

RoboRugby 2010

Robotics Design Project
EEEN 10020

Lecture 2 - Design Process...



UCD School of Electrical,
Electronic and Mechanical
Engineering

Scoil na hInnealtóireacta
Leictre, Leictreonaí agus
Meicniúla UCD

What is Design?

- A plan or sketch for the making of a building, machine, garment, etc.
- A plan, purpose, intention.
- To form or conceive in the mind, to invent...
- A structured creative process...
- ... application of creativity to bring ideas into use.
- Process of converting an idea or market need into the detailed information from which a product or system can be made.



2

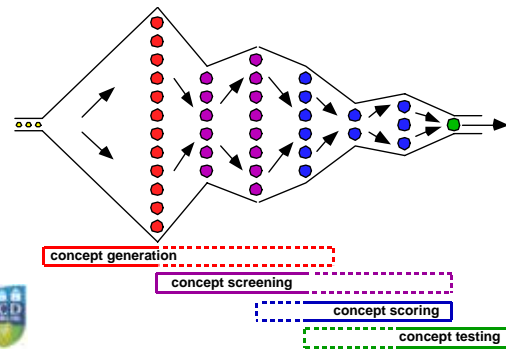
Design Process - the first steps

- 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



3

Concept Development Funnel



4

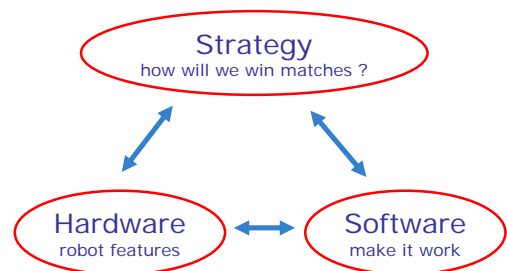
Concept Generation - Brainstorming

- Sketch or write down ideas as they arise
 - rough idea - not too much detail yet
 - work quickly, let the ideas out
- Combine and develop ideas
- Pursue a thought stream to its end
 - then start on a different idea
- Brainstorming session typically 20-30 minutes
 - need lots of ideas!
 - no criticism of ideas allowed
 - allow time to think
 - encourage modifications to ideas



5

Robot Design



6

Strategy Design Process

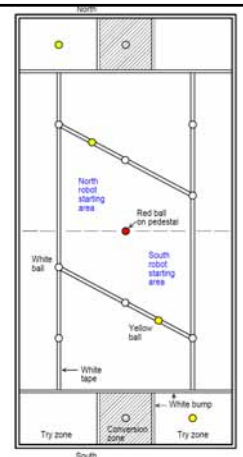
- Define requirements
- Generate possible solutions
 - brainstorming
- Evaluate solutions - pick a few good options
 - strengths / weaknesses / threats
 - what if the other robot did X ... ?
- More detailed design of chosen few
 - how will robot navigate?
 - how can we defend against threats?
- Choose a strategy
- Implement, test, improve...



7

Table Layout

- Table
 - surface matt black
 - matt grey in conversion zone
 - white tape 19 mm wide
 - white bumps 4 mm high
 - detailed dimensions on web
- Balls
 - 42 mm diameter, 7 g
 - red ball on 90 mm pedestal
- Starting area
 - anywhere in marked area
 - must not touch or cover line, ball or pedestal



Rules (still subject to change...)

- Play (in each match)
 - 60 seconds, then wait for everything to stop
 - team members stand back - no intervention
 - match may stop earlier if both teams agree
- Fair Play
 - aim is to score & to prevent opponent scoring
 - rules discourage attack on opponent
- Scoring
 - points for balls in scoring area at end of match
 - balls must touch table surface to score
 - 1 point for white ball, 2 for yellow, 4 for red
 - central "conversion zone" gets double points
 - robot starting on South side scores in North areas
 - see Rules web page for all the details



