# 4 Implementation Chapter

## IsWalled() function

This function will return a Boolean variable, it uses the variables “wallCheck” which is an empty game object that is placed on the side of the player, “wallLayer” which is a layer mask of all the walls with the Layer “Wall”. And “radOfCircle” (the same variable is used in “IsGrounded()”) which is the radius used to check if the player and the wall are touching this circle.

A black background with white text

Description automatically generated

A computer screen with white text

Description automatically generated

This is showing the “Walls” object is tagged with the layer “Wall”

A blue stripe on a black background

Description automatically generated

The Wall Check object is part of the player like Ground Check.



In the inspector the Wall Layer is set on “Wall” and the Wall Check object selected.

A screen shot of a computer

Description automatically generated

## IsGrounded() Function

This function returns a Boolean variable, it uses the variables “groundCheck”, the position of this is just under the player’s collider, “radOfCircle”, which is the radius of the circle, and the layer mask called “groundMask”. The ground mask is applied to all objects that are in the layer “Ground”. The Boolean returns true if the ground mask overlaps with the circle under the player’s collider and false if it doesn’t.

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Description automatically generated

The author also draws a Gizmo which can be seen in the editor but not in game. This makes it easier to see where the ground is intersecting with the player.

Graphical user interface, text

Description automatically generated

Graphical user interface, text

Description automatically generated

## “WallSlide()” Function

This function makes the player slowly slide down a wall when the move into it if they are not on the ground already. The “Y” velocity is Clamped to not go over a certain speed. This function uses the “isWallSliding” Boolean and “wallSlidingSpeed” float which controlls the speed the player will fall at.

The player will slide down the wall as long as the are moving towards the wall.

A screenshot of a computer screen

Description automatically generated

A computer screen shot of a code

Description automatically generated

## Flip() Function

This function will change the direction of the object it is used on the author changes the scale of the object’s X value by multiplying it by -1 which just flips the direction the object is facing.

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Description automatically generated

This is how the flip function is used In the “Update()” function. This checks if the object is not facing right, and the direction value is greater than 0 then flip the object to the other direction and vice versa.

Text

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## Player Movement

The author uses Unity’s new Input System for keyboard and mouse the player will use the “A” and “D” key to move direction, and the “Space” key to Jump.

Graphical user interface, application

Description automatically generatedGraphical user interface, text, application

Description automatically generated

In the Events tab the author has their “PlayerScript” script that is attached to the player. They use the “Move()”, “Jump()”, “Dash(), and “Fire()” functions. For example, when the space bar is pressed the “Jump()” function checks if the action was performed and if the player has a jump available, it will make the player jump. The Author will go into more detail in the individual Functions later in this section.

A screenshot of a computer

Description automatically generatedA screenshot of a computer

Description automatically generatedA screenshot of a computer

Description automatically generatedA grey rectangular box with white text

Description automatically generated

The Author created the “Move()” function which gets the direction the player is trying to move the direction is a value of 1, -1 or 0. If the player is not moving the value is 0. If the player is moving the value is 1 or -1 depending on the direction. This function also starts the run animation which happens when speed is not 0 however the jump animation take priority over the run animation. For example, if the player jumps and is moving to the side it will not play the run animation because the jump animation is being played.

### Dash

The Author created the “Fire()” function which first checks

1. if the player can attack and if they can, it will use the “Attack()” function which activates the “attack1” trigger, this plays the attack animation, it is called attack1 because the author wants there to be two swings of the attack if the player presses attack in quick succession, this might not be implemented because of time constraints.
2. Next the “Attack()” function will put all enemies that are in the attack range when the button is pressed into an array called “hitEnemies”
3. it will run the array through a foreach loop that will deal damage to all the enemies hit.
4. “Fire()” will then put the attack on a “Cooldown” where the player cannot attack again for about a second.

