RoboRugby 2014

Robotics Design Project

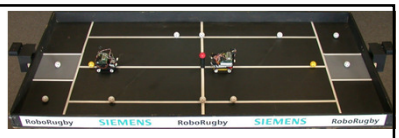
EEEN 10020

Brian Mulkeen

UCD School of Electrical, Electronic and Communications Engineering

Scoil na hInnealtóireachta Leictrí, Leictreonaí agus Cumarsáide UCD

What is RoboRugby?



- A game for small *autonomous* robots
  - score points by moving balls into scoring areas
  - 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
  - solve problems with many possible solutions
  - develop creative thinking and design skills
- Basis of Robotics Design Project
  - a module ⇒ assessment, grades, credit

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Workload

- Lectures - Monday 15:00, Eng. 135
  - explain concepts, design principles, rules, etc.
- Tutorials - Monday 16:00, Eng. 135 (early 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 work - outside lab
  - read, think, design…
  - teamwork continues…
  - write reports

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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. Find beacon & drive to it, find ball … More strategy development, report.
- Week 4 More algorithms – follow lines… Start competition robot design…
- Week 5 More robot design, start building…
- Week 6 Start programming new robot…

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Schedule (continued)

- Week 7 Demonstrate working (if basic) robot in action. 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

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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!
  - details later…

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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!

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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…

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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…

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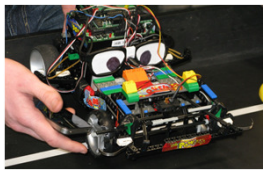
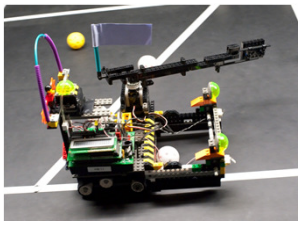
Robots





- 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

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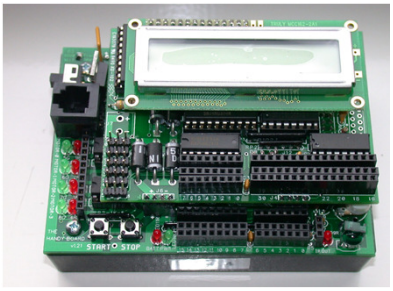
Computer

Handyboard - small computer, "brain" of robot

- lots of sockets to connect motors, sensors, etc.
- includes battery pack…



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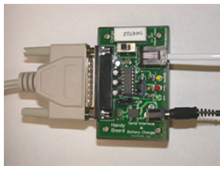
Using the Handyboard



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

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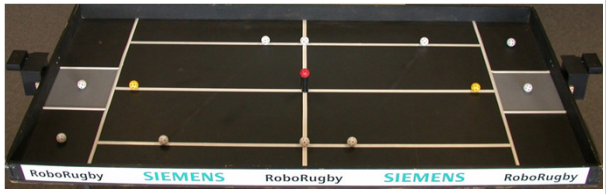
RoboRugby Table (2013 layout)



- 2.4 m x 1.2 m, balls ~40 mm diameter
  - bumps around scoring zones at each end
  - pedestal in centre supporting red ball
- Robot can use sensors:
  - detect walls, obstacles, white lines
  - detect small objects (e.g. balls)
  - receive infra-red signals from beacons at ends

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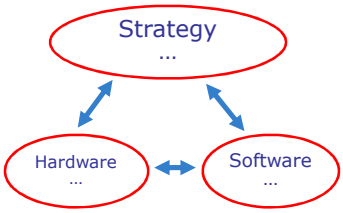
Robot Design



Three related design problems…

For each design:

1. Define the requirements
   - what do you need this thing to be or do?
2. Generate possible solutions
   - brainstorming - best done as a team
3. Select best solution(s)
   - evaluate possible solutions - strengths, weaknesses
   - gradually reduce the list of options

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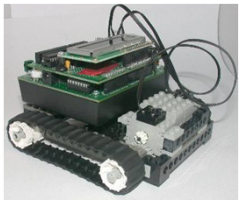
Lab on Wednesday



- Build a simple robot
  - step-by-step instructions
  - not for competition
  - just for learning:
    - how to program
    - controlling motors
    - using sensors, etc.
- Program it to drive in a fixed pattern
  - no sensors yet…
  - "dead reckoning" - navigation without inputs
  - simple, but not a good long-term solution!
- Add sensors…
  - first to detect collisions, then lines…

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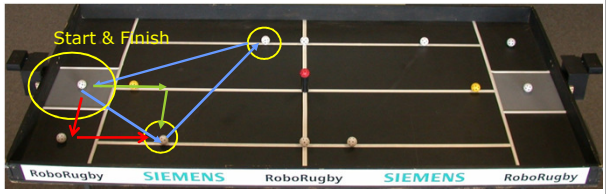
Goal for First Lab



- Challenge
  - start in grey zone at one end of table, any orientation
  - finish in the same grey zone
  - hit the two marked balls on the way
- Route is up to you
  - 3 straight lines at different angles ?
  - more movements, but all right-angle turns ?

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Before Wednesday

- Decide if you want to take this module
  - no penalty if you withdraw now
  - online registration system is still open…
- Organise yourselves into teams
  - teams of three (or two if necessary)
  - a mix of expertise is 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
  - know what you are supposed to be doing!

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