ECE 100 - ITP

Lecture 9

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Questions?

- Post-lab 8 Milestone due this week (last of the lab reports)
- Round 2a Competition - this week in lab (1.5 hours to prepare)
- Round 2b Competition - next week in lab
- Round 2b Extra Credit for all teams
  - 0.2 pt * Teamwork Score for each puck pushed into scoring position during Round Robin, even if the other team pushes it out of scoring position
- Final Design Portfolio due Mon, Dec 3 at 1:30 PM in SH 118
Round 2 - Performance Tuning

- **Observations**
  - Fragile robots, exquisite claws, unreliable touch bumpers
  - Code: lots of complicated code (hard to debug!); lots of untested code; lots of code written in lab; lots of time wasted

- **Post-lab 8: Performance Tuning**
  - Construction/Implementation - Discuss modifications to hardware & software
  - Analysis & Testing
    - Did the robot push two pucks into scoring position? Was it reliable? Why/why not?
    - Were you able to push three pucks into scoring position reliably? Why or why not?
  - Future Work / New Optimum Solution
    - Need new optimum solution and perhaps an alternative solution (implemented in IC) and corresponding flowcharts for pushing all three pucks into scoring position.

- **Lab 9: Round 2a Competition**
  - Code should be able to push all three pucks into scoring position.

Lab Observations

- **Need to prepare outside of lab.**
  - Choose strategy
  - Distribute tasks
  - Code: compile, check syntax, debug
  - Plan physical robot modifications (keep it simple)

- **Need to work as a team in lab.**
  - All group members should have some responsibility
  - All group members should understand the code
  - Open communication is critical

- **Need to observe and analyze in lab.**
  - Document your design modifications
  - Generate performance statistics based on trials
  - Debugging: Test all assumptions, even the obvious ones; find out what went wrong by testing subsections of code
  - Debugging: Insert “aoi(); sleep(5.0);” at the beginning of each of the states
  - Build simple diagnostics code to test analog/digital ports, motor power, etc.
State Machine

- One main event loop: while (timer() < 90)
  - Create a series of "if-then-else" statements
    - if (conditional) {
      <statements>
    } else {
      if (conditional) {
        <statements>
      } else {
        <statements>
      }
    }
  - Check the current state and a transition condition
    - If true, modify motors (if necessary), change state
    - If false, go to the next state check

- Related issues
  - Use "seconds()" function to implement global timers
  - Avoid long "sleep" times - drift, sensor blackout
  - Avoid nested "while" loops

Final Design Portfolio - Due at 1:30 PM on Mon, Dec 3

- The body will follow the Design Portfolio structure, including
  - Problem Statement: concise, precise, complete sentences.
  - Research/Investigation: Present a theory for getting the job done.
  - Alternative Solutions: List the strategies that you actually developed in IC.
  - Analysis & Testing: Provide the results of your lab experimentation, including competition outcomes.
  - Final Evaluation/Conclusion: Problems? Adequate Solution? Future Work; Justify additional funding/support.
Final Design Portfolio - Point Breakdown

- Point breakdown (total of 120 points worth 20% of your final grade)

- The following sections are 10 points each:
  - PS, R/I, AS, OS, C/I, AT, FE, Appendix (IC Code)

- The executive summary is worth 30 points.

- The remaining items will be worth 10 points in total (approx. 2 points each).
  - Cover, Table of Contents, List of Figures, List of Tables, Acknowledgements, References

Physical Layout of Portfolio

- Bind your portfolio (clear plastic folder or 3-ring binder).
  - Do NOT put each sheet of paper in its own plastic sleeve!
- Cover Page: Who, What, Where (ECE 100-X), When (due date)
- Table of Contents (reference the 13 sections below)
- List of Figures (list of diagrams that appear in body of report)
- List of Tables (list of tables that appear in body of report)
- Acknowledgements (group members, TA, etc.)
- Executive Summary (one page max)
- Body (PS, R/I, AS, OS, C/I, AT, FE)
- Appendix (IC code)
- References
**Formatting and Max # of Pages**

- The following items should be one page each:
  - Cover, Table of Contents, List of Figures, List of Tables, Acknowledgements, Executive Summary, References
- The body of the report should contain the relevant body section headings and should flow continuously.
  - Do not insert page breaks before each body section.
- Line spacing should be no more than 1.5; single is fine, but make sure it is easy to read.
- The font size should be no smaller than 10 and no larger than 12.
  - Twelve point font may not allow you to describe your design adequately.
- The Appendix (IC Code ONLY) should begin on a new page.
  - Only your final solution code should appear in the Appendix.
- The document (excluding the IC Code Appendix and References) is limited to 20 pages. Each page must be numbered.
- The body of your portfolio is limited to 14 pages, once you subtract the first six pages from the 20 page limit.

