RoboCup 2021
Junior soccer simulation

F1_Formula Team Description Paper

Sarah Musaei [1], Saba Musaei[2], Mahdieh Kargaran[3]
[1]Farzanegan1 junior high school,
Tehran, Iran
Tel: +989127758437
mahdieh_srk@yahoo.com

Abstract. This article is about our team's efforts along the way to reach to the soccer league in RCJ robotic competition 2021 in simulation filed and contains our progress in this year. Software, different strategies and architectures are some of the items we had mentioned in this article. Furthermore, Topics like ball kickoff algorithm, in which we had explained our solution for scoring more points with a sort of algorithms, using the lack of progress of the ball. Also, goal keeper robot algorithm, that we gave a different new way for losing less points. We also mentioned our algorithms in flowcharts for better understanding. And after explaining our opinions, we gestured our experiences and ideas that guided us to this level. Also, if you are interested to know more about us and some other ways which we use for improving our robots, you can find some useful information in this article.

Keywords: RCJ robotic competition 2021, Soccer league, Software, Algorithm, Kick off, Goal Keeper robot, Strategies, Simulation, Flowchart

1 Introduction

The RCJ robotic championship is held every year in order to test our abilities in an educator and entertaining way. Our team has been preparing for this competition for about 3 years, and now, as the Covid-19 Has spread all over the world, unfortunately we are attending this competition online.

We got familiar with soccer robots' field in 2016 and our team has experienced different situations through this way. With hard-work and passion, we have succeeded in some of them, and have learned valuable experienced from others. At first, we were working with real robots, made by ourselves. But as the pandemic and quarantine started, we were unable to continue our progress. At the first year, we had entered the F.I.R.A. cup competition (an international competition), we had won three prizes in ice hockey league, third place in individual part, second place in super team part and second place in world champion. Just after this competition, we had attended the junior cup competition, in which we had won two prizes, third place in the individual and first place in super team. As the Covid-19 pandemic started on the year after, we were not able to take part in a competition; but as we started our classes online, we had attended a competition named junior cup again and had won one prize, third place in the individual part, as the competition did not contain a super team part.

Until we got to know about robotics soccer simulator. So as before, we started our work with a lot of passion. Although working online and without meeting each other had made this process harder, but we could not give up. And as a result, we could prepare for attending this competition. [fig. 1&2]


Certificate of the
Super Team
Fara Cup 1398
Junior Cup2019
11 - 12 Jfrd , Farzanegan 4 highschool
Farzanegan1
League
Light Weight
Primary
Affiliation
Farzanegan 1
High School


Certificate of
3rd Place
Fara Cup 1398
Junior Cup2019
11 - 12 Jfrd , Farzanegan 4 highschool
Sarah Mousaei
Team
Farzanegan1
League
Light Weight
Primary
Affiliation
Farzanegan1
High School


Certificate
of Award
solo
Farzanegan 1
Ice Hockey


Certificate
of Award
united
Farzanegan 1
Ice Hockey


Certificate
of Award
World champion
farzanegan 1
Ice Hockey

2 Robots and Results

Software:

- Guiding the ball:

  The most important part in the algorithm in soccer robots is the moving part. In order to follow the ball, first of all the robot turns until it faces its target point then it simply just moves towards it. But this is not the best algorithm as the robot can push the ball toward its gate. We changed our algorithm. The robot needs to go behind the ball then follow it so it increases the probability of getting scores by robot. Depending on the x and y of the ball and robot position, it decides in which direction it should follow the ball. For better understanding, we have included our motion function code.

```
def motion(self, x, y):
   goal = {'x': x, 'y': y}
   angle, robot_angle = self.get_angles(goal, self.robot_pos)
   goal_direction = utils.get_direction(angle)
    if goal_direction == 0:
        left_speed = -10
        right_speed = -10
    else:
        left_speed = goal_direction * 10
        right_speed = goal_direction * -10

    self.left_motor.setVelocity(left_speed)
    self.right_motor.setVelocity(right_speed)
```

[Motion function]

- Switching:

  The best algorithm through the match is that the furthest robot from the ball becomes the goal keeper. That increases the probability of getting scores and decreases the goals that the other teams get.

