# Democritus

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**Abstract.** This paper presents our first submission for this year's (2020-2021) RoboCup Junior Soccer Simulation League as well as present an overview of our algorithm and some of the problems we faced along the way.

**Keywords:** RoboCup Junior, Simulation Soccer League, Football, Democritus .

## 1. Introduction

Team Democritus is a team originating from the small town of Xanthi ,which is located in the northern part of Greece, and is participating in this year's RoboCup Junior Soccer Simulation League.

## 2. The actual work

### 2.1. The Algorithm

We decided to create a Finite State Machine, as such complex problems such as a football game require simplified workflows that determine the behavioural patterns of the robots according to specific input also known as states. Consequently we started by creating basic states that describe the movement of our robots, and later moved onto more composite notions such as the behaviour of the goalkeeper.

Our Program is Separated into 25 states that describe different patterns, each state is categorized according to the role that is supposed to perform these actions. For instance the robot that gets the role "MIDDLE" assigned has 14 states at its disposal plus one to assist the selection for the other states.

### 2.2. Early game

The game starts with every player being assigned the “ATTACKER” role which consists of two states. Each state expresses the way the robot should follow the ball according to its location.

After the 5th second has passed each robot gets assigned a different role according to its distance from the ball.

The furthest robot gets assigned the “DEFENDER” role which basically acts as the goalkeeper, the second furthest robot gets assigned the role “MIDDLE” and the closest robot remains an attacker.

### 2.3. Mid-game

After each role gets assigned our program checks for three situations.

1. We are attacking.
2. We are defending
3. The ball is stuck

Each flag triggers certain states for our robots to positionaly prepare, for instance if we are attacking the defender should wait in the middle of the goal or if we are defending the middle player should move at the lower left or right part of the court according to the ball’s y coordinate.

As with regards to the last flag, if the ball gets stuck new roles are assigned to each robot using the same method as before but now the remaining robots prepare for the ball to reappear near the center.

### 2.4. Tools used and improvements that can be made

In order to achieve certain actions, such as the assignment of roles or the movement of the robots, we used certain functions.

One of the most commonly used tool-functions is the one that calculates the euclidean distance between two objects using the pythagorean theorem.

$$d(x,y) = \sqrt{(x_0 - y_0)^2 + (x_1 - y_1)^2 + \ldots + (x_n - y_n)^2}$$

As with regards to the improvements, our algorithm is far from complete and needs major improvements which we hope to have implemented by next year’s time.

But one of the nearly implemented features was that of the implementation of a bezier path tracer which calculates an x amount of points that the robot can follow in order to hit the ball in a specific angle, given by the following function.

$$B(t) = (1-t)^2 P_0 + 2(1-t)tP_1 + t^2 P_2, \; 0 \leq t \leq 1$$

## 3. Conclusion

In conclusion over the course of the previous couple of months we have learned a lot not only about problem solving but also how to cooperate as a team and alongside some theoretical concepts such as what a Finite State Machine is.

As per the future, we would like to continue evolving and improving.