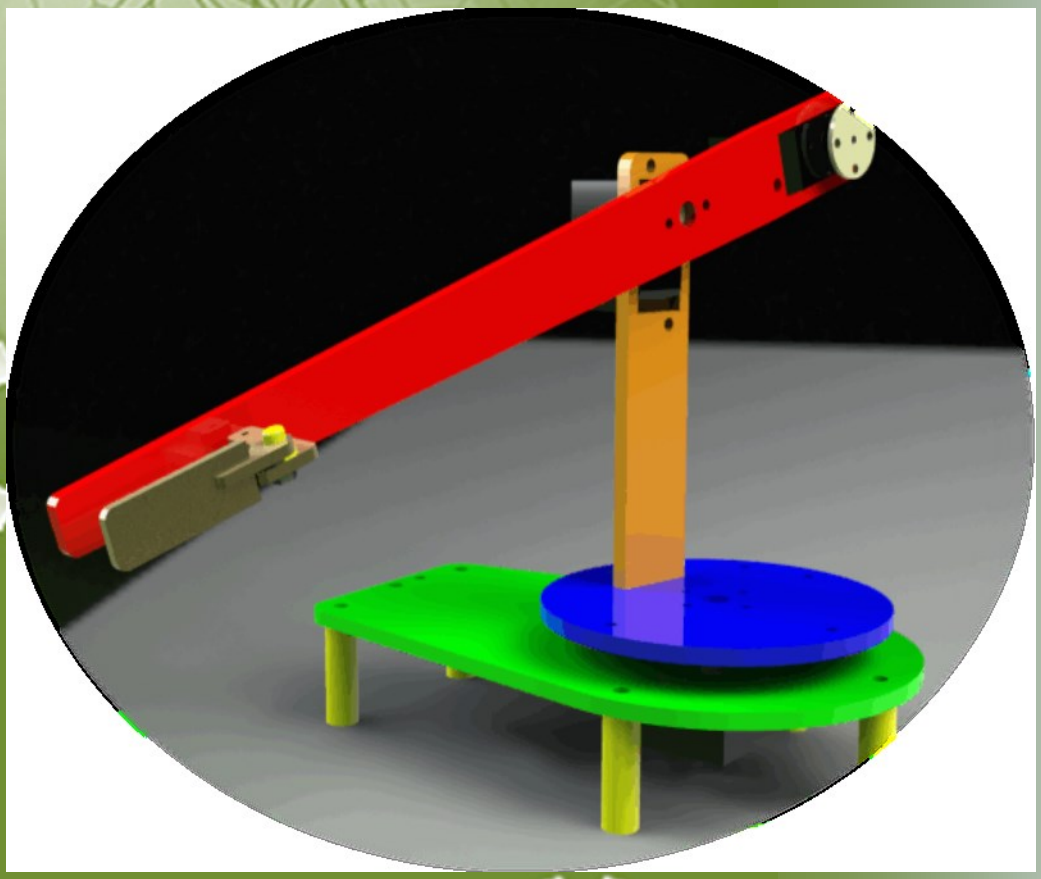
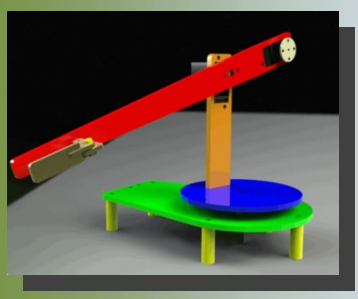
Technology Subjects Support Service

Sample L.C. Technology Classroom Control Project



Sample L.C. Technology Classroom Control Project

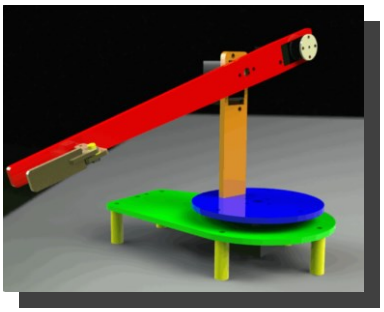
PDST An tSeirbhís um Fhorbairt Ghairmiúil do Mhúinteoirí | Professional Development Service for Teachers



(c) Galway Education Centre 2011

Leaving Certificate Technology – Classroom Control Project

Pick and Place 3 Axis Robot



Design Brief

Design and make a 3 Axis Pick and Place Robot which is capable of moving a small load from one position to another.

1. Introduction.

This project is a 3-Axis Servo controlled Robotic Arm which is capable of moving an object from one position to another.

