EDSGN100
Toys’N MORE

Harold (Hal) N. Scholz
Pennsylvania State University Lehigh Valley
hns12@psu.edu

EDSGN100

• Project oriented course
  – Take a project through prototype phase
    • Customer needs
    • Product Specs
    • Concept generation/Selection
    • Prototype(s)
    • Testing
• Team based
  – 3-5 member teams
  – Decision making
  – Presentations at each phase
• Classroom run as if a company
  – Each group is a design group in the company
  – They are responsible for completing their design
  – Must report progress, issues and schedule at each step

Course Given Using Different Project Definitions

• Fall 2009 Semester Project
  – Each team could design any toy
  – Must design and build a prototype
  – Students came up with their own ideas for projects
  – Option to use Lego Mindstorm Robots
• Spring 2010 - 2012 Semester Projects
  – Must build robot that can autonomously navigate a maze
  – Each group came up with their own design and programming

Toy Project

• Defined what ideas as to what to build
• Contacted prospective customers
• Presented ideas and customer feedback and determined the project they would complete
• Developed concepts and went through selection process
• Lego Mindstorms® NXT 2.0 Robots were available for use
Toy Project

• Pros
  – Students were initially very enthusiastic
    • They bought into their own ideas
  – Diverse set of projects
  – From Customer needs through concept phase all students were very involved
• Cons
  – In the prototyping stage, one person in each group tended to take over
  – Results ended up being more of a “craft” project than an engineering project
  – Some students basically withdrew from the process and let the “expert” take over

Robotics Toy Project

• Given a very specific set of requirements
  – Maze dimensions, wall heights, gaps, ...
  – Given a task – find the red ball and bring it back to the starting point
  – Robot must be autonomous
• Must include a functional 3D part
  – Makerbot 3D printer
  – CNC milling machine
  – Fall 2012
  – Design part in solidworks
• Actual mechanisms, programming and looks must be determined by each group
• Final project grade based on
  – Functionality in maze
  – Time bonus
  – Customer needs bonus

Robotics Project

• Pros
  – Project well defined
  – Project is possible to complete
  – Challenging engineering issues
    • Mechanical
      – 3D part
      – Robustness
      – Sensor placement
    • Software
      – Algorithm
      – Implementation
      – Mechanical / Software interactions
    • Unexpected issues
      – Gaps, light changes, going in a straight line
• Cons
  – Initial phase is more defined
  – Customer needs becomes less exciting

Lego Mindstorms NXT programming

• Graphical
• Most common functions available
  – Includes Variables
  – Includes Arrays
  – Logic functions
  – Sensors
  – Motors
  – Loops
  – Conditionals (switches)
  – Subroutines (myblocks)
• Somewhat intuitive – do not need to be a programmer
• Cumbersome at times for students with programming knowledge
• Program stability and file integrity has been an issue
  – Save often as new project
  – Back up with pack and go if using myblocks
Lego Mindstorms NXT programming

Group Dynamics Robotics

- Less enthusiasm during the Customer needs phase since much of the project was defined
- Conflict resolution
  - Very heated discussions over problem solutions
- Leadership changed hands
- Initially, the well organized students lead project to get things completed on time
- Once into the prototyping, students with programming came out of the background and became group leaders
- Students with strong mechanical background lead efforts
  - Construction
  - Test/repair
  - 3D part
- All had to work together to get the hardware and software to operate together

Prototype testing

Robot Video
Lego Robotics

- Equipment
- LEGO MINDSTORMS Education NXT Base Set
  - Must have, includes computer, motors, sensors
- MINDSTORMS Education Set
  - Many extra parts, allows flexibility
- HiTechnic Color Sensor
  - Only one available when we purchased
- Cost ~$400/set
- Maze – materials <$100

Makerbot Thing-O-Matic

- 3D printer
- Kit form
  - 1 semester project for 2 students
- Newest model cost ~$1700 and is prebuilt
- Part built up in clear view
- Machine is open source
  - All parts design info available
  - SW is open source
- Does require maintenance!

CNC Milling Machine

Deepgroove1

- http://www.deepgroove1.com/cncmill.htm
- 4 Axis machine
  - X, Y, Z + rotation about X
  - ~$2,100
- Mach3 controller
  - A bit of a problem installing drivers on some machines
  - ~$174 extra
- Pycam CAM
  - Convert to gcode
  - Not production worthy, but works for 3D
  - Manual edits for efficiency
  - http://pycam.sourceforge.net/
  - Open source

CNC Milling Machine

Rocket Nose Cone
Other Observations

• Robotics project is well defined
  – Gives students a target and consequences
  – Increasing the emphasis on results improves focus
• 3D part(s) keep everyone busy
• Groups larger than 4 do not work as well
• Groups of 3 are OK, but if a student drops, 2 could be an issue

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