Robot Proposal: SoccerFan

EEL 5666 Intelligent Machines Design Laboratory

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Abstract

This proposal will describe the design of my robot named SoccerFan. SoccerFan is a wheel-based robot that can locate a colored ball and hit it into a colored goal. This proposal outlines all SoccerFan's components, how each component functions and the overall behavior.

Introduction

I like playing soccer, as well as soccer video games. This motivates me to build a robot that can play soccer. SoccerFan will be an autonomous robot that can perform basic soccer skills: locate a ball and hit the ball into a goal. SoccerFan uses differential drive of two wheels to move, a CMU camera to detect the ball and goal (painted with different colors), and a sonar and IRs to determine distances. With the knowledge of objects' positions and distances, SoccerFan can carefully align itself with the ball and goal in one line. Then it hits the ball into the goal to finish the task.

Integrated System

The system configuration is outlined in Figure 1.

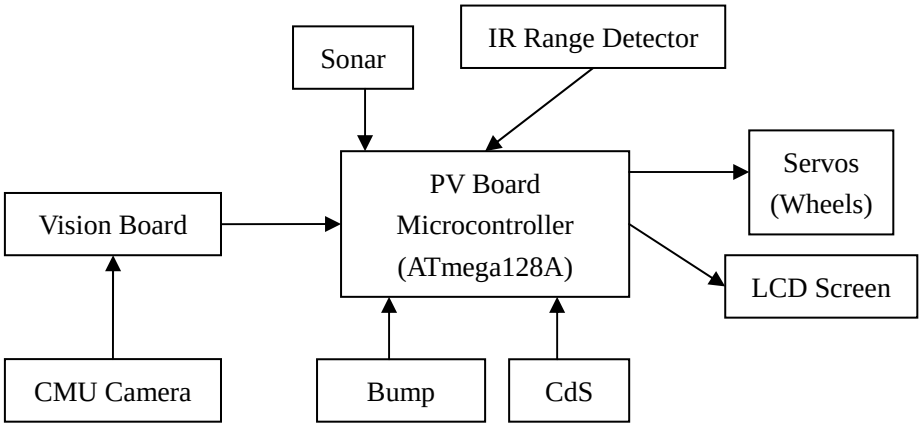

Figure 1

An ATmega128A microcontroller seated on the Pridgen-Vermeer board interfaces with all peripherals, including various sensors and servos. The CMU camera is used to locate the ball and the goal by color. IR range detectors and sonar assist the camera in locating the objects. Moreover, IR range detectors, which are effective for calculating short ranges, help the robot move close to the ball with a proper distance. A bump is used to detect the collision between the robot and the ball (which happens

when SoccerFan hits the ball). By analyzing the information from sensors, the microcontroller sends signals to servos which drive the motors to perform certain movements. An LCD screen shows the current status of the robot, mostly for debug convenience. A CdS light sensor is used to receive the torch light that specifies the start and end of the whole task.

Mobile Platform

The platform of SoccerFan will be cut out of a wood board using the T-tech machine. Figure 2 shows the platform layout. Two servos in the back drive two wheels and there is a caster wheel (not shown in the figure) in the front to balance the robot. A sonar and three IR range detectors are mounted in the front to determine the distances between objects and the robot. The bump switch is also mounted in the front. Two additional IRs are put on the sides for obstacle avoidance. The LCD screen, CdS light sensor, CMU camera and PV board are mounted in the middle. Especially the camera sits on a high bracket and tilted slightly downward.

