A METHOD TO CREATE THE MOST ACCURATE TARGETING IN 1 ON 1 SOCCER ROBOTS

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Abstract: Because the final state of robo soccer is targeting the goal, it's very important to design and use standard high accuracy methods. In this paper we discuss about goal targeting and design a method for robo soccer to target more accurate than the other methods. This method is easier, less complicated and needs less space on processor flash memory.

1 INTRODUCTION

The main goal of robocup is to, by the year 2050, develop a team of fully autonomous humanoid robots that can win against the human world soccer champion. Up to now, many fields of soccer robot have been developed such as Humanoid Robots , Small & Middel Size Robots , 1 on 1 and 2 by 2 soccer Robots.

This is why soccer robots must be autonamous . Designing their algorithm is disscused as the most important aspect.

Therfore a research has been done to design an optimum and more accurate with the least slip algorithm for goal targeting in 1 on 1 soccer robots.

In this event, 1 on 1 autonomous mobile robot team plays in a highly dynamic environment, tracking a special light-emitting ball in an enclosed, landmarked field.

In this paper we first define the problem in part 2, in part 3 we have a discussion about method and materials, in part 4 we introduce the results of testing this method with a robot , and finally in part 5 we come to a conclusion and give suggestion how to develop this alghorithm to other kinds of soccer robot.

2 DEFINING THE PROBLEM

In this section we speak about the problem and use the global standard rules of 1 on 1soccer robots made by Robocup organization and used in international robocups.

Two different kind of fields, named SOCCER A and SOCCER B, may be used at a tournament.

SOCCER A: The playing-field is 122 cm by 183 cm. The corners are flattened.

SOCCER B: The playing-field is 122 cm by 183 cm. There is an open space of 30 cm width around the field.

Walls are placed all around the field, including behind the goals and, if applicable, the open space. The height of the walls is 14 cm. The walls are painted matte black.

SOCCER A: The width of each goal is 45 cm, centered on each of the shorter sides of the playing-field. The goal is 14 cm high. It has a cross-bar on top (to prevent robots from entering the goal). The interior of the goal including floor, walls and cross-bar painted, one side yellow and the other side blue. The exterior is painted black.

SOCCER B: The width of each goal is 60 cm, centerd on each shorter sides of the playing-field. The goal is 10 cm high. It has a cross-bar on top (to prevent robots from entering the goal). The interior of the goal including floor, walls and cross-bar painted, one side yellow and the other side blue. The exterior painted black.

The fields should be placed such that the influence of external infrared light be as low as possible and the magnetic field of the earth is disturbed as little as possible. Perfect conditions cannot be guaranteed, however.

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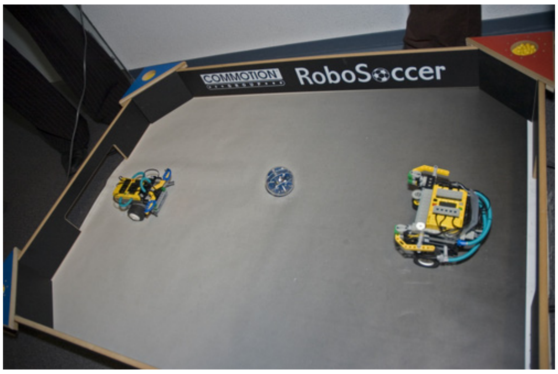

Figure1: A standard Robocup field.

A well-balanced electronic ball shall be used. The ball will emit infrared (IR) light.

Figure 2: The standard ball with IR Sensors.

So robot should have IR sensors in different vectors to detect the ball and come to get it.

But the main problem discussed in this paper is after detecting ball and getting it, How we can detect the goal and shoot to the goal with high accuracy and make sure that our robot is in a suitable situation or not?

3 METHODS AND MATERIALS

In this section we discuss the algorithm we use to have an accurate goal detecting and shooting.

3.1 Situation Detecting Hardware

First we should define the materials use to detect our situation. In this research a compilation of spherical & cubic coordinate is used to locate the situation. So distance detecting and angle detecting sensors are needed.

We use ultrasound sensors for distance and apply a compass sensor to detect angle.

Notice that because of special kind of ball any IR-based sensor that is used for distance or angle detection is not accurate enough.

Figure 3: Ultrasound Sensors.

Figure 4: Compass Sensor.

We also need a processor to process the output signal of these sensors.

Figure 5 shows a soccer robot made by the author of this paper. This robot has the same hardware and algorithm.

Figure 5: Soccer robot.

3.2 Situation Detecting Algorithm

To detect the situation we should use our output signals of sensors and process them.

As default we use 4 sensors in robot, one in each side of robot (east, west, north and south). Also the zero degree of angle is shown in figure 6.

In this method robot finds the target with its distance to the walls of field and its angle. Indisputable for an accurate shoot, robot should turn to appropriate angle ratio to goal .since the angle is variable into the situation, we use the total distance to walls to find appropriate angle. In this way robot first finds its situation and then finds the accurate angle for shooting the ball (shooting angle), then the robot rotates to the proper angle and shoots the ball.

