Armik Soccer 2D Simulation
Team Description Proposal

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Abstract. This paper introduces Multi-Layer Neural Network for choosing a suitable player to receive the pass as the main innovation used for Armik 2D soccer simulation team. Furthermore several improvements are utilized. First team decision tree was recreated to cover all players operation in all parts of field. Then a new algorithm is proposed for throw pass. Finally, defense system has altered to enhance team's reaction against opponent's attacks.

Keywords: Neural Network, Decision Tree, Throw Pass, Marking, Defense

1 Introduction

Armik Team has started by some students of Islamic Azad University – Lahijan Branch, in Dr. Hesabi Robotic Center. They began their research on Soccer 2D Simulation field from 2011 and participated in several competitions including IranOpen 2012 and the placed 3th in Caspian Robotic competitions 2012.

Armik's early works based on WrightEagle base code. While earning more experience on soccer simulation, migrated to Agent2D as base code which continues till now.

Our new effort were put on high level skills such as implementation of new pass that is, completely difference from that of 2011. Defense system has also more ever an extended decision tree was utilized that completely covers all situations in game.

2 Team's Decision Tree

An extender decision tree for players operations will make coordinate teamwork in during game. Therefor implementing an accurate decision tree seems to be necessary.

Decision tree for ball owner player consists of three parts that depend on player's position in playground. In first one-third, discreet game intended because risk in this area could be expense.

Then player in the middle one-third take forward the game by dribble and pass until arrive to offence on-third. In This area the opponent goal is near so he performs more tactics to get better results. The team's decision tree is depicted in Fig. 1.

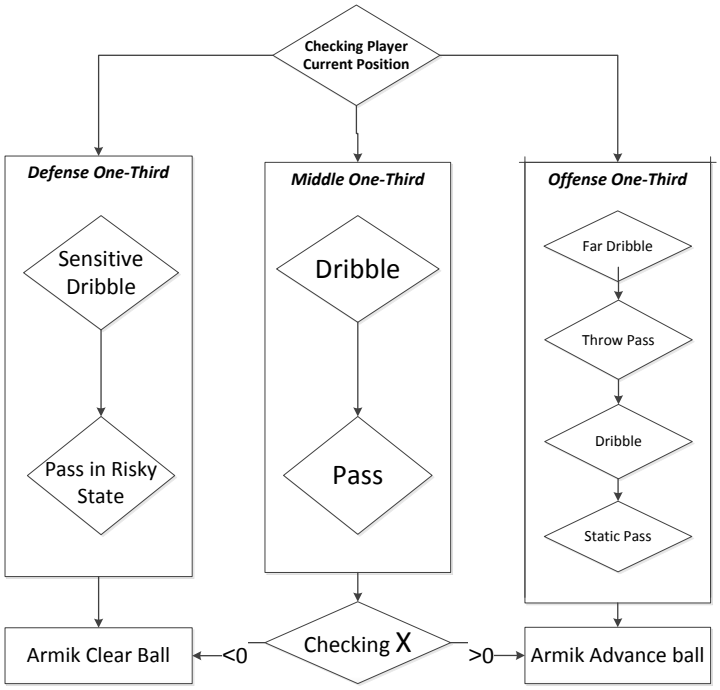


Fig. 1. *Armik* Team Decision Tree

3 Static Pass

Pass algorithm will have best performance when pass receiver has best situation for receiving ball and Armik has two separated algorithms for this propose:

3.1 Using Neural Network

The idea of Armik is playing like a real soccer player. Thus, it should train as a human for deciding in different situations. Several methods were studied and found

that Neural Network [3][4][5][6][7][8] as a suitable method for modeling the portion of soccer player's brain which analyze a pass problem and make the best decision.

For using neural network there are two important steps:

Gathering Data. A set of suitable data are necessary for training a neural network. Armik chooses real data for this purpose. One of the best soccer passer of the world, *Andrés Iniesta*[1], has been chosen for this study.

For this purpose a lot of matches that *Andrés Iniesta* plays in them observed and his pass situations captured, as shown as in Fig.2 and converted to 2D Mode that shown in Fig. 3.

