

**University of
South Wales
Prifysgol
De Cymru**

Heatmap Weighted A* Algorithm for NPC Pathfinding

The Fourteenth International Conference on Advances in
System Simulation
SIMUL October 2022

Authors:

Paul Williamson and Dr Christopher Tubb

Contact:

paul.williamson@southwales.ac.uk



**University of
South Wales
Prifysgol
De Cymru**

Heatmap Weighted A* Algorithm for NPC Pathfinding

First Author and Presenter: Paul Williamson

- 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
- A* Algorithm



The Problem!

Pathfinding for NPCs

Why current A* techniques fail to imitate players and how this could be remedied.

- Problem with standard A*
- Pathfinding when NPCs are fulfilling human based role
- Interaction between human and NPCs



Using Human Data to Influence NPCs Pathfinding

Modelling Player Gameplay

Using actual player data to influence how NPCs should behave when navigating the environment.

- Using data gathered from human subjects
- Using standard pathfinding techniques used in the gaming industry
- Potential impact of this research

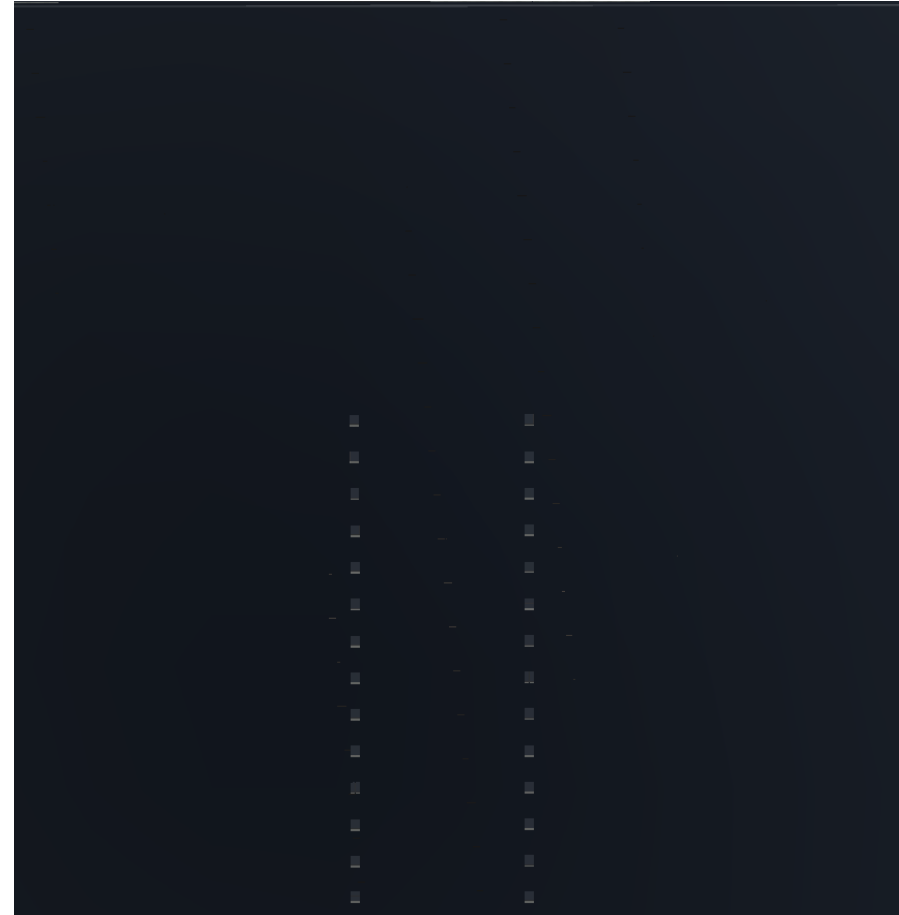


Data Capture Experiment

Experiment Purpose

The purpose of this experiment is to acquire navigational behaviour data of human subjects.