### Jump

The Author created the “Jump()” function which will first check

1. if the player can wall jump, which is something the player can only do when they are touching a wall. if true this will start a “Coroutine” called “WallBounce()” which will play the jump animation and set the players gravity scale to 0 so the wall jump isn’t affected by outside forces. It then pushes the player away from the wall and up into the air as if they jumped off the wall. The players gravity scale is then reset back to its original value.
2. Next if the player is not “isWallSliding” (the variable used to check if the player is sliding on the wall) and their max number of jumps is greater than the current number of jumps used. The variable “jumpForce” is applied to the player which makes the player jump. This is also where the Coyote Timer is used which will be discussed later under “Coyote Time Jump”.
3. Next “Jump()” will check if the “Jump” key was let go of or cancelled while the player was moving up (y velocity greater than 0) when this happens the y velocity is multiplied by 0.5 to make the player not instantly stop going up but look like they are slowing down, this allows the player to jump at different heights depending on how long they hold the “Jump” key for.

### Dash

The Author created the “Dash()” function which first checks

1. If the player can dash with the Boolean “canDash”
2. If true it will start the “Coroutine” “Dash()”
3. This “Coroutine” sets the “dashing” animation trigger, makes the players gravity scale 0, adds a velocity to the player and starts emitting a trail renderer. It will wait for “dashingTime” seconds
4. Once done waiting it will turn off the trail renderer, reset the players gravity scale and reset the “dashing” animation trigger. It will then wait for (dashingCooldown) seconds before setting “canDash” back to true.

## Fire() Function

The “Fire()” function is using the new input system in Unity, when the specified input is pressed (J on keyboard, Right Trigger on gamepad) the player will attack. This function needs the following variables; “attackRange” this is the circumference of the circle that is where an enemy can be hit, “attackPoint” this is a transform, this is attached to the player object and will move with them. “enemyLayers” this layer mask will be used to check for any enemy’s that have the enemy layer hit in the attack range. “attackDamage” is how much damage the player will do to the enemy that’s hit. “attacking” is used to check if the player is attacking or not. The author was planning on having a two step swing where the first swing is a down swing and the second is an up swing, if attacking back to back the player would do the first attack then the second. But there was not enough time to implement this. “attackRate” is used for a cooldown on the player attack so the player cannot attack to quickly. And the “nextAttackTime” variable is used to check if the player can do their next attack.

A screen shot of a computer program

Description automatically generated

When the fire Input action (J key on keyboard, Right trigger on gamepad) is pressed it checks if the current time is greater than the next attack variable, this makes it so the player cant attack while the attack cooldown is in progress. “Fire()” then uses the “Attack()” function which plays the attack animation, detects the enemies in the attack range and then damages them.

A screen shot of a computer program

Description automatically generated

### Detecting the enemies

The “Collider2D[]” array “hitEnemies” stores any enemies that are tagged with the “enemyLayers” layer mask in the “attackRange”

### Damaging enemies

Running a “foreach” loop it iterates through each enemy in “hitEnemies” (the array that stored all enemies hit in the attack range) then the function “TakeDamage()” is used to deal the attack damage variable amount to the enemy.

A computer screen shot of a program code

Description automatically generated

The “TakeDamage()” function from “EnemyScript.cs” takes in a float the damage done is taken away from the “currentHealth” variable that stores the current health of the character. This will be updated so that the player and enemies will share this function with inheritance. Once the damage is done, the animation for “Hurt” will trigger. If the health is less than 0 the character will “Die()”

A computer screen shot of text

Description automatically generated

The “Die()” function from “EnemyScript.cs” will play the death animation, and start the “Coroutine” “DisableOnDeath()”

A screen shot of a computer code

Description automatically generated

The “DisableOnDeath()” Coroutine from “EnemyScript.cs” will wait for a duration for the death animation to finish then it will disable both the “Collider2D” and the “SpriteRenderer” this will make it so the object will turn invisible and not be collided with.

A screen shot of a computer code

Description automatically generated

## Move() Function

Text

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In the Update function the rigid body (the player) is given a velocity which is a Vector 2 this value is the direction multiplied by the “speed” variable which is 8 by default. Since this is only changing which direction the player moves the y value is not changed.

