RoadNarrows Presents General Purpose Brain-Packs, Controller Boards, and Robots for Education and Research

Kim Wheeler, CEO

RoadNarrows LLC
1151 Eagle Dr. #140
Loveland, Colorado 80537
kim.wheeler@roadnarrows.com

Abstract

RoadNarrows is excited to demonstrate and discuss some new and up-coming products in robotics. These demonstrations include:

- Humanoid and legged robots interfaced with RoadNarrows' brain-and-sensor pack.
- A general-purpose robotic controller board called the OrcBoard used by MIT's Maslab robotics program, and RoadNarrows' plans for its productization.
- Complete robot products, such as the low-cost high-mobility Good Samaritan robot for rough terrain applications, developed by Colorado State University, and K-Team's new K3 professional Linux-based robot.
- Other new technologies e.g. a fuel-cell battery-pack that RoadNarrows is integrating into robot systems.

RoadNarrows would love feedback from the AI community in terms of important features they would like to see in new products. Alternatively, RoadNarrows presents challenges of operating a small U.S.-based robotics business to give educators and researchers insight from the business side. Supporting small robotics businesses helps develop the local industry in general, and creates jobs for future graduating students.

Description

Legged Robot Brain-and-Sensor Packs ("Robot Cerebrum")

Many new humanoid and legged robot kits are becoming available, and RoadNarrows is working on a generalized interface for some of these platforms. For the most part, these kits have few if any sensors and no processing power beyond a controller board, which makes it uninteresting to AI researchers. With a small Linux-based "brain-pack" which includes digital and analog I/O abilities to support sensors, suddenly these legged machines become true robots. By developing a re-usable system or "brain-pack" consisting of a small SBC, a set of sensors, and standard software interfaces, roboticists can turn many off-the-shelf robots into interesting tools for AI education and research.

Using a well-supported operating system such as Linux gives roboticists confidence that their work will be portable to other Linux-based solutions as the brain-pack hardware evolves to take advantage of new processing power on the market. The abstraction of the higher-level processing from the body and mechanics of the robot can also be compared to animal physiological models. This may be important for educational aspects of robotics, as well as engineering good robotic applications.

OrcBoard Robot Controller ("Robot Cerebellum")

Following a goal of module re-use like the brain-pack, robot controller boards should also be designed to be compatible with a variety of robot solutions. Many good robot controller boards are now on the market so there are a lot of choices to consider. In general, wheeled robots require less number of motors and/or servos to control than legged robots. If a roboticist would like to use the same make of controller board to move both a wheeled robot and a 17 degree-of-freedom humanoid, for example, they would have to pick a controller board that has at least 17 motor/servo interfaces.

A very important aspect of choosing a controller board (or a robot based on a particular controller board) is the documentation, open-source software and hardware, and community support. A generalized controller board which is designed to fit all situations may not be cost effective, but a family of controller boards that are designed for different robot specifications but re-uses the software and majority of the design with consistent interfaces could be ideal.

RoadNarrows will demonstrate a controller board called the OrcBoard. This robot board is developed by MIT's Edwin Olson and is being used by MIT in their Maslab robotics program. It has great documentation and an open java-based software architecture, which make it a very good choice for a generalized robotics controller. It is designed to communicate with a computer or processing board (such as a Nano ITX) via USB or Ethernet.

The OrcBoard and products evolved from it are planned to be the platform for a new line of future RoadNarrows'

robots, including wheeled robots, legged robots, and a search-and-rescue robot.

Complete Robots

K-Team's Korebot embedded Linux SBC product is the processing brain for their new K3 robot. The K3 has some very nice built-in sensors and features, such as Ultrasound sensors and a swappable battery pack. By moving to a Linux-based system, K-Team is taking advantage of a large open-source community for software support.

The Korebot is also the platform that RoadNarrows' legged robot Brain-and-Sensor Pack is based upon. This is a logical choice for RoadNarrows, since many of their customers are familiar with the K3 robot and the Korebot. Sensors and software can easily be re-used.

For other robot products, RoadNarrows is considering additional solutions. Many roboticists like the idea of putting a laptop on a robot, or using another platform they prefer such as a PC104, Nano-ITX or Mac Mini. Having robot platforms which are flexible with inter-operable components is a goal of RoadNarrows.

Other Technologies

RoadNarrows is pursuing other technologies to enhance the educational and research benefits of their line of products. One area is the development of a fuel-cell robot battery pack to help advertise the issues of alternative energy, and to help foster growth in this area. RoadNarrows is also interested in partnering with researchers who have developed new sensors, software, robots, and curricula to enhance the company's product line.

Discussion

Changes in commercially-available technology related to robotics are occurring every year. For the most part, these changes are improvements that academics and researchers would like to adopt as soon as possible in order to advance their goals. This is especially true in the field of AI, because issues such as computing constraints and reliable sensor/actuator technology are very critical for proving algorithms. However, the trade-off is the effort to learn a new robotic system, new operating system, and re-integrate higher-level applications to the new software and hardware interfaces. The user also needs some confidence that the robot platform will be well-supported for the expected number of years the tools are planned on being used. Continued support is very important for robotic laboratories and classrooms. Finally, roboticists desire flexibility. A variety of robot types, e.g. humanoid, wheeled, flying, can inspire a diverse set of students, or be more suitable for a variety of research goals.

As a small robotics company, RoadNarrows is trying to address some of the challenges of researchers and educators trying to adopt new robot-related technologies. Hardware and software re-use, portability of components, common tools, etc. are well-established ideas in industry. How can systems be designed with re-use in mind, but at that same time take advantage of great new ideas and systems? What are the trends in the robot community? What do researchers and educators want in their classrooms in the coming years?

Changes in technology occur at different rates for different components of a typical robotic system. For example, the wheels and frame technology of a mobile-based robot may not have significant changes over a period of years, but advances in processor board and memory capability change rapidly. A roboticist may desire to swap out the processor board with a compatible but faster processor without changing the robot base. The robot base itself may occasionally change. New materials such as light-weight, strong carbon fiber or better traction wheels may increase potential applications for a robot and make it more interesting to use. Wouldn't it be wonderful if all the work that you developed on a small indoor robot be plug-and-play onto an outdoor robot used to navigate rough terrain? What if your current robot now has an out-dated, slow processor and your work has reached the robots' limits in terms of number of sensors and processing it can handle? Wouldn't it be wonderful to plug in more memory, a faster processor, better peripherals, and have all of your software and sensors still be supported?

RoadNarrows is developing a modular system of robotic components. Robot platforms such as search and rescue robots, wheeled robots, and legged robots all share basic high-level components. One component is a controller board for low-level sensors and actuators. This can be considered to be part of a robot's peripheral nervous system, cerebellum, and motor cortex. A second component is a central computing or processor board solution for higher level decision making (e.g. the robot's cerebrum) that manages higher-level sensors such as vision, and communication with other robots or with a master computer for extending reasoning and processing functions.

About RoadNarrows

RoadNarrows specializes in robotics for the research and education markets. The company sells and provides technical support for some of the most popular robotic product lines used by the academic community, including K-Team robots and Cyberotics' Webots(TM) software. RoadNarrows' R&D team is developing and integrating open-interface hardware and software robotic solutions to add more choices in configuration options with a focus on re-usability and portability of hardware and software components.