PBLE: Competition Entry

(Complete according to the accompanying guidelines before this document)

Name(s) of entrant(s)	Dr Roger Penlington
Institution	Northumbria University
Faculty / School	School of Engineering and Technology
Department	School of Engineering and Technology
Degree Programme(s)	Engineering and Technology Foundation Year (inc. Elec. Electronic Eng., Mech. Eng., CAE., Computer Network Tech., Prod. Design Tech.,)
Award(s)	Access course to BEng Programmes within the School of Engineering & Technology. Year(s) of study 0
Title(s) of Module(s)	EN006 An Introduction to Engineering Design & Problem Solving
Project Title	A servo motor controlled electromechanical device
Module Credits	20 of year total 120 % project assessment 50
Project deliverables	A range of knowledge supporting skill based tasks including the ability to tackle design and make engineering problems by 'thinking and describing'.

Industrial/ Professional Involvement ~~**YES**~~**/ NO** but submitted to External Examiner and IMechE accreditation

Group Project: **YES/** ~~**NO**~~ Group Size 3 or 4 Group Selection: ~~**TUTOR**~~**/STUDENT/**~~**SEEDED**~~

Synopsis of Project (max 100 words)
Describe the nature, objectives, structure and methodologies of the project

The project serves to give the students the opportunity to demonstrate a range of skills/knowledge acquired earlier in this module and other modules of the Foundation Year. The students are encouraged to develop a structured approach to a design project through a series of linked problem solving tasks which may require them acquire specialist knowledge or develop key skills. A specific feature of the project is its suitability for students from a range of backgrounds, prior learning experiences and intended undergraduate programmes. To meet these objectives the project is based upon an electro-mechanical task powered by PC controlled servo motors.

Intended learning outcomes of the project

The project sets out to introduce and develop the following areas of basic knowledge, problem solving and design skills:

- the application of simple theory to engineering applications.
- simple electromechanical devices.

It will also contribute towards the following module learning outcomes;

The student will be able to:-

- Analyse a problem, break it down into constituent parts and recognise the knowledge required for a novel solution.
- Employ an interdisciplinary approach to describing the solution to electromechanical design problems.
- Demonstrate the ability to plan and control the progress of group work.
- Tackle engineering problems by 'thinking and describing'.

Student Selection

How are projects assigned to students? In addition, if a group project, how are the groups formed?

The project task is common to all groups, electrical, mechanical or computer networking, and incorporates a notional competitive element with which to finish the second semester. Due to the diverse cohort, prior experience and key skill level the specific direction, or difficulties faced, of each group will differ but the generic similarity of the task will aid the supervision and assessment task. Students will select their own groups, possibly with prompting to remove indecision, often informed by their prior experience of earlier group work.

Some students are aware of specific ability or skills within the group and plan their membership, others select on motivation grounds – not wanting a poor attendee in their group.

The application of a guiding hand to indecisive groups often serves to generate an complementary cultural mix, with the students finding unknown talents.

Project Implementation

Describe the activities a student would undertake during this project

As an activity for Foundation Year students the project serves many purposes but has been designed to do this in a regulated manner through identification of sub-tasks. If they have a task related to the acquiring of some specific knowledge then their understanding of that will take priority over their presentation of the knowledge. By structuring these tasks throughout the project and regularly reviewing progress and direction then students can work on their weaknesses whilst being confident of their strengths.

The students are not aware of all the project details at the start, they are given the title, this year 'A servo motor controlled device' along with the project aims, learning outcomes duration etc. Broader aspects of the project will be discussed and then the first sub-tasks will be outlined, for example, 'to develop a basic understanding of cams, gears and levers'.

As a 12 week project it is important with these inexperienced learners to have clear milestones and to review and reflect upon progress at predetermined points. These reviews are initially weekly but later less frequently and require the group to complete a record sheet which includes a simple reflective commentary. These sheets together with a small amount of design work are record of the 'process' which can then form part of the assessment.

The class size of around 25 is supervised by two staff members within a space which allows free access to open bench space, a workshop, experimental and test facilities and computing facilities. At present the only facility not locally available is a photocopier, which forces the students to be more innovative within their communication and hopefully develop their sketching and summarising skills which were introduced earlier within the module.