Text

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## Updated Move() Function

This was moved to the “FixedUpdate()” function because it is better to deal with physics in the “FixedUpdate()” the player would sometimes glitch through walls and objects.A computer code on a black background

Description automatically generated

The “Move()” function was updated because the player should not be able to move while wall jumping until the jump is finished. This code makes it so when the player tries to move, they can’t while wall jumping, but can while not wall jumping.

The author also changed the speed to not be an absolute value this made the game more unique with slight physics speed up / slow down movement, but the author preferred having snappy movement over this.

A screen shot of a computer program

Description automatically generated

## Player Jump

As stated in the player movement section this is using Unity’s new Input System. The Jump function takes in an Input from the controller or keyboard. When the jump button is pressed, and the player has more than 0 jumps left (a variable stores how many jumps the player has left) a vertical velocity (“jumpForce”) is applied to the player and moves it up. The “jump” animation is played here. Once the player has jumped the “jumpsLeft” variable is now -1 of what it was.

If the player cancels the jump (lets go of the “jump” button) but their vertical velocity is greater than 0 i.e. they are still moving up. The velocity will be multiplied by .5 which lets the player choose how high they can jump. The player can jump the highest by holding the “jump” button or they can choose to jump lower by letting go early.

Text

Description automatically generated

## Jump() function Updated

The jump function is almost the same but with added functionality, it now will not let the player jump while the game is paused. It will use the “Coroutine” “WallBounce()” if the jump button is pressed while “canWallJump” is true.

A screen shot of a computer program

Description automatically generated

“WallBounce()” is explained in detail in the “WallBounce()” function later in this chapter. Basically, it lets the player wall jump.

The “jumpsLeft” variable was changed to the more fitting name “jumps”.

When the “jump” button is pressed and “maxJumps” Is greater than “jumps” and the player isn’t wall sliding. The jump force is applied to the player rigidbody. Then the “jumps” increases by 1 until the player touches the ground.

A computer screen shot of text

Description automatically generated

When the jump is cancelled while the player is moving up (while the jump is not yet complete) it will make the player slow down its upward velocity and start to fall.

A computer screen shot of text

Description automatically generatedA computer screen with white and blue text

Description automatically generated

## Coyote Time Jump

Coyote time is used to add a short window after the player leaves the ground to still be able to jump. This takes account for human error giving the player a .2 second window to jump after they leave the ground or a platform.

Two variables are needed. One to store how long the error window will be and one that can be changed.

Text

Description automatically generated

In the “Update()” function when the player is on the ground the coyoteTime is assigned to the variable “coyoteTimeCounter”. Once the player leaves the ground the “coyoteTimeCounter” will count down, when the timer gets to 0 or less the player will no longer be able to use their first jump.

Text

Description automatically generated

If the coyote timer is less than or equal to 0 then it will take away 1 jump from the “jumpsLeft” variable. This makes it so the player cant get extra jumps from the coyote timer.

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Description automatically generated

To make sure the player can’t jump indefinitely by pressing the jump button fast the timer has to be set to 0 once the jump button is released.

Text

Description automatically generated

The “Jump()” Function was Updated but the Coyote Timer does the same thing

A screenshot of a computer program

Description automatically generated

## WallBounce() Coroutine function or Wall Jump

This Coroutine is preformed in the “Jump()” function when the canWallJump variable is true. “WallBounce()” will make “canWallJump” false, “isWallJumping”, true and trigger the “jump” animation. it will set the players gravity scale to 0 and apply the velocity wallJumpingPower to the player, the direction the player is launched is opposite to the direction the player is facing. Then it will wait for “wallJumpingTime” seconds before resetting the players gravity scale, changing “isWallJumping” to false and resetting the “jump” animation trigger.

A screen shot of a computer code

Description automatically generated

A screen shot of a computer program

Description automatically generated

A screen shot of a computer program

Description automatically generated

In the “Update()” function the “wallJumpingDirection” is set to the opposite of the current direction, and “wallJumpingTime” is assigned while the player is touching the wall.