  In order to switch the roles (the goal keeper and the forwards) between our robots we decided to use a variable which determines the role of the robot; every robot gets the position of the three robots and it calculates the distance between the ball and all of the robots so every robot decides which role should it take without disturbing others. [fig. 3&4][1,2]

  Distance formula:

$$\sqrt{a^2 + b^2} = c \qquad (1)$$

$$\sqrt{(\Delta x)^2 + (\Delta y)^2} = distance \qquad (2)$$

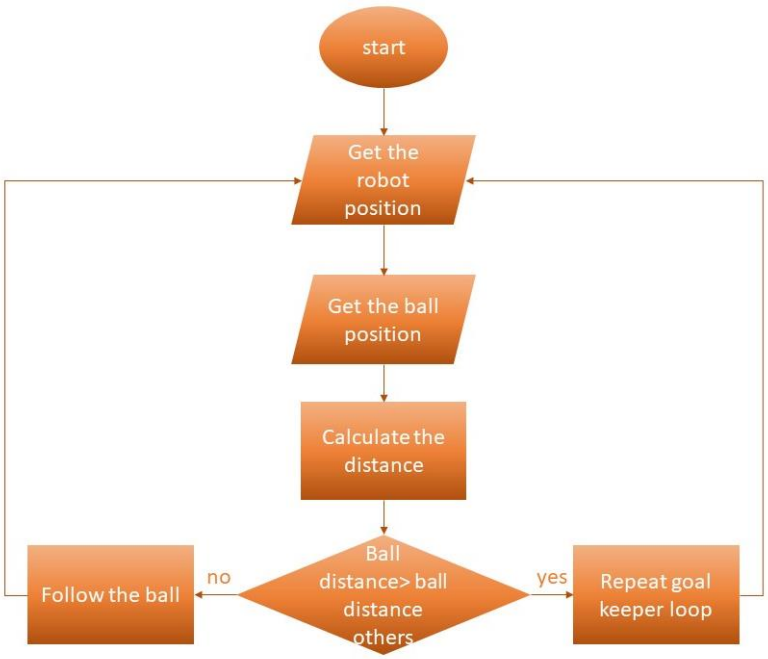

fig. 3. Flow chart of the switching rubric

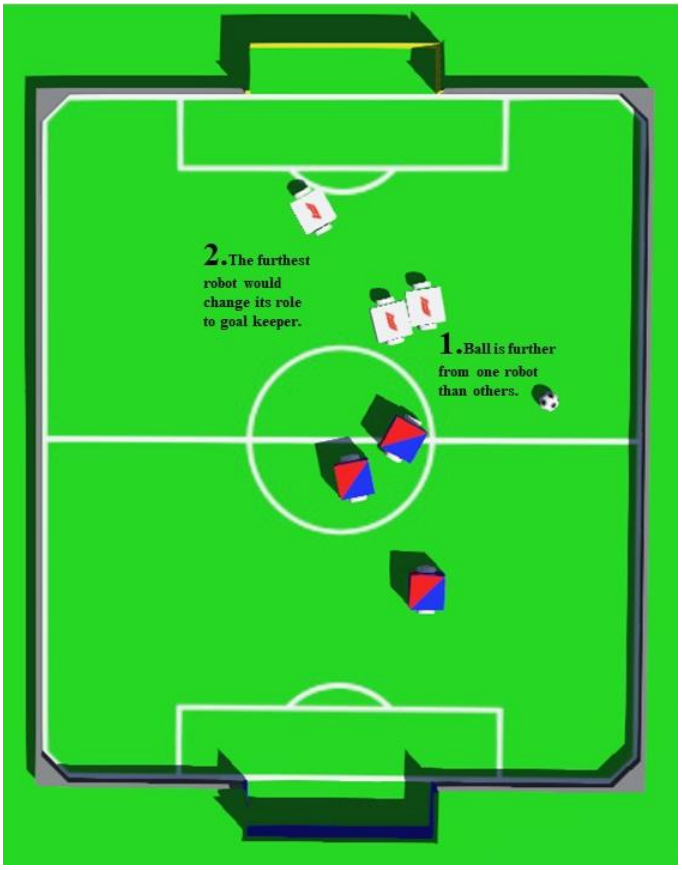

fig. 4. Simulated guidance

- The goal keeper:

