

Developing Project Management Skills Through Using Robots


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Workshop Format

- Why project based learning? (James Flint)
 - Issues and strategies for group work.
 - How we deliver a group project based module.
- Briefing for your workshop group task. (Chin Panagamuwa)
- Working time (approx. 45 minutes.) (Peter Godfrey)
- 'The Event'.
- Roundup and discussions.




Why project based learning?

- Engages enthusiasm and creativity.
- Clear sense of purpose - not 'learning for learning's sake'.
- Self-differentiating – harder projects generally attempted by more able students.
- Development of key skills through practice.



Issues for group project work

- Potential for conflict.
- Robustness of assessment (who did the work?).
- Mark distribution.
- Can be dominated by one or more group members.



These issues are worth overcoming

- It's realistic. In particular, the concept of joint responsibility for a deliverable is a fact in many employments.
- Students learn a lot from informal peer assessment/feedback.
- They are encouraged to learn key skills without explicit instruction or exercises.
- Encourages creative engineering – valued by employers.

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Philosophy adopted

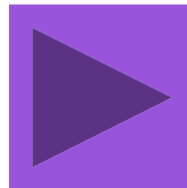
- The assessment of group work should award individuals who perform well in a team.
- Group members should take joint responsibility for deliverables.
- Dispute resolution and avoidance is a skill in group work.



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Triskaidekaphobics look away...

- The example module (code ELB013) is called ENGINEERING PROJECT MANAGEMENT.
- Taught to second year students over two semesters.
- Various assessments to encourage engagement of students.
- The task is to develop a robot which competes in a 'Robotic Olympics' at the end of the teaching.



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Assessment

**Management report (15%)
Week 10**

**Minutes from one
meeting (15%)
(5 days after the meeting)**

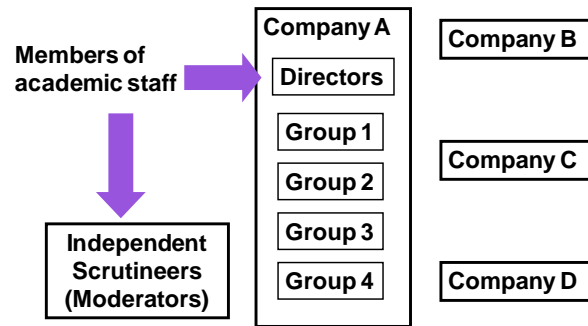
**Attendance and group
interaction (20%)
(Continuous assessment)**

**Presentation (15%)
Week 20**

**Technical achievement (35%)
Data sheet: Week 19
Demo/Olympiad: Week 20**

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Group organisation



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Directly taught elements

- Management theory.
- Time planning.
- Technical skills, including soldering (delivered largely by technical staff).
- How to write a technical data sheet,
- Presentation skills.
- Human factors.
- Team working and analysis.

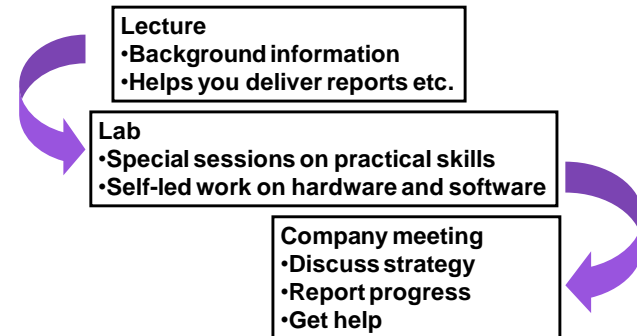
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Extensive use of VLE

Discussion	Started by	Replies	Unread	Last post
Feelers	Joshua Samuel Davis	1	0	Christina Panagiotou Fri, 19 Nov 2008, 16:42 AM
Air Powered (shot Put)	Philip James Day	1	0	Christina Panagiotou Fri, 19 Nov 2008, 12:17 AM
Adding extra power supplies	Christina Panagiotou	0	0	Christina Panagiotou Thu, 13 Nov 2008, 01:48 AM
Information for groups with USB Bee-Bots	P.J Godfrey	0	0	P.J Godfrey Thu, 20 Nov 2008, 04:43 AM
Code supplied with the Bee-Bots	P.J Godfrey	0	0	P.J Godfrey Fri, 04 Dec 2008, 12:21 PM
Code supplied with the Stampbug	P.J Godfrey	0	0	P.J Godfrey Fri, 04 Dec 2008, 11:08 AM
Stampbug and Bee-Bot information	P.J Godfrey	0	0	P.J Godfrey Fri, 04 Dec 2008, 12:38 AM

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The project day



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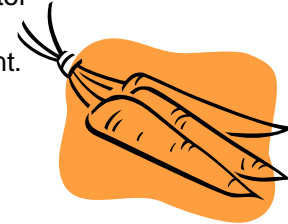
Conflict resolution method

- Confidential self assessment ONLY after feedback on group assessed elements.
- Students must provide evidence that they have attempted to engage absent/sleeping group members.
- Marks can only go up.
- Very rarely used mechanism (though openly available).

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The event – the ‘carrot’

- ... is completely separated from the assessed elements.
- ... provides a strong motivator for the outcomes without jeopardising the assessment.
- ... is liked by students(!)
- ... has educational value.



