Modelling Player Combat Behaviour for Dynamic Difficulty Scaling in First Person Shooter Games

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- BSc First Class Honours in Computing
- MSc by Research
- Currently Undertaking PhD

Introduction

Research Thesis

Modelling Human Behaviour for NPC
Imitation in a virtual environment

- Paul Williamson
- Dr Christopher Tubb
- PhD Thesis
- Combat Behaviour

The Problem!

Accurately Scaling Difficulty For All Players

The problem with current scaling difficulty is due to having predefined subjective categories, such as easy, medium, and hard.

- Generalised difficulties
- Problem with difficulty categorization
- The impact of poorly designed difficulties

Modelling Human Player Combat Data for NPC Difficulty

Modelling Player Combat

A solution could be found by using player data to define the generalised limits of skill and having NPCs that exhibit scalable difficulty in real-time.

- Identifying how combat efficiency is determined
- The problem with artificial difficulty
- What data will be required to model player combat
- What impact this research could have on difficulty

Combat Modelling Experiment

Experiment Purpose

The purpose of this experiment is to gather combat data under predefined scenarios and constraints.

- Five Scenarios
  - Normal, Increased Spawn, Grouped, Size, Moving
- Two Weapons
  - Assault Rifle, Pistol
- Two Aim Stances
  - Off Hip, Aiming Down Sights
- Data Storage and Targeted Audience
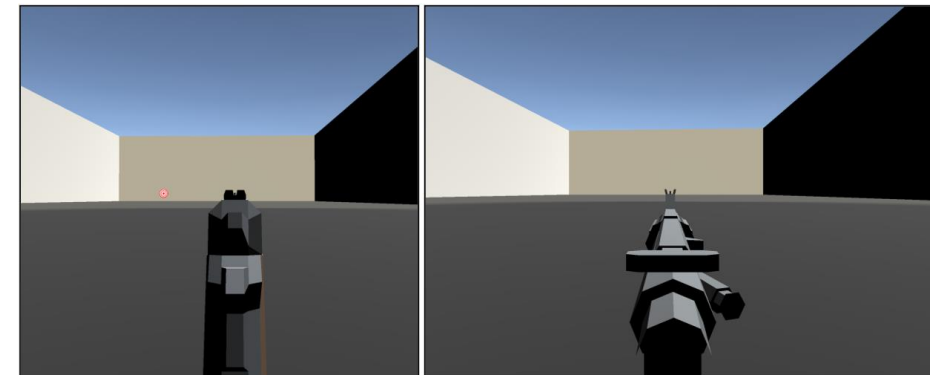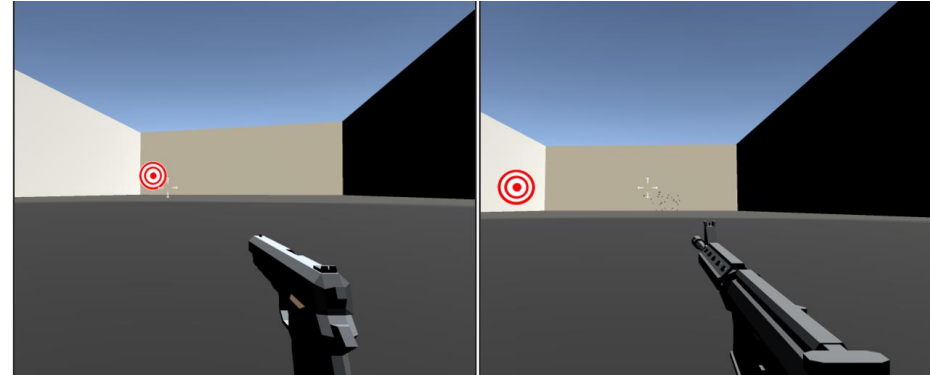
Combat Model Overview 1

Generalised Combat Model
The generalised model is derived by finding the combat averages from all subjects.

- Generalised and Individual
- Using Traditional Techniques
- Base Skill Attribute
- Adjustable Active Skill Attribute

Combat Model Overview 2

Generalised Combat Model
The generalised model is derived by finding the averages from all subjects.