  There are six robots in the filed so they keep disturbing each other and as a result our efficiency decreases; further more just like real football games having a goal keeper can be very helpful in decreasing the loss of point.

  We divided our goal keeper algorithm into two parts the follow ball part and the chasing part. The goal keeper follows the ball if the ball was in its part of filed but if the ball was in the other part of the filed it chases the ball but it doesn't go towards it. It keeps following the ball in the x axel. [fig. 5&7]

fig. 5. Simulated guidance

- The ball kickoff algorithm:

  In the match sometimes the ball stops in the filed because of the robots' crash. In these Situations the simulation moves the ball to the nearest neutral point. Then it takes the robots a long time to reach the ball.

  In these times if one of your robots predict where the simulation will place the ball and move near there then it can easily score a goal after the ball was moved. In order to do that we need two variables that are the position of the ball but with time difference. Then if the position of the robot wasn't changing very much it understands it is in a ball kickoff situation. [fig. 6&7]

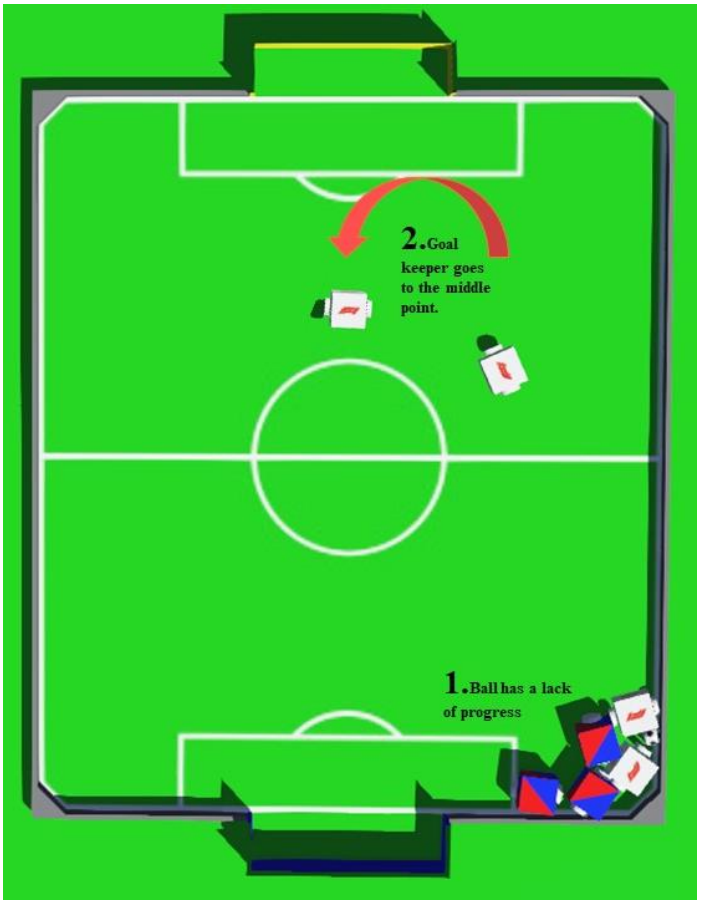

Fig. 6. simulated guidance

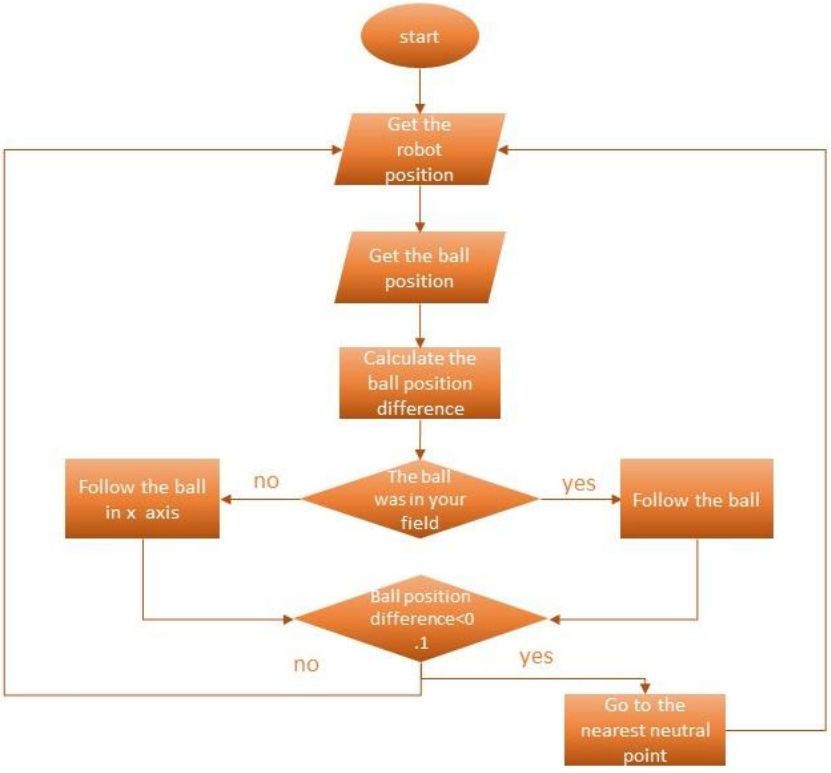

Fig.7. Flow chart of the goal keeper and kickoff sections.

Results

Through this way we tried various strategies and algorithms. And to decide between the codes we ran them in front of each other many times to test their abilities. For example, we tested two algorithms for moving. One of them used a kind of reverse to reach behind the ball dividing the 360-degree ball angle into 16 parts (like sensors we used in real light weight robots) and gave each one a movement depending on the ball's place; but as we tried it in front of the simpler algorithm, we found out there was a big delay while moving back in this algorithm. And also, we tested this different goal keeper algorithm in front of a simpler algorithm that just chased the ball in the x axel and didn't go further from its gate and we chose this algorithm as the simple chasing algorithm didn't match our switching algorithm and had a delay in protect our gate that could be dangerous for our team

