Evolutionary Artificial Intelligence for MOBA / Action-RTS Games using Genetic Algorithms

Siddhesh V. Kolwankar
Thakur College of Science and Commerce, University of Mumbai
Thakur Village, Kandivali (East), Mumbai - 400101
Maharashtra, India

ABSTRACT

This paper deals with implementing Evolutionary Artificial Intelligence for MOBA Games that employs Genetic Algorithms to adjust and correct its own actions during the course of the game, becoming progressively better at gameplay over time. The typical operators of Genetic Algorithms such as Crossover and Mutation are used in a different sense. On the contrary to the traditional methodology of the Genetic Algorithms, Crossover and Mutations now may happen infrequently and without a definite sequential order. The individual in the population consists of the parameters necessary to drive the AI into the gameplay. The crossover points are the interactions of the AI with its allies in the game while the encounters with enemy AI serves as the Mutation points. Due to the nature of MOBA games, one may precede or succeed each other randomly and in real-time.

The Genetic Algorithms hence defines an Evolutionary AI which is required for a typical MOBA or Action RTS game, thus making the AI capable of altering itself to better match the needs of the team, and also allowing the multi-reactive response of the enemy. Since Genetic Algorithms do not rewrite the entire AI behavior but only balance and optimize the parameters necessary for the actions taken by AI during the gameplay, it allows the AI to perform their duties in the game as deemed necessary by their characters' roles.

Keywords

Multiplayer Online Battle Arena, MOBA, Action-RTS, DotA, Artificial Intelligence, Genetic Algorithm, Competitive.

1. INTRODUCTION

The Gameplay Genre MOBA – Multiplayer Online Battle Arena, also known as Action-RTS is the sub-genre of the Classic RTS (Real Time Strategy) Genre, it employs the similar GUI to the RTS games such as Age of Empires, StarCraft or more typically, WarCraft III. However, it differs from traditional RTS in gameplay in that there is no base construction and players control only one character. It is a fusion of Action Games with RTS genre. Since it majorly consists of two teams fighting each other to destroy a static structure at opposite ends of the Map, it has been called as the Multiplayer Online Battle Arena or MOBA by Riot Games, while VALVe Corporation suggested the genre to be called as Action-RTS due to its resemblance with other Role-Playing games, such as Diablo series by Blizzard Entertainment.

The game traces its roots to Aeon of Strife, a custom map made for StarCraft, Defense of the Ancients was the map based on Aeon of Strife for WarCraft III and its expansion The Frozen Throne which grew drastically popular over time, which still boasts it player-base in millions. DotA was the first major MOBA title from which the other titles are derived. The genre saw entries such as Minions, Demigod, League of Legends, Heroes of Newerth, DotA 2, Blizzard All-Stars, Rise of the Immortals, Realm of the Titans and SMITE. Few games such as Awesomenauts and Monday Night Combat differed from the original genre in terms of gameplay and GUI. The original DotA, which was a modification for WarCraft III also saw the releases of many other modifications which were similar in gameplay, such as Advent of the Zenith, Samurai Legends and Eve of the Apocalypse.

2. GAMEPLAY – MOBA /ACTION-RTS

There are two opposing teams whose goal collectively as a team is to destroy their enemy's base to win. Typically, there is one main structure which must be destroyed to win, though destroying other structures within the opposing team's base can confer other benefits. Defensive towers are in place to prevent this, as well as weak computer-controlled units which are periodically spawned at each base and which travel down pre-programmed paths toward the opposing base.

A player controls a single powerful in-game unit generally called a hero. When a hero kills an enemy unit, it gains experience points which allow the hero to level up. When the heroes level up, they have the ability to learn more powerful skills and abilities. When heroes die, they have to wait a designated time, which increases as they level up, until they revive at their base.

Each player constantly receives a small amount of gold per second from their base. Moderate amounts of gold are rewarded for killing hostile computer-controlled units and large amounts are rewarded for killing enemy heroes. Heroes use the gold they gain to buy a variety of different items that range in price and impact.

