

RoboRugby 2010

Robotics Design Project
EEEN 10020

Brian Mulkeen (module coordinator)
Scott Rickard Chris Bleakley



UCD School of Electrical,
Electronic and Mechanical
Engineering

Scoll na hInnealtóireacta
Leictre, Leictreonaí agus
Meicniúla UCD

What is RoboRugby?

- A game for small *autonomous* robots
 - aim is to score points by moving balls into scoring areas on table
 - opponent scores points in different scoring areas
 - *autonomous* ⇒ on-board computer, programmed in advance (no remote control)
- A design exercise for students
 - design is fundamental to Engineering
 - important in Computer Science also
 - solve problems with many solutions
 - develop creative thinking and design skills
- A module ⇒ assessment, grade, credit



2

Sessions

- Lectures - Monday 15:00, Eng. 135
 - explain concepts, design principles, rules, etc.
- Tutorials - Monday 16:00, Eng. 135 (some weeks)
 - mostly computer programming
- Labs - Wednesday 15:00 to 18:00, Eng. 329
 - build robots - Lego Technic® + sensors, etc.
 - program robots to behave as you want
 - teamwork...
- Independent learning - outside lab
 - read, think, design...
 - teamwork continues...
 - write reports



3

Likely Schedule

- Week 1 Build basic robot chassis, write simple programs, add some sensors.
- Week 2 More complex programs - use sensors, respond to collision, detect lines... Start design of competition strategy...
- Week 3 More sensors, algorithms to use them. Follow lines, find beacons, etc. More strategy development, **report**.
- Week 4 More sensors, algorithms - find balls. Start competition robot design...
- Week 5 More robot design, start building...
- Week 6 Start programming new robot...



4

Likely Schedule (continued)

- Week 7 Working (if basic) competition robot. Interim **report due**.
mid-semester break
- Week 8 Refine strategy, develop robot, develop software...
- Week 9 Continue development...
- Week 10 Ranking round - each robot alone... results decide seeding for competition
- Week 11 Final improvements, robots impounded
competition - evening event
- Week 12 De-brief, restore kit...
Final report due



5

Information

- Entirely web-based
- <http://roborugby.ucd.ie> or through Blackboard
- Find:
 - lecture notes
 - some tutorial notes
 - lab instructions
 - technical information on parts, Handyboard, etc.
 - information on programming
 - design tips
 - links to other competitions
- Sponsor - Siemens Ireland - prizes!



6

Assessment

- Weeks 1-4: Challenge each week
 - submit program & very brief report
- Strategy report
 - describe strategy development (brief)
- Interim report
 - robot design so far, software, performance, etc.
- Final report
 - design, implementation, performance
- Presentation
 - short talk on your robot, at ranking round
- Design & Performance of robot
 - we assess how good your design is
- No formal exam!



7

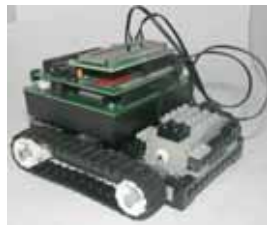
Warnings!

- Problem-based learning
 - no step-by-step instructions for your design
 - you will have to think for yourself
 - hard work, but should be fun also!
- Teamwork
 - you will have to co-operate with others
 - about 40% of assessment will be team-based
- No re-assessment opportunity (resit)
 - unlike most other modules
 - no quick fix for failure!
- Withdraw now if you don't like these!
 - your team will suffer if you drop out later...



8

Robots



- Built mainly from Lego Technics® parts
 - various electronic sensors added
 - one servo actuator available
- Driven by Lego motors
 - usually one each side – must be identical motors!
 - turn or steer by driving motors at different speeds
 - car-type steering possible



9

Computer

Handyboard - small computer, "brain" of robot
lots of sockets to connect motors, sensors, etc.



10

Using the Handyboard

- Program written on PC
 - downloaded to Handyboard
 - retained in memory
- Program runs on Handyboard
 - independent of PC
- Rechargeable battery
 - powers Handyboard **and** robot
 - you need to keep battery charged - vital later
 - ~16 hours charging from empty to full!
- Interface unit connects to PC & power supply
 - allows program download
 - charges battery
 - keep connected whenever possible!



11

RoboRugby Table



- 2.4m x 1.2m, balls ~40mm diameter
- Bumps around scoring zones at each end
- Robot can use sensors:
 - detect walls or other obstacles
 - detect and follow white lines
 - detect small objects (e.g. balls)
 - receive infra-red signals from beacons at ends



12

Humans & Teamwork



- Teams of 3 students
 - maybe some teams of 2
 - maybe friends, maybe strangers...
 - all with different strengths and weaknesses...
 - just like in the real world
- You have to work together for 12 weeks
 - work effectively, produce results in limited time
 - each member must contribute to the team
 - the team must support each member
 - fair distribution of work...



13

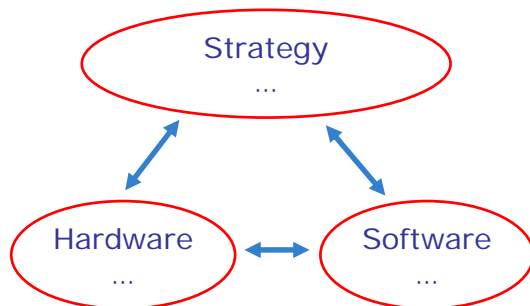
Design Process - the first steps

- Define the requirements
 - what do you need/want the product to be or do?
 - keep it broad - don't tie down the result yet
 - distinguish *need* from *want*
 - write it down!
- Generate possible solutions
 - brainstorming - best done as a team
 - need lots of ideas - 60:1 in big projects
 - no idea is stupid!
- Select best solution(s)
 - evaluate possible solutions - strengths, weaknesses
 - gradually reduce the list of options



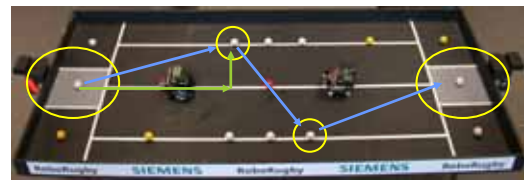
14

Robot Design



15

Lab on Wednesday



- Build one of the basic robots
 - step-by-step instructions given
- Program it to drive in a fixed pattern
 - no sensors yet...
 - "dead reckoning" - navigation without inputs
 - mainly to see how hard it is!
- Add sensors...



16

Before Wednesday

- Decide if you want to take this module
- Organise yourselves into teams
 - teams of three (or two if necessary)
 - max one Computer Science student per team
 - mix of expertise useful
 - check that you have compatible ambitions!
- We will form or complete teams if necessary
 - at start of lab session on Wednesday
- Read lab instructions
 - on web site tomorrow
 - know what you are supposed to be doing!
- Decide if using your own computer
 - if so, it must be available every week!



17