PRACTICAL 2: ROBOTRON 4303

30th October 2019

190020774
University of St. Andrews
CS4303 Video Games

Contents

1 Introduction

Based on the classic twin-stick shooter *Robotron 2084*, Robotron 4303 is a game where players take control of a superhuman character in a world where robots have revolted and destroyed humanity.
In each procedurally generated level, the player must save the last 3 humans left whilst fighting off hordes of robots. There are also obstacles placed across the game world which will hinder the player's progress, however there are also a number of power-ups which the player can use to their advantage.
The player starts with 3 lives; the game is over when all of these lives have been spent. Reaching a score of 1000 will provide the player with an additional life.
The control scheme for the player is as follows: Arrow keys control the player's movement, whilst aiming and firing is performed with the mouse and left mouse button.

2 The Game World

Figure 1 depicts a typical arrangement of the game world. The world is represented by a series of tiles which are built into a system of rooms and corridors.

2.1 Procedural Generation

In *Robotron 2084*, the game world is a simple square however in this version each level is procedurally generated.
The method of procedural generation used was an agent-based approach known as a stochastic digger[1]. Before the start of the game and between each level the agent starts at a random location and moves around creating the game world. The digger initially moves in a random direction, placing a tile at each step. Upon each successive step the chance that the agent will change to another random direction increased by 5%. At the same time, there is a chance that the agent will place a room of random size at each successive step. From using trial and error to find the most effective room placement chance, this was found to be an increase of 2% for each step.
This is a fairly simplistic approach, as although the agent is able to generate worlds fairly quickly, there is a chance that there will be some dead-end corridors. However the number of dead-end corridors is consistently very small, and I argue that this adds to the challenge as the player cannot simply move away from enemies; they must shoot their way out.

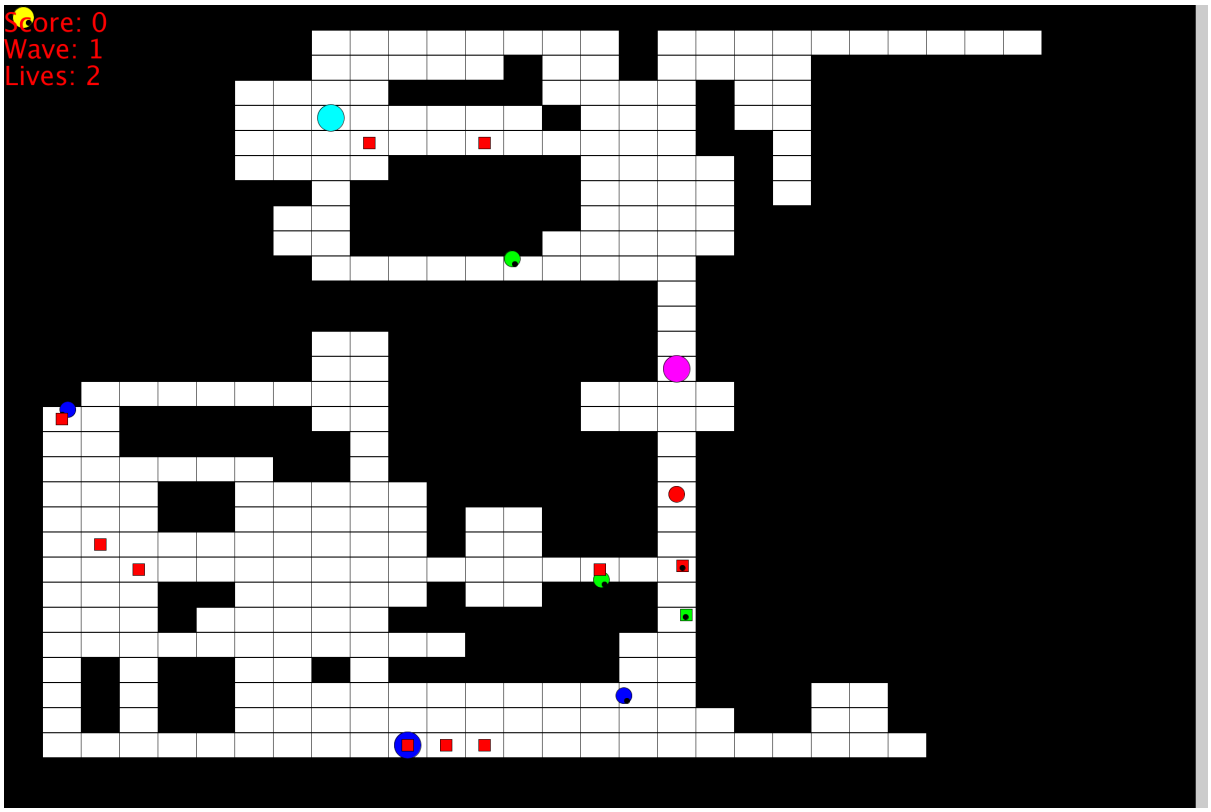

Figure 1: Typical Level Layout

2.2 The Last Human Family

In each level there are 3 characters representing the last human family. The player should attempt to save these humans by touching them. These are presented in game as simple squares as shown in figure 2. These humans will attempt to seek the player if the player

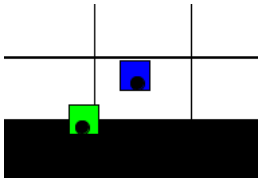

Figure 2: The last human family

is in their line of sight, otherwise they will wander randomly around the game world. The humans are killed if they come into contact with one of the robots that attempt to seek them. Each family member has a different score for a successful rescue: 50 for red, 100 for green, and 150 for blue.