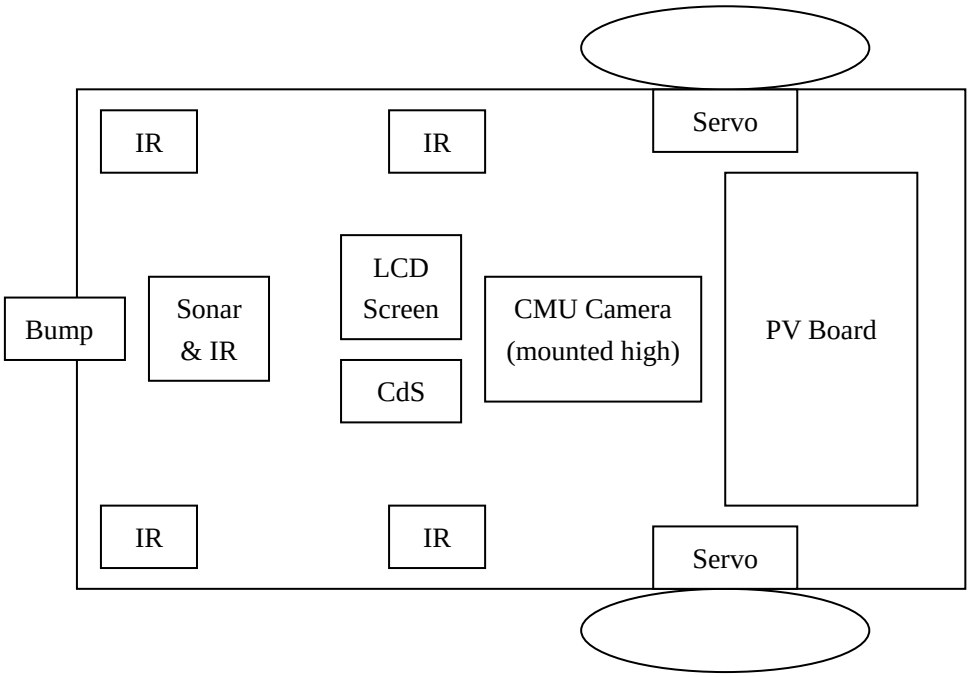

Figure 2

Behaviors

The experiment will be carried out in an open field, e.g. 10 feet by 10 feet. There are two goals and several balls on the field, as shown in Figure 3. All balls are red, one goal is blue and the other goal is green. SoccerFan aims to hit a ball into the blue goal first and then hit another ball into the green goal. After that, if there are balls left, SoccerFan will hit the balls following the “first blue goal then green goal” rule.

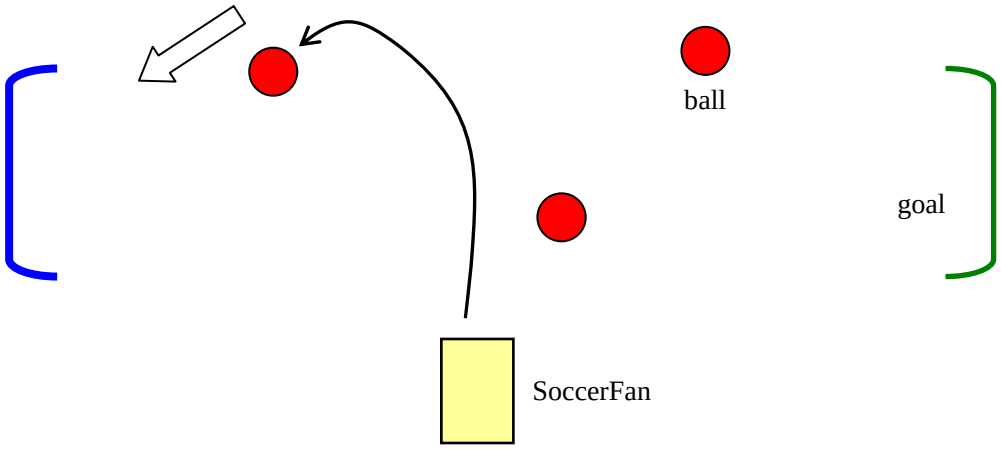

Figure 3

Since we put the balls randomly on the field, the first thing that SoccerFan needs to do is to locate a ball. SoccerFan spins and lock the first red object. If it does not discover any red objects (e.g. all balls are far away relative to the CMU camera sensitive distance), it will use the sonar to locate nearby objects and move close to them until a red ball is located. After successfully locating a ball, SoccerFan will happily roll towards the ball. The IR range detector tells the distance between the ball and the robot, and SoccerFan should stop in front of the ball at a distance (say, 3 inches) proper for it to maneuver. Assume that now SoccerFan is at location A, as shown in Figure 4.

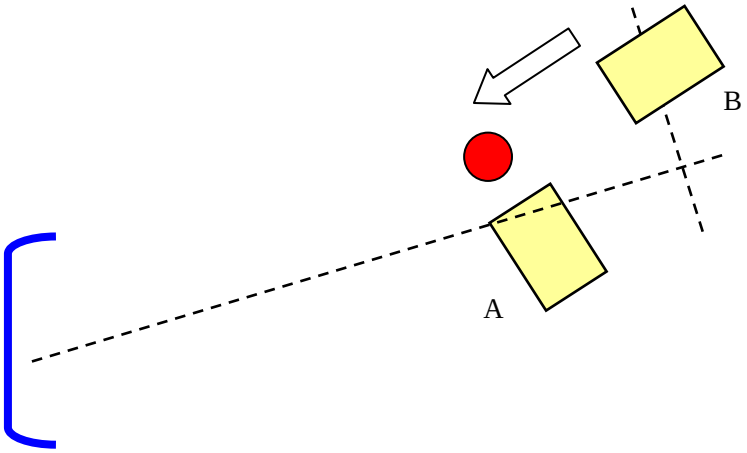

Figure 4

After reaching location A, SoccerFan uses the CMU camera to determine positions of the ball and goal again. Next, it tries to align itself with the goal and the ball in a line. It backs up from the goal, makes a 90 degree turn and finally sneaks behind (and with head towards) the ball; denote this position as B. As Figure 4 illustrates, now SoccerFan can rush to the ball and hit it into the goal.

The bump switch will signal when SoccerFan hits the ball. Hence SoccerFan knows

that now it is time to search for another ball and hit it into the green goal.

SoccerFan continues searching and hitting until I light a torch in front of it. The CdS light sensor senses the torch and tells SoccerFan to stop working.

Conclusion

I have addressed the functions of my robot and how to achieve these functions in this proposal. The design is not involved and should be feasible. The difficult part is how to align the robot with the ball and the goal in one line. The design is expected to be adjusted as the real work is carried out.