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A screenshot of a news article from 'news@lboro'. The article is titled 'Robotic athletics challenge students' and is dated 'Issue No. 28 July 2009'. It features a photograph of four students in business attire. The text describes a project management module where students worked on a 'StampOlympiad' challenge. The article mentions that the students worked in teams, with some acting as directors and others as team members. It also notes that the students received a weekly board meeting and that the competition was a success, with individual prizes awarded to several students.

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Boe-bot robot kit



- Boe-bots bought in kit form for about \$160
- Constructed robots given to students at the start of the project
- Additional coding and electronics developed by students

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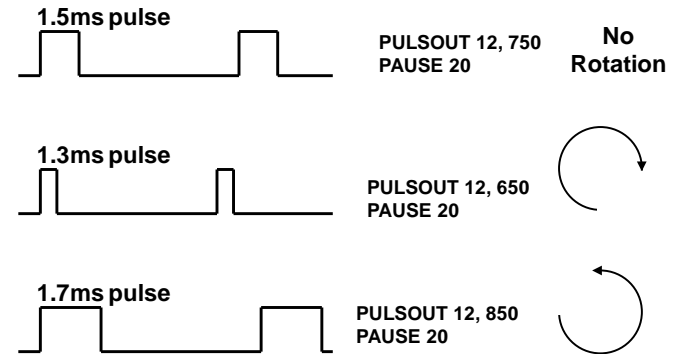
Motors



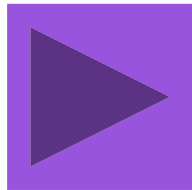
- Boe-bot fitted with two continuous rotation servo motors
- Mounted in a mirrored fashion – one rotates clockwise and the other anti-clockwise for the robot to move forward
- Servo motors are controlled using pulses to pins 12 and 13
 - Pin 13 – left motor
 - Pin 12 – right motor



Servo Control



Student group project

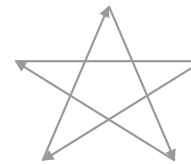


- Orienteering event required remote control of the boe-bot
- Task was to navigate the obstacle course as quickly as possible to reach the token
- The token had to be returned to the start point



Today's Task

- Program Boe-bot to travel along a path that describes a N-point star and return to the starting point
- It must cross a previously taken path at least once
- Error between the start and finish points should be as **small** as possible
- Number of points in the star (N) should be as **large** as possible



N = 5



Determining winner

- The winning team will have the **lowest** score calculated from the following equation:

$$\text{Score} = \frac{\text{Error distance (measured in mm)}}{\text{Number of points in star (N)}}$$

- Consider carefully the advantages and disadvantages of increasing N



Movement subroutines

Forward_Pulse: Left_Pulse:
 PULSOUT 13, 850 PULSOUT 13, 650
 PULSOUT 12, 650 PULSOUT 12, 650
 PAUSE 20 PAUSE 20
 RETURN RETURN

Backward_Pulse: Right_Pulse:
 PULSOUT 13, 650 PULSOUT 13, 850
 PULSOUT 12, 850 PULSOUT 12, 850
 PAUSE 20 PAUSE 20
 RETURN RETURN

- The four movement subroutines provide very small movements
- Repeat calling of the subroutines result in larger movements



Example code -Triangle routine

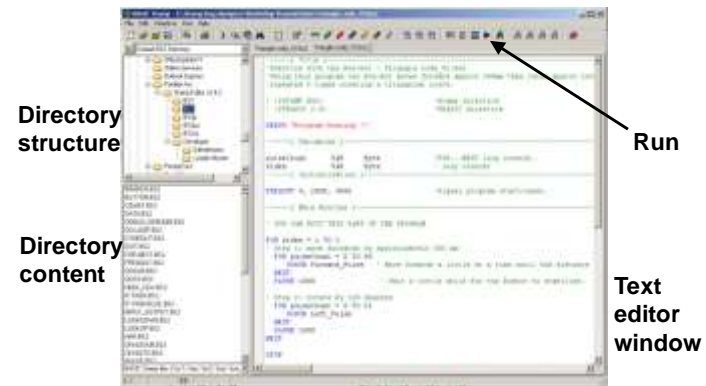
```
FOR sides = 1 TO 3
' Step 1: move forwards by approximately 300 mm
FOR pulseCount = 0 TO 60
  GOSUB Forward_Pulse
NEXT
PAUSE 1000

' Step 2: rotate by 120 degrees
FOR pulseCount = 0 TO 21
  GOSUB Left_Pulse
NEXT
PAUSE 1000
NEXT
STOP
```

- This example code shows how to move the robot along an equilateral triangle
- Move forward and turn left subroutines are called repeatedly to achieve the required distance and turn respectively



BASIC Stamp editor window



Programming and running the robot



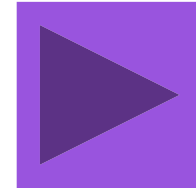
- 0 – Power Off
- 1 – Program Upload
- 2 – Run Program

- Reset – Reset Program

Roundup – Discussion points and questions

- Feel free to ask us anything you like.

- Discussion points:
 - Other institution practices
 - Peer assessment
 - International students
 - Input from industrial partners



Thanks to...

- All staff and students who have contributed to the development of the module, especially Keith Gregory & Simon Pomeroy (+ photos).

