INSTITUTE for SIMULATION & TRAINING

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A robot with laser range finder, infrared video camera mounted. It also has a 802.11b wireless hub, Motorola GPS and JStik inside the body of the tank.

Autonomous Wireless Robots

Overview

The objective of this research is to develop a new generation of autonomous, wireless robots to carry Intelligent Sensor Agents (ISAs). The ISAs will continuously collect sensory data from an unfamiliar environment through a distributed network of mobile and stationary devices. Our research will explore creative techniques to integrate GPS, MOTE sensors, a continuous localization algorithm and ad-hoc networking on a robotic platform for developing a seamless indoor geo-location system. Currently, we are developing a team of robots mounted with various sensors (such as, a GPS receiver, laser range finder, gyro, and wireless video system) to continuously map and investigate an unknown terrain and also establish a long-term monitoring capability.

Features

The primary computing source for our robots is the JStik, a very compact, high speed, and low power microcontroller. The JStik requires no firmware or operating system, but instead uses Java as a speedy, low-level assembly language on a native Java execution controller. The JStik manages a number of different features on the robot including: drive control servos, video and laser range finder movement servos, GPS data, laser range finder data, and eventually communication with other tank vehicles. Also mounted on the platform is a VIA EPIA Mini-ITX main board. One of the smallest motherboards available, the VIA board incorporates a low power, 800 MHz C3 processor, sound, video and 10/100 Ethernet all in one board and measures at just 170mm x 170mm.

A variety of sensors mounted onto the robotic platform capture the sensory data of the unknown terrain. These include a laser range finder, wireless video camera and GPS. The sensory data will be transmitted through an 802.11g link to a command and control station that will direct the robots' movement. The GUI being developed for the command and control station will have the capability to display the real-time sensory information.

Ongoing and Future Work

In upcoming work, we will modify the continuous localization code developed by the Naval Research Laboratory and incorporate it onto the robots so that they can autonomously

A robot with a wireless video camera and a wireless hub for transmitting real-time video to a control station.

map and navigate inside an unknown terrain. Additionally, we will be mounting MOTE sensors onto the robots so that they can carry a finite number of tiny sensor devices to drop off at specific locations inside the terrain. The MOTE devices will switch to a power saving mode and, using an *ad-hoc* networking protocol, will relay sensory data back to the GUI interface at the user monitoring post. Using this technique we can continue to monitor the terrain long-term. Based on previous work, we will implement a new network architecture called "Cognitive Packet Network (CPN)" on the MOTE sensors and the robots to establish a reliable communication link between the different sensor nodes. The CPN protocol is unique in that the routing intelligence is constructed into the packets as opposed to traditional packet switching networks, which rely on the nodes for routing packets. Cognitive packets route themselves, learn to avoid congestion and avoid being lost or destroyed.

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