Developing a Laboratory for Engineering Education in Mechatronics

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Introduction

A report on development of a mechatronics lab for mechanical engineering.

- Labs are designed to align with learning outcomes and graduate attributes.
- Labs rely on low cost mass market electronic devices and open source software.

Figure 1- Students in the redesigned mechatronics lab

The Microcontroller

Experiments are designed with the microcontroller as the focal point.

- Arduino microcontroller chosen for availability and ease of operation.
- Focus on practical application rather than microcontroller architecture.

Figure 3- Arduino microcontroller as the focal point of mechatronics lab

Actuators and Sensors

A variety of low cost actuators and sensors are introduced, interfacing with microcontroller.

- Actuators chosen to emphasize learning outcomes.
- Employed user-developed open-source software.

Figure 4- Experiments developed with actuators and sensors interfacing with microcontroller

Student Feedback

Labs were met with universal student approval, feedback included:

- "Very fun and practical applications."
- "Labs were challenging but very useful."
- "Lab is really interesting. Doesn't happen often enough."
- "Lab is cool and interesting."
- "The labs were somewhat challenging but really interesting and beneficial."
- "I enjoyed the labs a lot it was fun to learn about micro processors."

Syllabus and Learning Outcomes

- Application of electromechanical actuators.
- Common devices for sensing and measurement.
- Design of basic mechatronic systems with sensors and actuators.

Figure 2- Mechatronics lab was redesigned to match learning outcomes

The Mobile Robot

The microcontroller is combined with sensors and actuators to create a mobile robot.

- Group project involving programming and operation of a mobile robot in obstacle avoiding perpetual motion.
- Combines skills from multiple experiments into a final lab.

Figure 5- Labs culminated in a group project on a mobile robot

Graduate Attributes

- *Use of Engineering Tools*
Modern engineering tools including the microcontroller, actuators and sensors were incorporated.

- *Design*
The partly open-ended mobile robot project encourages students to cooperate and experiment to solve an engineering problem.

Figure 6- Students testing their programming on obstacle avoiding mobile robot

Challenges and limitations

- Low-cost devices pose reliability issues.
- Arduino IDE is simple to use, but not sufficient for industrial practice.
- Open-source software availability discourages discovery.
- Dedicated data acquisition hardware advantageous.
- Assessment of project-based labs can be improved.
- Time, prerequisite student skills are limiting factors.

Literature cited

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