

NEA

Name: Jez Snelson
Candidate Number: 1209
Centre Number: 62337

Contents

1 Analysis	1
1.1 Dungeon Crawlers	1
1.2 The Problem	1
1.3 Stakeholders	1
1.3.1 Survey	1
1.3.2 Survey Results	2
1.3.3 About Stakeholders	3
1.4 Research	4
1.4.1 Existing Solutions	4
1.5 Limitations and Requirements	7
1.6 Features	8
1.6.1 Essential Features	8
1.6.2 Desirable Features	9
1.7 Success Criteria	10
1.8 Computational Methods	13
2 Design & Plan	14
2.1 Overview	14
2.1.1 Global Variables	14
2.1.2 Folder Structure	14
2.1.3 Naming Convention	14
2.2 Database Design	15
2.2.1 ERD	15
2.2.2 Database Naming Conventions	16
2.2.3 SQL Queries	17
2.2.4 Algorithms	18
2.2.5 Testing Plan	19
2.3 Login System	20
2.3.1 Activity Diagram	20
2.3.2 Algorithms	20
2.3.3 Testing Plan	21
2.3.4 Mockup Forms	21
2.4 Save Select System	22
2.4.1 Algorithms	22
2.5 Item Design	22
2.5.1 Class Diagram	23
2.5.2 Algorithms	23
2.6 Inventory Design	24
2.6.1 Stored Items	24
2.6.2 Equipped Items	24
2.6.3 Clarification	24
2.6.4 Algorithms	24
2.6.5 Testing Plan	26
2.7 Player Character	27
2.7.1 Composition	27
2.7.2 Animations	27
2.7.3 Help Screen	27
2.7.4 Algorithms	27
2.8 Weapon Hurtbox	28
2.8.1 Algorithms	29
2.9 Dungeon Environment Design	29
2.9.1 Generic Tiles	29
2.9.2 Chests	29
2.9.3 Doors	29
2.9.4 Algorithms	29
2.10 Projectile Design	30
2.10.1 Overview	30
2.10.2 Ranged	30

2.10.3	Area Of Effect	30
2.10.4	Algorithms	30
2.11	Enemy Design	31
2.11.1	Overview	31
2.11.2	Composition	31
2.11.3	Navigation	31
2.11.4	Animation	31
2.11.5	Projectile Enemies	32
2.11.6	Algorithms	32
2.12	UI	33
2.12.1	Display Strings	33
2.12.2	Inventory UI	34
2.12.3	Game UI	34
2.12.4	Algorithms	34
2.13	Procedural Generation Design	35
2.13.1	Overview	35
3	Development & Testing	35
3.1	Database Development	35
3.1.1	_ready()	36
3.1.2	Hashing	36
3.1.3	Login Functions	37
3.1.4	Testing	38
3.2	Login System Development	39
3.2.1	Login Form	40
3.2.2	Reset Password Form	41
3.2.3	Create Account Form	41
3.3	Save Select System	43
3.4	Item Development	44
3.4.1	Folder Structure	44
3.4.2	Item	44
3.4.3	Equipable	45
3.4.4	Armour	45
3.4.5	Charm	45
3.4.6	Weapon	46
3.4.7	Key	46
3.4.8	Revision	47
3.5	Inventory Development	47
3.5.1	Add Item	47
3.5.2	Remove Item	47
3.5.3	Unequip Item	48
3.5.4	Equip Item	48
3.5.5	Testing	49
3.6	Hurtbox Development	52
3.6.1	Layout	52
3.6.2	Script	53
3.7	Player Development	53
3.7.1	Layout and Structure	53
3.7.2	_physics_process(delta):	54
3.7.3	Player Animation	54
3.7.4	Player Attack	55
3.8	TileMap Development	55
3.9	Dummy Development	56
3.10	Stakeholder Feedback 1	56
3.10.1	Login System and Save Menu	56
3.10.2	Test Scene	57
3.11	Dungeon Environment Development	58
3.11.1	Door	58
3.11.2	Chest	59
3.12	Projectile Development	60

3.12.1 Ranged	60
3.12.2 Area	60
3.13 Magic Weapon Development	60
3.14 Enemy Development	60
3.14.1 Layout and Structure	60
3.14.2 General Script	61
3.14.3 _physics_process():	61
3.14.4 take_damage(damage, damage_type):	62
3.14.5 Animation	62
3.15 UI Development	63
3.16 Tutorial Development	63
3.17 Stakeholder Feedback 2	63
3.17.1 Save Menu Feedback	63
4 References	64
5 Code Listings	65
5.1 resources/scripts	65
5.2 scenes	66
5.2.1 game/enemies	66
5.2.2 game/player	69
5.2.3 game/projectiles	72
5.2.4 game/worlds	74
5.2.5 menu	78
5.3 src	80
5.4 utils	86

1 Analysis

1.1 Dungeon Crawlers

A dungeon crawl is a scenario in role playing games in which the main character navigates a dungeon environment often solving traps or fighting monsters to progress through the level. A video game or board game made up of predominantly dungeon crawls is considered to be a dungeon crawler.

Most dungeon crawlers have a fixed map that is the same every time which can lead to little replay value as it can be boring to replay the same map over and over.

1.2 The Problem

Dungeon Crawler style games can be boring and repetitive, this means they can have little to none replay value. Additionally a lot of Dungeon crawlers have a steep learning curve that makes it hard for new or casual players to fully enjoy them. These games are also very complex often demanding lots of time for a simple playthrough. In addition, Non-Computational Methods are inconvenient as they can take up a lot of space, take a long time to set up and you cannot save your game state to pick it up later easily.

1.3 Stakeholders

1.3.1 Survey

I chose a set of questions in order to survey my stakeholders and help me find success criteria for the project to fulfill their needs.

1. How often would you say you play video games on a scale of 1-10 (1 being every other week 10 being every day)
2. Do you have any specific or requirements for this computer game?
3. How would you use this game?
4. Would you say you have the time to commit to learning a complex or unintuitive game?(yes, probably not,no)
5. How long would you say is your average gaming session?(1-5 hours)
6. Which different ways do you play video games?(multiple choice: controller, wasd, arrows)
7. Have you played any Dungeon Crawler games(e.g. Legend of Zelda, Binding of Isaac, Dead Cells, Hades)?
8. If not would you want to try a Dungeon Crawler Game?
9. Rank the features of classic dungeon crawlers you dislike the most(Lack of Replayability, Long Unskippable Cinematics, High length of time required for a playing session, The Learning Curve, The Difficulty)
10. Rank the features you think are most essential for the game to be enjoyable for you(Procedurally Generated Dungeons, Loot to Collect and utilise, Some Sort of skill tree, Co-Op mode, Puzzles, Hidden Areas)

1.3.2 Survey Results

Time available:

On average my stakeholders session length is around 2 hours for a single game. On average they play videogames almost every day however there is one that plays infrequently. Because of this I will have to try and make it easy to pick up without much you have to remember about previous sessions.

Most of my stakeholders do not have time to commit to learning a complex or unintuitive game and so I will have to make the game easy to pick up but still have complexities for those who want a challenge.

All controlling mechanisms were popular but WASD was the most so I will prioritise that.

50% of my stakeholders have played dungeon crawlers and so may be experienced with it but 50% have not so I should aim to make it a good introduction to the dungeon crawler genre with the potential of adding optional difficulty for those more experienced.

Disliked Features (Ranked most to least disliked):

1. Lack of replayability.
2. High length of time required for a playing session.
3. The Learning Curve.
4. Long Unskippable Cinematics.
5. The Difficulty.

Due to this I will focus on replayability through the use of procedural generation whilst still aiming to exclude the more disliked features.

Liked Features (Ranked from most to least liked):

1. Some sort of skill tree.
2. Hidden Areas
3. Procedurally Generated Dungeons.
4. Loot to collect and utilise (e.g. weapons).
5. Puzzles.
6. Co-Op Mode.

Because of this I will prioritise getting the more liked features done and exclude some of the less liked features from my success criteria.

1.3.3 About Stakeholders

Name	Description	How they will use my product
Samuel Vanderstelt-Hook	18 year old Male Sixth Form Computer Science Student, Casual Gamer who enjoys a wide range of games.	Sam will use my solution for casual gaming for fun as a break from his studies. He has stated needs for a game that is replayable and gives him a reason to come back to it.
Daniel Olde Scheper	18 year old Male A Level Computer Science Student	Daniel will use my solution as a way to relax from his A-Level Studies. He has stated needs for a fun, replayable and easy to pick up game.
Peter Dunn	17 year old Male College Student and aspiring hobbyist game developer.	Peter will use my solution as a form of entertainment after studies and as he loves Dungeon Crawl Style games. He needs a replayable game with an intuitive combat system.
Sadiya Shorkar	17 year old Female Student and Casual Video Game Enjoyer	Sadiya will use my solution as a form of casual entertainment for short sessions. Sadiya has seizures and so needs accessibility options like volume control and options for less vibrancy.
Penelope Castiau	18 year old Female Sixth Form Student, Avid Computer Gaming Enjoyer and Hobbyist Streamer.	Penny will use my product for entertainment purposes and to play on stream. Because of this Penny needs subtitles to make the game easy to follow for viewers.
Steff Stylianatos	17 year old Female College Student and Game Developer	Steff will use my product to relax from studies. Steff needs a replayable game but also want it to be engaging.

1.4 Research

1.4.1 Existing Solutions

Edmund McMillen's The Binding of Isaac

Edmund McMillen created the popular dungeon crawler roguelike The Binding of Isaac and released it on Steam⁽¹⁾. This game was relatively unique as it had procedurally generated dungeons using a system of rooms that tesalate with each other.

The procedurally generated dungeons consist of different shaped square based rooms that tesalate and are generated next to each other in a psuedo random fashion whilst obeying a set of rules. The mobs that spawn in each room can vary but there is usually only one or two enemy types per room and as you go up levels the amount of enemies and difficulty the pose increases. This system allows for every playthrough of the game to be different to the next with the same recurring theme/difficulty which allows for lots of replay oppurtunity. This would be an appropriate way for me to fix the replayability issue.

I like the games simple UI design as it clearly indicates all the necessary parts. The Map also shows the basic stucture of the level without revealing too much. I want to take inspiration from the simplicity of ui in order to help my game be intuitive.

However, the game has a couple issues that mean that it does not completely solve our problem. First is the steep learning curve that the game presents which, although to some is a welcome challenge, can put off new or less experienced players especially due to its roguelike nature meaning when you die you start from scratch. The game also has an unintuitive movement and fighting system as there is only really quad directional projectiles and a simple walking design which when combined contributes to the steep learning curve. These are some of the features I will not include in my product opting to instead try for an easier approach by allowing scaleable difficulty and oct-directional movement and attacks.



Figure 1: A screenshot of The Binding of Isaac UI and Map

Motion Twin's Dead Cells

Motion Twin created the roguelike dungeon crawler and metroidvania Dead Cells which is released on steam⁽²⁾. This game is known for its permadeath system and its procedurally generated dungeons.

The way Dead Cells uses procedural generation interests me as it allows for there to be some fixed attributes to the level whilst still allowing elements of randomness. The developers talk about how they do this in a video devlog⁽³⁾, here the dev talks about his system of having a fixed structure for each level almost like a skeleton. This skeleton will include stuff like important rooms along the way and how much distance of rooms has to be between them. It then fills in all the spaces for rooms with one of the many handmade rooms made by the developers. After one room has been chosen for a spot this leaves less choice for the other spots as the rooms need to join and flow into each other properly and so as it chooses more of them the structure of the level is determined similar to the wave function collapse algorithm⁽⁴⁾.

This style of generation allows for a unique experience each time whilst keeping a hand crafted and natural feel to the levels that is often lost in other techniques. Because of these advantages I will take heavy inspiration from this style of procedural generation for my level generation in order to make them more unique.

However due to the game being aimed at more hardcore gamers with it being part of the roguelike genre it can often appear complex and offputting to newer players who don't like the idea of taking multiple runs just to have very little to show for it and not much forward progress in the game. Although the game is a side on game I think that I will use the idea of its procedural generation as inspiration in my product as well as aiming to forgo some of the game's more complex or challenging mechanics such as permadeath in order to create a more accessible game.



Figure 2: Dead Cells Level Generation Example

Nintendo's Legend Of Zelda Breath of the Wild

Nintendo created the open-world dungeon crawler which is released on the Nintendo Wii U and the Nintendo Switch⁽⁵⁾. This game is known for its open world approach to dungeon crawlers as well as its easy to pick up nature for first time players.

The game starts with a tutorial that teaches players the mechanics of the game (combat, exploration, and resource gathering). This tutorial helps players into the world without overwhelming them, offering opportunities to learn at their own pace which helps reduce the steep learning curve of other games in the genre. The open-world nature of the game also adds to its replayability, allowing the player to take many different routes to complete the game. However, while the game's size allows for a lot of replayability, the volume of content and time required to explore everything can reduce its effectiveness as a game that can be picked up easily for shorter sessions. Its 3D world and complex systems are features that would be too tricky to implement within the scope of an A-level computer science project. It also does not fully fit the dungeon-crawler genre, particularly as it is less dungeon-focused.

I want to take inspiration from the open-world nature of the game to allow different routes through my game to increase replayability as well as its approach to tutorials in order to make the learning curve steeper. On top of this another feature I would like to take inspiration from is the intuitiveness of the combat system which is easy to learn but hard to master in particular its feature of being able to lock onto enemies.

Some features I will not be including are the 3D nature and the overall content heaviness as well as the focus less on dungeon crawling as I believe these would be unnecessary features which would drive up the complexity of the solution both to make and run.



Figure 3: BOTW tutorial map

This map shows how the BOTW tutorial has the different "shrines" placed to help the player learn the basic mechanics of the game.

1.5 Limitations and Requirements

Requirement	Description	Justification
Hardware	PC or laptop with a Keyboard or Game Controller, minimum of 4GB RAM. For Windows/Linux: x86_32 CPU with SSE2 instructions, any x86_64 CPU, ARMv8 CPU. For Macos: x86_64 or ARM CPU. Integrated graphics with full OpenGL 3.3 support	These are the requirements for running an executable from Godot. The keyboard(WASD) or controller is needed as the input for the game.
Software	I will be using the Godot Game Engine and GDScript to program my game.	I will be using Godot as it is a good 2D game designer that is Free and Open-Source it changes less often than alternatives such as Unity. On top of this I have prior experience in Godot and GDScript.
OS Limitations	For Native Exports: Windows 7 or newer, macOS 10.13 or newer, Linux distribution released after 2016 For Web: Firefox 79, Chrome 68, Edge 79, Safari 15.2, Opera 64	Godot can export easily to any of these platforms and more accessibility is good and I can also export a HTML5 version to be hosted in a website such as https://www.itch.io .
General System Limitations	A visually or auditory excellent experience	I do not have the experience with shaders or music and sound effects to add these features to the game in this time and it would make the game requirements higher.

1.6 Features

1.6.1 Essential Features

Feature#	Feature	Description	Justification
1	Player Movement and Controls	The player will control movement using the WASD keys for up, left, down and right respectively Q will trigger a dash. Alternatively they will use the left control stick of a controller.	This will be used to navigate around the Dungeon environment and WASD was the most popular control mechanism for the stakeholders with controller close behind. The controls of my game aim to follow the stakeholder feedback aswell as the general controls that seemed to be favoured in my research
2	A Basic Combat System	The combat system will consist of a primary weapon (melee, magic or ranged) on mouse-1/1 key/X button and a shield or secondary weapon on mouse-2/2 key/Y button. I will have to implement projectiles and hitboxes for both the player and enemies.	A basic combat system is essential as it will provide the main difficulty and entertainment within the game. The existing solutions all have at least a basic combat system as one of the driving forces for progress through the game.
3	Dungeon Environment	The Dungeon Environment will consist of different shaped rooms with different purposes(e.g. boss room, chest room and shop room.) with hallways connecting inbetween them and a starting room.	A Dungeon Environment is essential as it is the environment the player will play in. All the existing solutions had dungeon environments as this is an essential part of a 'dungeon crawler'.
4	Different Enemies	The Enemies will consist of a variety of enemies that attack the player with different patterns and have different looks and animations.	This is essential as it will add variety to the gameplay and each enemy will provide a challenge to the player as I saw it used during my research.
5	Appearance and Animations of the Player	The Player will have a recognisable appearance aswell as animations for all its actions such as walking and fighting	This is essential as it tells you about where your character is aswell as what they are doing even if the animations are basic like in Binding of Isaac.
6	Login System	Users will be able to login in order to save and reload their progress. The login system will use a username and password with the details being encrypted and stored in an external database. Their will be options for signing in or creating a new account aswell as resetting your password.	This is an essential feature as saving progress is essential for making the game replayable. All the Existing solutions I looked at either had login systems or used an existing login system (e.g. steam) in order to manage seperate user saves.
7	User Interface	A Simple UI that shows status indicators like health, weapons being used, enemy health and magic points.	This would allow the player to be aware of the characters health and communicate necessary information for playing the game as I found through the Binding of Isaac UI.

1.6.2 Desireable Features

Feature#	Feature	Description	Justification
8	Weapons and a more Advanced Combat System.	A system of weapons where you can get them from boss drops and potentially shops and a combat system with normal, charged (based on how long you hold down) and special attacks (using a special key).	Different weapons will allow each player to have a playstyle more customized to them and will allow for the player getting stronger as they progress more. An advanced combat system will allow for a more smooth and enjoyable fighting experience as I saw through my research into Dead Cells and BOTW.
9	Skill Tree	A skill tree to unlock unique skills/abilities and get better at using existing skills/weapons. You would gain points from playing the game and can then put them into different areas in order to create a customized character build	This would further allow the player to choose their own play style and add an element of replayability where you can try going for a different build each time you play. This was also requested by the stakeholders and can be seen in Dead Cells.
10	Procedurally Generated Dungeons	The Dungeons would be procedurally generated whilst keeping some amount of structure (e.g. the same amount of distance between bosses and key rooms). This would happen through many similar small room sections that can be slotted together in order to make a full dungeon.	This would create a more engaging game which is different each time you play it and therefore increase replayability exponentially as the different combinations of room increases. This was also requested by the stakeholders and was used in Dead Cells to allow for greater replayability.
11	Hidden Areas	Secret areas that can be unlocked through ways such as progressing further in the game and coming back or through puzzles/fake walls. Could have secret loot or bosses.	This feature was highly requested by the stakeholders and can be seen in a lot of existing solutions and would allow for more time spent having fun in the game through finding these areas.
12	Inventory System	An Inventory to be opened with the E key or the + button through which you will manage equipped weapons, key items, skills and more.	An Inventory System is an essential feature if we want to add more weapons/weapon types and a skill tree. It can be seen in BOTW and less complex in Dead Cells.
13	Settings and Volume Control	A settings page to control the volume of noises as well as the vibrancy of colours.	One of the Stakeholders has requested this as a feature to help the game be more accessible to them.
14	Difficulty Levels and Hardcore Mode	A Difficulty level selector which allows the user to up the difficulty(damage the enemies do etc) and a Hardcore Mode which switches the game to a roguelike format with separate save state to the normal game.	50% of the stakeholders are experienced with Dungeon Crawlers so in order to help the game still be reasonably challenging for them I will add a difficulty slider.