2.3 Obstacles

During generation of the game world, a number of obstacles are placed in the game world, as shown in figure 3. If the player touches one of these obstacles they will lose a

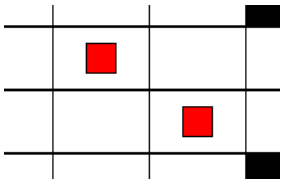

Figure 3: Obstacles represented as a square

life, however the player can simply shoot these obstacles in order to destroy it and pass through safely.

2.4 Power Ups

At the start of each level, there are 3 power-ups placed in random locations which the player can utilise to their advantage. These power ups are activated once the player touches them. The 3 power ups are as follows:

- Invincibility: The player and 3 humans are invincible to all attacks that would kill them for the next 15 seconds.
- Freeze: All robots are frozen and cannot move for the next 15 seconds.
- Bomb: All robots in the surrounding area are instantly destroyed.

3 Enemies

Whilst the player traverses the game world and attempts to save the humans, there are a number of different enemy robots which will attempt to kill either the player or the remaining humans. In *Robotron 4303* there are 3 different robot types which each perform a different task. The number of enemies present in each level is randomly generated, however this number if influenced by the current wave number such that the game gets increasingly more difficult.

3.1 Attack Player Robots

The robots that will seek out and follow the player are distinguished by their green colour as seen in figure 4. These robots will continuously follow the player around the world via a path which is found through the use of A* search. A* search is an informed search which uses a heuristic to find the optimal path to the goal. For this case, the heurstic is a function of both the current path cost, and the Manhattan distance to the goal. The Manhattan distance between two positions in a grid $(x1, y1)$ and $(x2, y2)$ is given by: $|x2 - x1| + |y2 - y1|$. In order to add a significant challenge to the game, since it can be

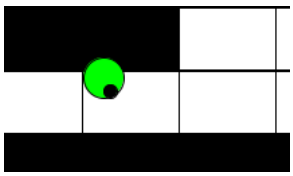

Figure 4: Robot that follows player

fairly straightforward to move out of the line of sight of an enemy, these kinds of robots will follow the player regardless of line of sight. As it would be too costly to perform an entire A* search for each robot at every frame, an initial search is ran once the level is generated, and each robot will only perform another search once it has reached its goal or if the player is closer to its current position than the goal.

3.2 Attack Human Robots

The second kind of robot is one which will try to attack the human family. These robots are blue in colour and can be seen in action in figure 5. These robots will only try to

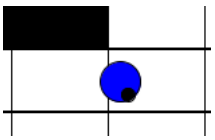

Figure 5: Robot that follows humans

pursue the humans if there is a clear line of sight between them i.e. if drawing a straight line between the two does not intersect with any tiles that are not part of the game world. Once a human is detected, the robots will follow them until they are caught, or if line of sight is broken. When the robot cannot see a human, it will move randomly around the world. Although these robots only try to attack the humans, they are still lethal to the player if they come into contact with each other.

3.3 Conversion Robots

The final type of robot is a subclass of the attack player robot with a unique ability. Whilst this robot either follows the humans or wanders randomly as described above, instead of killing the human if they come into contact they will transform the human into a powerful enemy as seen in figure 6.

This powerful enemy follows the player around via A* search in the same fashion as

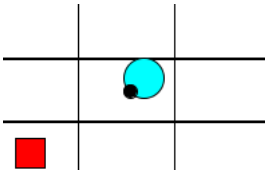

Figure 6: Robot that converts humans

the first type of robot, this robot moves much faster and fires projectiles which kill the player on impact, whilst also requiring more shots to be taken down. As this enemy is so powerful, only one of this kind of robot is spawned each round. This robot cannot be killed before it has made a conversion, but conversely it cannot take a player's life when it is in this state.

In practice, creating this converted kind of robot proved to be extremely challenging, and so unfortunately the converted robot is not present in the final submission.

4 Issues

4.1 Running the Game

When initially loading the game and when the game transitions between levels, the game tends to occasionally freeze due to the large number of objects being generated on screen. Whilst it may at first appear that the game has crashed, simply waiting will fix this issue and after a while the game will continue to run as usual.

References

[1] Shaker, Togelius Nelson *Procedural Content Generation in Games. p. 40.* 30th October 2019. Web. `http://pcgbook.com/wp-content/uploads/chapter03.pdf`