Name Alan Kilian

Title A Procedural Guide to Adjusting Motor Controlling Equipment

Description: The purpose of this project was to write a guide to help novice engineers adjust the equipment to control a motor.

The final version of the guide to adjusting motor-controlling equipment was published in the July 2000 issue of Circuit Cellar magazine. This magazine is published for the working engineer as well as hobbyist, and has over 15,000 paid subscribers.

The article was also selected by the editors to be provided online. It remains available at: http://www.circuitcellar.com/pastissues/articles/Kilian120/Kilian120.pdf

Background and Rationale In 1995 I needed to adjust the equipment that controlled several motors in a machine that moved a camera from one location to another. The camera was used to take pictures of electronic parts that were attached to a circuit board. While learning how to perform these adjustments, I developed a procedure that could be used to choose systematically the values for the parameters that would control the motor in this machine. This is a procedure that can be used while adjusting many kinds of motors in many types of machines, including motorized package conveyor belts, automobile cruise control systems and elevator controlling machinery.

After discussing this procedure with other engineers in my company, I was encouraged to write up my procedures so that they could be used by other engineers in the company. I decided to write up my procedure in the form of an article that could be submitted to a magazine read by engineers so that the procedure could be distributed to a wider audience.

In order to document the procedure without revealing my company's proprietary mechanical and electrical systems, it was necessary to build a mechanical system that I could use to demonstrate motor-control techniques.

Objectives To demonstrate my understanding of motor-control systems by constructing a motor-control system. That system included the following:

- A mechanical system of motors, gears and a child's Etch-A-Sketch toy;
- An electrical system for controlling the motors and communicating to a computer;
- A software system for causing the motors to move;
- A software system for capturing and analyzing the motion of the motors.

To write my results in the form of a tutorial on the basic theory of motor-control and submit it for publication.

To gain experience in presenting theories and practical methods by demonstrating the final mechanical system to a group of engineers.

Methods: I researched motor-control adjustment techniques using online searches and library searches; built mechanical, electrical and software tools to test my adjustment procedures; experimented with the motor-control system; captured and

. analyzed results; wrote several versions of the guide; gave a talk to a local group of robotics hobbyists; and submitted the article for publication.

Results

A two-motor mechanical system was constructed to move the dials on an Etch-A-Sketch child's toy.

A two-channel motor-control system was built using J.R.Kerr motor-control devices.

Software was written to communicate to the motor-control system so that it could perform tests of the system and gather results.

• The motor-control system was tested using the procedures in the motor-control tuning guide, and the results of each step were graphed in preparation for writing a guide to motor control.

An initial draft of the guide was written.

A demonstration of the system was performed and the initial draft of the guide was distributed at the Science Museum of Minnesota during a meeting of the Twin Cities Robotics Group.

A revised draft of the guide was submitted to Circuit Cellar magazine.

The guide was revised based on the comments of the magazine staff.

The final version of my guide to adjusting motor-controlling equipment was published in the July 2000 issue of Circuit Cellar magazine.

The article was also posted online.
It remains available at: <http://www.circuitcellar.com/pastissues/articles/Kilian120/Kilian120.pdf>

Schedule

1996 and 1997 for approximately 100 hours:
- Researched, built and experimented with the motor control system. Wrote document; presented results to colleagues,; edited document.

• 2000 for approximately 70 hours:
- Presented to Twin Cities Robotics Group; rewrote document in the form of a magazine article; submitted article to magazine; edited article based on editor's comments; resubmitted article to magazine.

Spring 2002 for approximately 20 hours:
- Collected documents, hardware and images and incorporated them into one project document.
- Wrote project proposal; updated proposal.

Evaluator

Dr William Durfee Department of Mechanical Engineering, University of Minnesota.

Evaluation questions

Discuss how well the article demonstrated the student's understanding of constructing and adjusting motion-control systems.

How would the information in the article be useful to the target audience?

Compare the level of learning demonstrated with other undergraduate work in the field of control-systems design.

Describe the quality of the writing, organization and

• presentation of the article.

Based on the article, discuss the student's ability to proceed into a more rigorous study of motion-control systems.

Bibliography

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