Building Bots for Shooter Games based on the Bartle's Player Types and Finite State Machines: A Battling Behaviour Analysis

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***Abstract*—The players types are increasingly demanding especially in relation to the experience that the game provides. In shooter games, although the bots often have the same level of skill and follow specific rules throughout the game, not presenting their own strategies. This fact can mean a fragility in the game design process, since players expect even more realism in shooter games. In this context, the creation of bots showing believable behaviours can be decisive for the success of a shooter game next to its target audience. This work presents a proposal of revisiting the Bartle's typology in order to adapt it to bots behaviour. Then, considering a shooter battle arena scenario, this work assumed that realistic and efficient bots for shooter games can be developed based on four behaviour types: killer, achiever, explorer, and beginner. Each bot behaviour was defined through a finite state machine based on the verification of the environment and decision making. From the experiments results analyses, it is possible to conclude that as important as the behaviour of the bots, is the interaction of this with the environment, which plays a fundamental role in the question of player experience and the believability related to immersion into the battle scenario.**

***Keywords*-Game Bots; Shooter Games; Behaviour Analisys; Player Types; Finite State Machines;**

I. Introduction

The term "shooter game" refers to a combat-oriented games with firearms in which the player must control an avatar and take out enemies. Besides the combative nature, shooter games are characterized by fast action and, since early 90's, are still one of the most popular genre of games. Shooter games have sub-genres as first-person shooters (FPS), third-person shooters (TPS), tactical shooters among others.

In shooter games, the AI is mostly controlled by finite state machines (FSM) and scripting to determine how a bot should act in diverse situations [1] [2] [3]. Scripting techniques allow the player to create new types of bots (or modify an existing character according to their style of play) and are strongly based on rule systems. On the other hand, FSM techniques are logical structures composed of a set of states and a set of rules of transition between these states such as finite automata [4].

Then, for the definition of behaviors for bots next to the behaviour of players is necessary to consider different shooter player types as beginner, competitor, killer, and explorer. In this context, the Bartle's taxonomy of player types (or archetypes) [5] involves the psychology in how they perceive and play a game. This theory corresponds to a functional model of human personality in a game playing context and was based on Multi-User Dungeon (MUD), the ancestor of Massively Multiplayer Online Role-Playing Game (MMORPG). Although the original proposal is based on MUD, Bartle's taxonomy constitutes a more general personality model that can be extended to other gaming genres [6].

According to Bartle's player types, there are two dimensions to playing: (1) action vs. interaction, related to the degree to which the player interacts with other objects/players in the game, and (2) players-orientation vs. world-orientation, which refers to the degree to which the player emphasizes the virtual world or other players. These two dimensions determine four player types:

- The killers seek to affirm their existence in competition with other players or with the environment.
- The achievers want to accumulate wealth and make points.
- The explorers aim to discover all aspects of the game world.
- The socializers prioritize the relationship with other players, even outside the role of your character.

While killers and achievers are mostly interested in acting on the environment, explorers and socializers prefer a deeper level of interacting with things or other people. Still, killers and socializers have emphasis on players and achievers and explorers have focus on the environment.

From these aspects, this work aims to analyze the bots behaviour in a shooter battle arena developed by the authors using Unity Game Engine, considering different specificities inherent to the Bartle's typology and without the presence of a player. In this context, it is assumed that realistic and efficient bots for shooter games can be developed based

on well-understood behavior-based approach. This study employs three Batler's player types: killers, achievers and explorers bots. Once the socializer type don't have a battle nature, it was replaced by the "begginer", a common type in games universe. Each bot behaviour was defined through a FSM based on the verification of the environment and decision making.

From the obtained experiments results, it is concluded that as important as the behaviour of the bots is the interaction of this with the environment, which plays a fundamental role in the question of player experience and the believability related to immersion into the battle scenario.

Section II presents aspects of the building of bots behaviour. Experimental procedures are detailed and results are presented in section III. The section IV contains the final comments.

II. Bots Behaviour Approach

As mentioned in the introductory section, in order to evaluate the believability of bots that mimic players, the bots behaviour were defined based on the Bartle's typology [5].

However, this work proposed to replace the socializer by the beginner because the socializer profile does not usually covered in shooter games, which often test the player's speed and reaction time using some kind of weapon against enemies represented by bots.

Then, the following behaviour for the bots type proposed were defined:

- The killer: This bot walks endlessly through the battle arena, straying from its limits, and shoot whenever it detects items that are not walls.
- The achiever: This bot aims to look for items that will improve your life and, at the same time, deviates from traps and fights some enemies.
- The explorer: This bot aim to discover all aspects of the game world, including items that damage his life.
- The beginner: This bot avoids dangerous situations, since it is still a beginner in the game. So, it does not completely explore the scenario, but shoots at all enemies.

The battle scenario is formed by eight bots with behaviors defined by finite state machines (FSM). The purpose of the agents is to destroy any other bot detected by their radius of vision. The simulation control determines that a new round will be started if there is less than two active agents. In addition to the bots, the simulation consists of lives, which are collectible items that increase integrity, bombs, which damage bots and decrease their integrity, and missiles fired by bots in order to decrease integrity of opponents.