1.7 Success Criteria

Criteria #	Abstraction	Success Criteria	Success Indicators
1	Players to be able to control and move the player using both the WASD keys and a controller.	1.1 W key - Forward 1.2 A key - Left 1.3 S key - Backward 1.4 D key - Right 1.5 Q key - Dash 1.6 Left Control Stick directional movement corresponds to player movement.	WASD/Left Stick direction - Move in that direction Q - Faster movement in direction player is facing
2	Players to be able to have different weapons and attack with them.	2.1 mouse-1/1 key/X button - Primary Attack 2.2 mouse-2/2 key/Y button - Secondary Attack 2.3 Add a basic melee sword 2.4 Add a basic ranged bow and projectiles 2.5 Add a basic magic staff and projectiles 2.6 Add a basic magic staff with area of effect attacks 2.7 Add a hitbox for the player 2.8 Add a health bar for the player 2.9 Make sure all attacks go in the direction the player is facing	Attacks are triggered when their corresponding controls are pressed. Melee attacks affect all enemies within range in the direction the player is facing causing them to lose health. Projectiles launch on a ranged attack and travel in the direction the player is facing Area of effect attacks spawn an area around the player that slowly damages enemies that come into it. Enemy attacks cause player health to go down. Player health accurately displayed on a health bar in the UI
3	A Dungeon environment for the character to walk around and different rooms	3.1 Walls that you cannot walk through 3.2 Floor of the Dungeon 3.3 Interactive chests for loot 3.4 Separate Boss, Chest and Monster Rooms 3.5 A room Door that only opens on a certain condition 3.6 A Dungeon Environment built out of the rooms and corridors	Ability to walk around the dungeon environment and remain contained by it. Ability to open chests and receive a specific quantity of random loot from a pool. A level built out of specific purpose built rooms and corridors.
4	Different Enemies for the player to face including bosses	4.1 Enemy Sprites 4.2 Enemy Pathfinding Abilities 4.3 Enemy sight range 4.4 Enemy hitbox 4.5 Enemy health tracking 4.6 Melee Enemies 4.7 Projectile Enemies 4.8 Boss Enemies with different attack combinations	Enemies have distinct and visually recognisable sprites with smooth animations. Enemies navigate around walls and obstacles and follow the player. Enemies detect the player within a certain range and react. Player attacks are registered and decrease enemy health. When an enemy's health runs out it will die. Melee enemies attack the player within close range.

5	Appearance and Animations of the Player	5.1 Player Sprite 5.2 Walking Animation 5.3 Player sprite turns to face the direction of movement 5.4 Melee Animation 5.5 Magic Animation 5.6 Dash Animation	The Player has a distinct and visually recognisable sprite with smooth animations for walking, melee attacks and others. The direction of the player changes based on last direction moved.
6	Login System	6.1 Password Hashing Algorithm 6.2 SQL Table to store username and hashed password pairs 6.3 Ability to create a new account with unique username 6.4 Validation of Usernames ($1 \leq \text{chars} < 15$) 6.5 Input Sanitisation (Removing any escape chars for SQL before sending the command) 6.6 Ability to log in with an existing account and correct password 6.7 Ability to reset password (With challenge question) 6.8 A general login form which links the other forms. 6.9 Ability to delete an account.	Uses a strong hashing algorithm with salting. Username password pairs are stored in an SQL table. Users can only create an account if the username is unique and between 1 and 14 characters. Prevention of SQL injection attacks. User's can login with credentials. User's can reset their password. A general login form links to registration, password reset and logging in.
7	User Interface	7.1 Health Bar 7.2 Magic Points Bar 7.3 Display of the weapon being used 7.4 Popup display with enemy health over their head when they get damaged 7.5 ability to switch between weapons	Displays Player health and MP accurately and updates dynamically. Clearly indicates which weapon is being used. Clearly displays enemies health when they get damaged. Allows switching between weapons.
8	Weapons And a More Advanced Combat System	8.1 Different Styles of melee, magic and ranged weapons 8.2 Boss Drops 8.3 Shop System that appears throughout levels 8.4 Charged Attacks (based on how long you hold down) 8.5 Special attacks	Distinct different weapon styles, levels and dynamics. Defeated Bosses drop unique or rare items. Shops can appear throughout levels. Holding down attack button increases power of attacks. More powerful secondary special attacks.
9	Skill Tree	9.1 UI Menu for the skill tree (Some skills required before others unlocked). 9.2 Different Branches (Melee, Ranged, Magic, Defense) 9.3 Experience system. 9.3.1 Experience gained after killing enemies/bosses 9.3.2 Different experience amounts required for different skills 9.4 Ability to unlock skills 9.5 Ability to reset your skill tree	A user-friendly menu displaying skills and prerequisites. Separate branches for Melee, Ranged, Magic and Defense skills. Players gain xp from defeating enemies and bosses. Different skills requiring different amounts of XP to unlock. Players can spend XP to unlock skills. Players can reset and redistribute points in the skill tree.

10	Procedurally Generated Dungeons	<p>10.1 Creating requirements for each level to satisfy</p> <p>10.2 Creating different room sections/rooms to piece together</p> <p>10.3 Creating the algorithm to generate which room sections are slotted together where.</p> <p>10.4 Create an algorithm to piece the sections together to create a fully playable level.</p> <ul style="list-style-type: none"> 10.4.1 Level's generated satisfy length requirements 10.4.2 Level's generated contain all the special rooms needed (chest room, secret rooms, etc.) 	<p>Each level generated meets specific preconditions.</p> <p>Different Room sections are designed to be pieced together dynamically.</p> <p>An algorithm places room sections together to form a level layout.</p> <p>Generated levels are fully playable and contain all rooms needed.</p>
11	Hidden Areas	<p>11.1 Add mechanics to get into the secret rooms (breakable walls, climbing vines, keys, etc.)</p> <ul style="list-style-type: none"> 11.1.1 Add a hammer to break walls with 11.1.2 Add climbing gloves which you need in order to climb vines <p>11.2 Add secret Boss and Treasure rooms for behind these obstacles.</p>	<p>Players can access secret rooms using specific methods.</p> <p>A hammer item allows players to break walls.</p> <p>Players need climbing gloves to scale vines.</p> <p>Secret areas contain unique bosses or loot.</p>
12	Inventory System	<p>12.1 UI for Inventory</p> <p>12.2 Storage of Extra weapons and key items (keys, armour, charms, etc)</p> <p>12.3 E key to open up the inventory</p> <p>12.4 Ability to switch out what Weapons, Armour and charms are equipped.</p> <p>12.5 Ability to add or remove items from the inventory.</p> <p>12.6 SQL table to store inventory contents</p>	<p>A clear and intuitive menu for managing items.</p> <p>Players can store extra weapons and items to be saved in their inventory.</p> <p>E Key - Open Inventory UI.</p> <p>Players can swap weapons/armour.</p> <p>Players can remove items from their inventory.</p> <p>Inventory state persists even when game closes.</p>
13	Settings and Volume Control	<p>13.1 Settings UI with buttons for each setting</p> <p>13.2 Ability to control the volume</p> <p>13.3 Ability to control the vibrancy of colours in the game.</p>	<p>A clear and accessible menu with buttons for different settings.</p> <p>Players can adjust the volume of each source of noise in the game.</p> <p>Allow users to adjust colour intensity along with accessibility needs.</p>
14	Difficulty Levels and Hardcore Mode	<p>14.1 A slider for difficulty in create save</p> <p>14.2 Increasing difficulty based on the slider</p> <ul style="list-style-type: none"> 14.2.1 Increasing enemy health 14.2.2 Decreasing player health 14.2.3 Increasing number of enemies <p>14.3 A Hardcore mode at maximum difficulty with a separate save state to the normal game.</p> <ul style="list-style-type: none"> 14.3.1 roguelike features (permadeath, resource management, etc) <p>14.4 SQL table to store different saves</p>	<p>A difficulty slider in the save menu.</p> <p>The game adjusts difficulty by increasing enemy health and damage and increasing the number of enemies.</p> <p>A hardcore mode with permadeath that can be toggled in the save creation menu.</p> <p>Saves persist even when game closes.</p>

1.8 Computational Methods

2 Design & Plan

2.1 Overview

2.1.1 Global Variables

I have a couple of main global variable scripts Global, Inventory, Database etc.

Source	Identifier	Data Type	Justification
--------	------------	-----------	---------------

2.1.2 Folder Structure

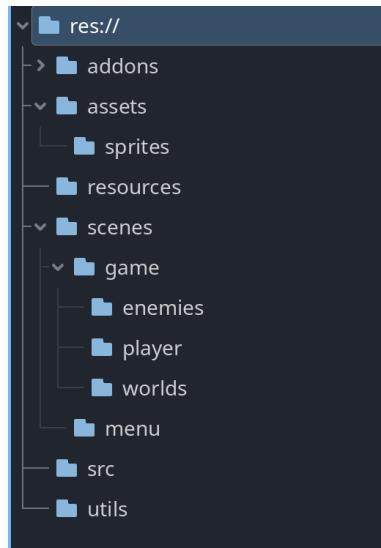


Figure 4: Folder Structure

I chose this folder structure as it will allow me to clearly define where all the different parts of the game are aswell as easily being able to access the closely related parts.

The assets folder will contain all of the external assets, sprites, spritesheets and audio.

The resources folder will contain all of the items (weapons, armour, keys and charms) that I will make to be included in the game.

The scenes folder will contain all the scenes for the menu and the game sorted into their respective folders.

The src folder will contain all of the preloaded scripts for the game.

the utils folder will contain any testing or debugging scripts/scenes to help with the development process.

2.1.3 Naming Convention

For naming I conventions I will adopt the naming conventions already used in godot for ease of integration, readability and consistency with documentation.

The naming conventions are as follows.

Type	Convention	Info
File Names	snake_case	yaml_parsed.gd
Class Names	PascalCase	YAMLParser
Node Names	PascalCase	
Functions	snake_case	
Variables	snake_case	
Signals	snake_case	Past tense "door_opened"
Constants	CONSTANT_CASE	

2.2 Database Design

I will be using an SQL Database in order to store the data about my users.

2.2.1 ERD

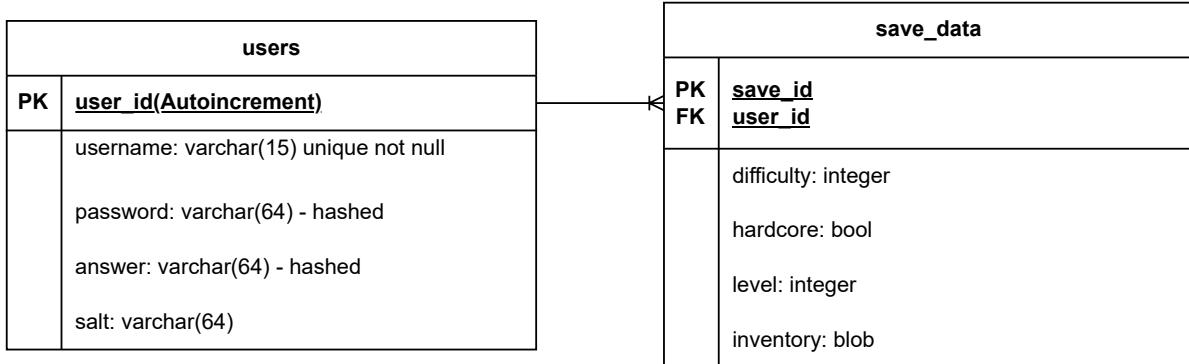


Figure 5: Database Design

Figure 2 shows the Database Design:

The users table will be the main table containing all the login details.

Each user will be able to have multiple save instances which will be stored in save data.

Upon designing the inventory I have decided that I will split the inventory into the stored items which I will use a separate table to store with the item_id (the path to the item resources location in the game files) as a primary composite key with the save_id as well as storing the equipped items in the save_data table. I have also decided to split the composite key in the save_data table and just have the save_id as the primary key autoincrementing. This will help keep the inventory more accessible and prevent the need for a BLOB decoder.

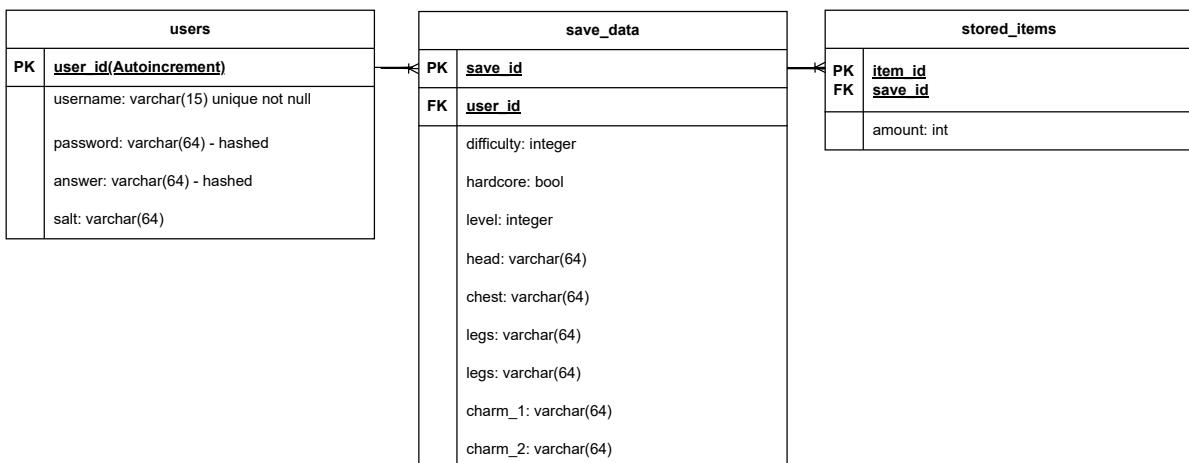


Figure 6: Database Design

2.2.2 Database Naming Conventions

The naming conventions I will adopt for the database is as follows.

Abstract	Convention	Examples	Justification
Tables	Plural snake_case	users, save_data	
Fields	Singular snake_case	inventory_content, username	
Keys	singular snake_case_table_id	user_id, save_data_id	SQL is case insensitive so with CamelCase it can't tell the difference between undervalue and underValue

2.2.3 SQL Queries

I have to write Queries for each of the actions I want to do.

Name	Description/Justification	SQL
create_table_users	Create's a table for users if it does not exist.	<pre>CREATE TABLE IF NOT EXISTS users (user_id INTEGER PRIMARY KEY AUTOINCREMENT, username VARCHAR(15) NOT NULL, password VARCHAR(64) UNIQUE NOT NULL, salt VARCHAR(64) NOT NULL, answer VARCHAR(64) NOT NULL);</pre>
get_user_data	Returns the user data assuming it exists. If it doesn't it will return null.	<pre>SELECT * FROM users WHERE username = ?;</pre>
add_new_user	Inserts a new user into users with username, password, challenge question answer and salt	<pre>--Assume hashed password and answer INSERT INTO users(username,password,answer,salt) VALUES (?, ?, ?, ?);</pre>
reset_password	Changes a users password	<pre>--Assume hashed password and answer UPDATE TABLE users SET password = ? WHERE username = ?</pre>
create_table_save_data	Create's a table for save_data if it does not exist.	<pre>CREATE TABLE IF NOT EXISTS save_data (save_id INTEGER AUTOINCREMENT, FOREIGN KEY (user_id) REFERENCES users(user_id), difficulty INTEGER, hardcore INTEGER, level INTEGER, head VARCHAR(32), chest VARCHAR(32), legs VARCHAR(32), weapon VARCHAR(32), charm_1 VARCHAR(32), charm_2 VARCHAR(32));</pre>
add_new_save_data	Adds new save data for a user.	<pre>INSERT INTO save_data(user_id,difficulty,hardcore,level) VALUES (?, ?, ?, ?);</pre>
get_save_data	Get's the save data with a specific user_id and save_id	<pre>SELECT * FROM save_data WHERE user_id = ? AND save_id = ?;</pre>
get_user_save_data	Get's the save data for all entries with a specific user_id	<pre>SELECT level, hardcore FROM save_data WHERE user_id = ?;</pre>
update_save_data	updateSave	<pre>UPDATE save_data SET head = ?, chest = ?, legs = ?, weapon = ?, charm_1 = ?, charm_2 = ?, level = ? WHERE user_id = ? AND save_id = ?;</pre>

Name	Description/Justification	SQL
create_table_stored_items	Create's a table for stored_items if it does not exist.	CREATE TABLE IF NOT EXISTS stored_items (item_id INTEGER NOT NULL, save_id INTEGER NOT NULL, PRIMARY KEY(item_id,save_id), FOREIGN KEY(save_id) REFERENCES save_data(save_id));
update_stored_item_amount	Update's a specific person's stored items to increase the amount of something stored (assumes it is stored)	UPDATE stored_items SET amount = amount + ? WHERE item_id = ? AND save_id = ?;
get_stored_item_amount	Get's the amount of an item being stored	SELECT amount FROM stored_items WHERE save_id = ? AND item_id = ?;
add_stored_item	Adds an item to the stored_items	INSERT INTO stored_items(save_id,item_id,amount) VALUES (?,?,?);
count_stored_items	Count's the number of items stored for a save_id	SELECT COUNT(*) FROM stored_items WHERE save_id = ?;
remove_stored_item	Removes an item from stored_items	DELETE * FROM stored_items WHERE save_id = ? AND item_id = ?;
get_slot_value	Gets the file path of the item equipped in the slot	SELECT ? FROM save_data WHERE save_id = ?;
set_slot_value	Sets the value of the slot to the file path	UPDATE save_data SET ? = ? WHERE save_id = ?;

I will use godot's `query_with_bindings()` function in order to substitute in the bindings for the ?s in the queries. This is useful as it automatically performs input sanitisation so that the system isn't vulnerable to SQL injection.

2.2.4 Algorithms

`login():`

The login function will be used to find if the user exists and then check the hashed password if it does. This will help fulfill criteria 6.6.

```
def login(username,password):
    query_result = get_user_data(username) #Getting user data
    if len(query_result) == 0: #If user doesn't exist
        return "InvalidUsernameError"
    if hash(password) == query_result["password"]: #Checking password hash against stored hash
        return True
    return "IncorrectPasswordError" #If password doesn't match
```

add_user():

The add_user function will be used to generate salt for the user check if the username is unique and add the user. This will help fulfill criteria 6.3

```
def add_user(username, password, answer):
    salt = gen_salt() #Generating new salt
    hashed_password = hash(password,salt)
    hashed_answer = hash(answer,salt)
    if not add_new_user(username, hashed_password, hashed_answer, salt): #Tries to add user
        with hashed password and answer
            return "InvalidUsernameError" #If user cannot be added then the username must be
                                            invalid
    return True
```

reset_password():

The reset_password function will be used to check if the username is valid, fetch the user data and then check if the hashed answer is the same as the stored answer before updating the stored password. This will help fulfill criteria 6.7.

```
def reset_password(username, answer, password):
    query_result = get_user_data(username) #Getting user data
    if len(query_result) == 0: #If user doesnt exist
        return "InvalidUsernameError"
    if hash(answer) == query_result["answer"]: #Checking the answer hash against the stored
                                                hash
        reset_password(password,username)
        return True
    return "IncorrectAnswerError" #If answer doesnt match
```

2.2.5 Testing Plan

Test #	Function	Parameters	Expected Outcome
6.3.1	add_user()	"Hyrule", "Password", "Answer"	True
6.3.2	add_user()	"Hyrule", "Password", "Answer"	"InvalidUsernameError" as a user already exists with that username
6.6.1	login()	"Hyrule", "Password"	"InvalidUsernameError"
6.6.2	login()	"Hyrule", "Password"	True
6.7.1	reset_password()	"Hyrule", "Answer", "password"	"InvalidUsernameError"
6.7.2	reset_password()	"Hyrule", "answer", "password"	"IncorrectAnswerError"
6.7.3	reset_password()	"Hyrule", "Answer", "password"	True
6.6.3	login()	"Hyrule", "Password"	"IncorrectPasswordError"
			These

tests will be used to evaluate to what extent I have met the criteria and allow me to identify and fix any issues in my code.

