Report NDVW : Sprint 3

GROUP 5

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1   Introduction

The game we are developing is inspired by classic titles like "Bombit" and "Playing With Fire", but with some slight changes. The game is set in a maze-like environment where the player competes against an AI-controlled opponent. The game looks like a field of flowers, and therefore has the fitting name "Garden Of Flowers". The goal of the game is to kill the other player. The player that survives last is the winner of the game. Every player is represented by a different color of bell pepper. This is a vegetable that is common in a garden and therefore fits in the game scenario. Our goal is for this game to be entertaining and center on the fun story of what the best bell pepper is. The players are not able to move over the flowers, so the core mechanics revolve around setting traps that release rabbits to increase game space and destroy the opponent. The rabbits that come out of the traps act as dynamic projectiles that traverse the game space and can be used to kill other players or eat the flowers. The flower will be removed from the field once it has been eaten to increase the game space of the players.

Game Overview:

- **Starting Point:** The player and the opponent AI start at opposite corners of a maze, where the players have a small space to move around.

- **Obstacles:** The maze is filled with flowers, which act as destructible barriers.

- **Traps and Rabbits:** Players set traps that, after a brief delay, release rabbits. These rabbits move in four directions (up, down, left, right) from the trap's location.

- **Movement and Collisions:** Rabbits travel until they either hit an obstacle, reach their maximum distance, or collide with a player, resulting in a game over. Along their way they will destroy flowers, which increases the game space.

- **Power-ups:** Destroyed flowers may drop power-ups, such as:
  - **Speed Boost:** Increases the player's movement speed.
  - **Extended Rabbit Range:** Increases the distance rabbits can travel.
  - **Additional Traps:** Allows the player to set more traps simultaneously.

The objective for the player is to strategically place traps to eliminate the AI opponent while avoiding their own traps and those set by the AI. The gameplay combines strategic planning with quick reflexes, as players must time their traps while navigating the maze. The winning condition is achieved when all other players are eliminated, and the player is the last one standing.

AI Approach: We use a library called NavMeshPlus for our pathfinding, and then we use Behavior Bricks which is a free package for Unity, it allowed us to make our Behavior Tree visually.

2   Related Work

The following games share similarities with our game, particularly in their mechanics involving strategic placement of obstacles and destructible environments:

- **Bombit**
- **Bomberman**
- **Playing With Fire**

All of these games involve placing objects in a maze-like environment to eliminate opponents or clear obstacles. They use elements like bombs or explosives to alter the game space dynamically, requiring players to think strategically about timing and placement. Our game follows a similar concept but introduces a unique twist with the use of rabbits as dynamic projectiles that move from traps.

3   AI Design

The design of the AI opponent in our game focuses on creating a challenging and dynamic adversary for the player. To achieve this, we utilize two key Unity tools: NavMeshPlus and Behavior Bricks.

3.1   Pathfinding with NavMeshPlus

NavMeshPlus is an enhanced version of Unity's built-in NavMesh system that enables pathfinding in non-standard environments, such as 2D tilemaps. In our game, the AI opponent uses NavMeshPlus to navigate the maze-like environment effectively. By calculating optimal paths around obstacles like flowers and brick tiles, the AI can dynamically adjust its movement strategy in response to changes in the game space, such as newly destroyed flowers or placed traps. This ensures that the AI always has a viable route to approach the player while maintaining strategic positioning.

3.2   Behavior Trees with Behavior Bricks

Behavior Bricks, a free Unity package for visualizing and implementing behavior trees, is central to our AI design. Behavior trees allow for modular and flexible AI decision-making by breaking down complex behaviors into smaller, reusable tasks. The AI's behavior tree consists of the following key nodes:

- **Survive:** The highest priority for the AI is to ensure its survival. If there is a trap nearby or an incoming rabbit detected, the AI will immediately calculate and move to the nearest safe zone using NavMeshPlus. This defensive behavior ensures the AI remains active and continues to pose a challenge to the player.

- **Item Pickup:** If the agent can move to a power-up it will go there and pick it up. This makes the AI harder to play against as the game goes on for longer, rewarding the player for being aggressive in the beginning.

