Advanced Gameplay Strategy Based on Grey Wolf Optimization

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Abstract— **Artificial intelligence is one of the most important part of the gaming industry. It has been part of the gaming industry since 1950. In games, Artificial Intelligence is used to generate responsive, adaptive and intelligent behavior just like a human player. Modern games use existing techniques from the field of AI, like – Path Finding and Decision Making to guide the actions of the NPC's (Non-Playable Characters). AI is also used in mechanisms which are not immediately visible to the user, like – Data Mining and Procedural Content generation. In this paper, we have derived a new algorithm. Our proposed algorithm is based on Gray Wolf Optimizer Algorithm. We have proposed and discussed a new technique which can be used to provide new features in video games.**

Keywords— **Hero Shooter, Gray Wolf Algorithm, GWO, Gray Wolf Optimizer, Artificial Intelligence, AI.**

I. INTRODUCTION

The games have evolved from the text-based to the open world AI. Just like any other industry, the gaming industry has evolved substantially and is still growing. The gaming industry is one of the fields where the AI has left its imprints. It is true that the gaming industry has been dependent on the hardware resources and has used those resources to their extent. It is also true that the industry has also made use of the software part and has used it to its full extent.

Hero Shooter games are a variation of multiplayer first and third person arena based shooters where players split among two or more teams, select a pre-designated "Hero" (characters which possess unique abilities, skills, weapons and other activated abilities). Hero shooter strongly encourages teamwork between players on a team, guiding players to select an effective combination of hero characters and coordinate the use of Hero ability during a match. This genre of game was inspired by Multiplayer Online Battle Arena (MOBA) games. Hero shooter has mixed the aspects of MOBA and FPS games and made a whole new genre. The aim of this paper is to improve the quality of the bots which are used in Hero Shooter games. All of this has to give players the quality and the entertainment that they deserve.

The earliest Hero Shooter game which started the Hero Shooter game trend was Team Fortress 2. Team Fortress 2 was released back in 2007. It was developed and produced by Valve Corporation. This wasn't the first Hero Shooter but it was the game that made the Hero Shooter genre go boom. If we talk about the very first Hero Shooter, it was Team Fortress 1 mod for Quake [2]. This mod was released back in 1996. Quake was the basic FPS game. Now, these Hero Shooter games have been made very advanced and have outstanding graphics compared to the game which originated them. In today's world, these Hero Shooter games have generated millions of dollars for the Game Industry and are still booming.

Team Fortress 2 has boomed the Hero Shooter genre and because of it, there are many games in the market now. The games are – Overwatch - published and developed by Blizzard Entertainment; Paladins - published by Hi-Rez Studio and developed by Evil Mojo Games; Quake Champions - published by Bethesda Softworks and developed by id Software. These games are played by millions of people throughout the world and have been turned into an E-sport.

But these games lack good AI to practice before facing the real players. The most important thing in these games is teamwork. But when you play with bots you don't have to play as a team. You can just play solo and still win because the level of AI is too low [1]. This paper will introduce an algorithm for a new kind of bot which will be made using a new AI algorithm: Grey Wolf Optimizer Algorithm.

Rest of the paper is divided into certain sections: - Section (II) talks about the related research done and the reference that has been taken for this paper. Section (III) is about the Grey Wolf Algorithm. And finally section (IV) is the conclusion of this paper.

II. LITERATURE REVIEW

Team Fortress sure was the game that made Hero Shooter genre go boom. But it was Overwatch that started the revolution. When Overwatch was released it accumulated over 7 million players within the month. Later as the year progressed, the number of players increased. Now Overwatch has over 40 million people playing the game. The games AI is also very advance and uses some of the most common AI techniques in the game. The 2 most common AI techniques which this game uses are – A* algorithm for Path Finding and FSM (Finite State Machine) to create states and give them actions to perform. The FSM is used to control the movement of bots and the A* algorithm is used for the Path Finding of bots. What it means is, it calculates the shortest path to reach a certain point and choose that path to travel [3].

There exist a few more techniques which are used in this genre of games. Some of these AI techniques are so

advanced that they learn own their own while playing against other players. Although these kind of techniques are not yet used in Hero Shooter games. Some of these techniques are – Neural Networks, Genetic Algorithm and Turing Test.

The use of the Turing Test in the game is to make a smart and convincing AI system. An AI system which makes a human player question that is he/she playing against a bot or a real player. We can also make the AI in such a way that it will make mistakes intentionally. We do this to give AI a human touch[4]. This will also make people feel that they are not playing against an AI.

If we make an AI that makes no mistakes then the AI will be too strong or maybe impossible to beat. This will make players lose interest in the game because they couldn't advance at all.

Neural Network and Genetic Algorithm are used to give AI a biological approach. Biological approach is mainly taken by the Genetic Algorithm which solves the problems. This algorithm picks up a problem and starts evolving it [10]. It keeps evolving it until it finds an optimal or the best solution for the problem.

The use of Neural Network is that it mimics the biological learning of the players. In simple words, it means that the neural network copies the way a human player think while playing a game. It has a predefined structure that acts as neurons and a specified number of links [6].

These techniques make a fool out of a human making them think that they are playing against a real human. There are more ways in which AI can contribute to the gaming industry. Some of them are the unit movement, resource allocation, spatial reasoning, target selection and many more. The animation and audio used in games also come under this section.

III. GREY WOLF OPTIMIZER

The GWO (Gray Wolf Optimizer) algorithm is an algorithm which was inspired by the gray wolves themselves. This algorithm was proposed by Mirjalili in 2014. In this algorithm, it is described how we can use the hunting skills of these grey wolves in the field of AI.

