects other than those already proposed by LEGO, and bring about more possibilities for creating new projects/labs;
- : many cost and fee items structured in EV3 price, such as R&D and marketing fees, possibly avoided because the new robot is designed in-house from scratch.

Approach and Requirements

The system will be designed and implemented, using components available at the school and/or market as well as custom-built parts as needed. The new robot will use the available mechanical parts from LEGO EV3 kit because they can be easily used in assembling different designs and allow students to be more creative with different mechanical designs. The project team will be responsible for other electrical, software designs, as well as prototype building. The processor will be integrated in a brick-like enclosure with mounts/holes for easy assembling in different mechanical designs. This enclosure is expected to act as a replacement for the EV3 Brick, i.e., matching I/O, display, and the overall peripheral.

- The prototype design should be driven by mass production possibilities;
- Deliverable documents should be well written and easy to read/understand. Lab handouts for different projects/labs should be designed and prepared for students.

Deliverables

- Functional prototype;
- Source Codes;
- Sample Programs;
- User Manual, labs