INTELLIGENT GUIDE ROBOT

FUNCTIONAL REQUIREMENTS LIST
&
PERFORMANCE SPECIFICATIONS

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INTRODUCTION & SYSTEM GOALS

The objective of this project is to design an autonomous mobile robot that will act as a tour guide for any visitor of the Electrical and Computer Engineering Department (ECE) at Bradley University. To meet this objective the Intelligent Guide Robot (I-GUIDE) must meet the following goals:

- Successfully navigate the ECE Department
- Identify key points throughout a tour
- Provide accurate information to the user
- Provide a means for user input

SYSTEM BLOCK DIAGRAM

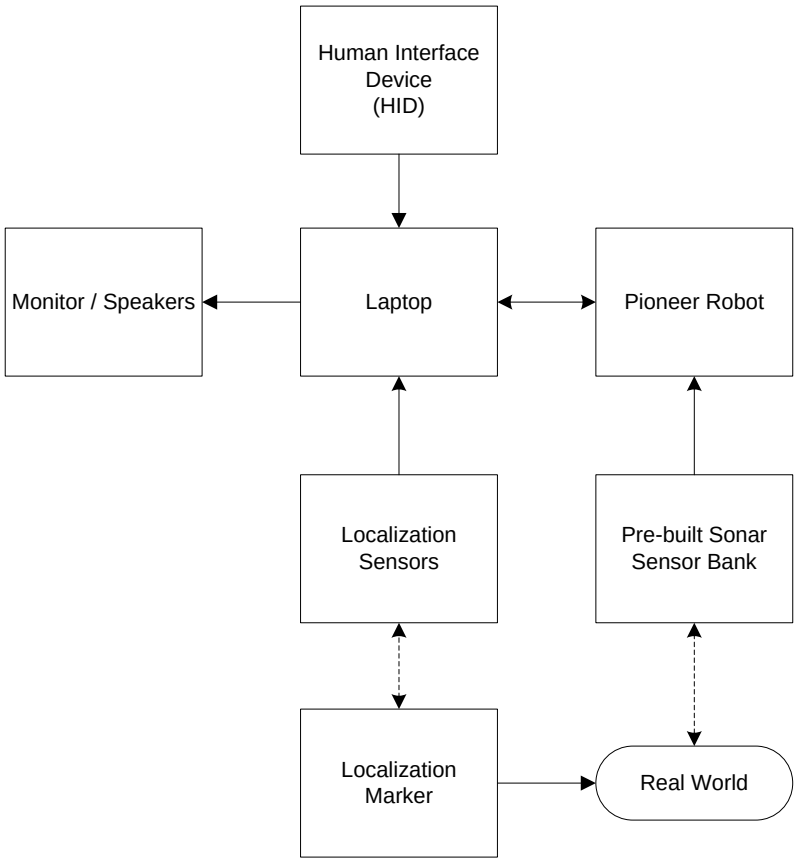

Figure 1 - High-Level Block Diagram

SOFTWARE BLOCK DIAGRAM

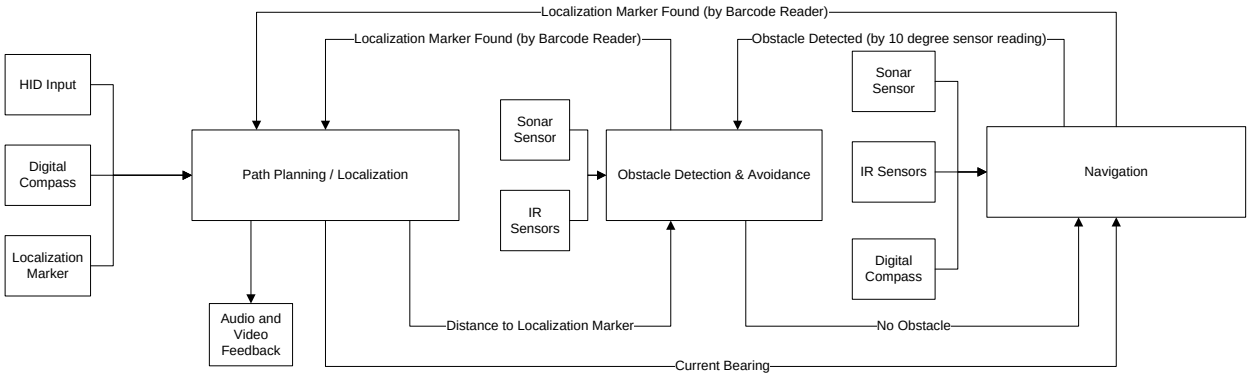

Figure 2 - High-Level Software Block Diagram

FUNCTIONAL REQUIREMENTS AND PERFORMANCE SPECIFICATIONS

The success of this project depends on the accuracy of the position and response speed of the robot. Since I-GUIDE is designed to interact with humans, normal human interactions with the environment shall serve as a baseline for the robot. Furthermore, humans function well in real-time navigation and decision making, so human reaction time shall serve as a baseline for the robot.

The robot must locate its desired position within a 4' radius. This is half the width of the hall and close enough that humans will understand which landmark the robot is discussing while giving the tour. I-GUIDE must also be able to navigate through its environment while avoiding any obstacles and maintaining a speed no greater than the average human walking speed, which is 31.5in/sec [1]. The obstacles encountered by I-GUIDE may be both stationary and moving. This requires a specified range sensor accuracy as well as magnetic bearing accuracy. The sensors must have a range of 6" to 10' to detect both sides of a hallway, detect obstacles early enough to correct I-GUIDE's trajectory, and ensure that the robot bypasses the object safely. The sensors must also have measurement accuracy of at least ±5" to allow a minimum distance from an object of 1". The magnetic bearing accuracy must be within 10° to provide accurate localization. This is the maximum bearing error that allows I-GUIDE to drive straight down its longest path while staying greater than 1" away from the wall. Operating in a real-time environment and interacting with humans demands that the robot can react faster than a human being. Human reaction time is 180ms [1]. I-GUIDE must also allow the user to select any of 28 destinations within the ECE department, including classrooms, faculty offices, and

laboratories. Lastly, the robot should detect when the battery is at 10% of max charge and plan accordingly to preserve the system.

PERFORMANCE SPECIFICATIONS SUMMARY

I-GUIDE shall be capable of:

- Reaching intended goals within a 4’ radius
- Avoiding all obstacles, moving or stationary
- Detecting when battery is at 10% of max charge
- Responding to all stimuli in less than 180 ms (maximum runtime for software loop)
- Maintaining an average speed of 31.5 in/sec during transit
- Allowing users to select one of 28 locations or one of 3 complete floor tours

Additional sensor specifications include:

- Distance/Proximity sensors with a minimum range from 6” to 10’
- Distance/Proximity sensors with a minimum accuracy of ±5”
- Compass sensor accurate to within ±10°

REFRENCES

[1] G. Elert, " Fingertip reaction time," The Physics Factbook, 2006.