This algorithm mimics the leadership skills of the hunting grey wolves. These wolves belong to Canidae family. They are considered the Apex predators which means that they are at the top of the food chain. They live in a pack of 5-12 wolves.

There are 4 types of grey wolves in the pack such as Alpha, Beta, Delta and Omega [5]. These wolves simulate leadership qualities. There are 3 main steps in which these wolves hunt: Searching for Prey, Encircling Prey and Attacking Prey. These are the things that are implemented in the algorithm.

The Alphas are the leaders of the pack. There is one male Alpha and one female Alpha. They are the wolves which make the decision for the pack like Hunting, Sleeping, Waking, Moving, etc. In some packs, Alphas have been seen showing domestic behavior. By domestic behavior we mean that an Alpha of a pack follows other wolves in the pack. The pack acknowledges the Alpha by holding their tail down. Interestingly, the Alpha is not necessarily the strongest in the pack but the best when it comes to taking care of the pack.

Beta is at the second level of the hierarchy. The role of Betas is to help the Alphas in decision making and other pack related activities [7]. They are known as subordinate wolves. The Beta wolves can either be a male or a female. The Beta wolves are next in the line to become Alpha if the current Alpha dies or become old. Beta wolves have to respect Alpha and their decision and passes orders to the lower-level wolves. After passing down the order to the lower levels wolves, Beta gives feedback to Alpha.

At the bottom of this hierarchy is the Omega wolves. Although Omega might be at the bottom of the hierarchy it plays a very important role in the pack [8]. It plays the role of the scapegoat. Because these wolves are at the bottom of the hierarchy they always have to submit to the other high-rank wolves and get to eat at the very last. The Omega is known as babysitters of the pack. It has been seen that, if something happens to the Omega the whole pack faces an internal dispute and fight amongst each other.

There are some wolves in the pack who are neither an Alpha, Beta nor Omega. These wolves are known as subordinate or Delta wolves [9]. The scouts, sentinels, elders, hunters and caretakers belong to the Delta hierarchy. The role of the scouts is to watch the boundaries of the territory and warn the pack if there is any danger approaching them or nearby. The role of the sentinels is to look over the pack. They guarantee the packs safety and protect them. Elders are the old wolves of the pack. They used to be the Alpha or Beta of the pack. The role of the hunters is to aid the Alphas and Betas in hunting. They provide food for the pack by hunting. The last one, the caretakers, they take care of the pack. They have responsibilities of the whole pack. They take care of the wounded, ill and weak wolves in the pack.

IV. PROPOSED ALGORITHM

In the last section we understood what you call the wolves of different hierarchy. We also understood the role of different hierarchy of wolves. We learnt that the Alphas lead the group, the Betas pass out the orders to the group, the Omegas who are at the lowest hierarchy of wolves are not less important than the Alphas and how the Deltas look after the whole pack.

Other than the social hierarchy of the wolves, there exist another social behaviour of the wolves which has been seen is group hunting. According to Muro et al:-

- The main phases of gray wolf hunting are as follows:

- Tracking, chasing and approaching the

- Pursuing, encircling, and harassing the prey until it stops moving

- Attacking the prey

We will use GWO algorithm logic and derive a pseudo-algorithm in a Hero Shooter game.

Pseudo-Algorithm:

Frontline (Omegas) – Absorbs damage.

Burster (Deltas) – Deal a lot of damage in a short amount of time.

Damage dealer (Alphas) – gives out continuous damage.

Healer (Betas) – heals others and stays at the back line.

1) Game starts.
2) Bot consists of 2 Frontlines, 1 Burster, 1 Damage Dealer and 1 Healer
3) Since Damage Dealer is the alpha, it will be making all the shot calling.
4) According to the map, randomly selects:
    a. Flank right.
    b. Flank left.
    c. Go straight to the point.
5) Always keep Frontline in front.
6) Always send a Burster to flank at the opposite side of the team.
    a. If Burster finds:
        i. No enemies. Burster goes around the players and attack from behind.
        ii. <= 1 player. Burster engages players.
            1. After killing the enemy:
                a. Come to the healer if low health.
                b. Goes around enemy if health above 80%.
        iii. 2=> players. Burster falls back and informs the leader that enemies coming from its side.
7) The bots engage if:
    a. >=3 players are at bot side.
        i. If they kill all they go to the point and secure it.
    b. 4=> players are at bot side.
        i. Bots fall back.
    c. Go to the point.
8) Damage Dealer always aims the person on the point.
    a. If:
        i. The Damage dealer is being hit from behind then it pings healer for heals.
        ii. Someone comes on the view of the damage dealer then the damage dealer will deal damage to them.
        iii. There are multiple targets then it will hit the one with low health.
9) If any bot dies:
    a. Count how many players are alive:
        i. If players more than bots then the bots fall back and group.
        ii. If bots more than players they hold the point.
10) Keep repeating from step 6 till the players capture the point and win or bots capture the points and win.

V. CONCLUSION

This paper present a pseudo code for the Grey Wolf Optimizer algorithm which was deduced for a Hero Shooter game. The paper has also looked into few more AI techniques which are used in making an AI bot. Techniques like A* algorithm, FSM, Turing Test, Neural Network and Genetic Algorithm.

All these techniques are equally important when it comes to making of an AI bot. If we put all these techniques into a single AI then we can create will be able to create an AI that will be equal to mimicking human being.

Further I would like to add that the pseudo algorithm can be further improved and if implemented, it can give pro player run for their money.

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