During the battle simulation, raycasting are used for the collision detection with objects from scenario [7]. This is done by casting two rays outwards from the central point of the bots in each render cycle. While the first ray (shown in green color in the Figure 1) aims to detect far objects, the second (red in the Figure 1) seeks to detect nearby objects.

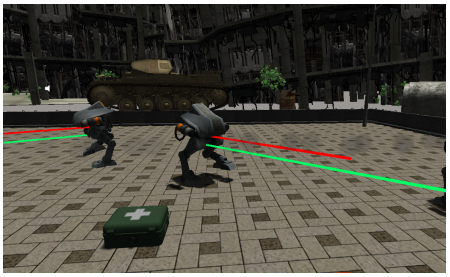

Figure 1. Bots raycasting

When defining a game environment or simulation, it is necessary to consolidate the context rules [8] [9]. In this work, the constitution of battle rules were delimited in: Bots can move forward; Bots can rotate left or right; Bots can fire with a delay of ten seconds; Bots can stop their actions;;Bots can detect objects at short and long distances from their raycast; Bots can not go beyond the scenario limits; Bots can collide with lives and bombs involuntarily, and have their integrity affected; The initial position of bots and items is set at random; A bot is destroyed when it has less than one life point; Each round will end when there are less than two active bots. The next subsection presents the FSMs that define the bots behavior.

III. Experiments

The experiments proposed have as objective to identify which bot type adopts the best strategy in the battle arena as well as to observe the different behaviors.

After a random distribution of initial behaviour for each of the eight bots, the bots assume one of four FSM types every fifteen (15) seconds. This change in bot behaviour during the battle was proposed to increase the variability of presented situations. Each battle is ended when less than two bots are active in the scenario. Each bot starts the round with its life worth one hundred (100). In addition to colliding with bombs, bots can fire missiles at their enemies or be hit by missiles launched by them. Each collision with a bomb or missile causes a forty (40) point reduction in life. Upon reaching an life value less than one, the bot is eliminated from the round.

Including the round time (seconds), the data collected at each round for each bot type are: Number of raycasting; Number of shots fired; Number of shots fired at other bots; Number of shots fired at lives; Number of lives collected; Number of deaths; Time (seconds) of life; Time (seconds) deflecting bombs; Time (seconds) deflecting walls; Time (seconds) detecting bots; Total time (seconds) assuming each behaviour type.

Related to the lifetime and time spent to deflect bombs, walls and bots, the results can be observed in the Figure

2. It is noticed that the lifetimes are similar to the bots, but with difference for the times related to deflect walls, where the beginner had the worst performance. On the other hand, the achiever had the worst result related to detect bots. The bombs deflection time is so low in relation to the total lifetime of each bot that it becomes irrelevant to the behaviour analysis.

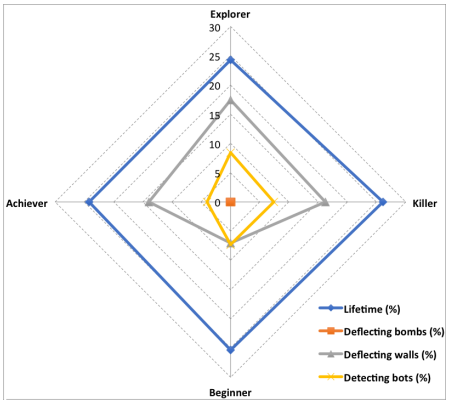

Figure 2. Values for lifetime and time spent to deflect bombs, wall and detect bots

Considering the number of times each bot took a specific behavior, Figure 3 shows the relationship between survival and death.

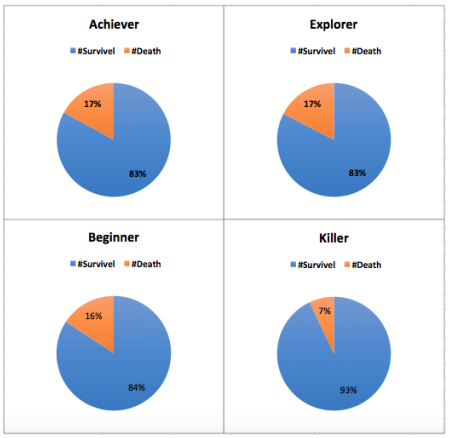

Figure 3. Survival x deaths

The Figure 4, in turn, shows the relationship between shots and death. From the collected data, the killer died a smaller number of times and was the most shot firing, although part of those shots was not against bots. Analyzing the difference between shots fired at bots, the killer hit approximately 5% more than other bots. Thus, it is possible to infer in this experiment that the shots not fired directly at robots impacted performance, which may be related to the context of the environment.