Finally the distance of *passer to teammates*, *teammates to opponent goalie* and *teammate to some opponents who are near* obtained[2]. So the data fed to network as training set**.**

Fig. 2. One of Pass Situations

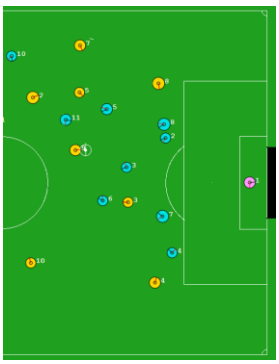


Fig. 3. 2d Version of Fig.2

Using Multi-Layer Perceptron. A neural network is a system of data storage points called nodes. These nodes are set up in such a way that the values in some of nodes determine the value in other node. The nodes are fully connected. A weight is associated with each connection that determines to which degree the value in the next node is influenced by the value of the previous node. A neural network has a set of input, outputs nodes. It also has intermediate nodes called hidden nodes.

The nodes of input layer are connected to every node in the next layer, the first hidden layer. Each hidden node calculates a weighted sum of all the input values of the input nodes to which it is connected. An activation function then scales each resulting sum to within a specified range. The hidden layer is similarly fully connected to the output layer and hidden layer values are passed to the output layer where the weighted sums followed in the same fasion. This process of calculating is called propagation. In this project MLP which is a feed forward artificial neural network has been used. Number of nodes in each layer is 15, 6, and 1 for input, hidden and output layer respectively. The team used sigmoid function as activation

[1] `http://en.wikipedia.org/wiki/Andres_Iniesta`

[2] Eagle Eye Pro Viewer `http://www.eagleeyedv.com`

function for input to hidden layer and tan hyperbolic for hidden to output layer. To discourage oscillation we used momentum as 4% which found trial and error.

According to the number of nodes, network needs 103 weights including bias and their value considered randomly between 0 and 1. A learning rate (η) has been used to control the magnitude of the increment in weights change.

A back propagation applied to train the network's weights. The output value of the network is compared to a desired value or target output so the error is produced. The next phase is backward computation and adjusting the synaptic weights of the network. The last phase is iterating the forward and backward computations by presenting new epochs of training examples to the network until the stopping criterion is met.

3.2 Rating Algorithm

Also, there is another algorithm for finding best player to receive pass which is called Rating Algorithm. In this algorithm a variety of parameters Interfere to choosing suitable player and have direct relation with position of passer and pass receiver. Thus football field divided to three parts, defensive one-third, middle one-third and offensive one-third, respectively. The rate of pass receiver calculated according to his one-third and the distance to passer individually in each one-third of field. Each parts of field have its own importance: low importance, normal and high importance.

Parameters which Interfere, listed as follows:

- Distance of Passer to Pass receiver
- Distance of pass receiver to goal
- Influence of backward pass
- Count of Opponents around of pass receiver
- Rate of position

This Formula is used for calculating rate:

$$N + \sum_{k=1}^{n} M_k(j) \tag{1}$$

That N is equal to rate of area where player is there, M is Substitute for other parameters that its value changes depending on value of J, in other word J is a variable that declares each one-third of field.

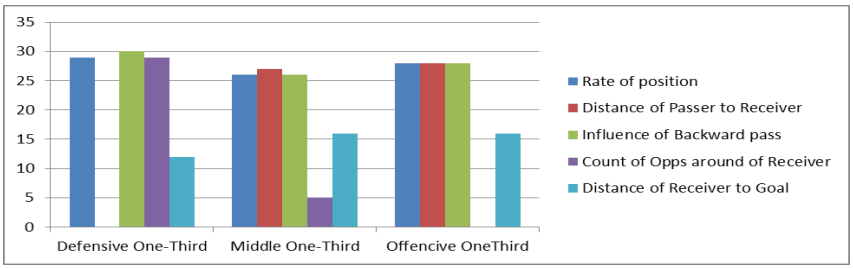


Fig. 4. Amount of influence of parameters in rating

4 Through Pass

Through pass means passer sends ball to depth of opponent defense line and a few steps ahead of teammate in order to prepare for an attack. Therefor for gaining to the best point for sending ball, consider two lines from ball owner position(1), one line in parallel with X axis (L1) and another conjuncts to pass receiver position (L2), these two lines make up a range for sending pass.

Now, two additional lines will be considered, one line in parallel with Y axis (L3), another in continuation of the previous line (L2). The result of these lines is two angles α and β that depicted in Fig 5.

