

Name: Alan Kilian

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Title: Design and construct an absolute heading sensor for a mobile robot.

Description: This project will produce a sensor capable of determining the direction it is pointed and will demonstrate the sensor's capabilities by attaching it to a mobile robot and use it to control the robot's motions. This project intends to demonstrate proficiency using the tools required to design, build and test a sensor. A paper will be written describing the process used to design, build and test the sensor.

Background and Rationale: The successful completion of a degree in mechatronics will require an understanding of mechanical, electrical and computer systems as well as the tools used to design and implement each of these systems in order to produce a machine capable of performing a specific task. This project will allow me to learn these tools through self-paced experiential learning. This is the learning method most successful for me. In my previous project '*Design and construct a Holonomic motion platform and control system.*' I built a three-wheeled robot and a computer to control it. For this project I will design and build a sensor system to measure the heading direction of this robot. This project represents learning in two areas. *Physical sciences* through the electrical engineering and mechanical engineering research and design required to design and build the sensor. *Mathematical thinking* through the computer science software development required to test the sensor's performance.

Objectives:

1. To understand the design principles and mechanics of an absolute heading sensor for a mobile robot.
2. To determine a measuring system that allows the robot to move in a straight line and to turn precisely.
3. To design and construct an absolute heading sensor for a mobile robot.
4. To incorporate the sensor into a robot and measure the sensor's ability to guide the robot along a straight line and to make precise turns.

Methods: I will research possible measuring systems that will allow the robot to move along a straight line and turn a desired angle. I will select a sensor system design, acquire or build the required parts, assemble and test the sensor system. I will attach the sensor to the robot and I will measure the performance of the completed mechanical system.

Results: The project will result in a robot capable of moving along a straight line and capable of turning precise angles as well as a 5-7 page paper addressing the theoretical and conceptual framework that I used in the design and development of the sensor.

Schedule:

October 2004 -	Studied heading measurement systems,	120 hours
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November 2004	selected and implemented an electrical system.	
November 2006 – November 2009	Implemented a real-time Operating system and integrated the measurement procedure for the rate gyroscope.	80-120 Hours
November 2009 – November 2010	Designed and implemented the software for the final demonstration.	200-300 Hours
June 2011	Write and submit draft paper to PIL advisor	40 Hours
June 2011	Edit final paper	4 Hours
July 2011	Submit paper to evaluator	4 Hours

Evaluator: Dr Maria Gini Department of Computer Science, University of Minnesota, Minneapolis Minnesota

Evaluation:

1. Please comment on how well the student understands the design principles and mechanics of an absolute heading sensor for a mobile robot.
2. How well did the student determine a measuring system that allows the robot to move in a straight line and to make precise turns?
3. How well did the student select electrical components, fabricate parts and assemble a working absolute heading sensor for the robot?
4. Please comment on how well the student measured the ability of the absolute heading sensor to guide the robot along straight lines and to make precise turns.
5. How does the quality of this project compare to other undergraduate projects of a similar nature?

Bibliography:

Dahlin, Tom & Krantz, Don (1992) Closing the Loop on DC Motor Control. *The Computer Applications Journal*, 28, 50-57

DC Motors Speed Controls Servo Systems (2nd Ed.). (1973) Minneapolis, MN: Electro-Craft Corporation

Hunt, Steven (1999, January) In *National Semiconductor Application note 693 LM628 Programming guide*. Retrieved from <http://www.national.com/an/AN/AN-693.pdf>

Jones, Joseph I., Flynn, Anita M. (1993) *Mobile Robots Inspiration to Implementation*. Wellesley, MA: A K Peters

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