**List of Figures & List of Tables**

- Your report must have at least two figures.
  - Examples: pictures of your robot, flowcharts, diagrams
- Your report must have at least two tables
  - Examples: results of competitions, matrix of alternative solutions with solutions appearing as rows/records and various attributes heading each column
- Add additional figures and tables that enhance reader comprehension. They can add punch to your report.
- The List of Figures should use a tabular format:
  - Figure #: Descriptive Title of Figure .......... p. #
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- The same format should be used for your List of Tables.
  - Please choose figure/table titles that are descriptive so that your reader can jump to the specific information of interest.
**Scope and Executive Summary**

- Final Design Portfolio covers the entire course.
- Focus on customer need (as defined by you) by relating to Round 2 (Mint Shuffle), but be sure to include earlier work in Rounds 0 and 1.
  - Research/Investigation is a great place to cover earlier Rounds.
- Motivate management to provide additional funds for your project.
- You must provide real evidence of your progress to justify additional funds.
- Stick to the actual results obtained in the laboratory.
- Based on your achievements with your prototype, describe how your robot will meet the needs of your company's target market.

**Problem Statement**

- Must be complete sentences. Keep it short and to the point.
- Keep in mind that the Problem Statement should set the stage for everything else in your Final Report.
  - Example: Develop an autonomous robot prototype to ... (fill in the customer need)
- Your Problem Statement section should include four items:
  - Short statement of the overall problem (1-2 sentences max)
  - List of criteria that you used to judge your overall performance as well as your robot's performance in the various sub-problems
  - List of constraints that were imposed on all teams (not just Round 2 specs)
  - List of assumptions that you made during the project
  - Bullet point lists need not be complete sentences
  - Focus on a few of the most important items for the lists - no grocery lists
- Common assumption:
  - Infinite energy battery pack, but "state-of-charge" decreases over time, especially when the motors are used heavily
**Research/Investigation**

- Explain the theory behind the robot’s behavior.
  - In path following, the light sensors react to reflected ambient light focused by the sensor shields.
- Include your Round 0 and Round 1 competitions as key investigations into the capabilities of the touch sensors, light sensors, DC motors, controller board, Interactive C development environment, etc.
- Reference the textbook, class web site, and any other sources that you have used in your research.
- Cite your sources with numbers in square brackets (e.g., [1]) which refer to the citations in the References section at the end of your report.

**Alternative Solutions**

- In order to call it the “Alternative Solutions” section, there must be more than one proposed solution.
- There is no upper limit to the number of alternatives that you present, but be sure to describe them adequately.
- Give brief descriptions of your brainstorming outcomes.
- Explain the strategies with simple flowcharts inserted in the text, not in the Appendix.
- Briefly enumerate advantages/disadvantages.
- Your optimum solution should be included briefly in "alternatives".
  - Then, under "Optimum Solution" you should describe your best idea in more detail.
Optimum Solution

- This depends on the criteria you chose in the Problem Statement.
- Keep in mind the list of "desirable characteristics" that we developed in a brainstorming session in lecture.
- Why is the algorithm optimal?
- What are its desirable characteristics?
- Describe your plan for implementing your optimum solution.
- Give a detailed description of your algorithm, but don’t include your IC code. Consider the following methods for presenting the details (note: do not repeat overview from previous section):
  - Pseudo-code describing the core features
  - Additional flowchart illustrating core features

Construction/Implementation

- This section should explain your code and your robot.
- Focus on the implementation of your optimum solution.
  - The key features should be directly related to your criteria.
  - Each key feature should help your design solution achieve your goal.
  - How did you build the robot or write the code to implement the feature?
- Reference the complete IC code in the Appendix.
- Show key segments of IC code (no pseudo-code).
- Point out the important features of code.
  - Abstraction
  - Global variables
  - Configurable parameters
- Include one or two pictures of your final robot.
Analysis and Testing

- Describe your testing procedure.
- Provide figures explaining test procedures.
- Provide tables demonstrating performance.
- Present the results of Round 2.
- Discuss any iterative improvements
  - What was wrong?
  - How did you try to fix it?
  - How well did your "improvement" work?
- Propose future improvements to solve any remaining problems.

Final Evaluation/Conclusion

- Restate objective.
- Briefly describe your key design features.
- Reiterate successes and benefits.
- Briefly explain future improvements.
- Evaluate your design with a critical eye.
- Motivate management to provide additional funds.
Appendix - IC Source Code

- Final solution only
- Comment headers should appear at the top of every source file.
  - Overall purpose
  - Tunable parameters
  - Author(s)
  - Date
- IC source should contain comments explaining significant code segments.

References/Bibliography

- The "References" page at the end of the Final Design Portfolio should contain all of your citations.
  - Include the textbook, the class web site (if you've included any web site materials such as competition specifications), and any other print or online resources.
  - Think of the References page as a page of footnote citations, often called endnote citations. It is similar to a bibliography, but the entries are numbered sequentially, rather than alphabetized.
- The References page should contain reference numbers in square brackets.
  - The bracketed numbers should be used throughout your report to cite the original source of any reference material of which you were not the original author.
  - Please use bracketed numbers rather than superscript numbers.
- Follow the CAC web site link to online resources for citation notes:
  - Click on "CAC Writing Guides" under "Links" on the ECE 100 web site.
  - Click on "Documentation Styles" then go to "Purdue Online Writing Lab". Use the format of the MLA "Works Cited" or the APA "Reference List".