9

Winning a Match

- The first rule which can distinguish decides
 1. robot which scored more points
 2. robot which scored the red ball
 3. robot which scored more yellow balls
 4. robot with more yellow balls in conversion zone
 5. robot with more balls in conversion zone
 6. robot with red ball on its scoring side of the table
 7. robot with more yellow balls on its scoring side
 8. robot with more white balls on its scoring side
 9. robot which is itself on its scoring side of the table
 10. robot which moved under its own power
 11. robot with better result in ranking round



10

Rules

- Ranking Round
 - robot plays match alone in week 10
 - results used to seed tournament
- Robot
 - must be built from kit of parts provided
 - limit on dimensions: 400 x 320 x 300 mm
 - may not separate into more than 3 parts
 - detailed rules on web site
- Start of match
 - robot must be in correct starting area
 - can face any direction
 - but must be able to see home beacon...
 - 60 second set up time before each match
 - could select strategy to suit opponent ?



11

Strategy - how to win competition

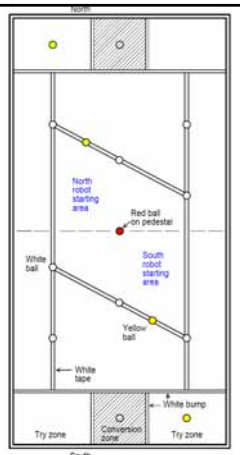
- Win competition by winning matches
- Win matches by moving balls
 - no point in fighting other robot to the death!
- First 10 seconds?
 - balls probably still in known places
 - relatively easy to score points
 - which balls to go for?
 - count points & assess risks for each option
- What will the opposing robot do?
 - could this defeat your strategy?
 - is it worth delaying to defend or block?
 - is it better to plan to avoid the opponent?



12

Strategy - Stage 1

- **Where to start?**
 - right, centre, left ?
 - where will opponent be?
 - forward, back ?
 - facing which way?
 - large robot restricted here!!
- **Which direction to go?**
 - forward along side line?
 - along side and diagonal lines?
 - forward collecting red ball?
 - back to get more balls?
 - how far back?
- **What will the other robot do?**



Strategy - continued

- **Stage 2 - next moves...**
 - protect balls already scored?
 - find and score more balls?
 - remove balls from home scoring area?
- **Stage 3 - final moves...**
 - last 10 - 15 seconds (if robot still working!)
 - where do you want to be?
 - what do you want to do?
- **Multiple strategies ?**
 - different plan for ranking round - no opponent
 - different options depending on opponent
 - can select option during set-up



14

Strategy - continued

- **How to move balls?**
 - carry / push / kick / collect ?
 - one at a time / many balls ?
- **How to find balls ?**
 - navigation - find your way around the table
 - hunting - find balls on the table
- **Defence ? Offence ? Obstruct ?**
- **What will the opposing robot do ?**
- **Need to see design process in reports**
 - ideas considered
 - analysis of ideas - strengths, weaknesses, threats
 - reasons for design decisions
 - keep notes of your work!



15

Teamwork

- **One person cannot do this in time available**
 - team must work as a team to achieve goals
- **Team members have different strengths**
 - use strengths, accommodate weaknesses
- **Plan - what do you all want from this?**
 - how will you achieve it in time available?
- **Brainstorming - combine ideas**
 - don't hold back - every idea can contribute
 - don't knock other ideas - be fair
- **Division of labour**
 - team members may choose to specialise
 - everyone must be familiar with everything



16

Homework

- Read MIT "6.270 Course Notes":
 - Chapter 3 - human factors, teamwork, etc.
- Team meeting - sometime this week
 - topic is strategy - how to win competition!
 - brainstorm - collect ideas
 - evaluate ideas - select a few
 - refine ideas - more detail
 - **write it all down!**
 - it will be needed for reports...



17

Lab Session

- See instructions on web site – sessions page
 - using switches and line sensors
- Task 2 - drive around, bounce off walls
- Task 4 - drive around, bounce off lines
- **Challenge 2 combines parts of both**
 - hit walls 4 times, then stop when see line
 - lots of options to improve on basic requirement
- **Report on Challenge 2**
 - paragraph of comments at start of program
 - submit entire file to Blackboard or on paper
 - different author each week ?



18