PROJECT REPORT
SIMULATION OF MULTI-ROBOT SOCCER GAME

BACHELOR OF TECHNOLOGY
in ELECTRICAL ENGINEERING

MODELING AND CONTROL OF AUTONOMOUS MOBILE ROBOTS
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Statement:

System-level simulation of a Simple robot soccer game using Matlab and Simulink.

Introduction:

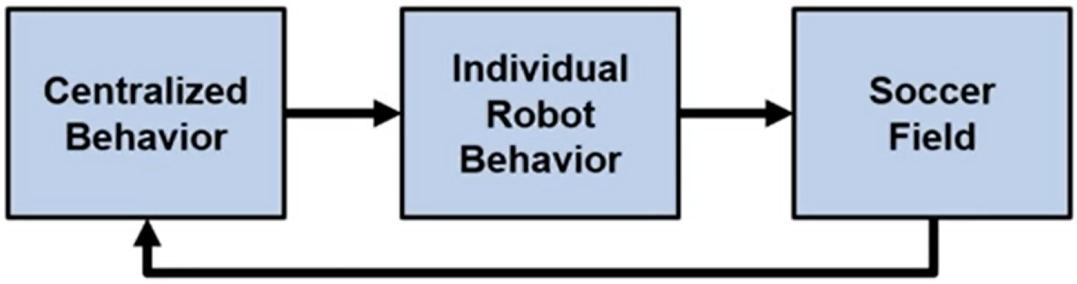
We are simulating a multi-robot soccer game played by two teams, and the winning team will score the maximum number of goals. Teams will compete against each other to score goals. Each team is divided into three kinds of players defined by their roles as goalkeepers, attackers and defenders.

The role of the goalkeeper is to stop the opposite team from scoring goals. The attacker tries to pass the ball and will try to make a goal, whereas the defender tries to prevent the attacker from either passing forward, dribbling toward the goal or shooting.

We will simulate this model in Simulink and Matlab.

System model:

Here we divided the system into three subsystems which a Centralised behaviour, Individual Robot behaviour and the soccer field.



Soccer field:

This simulation represents the physical part where it will be replaced in the real world.

State flow is used in designing the hybrid dynamic system, which means one can switch from a dynamic system of equations to something purely algebraic.

Here, the Position of the ball is attached to the position of the robot holding it, so no dynamics is primarily involved for the ball.

When no player is holding the ball it is known as the free state or the Simulink state becomes a dynamic system. It will be first-order damped system in velocity because the velocity changes when the ball is moving in the free state as there is a damping quotient in the velocity.

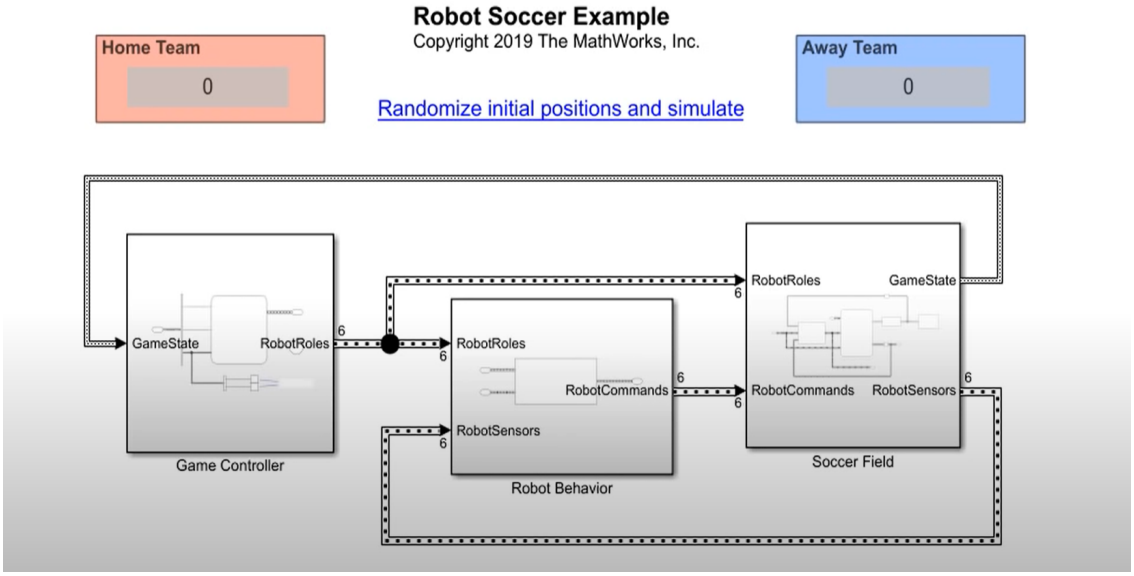
Individual robot behaviour:

- The same logic is represented for all the robots.
- Each of them receives the sensors and behaviour and gives the output to the robot.
- Roles are attached to the robot, whether they are attacker, defender or goalkeeper.

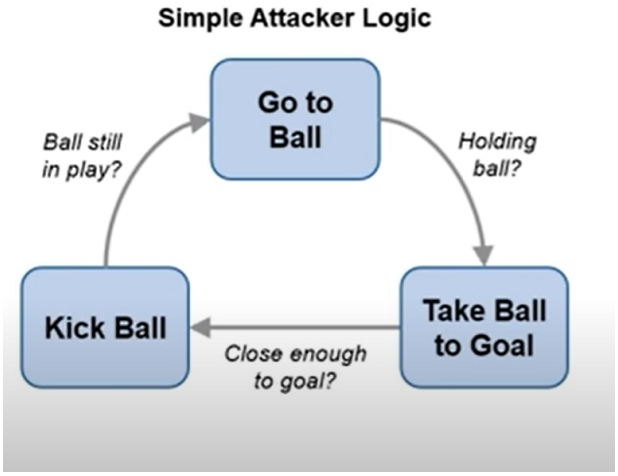
Centralized game controller:

Connected to a controller PC which measures the locations of the robots, ball and sets the state of the game. It communicates with each board or the computer of the individual robots.

System model in simulink:



Stateflow and logic:



Go to the ball:

Firstly, when the ball is in the free path, the player is directed towards the ball. This we call the "go to ball" state.

Take ball to Goal:

When the player reaches the ball, he holds it and now the next step will be to take the ball in the direction of the goal. This is the "take ball to goal" state.

Kick ball:

When the plates takes the ball to a set length away from the goal post, he will now have to kick the ball. This we call the "kick ball" state.

And this process moves in cycles as if the goal is missed, then again the player has to go towards the ball, take it, then kick it and so on.

Working process:

- Firstly, we will design the soccer field by giving the required dimensions and different lines required for the game. The required coordinates for the goal post and field are given.
- The initial positions of the players will be randomly generated. We will be giving the velocities for the players, that is the velocities with which they will be running in the field and also the angles in which the ball will change based on the role of player.
- We will detect the ball whether it's in the hands of the players or on the free path.

- The velocity of the ball is set such that it follows a first-order damped system by introducing the gain component in the feedback position. We will give the damping quotient for the velocity of the ball.
- The ball is released from the middle of the field, and both teams will fight to score the goals which will result in winning the team with more goals in a specific amount of time.

Results and conclusion:

From the above-performed simulation, with the help of matlab and simulink we can get a simulation of team winning the game by scoring more goals in the given time.
This simulation can be used to perform a real soccer game between the robots in the arena.

References:

1. https://www.youtube.com/watch?v=7Lsnwux6d0Y&list=PLn8PRpmsu08rdL7jwgrQjewdFXxDHbyIV&index=13
2. Toolbox: https://in.mathworks.com/matlabcentral/fileexchange/66586-mobile-robotics-simulation-toolbox?s_eid=PSM_15028