- **Attack:** If there is a clear line of sight to the player and no immediate threats, the AI will move towards the player strategically and place a trap nearby. This aggressive action is designed to pressure the player into defensive maneuvers or force errors.

- **Destroy Flowers:** In the absence of immediate threats or a direct path to the player, the AI will place traps near destructible flowers. This action expands its movement area and works towards creating an eventual pathway to the player. It also introduces unpredictability in the game by altering the maze's layout dynamically.
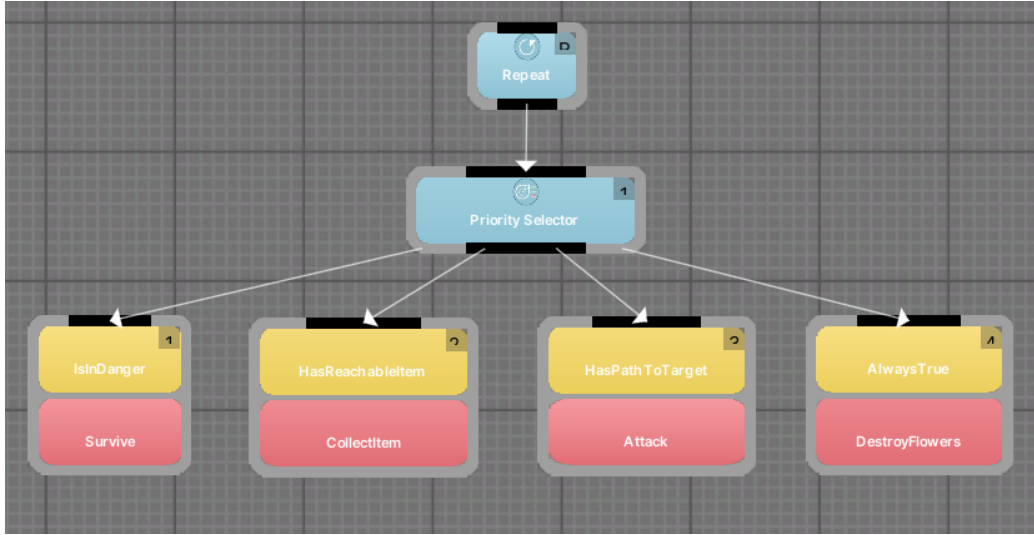

Figure 1: The four different behaviors in our behavior tree.

These action nodes are executed sequentially based on priority, ensuring the AI behaves intelligently and adapts to the evolving game environment. A visual representation of the behavior tree can bee seen in figure 1. The modularity of behavior trees allows us to further refine these actions or introduce additional nodes, such as prioritizing power-ups or baiting the player into traps, in future iterations.