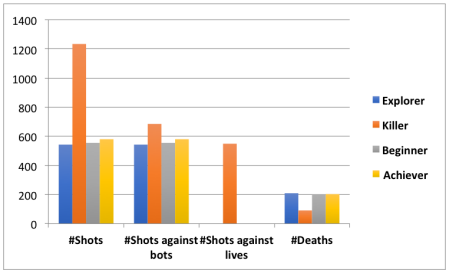

Figure 4. Number of total shots fired by bot, shots against bots and lives and deaths

Considering the definition of non-deliberative agents [10] [11], the balancing between the efficiency of the bots and the stimuli generated by the environment are relevant. These stimuli are related to three main elements: wall and bombs deflection and lives collection.

Regarding the lives collection, the achiever performs this action intentionally, from the detection of lives by raycasting. The killer, explorer, and beginner collect lives involuntarily by colliding with them while focusing on another action. However, the number of lives collected are similar as can be seen in the Figure 5. Although is not the focus of the killer, explorer and beginner, they have collected a considerable number of lives. On the other hand, the achiever could not reduce his number of deaths despite being the bot who collected most lives.

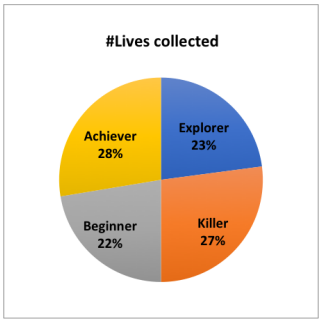

Figure 5. Total number of lives collected by bots

The accuracy related to the confrontation of the enemies in the context of the open arena used in this work is related to two types of data collected: detection of bots and shots fired against bots. This subsection seeks to analyze this relationship between shots fired and death numbers of each bot type.

As mentioned earlier, the killer was the bot that accumulated the lowest number of deaths, around 50% less than the other types. In relation to bot detection, there were no substantial differences between explorer, killer and beginner (Figure 2). The achiever, however, showed less detection times than other profiles, reaching about 50% less than the explorer. The achiever is strongly focused on interacting with

collectible objects, his focus is not overly combative, which leads to less precision considering the enemy detection aspect. In addition, achiever is the only type of player that avoids contact with nearby bots.

Observing the accuracy of the shots fired at other bots, the killer had the highest score, followed by achiever, beginner and explorer. The difference between the detection of bots and shots in bots is disproportionate in the case of the achiever, once he had the bots detection lower but, on the other hand, was the second bot (behind killer) that fired more times against bots. Besides, killer had approximately 50% fewer deaths even having only about 10% more shots against robots than the other profiles Again, the environment factor should be considered and, as previously shown (Figure 6) the killer's total shot is higher than the other profiles, which may have contributed for the result.

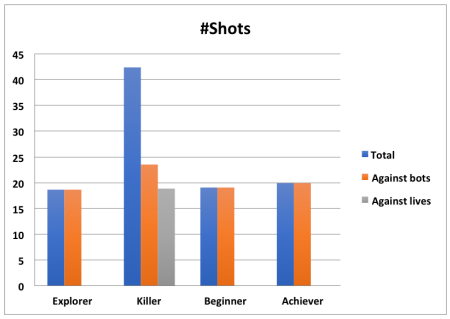

Figure 6. Total shots x shots against bots x shots against lives

Finally, the difference in the shots fired between explorer, beginner and achiever does not show too many variations, as well as their respective death rates. The accuracy of the shots tends to be more determinant than the detection of bots, although the detection leads to strategic actions like to deflect of near enemies, as observed in the achiever. To determine the impact of actions, it is important to observe the rules and characteristics of the game: if short range shots have more damage than long shots, the state of shunting of nearby agents could be more impacting to the achiever and decrease their death rate. Thus, a higher correlation between detection accuracy and death rates could occur.

IV. Conclusions

Shooter games have a combative nature and are characterized by fast action and tactical level of players and bots which should be able to perform their tasks in short time. Generally, in these games genre, bots have the same level of skill and follow specific rules, related to move around in an environment, avoid obstacles, aim, shoot, pick up items, run among other actions. For implementation of bots basic behaviours, techniques of AI are employed highlighting those based on FSM related to verification of environment and decision making.

Then, four bots type were proposed related to shooter games: the beginer, the achiever, the killer, and the explorer. In order to do that, four weel-based FSM were proposed, related to a battle scenario definitions and rules. However, after the experiments results, it is noticed that it is not possible to design bots, regardless of whether they are based on Bartle's typology or on another model, if the game context is not considered. Each game has singularities in its implementations and rules [8] [9]. Thus, the behaviour of the agents must be a support for the game, respecting the defined rules, and the behaviour data gathered analysis can contribute to the refinement and balancing of the game.

In the context of the presented experiment, an efficient killer performance is natural. Possibly, in an environment where item collection was extremely critical to performance, the achiever and the explorer could get better results. However, it was not expected that the killer had an interaction with the environment as efficient as the other types, and even superior to the achiever, designed to have this focus.

Thus, the agents design must emerge through experimentation besides differents scenarios. In this work the environment as an open arena was decisive to results.

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