The key focus areas of this project are:

1 The introduction of robotic control and applications.

2 The use of control software to:

- control a number of servo motors
- respond to feedback from sensors

3 The use of CAD/CAM systems in support of design development.

2. Year Group/Term

This project would be suitable for the end of fifth year / start sixth year.

3. Syllabus Topics & Learning Outcomes.

The Project may be used to cover elements of the following syllabus areas:

Design: Using a model to test a design and plan a sequence of manufacture.

Communication: Using computer graphics software (SolidWorks) to develop and visually represent ideas

Materials: Developing skills in marking out and/or cutting using CNC Router. The assembly of components and finishing acrylic.

Structures: Describe and analyse the effects of forces acting on a structure and also to carry out some simple calculations of moments.

Robotics: Identify robot types, understand what is meant by degrees of freedom, work envelope, end effectors and understand the principles of controlling servo motors.

Quality Management: Identify, estimate and classify the costs associated with a product and the relationship between cost and quality.

Manufacturing Systems: Devise work cells for simple processes of manufacture, assembly and packaging.

Aims:

- To introduce students to robotics and robotic control using servo motors and control software.
- To design and select suitable materials for construction of robot, and to perform calculations to determine moments of force.
- To develop an understanding of analogue signals, and how to utilise them to provide feedback when controlling robotic movement.

Learning Outcomes:

- Students should be able to identify robotic structures and configurations suitable for specific tasks.
- Students should be able to programme a robotic device to do specified tasks and to be able to modify outputs in response to sensed conditions.
- Students should be able to perform simple calculations of forces and moments.
- Students should be able to select/design suitable grippers for various automated processes.
- Students should be able to identify industrial applications of robotics.

4. Prerequisite Knowledge:

Experience of manufacture and assembly of various projects, including circuit boards. Use of CAD/CAM systems and a basic understanding of PIC's and programming software.

5. Specific Equipment.

3 servo motors and a suitable PIC control board.

6. Materials Required

3mm & 5mm acrylic sheet, 1.5mm diameter brass/ steel rod. 3 servo motors with attachments. PIC Board and components, download cable and programming software.

7. Suggested methodology:

There are a number of approaches to this project depending on the ability of the students and the time available.

Option 1.

Basic control of servo motors using control software to programme a 3 axis robot arm. The arm is to move to various locations and provide pick and place capabilities.

Option 2.

Design a separate control panel to provide manual control

- of two axis using two potentiometers.
- to operate a gripper using an LDR

Option 3.

Challenge students to design a robotic system which will separate different coloured balls / blocks into various containers.

8. Procedure/instructions/ information.

See attached drawings for constuction/assembly details

9. Health & Safety:

The Technology room Health & Safety rules and regulations apply.

Hazards specific to this project include the following:

- Hot Tips associated with the use of the soldering. The risk of burns or damaging surfaces can be mitigated by the use of suitable stands.
- Soldering to be carried out in a well ventilated area.
- Potential bonding of body tissue due to the use of Super Glue Gel.
- Possible cutting from metal swarf on the end of 2mm diameter rods. Students' attention should be drawn to this hazard and the mitigation of the risk by removing the swarf with a file immediately after cutting.
- Sharp end of rod, should be protected at all times to prevent eye injuries etc.

10. Integration of Options.

Applied control systems, levers / linkages/ mechanisms, moments of force, degree's of freedom, hybrid manufacturing systems, material selection and properties, assembly and application of control circuits, use of CAD/CAM systems.

11. **Assessment:**

Quality of working drawings and presentation.

The successful use of control software in programming a 3 axis robot arm. The integration of analogue sensors to provide feedback.

The functionality, quality and finish of the final product could be assessed by the teacher.

Portfolio Integration:

Alternative designs of robotic arms - 5 axis robot etc.

Various designs of grippers for a range of applications.

Robotic applications in industry, home, medical, space etc.

Walk through programming and its applications.

SolidWorks drawings and animation

The use of sketching / rendering.

12. Suggested Links:

T4 Resource CD/Website
Resources by Topic/Core: Gears,
Intro. to Structures & Mechanisms etc.
Assembly, Finishing materials.
Applied Control option

Useful Websites:

www.t4.ie

www.technologystudent.com

www.flyingpig.com

www.robives.com/mechs

www.Arexx.com

http://www.servoshop.co.uk/

www.lynxmotion.com

www.mindsetsonline.co.uk

http://www.sparkfun.com/products/9032