2.3 Login System

2.3.1 Activity Diagram

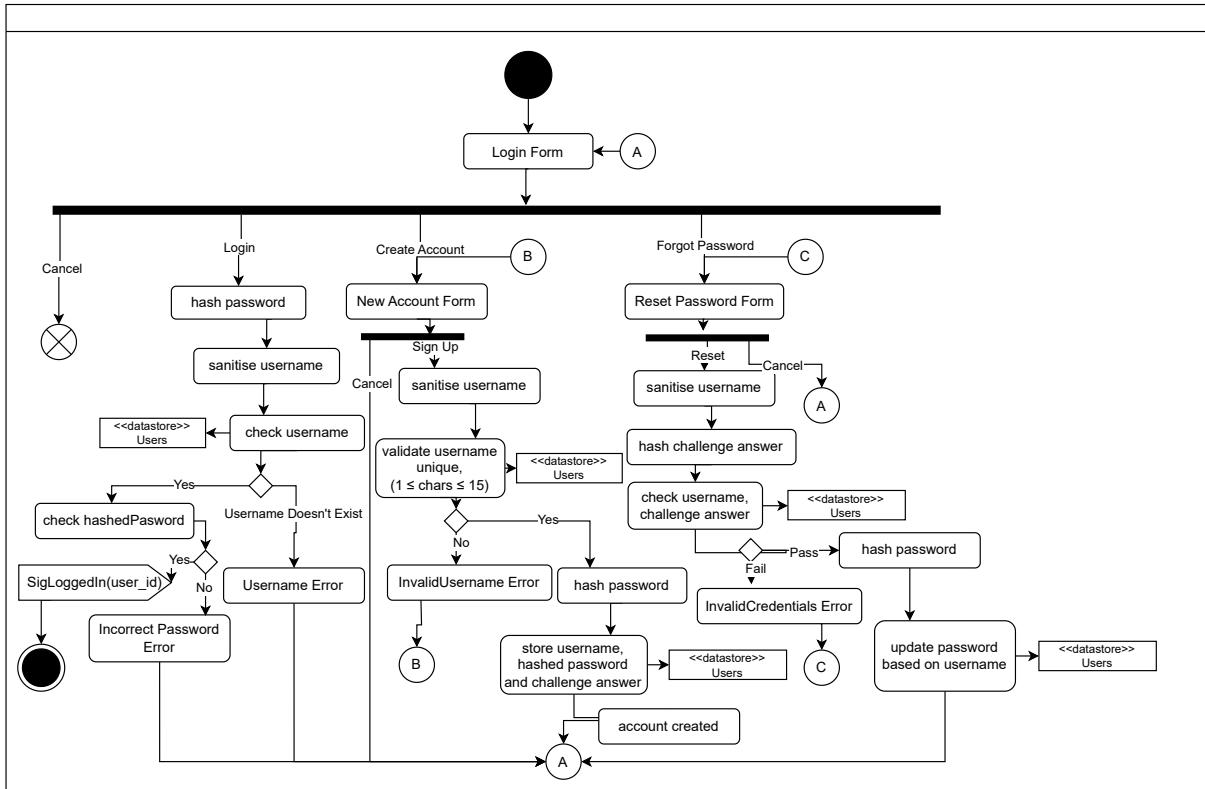


Figure 7: Activity Diagram for login forms

The login form will allow users to create accounts aswell as login with an existing account and reset a password. Upon successful login the user will be redirected to the GAME system. This login form along with the database functions provides all the necessary UI and algorithmic elements to fulfill criteria 6.

2.3.2 Algorithms

hash():

This function alternates between two different hashing functions a consistent number of times while making sure the final hash is a consistent length. It also adds in a unique salt for every user which is necessary to prevent rainbow table lookups and keep the passwords secure even if it is generic. This and the salt function fulfills criteria 6.1.

```

def hash(password: str, salt: str):
    hashedPassword = password
    #Repeating a consistent but unpredictible amount of times
    #On even rounds the password is sandwiched on odd rounds the salt is sandwiched
    #Alternating the use of sha256 and md5 but making sure to end on sha256 so the hash is a
    #predictable length.
    for x in range(1,6*len(password)+1):
        if x%2 == 0:
            hashedPassword = sha256(md5(salt[x:]+hashedPassword+salt[:x]))
        else:
            hashedPassword = md5(sha256(hashedPassword[:x]+salt+hashedPassword[x:]))
    return hashedPassword
    
```

genSalt():

The genSalt function uses random processes to generate a salt string to be used in the hashing of the password and challenge question. This needs to be random for every user to prevent the potential to create a table of

common password hashes to loop up user's passwords in.

```
def gen_salt():
    salt = "string"
    x = randint(5,10)
    for i in range(2**x):
        salt = hash(salt,sha256(str(i)))
    return salt
```

2.3.3 Testing Plan

Test #	Function	Parameters	Expected Outcome
6.1.1	gen_salt()		random 256 bit hex string
6.1.2	hash()	"password", "salt"	random 256 bit hex string
6.1.3	hash()	"password", "salt"	the same random 256 bit hex string
6.1.2	hash()	"Password", "salt"	random 256 bit hex string different from before

2.3.4 Mockup Forms

Sign In

User Name:
johndoe

Password:

SIGN IN **CANCEL**

[Forgot Password?](#)

New User
SIGN UP

Create Account

User Name:
johndoe

Password:

What was the name of your first school?

SIGN UP **CANCEL**

[Reset Password](#)

Reset Password

User Name:
johndoe

What was the name of your first school?

New Password:

RESET **CANCEL**

[Sign Up](#)

Figure 8: Login Form

Figure 9: New Account Form

Figure 10: Reset Password Form

These forms would be used in order to create an account, reset your password and login, helping fulfill criteria 6.3, 6.6, 6.7 and 6.8.

The Password and Challenge question entries would be hidden/starred for privacy.

2.4 Save Select System

I will implement the save select system as an additional menu for the login system in order to improve replayability to help using a ScrollContainer with a VBoxContainer inside to create a list of scrollable items. I will get the list of saves for a given user_id and then display them and when the button for that save is pressed the current_save_id will be set and the scene will be switched to the current level.

In order to add new save's I will add a button for hardcore and a slider for difficulty as well as an add save button which will add the save and update the list.

2.4.1 Algorithms

_ready():

```
def _ready():
    save_data_list = get_user_save_data(current_user_id)
    for save_data in save_data_list:
        button = Button.new()
        button.text = f"Level: {save_data['level']} \t Difficulty: {save_data['difficulty']} \n Hardcore: {save_data['hardcore']}"
        button.connect("pressed", self, "_on_save_selected", [save_data])
    add_child(button)
```

_on_save_selected():

```
def _on_save_selected(save_data):
    current_save_id = save_data["save_id"]
    get_tree().change_scene_to_file(world)
```

2.5 Item Design

I will implement the different item types using Godot's resource system. This will allow me to define properties that all items of the same type will share and I can use inheritance to allow classes to derive from a parent class.

The resource system is useful as it is reusable throughout scenes and scripts and it can easily be saved and loaded from disk.

The types of items I will aim to implement will be different weapon types, charms/trinkets/amulets, armour and keys.

2.5.1 Class Diagram

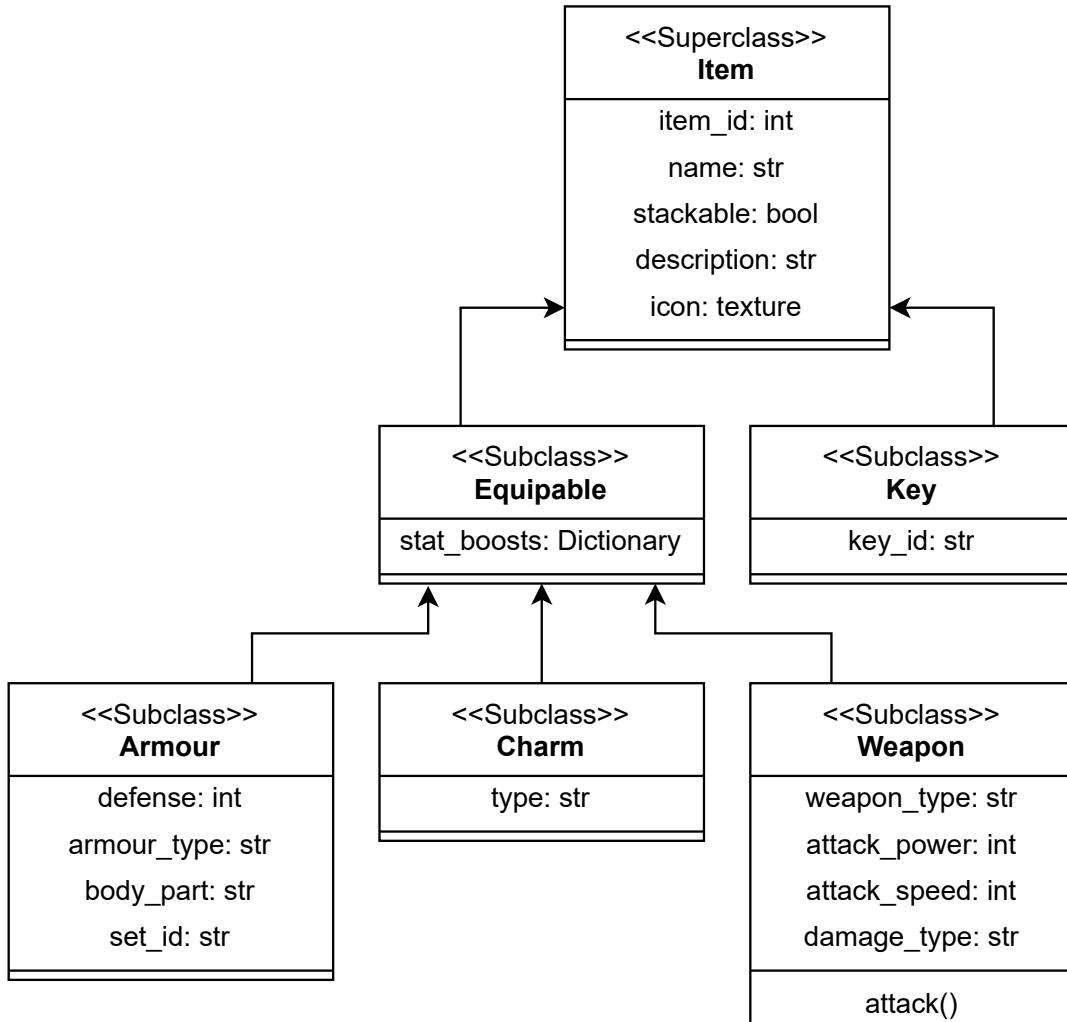


Figure 11: Player Class Diagram

2.5.2 Algorithms

attack():

I will have a number of different weapon types that will have different attacks.

I will implement the attack cooldown through the use of a CooldownTimer(timer node) attached to the player. Melee:

I will implement the melee attack by creating a variable size hitbox(area2D) scene that can be instantiated as a child of the player in order to detect enemies that would be attacked in the range specified in the resource.

```

def attack(owner: node, direction):
    #Load the hitbox scene
    hitbox_scene = load(hitbox_scene_path)
    hitbox_instance = hitbox_scene.instantiate()
    hitbox_instance.range = range
    hitbox_instance.damage = damage
    hitbox_instance.rotation = direction.angle()

    #Add child
    owner.add_child(hitbox_instance)

    #Hitbox lasts for a tenth of a second
    sleep(0.1)

    hitbox_instance.queue_free()
  
```

Ranged:

My Bows and ranged magic weapons will shoot out projectiles.

```
def attack():
    #Load the projectile scene
    projectile_scene = load(projectile_scene_path)
    projectile_instance = projectile_scene.instantiate()
    projectile_instance.damage = damage

    #Add Child
    owner.add_child(projectile_instance)
```

display_string(): Upon designing the Inventory UI I have decided to add a function to output a string describing the item, this would make use of polymorphism to behave differently for each item and display the key stats like the name, stat_boosts and such.

2.6 Inventory Design

My inventory design will cover two main parts the equipped items and the item storage. I will have a maximum inventory size script variable so that we can still display all the items in the inventory and a max stack size for stackable items.

2.6.1 Stored Items

I will implement the stored items through a dictionary that stores the item resource and the quantity of it. I will implement add and remove item functions. I will also add a max inventory size.

2.6.2 Equipped Items

I will implement the equipped items through a dictionary where the keys are the slots and the values are what is equipped in that slot. I will also add a equip function to equip an item and an unequip function to unequip the item in a slot.

2.6.3 Clarification

Upon further thought I have decided it is best to use SQL tables instead of dictionaries and use SQL queries to manage the inventory.

2.6.4 Algorithms

add_item():

```
def add_item(item_id: file_path, amount):
    if get_stored_item_amount(save_id, item_id) and item.stackable: #Checks if you can stack
        the item
        update_stored_item_amount(amount, item_id, save_id)
    elif count_stored_items(save_id) >= max_inventory_size: #Full Inventory
        return "FullInventoryError"
    else:
        add_stored_item(save_id, item_id, amount)
    return True
```

remove_item():

```
def remove_item(item_id: Resource, amount: int = 1):
    if get_stored_item_amount(save_id, item_id): #If the item is in the database
        if get_stored_item_amount(save_id, item_id) < amount: #Not enough items
            return "ItemQuantityError"
        if get_stored_item_amount(save_id, item_id) == amount: #Exactly enough items
            remove_stored_item(save_id, item_id)
        else:
```

```

update_stored_item_amount(-amount, item_id, save_id) #Removes the amount of that
                                                    item
return True #Indicates that it was successful
return "ItemQuantityError" #Indicates that there is an item quantity error

```

`unequip_item():`

```

def unequip_item(slot: str):
    #Checks if there is an item to unequip
    if get_slot_value(slot, save_id) != null:
        item = get_slot_value(slot, save_id)
        if (add_item(item, 1) == "FullInventoryError"): #Adds the item back to the stored_items
                                                       and checks if the inventory is full
            return "FullInventoryError"
        set_slot_value(slot, null, save_id) #Sets the slot back to null
        return True
    return True #If not item in slot it is unequipped

```

`equip_item():`

```

def equip_item(item: Resource):
    #Checks if the item is Equipable
    if not(item.is_class(Equipable)):
        return False
    #Gets the slot to equip it into
    if item.is_class(Armour):
        slot = item.body_part
    elif item.is_class(Weapon):
        slot = "weapon"
    else:
        equipped = false
        #Tries both charm slots
        for slot in ["charm1", "charm2"]:
            if get_slot_value(slot, save_id) == null and not(equipped):
                set_slot_value(slot, item, save_id) #Equips item
                remove_item(item) #Removes from stored_items
                equipped = True
    if not(equipped):
        unequip_item(slot)
        set_slot_value(slot, item, save_id) #Equips item
        remove_item(item) #Removes from stored_items
    return True
unequip_item(slot)
set_slot_value(slot, item, save_id) #Equips item
remove_item(item) #Removes from stored_items
return True

```

2.6.5 Testing Plan

Test #	Function	Parameters	Expected Outcome
12.5.1	add_item()	"test_item.tres", 2	Adds test item to the stored_items table.
12.5.2	add_item()	"test_item.tres", 3	As the item already exists it should add 3 to the amount.
12.5.3	add_item()	"test_weapon.tres", 1	As in the testing environment the max inventory size will be 1 and this should return "FullInventoryError"
12.5.4	remove_item()	"test_item.tres", 2	As more than the amount of the item is in the inventory it should subtract 2.
12.5.5	remove_item()	"test_item.tres", 10	"ItemQuantityError" as there isn't enough of the item in the database
12.5.6	remove_item()	"test_item.tres", 3	As exactly the amount is in the database the item entry should get removed.
12.5.7	remove_item()	"test_item.tres", 2	"ItemQuantityError" as there isn't any of the item in the database
12.4.1	unequip_item()	"head"	True and the head slot should remain as NULL
12.4.2	equip_item()	"test_helmet.tres"	True and the head slot should become "test_helmet.tres"
12.4.3	equip_item()	"test_helmet_2.tres"	True and the head slot should become "test_helmet.tres"
12.4.4	unequip_item()	"head"	"FullInventoryError"
12.4.5	unequip_item()	"head"	True as I will empty the inventory and the head should be NULL and the inventory should contain the helmet.

2.7 Player Character

This is my design for the physical player character and sprite.

2.7.1 Composition

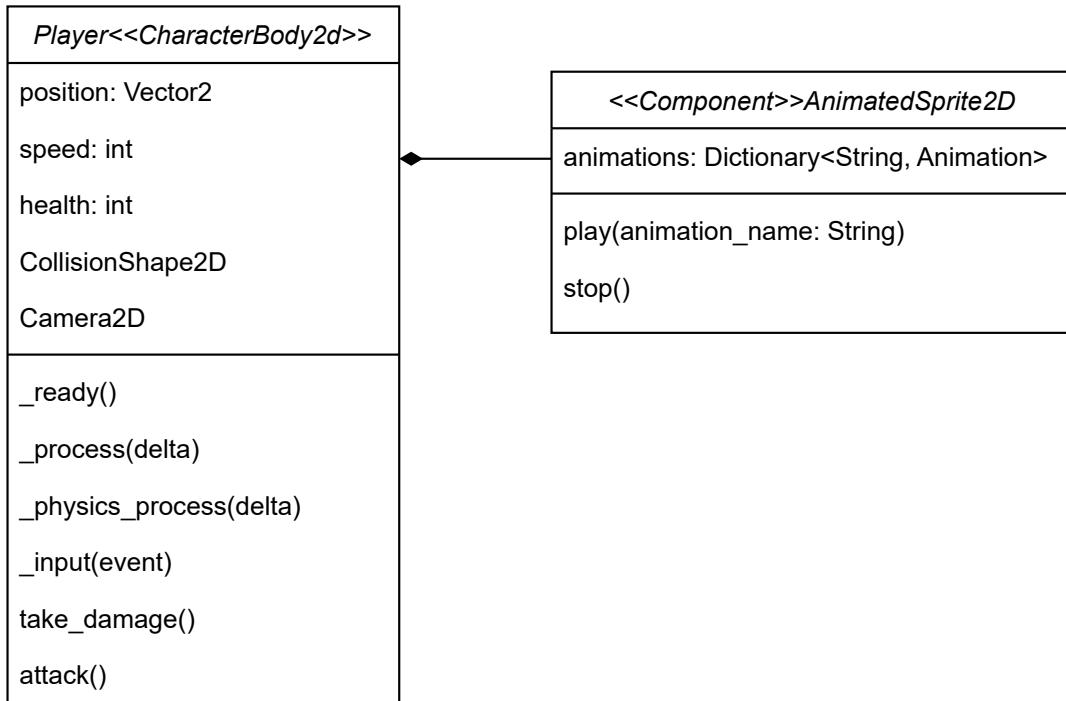


Figure 12: Player Class Diagram

The root node of the player which will contain all the child nodes will be Godot's `CharacterBody2D` as this will allow for a user controlled physics body. It will then have child nodes of `CollisionShape2D`(for collision detection), `AnimatedSprite2D`(for an animated character sprite) and `Camera2D`(for the player's view window to be centered on).