- Objective: Roam Map and Collect Coins
- Map Overview
- Experiment Constraints
- Data Retrieval and Storage

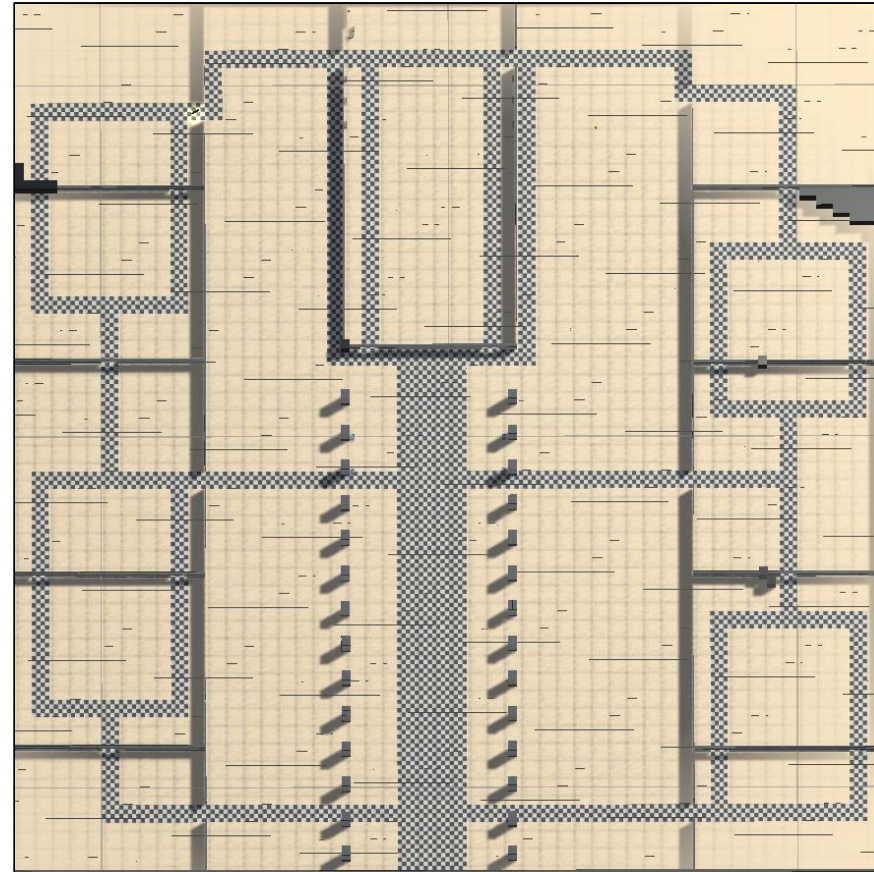


Data Capture Analysis

Experiment Outcome

The experiment outcome show that navigation patterns emerge.

- Heatmap!
- Roaming is not random
- Funnel points are important
- Behaviour Switching
- Decent Navigational Efficiency

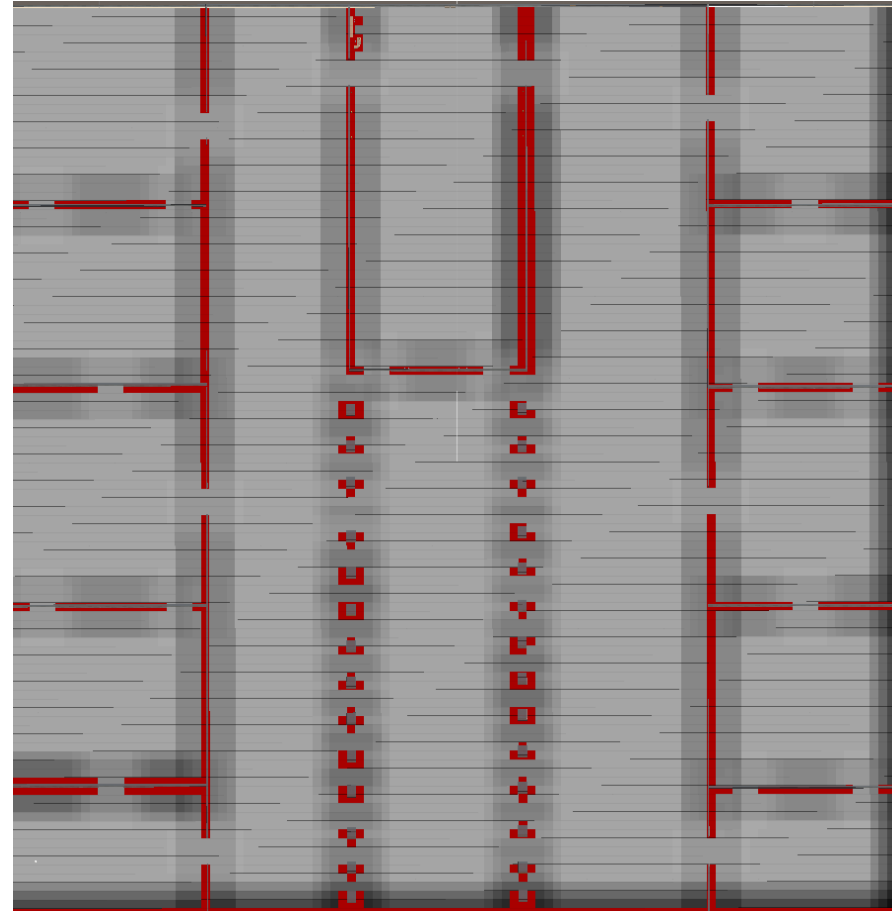


Model Overview

Developing the Roaming Model

It was crucial for NPC to display a range of roaming behaviours.