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4 Methodology

4.1 Unity Scene

For this game we make use of one Unity scene which shows a top-view of the game. In figure 2 you can see a screenshot of the start scene of the game. The graphics and designs have been significantly enhanced thanks to Olivia's work. The visuals now incorporate animations and a more polished appearance. The player, visualized as a red bell pepper, starts at the left top corner at the start of the game. The AI opponent, represented as a yellow bell pepper, begins on the opposite corner. Green blocks represent grass in the garden and the player is allowed to walk on them. The purple flowers represent the destructible barriers. The player cannot walk through them and therefore has to set traps in order to increase the game space. The wall blocks form the indestructible outline of the game and are strategically placed within the field to allow players to hide behind them to avoid traps.
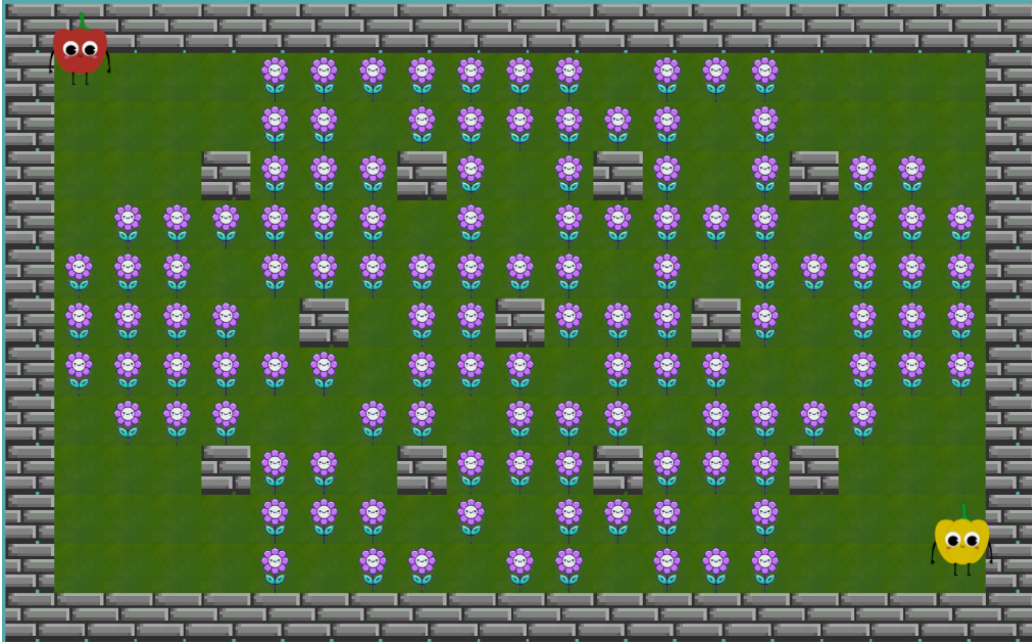

Figure 2: Screenshot of the start scene of Garden Of Flowers game.

4.2 Characters

The game features the player character as a red bell pepper (figure 3). The player can move around using the arrow keys and place traps with the space bar. The bell pepper always faces the direction it is walking and therefore can be viewed from four different sides. The traps release rabbits three seconds after they are being placed, and players can move them around before they detonate, adding a strategic element to the game. The AI opponent is represented by a yellow bell pepper (figure 4). The decision to visualize the characters as bell peppers comes from the fact that this is a common vegetable in a garden and come in different colors (red, orange, yellow and green). In future versions of the game we want to include that players can chose which bell pepper to play with. This adds a fun and competitive element to the game of which bell pepper is the best.
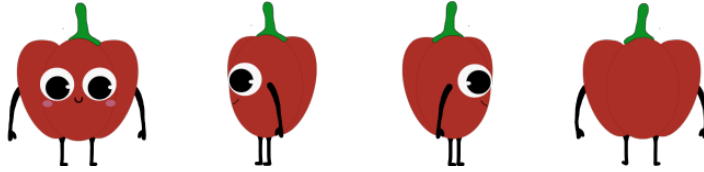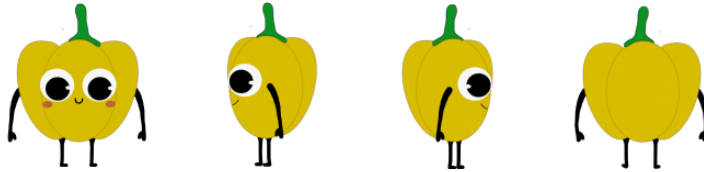

Figure 3: Four side views of red bell pepper character.

Figure 4: Four side views of yellow bell pepper character.

4.3 Animations

4.3.1 Characters

The characters are represented by a bell peppers, with multiple sprites available to animate its movement across the map (figure 3 and 4). These sprites allow for smooth animation as the character moves in different directions.

4.3.2 Traps and Rabbits

In the game players are able to set traps in order to destroy the flowers and increase game space. As said before the traps are visualized as a basket with a bunny in it. We downloaded both the rabbit and basket from the Unity asset store for this and manually placed the rabbit in the basket. A screenshot of the 3D basket with rabbit can be seen in figure 5. After three second the basket with the rabbit is removed and four rabbits are spawned that move in four different directions. A screenshot of such a rabbit can be seen in figure 6.

Figure 5: Screenshot of basket trap.

Figure 6: Screenshot of white rabbit.