I have chosen to store the speed and health variables within the player class as they will reset/ be recalculated based of the equipment equipped.

2.7.2 Animations

I have an animation set for the player that includes 8 Directional top down animations for all player actions and so how I will decide which directional animation will be based of the last direction the player walked. I will use a `get_animation` function in order to get the directional animation to play.

2.7.3 Help Screen

I have decided to add a simple Help Screen in order to allow the user to check the controls when they want a reminder. I will implement this by creating a seperate scene with a label and then when the help button is pressed I will pause the tree and instance the scene before waiting for the help button to be pressed again to unpause the scene tree and queue_free the label.

2.7.4 Algorithms

`_ready():`

The `_ready()` function gets called whenever the player is instantiated in a scene and so it will be used to setup

variables and the environment based on existing stuff.

```
def _ready():
    #Inventory calculates the speed based on any modifiers equipped.
    speed = Inventory.calc_speed()
    #Global Script calculates the health based on the player level and any modifiers
    #equipped.
    health = Global.calc_health()
```

_physics_process(delta):

The _physics_process(delta) function gets called every frame where delta is the time since the last fram and is usually used to deal with movement and physics processes.

```
def _physics_process(delta):
    direction = Input.get_vector("left", "right", "up", "down")
    velocity = direction * speed
    if direction:
        last_direction = direction
        anim.play(get_animation("run"))
    else:
        anim.play(get_animation("idle"))
    move_and_slide()
```

_input(event):

```
def _input(event):
    if event.is_action_pressed('attack'):
        attack()
    if event.is_action_pressed('help'):
        help_screen = preload("path/to/help/scene").instantiate()
        add_child(help_screen)
        get_tree().paused = True
        while not Input.is_action_just_pressed("help"):
            sleep(0.01)
        help_scene.queue_free()
        get_tree().paused = False
```

attack():

```
def attack():
    anim_player.play(get_animation("melee"))
    Inventory.get_weapon().attack(last_direction)
```

get_animation():

```
def get_animation(animation_type):
    anim = animation_type + "_"
    if direction.x:
        if direction.x == 1:
            anim += "r"
        else:
            anim += "l"
    if direction.y:
        if direction.y == 1:
            anim += "d"
        else:
            anim += "u"
    return anim
```

2.8 Weapon Hurtbox

I will use an Area2D node with a capsule shape CollisionShape2D node attached oriented in order to encompass the sword swing area and then I will rotate it around the player dependent on the direction of attack. It will have variables for the damage and damage_type

2.8.1 Algorithms

`_ready()`: This script is used to get the bodies overlapping and if they are enemies call their take_damage function using polymorphism to decide the effect this will have on the specific enemy.

```
def _ready():
    bodies = self.get_overlapping_bodies() #Get bodies in the area
    for body in bodies:
        if body.is_in_group("enemies"): #Damages bodies if they are an enemy.
            body.take_damage(damage, damage_type)
```

2.9 Dungeon Environment Design

2.9.1 Generic Tiles

I will use a TileMap node as that will allow me to import a spritesheet for a tilemap and define the properties of the tiles such as hitboxes and place them down easily. This will be used for criteria 3.1 and 3.2.

2.9.2 Chests

I will implement Chests, the basic structure of the chest will be a StaticBody2D with a circular area2D node to tell if the player is within range to open the chest aswell as the chest sprite. Each chest will have a key path for the key needed to unlock it. The chests will have a loot pool given by a dictionary where the key is the item path and the value relates to the ratio of getting it. There will also be a variable for the amount of items given by the chest and upon opening the chest will give that many items.

2.9.3 Doors

I will implement doors, the basic structure of the door will be using a StaticBody2D with an Area2D Node to detect if the player is in front of the door. If the player is in front of the door and if the I key is pressed the door will either disappear revealing another room or switch the scene to another room depending on the purpose. I will export the variables for the scene to go to and whether it just disappears or changes scene. This would fulfill all of criteria 3.5

2.9.4 Algorithms

Chest Script:

This will consist of the exported variables aswell as an input function that checks if the requirements to unlock the chest are met before generating the random items based on their probabilities which will be set up using an array and after the chest is opened then it will disappear.

```
@export item_pool: dict
@export item_number: int
@export key_path: string

#Constructing the item_list
def _ready():
    item_list = []
    for item in item_pool: #For all items
        item_list += [item for x in range(item_pool[item])] #Adding on the amount relevant to
                                                               #the ratio of the item

def _input(event):
    if event.is_action_pressed("enter") and Area2D.overlaps_body("player"): #Check if player
                                                                           #within range and pressed button
        if Inventory.remove_item(key_path, 1) is bool: #Check if player has the key to unlock it
            for x in range(item_number):
                Inventory.add_item(item_list[randint(0, len(item_list)-1)])
            queue_free()
```

Door Script:

This consists of the variables and input function that checks if the right key is pressed then it checks if the

player is in the Area2D Node and if so will check if the player has the correct key perform the right action

```
@export change_scene: bool
@export scene_path: string
@export key_path: string

def _input(event):
    if event.is_action_pressed("enter") and Area2D.overlaps_body("player"): #Check if player
        within range and pressed button
            if Inventory.remove_item(key_path, 1) is bool: #Check if player has the key to unlock it
                if change_scene:
                    get_tree().change_scene_to_file(scene_path) #Change Scene
                else:
                    queue_free() #Disappear
```

2.10 Projectile Design

2.10.1 Overview

I will create two types of projectiles, one ranged type which will deal damage on impact and disappear and one area of effect which will deal damage on an enemy or the player entering it and spawn next to the player/enemy that casts it. These projectiles will allow me to fulfill criteria 2.4, 2.5, 2.6, 4.7 and be used for the creation of boss enemies in 4.8.

2.10.2 Ranged

This will have the damage and damage_type variables to be used to call other entities take_damage functions, a variable so it only impacts once called attacking and a speed to determine how fast it goes. It will be comprised of a CharacterBody2D node and a AnimatedSprite2D node which will play the default animation until collision.

Its physics process will handle movement in the direction of rotation (as projectiles can be fired in any direction) and handle collisions.

2.10.3 Area Of Effect

This will have the damage and damage_type variables to be used to call other entities take_damage functions and a time variable for how long it lasts. It will be comprised of an Area2D node and an AnimatedSprite2D node which will play the default animation.

The ready function will be used to await the timer timeout before queue_freeing the area.

The _on_body_entered function will be linked from the Area2D and will deal damage if the body is an enemy or the player.

2.10.4 Algorithms

_physics_process(delta):

For the ranged projectile to handle movement in rotation direction and collisions.

```
def _physics_process(delta):
    #Rotated Movement
    velocity.x = speed * cos(rotation)
    velocity.y = speed * sin(rotation)
    if not attacking:
        move_and_slide()
    #Collisions
    for i in range(get_slide_collision_count()): #Loops through collisions
        if not attacking:
            attacking = true
            collision = get_slide_collision(i)
            collider = collision.get_collider()
            if collider.is_in_group("player") or collider.is_in_group("enemies"): #Damages what
                it hits if its an enemy or the player
                collider.take_damage(damage, damage_type)
```

```

CollisionShape2D.disabled = true #Disable collision shape so cant block other
                                projectiles
AnimatedSprite2D.play("impact")
await AnimatedSprite2D.animation_finished #Wait for animation to finish
queue_free()

```

_ready():

Will set the area of effect to disappear after a certain time

```

def _ready():
    await get_tree().create_timer(time).timeout
    queue_free()

```

_on_body_entered(body):

This is called by the Area2D node upon a body entering it with that body passed as a parameter so we can make it take damage if it needs to.

```

def _on_body_entered(body):
    if body.is_in_group("enemies") or body.is_in_group("player"): # If its an enemy or player
                                                                it will damage It
        body.take_damage(damage, damage_type)

```

2.11 Enemy Design

2.11.1 Overview

For my basic enemies I have decided to go with different types of slimes representing different elements. The slimes will have animations and collisions aswell as a radius that they will detect the player and navigate towards them dealing damage upon impact. Each unique slime will deal a different damage type and have a different look.

2.11.2 Composition

The root node of the slimes will be a CharacterBody2D node to allow for a physics body that can be easily moved via the script. I will then have a CollisionShape2D for collision detection aswell as an Area2D node for detecting the player. It will contain an AnimatedSprite2D for the animations.

Identifier	Data Type	Justification
speed	Exported Integer	This allows slimes to have variable speeds to allow for difficulty increase.
health	Exported Integer	This allows for slimes to have variable healths to allow for difficulty increase.
damage	Exported Integer	This allows for slimes to deal variable damage to allow for difficulty increase.
damage_type	Exported String	This allows for slimes to deal different damage types to pose a different challenge.
direction	Vector2	This is used for direction to move in and the type of animation to play.
weaknesses	Exported List	Shows which damage_types to take more damage from.

2.11.3 Navigation

Upon researching I found the godot documentation on 2D navigation⁽⁶⁾ and decided to use the NavigationAgent2D node to utilise the A* algorithm, this means that I would need to add a navigation layer to my tilesheet to show the areas that the navigation agent can use. I decided to use a Timer node that autostarts and repeats and update the navigation path on the timeout so that the player can evade the slimes to a certain extent. Ontop of this I used a circular CollisionShape2D with and Area2D node to detect when the player is within a certain range and pathfind towards them.

2.11.4 Animation

I decided to add idle animations for all of the 4 cardinal directions aswell as idle and hurt animations. I used a get_animation() function to get the relevant animation based on the direction.

2.11.5 Projectile Enemies

There will be some enemies that will shoot a projectile instead of navigating in the direction given by the NavigationAgent2D so that the targetting would only update every couple seconds. These enemies will be non moving enemies.

2.11.6 Algorithms

`get_animation(animation_type):`

This gets the animation based on the type and direction.

```
def get_animation(animation_type: String):
    if abs(direction.x) > abs(direction.y):
        if direction.x > 0:
            return animation_type + "_r"
        else:
            return animation_type + "_l"
    else:
        if direction.y > 0:
            return animation_type + "_d"
        else:
            return animation_type + "_u"
```

`_ready():`

This is ran on addition to the scene tree to add the slime to the enemies group.

```
def _ready():
    add_to_group("enemies")
```

`_physics_process(delta):`

Melee Enemies:

This checks if the player is within the detection range and if so moves towards them aswell as handling animations and detecting if the slime collides with the player so that the player will be damaged.

```
def _physics_process(delta):
    move = false
    for body in Area2D.get_overlapping_bodies(): #Checking if player in the detection area
        if body.name == "Player":
            move = true
    if not animating: #If not playing a different animation
        if move: #If the slime can move
            direction = NavigationAgent2D.get_next_path_position().normalized() #Getting the
            #direction of the next point on the
            path
            velocity = direction * speed
            AnimatedSprite2D.play(get_animation("walk"))
        else:
            AnimatedSprite2D.play(get_animation("idle"))
    move_and_slide() #moving

    if can_attack: #If the attack cooldown is done
        for i in range(get_slide_collision_count()): #Loops through collisions
            collision = get_slide_collision(i)
            collider = collision.get_collider()
            if collider.is_in_group("player"): #Checks if collision is with the player
                collider.take_damage(damage, damage_type) #Deals damage
                can_attack=False
                AttackTimer.start() #Starts attack cooldown
```

Ranged Enemies:

This checks if the player is within detection range and if so will fire a projectile towards them.

```
def _physics_process(delta):
    var player_detected = false
    for body in Area2D.get_overlapping_bodies(): #Checking if the player is in the detection
        #Area
        if body.name == "Player":
```

```

        player_detected = true
if not animating: #If not playing a different animation
    AnimatedSprite2D.play(get_animation("idle"))
if player_detected and can_attack: # Will instantiate a projectile scene aimed at the
                                    # player if it can attack and detects the
                                    # player
    direction = NavigationAgent2D.get_next_path_position.normalized()
    var projectile = load(projectile_scene_path).instantiate()
    projectile.rotation_degrees = direction.angle()
    projectile.position = position + 20*direction
    projectile.damage = damage
    get_parent.add_child(projectile)
    can_attack = false
    AttackTimer.start() #Starts the attack cooldown

```

take_damage(damage, damage_type):

The take damage function will allow the enemies to take more or less damage based on weaknesses and update their health aswell as applying knockback and checking to see if the enemy should die.

```

def take_damage(damage, damage_type):
    player = get_tree().get_first_node_in_group("player")
    animating = true
    if damage_type in weaknesses: # If the enemy is weak to a specific damage type then they
                                    # will take more damage
        health -= 2*damage
    else:
        health -= damage
    velocity = - 25 * player.global_position.normalized() # Move away from the player for
                                                       # knockback
    if health <= 0:
        queue_free()
    else:
        AnimatedSprite2D.play(get_animation("hurt"))
        await AnimatedSprite2D.animation_finished
    animating = false

```

_on_navigation_timer_timeout():

This will run when the navigation timer runs out and only update the navigation then to allow the enemies to not have perfect tracking so the player can avoid them easier.

```

def _on_navigation_timer_timeout() -> void:
    player = get_tree().get_first_node_in_group("player")
    NavigationAgent2D.set_target_position(player.global_position)

```

_on_attack_timer_timeout():

Thus function will run when the attack timer ends (1 second after an attack) to allow the enemy to attack again.

```

def _on_attack_timer_timeout():
    can_attack = True

```

2.12 UI

2.12.1 Display Strings

In order to allow for better displaying of items I have decided to add a display string function to all items that will return nicely formatted key information about the item that can be displayed.

Weapon:

```

def display_string():
    return f"Weapon\nName: {resource_name}\nType: {weapon_type}\nDamage: {attack_power}\n
           Damage Type: {damage_type}\n Description:
           {description}"

```

Armour:

```
def display_string():
    return f"Armour\nName: {resource_name}\nType: {armour_type}\nDefense: {defense}\nDescription: {description}"
```

Charm:

```
def display_string():
    return f"Charm\nName: {resource_name}\nType: {charm_type}\nDescription: {description}"
```

Key:

```
def display_string():
    return f"Key\nName: {resource_name}\nDescription: {description}"
```

2.12.2 Inventory UI

The Inventory UI will be displayed upon pressing the E key (detected in the global script).

For the Inventory UI the important things to display are the stored items and the equipped items

For equipped items I decided to use labels displaying the items display strings.

For stored items I decided to use a ScrollContainer with a VBoxContainer and then append HBoxContainers with 4 buttons per container to display item display strings to create a 4 wide vertically scrolling system. I would have a selected script variable to be changed when a button is pressed and keep track of the last one pressed aswell as buttons to bin or equip the selected item.

2.12.3 Game UI

For the Game UI the important things to display are the player health and magic points aswell as the equipped weapon.

For the player health and magic points I have decided to use Progress Bars with custom textures to get the correct colours that have their maximum value set on going into the level and update each frame. These will aloow the players to see the percentage of their total health they have left.

For the weapon I have decided to display the display string in the bottom right corner. I will exclude the description of the weapon as this will take up too much screen space when displayed.

2.12.4 Algorithms

Inventory UI refresh():

This function will be called to setup the ui and refresh the ui every time an item is equipped or binned. It will set up the scrolling inventory aswell as the labells for equipped items.

```
def refresh():
    inventory = Database.get_stored_items()
    item_count = 0
    for child in ScrollContainer.VBoxContainer.get_children(): #Get rid of existing
                                                                HBoxContainers
        child.queue_free()
    for item in inventory: # Creates a button for each item in inventory with the display
                           string
        var button = Button.new()
        if item_count % 4 == 0:
            hbox = HBoxContainer.new()
            ScrollContainer.VBoxContainer.add_child(hbox)
            button.text = load(item["item_id"]).display_string() + f"\nAmount: {item["amount"]}"
            button.connect("pressed", _select.bind(item["item_id"]))
            button.custom_minimum_size = Vector2(250, 200)
            hbox.add_child(button)
            item_count += 1

    # Loads the equipped items display strings and displays them
    if Database.get_slot_value("weapon"):
        WeaponLabel.text = load(Database.get_slot_value("weapon")).display_string()
    if Database.get_slot_value("head"):
        HeadLabel.text = load(Database.get_slot_value("head")).display_string()
```

```

if Database.get_slot_value("chest"):
    ChestLabel.text = load(Database.get_slot_value("chest")).display_string()
if Database.get_slot_value("legs"):
    LegsLabel.text = load(Database.get_slot_value("legs")).display_string()
if Database.get_slot_value("charm_1"):
    Charm1Label.text = load(Database.get_slot_value("charm_1")).display_string()
if Database.get_slot_value("charm_2"):
    Charm2Label.text = load(Database.get_slot_value("charm_2")).display_string()

```

Inventory UI _select():, equip button and bin button

The select and button functions make use of script variables or existing inventory functions to perform their purposes.

```

def _select(item_id):
    selected = item_id

def _on_equip_button_pressed():
    if selected != "":
        Inventory.equip_item(selected)
        refresh()

def _on_bin_button_pressed():
    if selected != "":
        Database.remove_stored_item(selected)

```

Game UI script

The Game UI script will consist of a _ready function that sets the maximum player health and magic points, an update_ui function that is called in the _ready function and a _process function that is called every frame to update the current player health and magic points.

```

def _ready():
    player = get_tree().get_first_node_in_group("player")
    HealthBar.max_value = player.health
    MagicBar.max_value = player.mana
    update_ui()

def _process(delta: float) -> void:
    player = get_tree().get_first_node_in_group("player")
    HealthBar.value = player.health
    MagicBar.value = player.mana

def update_ui():
    if Database.get_slot_value("weapon"):
        weapon = load(Database.get_slot_value("weapon"))
        WeaponLabel.text = weapon.display_string()

```

2.13 Procedural Generation Design

2.13.1 Overview

3 Development & Testing

3.1 Database Development

I used a global autoloaded script database.gd in order to implement all of my functions for handling the database. Upon testing the functions I realised that the reset_password query was incorrect as it says UPDATE TABLE instead of just update.

I added all the prepared queries as private variables with strings in order to use db.query_with_bindings to sanitise and substitute inputs aswell as run the queries. This function would output wether the query succeeded or failed.

I then could use db.query_result in order to get the results of the query.

3.1.1 _ready()

```

func _ready() -> void:
    db.path = "res://game_data.db"
    db.open_db()
    if not db.query(_create_table_users):
        print("Error: users table unable to be created")
        return
    if not db.query(_create_table_save_data):
        print("Error: save_data table unable to be created")
        return
    if not db.query(_create_table_stored_items):
        print("Error: stored_items table unable to be created")
        return
    db.query("PRAGMA foreign_keys = ON;")

```

Figure 13: _ready

In the database script db is declared using *SQLLite.new()*. I use the script to load the database and make sure all the necessary tables are present.

I also made it so that the database is closed when the script exits the tree so as to make sure all the data is saved properly using godot's *_exit_tree()* function.

