

CSE 398-011
Exercise 2:
Lab Dates:

Robocup
Introduction to Behaviors & Sensing
27 Jan -3 Feb 06



A. Objectives:

- a. Your objective is to develop a ball-following behavior that includes a reactive obstacle avoidance controller using the on-board IR sensors.
- b. Your robot will navigate in a cluttered environment while searching for the ball. Once found the robot will proceed toward the ball, stopping when the ball is immediately in front of the Aibo (~10 cm away).

B. References:

- a. Tekkotsu Code Reference,
<http://www.cs.cmu.edu/~tekkotsu/dox/index.html>
- b. Developer's Pages,
<http://www.cs.cmu.edu/~tekkotsu/development.html>
- c. Motion Planning notes from CSE397/497 Intro to Mobile Robotics
http://www.cse.lehigh.edu/%7Espletzer/cse397_Fall05/lec014_MotionPlanning.pdf
- d. OA example by Salkin & Turner from the University at Albany at
<http://www.ils.albany.edu/robotics/WalkForwardAndStop.h>

C. **The Challenge:** Completion of this exercise will require the development of a behavior which supports obstacle avoidance via the IR sensors and color segmentation.

a. Color Segmentation

- i. Begin by examining the default `ChaseBall` behavior in the Tekkotsu framework. This behavior should serve as the base from which to work from.
- ii. The first step should be to modify the dog to chase the orange ball instead of the pink ball which is the default. The simplest way would be to simply change what the color pink is defined as. See the references for tutorials on color segmentation and camera tools.
- iii. Hint - The framework is newer than some of the documentation. The new color segmentation tool is called `EasyTrain` and it allows you to select the colors you wish to segment.

b. Obstacle Avoidance:

- i. Start by getting the IR sensors to work separately from everything else. This allows you to investigate the pros and cons of each sensor and determine the utility of each.
- ii. There are two IR sensors on the Aibo. One is in the nose which can be used for obstacle detection. The second is in the Aibo's chest. The latter is raked at a steep angle to detect dropoffs (so the Aibo could detect a flight of stairs in your home and hopefully avoid them). While the nose sensor will be useful for obstacle avoidance, the latter should be used to detect the ball when you approach and stop at the appropriate standoff distance.
- iii. You may assume that obstacles will be roughly the same height as the Aibo.
- iv. Panning the dog's head while recording the distance measurements provides a lot more useful information than a single point alone. Your obstacle avoider **MUST** employ such a technique.
- v. You may implement whatever obstacle avoidance mechanism you deem appropriate. Review the notes from Intro to Mobile Robotics for some possibilities (e.g. potential field, vector field histogram, etc.)

D. Some Potentially Helpful Tips:

- a. I strongly suggest you re-review the beginner's tutorial on Events and Motion Commands.
- b. Sensor information can be obtained from the global state object `state` (see the documentation for `WorldState`).
- c. Walk commands can be constructed similarly to the head motion commands in the motion example.

```
MMAccessor<WalkMC> walk_acc(walk_id);
walk_acc.mc()->setTargetVelocity(50, 50, 0);
```

will enable Main to set the velocity of the Aibo to (vX=50, vY=50) by locking out the `MotionManager` and executing the `setTargetVelocity` motion command. There are velocity limits. You probably want to look under `WalkMC` for more details.

- d. For those of you who feel that you learn better through example, there is a rudimentary OA example by Salkin & Turner from the University at Albany at <http://www.ils.albany.edu/robotics/WalkForwardAndStop.h> NOTE: Some this code is from a previous Tekkotsue release, and may not compile correctly with our release.
- e. Once you have all of the components of your OA behavior working correctly, increase the speed of your Aibo to characterize the performance envelope of your obstacle avoider.

WARNING: CHECK WITH CHRIS MANSLEY AS TO WHAT SAFE SPEEDS CAN BE USED WITH THE AIBO BEFORE ATTEMPTING THIS STEP!