King Fahd University of Petroleum and Minerals
Department of Computer Engineering

INTRODUCTION TO ROBOTICS COE 484

Homework No 3 (Due on April 19, 2008)

Questions	Grading
1	
2	
3	
4	
5	
TOTAL	

QUESTION 1: GT 2005 modules to implement the sense-think-Act paradigm for Soccer

GT 2005 describes their humanoid system as composed of three major modules: (1) Low-Level Vision, (2) Self-Localization, and (3) Behavior Programming. The above scheme describes one iteration of Sensing, Processing, Thinking, and Acting. The above iteration repeats (soccer playing) until the program is aborted.

Describe each of the above three modules by presenting:

(1) The module inputs and outputs,
(2) The meaning of the input and output parameters by referring to the robot, player, ball, and field,
(3) The processing which is done by each module in connection with Sensing, Processing, Thinking, and Acting.

At the end, link the above three modules to present the "Soccer Playing" approach in GT 2005.

QUESTION 2: GT 2005 Low-Level Vision System for the GT 2005

The low-level vision processing (image processor) takes as input an image grabbed using a low-resolution camera, e.g. 208 ×160 pixels. Although GT 2005 uses a low-resolution camera of 208×160 pixels the image processing is still time consuming in computing the percepts of the ball, the field lines, the goals, the flags, the other players, and the obstacles. Answer with details each of the following questions:

(1) Describe the approach used in used GT 2005 to reduce the amount of processed pixels and the scanning strategy.

(2) What approach is used to ensure that each pixel is visited once.

(3) GT 2005 used a set of Procedures for the detection of ball, field lines, goals, flags (beacons), other players, and obstacles. How these procedures are invoked in view of the fact that each pixel is visited once.

QUESTION 3: Object Detection by the Low-Level Vision System

Answer with details each of the following questions:

1. For what reason the Gradient operator is used for the detection of the field lines! Refer to the nature of the elements of the LandMarksPercept in your description.

2. Which module uses the LandMarksPercept and why! What happens when some elements of the LandMarksPercept are not seen in the current picture.

3. Describe how the centre circle is detected. Suggest a check that improves the reliability of the computed centre.

4. Describe how the ball and the centre of the Ball are detected. How to eliminate false-positive for the ball detection.

5. Describe how the Beacons are detected. How to eliminate false-positive for the ball detection. Is it possible that the detection is confused on where is located a specific beacon with respect to the field.

6. For what reason the field detection procedure uses an extended color classification based on a generalized distance function (Chi-Square).

QUESTION 4: The Monte-Carlo Self-Localization (MCSL)Module

1. State the problem that the MCSL SelfLocator tries to solve by referring to the initial robot Pose, robot motion given by Delta_Pose(Odometry), and the vision percepts.

2. Describe the details of MCSL SelfLocator algorithm using (1) motion model, (2) observation model, (3) evaluation model, (4) evaluation, (5) selection, and (6) re-sampling.