A computer screen shot of white text

Description automatically generated

### WallJumpCooldown() Coroutine function

This function is used to make sure the first time the player jumps onto the wall and every time after, there will be a cooldown between jumps. In the “FixedUpdate()” it checks if the player “IsWalled()” if they are it will start the “WallJumpCooldown()” Coroutine

A screen shot of a computer code

Description automatically generated

This Coroutine will wait for “wallJumpingCooldown” seconds before making “canWallJump” true again, which allows the player to jump.

A computer screen shot of a code

Description automatically generated

## Double Jump

In “PlayerScript.cs” the “Start()” function sets the current amount of times the player has Jumped to the “jumps” Variable

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Description automatically generated

In the “Update()” function ever time the player is on the ground the “jumpsLeft” variable will reset to the max number of jumps.

Text

Description automatically generated

In the “Jump()” function as long as there is more than 0 “jumpsLeft” the player will be able to jump. So, if “maxJumps” is at 2 the player will be able to double jump

Text

Description automatically generated

Once the jump is pressed the “jumpsLeft” will be updated with the new number of jumps left which is 1 less.

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In the “Update()” function “maxJumps” is set to “jumpsLeft” when the player is on the ground. This means the players “jumpsLeft” will reset to whatever value of “maxJumps” when they are on the ground.

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Description automatically generated

## Dash() Function

When the dash button is pressed (K on keyboard / button east on gamepad) and the player is able to dash the “Dash()” coroutine will run. This function uses a trail renderer, a float for the power of the dash a float for the duration of the dash, a bool to check if the player can dash, a bool to check if the player is dashing (to not allow movement while dashing) and a float for the dash cool down.

A computer screen shot of a program

Description automatically generated

### Dash() Coroutine Function

This function sets the “canDash” variable to false to stop multiple dashes while the current dash is activated. “IsDashing” is set to true to stop the players other movement abilities A screen shot of a computer program

Description automatically generated

The “dashing” animation is played, the gravity scale is set to 0, the dashing power is given to the players “rigidbody”, and the trail renderer starts emitting. The coroutine waits for “dashingTime” seconds and turns off the trail renderer, resets the players gravity scale, animation and “isDashing”. It waits for the cool down to finish before setting “canDash” back to true.

A computer screen shot of a program code

Description automatically generated

## Interact() Function

The “Interact()” function can be improved still but for now it does its job. The author will explain how they will make it better at the end of this section. The button to Interact on Keyboard is “E” and on Gamepad is the north button on the right side. When preformed the Function “CheckInteractions()” used. The Variables that will be used in the “PlayerScript.cs” are “interactRange”, this will be the radius of the circle that surrounds the NPC or interactable object. “NPCLayers” is a layer mask used to check if the player is overlapping the “interactRange” of any NPC or Interactable object.

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Description automatically generated

A screen shot of a computer program

Description automatically generated

### CheckInteractions() Function

This function gets an array of colliders that the player is beside (Collider2D) and stores them in a variable. Then uses a “foreach” loop to iterate through each “Collider2D” in the array and uses the Unity Function “TryGetComponent()”

The author has Created a C# script “NPCInteractable.cs” which is attached to NPCs. This script will be explained after this section.

If it gets the component it will use the “Interact()” function from that script.

A screen shot of a computer program

Description automatically generated

## NPCInteractable.cs

This script was created to allow the player to interact with characters, through text, but in the future can be changed to also include object interactions but the author does not have enough time with the project time constraints.

## One Way platforms

The one-way platforms use the variable “fallThrough” this will be a toggleable Boolean for weather the player can fall through the object or not.

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Description automatically generated

This is currently only working for keyboard, when the player presses the down arrow or “S” key the player will fall through the object.

A computer screen shot of a computer error

Description automatically generated

## OneWayPlatform.cs script

This script will first get the “BoxCollider2D” from the object it is placed on

A black background with white text

Description automatically generated

When another object first collides with this object it checks for the Tag “Player “.

A screen shot of a computer program

Description automatically generated

When the player is still in contact with this object and the variable “fallThrough” from “PlayerScript.cs” is true, the “Coroutine” “DisableCollision()” will start.