4.3.3 Flowers

Once the rabbit collides with a flower, an animation of a flower being eaten will be shown, as can be seen in figure 7. The first picture on the left shows the whole flower as they are placed in the game field. At the end of the animation the flower is removed from the field and the player is able to walk on the grass.

Figure 7: Animation of flower being eaten.

4.3.4 Power-Ups

Once a flower has been eaten, different power-ups could appear. It has been chosen to visualize these power-ups as different Easter eggs, as we find this fitting with the theme of the game and the rabbits. Figure 8 shows the three different Easter eggs that each represent a different power-up. From left to right, the first Easter egg, the red one with three arrows, increases the speed of the character. The middle Easter egg shows a bunny coming out of an egg. This power-up allows to player to place an extra trap. The most right Easter egg that is orange with four arrows extends the range of the rabbits that

destroy the flowers. At the start of the game all rabbits move only one tile in every direction. With this power-up, the rabbits move one tile further in every direction, allowing the player to destroy flowers in a bigger range.

Figure 8: The three different power-up Easter eggs.

5   Results

In this project we have build in two-player Unity game called Garden of Flowers. In this game players visualized as bell peppers and the goal is to destroy the other player. The player can only walk on the grass. The flower field, that can be seen in figure 2, act a destructible barriers and therefore the player cannot walk on them. To be able to get to the other player traps can be placed that destroy the flowers. These traps are visualized by a basket with a rabbit. After three second four rabbits will jump out of the basket that each move one tile in every direction and eat the flowers that they collide with. This will destroy the flower and therefore increase the game space of the player. Once a flower has been eaten, different power-ups could appear in the form of Easter eggs. These power-ups can either increase the speed of the player, extend the rabbit range or allow the player to place an additional trap. In figure 9 you can see a screenshot of the game scene while the game in being played. In this screenshot you can see the three different power-ups, the basket trap that is placed and different bunnies running.
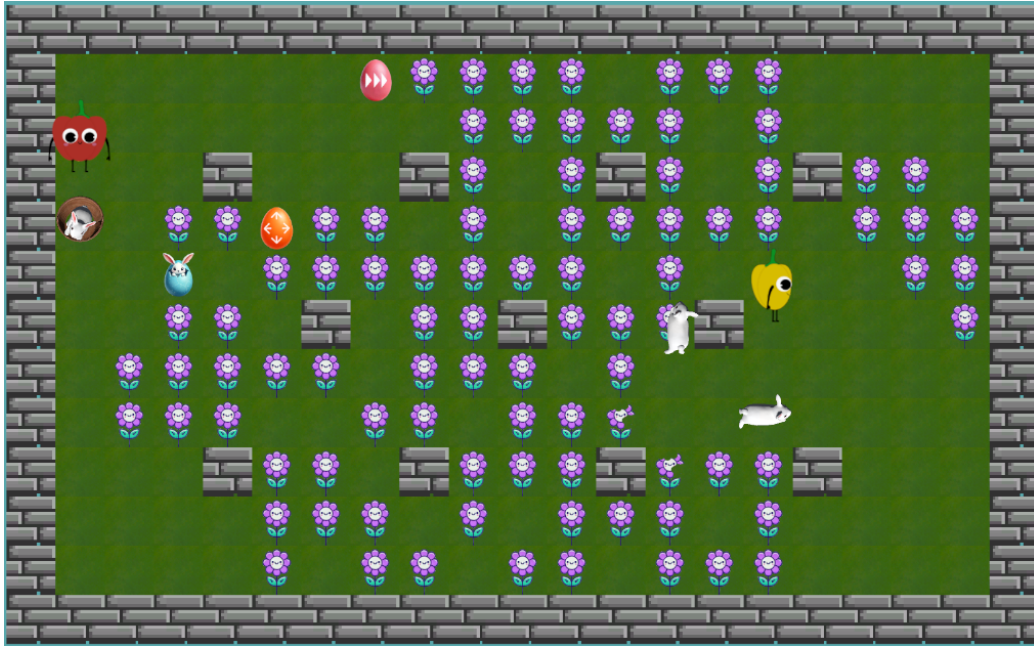
Figure 9: Screenshot of the Garden Of Flowers game.

