CALIFORNIA STATE SCIENCE FAIR
2007 PROJECT SUMMARY

Name(s)
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Project Number
S0218

Project Title
Invention of an Autonomous Navigation System: Design, Development, and Systems Integration

Abstract

Objectives/Goals
The objective of this project was the development of an autonomous navigation system that does not require human input. To achieve this overall goal, additional objectives included development of a test device that could be used to facilitate systems integration, testing, and three-dimensional modeling capabilities to optimize individual subsystems as well as the entire integrated system.

Methods/Materials
A prototype device was built to facilitate the integration and testing of a novel autonomous navigation system. The navigation system is defined as the mechanical structure that houses the steering and propulsion systems, the electronics systems which collect, send and receive data, the computer program which processes the data and the communication systems which establish and maintain two way communication. A microprocessor network collects data from the sensors and sends the information to the AutoNavigator program which processes the data and calculates the appropriate motor settings. Commands are sent to a second microprocessor which translates the information into motor instructions. A communications system was added to facilitate remote monitoring and operation. In addition, Mathematica 6.0 was embedded within the AutoNavigator program to enhance the math computing capabilities of AutoNavigator and provide a modeling capability.

Results
Using a 2 meter test rail system, individual components of the AutoNavigator system were tested and demonstrated to function properly. The test rail was used to perform additional testing of the electrical, mechanical and propulsions systems. Results demonstrated that higher voltage batteries generate more force per engine compared to lower voltage batteries but with a lower overall efficiency. In addition, 6 different propellers with varying combinations of length and pitch were tested. Data obtained from these tests were used to determine the optimal fixed angle propeller. Finally, embedding Mathematica 6.0 into AutoNavigator allowed the AutoNavigation system to be used as a modeling tool. Data collected by the AutoNavigation system was analyzed by Mathematica 6.0 in real time and the forces acting on the system were displayed using vector field diagrams.

Conclusions/Discussion
This work demonstrates the feasibility of autonomous navigation and that the autonomous navigation system described is an excellent model system for future development work.

Summary Statement
A multiuse, autonomous navigation system with 3 dimensional modeling capabilities was designed, built, integrated and shown to be fully funcional.

Help Received
Mr. Regis reviewed plans for the motor housing unit and Mr. Wallace fabricated the motor housing components. A7 Engineering provided BlueTooth units. Wolfram Inc, provided prelease access to Mathematica 6.0.