3 Conclusion & Future Work:

As you had read, we tried to present our updates and the whole progress in a useful way. So as a conclusion, we would like to have a small look to it. As we had explained in the main part, the most important part in soccer robots is the movement. So, in order to increase the possibility of scoring a goal, we decided to change the simple way into a more complicated but efficient algorithm. As a result of that, our robot instead of just following the ball, goes behind it. But for have a higher chance of victory; we decided to add some other algorithms such as the goal keeper algorithm, in which we had paste a robot defending the gate, for a lower chance of losing score. Also, we had added a switching part to improve the speed and performance rubric, also to have a smoother coordination.

Having a plan for future is the first step to get closer to them. So, in order to keep ourselves up to date and keep getting better, we have listed some of our future plans in this part; hoping to be a source of inspiration for you.
Some of our future plans are as follows:

- To have a connection between our robots can really improve their function. For example, to have an algorithm in which robots pass the ball to each other, similar to real methods in soccer games.
- Having a strong intelligent goal keeper is one of the best ways to guarantee your priority. So, one of our main plans' is to improve our goal keeper with an algorithm, which includes faster processing and simplified orders.
- We have to use every opportunity for scoring a goal and be a step ahead of our competitors. And as to use every good condition, we are thinking of an algorithm for shooting the ball into the gate.

As the pandemic has spread all around the world, at the moment, we are unable to achieve some of our targets with the present situation and lack of facilities. But hopefully, we will be able to come over this challenge as we had done it before, continue to get better, for a better future.

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