Once one of the players has died, a game over scene will be showed. This will either show the text "You Won" when the AI opponent has died, or it shows "Game Over" when the player itself has died. Both of the players will be removed as soon as the one of the players has died. Figure 10 shows a screenshot of the game over scene. On the scene you see a button with the text "Play Again". Once the player hits this button, the game will be restarted and the player again sees the start scene as in figure 2.
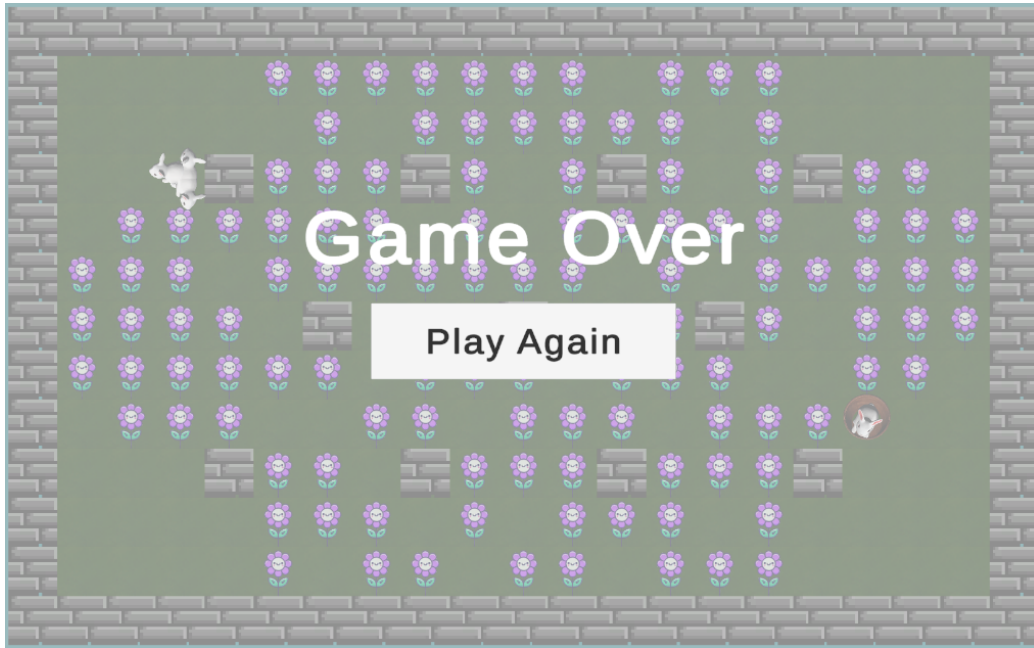
Figure 10: Screenshot of the Game Over scene.

Here you can find a link to the video of the game: Video Gameplay

6   Conclusions and Future Work

In this project we have designed our own game called Garden of Flowers. As most of our group members did not have any experience with Unity, we are very proud of the end result of the game. We learned a lot of new skills related to programming in Unity and making animations. However, due to the limited time of this project we were not able to include more different power-ups. The game includes three power-ups, but in the future we would like to also include a power-up that removes a whole row of flowers, and a power-up that reduces the speed of the other player. This could make the game more interesting.

Additionally, in the future we would want to create the game in 3D. The basket and rabbit are both in 3D and we feel this adds much more dimension to the game. Because of the lack of Unity experience in our group we were

not able to achieve this in the limited time of this project.

Lastly, currently only one player can play against and AI. However, in the future we would like to improve the game by adding more playable characters. The current characters in the game are the red and yellow bell pepper, but in the future two more players could be visualized by a green and orange bell pepper. This allows friends to play together and introduces more tactics as players should be aware of multiple players setting traps that could kill the player.

As for the AI, there are areas for improvement even if the current implementation of the AI achieves basic functionality, Currently, the AI places traps somewhat randomly if no direct path to the player exists. In the future we would like to implement heuristic-based trap placement that considers the shortest potential path to the player.

After it places one trap, it waits until it explodes. Without this restriction the AI would often place traps in a way where it would kill itself because it had no safe place to run to. A future improvement would be to remove this restriction, but in a smarter way. This would hopefully make the agent even more difficult which brings us to the last improvement we would like to make.

