

PROGRAM FOR INDIVIDUALIZED LEARNING
UNIVERSITY OF MINNESOTA

NARRATIVE TRANSCRIPT FOR: Alan E. Kilian

PROJECT TITLE: Design and Construct an Absolute Heading Sensor for a Mobile Robot

PROJECT 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.

PROJECT DURATION: October 2004 – August 2011

PROJECT EVALUATOR: *Maria Gini, Professor, Computer Science and Engineering, University of Minnesota, Minneapolis, MN.

1. Please comment on how well the student understands the design principles and mechanics of an absolute heading sensor for a mobile robot.

The student demonstrated knowledge of design principles through multiple designs. He tried for a geomagnetic compass unit, which did not work because the viscous fluid used in it to dampen the vibrations caused a significant lag in the measurements. The next sensor he tried was a solid-state sensor, which had a discontinuity around 0 and 359.9 degrees, but low drift and small noise. He then tried a gyroscope and measured its drift. The drift grew with time and made it unsuitable for absolute heading. Finally he tried a MEMS rate gyro with two axes. When making a small turn the gyro does not change. This produces an overshoot in the angle of rotation when the robot starts and stops the motion.

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?

The student measured the rotation using the compass and marking the new orientation on a piece of paper taped to the floor after each rotation. The rotation turned out to be not very precise. The student conjectured that the error was caused by iron-objects in the room. He repeated the experiment using the gyro. The heading is more correct but has variability.

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3. How well did the student select electrical components, fabricate parts and assemble a working absolute heading sensor for the robot?

He made good selections given the limited budget available, and used appropriate fabrication methods.

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.

The measurements have been done properly, but the sensors used have errors that limit the accuracy of the results obtained. Hence the ability of the robot to make precise turns is somewhat limited.

5. How does the quality of this project compare to other undergraduate projects of a similar nature?

The project investigated different types of sensors to measure absolute heading and measured their performance. The student has completed the work stated in the project proposal. The quality of the work is adequate.