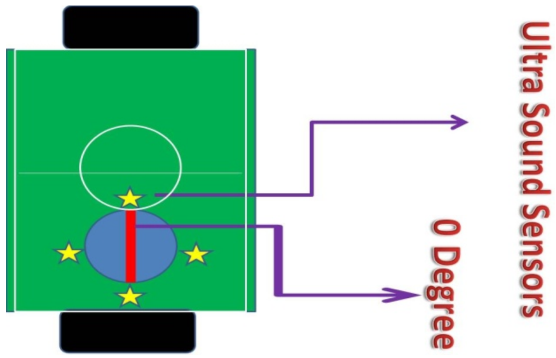

Figure 6: Robot's Ultra sensor and 0 degree.

3.2.1 Single Situation Detection

In this way , first suppose that just one robot is in the field, the total distance of robot to the walls in x & y are constant extent and equal to width and length of the field. Another alternative is when we calibrating the robot in the field it defines the front gate as rival's and the behind as it's own. So according to figure 6, the angle in attack normally varies between - 90 degree (right) to +90 degree (left).

To define coordination as shown in figure 7, robot has 4 numbers to show its coordination. Variables x1 and x2 are to define coordination in x vector and variables y1 and y2 are to define coordination in y vector.

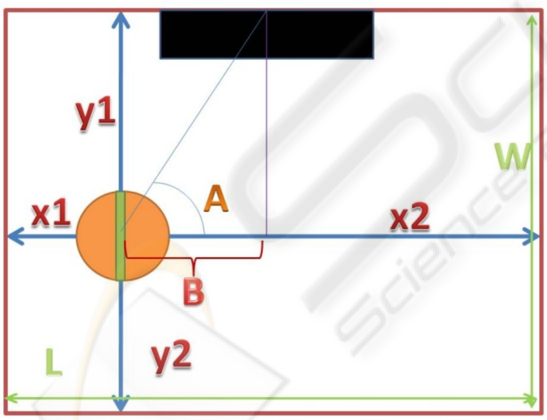

Figure 7: coordination parameters.

The black box is the target and the violet line is drawn from the center of the target. Another line is drawn from the center of target to the center of robot's shooter device. Angle A is the appropriate angle for shooting. In other words, if robot rotates from its 0 to A and then shoots the ball, it will hit the target.

To calculate the amount of A in this method robot first should denote whether it's in the right-half of field or left one. Here is this detection code in C++ programming language.

```
Int cor ;
   Float x1,x2,B,angle;
   if(x1>x2) cor=1;//denote right
   else if (x1<x2) cor=2;//denote left
   else cor=0;//denote middle

   switch (cor) {
   case 1:
   B=L/2-x1;
   Break;

   Case 2:
   B=L/2-x2;
   Break;

   Case 0:
   B=L/2;
   };
```

After defining the robot area, now it's the time to calculate angle A. As shown in figure 7 we suppose that X2 > X1 so according to upper code cor = 2. Other supposition are the Length (=L) and Width (=W) of the field. So as shown in equations bellow:

$$B = x1 - (L/2) \quad (1)$$

$$A=\arctan(y1/B) \quad (2)$$

According to Figure 6 if x1 > x2 we should subtracting A to -1 and if x1 < x2 we should subtract A to 1.

So according to equations (1) and (2) robot can calculates the amount of angle A.

In other words this method consist of 5 stage:

1) Robot should detect the ball and go to get it.
2) after getting the ball, Robot should turn to its 0 degree.
3) after turning to zero, robot should calculate the appropriate angle (A) .
4) after calculating the angle, robot should turn to that angle .
5) shooting and Goal!

3.2.3 Situation Detection in Match

Because in 1 on 1 soccer there are only two robots in the field, this method suffers some error states that cause problems for robot .These stages happen when one robot is sensing by ultrasound sensors at the time that the other robot wants to shoot. In this occasion the stricker robot should move to change its situation. This scape from the last occasion depends on the robot's velocity and the clock of system.

3.2.3.1 How to Detect this Error Situations

As shown in figure 7 we have equations below:

$$x1 + x2 = L \quad (3)$$

$$y1 + y2 = W \quad (4)$$

In fact according to the situation two variables of x1, x2, y1, y2 are as data and the others are as parity. In other words, before using this method to notice that whether robot is in the error state or not, it should use the equations 3, 4 as provision to continue the method.

4 RESULTS

This method has been tested with the soccer robot shown in figure 5. The field was 182 (=L) * 122 (=W). The coordination, targeting angle and average of accuracy in 100 times of trying out (20 times for each one) shown in table 1.

Table 1: The results of testing this method with a robot.

Number	X1	Y1	Angle	Accuracy
1	31.6	59.3	0.772284	100%
2	42.1	96.7	0.601476	100%
3	132.9	100.2	-1.18239	100%
4	91.6	90.2	-1.56969	100%
5	60.0	88.2	1.227777	100%

5 CONCLUSIONS

In this paper we first mooted a problem in targeting goal in 1 on 1 soccer autonomous robots. Then we designed a method to have a most accurate targeting.

In this method robot in each situation could easily finds the appropriate targeting angle to the center of goal.

By using this method robot has a most accurate targeting than the other methods. As shown in table - 1 the accuracy of this method for 100 times of trying out is 100%.

Though this method is designed for 1 on 1 soccer robots, but it could be used in other soccer robots like small size or middle size leagues.

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