Having different levels of difficulty for the AI, and also overall just making it act more human-like would be a fun addition to the game.

Appendix A Sprint 2, Nov. 20th, 2023

Appendix A.1 Planned Tasks

The primary objective of the second sprint was to establish the fundamental structure of the game. Concurrently, we will put a great focus on developing the characters and obstacles that will populate the game. Furthermore, we are investing considerable time and resources into planning and preparing the artificial intelligence (AI) components of the game. Given that AI can only be implemented once the game's essential features are in place, this part will be addressed at a subsequent sprint.

Appendix A.2 Work Done

Appendix A.2.1 Unity Game

During this sprint Anke and Gatien started on the basic game in Unity. The first basics characteristics have been added, which includes the game field, the player movement and the placing of traps.

Appendix A.2.2 AI

Ludwig has done research on which type of AI is best to use for our game and the enemy agent we want to have.

Appendix A.2.3 Sprites & Animation

During the second sprint, Olivia has initiated the development of the characters for the players and the flowers that will serve as obstacles in the game. The user will be provided with a red bell pepper, while the opponents will be given other colors. Blender has been used to create the characters and the animation. During this sprint, a focus has been on making the characters run.

Appendix A.3 Work in Progress

Appendix A.3.1 Unity Game

During the next sprint will work on finishing the basic characteristics of the game in Unity.

Appendix A.3.2   AI

We have imported assets from the Unity assets store in order to start work on the Behavior Tree for the AI agent during next sprint.

Appendix A.3.3   Sprites & Animation

The development of the floral design will continue, as it is still a work in progress. Furthermore, consideration will be given to the facial expressions of the characters in the game as they enter different situations.

Appendix A.4   Remaining work for Sprint 3

Appendix A.4.1   Unity Game

During the next sprint Anke and Gatien will work on finishing the basic game in Unity. The first step is to add rabbits that come out the the traps in all four directions. Next the rabbits need to be able to destroy the flowers. Lastly a gameover state should be included such that the player dies when it touches a rabbit.

Appendix A.4.2   AI

During the next sprint Ludwig will code the logic for the enemy AI using a Behavior Tree.

Appendix A.4.3   Sprites & Animation

Next sprint, Olivia will be focusing more on creating the traps and the animations. The traps will be a basket of rabbits that the user can place in a strategic spot to attack the opponent.

Appendix B Sprint 3, Dec. 20th, 2024

Appendix B.1 Planned Tasks

Appendix B.1.1 Unity Game

The primary tasks for this phase were to complete the core mechanics of the game, including player control, trap placement, and the destruction of destructible objects so that once it was finished we could focus on implenting the AI and the animations.

Appendix B.1.2 AI

During this sprint we planned to be completely finished with the AI agent, this task was appointed to Ludwig.

Appendix B.1.3 Sprites & Animation

The task for this phase was to enhance the game's animations. Previously, the game only featured dots moving around a maze with cells of different colors. Our plan was to replace these simplistic visuals with new designs more fitting to the game's theme, Garden Of Flowers.

Appendix B.2 Work Done

Appendix B.2.1 Unity Game

The core mechanics of the game, including player control, trap placement, and destructible interactions, were implemented by Anke and Gatien.

Appendix B.2.2 AI

Ludwig managed to get most of the AI working as intended. However, there are still some minor with AI that need to be fixed before the final deadline.

Appendix B.2.3 Sprites & Animation

The sprites and animations were created by Olivia.

Appendix B.3 Work in Progress

Appendix B.3.1 Unity Game

At this stage, we don't intend to add new mechanics, as our focus is towards the AI for the game.

Appendix B.3.2 AI

For the final deadline Ludwig will need to do the final touches of the AI. The biggest issue right now is that until there is a clear path between the player and the opponent, the AI will simply place traps without purpose, forcing the player to dig through the flowers towards the AI. In the final version we would like the AI to calculate more where the best placement of their traps is in order to get to the player faster.

Appendix B.3.3 Sprites & Animation

As with the core mechanics, our focus is now on the AI, and we do not plan to add additional animations at this stage.