Members of the genre do not feature several other elements found in real-time strategy games, notably base management, resource collection, and army building. The RPG genre has a much closer resemblance to the gameplay, only limited to an arena or the map.

3. OBJECTIVE

3.1 The Vision

The Evolutionary AI implemented for MOBA / Action-RTS defines base set of parameters that define the actions taken by the AI in the game. These parameters involve the factor to which AI will follow is state and actions such as Aggression over the Lane, or against an enemy Hero, usage of spells or skills, Hit-points / Health or Mana threshold to return to the base etc. This makes the AI play progressively better over the course of the game.

The Crossover and Mutation can happen anytime and in any order due to the Real-time nature of the game. Crossover points are interactions of AI with the team-mate which may be another AI or Human. While Mutation points are encounters

with the enemy that force AI to change its base parameters depending the outcome of the battle. If AI emerges victor in the encounter, its aggression parameters will be improved, but suffering defeat will cause AI play more defensively for next few encounters. Since the game itself is slightly more punishing to the player which loses an encounter, the defensive parameter increment will be substantial in magnitude.

Interaction with the team is Crossover point in which AI will mimic the parameters of the teammate faring relatively better in the game. These adaptations are short lived and usually last till the end of the limited partnership. Thus AI working in team becomes progressively better than AI wandering and fighting alone.

The paper demonstrates a sample Evolutionary AI using the Authors own version of MOBA / Action-RTS genre. It was created as a mod for WarCraft III, since DotA in itself began as the WarCraft III modification and since WarCraft III supports custom made content by providing its own toolkit known as the World Editor, which allows rapid development and deployment of such modifications. The version adapts DotA's three lanes and three towers model of gameplay and All-Pick Hero selection. However, it removes Gold Income and Items from the gameplay to give maximized space towards skill and hence for emphasizing the Evolutionary approach of AI implemented.

3.2 The Iterative Approach - BftC

Since MOBA Games are built on a few basic rules, as explained earlier in this paper, it was possible for the Author to build another variation of the MOBA Game that adheres to all of the Basic rules, but leaves enough scope for experimentation with Artificial Intelligence with Genetic Algorithms.

quicker, fast paced game-play and small number but more defined roles of characters. The characters are designed to give maximized potency for teamwork and abilities and skill set that can be used in combination with variety of other characters' skills, thus making it a smaller but more competitive variant of the MOBA genre.

The terrain of the map is quite linear but retains similarities with DotA / HoN' terrains, and remains significantly similar to League of Legends most popular terrain set – Summoner's Rift.

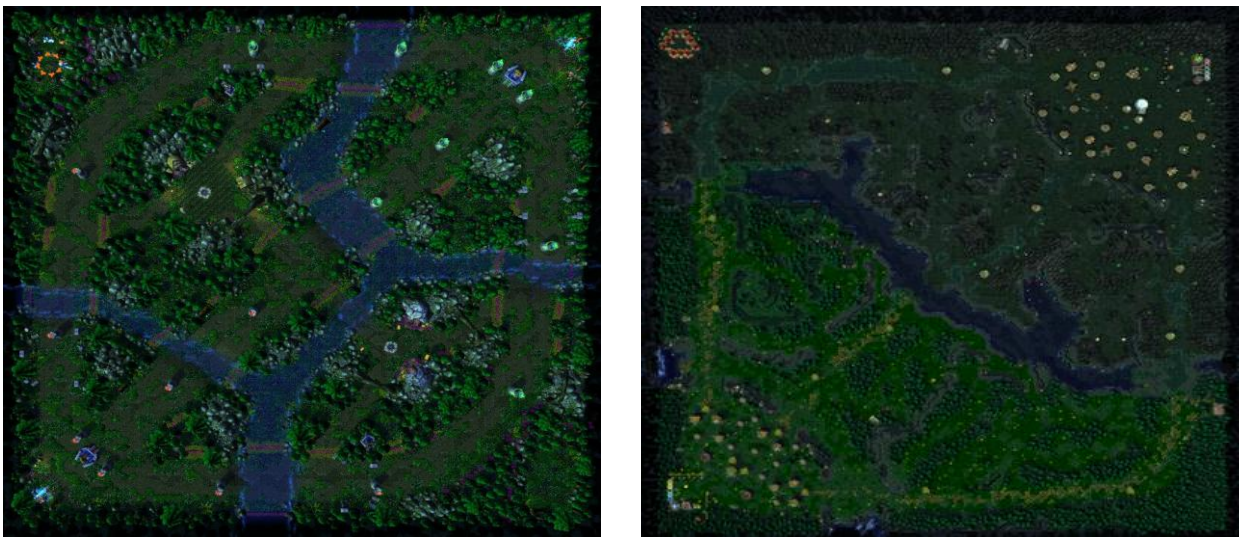
The primary objective behind making a new experimental MOBA game was to allow the freedom of varied testing and flexibility in the otherwise rigid rule set of the game genre. Additionally, having smaller but more defined characters also simplified the programming aspect.

