Robotic Delivery System with Simultaneous Localization and Mapping

Functional Requirements List and Performance Specifications

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Introduction

The purpose of the Robotic Delivery System with Simultaneous Localization and Mapping (SLAM) is to locate a user with a wireless remote and bring them an object upon request. This system could be used for any purpose ranging from bringing someone a drink to increasing productivity of a company by autonomously delivering packages. This is particularly useful to increase the freedom of those who are immobilized due to sickness or disability. Our implementation will bring the user a drink, but this foundation will allow for further development of more useful applications which require more complicated mechanical interfaces.

The goals of the project are to develop WiFi signal strength acquisition software, robotic obstacle avoidance software, localization and mapping software, and best path algorithm software which assists in the WiFi based navigation of the Robotic Delivery System. The Pioneer p3dx is our robotic platform that uses an onboard PC. This PC interfaces with wireless access points and a user PC or remote as seen in Figure 1. Optionally, a web based server will be created to allow for real time robot tracking by multiple users.

System Block Diagram

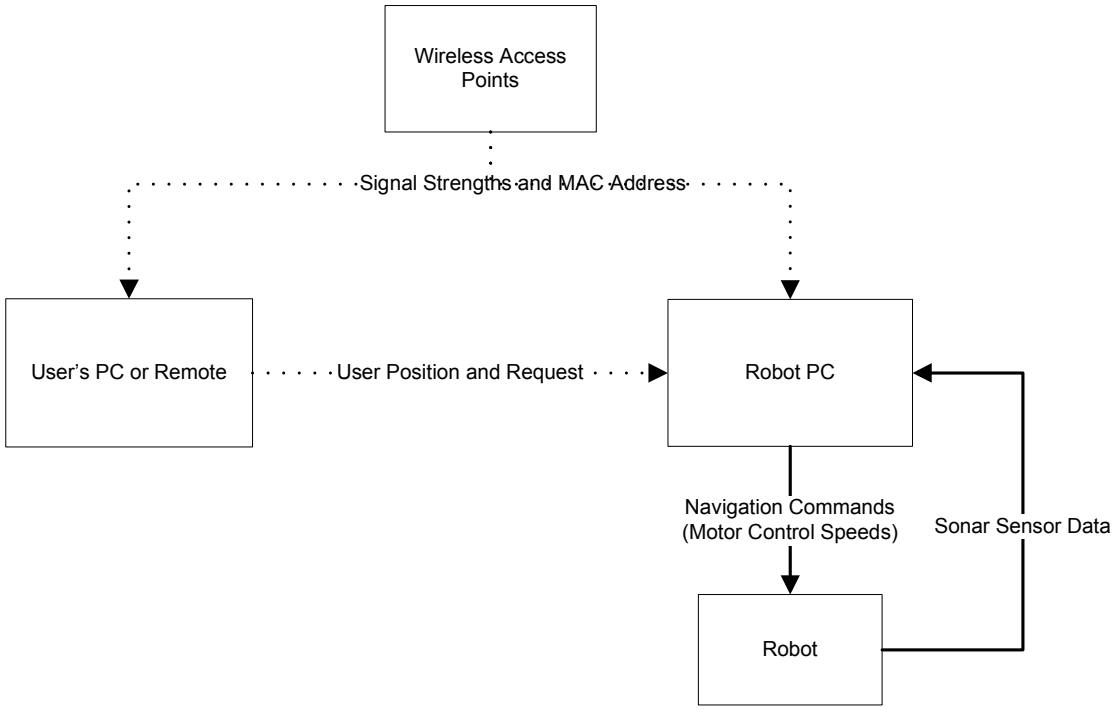

Figure 1: System Block Diagram

A system block diagram of the Robotic Delivery System is shown in Figure 1. Wireless connections are shown as dotted lines; wired connections are shown as solid lines.
The system block diagram summarizes the inputs and outputs of each component in the RDS.

Functional Requirements

These are the functional requirements identified for the Robotic Delivery System. The quantitative values of the requirements are subject to change through experimentation and research.

Navigation Requirements

The robot will be able to navigate through the space of a standard hall doorway (0.81 meters in the US). This specification requires that the width of the robot plus the minimum range for valid sensor readings is less than the doorway.

The software will localize itself on a grid of 0.5 m x 0.5 m squares. This is larger than the robot (0.22 x 0.38 m).

The Pioneer will maintain a nominal distance of 0.25 meters from its edge to obstacles. This allows for safe navigation throughout the environments in which the RDS will be used. The minimum width of detected obstacles will be determined through testing of sensor quality.

A sensor accuracy specification will be determined via research of different sensors. Tradeoffs between cost and accuracy will influence which sensor is used.

The speed of the robot will be established through later experimentation. This speed will be the maximum speed that allows for accurate sensor readings.

Wi-Fi Requirements

The wireless Ethernet adapters should scan for wireless access points at least every 100 ms. There must be at least three wireless access points within range of the wireless adapters for the RDS to guide the robot to the user accurately.

The Wi-Fi scanning process will calculate a rolling average based on the amount of time required to pass through a square of the localization grid at nominal speed.

The Wi-Fi based localization will guide the robot within 0.5 m of the user. This roughly estimates an arm's length.