3.1.2 Hashing

```

#Function for generating salt
func gen_salt() -> String:
    var salt = "string"
    var x = randi_range(5,10)
    for i in range(2**x):
        salt = j_hash(salt,str(i*randi_range(1,10)))
    return salt

```

Figure 14: gen_salt

```

#Function for hashing a password or challenge answer
func j_hash(string, salt):
    var hashedString = string
    #Repeating a consistent but unpredictable amount of times
    #On even rounds the password is sandwiched on odd rounds the salt is sandwiched
    #Alternating the use of sha256 and md5 but making sure to end on sha256 so the hash is a predictable length.
    for x in range(1,6*len(string)+1):
        if x % 2 == 0:
            hashedString = (salt.substr(x,hashedString.length()-x)+hashedString+salt.substr(0,x)).md5_text().sha256_text()
        else:
            hashedString = (hashedString.substr(0,x)+salt+hashedString.substr(x,hashedString.length()-x)).sha256_text().md5_text()
    return hashedString

```

Figure 15: hash

The hash and gen_salt functions implementation followed the pseudocode pretty faithfully apart from the fact I decided to not hash the number turned into a string as the salt doesn't have to be a certain length for the code to work. I also decided to times the number by a random integer to increase randomness and the number of possible salts as before there was not enough different salts to properly prevent rainbow tables.

3.1.3 Login Functions

```

func login(username,password):
    >I db.query_with_bindings(_get_user_data,[username]) # Getting user data
    >I if len(db.query_result) == 0: # If user doesnt exist
    >I     >I     return "InvalidUsernameError"
    >I     var user_data = db.query_result[0]
    >I     var hashed_password = j_hash(password,user_data["salt"])
    >I if hashed_password == user_data["password"]: # Checking password hash against stored hash
    >I     >I     current_user_id = user_data["user_id"]
    >I     >I     return true
    >I return "IncorrectPasswordError" # If password doesnt match

```

Figure 16: login

This algorithm is a copy of the design algorithm just using godot's relevant functions instead. I further saved the current_user_id for ease of future queries.

```

#Function for creating a user
func add_user(username, password, answer):
    >I var salt = gen_salt() #Generating new salt
    >I var hashedPassword = j_hash(password, salt)
    >I var hashedAnswer = j_hash(answer, salt)
    >I if not db.query_with_bindings(_add_new_user,[username,hashedPassword,hashedAnswer,salt]): #Tries to add user
    >I     >I     return "InvalidUsernameError" #If user cannot be added then the username must be invalid
    >I return true

```

Figure 17: add_user

This algorithm is a copy of the design algorithm just using godot's relevant functions instead.

```

func reset_password(username, answer, password):
    >I db.query_with_bindings(_get_user_data,[username]) # Getting user data
    >I if len(db.query_result) == 0: # If user doesnt exist
    >I     >I     return "InvalidUsernameError"
    >I     var user_data = db.query_result[0]
    >I     var hashed_answer = j_hash(password,user_data["salt"])
    >I     if hashed_answer == user_data["answer"]: # Checking the answer hash against the stored hash
    >I     >I     db.query_with_bindings(_reset_password,[password,username])
    >I     >I     return true
    >I return "IncorrectAnswerError" # If answer doesnt match

```

Figure 18: reset_password

This algorithm is a copy of the design algorithm just using godot's relevant functions instead.

3.1.4 Testing

```

func test_database():
    #Criteria 6.
    print("6.1:")
    print((len(db.gen_salt()) == 64) and (db.gen_salt() != db.gen_salt())) # Test 6.1.1
    print(len(db.j_hash("password", "salt")) == 64) # Test 6.1.2
    print(db.j_hash("password", "salt") == db.j_hash("password", "salt")) # Test 6.1.3
    print(db.j_hash("password", "salt") != db.j_hash("Password", "salt")) # Test 6.1.4
    print("6.3:")
    print(db.add_user("Hyrule", "Password", "Answer")) # Test 6.3.1
    print(db.add_user("Hyrule", "Password", "Answer") == "InvalidUsernameError") # Test 6.3.2
    print("6.7,6.8,6.10")
    print(db.login("Hyrule", "Password") == "InvalidUsernameError") # Test 6.7.1
    print(db.login("Hyrule", "Password")) # Test 6.7.2
    print(db.reset_password("Hyrule", "Answer", "password") == "InvalidUsernameError") # Test 6.8.1
    print(db.reset_password("Hyrule", "answer", "password") == "IncorrectAnswerError") # Test 6.8.2
    print(db.reset_password("Hyrule", "Answer", "password")) # Test 6.8.3
    print(db.login("Hyrule", "Password") == "IncorrectPasswordError") # Test 6.7.3

```

Figure 19: test_database.gd

This testing function was implemented as detailed in my testing plan that I designed.

Test #	Function	Parameters	Expected Outcome	Actual Outcome
6.1.1	gen_salt()		random 256 bit hex string	Success
6.1.2	hash()	"password", "salt"	random 256 bit hex string	Success
6.1.3	hash()	"password", "salt"	the same random 256 bit hex string	Success
6.1.2	hash()	"Password", "salt"	random 256 bit hex string different from before	Success
6.3.1	add_user()	"Hyrule", "Password", "Answer"	True	Success
6.3.2	add_user()	"Hyrule", "Password", "Answer"	"InvalidUsernameError" as a user already exists with that username	Success
6.6.1	login()	"Hyrule", "Password"	"InvalidUsernameError"	Success
6.6.2	login()	"Hyrule", "Password"	True	Success
6.7.1	reset_password()	"Hyrule", "Answer", "password"	"InvalidUsernameError"	Success
6.7.2	reset_password()	"Hyrule", "answer", "password"	"IncorrectAnswerError"	Success
6.7.3	reset_password()	"Hyrule", "Answer", "password"	True	Success
6.6.3	login()	"Hyrule", "Password"	"IncorrectPasswordError"	Success

Upon Testing I realised I needed a delete user function so that the user can be deleted.

I designed a simple SQL query and created a function to delete users.

```
var _delete_user = """
DELETE FROM users
WHERE username = ?;
"""
```

Figure 20: _delete_user

```
func delete_user(username, password):
    db.query_with_bindings(_get_user_data,[username])
    if len(db.query_result) == 0: # If user doesn't exist
        return "InvalidUsernameError"
    var user_data = db.query_result[0]
    var hashed_password = j_hash(password,user_data["salt"])
    if hashed_password == user_data["password"]:# Checking password hash against stored hash
        db.query_with_bindings(_delete_user,[username]) # Deleting User
        return true
    return "IncorrectPasswordError" # If password doesn't match
```

Figure 21: delete_user

Test #	Function	Parameters	Expected Outcome	Actual Outcome
6.9.1	delete_user()	"Hyrule", "Password"	IncorrectPasswordError	Success
6.9.2	delete_user()	"Hyrule", "password"	True	Success
6.6.4	login()	"Hyrule", "password"	InvalidUsernameError	Success

```
print(db.delete_user("Hyrule", "Password") == "IncorrectPasswordError") # Test 6.10.1
print(db.delete_user("Hyrule", "password")) # Test 6.10.2
print(db.reset_password("Hyrule", "Answer", "password") == "InvalidUsernameError") # Test 6.7.4
```

Figure 22: Test Remove User

Upon Testing the remove functions in the database I have updated the table queries to add ON DELETE CASCADE so that if the user gets deleted all their saves get deleted.

3.2 Login System Development

I used godot's inbuilt label, button and line edit node's in order to construct my forms. To each form I added an extra label in order to display Errors to the user.

I linked the buttons pressed signals to a script in order to determine what happens when the button is pressed and used variables to fetch and store the data from the line edit nodes.

I used node2ds in order to create groups of the nodes for more organisation and I kept the form layout mostly the same without some of the fancier unnecessary design elements from the mockup forms.

3.2.1 Login Form



Figure 23: Layout

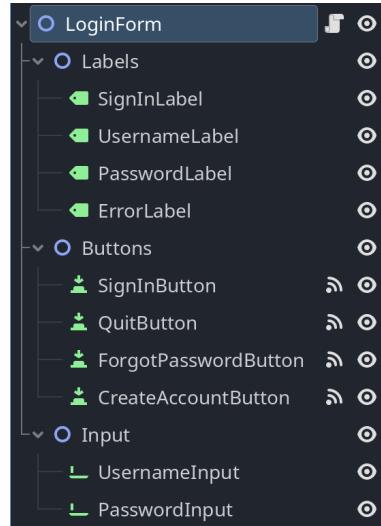


Figure 24: Structure

The layout and structure are as designed but I decided to group all the Labels, Buttons and Input Boxes using Node2D to have a neater structure.

```

    func _on_forgot_password_button_pressed() -> void:
        get_tree().change_scene_to_file("res://scenes/reset_password_form.tscn")

    func _on_create_account_button_pressed() -> void:
        get_tree().change_scene_to_file("res://scenes/menu/create_account_form.tscn")

    func _on_quit_button_pressed() -> void:
        global.quit()

```

Figure 25: button_pressed functions

These button functions are pretty simple as I only need to change scene or quit the game.

```

    func _on_sign_in_button_pressed() -> void:
        var username = $Input/UsernameInput.text
        var password = $Input/PasswordInput.text
        var success = database.login(username, password)
        if not (typeof(success) == TYPE_BOOL and success == true):
            if success == "InvalidUsernameError":
                $Labels/ErrorLabel.text = "Invalid Username"
            elif success == "IncorrectPasswordError":
                $Labels/ErrorLabel.text = "Incorrect Password"
            else:
                get_tree().change_scene_to_file("res://scenes/menu/save_menu.tscn")

```

Figure 26: _on_sign_in_button_pressed

This is the function for when the sign in button is pressed it fetches the data and tries to login, displaying any errors it gets. If the login is successful then it switches the scene to the save_menu scene.

3.2.2 Reset Password Form

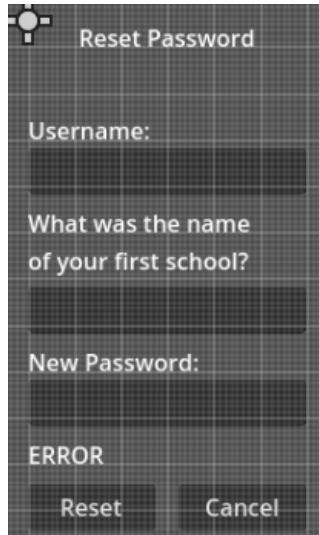


Figure 27: Layout

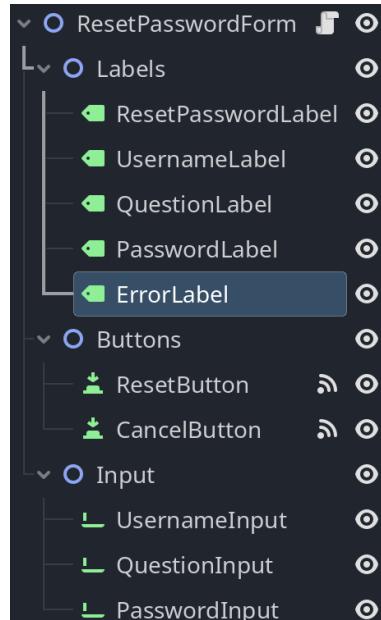


Figure 28: Structure

The layout and structure are as designed but I decided to group all the Labels, Buttons and Input Boxes using Node2D to have a neater structure.

```
> func _on_cancel_button_pressed() -> void:
>     get_tree().change_scene_to_file("res://scenes/menu/login_form.tscn")
```

Figure 29: _on_cancel_button_pressed

This button function is pretty simple as I only need to change scene back to the login form.

```
<> func _on_reset_button_pressed() -> void:
<>     var username = $Input/UsernameInput.text
<>     var answer = $Input/QuestionInput.text
<>     var password = $Input/PasswordInput.text
<>     var success = database.reset_password(username, answer, password)
<>     if not (typeof(success) == TYPE_BOOL and success == true):
<>         if success == "InvalidUsernameError":
<>             $Labels/ErrorLabel.text = "Invalid Username"
<>         elif success == "IncorrectAnswerError":
<>             $Labels/ErrorLabel.text = "Incorrect Answer"
<>         else:
<>             get_tree().change_scene_to_file("res://scenes/menu/login_form.tscn")
```

Figure 30: _on_reset_password_button_pressed

This is the function for when the reset password button is pressed it fetches the data and tries to reset the password, displaying any errors it gets. If the reset is successful then it switches the scene to the login_form scene.

3.2.3 Create Account Form

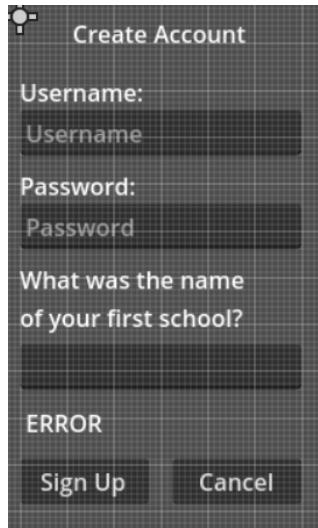


Figure 31: Layout

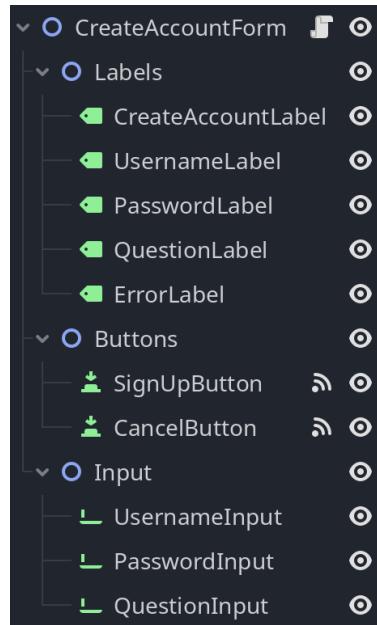


Figure 32: Structure

The layout and structure are as designed but I decided to group all the Labels, Buttons and Input Boxes using Node2D to have a neater structure.

```

    func _on_cancel_button_pressed() -> void:
        get_tree().change_scene_to_file("res://scenes/menu/login_form.tscn")
  
```

Figure 33: _on_cancel_button_pressed

This button function is pretty simple as I only need to change scene back to the login form.

```

    func _on_sign_up_button_pressed() -> void:
        var username = $Input/UsernameInput.text
        var password = $Input/PasswordInput.text
        var answer = $Input/QuestionInput.text
        var success = database.add_user(username, password, answer)
        if not (typeof(success) == TYPE_BOOL and success == true):
            if success == "InvalidUsernameError":
                $Labels/ErrorLabel.text = "Invalid Username"
            else:
                get_tree().change_scene_to_file("res://scenes/menu/login_form.tscn")
  
```

Figure 34: _on_sign_up_button_pressed

This is the function for when the create account button is pressed it fetches the data and tries to create the account, displaying any errors it gets. If the reset is successful then it switches the scene to the login_form scene.

3.3 Save Select System

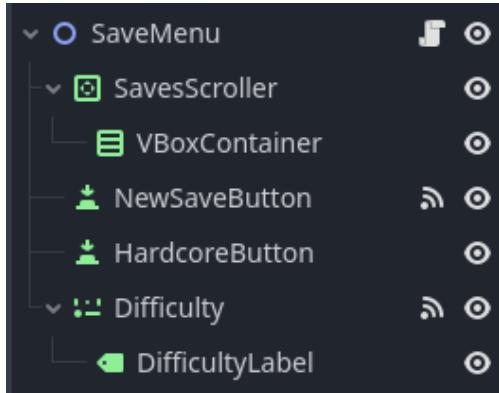


Figure 35: Structure

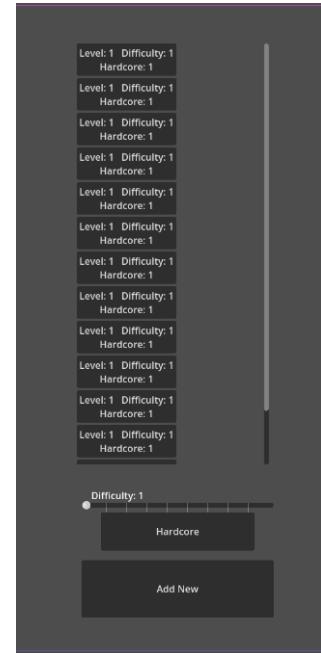


Figure 36: Layout

The structure is as was described with the VBoxContainer in the ScrollContainer to make sure the save buttons are only stacked vertically. There is also a label attached to the Difficulty slider.

The layout is simple with the save list in the center and scrollbar next to it and the add new elements underneath.

```
extends Node2D

#Function to load the list
func _load_list():
    var save_data_list = Database.get_user_save_data()
    for save_data in save_data_list:
        var button = Button.new()
        button.text = "Level: %s \t Difficulty: %s\nHardcore: %s" % [save_data["level"], save_data["difficulty"], save_data["hardcore"]]
        button.connect("pressed",_on_save_selected.bind(save_data))
        $SavesScroller/VBoxContainer.add_child(button)

    # Called when the node enters the scene tree for the first time.
func _ready() -> void:
    _load_list()

func _on_save_selected(save_data):
    Database.current_save_id = save_data["save_id"]
    #Link to current level when made

func _on_difficulty_drag-ended(value_changed: bool) -> void:
    $Difficulty/DifficultyLabel.text = "Difficulty: " + str($Difficulty.value)

func _on_new_save_button_pressed() -> void:
    Database.add_new_save_data($Difficulty.value,$HardcoreButton.button_pressed)
    _load_list()
```

Figure 37: Script

This script is similar to pseudocode with the string formatting changed to work in godot and the code to load the save list moved to another function so the save list can be reloaded every time a new save is added as well as a function linked to the Difficulty slider to update the Difficulty label.

3.4 Item Development

I will use resource scripts in order to implement the item classes and I will export the variables so that when I create new resources I can set the values.

In order to export the armour_type, body_part, charm_type, weapon_type and damage_type I will use an enum as it can only take one of the values in the list. This means the variables will take the form of an integer instead of a string.

3.4.1 Folder Structure

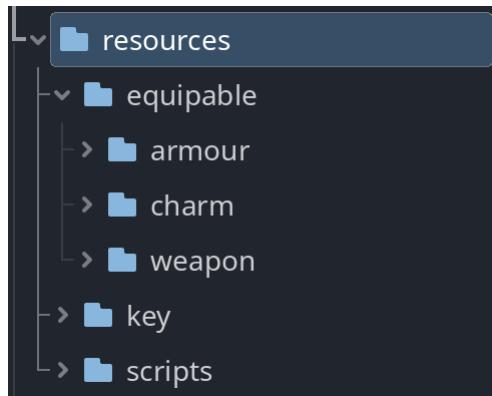


Figure 38: Folder Structure

I added more folders in order to organise the items into their groups aswell as keeping the resource scripts in a scripts folder.

3.4.2 Item

```

1  extends Resource
2
3  class_name Item
4
5  @export var stackable: bool
6  @export var description: String
7  @export var icon: Texture
  
```

Figure 39: Item Script

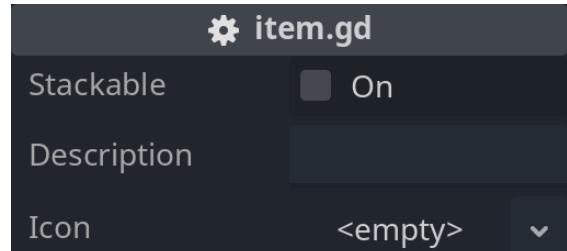


Figure 40: Item Exports

This shows the Item script and exported variables which I can set for each instance of that class including instances of classes that inherit from item.