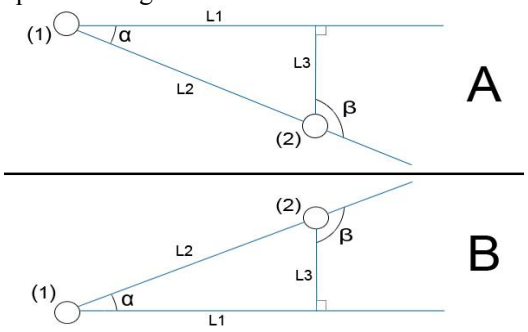


Fig. 5. Considerd lines in Through pass algorithm

For obtaining accurate point, these two angles will be divided to 10 degree angles and the result of collision[10] of these lines is a set of points[4] that each of them could be destination of through pass but best of them should be selected.

In the following best point will be found by checking each of the points, whether ball direction is in opponent kickable area or cycle count of opponents is less than teammates to arrive at destination of ball.

5 Marking System and Defense System

For nullify opponent team attacks, it has been decided to implement several marking system and also, according to principles of defense in real soccer, try to improve team defense system which causes a counter attack.

5.1 Marking in Play_on Mode

Teammates arrange is very important at Defense time. By using a marking system when opponent is attacking from wings, opponent players will be marked by an algorithm that will be explained in the following and ball owner will not be able to find his teammates and in this case shoots to goal or loses the ball.

At first, algorithm checks some conditions for example whether marking system could be activated that conditions listed bellows:

- Position of ball
- Position of players
- Amount of Teammates Stamina

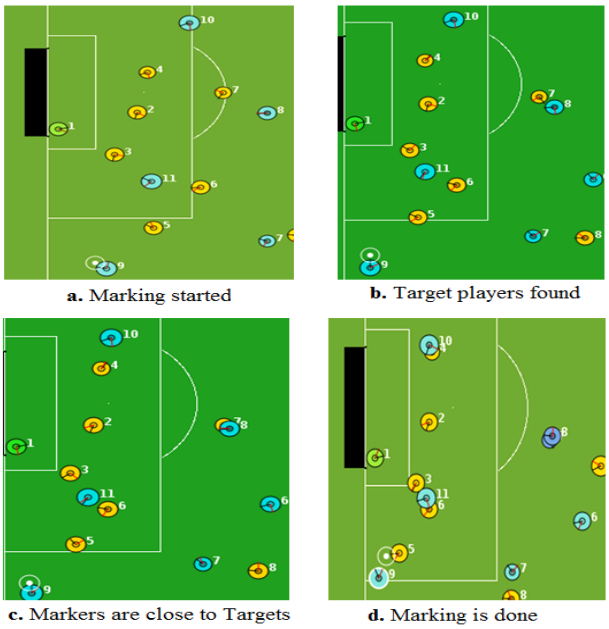
If these conditions were true, opponent players who can receive pass from ball owner will be chosen as marking target considering closing to the goal and distance to ball and then one of teammates who is closer to him and not distanced from others apply to mark him.

This process will continue until ball ownership change or ball goes out of field or play mode change. Of course worth noting that marking algorithm uses a prediction system that helps it to execute better.

Table 1. Marking Algorithm

```
SET CanPlayonMarkOpps ← canMarkInPlayOn()
IF CanPlayOnMarkOpps = FALSE THEN RETURN
SET Opps[] ← searchOppForMark()
SET SortedOppsForMark ← sortOpps(opps)
SET BestOppForMark ← whoCanIMark(SortedOppsForMark)
markBestOppPlayer(BestOppForMark)
```

The process of Marking depicted in Fig 6.



a. Marking started **b.** Target players found

c. Markers are close to Targets **d.** Marking is done

Fig. 6. Four Steps in Marking Algorithm.

5.2 Marking in Kick_in Mode

Another part of marking algorithm execute in Kick_in Mode, when one of the opponent players is throwing the ball, other opponent players will marked by our teammates and prevent him to send ball to them.

But this process is not plain as mentioned, opponents who have lesser distance to goal are marked because marking all opponent players disorganize the team formation and opponent could misuse of this situation.

5.3 Goalie Skills

This year, taking the ball away from goal added to goalie skills, because neutralization of opponent throw pass is very important.

In this state if goalie arrives to ball sooner than other teammates and opponent players, then goes to ball and shoots the ball to a low risk position as fast as possible.

6 Conclusion and Future Work

This year one of major works in Armik2013 was on implementing AI methods to learn from real games and used it to find the best target of pass, although it works well but need more improvement. Future work will be to employ other artificial intelligence methods such as ANFIS or Cellular Learning Automata[9] to other parts to get performance. This means that agents can behave like a best real player on many situations.

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