

HBRC Example Robot - Goals & Guidelines

Homer and Bart - Mobile Robots

Status: Discussion DRAFT

Introduction

This document is meant to outline the goals, guidelines, targets, phases, and thinking for the HBRC example robots Homer and Bart.

Goals

1. To serve as a learning project that support the three pillars of the HBRC:
 - a. Mechanics - Learn how to build the physical components.
 - b. Electronics - Understand and build the electronics.
 - c. Programming - Understand and code the programming.
2. To serve as a point of reference that beginners can learn from by building and then re-using or modifying in their own future robots. The robots can be seen as "jumping off" points to different or more advanced robotic components. To this end, all-in-one, end-to-end solutions will be avoided in favor of solutions that give builders a good sense of the issues to be solved and the components and techniques that can be used to solve them. This does not mean the design will require going all the way to the resistor level, using existing components will be fine. Understanding the issues and components will help inform future builds.
3. To serve as a learning example of using ROS as the base platform for a mobile robot. Someone new to robotics or someone more experienced can use the robots to learn about ROS and how it is applied to operating a robot.
4. The two robots are different 'flavors' of the same robot. Bart is the smaller robot, more appropriate for tabletop or hard floor applications. Homer is the larger robot, more appropriate for floorbot and varied room-size terrain applications. Even though their sizes make them better for different applications, the fundamental components will be similar. The goal is to use the same concepts and programming, with robot specific parameters and customizations as needed, across both robots. This will help in understanding how the same code could be applied to other robots.

Guidelines

1. All materials and components will be easily attainable, reasonably priced items. Some 3D printing or laser cutting of materials may be required, but will be kept to a minimum if possible. Printable/cuttable source files will be made available in the project git repository.
2. Electronics will be easily attainable, off-the-shelf, reasonably priced components. No custom PCBs will be required. However, the connecting of the various components may require some custom prototyping boards or breadboards. Creating a custom PCB to match is left as an exercise to the reader.

3. Differential drives will be used for the robots, though the placement of the wheels may be different for each robot.
4. The robots will support simulation.

Phases

The first three phases of the example robots align with the [basic challenges set out by the HBRC](#). Homer's phases align with the FloorBot challenges, and Bart's align with the TableBot challenges. When doing any challenge the robots must be fully autonomous. No remote control. Phase 0 addresses the expected safety and reliability of the built robots.

- Phase 0 - Before attempting any of the challenges below, both robots should be built with safety and reliability in mind. At no time should the robots pose a safety hazard to the builder or spectators. No exploding batteries, no electrical shocks, no flying robot parts, no accelerated charges into nearby shins. The robots should be able to reliably power up and begin their challenge when directed. Though acting autonomously during the challenge, the robot should be under user control at all times (ie "start challenge", "emergency stop").
- Phase 1 - Demonstrate the capability of the robot to move about and have some minimal sensing of the environment. Homer should be able to move from one side of a room to the other side. Bart should be able to move from one side of a table to the other side. This directly implies that the robots can detect and recognize the "sides" of their environment.
- Phase 2 - Demonstrate the capability to detect objects in the environment. Homer should be able to find an object in the room and "report" that the object was found. Bart should be able to find an object on the table and push it off.
- Phase 3 - Demonstrate the capability to manipulate objects in the environment with a purpose in mind. Homer should be able to find an object in the room and bring it back to a specific location. Bart should be able to find an object on the table and place the object in a bin located at the end of the table.

Targets

- ROS2 Galactic running on Ubuntu 20.04.
- Homer Phase 1: Under \$300, Bart Phase 1: Under \$150

(All of the great links that were here earlier have been moved to [the Example Robot Design document](#).)