- Finding a suitable weight for the heatmap
- Standard A*
- Box Blur Smoothing Technique
- Visual Navigation Decision Making
- Nuance Behaviours

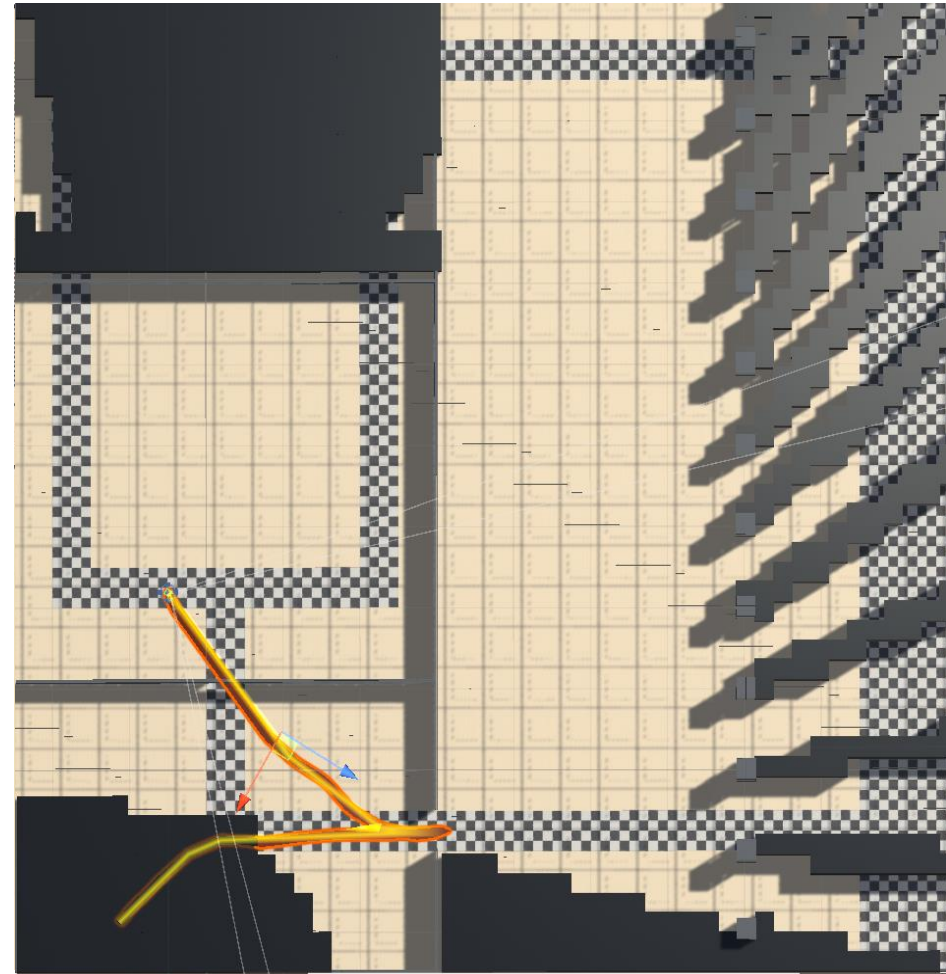


Model Analysis Experiment

Results from the NPC Experiment

NPCs completed the same experiment as the human subjects.

- Heatmap Comparison (8 coins)
- 40 Coins Analysis
- Predictable Pattern Analysis
- Map Coverage Comparison
- Implications of using heatmap for all behaviours
- Overall interpretation of the model



Conclusion

Roaming Model Outcome

This paper has shown that a heatmap weight A* graph can be generated from human player data, which influenced the pathfinding of NPCs.

- Roaming model shows navigation behaviours can be modelled
- Tagged environment helped developed a hybrid model
- Model failed when trying to imitate behaviours that were not roaming
- Future research required to model other navigation behaviours
- Thank you.