

UNIVERSITY OF NOTRE DAME
DEPARTMENT OF AEROSPACE AND MECHANICAL ENGINEERING
AME30362: Design Methodology, Fall 2009

P4 – Concept Design – Hand-held controller

Project Due Date: Tues. Oct. 29, 2009

During this project you will have the opportunity to develop a design concept for a component of a complex system that provides the interface between a human operator and a mechanical device. This project will provide you the chance to innovate and then evolve your ideas in order to contribute to the solution of a human-machine interaction problem. One of the primary tools you will use is prototyping - both physical and virtual - to develop, explore and demonstrate early, concept-phase design options.

Project Description:

The Laboratory for Perceptual Robotics of The University of Massachusetts, Amherst has designed and built a robot called uBot-5. This complex system has the ability to pickup, manipulate and relocate objects. It has the ability to balance itself on two wheels. It has a camera to identify objects and assist in their manipulation. One of the potential applications of this class of robotic devices could be to assist the elderly or people with mild physical disabilities around the house. For an example of how the current version of this class of robots can pick up an object and move it to another location, see:

<http://www-robotics.cs.umass.edu/Robots/Robots?action=download&upname=cup-pick-and-place.mov>

(Please note that the AME30362 class project has no affiliation with the U. Mass Laboratory for Perceptual Robotics and the uBot-5 is simply an exemplar for this class of robotic systems.)

You anticipate that there will be numerous other products like this developed in the near future and you are exploring solutions for the design of the hand-held controller for this type of system. In particular you are interested in the case where the customer will be elderly people that may have arthritis, limited mobility, Parkinson's disease and/or limited eyesight. For this phase of the system development project, you want to develop a design concept for the control box that will allow the operator to move the robot about, control a small laser-pointer to identify the object to be manipulated and activate the object-manipulation command [this feature will be an automated process that you only need to activate once the laser has tagged the object]. Thus your controller will need to have features/elements that will allow the user of an "uBot-5 class" robot to:

1. Turn on the robot.
2. Drive/maneuver the robot to orient the object in the robot's workspace.
3. Point the targeting-laser to identify/tag the object to be grasped.
4. Activate, via a mechanism (button, trigger, etc.), the "Grasp Object" command to the robot.
5. Drive/maneuver the robot to the location where the user wants to place the object.

You should assume:

1. The controller will need to contain a:
 - a. Power source - a rechargeable battery with dimensions - 1x1x3 inches, 6 oz.
 - b. A printed circuit board with dimensions - 0.5x2x4 inches, 3 oz.
 - c. Wiring harness to connect the power source to the circuit board and charging jack – details TBD by configuration of controller.

2. You will be working with the robot designers and control software engineers to determine the general nature of the control inputs to the robot. The control system (an embedded controller in the robot) will need to control the on/off operation, two motors for motion control, two servos for two-axis control of the laser pointer, and a single input to activate the grasp process based upon commands received from the controller. (Thus for this project in this course, you will need to make some assumptions about the input these other members of the design team would provide.)

Your responsibility is to develop and demonstrate via “looks like” prototyping a design concept to package the required internal components and to interface with the elderly operator. You are tasked with developing a concept design for the hand-held controller “box”. Your group will identify 3 different box designs, each one focused in only one feature. The target features are ergonomics, aesthetics, and manufacturability. The three designs will be combined into one final concept design.

Project Requirements:

Each project group will prepare a plan to conduct the project, assign responsibilities to individuals in the group, implement the plan and document the results of the project.

1. Each group will develop a series of “back-of-the-napkin sketches” for 3 hand-held controller designs. Each set of sketches for each initial concept should focus on one primary feature. The features are: 1) ergonomics, 2) aesthetics, and 3) manufacturability.
2. Based upon the 3 focused concepts, each group will evolve a single design concept that incorporates appropriate features of the three preliminary concepts and a rationale for the selection of key features. Once their single proposed concept is identified they will:
 - a. Fabricate a physical prototype/s that could be used to illustrate key features of the proposed concept – e.g. size, shape, weight, etc.. Extreme low cost and the use of readily available materials (recyclable) materials and simple, manual processing methods are strongly encouraged. Clever is better than “fancy” for this part of the project.
 - b. Develop a virtual prototype – a representation of the proposed concept in ProE – with appropriate external details to help demonstrate the form of the proposed concept.
3. Each group will document and present their work via:
 - a. A memo including the complete set of concept sketches with a single paragraph (no more than 100 words per concept) explanation of the key features of each of the 3 concepts.
 - b. A 4-slide power point presentation to document their results for this project. The presentation will be submitted in hard copy in class and electronically as a .pdf file. Some of the project groups will be asked to present their results to the entire class later in the semester.
4. In order to receive a grade for this project, each group member will prepare and submit a peer assessment. Details to be provided later.

Project TA Coordinator:

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