I chose to remove the item_id as it seemed complicated to autoincrement it and enforce uniqueness and so I will store the file path in the item_id column in the database instead of an integer and so I updated the create_table_stored_items query in order to allow that.

3.4.3 Equipable

```

1  extends Item
2
3  class_name Equipable
4
5  @export var stat_boosts: Dictionary = {}
6
7  func _init():
8    stackable = false

```

Figure 41: Equipable Script



Figure 42: Equipable Exports

This shows the Equipable script and exported variables which I can set in any instance of this class or classes that inherit from it. I am using a dictionary to store stat boosts where the key is the stat and the value is the boost and these pairs can be added through the inspector. I set stackable to false by default as Equipable items will not be stackable.

3.4.4 Armour

```

1  extends Equipable
2
3  class_name Armour
4
5  @export var defense: int
6  @export enum("Light", "Heavy") var armour_type: int
7  @export enum("Head", "Chest", "Legs") var body_part: int
8  @export var set_id: int

```

Figure 43: Armour Script

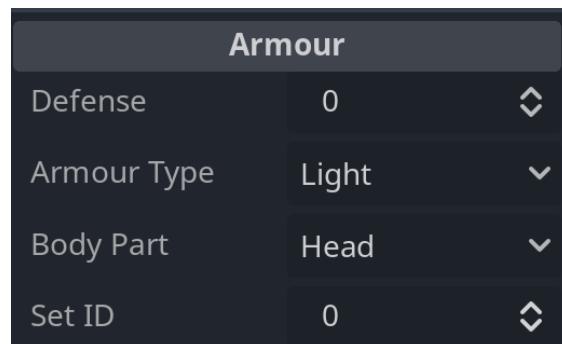


Figure 44: Armour Exports

This shows the Armour script and exported variables which I can set in any instance. I used an enum to represent the types of armour and body parts which it can be equipped on.

3.4.5 Charm

```

1  extends Equipable
2
3  class_name Charm
4
5  @export enum("Ice", "Fire", "Cursed", "Divine", "Poison") var charm_type: int

```

Figure 45: Charm Script

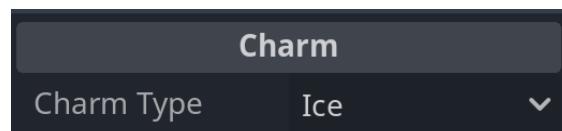


Figure 46: Charm Exports

This shows the Charm script and exported variables which I can set in any instance. I used an enum to represent the different charm types as you can only have one of them.

3.4.6 Weapon

```

1  extends Equipable
2
3  class_name Weapon
4
5  @export_enum("Ranged", "Magic", "Melee") var weapon_type: int
6  @export var attack_power: int
7  @export var attack_range: int
8  @export_enum("Ice", "Fire", "Cursed", "Divine", "Poison") var damage_type: int

```

Figure 47: Weapon Script



Figure 48: Weapon Exports

This shows the Weapon script and exported variables which I can set in any instance. I used an enum to represent the different weapon types and damage types so you can only select one

```

▼ func attack(owner, direction: Vector2):
    #Load the hurtbox scene
    var hurtbox_scene = load(hurtbox_scene_path)
    var hurtbox_instance = hurtbox_scene.instantiate()
    hurtbox_instance.range = attack_range
    hurtbox_instance.damage = attack_power
    hurtbox_instance.damage_type = damage_type
    hurtbox_instance.rotation = direction.angle()
    #Add child
    owner.add_child(hurtbox_instance)
    #Hitbox lasts for a tenth of a second
    await owner.get_tree().create_timer(0.1).timeout
    hurtbox_instance.queue_free()

```

Figure 49: Weapon attack() function

This shows the weapon attack script that I implemented I changed the name from hitbox to hurtbox as that is more accurate and I had to use a timer in order to sleep for an amount of time that the hitbox will last for.

3.4.7 Key

```

1  extends "res://resources/scripts/item.gd"
2
3  class_name Key
4
5  @export var key_id: String

```

Figure 50: Key Script

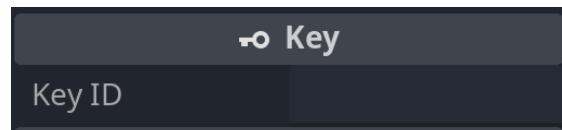


Figure 51: Key Exports

This shows the Key script and exported variables which I can set in any instance. The key ID will correspond to a door id and unlock that door.

3.4.8 Revision

Upon starting the inventory development I have decided to switch from enums to strings as the enums make it more complicated to access the string associated with the number.

3.5 Inventory Development

I used a separate autoloaded script inventory.gd in order to implement the inventory functions.

I added functions to the database script in order to utilise the current_save_id script variable so that I don't have to input the variable every time I want to run a save_data or stored_items query. The functions execute the query passing in the current_save_id and return the query result.

3.5.1 Add Item

```

func add_item(item_id, amount):
    var item = load(item_id) # Loads the item
    if Database.count_stored_items() > max_inventory_size and not(item.stackable): # Full Inventory
        return "FullInventoryError"
    else :
        # Checks if you can stack the item and either adds a new entry or stacks it
        if len(Database.get_stored_item_amount(item_id)) != 0 and item.stackable: # If the item is in the database
            Database.update_stored_item_amount(amount, item_id)
        else :
            Database.add_stored_item(item_id, amount)
    return true

```

Figure 52: add_item()

The add_item function stayed mostly faithful to the pseudocode except I moved stuff around for clarity.

3.5.2 Remove Item

```

func remove_item(item_id, amount):
    var amount_stored = Database.get_stored_item_amount(item_id)
    if len(amount_stored) != 0: # If the item is in the database
        amount_stored = amount_stored[0]["amount"]
        if amount_stored < amount: # Not enough items
            return "ItemQuantityError"
        elif amount_stored == amount: # Exactly enough items
            Database.remove_stored_item(item_id)
        else :
            Database.update_stored_item_amount(-amount, item_id) # Removes the amount of that item
    return true # Indicates that it was successful
    return "ItemQuantityError"

```

Figure 53: remove.item()

The remove_item function is mostly the same as the pseudocode except I extracted some of the query data so I don't end up running repeat queries.

3.5.3 Unequip Item

```
func unequip_item(slot):
    # Gets the slot value
    var value = Database.get_slot_value(slot)
    # Checks if there is an item to unequip
    if value != null:
        if (add_item(value, 1) == "FullInventoryError"): # Adds the item back to the stored_items/
            return "FullInventoryError"
        Database.set_slot_value(slot, null) # Sets the slot back to null
    return true
return true # If there is no item to unequip we have succeeded
```

Figure 54: unequip_item()

The unequip_item function is again close to the pseudocode except I extracted repeat queries to a variable.

3.5.4 Equip Item

```
func equip_item(item_id):
    var slot: String
    var item = load(item_id) # Loads the item
    # Checks if the item is Equipable
    if not(item is Equipable):
        return false
    # Gets the slot to equip it into
    if item is Armour:
        slot = item.body_part
    elif item is Weapon:
        slot = "weapon"
    else:
        if Database.get_slot_value("charm_1") == null:
            slot = "charm_1"
        else:
            slot = "charm_2"
    remove_item(item_id,1)
    var success = unequip_item(slot) # Checks the success of unequipping the item
    if not(success is bool) and success == "FullInventoryError":
        add_item(item_id,1)
    return "FullInventoryError"
    Database.set_slot_value(slot, item_id) # Equips the item
    return true
```

Figure 55: equip_item()

In the equip item function I decided to simplify the process of deciding which charm slot as it was unnecessarily complex and I also added a check for if the inventory is full making sure to still accept it if equipping the item leaves just enough room in the inventory.

3.5.5 Testing

```
func test_inventory():
>| Database.add_user("test", "password", "answer")
>| Database.login("test", "password")
>| Database.add_new_save_data(1,true)
>| Database.current_save_id = 1
>| #Criteria 12
>| print(Inventory.add_item("res://utils/test_item.tres", 2)) # Test 12.5.1
>| print(Inventory.item_amount("res://utils/test_item.tres") == 2)
>| print(Inventory.add_item("res://utils/test_item.tres", 3)) # Test 12.5.2
>| Inventory.max_inventory_size = 1
>| print(Inventory.add_item("res://utils/test_weapon.tres", 1) == "FullInventoryError") # Test 12.5.3
>| print(Inventory.item_amount("res://utils/test_item.tres") == 5)
>| print(Inventory.remove_item("res://utils/test_item.tres",2)) # Test 12.5.4
>| print(Inventory.item_amount("res://utils/test_item.tres") == 3)
>| print(Inventory.remove_item("res://utils/test_item.tres",10) == "ItemQuantityError") # Test 12.5.5
>| print(Inventory.remove_item("res://utils/test_item.tres",3)) # Test 12.5.6
>| print(Inventory.item_amount("res://utils/test_item.tres") == 0)
>| print(Inventory.remove_item("res://utils/test_item.tres",2) == "ItemQuantityError") # Test 12.5.7
>| print(Inventory.unequip_item("head")) # Test 12.4.1
>| Inventory.add_item("res://utils/test_helmet.tres",1) #Test 12.4.2
>| print(Inventory.equip_item("res://utils/test_helmet.tres"))
>| print(Database.get_slot_value("head") == "res://utils/test_helmet.tres")
>| print(Inventory.item_amount("res://utils/test_helmet.tres") == 0)
>| Inventory.add_item("res://utils/test_helmet2.tres",1) # Test 12.4.3
>| print(Inventory.equip_item("res://utils/test_helmet2.tres"))
>| print(Inventory.item_amount("res://utils/test_helmet.tres") == 1)
>| print(Inventory.unequip_item("head") == "FullInventoryError") # Test 12.4.4
>| Inventory.remove_item("res://utils/test_helmet.tres",1) # Test 12.4.5
>| print(Inventory.unequip_item("head"))
```

Figure 56: test_inventory()

I added the relevant test items in order to test the inventory functions with this script which I ran.

Test #	Function	Parameters	Expected Outcome	Actual Outcome
12.5.1	add_item()	"test_item.tres", 2	Adds test item to the stored_items table.	Success
12.5.2	add_item()	"test_item.tres", 3	As the item already exists it should add 3 to the amount.	Success
12.5.3	add_item()	"test_weapon.tres", 1	As in the testing environment the max inventory size will be 1 and this should return "FullInventoryError"	Fail
12.5.4	remove_item()	"test_item.tres", 2	As more than the amount of the item is in the inventory it should subtract 2.	Success
12.5.5	remove_item()	"test_item.tres", 10	"ItemQuantityError" as there isn't enough of the item in the database	Success
12.5.6	remove_item()	"test_item.tres", 3	As exactly the amount is in the database the item entry should get removed.	Success
12.5.7	remove_item()	"test_item.tres", 2	"ItemQuantityError" as there isn't any of the item in the database	Success
12.4.1	unequip_item()	"head"	True and the head slot should remain as NULL	Fail
12.4.2	equip_item()	"test_helmet.tres"	True and the head slot should become "test_helmet.tres"	Success
12.4.3	equip_item()	"test_helmet_2.tres"	True and the head slot should become "test_helmet.tres"	Success
12.4.4	unequip_item()	"head"	"FullInventoryError"	Success
12.4.5	unequip_item()	"head"	True as I will empty the inventory and the head should be NULL and the inventory should contain the helmet.	Success

The add_item function failed to return "FullInventoryError" as it only checked if the item wasn't stackable not if it wasn't stackable and already stored so I updated the script.

```

  func add_item (item_id, amount):
    var item = load(item_id) # Loads the item
    if Database.count_stored_items() >= max_inventory_size and not(item.stackable and item_amount(item_id) != 0):
      return "FullInventoryError"
    else :
      print("hi")
      # Checks if you can stack the item and either adds a new entry or stacks it
      if item_amount(item_id) != 0 and item.stackable: # If the item is in the database
        Database.update_stored_item_amount(amount, item_id)
      else :
        Database.add_stored_item(item_id, amount)
    return true

```

Figure 57: add_item() fixed

The remove_item failed due to a syntax error with the SQL statement so I edited the get_slot_value function to query for all values and then look it up I also updated the set_slot_value function to query the slot using a match case rather than bindings.

```

func get_slot_value(slot):
    db.query_with_bindings(_.get_slot_values, [current_user_id, current_save_id])
    print(db.query_result)
    if len(db.query_result) == 0:
        return null
    return db.query_result[0][slot]

```

Figure 58: get_slot_value() fixed

```

func set_slot_value(slot, item_id):
    match slot:
        "head": db.query_with_bindings(_.set_head_value, [item_id, current_save_id])
        "chest": db.query_with_bindings(_.set_chest_value, [item_id, current_save_id])
        "legs": db.query_with_bindings(_.set_legs_value, [item_id, current_save_id])
        "weapon": db.query_with_bindings(_.set_weapon_value, [item_id, current_save_id])
        "charm_1": db.query_with_bindings(_.set_charm_1_value, [item_id, current_save_id])
        "charm_2": db.query_with_bindings(_.set_charm_2_value, [item_id, current_save_id])
    return db.query_result

```

Figure 59: set_slot_value() fixed

The unequip_item function failed due to not checking if success is a boolean before comparing it so I amended it.

```

func unequip_item(slot):
    # Gets the slot value
    var value = Database.get_slot_value(slot)
    # Checks if there is an item to unequip
    if value != null:
        var success = add_item(value, 1)
        if (not(success is bool)) and success == "FullInventoryError": #
            return "FullInventoryError"
        Database.set_slot_value(slot, null) # Sets the slot back to null
        return true
    return true # If there is no item to unequip we have succeeded

```

Figure 60: unequip_item() fixed

Retesting:

Test #	Function	Parameters	Expected Outcome	Actual Outcome
12.5.1	add_item()	"test_item.tres", 2	Adds test item to the stored_items table.	Success
12.5.2	add_item()	"test_item.tres", 3	As the item already exists it should add 3 to the amount.	Success
12.5.3	add_item()	"test_weapon.tres", 1	As in the testing environment the max inventory size will be 1 and this should return "FullInventoryError"	Success
12.5.4	remove_item()	"test_item.tres", 2	As more than the amount of the item is in the inventory it should subtract 2.	Success
12.5.5	remove_item()	"test_item.tres", 10	"ItemQuantityError" as there isn't enough of the item in the database	Success
12.5.6	remove_item()	"test_item.tres", 3	As exactly the amount is in the database the item entry should get removed.	Success
12.5.7	remove_item()	"test_item.tres", 2	"ItemQuantityError" as there isn't any of the item in the database	Success
12.4.1	unequip_item()	"head"	True and the head slot should remain as NULL	Success
12.4.2	equip_item()	"test_helmet.tres"	True and the head slot should become "test_helmet.tres"	Success
12.4.3	equip_item()	"test_helmet_2.tres"	True and the head slot should become "test_helmet.tres"	Success
12.4.4	unequip_item()	"head"	"FullInventoryError"	Success
12.4.5	unequip_item()	"head"	True as I will empty the inventory and the head should be NULL and the inventory should contain the helmet.	Success

All the tests came out as a success so that concludes my testing.

3.6 Hurtbox Development

3.6.1 Layout

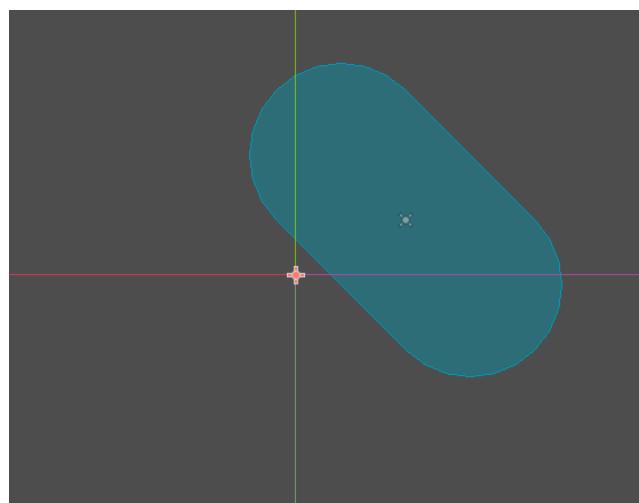


Figure 61: HurtBox Layout

I made the hurtbox like this as the center of the area2d node (the cross) can rotate allowing the actual collisionshape to rotate around the player depending on the direction of attack.

3.6.2 Script

```
extends Area2D

var damage: int
var damage_type: String
var range: int

func _on_body_entered(body: Node2D) -> void:
    if body.is_in_group("enemies"): # If its an enemy damages it
        body.take_damage(damage, damage_type)
```

Figure 62: Hurtbox Script

I changed the script from using the ready function to running every time a body enters the hurtbox as it allows the hurtbox to work for the duration of its existence rather than just at the start. Other than that the script is the same.

3.7 Player Development

3.7.1 Layout and Structure

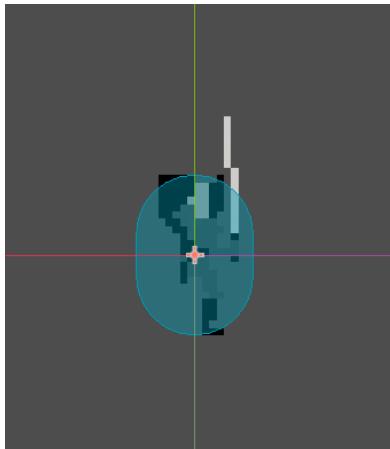


Figure 63: Layout

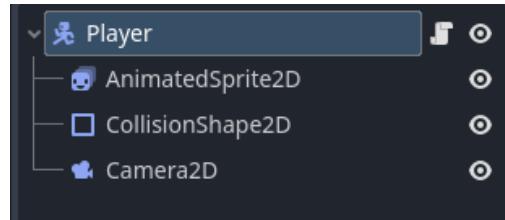


Figure 64: Structure

The structure is the same as was described in the class diagram and the layout is as such so that the player can interact with walls and enemy hits can register it.

3.7.2 _physics_process(delta):

```

    func _physics_process(delta: float) -> void:
        # Get the direction
        var direction = Vector2(Input.get_axis("left", "right"), Input.get_axis("up", "down"))
        # Velocity
        velocity = direction.normalized() * SPEED
        # Moving/Idling if its not already animating
        if not animating:
            if direction:
                last_direction = direction
                $AnimatedSprite2D.play(get_animation("walk"))
            else:
                $AnimatedSprite2D.play(get_animation("idle"))
                move_and_slide()

```

Figure 65: _physics_process():

I decided to add an animating flag for use in this script that will be flagged when animations that cannot be interrupted are playing (e.g. attacks) so that the player will not move or switch animations during that. Other than that the function is the same as the designed function with a slightly different method of getting direction.

3.7.3 Player Animation

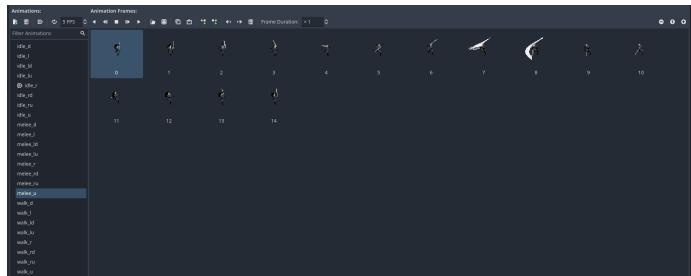


Figure 66: Animations

```

func get_animation(animation_type: String):
    var anim = animation_type + "_"
    if last_direction.x:
        if last_direction.x == 1:
            anim += 'r'
        else:
            anim += 'l'
    if last_direction.y:
        if last_direction.y == 1:
            anim += 'd'
        else:
            anim += 'u'
    return anim

```

Figure 67: get_animation():

I added the animation frames into separate animations in the Player's animationPlayer naming them such that the different directional animation names can be got using the get_animation() function.