This Mod – BftC was achieved with Blizzard Entertainment's World Editor which was released along with their title, WarCraft III – The tool that was used to develop original DotA and many other Modifications.

3.3 The Genetic Algorithms

Any character in MOBA game must go through a few phases during the course of the game. Early game focuses on gathering experience, gold and better equipments. The Mid Game phase focuses on pushing through the lanes and taking down the defensive towers of the opposite sides, winning the skirmishes against opposing team and maintaining the overall control of the game. The Late Game phase usually ends up in large team fights with one team emerging in a clear victory.

With Artificial Intelligence in charge of the characters and teams, they must adhere to these phases of game-play from the very beginning. Hence the basic patterns and game-play has already been programmed with the Artificial Intelligence.



BftC's Terrain
Used for implementing Evolutionary A.I. driven by Genetic Algorithms

DotA's Terrain
The base terrain that was adapted by Heroes of Newerth, Realm of the Titans and DotA2

Fig 1: Comparison of BftC and DotA Terrains

This particular iteration of MOBA was called Battle for the Conquest or BftC. It was Author's own take on MOBA Genre. This version features minimal interface, about 12 characters, no items or gold management. It focuses on

The Genetic Algorithms control the factors to which each character takes its own dynamic decisions, such as, when to retreat back to the base, or for how much distance should the enemy be chased into the opposing territory to consider it as escaped or still a valid target for assault. Since this iteration did not account for Gold income and equipments, the Genetic Algorithms A.I. was forced to work as a team from the very beginning of the game.

3.4 The Results

While it may be an unconventional methodology for traditional MOBA or A.I. for games altogether, the Genetic Algorithms prove to be a worthy candidate to be the next big thing in MOBA and Similar A.I. development. The Artificial Intelligence in BftC showed evolutionary characteristics such as retreating properly and preemptively after being dead in previous skirmishes, also, aggressive pushes and ambushes once a strategy is found to be successful. The Genetic Algorithms may be a little heavier on the processing power compared to traditional Artificial Intelligences; however, in this particular iteration it had no adverse effects on the game-play or performance of the game.

4. SCOPE OF THE PROJECT

Since MOBA / Action RTS genre is a modern genre given attention by many new and upcoming game development companies, such as Riot Game and Uber Entertainment, this paper may prove a critical insight as to how the AI for the genre can be made and refined. However many of these games are majorly multiplayer for PvP environments, the AI may still be implemented to enhance offline play or as a practice for new players.

5. CONCLUSION

The Evolutionary AI yields it success in becoming better over time of the game and adapting the actions of both teammates and opposing team, hence becoming a more competitive version of AI than those implemented previously. Although, this AI currently focuses on adapting itself in accordance to the allies and enemies, it may be further enhanced for wider reach in similar applications.

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