Multi-Robot Network

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Abstract

The Multi-Robot Network will be a network of robots and a central computer designed to explore and map out an unknown area. Exploring uncharted areas can be expensive, time consuming, and dangerous. This project will implement a system using the LEGO Mindstorms robotics kits and an infrared network to create a detailed, accurate, and usable map of the unknown area. The network will be scaleable to accommodate larger size areas or to speed up the process. Practical applications for this network can vary anywhere from space exploration to rescue efforts in disaster situations.

Acknowledgement

We would like to thank Professor Lawrence Genalo and the Toying with Technology lab for lending equipment to the project.

Introduction

General Background: Focus on the feasibility of using low cost robots and an infrared network to explore and map out an unknown area.

Technical Problem: Use the microprocessor based LEGO Mindstorms robots with touch, light, and other sensors to collect and send data to an SQL database.

Operating Environment: Flat, level surface with known outer boundaries and no communication interference.

Intended User(s) and Use(s): This type of system could be used to map out the earth's oceans, uncharted wilderness, or disaster areas.

Assumptions and Limitations:

- Robots will not exceed the range of reliable infrared communication.
- Robots will be surrounded with bumpers attached to touch sensors.
- Walls and obstacles will be immobile.
- The microprocesor has 3 inputs and 3 outputs, operates on AA batteries, has 32 KB of memory
- Infrared has a maximum range of 12' and is line-of-sight dependent.

Design Requirements

Design Objectives:

- Design and implement exploration algorithm.
- Design, build, and calibrate robots.
- Establish two-way communication between robot and server.
- Design and implement mapping software.

Functional Requirements:

- Server and mapping software will handle multiple inputs from robots.
- Creates usable and accurate map.

Design Constraints:

- Portable.
- Completes the task in under ten minutes.
- Battery power is sufficient to complete task.

Measurable Milestones:

- Define the scope and purpose of the project, including planning.
- Make decisions on specific technologies to be used.
- Make decisions on approaches and overall design.
- Build and document the multi-robot network.
- Testing and demonstration.

End-Product Description

This product is a multiple-robot network in which one or more robots traverse a user-defined area and report data about the interior of the area back to a central computer that meanwhile generates a map of the area. The robots are battery powered and communicate with the central computer through an infrared interface.
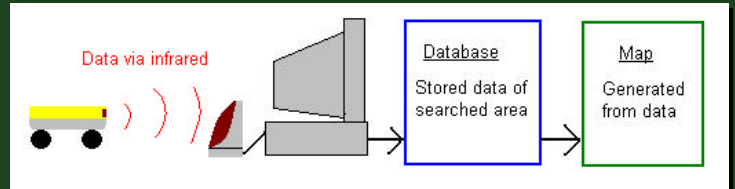
Technical Approach

Exploration Algorithm: Robots will perform a simultaneous sweep of the area. When an obstacle is detected, the robots will send data regarding the size and location to the server.

Server: The SQL database will function as a central processing system. The server will receive data from the robots and generate a usable map.

Operating System: A third-party JAVA based operating system will be used as firmware for the robots.

Networking Protocol: The required networking protocols are built into the operating system and will not be modified.

Sensors: The robots will use a variety of sensors including touch, light, and angle sensors.

Testing Approach

- Infrared Communication
- Exploration Algorithm
- Robot Mechanics
- Mapping Software

Budget and Personnel Effort

The total estimated cost of this project is $400

Todd Atkins	190 hours
Brian Barth	185 hours
Matt Will	180 hours
James Watts	175 hours
Total Personnel Effort	740 hours

References

BugOne's Lego RCX Design Site. Homepage. 30 September. 2001. *http://www.rcx.ic24.net.*

LEGO Mindstorms. Homepage. 25 September. 2001. *http://mindstorms.lego.com.*

Toying With Technology. Homepage. 25 September. 2001. *http://www.eng.iastate.edu/twt/.*