3.7.4 Player Attack

```

    func _input(event: InputEvent) -> void:
        if event.is_action_pressed("attack"):
            attack()

    func attack():
        if not animating:
            animating = true
            $AnimatedSprite2D.play(get_animation("melee"))
            load(Database.get_slot_value("weapon")).attack(self, last_direction)
            await $AnimatedSprite2D.animation_finished
            animating = false

```

Figure 68: Player Attack

I added code to the input function to call the player's attack function if the attack action is pressed which mostly does the same as the planned script except for setting the animating flag to true until it finishes animating to prevent the player from being able to attack twice or walk while attacking.

3.8 TileMap Development

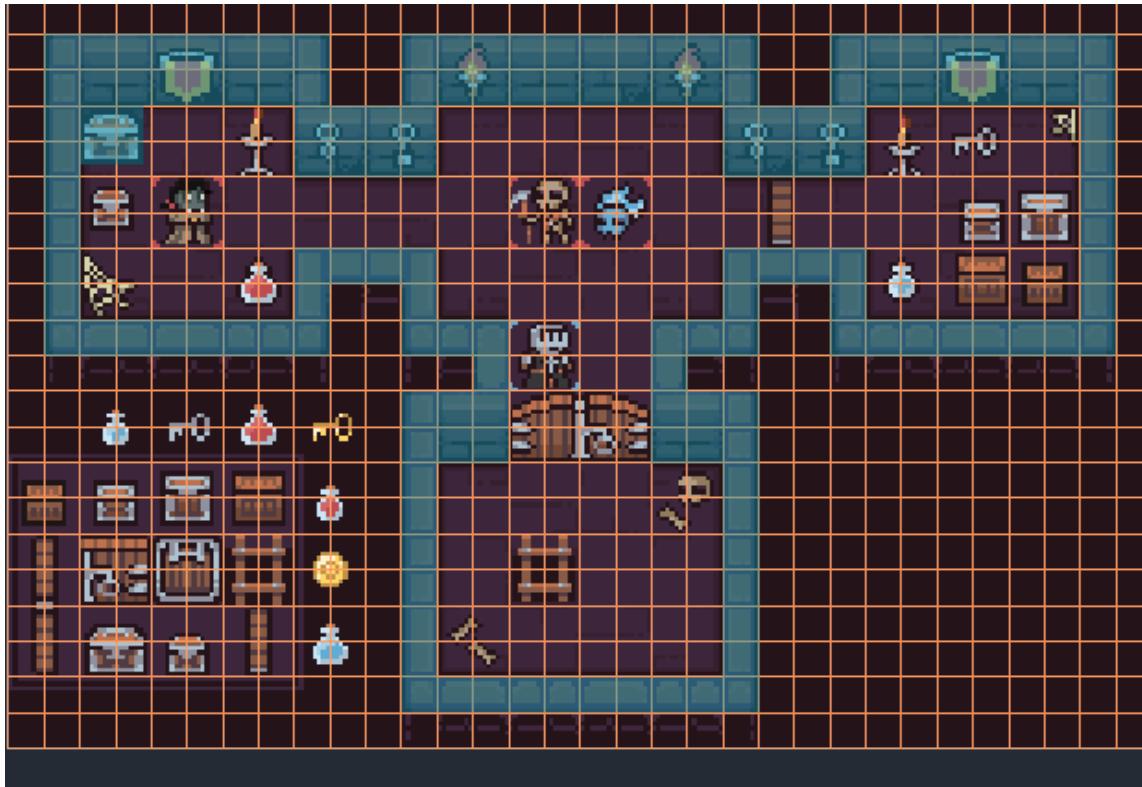


Figure 69: Physics Layer on TileMap

I added a TileMap using Godot's TileMap node and a free dungeon tileset painting a physics layer on the walls so that the player and enemies will collide with them. I can add this as a child to any scene and use it to place individual tiles and build level/room structures. I only added physics layers to the wall and floor tiles as I will only use them.

3.9 Dummy Development

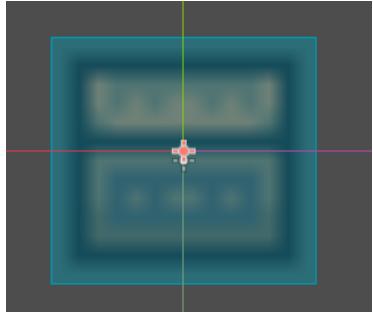


Figure 70: Layout

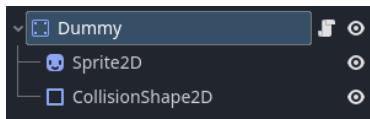


Figure 71: Structure

```
extends StaticBody2D

func _ready() -> void:
    >> add_to_group("enemies")

func take_damage(damage, damage_type):
    >> print(damage)
    >> print(damage_type)
```

Figure 72: Script

As part of my developmental testing I decided to create a simple dummy to test weapons on. The dummy consists of a StaticBody2D with a CollisionShape2D and a Sprite2D it also has a simple script for taking damage which I have set to print damage type and damage to the console.

3.10 Stakeholder Feedback 1

I got my first stakeholder feedback on 02/03/25 from Stakeholders Daniel and Samuel. I showed them my Login System and Save Select System aswell as player movement and

3.10.1 Login System and Save Menu

During the Demo of the Login System and Save Menu Samuel got stuck on the Save Menu and had to restart to log out, to fix this I added a simple Logout Button to the Save Menu which switches the scene back to the login page to allow login as another account.

```
func _on_log_out_button_pressed() -> void:
    >> get_tree().change_scene_to_file("res://scenes/menu/login_form.tscn")
```

Figure 73: Logout Button

Stakeholders mentioned how they would like the addition of a confirm password box to make sure that no mistypes in the password would affect logging in and so I added this with a simple check to see if the entered fields are equal.

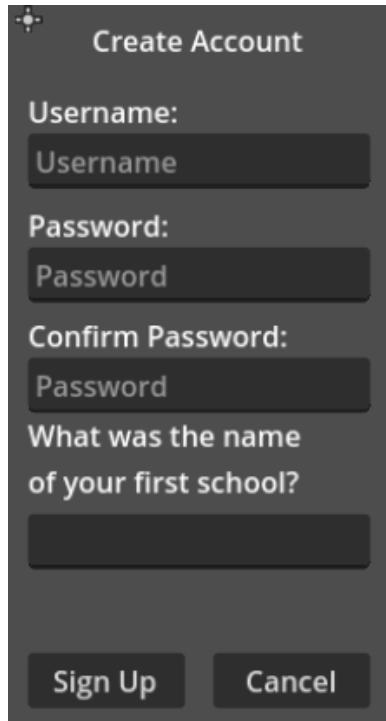


Figure 74: Confirm Password Field

```

func _on_sign_up_button_pressed() -> void:
    var username = $Input/UsernameInput.text
    var password = $Input/PasswordInput.text
    var answer = $Input/QuestionInput.text
    var success = Database.add_user(username, password, answer)
    if $Input/PasswordInput.text == $Input/ConfirmPasswordInput.text:
        if not (typeof(success) == TYPE_BOOL and success == true):
            if success == "InvalidUsernameError":
                $Labels/ErrorLabel.text = "Invalid Username"
            else:
                get_tree().change_scene_to_file("res://scenes/menu/login_form.tscn")
        else:
            $Labels/ErrorLabel.text = "Passwords Don't Match"

```

Figure 75: Updated Script

3.10.2 Test Scene

During the demo the stakeholders ran into an issue with the attacks where the attack function in the weapon scripts wasn't able to properly use await and timers due to them not being in the scene tree and so crashed the program when the player tried to attack, to fix this I moved the attack functions out of the weapon script and directly into the player's attack function sacrificing the polymorphism for the sake of time.

```

    func attack():
        if not animating:
            animating = true
            $AnimatedSprite2D.play(get_animation("melee"))
            weapon = load(Database.get_slot_value("weapon"))
            if weapon.weapon_type == "melee":
                #Load the hurtbox scene
                var hurtbox_scene = load(weapon.hurtbox_scene_path)
                var hurtbox_instance = hurtbox_scene.instantiate()
                hurtbox_instance.range = weapon.attack_range
                hurtbox_instance.damage = weapon.attack_power
                hurtbox_instance.damage_type = weapon.damage_type
                hurtbox_instance.rotation = last_direction.angle()
                #Add child
                add_child(hurtbox_instance)
                #Hitbox lasts for a tenth of a second
                await get_tree().create_timer(0.1).timeout
                print("yes")
                hurtbox_instance.queue_free()
                await $AnimatedSprite2D.animation_finished
            animating = false

```

Figure 76: Updated Player Attack Function

3.11 Dungeon Environment Development

3.11.1 Door

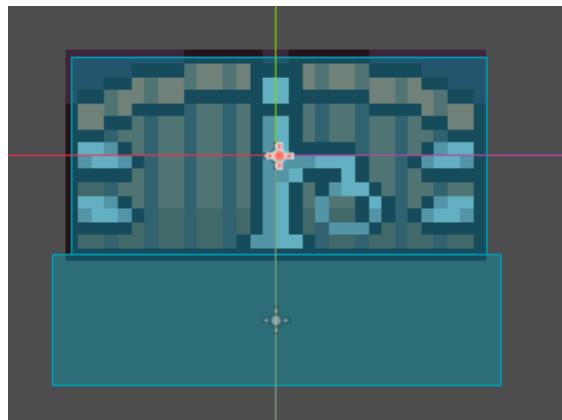


Figure 77: Layout

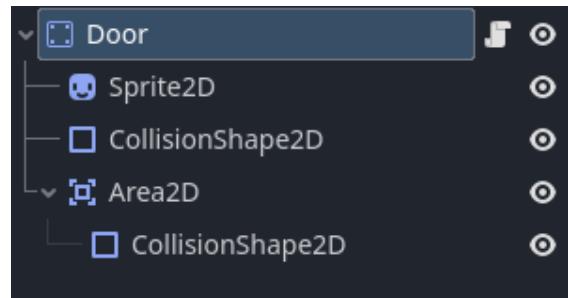


Figure 78: Structure

The layout and structure of the door is as shown above, mostly the same as was designed making sure to get the area2d in front of the door for opening.

```

extends StaticBody2D

@export var change_scene: bool
@export var scene_path: String
@export var key_path: String
@export var locked: bool

func _input(event: InputEvent) -> void:
    if event.is_action_pressed("interact"): # Check pressed button
        for x in $Area2D.get_overlapping_bodies():
            if x.name == "Player": # Check the player is within range
                if not(locked) or Inventory.remove_item(key_path,1) is bool: # Check if the player has the key and removes it if the door isn't locked
                    if change_scene:
                        get_tree().change_scene_to_file(scene_path) # Change Scene
                    else:
                        queue_free()

```

Figure 79: Script

I added a variable that determines whether or not the door is locked as well as looping through the overlapping bodies instead of checking if it overlaps a certain body as that was easier to implement.

3.11.2 Chest

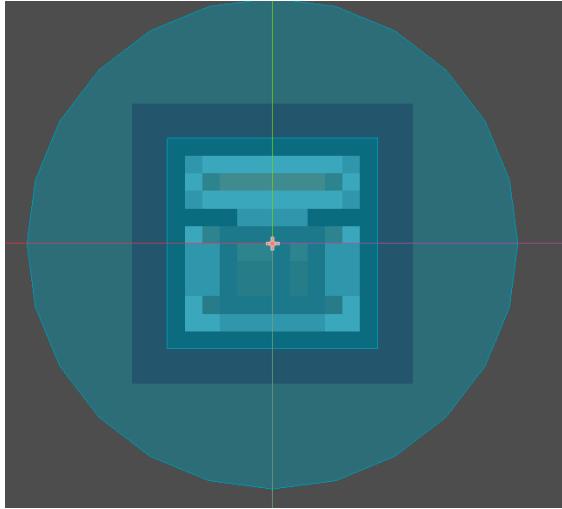


Figure 80: Layout

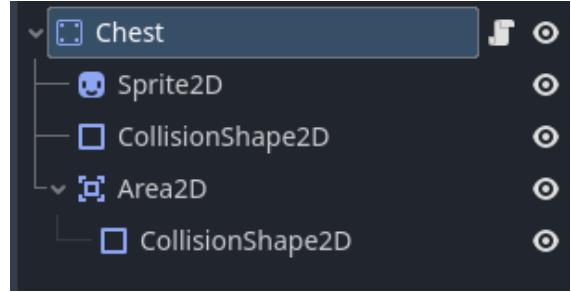


Figure 81: Structure

The layout and structure of the chest are mostly the same as was designed with the detection area being a circle around the chest.

```

extenus StaticBody2D

@export var item_pool: Dictionary
@export var item_number: int
@export var key_path: String
@export var locked: bool
var item_list: Array

func _ready() -> void:
    for item in item_pool:
        var add_list = []
        for x in item_pool[item]:
            add_list.append(item)
        item_list.append_array(add_list)

func _input(event):
    if event.is_action_pressed("interact"):
        for i in $Area2D.get_overlapping_bodies():
            if i.name == "Player": # Check the player is within range
                if not(locked) or Inventory.remove_item(key_path,1) is bool: # Check if the player has the key and removes it if the door isn't locked
                    for j in range(item_number):
                        Inventory.add_item(item_list[randi_range(0,len(item_list)-1)],1)
                    print(item_list)
                    queue_free()

```

Figure 82: Script

The chest script is has a couple changes from the design, the addition of a locked flag aswell as making the item list a script variable so that it can be accessed from the input function and constructing the list without the use of pythonic list comprehension. I also switched from directly seeing if the player body overlaps to looping through overlapping bodies again as this wasy easier to implement and works the same.

3.12 Projectile Development

3.12.1 Ranged

3.12.2 Area

3.13 Magic Weapon Development

3.14 Enemy Development

I implemented three types of enemies a default and poison slime with melee attacks aswell as a fire slime with ranged attacks.

3.14.1 Layout and Structure

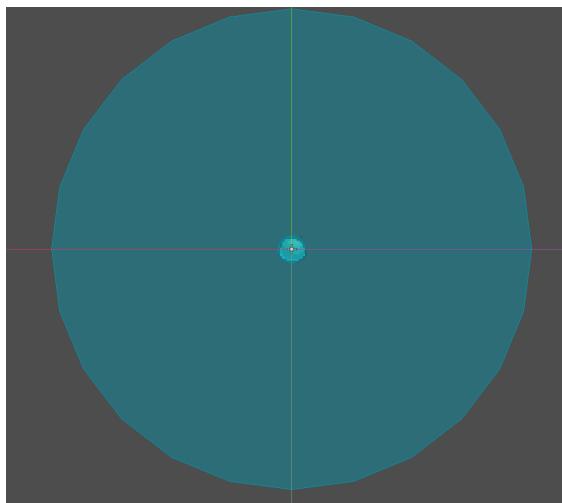


Figure 83: Layout

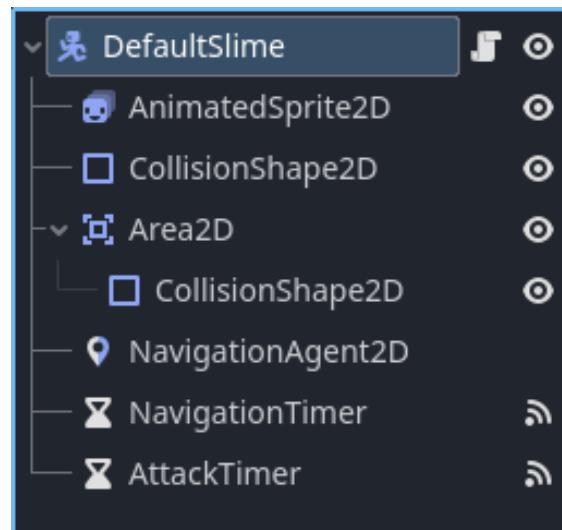


Figure 84: Structure

The layout and structure are as shown above with all the relevant timer nodes, the larger collision shape is the area2D for detecting the player whereas the smaller one handles physics collisions. The NavigationAgent2D handles the navigation and the AnimatedSprite2D handles animation.

3.14.2 General Script

```
extends CharacterBody2D

var direction = Vector2(0,1)
@export var speed:int = 20
@export var health: int = 10
@export var damage: int = 1
@export var damage_type: String = "normal"
@export var weaknesses: Array
var animating: bool
var can_attack = true

func get_animation(animation_type: String): @
func _ready(): @
func _physics_process(delta: float) -> void: @
func take_damage(damage, damage_type): @
func _on_navigation_timer_timeout() -> void: @
func _on_attack_timer_timeout() -> void: @
|
```

```
func _ready():
    add_to_group("enemies")
```

Figure 86: `_ready()`:

```
func _on_navigation_timer_timeout() -> void:
    var player = get_tree().get_first_node_in_group("player")
    $NavigationAgent2D.set_target_position(player.global_position)

func _on_attack_timer_timeout() -> void:
    can_attack = true
```

Figure 87: `timer_timeouts`

Figure 85: General Script and Variables

This shows the general script structure and variables as was described with the animating and can_attack flags declared as script variables so they can be used throughout the functions.

The ready function adds it to the enemies group so that the player's attacks will damage it and the navigation timer is set to autorun and when it times out the pathfinding towards the player (using NavigationAgent2D) is updated. When the attack timer runs out then the enemy can attack again.

3.14.3 `_physics_process()`:

```
func _physics_process(delta: float) -> void:
    var move = false
    for body in $Area2D.get_overlapping_bodies():
        if body.name == "Player":
            move = true
    if not animating:
        if move:
            direction = to_local($NavigationAgent2D.get_next_path_position()).normalized()
            velocity = direction * speed
            $AnimatedSprite2D.play(get_animation("walk"))
            move_and_slide()
        else:
            $AnimatedSprite2D.play(get_animation("idle"))
    else:
        move_and_slide()
```

Figure 88: melee `_physics_process(delta)`

This script is the same as the designed script except with the `move_and_slide` function moved so that the enemy will not move if the idle animation is playing.

```

    func _physics_process(delta: float) -> void:
        var player_detected = false
        for body in $Area2D.get_overlapping_bodies():
            if body.name == "Player":
                player_detected = true
        if not animating:
            $AnimatedSprite2D.play(get_animation("idle"))
        if player_detected and can_attack:
            direction = to_local($NavigationAgent2D.get_next_path_position()).normalized()
            var projectile = load("res://scenes/game/projectiles/fire_projectile.tscn").instantiate()
            projectile.rotation_degrees = rad_to_deg(direction.angle())
            projectile.position = position + 20*direction
            projectile.damage = damage
            get_parent().add_child(projectile)
            can_attack=false
            $AttackTimer.start()

```

Figure 89: ranged _physics_process(delta)

This is the same as the designed script using godot syntax and with the fire projectile scene added in as this is fire ranged slime.

3.14.4 take_damage(damage, damage_type):

```

    func take_damage(damage, damage_type):
        var player = get_tree().get_first_node_in_group("player")
        animating = true
        if damage_type in weaknesses:
            health -= 2*damage
        else:
            health -= damage
            velocity = - 25 * to_local(player.global_position).normalized()
        if health == 0:
            queue_free()
        else:
            $AnimatedSprite2D.play(get_animation("hurt"))
            await $AnimatedSprite2D.animation_finished
            animating = false

```

Figure 90: take_damage()

This is the same as the designed script but changing the player global position to a localised position relative to the enemy to properly get the direction.