The students make full use of these facilities for the 'design and make' portion of the project.

Project assessment

Describe how this project is assessed. If appropriate, include details of moderation and/or marks allocation.

The project serves several purposes, as described by the aims and learning outcomes, in addition to developing an understanding of the students responsibility to the learning process. Assessment

becomes complex were there is process and outcome. With traditional approaches to assessment the process would be incorporated as formative assessment and the outcome providing the summative component measuring achievement for progression. In this case the process is accumulated into the summative assessment, although it is seen as important that the weighting of the various components is not stressed to the students to avoid 'enough to pass' weak effort. For this reason a process to outcome ratio of 60:40 is used, I am most interested in the process and the student is motivated by the outcome, if the process is strong then it may be expected that the outcome will also be strong and it would not reward a group not engaged in the learning progress but able to generate a strong outcome.
The approach employed with this project is to develop a measure of student performance during the process which is a record of the formative review process. During the project the student is engaged in the review and reflection process whilst being aware of the future summative use of the forms. This focuses the students attention on the immediate task, i.e. the development of their learning skills, whilst the student sees it as efficient because they are aware that these sheets, with the addition of a final reflective summary, serve the purpose of their final report – thus removing a later task.
As the project is supervised by two staff the opportunity to develop a confidence within the continuous generation of a final assessment. Significant feedback is given to the students, ranging from verbal guidance and encouragement, written comments and targets on the review sheets and then a final summary with the summative measure of achievement.
The final outcome is internally moderated, although the moderator will also informally observe students during the process, and also subject to evaluation by the Programme External Examiner.

Supporting Students
Describe the facilities made available to the students undertaking this project.
Describe how your institution's staff supports the students undertaking the project.
Student support is a significant feature of the Foundation Year, with a diverse intake and serving to prepare students for engineering and technology undergraduate programmes, motivation and preparedness for HE are key issues. The project has been designed to incorporate the support of 'Personal Development Planning' (PDP or Progress Files). The project is supervised by the Programme Leader and another member of staff who also delivers another module – this serves to give some familiarity and also linkage between 'knowledge' and 'skill' components of the programme.
During the process of the regular project progress review meetings and the students filling in the review sheets they are expected to; "Reflect upon your process so far, *Did you plan well?, How well did your group work together and how will you approach the next weeks work?, Have you developed the knowledge that you may need?"*. The review sheets are appended by some supervisor comments and retained by the student.
The design space and workshop facilities are available to students outside time-tabled hours and technician support is also available.

External Involvement
If applicable, describe any external involvement
Not applicable

Project Design and Development
Describe how this project evolved to its current form (if appropriate, provide some historical context)
Two years ago the Foundation Year was restructured to restore alignment with the School's undergraduate portfolio. At this point it was seen that a module which consolidated the students' knowledge base by application of key skills within a framework of problem solving would encourage thinking, stimulate a learning culture and enhance the experience of the Foundation Year students.

Between the first and second years of delivery the structure of the review meeting was reinforced and revised. In addition the module is now delivered to larger cohorts by the use of two staff (moving from 1:16 to 1:12.5). It is planned that the review meetings will become 'paperless' by the use of a networked progress review and record system.

The incorporation of PDP within the module has been a function of the students' reluctance to record their 'reflection' upon their learning process whilst recognising the value of such an activity.

Project effectiveness

Describe what you think makes this project an effective teaching tool.

How are project resources managed to ensure the effectiveness and efficiency of this project?

The project seeks to consolidate the learning experience for the Foundation Year students by generating a sequential project based problem solving environment.

The use of two staff for time-tabled groups of 25 students allows considerable flexibility for student motivation, similar to a 'good cop, bad cop' scenario. Having students working within a large and varied physical space allows discussions with students not to be overheard and also strategic discussions between staff not to be overheard.

This strategy has proved effective at reaching the majority of students although there is clearly a difficulty in encouraging students to engage is reflection and timely planning of their project based learning activity This is to be further addressed in the next stage of the project evolution.

