Projects Based On

Development and Control of Autonomous Systems (e.g. robotic vehicles, automated assembly/measurement platforms)

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Area: Electronics, Computing, Communications – Projects most suited to undergraduate students on electronic engineering, with computing or with communications degrees

Sub-area: Software design/implementation including hardware/software interfacing

Nature of Project: Mixture of mechanical construction (from kits of parts), electronic construction (of varying levels), software development, including control algorithms and communication with multiple external devices (e.g. motors, sensors, etc.)

Relevant Modules in Year 2: Elements of H62SED, H62SPC, H62ECP, H62ELD useful

Relevant Modules in Year 3/4: Not essential to be taken, but of related interest might be H63END, H63ESD, H63RDC, H64INM/L

Distinctive skills to be gained as a result of the project

Students will gain experience of the full engineering cycle from developing ideas and designing solutions to solve specific engineering problems through to their ultimate implementation and demonstration. Students will gain experience across a breadth of areas including mechanical and electronic construction, motor control, the selection and use of sensors, design of control algorithms and their implementation in software.

Project Descriptions

The primary aim of any of these projects will be to construct a robotic vehicle or robotic arm from a one of selection of commercial-off-the-shelf kits (from Seeed Studio [1]) or pre-built mechanical systems.

Examples of robotic platforms, both wheeled and tracked, all driven by servo motors.

The project will initially involve the development of appropriate systems to move the vehicle/arm, either using commercial servo motor drivers or user-developed electronic drive circuitry. The control will be implemented using a single board micro-controller such as an Arduino [2], the programming of which requires a basic knowledge of C/C++. For

more advanced applications, however, the use of a more powerful controller (e.g. Raspberry Pi [3]) may be considered.

Examples of a commercial motor drive (left); Arduino (centre) and Raspberry Pi (right).

Sensors will be incorporated to allow the vehicle to navigate and sense its environment. Other devices may be used to monitor and/or log the position/location of the vehicle or movements undertaken by the robot. Additional sensors, controls and displays may be added to allow provide further functionality, alternative control methods and feedback to the operator, respectively. In some cases, these may be commercial modules, while in others it may be necessary to develop simple sensors and the associated electronics.

Examples of (left-right) sensors for light and temperature, a joystick controller and LCD.

Example Projects

The distinguishing features of each project offered will be in the specific application of (or functions accomplished by) the robotic vehicle/arm. Some examples might include:

- Simple vehicle navigation (e.g. following a line or object, etc.)
- Advanced vehicle navigation (e.g. completing a maze, avoiding obstacles, etc.)
- Mapping of terrain (e.g. with data logging, image capture, etc.)
- Motorised conveyors and robotic arms to move/inspect/sort objects
- A task of your choice

Generic Aims and Objectives

- Apply appropriate engineering design methodologies to solve to specific problems
- Construct a basic autonomous system, controlled by an Arduino or equivalent
- Interface sensors and other devices/circuits (which may need designing/ constructing) with the Arduino in order to provide additional functionality to the system
- Implement more advanced control algorithms to once again provide additional functionality to the overall system

Type of bench table needed

Construction/testing (plus appropriate storage for project work)

Key References

[1] Seeed Studio: www.seeedstudio.com

[2] Arduino: www.arduino.cc

[3] Raspberry Pi: www.raspberrypi.org