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Robot Vehicle with Manipulator Arm Design Project

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Type: Design
Student time: Semester
Location: Take home

Summary

Semester project for first year engineering students starting in the second week of classes.
It introduces various aspects of engineering design methodology in the context of a
problem which is faced by a local manufacturing company. Students are required to
design, build, and test a simple robotic vehicle for Local Mfg., Inc. The project also allows
for follow-on work in junior-senior courses and at the graduate level.

ABET Descriptors:

Engr Sci Content: First Year Engineering
Type: Components and system
Elements: Establishment of objectives and criteria, synthesis, modeling,
                          construction, testing, evaluation
Features: Design problem statement, conceptualization, creativity,
                          alternative solutions, communication, design methodology,
                          open-ended
Constraints: Economic factors, time, safety, man-machine interfaces
Effort: Team

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Background: You and your fellow team member(s) are summer interns who have been hired by the Local Mfg., Inc, which is a local manufacturing company in your area. They are considering the use of a robotic vehicle with a manipulator arm on it to load and transfer some of their engine system modules from one part of the plant to another. Your task is to design, build, and test scale models of several alternatives for this system, the final design of which has still not been finalized. An important outcome of your project will be final specifications for the robotic system which the company will buy.

Statement: Design a cheap set of robotic vehicles with reconfigurable manipulator arms which can be used by Local Mfg., Inc. These vehicles should be part of a testbed system to scale model the loading and transfer of a range of the engine system modules which the company makes in their Home City and Local Area plants. Safety is a primary consideration with Local Mfg., Inc. which has an excellent safety record. Include a plan for operator training and estimates of the cost of your design.

In doing your project work, you are required to do the following:

*   Respond to this statement of need by the Vice President for Manufacturing, and
          task statement request from the Vice President for Engineering.
*   Define the problem and the specifications which need to be met.
*   Brainstorm possible solutions, including ways to use Legos or Fisher construction
          kits with model robotic vehicle and reconfigurable arm manipulators. These can
          be used to quickly test/try-out ideas with various actuators, sensors, and manipu-
          lator arm (linkage and hand/gripper) designs.
*   Refine your problem statement addressing the approaches you would use.
*   Develop and implement a realistic action plan including what you will do to
          design, build, and test your system.
*   Make recommendations for follow-on/extensions of work with robotic systems in
          subsequent classes.
*   Report your project results in the formats discussed in class:
                    a. Oral with transparencies
                    b. Written, including graphical presentations of your data and working
                        drawings for the system option(s) which you are recommending to the
                        vice Presidents of Engineering and Manufacturing.

You should also be prepared to discuss in class how what you have learned and done in completing this project can be applied in the following areas: intelligent vehicle highway systems, microelectromechanical systems (MEMS), and mobile robotic appliances.

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Engineering Notes:

1.   It is assumed that students will be able to use the following:

        *   Word processors (Word 6.0 or WordPerfect 6.0/6.1)

        *   Presentation software (Powerpoint or Harvard Graphics)

        *   Spreadsheets (Excel or Quattro)

        *   CAD graphics packages (CADKEY or AUTOCAD)

        In addition, the first year students should also be able to use simple actuators, switches, and sensors.

2.   It is also assumed that the project has a budget sufficient to cover the cost of purchasing Legos or Fisher construction kits with additional motors, contact switches, and simple acoustic sensors.

3.   Further iterations with this project include what can be done in third and fourth year courses. Examples areas for capstone design courses include: intelligent vehicle highway systems, surgical applications of microelectromechanical systems (MEMS), and mobile robotic appliances.