A computer screen with text

Description automatically generated

The “DisableCollision()” function disables the “box” which will turn off the box collider of the object after half a second the object’s “box” will be enabled again. And the “playerControls” is set back to null to not allow the player to fall through the object again.

A screen shot of a computer program

Description automatically generated

The object’s box collider must have “Used By Effector” ticked.

A screenshot of a computer

Description automatically generated

The Platform Effector 2D makes it so the player can jump onto the object but only if the player is landing on the object from the specified angle e.g., below is 90 Degrees. This allows the player the jump up through the object but not down unless the down button is pressed while in contact with it.

A screenshot of a video game

Description automatically generated

A screenshot of a computer

Description automatically generated

## RespawnScript.cs

This script uses the player position and the respawn point position.

A screen shot of a computer program

Description automatically generated

This script is placed on the “RespawnCollider” object the box collider’s “Is Trigger” is checked.

When the player enters the box collider of “RespawnCollider” the “OnTriggerEnter2D” function moves the players current position to the respawn point’s position.

A screenshot of a computer

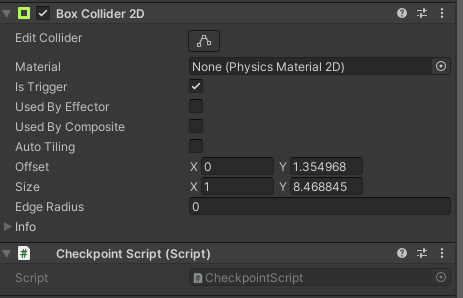
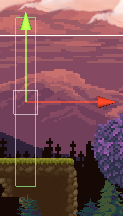
Description automatically generated

## CheckpointScript.cs

This script uses a reference to the “RespawnScript”, the “Awake()” function runs as soon as the script is started, it gets the component of the “RespawnCollider” and now the respawn point can be updated to a new point.

## A screen shot of a computer program Description automatically generated

These checkpoint objects are placed throughout the level and use a Box Collider 2D with the “Is Trigger” checked



## PauseScript.cs

This pause script is put on the empty menu controller object.



The variables used in this script are the GameObject Pause Menu and an “isPaused” which will enable / disable actions dependion on its state. A reference to “playerControls” is also used.

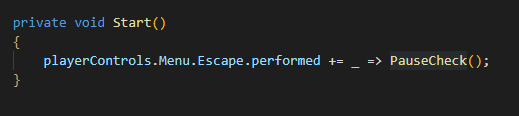
A screenshot of a computer screen

Description automatically generated

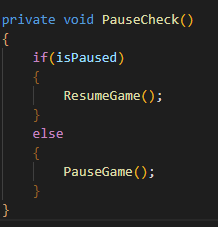
A black screen with white text

Description automatically generated

When the player presses escape the “PauseCheck()” function will run



“PauseCheck()” will check if the “isPaused” variable is true or false. If it is true it will run the “ResumeGame()” function otherwise it will run the “PauseGame()” function



A screen shot of a computer program

Description automatically generated

“PauseGame()” sets the Time scale to 0 stops the audio listeners and sets “isPaused” to true, then enables the Pause Menu UI.

A computer screen shot of a program code

Description automatically generatedA screenshot of a computer menu

Description automatically generated

“ResumeGame()” Sets the Time scale back to 1, enables the audio listeners, sets “isPaused” to false and disables the Pause Menu UI.

A computer screen shot of a program code

Description automatically generated

A screenshot of a menu

Description automatically generated

The Menu Input system from the new input system.

A screenshot of a program

Description automatically generated A screenshot of a computer

Description automatically generated

## EnemyScript.cs

All of the functions in this script have been explained previously in the “Fire()”. This script is placed on enemies it gets their rigid body and animator components, the “maxHealth” can be changed in the inspector. This script will be combined with the “PlayerScript.cs” once Inheritance is implemented as they both should use all these functions and variables.

A computer screen with text

Description automatically generated

## Tile map

Tile maps are used to create 2D worlds they allow the creator to select the tile they would like to place and draw the tiles into the scene.

A screenshot of a video game

Description automatically generated



## Sprite sheet

The player’s sprite sheet has been downloaded from the Unity assets store, this came with different animations that weren’t set up properly, I fixed this by just re selecting the animation frames that went together.