Student feedback

Please provide an anonymised summary of student feedback of the project. Where applicable, explain how any issues raised have been addressed. How does student feedback demonstrate the use of this project as a good teaching tool? Have developments occurred to improve the process as a result of student feedback?

There is a difficulty in obtaining direct student feedback for the projects based learning within this module – as the project is the last activity within the academic year feedback can only be obtained prior to the final assessment of the projects. Clearly the students are not in a suitable position to comment upon the full learning process.

Given this, there is an indication that the students are motivated by the ability to engage in an design and make project which allows them to take part in an overarching demonstration of their abilities.

If a student has progressed to this point in the academic year then it is likely that they intend to progress to their choice of UG programme, therefore they will be fully engaged within the learning experience. Verbal feedback to the module tutor during staff/student liaison meetings suggests that the students are not only pleased with the nature of these projects but find the nature of student support beneficial.

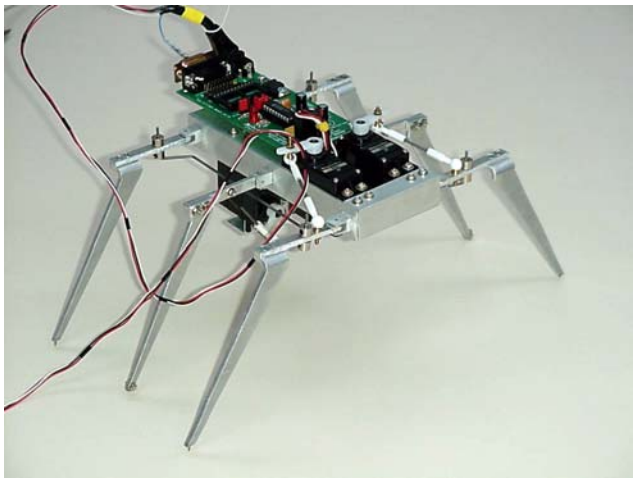
Innovation

Are there any features of your project you consider to be innovative or noteworthy?

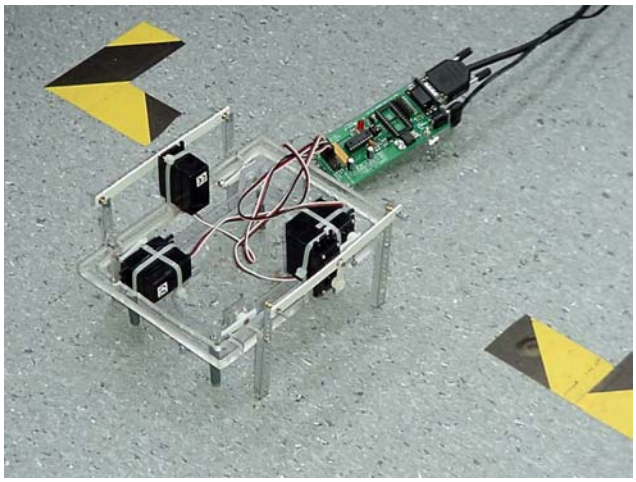
This project is innovative, in relation to other design projects, in that it incorporates more emphasis upon the process and developmental problem solving than upon the final product. It is a motivation and learning support module, ideally suited to project type work, where a prime aim of the module is for students to take on responsibility for their learning. The current mechanism of paper records for the progress review meetings is to become PC based where the students will be able to develop an electronic archive of their progress in a shared group database.

Due to the wide range of programmes supported by the Foundation Year it is vital that any project is seen to have elements relating to each specialism, using PC serial controlled servo motors allows students to write code, produce controller boards and motion devices to a depth of learning to suit their future programme needs.

Two examples of final devices are shown below, they illustrate the significance of assessing the process as well as the outcome. The first device is well crafted and of a more complex design whereas the second device although of a more basic construction actually was far more efficient in terms of operating and presented more learning challenges. When it cane to the final demonstration session the second device reached its goal with ease, the first found little purchase on the floor – having been tested on a carpet.



This walker demonstrated good skills but although of good appearance presented fewer problem solving opportunities.



This walker offered more developmental challenges and as such provided a deeper learning experience.