Robotics Testbed Abstract

Currently I am working with Professor Hougen in his robotics lab doing an independent study on embedded control systems and motor control. The lab has a NASA-inspired Field Integrated Design and Operations (FIDO) rover that was built by Dr. Miller and Matt Roman, from mechanical engineering. This robot needs a control system to become operational which I am building with the help of Mark Woehrer. The plan for the FIDO is to turn it into a robotics testbed with the goal of developing an embedded control system that can be used in future research experiments.

The FIDO-class planetary rover is large enough to carry a twenty pound sensor payload and is capable of driving at a walking pace. The rover moves about on six independent wheels that each have a 180 degree turning radius, enabling the robot to turn in place and move in any direction. This allows the FIDO robot a high degree of freedom while also introducing unique problems in designing embedded control systems. In a simple four wheel rover design, a single microcontroller is sufficient as each wheel isn't independently driven (Jones p48). In the FIDO robot, each wheel has built-in sensors, motors, and servos for driving and turning which will be integrated into each motor controller.

The embedded control system will consist of two-tiers with a central controller at the top and six motor controllers (one for each wheel) at the bottom. A client sends commands to the central controller which then translates them into tasks for each motor controller to perform. The client can be either a joystick for manual control or an on-board computer, which will interface with the central controller through a Universal Serial Bus (USB) link. A software library Application Programming Interface (API) will also be written to allow for custom programs to interface with the rover. This will allow for each wheel to be controlled independently or as a group which makes the software for controlling the rover as simple or complex as needed.

The FIDO rover will use one Atmel Atmega88 microcontroller for each motor controller and an Atmel AT43USB353M microcontroller will act as the central controller. Along with the necessary supporting hardware, each microcontroller can be integrated into modules which simplifies development. Another feature is the use of USB, which is a standard protocol and has a large install base on several platforms. It is the plan to be platform independent while supporting as many interfaces as possible to allow for several different final configurations.

Cited:
Jones, Joseph L. , Seiger, Bruce A. , Flynn, Anita M. , Mobile Robots:Inspiration to Implementation 2nd ed. A K Peters, Ltd. 1999.

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