Graphical user interface, text, application

Description automatically generatedGraphical user interface, text, application

Description automatically generated

## 

## Camera

The camera plays a huge part in a lot of Metroidvania games, The package the author uses to mauver the camera is Cinemachine.

### Cinemachine settings

## Parallax

The author uses Parallax to give depth to 2D game they are creating. In the image below is an example of how they get depth in their game. The layer labled “A” is the layer the player. In the Parallax.cs script the background behind the player layer will move as the player moves depending on how far away from the player layer they are.

### A screenshot of a video game Description automatically generated

### Parallax.cs

This script uses the Main Camera object and the players transform to determine how the background scene will move.

A screenshot of a computer

Description automatically generated

The “Start()” function assigns the startPosition and startZ variables.

A screen shot of a computer program

Description automatically generated

The “Vector2” variable “travel” is calculated each time the variable needs to be used. It holds the distance the camera has travelled from the “startPosition”.

The float “distanceFromSubject” is also calculated each time it is used, this distance is along the Z axis because the further behind the “subject” the background is then the less it should move.

The float “clippingPlane” is also calculated each time it is used, if the “distanceFromSubject” variable is greater than 0 (its behind the subject) add the z position of the cam to the “cam.farClipPlane” otherwise add the z position of the cam to “cam.nearClipPlane”

To get the parallax factor the float “parallaxFactor” is used and calculates what it is by dividing the “distanceFromSubject” by the “clippingPlane”.

A computer screen shot of a program code

Description automatically generated

In the “FixedUpdate()” function a new “Vector2” called “newPos” is used to calculate where the new position should be. And then it is moved there using a “transform.position”

A screen shot of a computer

Description automatically generated

## Animation

In the “PlayerMvt.cs” “Update()” function when the player is on the ground the falling Boolean is set to false this will stop the fall animation from continually playing after the player falls from anywhere.

Text

Description automatically generated

Once the player’s velocity is less than 0 the fall animation is played and the jump trigger is reset to make it so the player can jump again. The nested if statement checking if “IsGrounded()” is true to stop the falling animation if the player is still holding one of the movement buttons

In “PlayerMvt.cs” in the “Jump()” function when the player pressed the “Space” button the trigger variable jump is toggled and the Boolean variable “falling” is set to false this will play the “Jump” animation. When the “Space” key is let go the “Jump” trigger is reset and the “falling” variable is set to true.

Text

Description automatically generated

The “Idle”, “Jump”, “JumptoFall” and “Run” animations all work.

## A picture containing graphical user interface Description automatically generated

When the user doesn’t press any buttons and isn’t falling the idle animation will play, if the user presses the “A” or “D” key the run animation will play. if the user presses the “jump” key

From “Idle” to “Jump” a trigger condition that checks when the parameter “jump” is toggled is needed. Once the user reaches the peak of their jump the variable “falling” is set to true

Graphical user interface, application

Description automatically generated

When the user stops pressing the “Jump” key or when the user reaches the peak of their jump the “JumptoFall” animation will play when the falling variable is set to true

Graphical user interface, application

Description automatically generated

Once the Character lands on the ground “falling” is set to false and will no longer play the “JumptoFall” animation.

Graphical user interface

Description automatically generated

If the user falls off a platform the “JumptoFall” animation will play

A screenshot of a computer

Description automatically generated with low confidence

If the user presses the “A” or “D” key to move the “Run” animation will play. Checking if speed is greater than 0.0001 is making the response a bit quicker so the character will react faster to the input of the user.

Graphical user interface, application

Description automatically generated

If the user stops pressing the “A” or “D” keys the “Run” animation will stop playing. Checking if speed is less than 0.0001 is making the player character stop quicker.

A picture containing accessory, case

Description automatically generated

This is Updated so the JumpToFall will go back to idle at the correct time, and the player can go from “Run” to “JumpToFall” this makes it so the player isn’t running in mid-air or falling while moving on the ground.

A screenshot of a computer

Description automatically generated with low confidence