- Reaction Time Equation
- Off Hip Aiming Equation
- Aiming Down Sights Equation
- Fine Tuning the Equations

$$\text{Reaction Time} = \frac{Ts + ((S * M) * Dx)}{Dz}$$

$$\text{Off Hip} = \frac{Vp + Vf * (Mx * S)}{Sx * Ws}$$

$$\text{Aiming} = Vp + Vf * (Mx + (My * S))$$

Difficulty Scaling Analysis Experiment

Difficulty Scaling Experiment

The purpose of this experiment was to see if the NPCs numerically and perceptually increased in difficulty.

- Deathmatch Scenario
  - Two NPCs, all verses all
  - First to 5 eliminations
- Increasing NPC Skill
  - Three rounds with NPCs skill increasing each round
- Experiment Constraints
  - Three medic packs and ammunition packs throughout the map
- Data Required

Combat Model Analysis

Results from the Difficulty Scaling Experiment.
The results showed that the model was able to scale NPC combat efficiency in real-time but was over tuned.

- Overall Accuracy Analysis
- Reaction Time Comparison
- First and Last Stage Eliminations Comparison
- Subject Perception
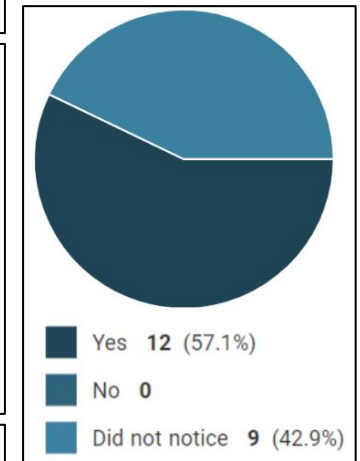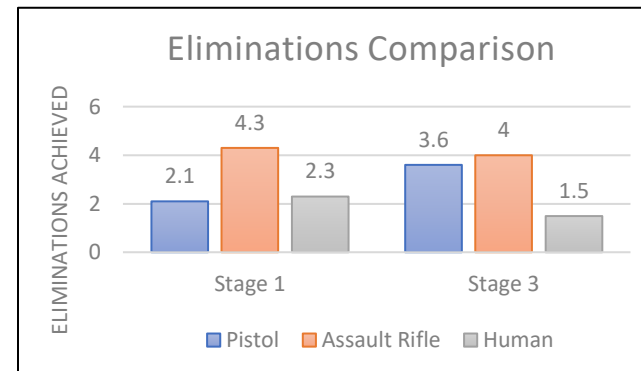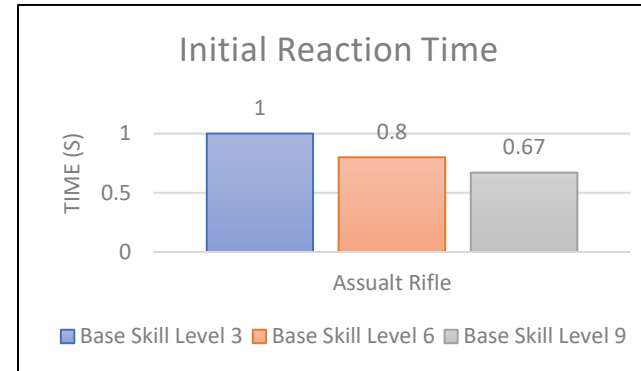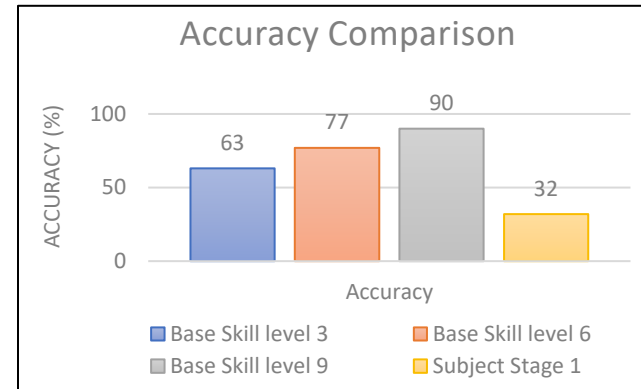
Conclusion

Combat Model Outcome

This paper has shown that using player combat data, it was a good solution for developing a model for scaling NPC combat efficiency in real-time.

- Skill level was flexible in real-time
- Other gameplay behaviours can affect perception
- Most subjects stated that they noticed the difficulty changing

Future Work

More Research Required

Since this paper was submitted, work has been undertaken to calculate the real-time generalised skill of a human player.

- Further skill balancing
- Automated dynamic skill scaling based on the current performance of the player
- Thank You