3.14.5 Animation

For animation I used three different spritesheets for the different types of slimes.

```
▼ func get_animation(animation_type: String):  
  ▼ ▶    if abs(direction.x) > abs(direction.y):  
    ▼ ▶      ▶    if direction.x > 0:  
      ▶      ▶      return animation_type + "_r"  
    ▼ ▶      else:  
      ▶      ▶      return animation_type + "_l"  
  ▼ ▶    else:  
    ▶      ▶    if direction.y > 0:  
      ▶      ▶      return animation_type + "_d"  
    ▼ ▶      else:  
      ▶      ▶      return animation_type + "_u"
```

Figure 91: get_animation()

This is exactly the same as the designed script.

3.15 UI Development

3.16 Tutorial Development

3.17 Stakeholder Feedback 2

3.17.1 Save Menu Feedback

I got feedback to add names to the saves and display them instead of the save_id aswell as editing the button text to make it clear it is to create a new save.

4 References

REF#	Date	Topic/Abstract	Type	URL or BOOK reference	How I used this
1	1/6/24	Research/ Existing Solutions	video games store, online	Steam (The Binding of Isaac)	One of the existing solutions I researched.
2	15/6/24	Research/ Existing Solutions	video games store, online	Steam (Dead Cells)	One of the existing solutions I researched
3	15/6/24	Research/ Existing Solutions	youtube video, online	Youtube (Motion Twin)	A dev log for an existing solution.
4	15/6/24	Research/ Existing Solutions	blog, online	roberheaton.com	An existing algorithm I researched.
5	25/11/24	Research/ Existing Solutions	video games store, online	Nintendo Store (Breath of The Wild)	One of the existing solutions I researched
6	04/03/25	Design/ Enemy Design	Game Engine Documentation, online	Godot Docs (2D navigation)	The documentation for godot's navigation nodes in 2D

5 Code Listings

5.1 resources/scripts

item.gd

```

1 extends Resource
2
3 class_name Item
4
5 @export var stackable: bool
6 @export var description: String
7 @export var icon: Texture

```

equipable.gd

```

1 extends Item
2
3 class_name Equipable
4
5 @export var stat_boosts: Dictionary = {}
6
7 func _init():
8     stackable = false

```

armour.gd

```

1 extends Equipable
2
3 class_name Armour
4
5 @export var defense: int
6 @export var armour_type: String # "light", "heavy"
7 @export var body_part: String # "head", "chest", "legs"
8 @export var set_id: int
9
10 func display_string():
11     return "Armour\nName: %s\nType: %s\nDefense: %s\n Description: %s" % [resource_name,
12                         armour_type.capitalize(), defense, description]

```

weapon.gd

```

1 extends Equipable
2
3 class_name Weapon
4
5 @export var weapon_type: String # "ranged_magic", "area_magic", "melee"
6 @export var attack_power: int
7 @export var attack_range: int
8 @export var damage_type: String # "normal", "ice", "fire", "thunder", "divine", "poison"
9 @export var mana_cost: int
10 var hurtbox_scene_path = "res://scenes/game/player/hurt_box.tscn"
11
12 func display_string():
13     return "Weapon\nName: %s\nType: %s\nDamage: %s\nDamage Type: %s\n Description: %s" % [
14         resource_name, weapon_type.replace("_", " ").capitalize(), attack_power, damage_type.
15         capitalize(), description]

```

charm.gd

```

1 extends Equipable
2
3 class_name Charm
4
5 @export var charm_type: String # "ice", "fire", "cursed", "divine", "poison"
6
7 func display_string():
8     return "Weapon\nName: %s\nType: %s\n Description: %s" % [resource_name, charm_type.
8         capitalize(), description]

```

key.gd

```
1 extends Item
2
3 class_name Key
4
5 @export var key_id: String
6
7
8 func display_string():
9     return "Key\nName: %s\n Description: %s" % [resource_name, description]
```

5.2 scenes

5.2.1 game/enemies

default_slime.gd

```
1 extends CharacterBody2D
2
3
4
5 var direction = Vector2(0,1)
6 @export var speed:int = 20
7 @export var health: int = 10
8 @export var damage: int = 1
9 @export var damage_type: String = "normal"
10 @export var weaknesses: Array
11 var animating: bool
12 var can_attack = true
13
14 func get_animation(animation_type: String):
15     if abs(direction.x) > abs(direction.y):
16         if direction.x > 0:
17             return animation_type + "_r"
18         else:
19             return animation_type + "_l"
20     else:
21         if direction.y > 0:
22             return animation_type + "_d"
23         else:
24             return animation_type + "_u"
25
26 func _ready():
27     add_to_group("enemies")
28     $HealthBar.max_value=health
29     $HealthBar.value=health
30
31 func _physics_process(delta: float) -> void:
32     var move = false
33     for body in $Area2D.get_overlapping_bodies():
34         if body.name == "Player":
35             move = true
36     if not animating:
37         if move:
38             direction = to_local($NavigationAgent2D.get_next_path_position())
39             normalized()
40             velocity = direction * speed
41             $AnimatedSprite2D.play(get_animation("walk"))
42             move_and_slide()
43         else:
44             $AnimatedSprite2D.play(get_animation("idle"))
45     else:
46         move_and_slide()
47
48     if can_attack:
49         for i in range(get_slide_collision_count()):
50             var collision = get_slide_collision(i)
51             var collider = collision.get_collider()
52             if collider.is_in_group("player"):
53                 collider.take_damage(damage, damage_type)
54                 can_attack=false
55                 $AttackTimer.start()
56
57 func take_damage(damage, damage_type):
```

```

57     var player = get_tree().get_first_node_in_group("player")
58     animating = true
59     if damage_type in weaknesses:
60         health -= 2*damage
61     else:
62         health -= damage
63     velocity = - 25 * to_local(player.global_position).normalized()
64     $HealthBar.value=health
65     $HealthBar.visible = true
66     if health <= 0:
67         queue_free()
68     else:
69         $AnimatedSprite2D.play(get_animation("hurt"))
70     await $AnimatedSprite2D.animation_finished
71     animating = false
72     velocity = Vector2(0,0)
73     $HealthBar.visible = false
74
75 func _on_navigation_timer_timeout() -> void:
76     var player = get_tree().get_first_node_in_group("player")
77     if player:
78         $NavigationAgent2D.set_target_position(player.global_position)
79
80 func _on_attack_timer_timeout() -> void:
81     can_attack = true
82
fire_slime.gd

```

```

1 extends CharacterBody2D
2
3
4
5 var direction = Vector2(0,1)
6 @export var speed:int = 20
7 @export var health: int = 10
8 @export var damage: int = 1
9 @export var damage_type: String = "fire"
10 @export var weaknesses: Array
11 var animating: bool
12 var can_attack = true
13
14 func get_animation(animation_type: String):
15     if abs(direction.x) > abs(direction.y):
16         if direction.x > 0:
17             return animation_type + "_r"
18         else:
19             return animation_type + "_l"
20     else:
21         if direction.y > 0:
22             return animation_type + "_d"
23         else:
24             return animation_type + "_u"
25
26
27 func _ready():
28     add_to_group("enemies")
29     $HealthBar.max_value = health
30     $HealthBar.value=health
31
32 func _physics_process(delta: float) -> void:
33     var player_detected = false
34     for body in $Area2D.get_overlapping_bodies():
35         if body.name == "Player":
36             player_detected = true
37     if not animating:
38         $AnimatedSprite2D.play(get_animation("idle"))
39     if player_detected and can_attack:
40         direction = to_local($NavigationAgent2D.get_next_path_position()).
41                     normalized()
42         var projectile = load("res://scenes/game/projectiles/fire_projectile.tsfn")
43             ".instantiate()"
44         projectile.rotation_degrees = rad_to_deg(direction.angle())
45         projectile.position = position + 20*direction
46         projectile.damage = damage
47         get_parent().add_child(projectile)
48         can_attack=false
49         $AttackTimer.start()

```

```

49
50 func take_damage(damage, damage_type):
51     var player = get_tree().get_first_node_in_group("player")
52     animating = true
53     if damage_type in weaknesses:
54         health -= 2*damage
55     else:
56         health -= damage
57     velocity = - 25 * to_local(player.global_position).normalized()
58     $HealthBar.value = health
59     $HealthBar.visible = true
60     if health <= 0:
61         queue_free()
62     else:
63         $AnimatedSprite2D.play(get_animation("hurt"))
64     await $AnimatedSprite2D.animation_finished
65     velocity = Vector2(0,0)
66     animating = false
67     $HealthBar.visible = false
68
69
70
71 func _on_navigation_timer_timeout() -> void:
72     var player = get_tree().get_first_node_in_group("player")
73     if player:
74         $NavigationAgent2D.set_target_position(player.global_position)
75
76
77 func _on_attack_timer_timeout() -> void:
78     can_attack = true

```

poison_slime.gd

```

1 extends CharacterBody2D
2
3
4
5 var direction = Vector2(0,1)
6 @export var speed:int = 20
7 @export var health: int = 10
8 @export var damage: int = 1
9 @export var damage_type: String = "poison"
10 @export var weaknesses: Array
11 var animating: bool
12 var can_attack = true
13
14 func get_animation(animation_type: String):
15     if abs(direction.x) > abs(direction.y):
16         if direction.x > 0:
17             return animation_type + "_r"
18         else:
19             return animation_type + "_l"
20     else:
21         if direction.y > 0:
22             return animation_type + "_d"
23         else:
24             return animation_type + "_u"
25
26
27 func _ready():
28     add_to_group("enemies")
29     $HealthBar.max_value = health
30     $HealthBar.value=health
31
32 func _physics_process(delta: float) -> void:
33     var move = false
34     for body in $Area2D.get_overlapping_bodies():
35         if body.name == "Player":
36             move = true
37     if not animating:
38         if move:
39             direction = to_local($NavigationAgent2D.get_next_path_position()).
40                     normalized()
41             velocity = direction * speed
42             $AnimatedSprite2D.play(get_animation("walk"))
43             move_and_slide()
44         else:
45             $AnimatedSprite2D.play(get_animation("idle"))

```

```

45     else:
46         move_and_slide()
47
48
49     if can_attack:
50         for i in range(get_slide_collision_count()):
51             var collision = get_slide_collision(i)
52             var collider = collision.get_collider()
53             if collider.is_in_group("player"):
54                 collider.take_damage(damage, damage_type)
55                 can_attack=false
56                 $AttackTimer.start()
57
58
59
60
61 func take_damage(damage, damage_type):
62     var player = get_tree().get_first_node_in_group("player")
63     animating = true
64     if damage_type in weaknesses:
65         health -= 2*damage
66     else:
67         health -= damage
68     velocity = - 25 * to_local(player.global_position).normalized()
69     $HealthBar.value = health
70     $HealthBar.visible = true
71     if health <= 0:
72         queue_free()
73     else:
74         $AnimatedSprite2D.play(get_animation("hurt"))
75     await $AnimatedSprite2D.animation_finished
76     animating = false
77     velocity = Vector2(0,0)
78     $HealthBar.visible = false
79
80
81
82
83 func _on_navigation_timer_timeout() -> void:
84     var player = get_tree().get_first_node_in_group("player")
85     if player:
86         $NavigationAgent2D.set_target_position(player.global_position)
87
88
89 func _on_attack_timer_timeout() -> void:
90     can_attack = true

```

5.2.2 game/player

player.gd

```

1 extends CharacterBody2D
2
3
4 var speed = 100
5 var health = 100
6 var mana = 100
7 var last_direction = Vector2(1,0)
8 var animating = false
9 var weapon
10 var can_dash = true
11 var ui = preload("res://scenes/game/player/ui.tscn")
12 func _ready():
13     add_to_group("player")
14     add_child(ui.instantiate())
15
16 func get_animation(animation_type: String):
17     var anim = animation_type + "_"
18     if last_direction.x:
19         if last_direction.x == 1:
20             anim += 'r'
21         else:
22             anim += 'l'
23     if last_direction.y:
24         if last_direction.y == 1:
25             anim += 'd'

```

```

26         else:
27             anim += 'u'
28     return anim
29
30
31 func _physics_process(delta: float) -> void:
32     # Get the direction
33     var direction = Vector2(Input.get_axis("left", "right"), Input.get_axis("up", "down"))
34     # Velocity
35     velocity = direction.normalized() * speed
36     # Moving/Idling if its not already animating
37     if not animating:
38         if direction:
39             last_direction = direction
40             $AnimatedSprite2D.play(get_animation("walk"))
41     else:
42         $AnimatedSprite2D.play(get_animation("idle"))
43     move_and_slide()
44
45
46 func _input(event: InputEvent) -> void:
47     if event.is_action_pressed("attack"):
48         attack()
49     elif event.is_action_pressed("dash"):
50         if can_dash:
51             speed = 8*speed
52             can_dash = false
53             await get_tree().create_timer(0.05).timeout
54             speed = speed/8
55             await get_tree().create_timer(0.5).timeout
56             can_dash = true
57
58
59
60
61 func attack():
62     if Database.get_slot_value("weapon"):
63         weapon = load(Database.get_slot_value("weapon"))
64         if not animating and mana >= weapon.mana_cost:
65             animating = true
66             mana -= weapon.mana_cost
67             if weapon.weapon_type == "melee":
68                 $AnimatedSprite2D.play(get_animation("melee"))
69                 await get_tree().create_timer(0.5).timeout # Account for
                                                animation delay
70                 #Load the hurtbox scene
71                 var hurtbox_scene = load(weapon.hurtbox_scene_path)
72                 var hurtbox_instance = hurtbox_scene.instantiate()
73                 hurtbox_instance.range = weapon.attack_range
74                 hurtbox_instance.damage = weapon.attack_power
75                 hurtbox_instance.damage_type = weapon.damage_type
76                 hurtbox_instance.rotation = last_direction.angle()
77                 #Add child
78                 add_child(hurtbox_instance)
79                 #Hitbox lasts for a tenth of a second
80                 await get_tree().create_timer(0.1).timeout
81                 print("yes")
82                 hurtbox_instance.queue_free()
83             elif weapon.weapon_type == "ranged_magic":
84                 $AnimatedSprite2D.play(get_animation("melee")) #Change later
85                 await get_tree().create_timer(0.5).timeout # Account for
                                                animation delay
86                 #Load the projectile scene
87                 var projectile = load("res://scenes/game/projectiles/%
88                                     s_projectile.tscn"%weapon.damage_type).instantiate()
89                 var projectile_direction = (get_viewport().get_mouse_position()-
90                                             Vector2(1920/2,1080/2)).normalized()
91                 projectile.rotation_degrees = rad_to_deg(projectile_direction.
92                                               angle())
93                 projectile.position = position + 20 * projectile_direction
94                 projectile.damage = weapon.attack_power
95                 get_parent().add_child(projectile)
96             elif weapon.weapon_type == "area_magic":
97                 $AnimatedSprite2D.play(get_animation("melee")) #Change later
98                 await get_tree().create_timer(0.5).timeout # Account for
                                                animation delay
99                 #Load the projectile scene

```

```
97         var area_direction = (get_viewport().get_mouse_position() - Vector2(1920/2, 1080/2)).normalized()
98         var area = load("res://scenes/game/projectiles/%s_area.tscn"%weapon.damage_type).instantiate()
99         area.position = position + 25 * area_direction
100        area.damage = weapon.attack_power
101        get_parent().add_child(area)
102        await $AnimatedSprite2D.animation_finished
103        animating = false
104
105
106
107 func take_damage(damage, damage_type):
108     if damage_type == "poison":
109         print("yes")
110         for x in range(damage):
111             health -= 1
112             if health <= 0:
113                 get_tree().change_scene_to_file("res://scenes/menu/save_menu.tscn")
114             await get_tree().create_timer(1).timeout
115     else:
116         health -= damage
117         if health <= 0:
118             get_tree().change_scene_to_file("res://scenes/menu/save_menu.tscn")
```

hurt_box.gd

```
1 extends Area2D
2
3 var damage: int
4 var damage_type: String
5 var range: int
6
7
8 func _on_body_entered(body: Node2D) -> void:
9     if body.is_in_group("enemies"): # If its an enemy damages it
10         body.take_damage(damage, damage_type)
```

inventory-ui.gd

```

16         var button = Button.new()
17         if item_count % 4 == 0:
18             hbox = HBoxContainer.new()
19             $ScrollContainer/VBoxContainer.add_child(hbox)
20             print(hbox)
21             button.text = load(item["item_id"]).display_string() + "\nAmount: %d" % item["amount"]
22             button.connect("pressed", _select.bind(item["item_id"]))
23             button.custom_minimum_size = Vector2(250,200)
24             hbox.add_child(button)
25             item_count += 1
26         if Database.get_slot_value("weapon"):
27             $WeaponLabel.text = load(Database.get_slot_value("weapon")).display_string()
28         if Database.get_slot_value("head"):
29             $HeadLabel.text = load(Database.get_slot_value("head")).display_string()
30         if Database.get_slot_value("chest"):
31             $ChestLabel.text = load(Database.get_slot_value("chest")).display_string()
32         if Database.get_slot_value("legs"):
33             $LegsLabel.text = load(Database.get_slot_value("legs")).display_string()
34         if Database.get_slot_value("charm_1"):
35             $Charm1Label.text = load(Database.get_slot_value("charm_1")).display_string()
36         if Database.get_slot_value("charm_2"):
37             $Charm2Label.text = load(Database.get_slot_value("charm_2")).display_string()
38
39 func _select(item_id):
40     selected = item_id
41
42
43 func _on_equip_button_pressed() -> void:
44     if selected != "":
45         Inventory.equip_item(selected)
46         refresh()
47
48
49 func _on_bin_button_pressed() -> void:
50     if selected != "":
51         Database.remove_stored_item(selected)
52
53
54 func _on_log_out_button_pressed() -> void:
55     get_tree().change_scene_to_file("res://scenes/menu/login_form.tscn")

```

ui.gd

```

1 extends CanvasLayer
2
3 var player
4
5 func _ready():
6     var player = get_tree().get_first_node_in_group("player")
7     $HealthBar.max_value = player.health
8     $MagicBar.max_value = player.mana
9     update_ui()
10
11
12 func _process(delta: float) -> void:
13     var player = get_tree().get_first_node_in_group("player")
14     $HealthBar.value = player.health
15     $MagicBar.value = player.mana
16
17
18 func update_ui():
19     if Database.get_slot_value("weapon"):
20         var weapon = load(Database.get_slot_value("weapon"))
21         $WeaponLabel.text = weapon.display_string()

```

5.2.3 game/projectiles

ice_projectile.gd

```

1 extends CharacterBody2D
2
3 var damage: int = 1
4 var damage_type: String = "ice"
5 var speed = 120

```

```

6 var attacking = false
7
8
9 func _physics_process(delta: float) -> void:
10     velocity.x = speed * cos(rotation)
11     velocity.y = speed * sin(rotation)
12     if not attacking:
13         move_and_slide()
14     #Collisions
15     for i in range(get_slide_collision_count()):
16         if not attacking:
17             attacking = true
18             var collision = get_slide_collision(i)
19             print(collision)
20             var collider = collision.get_collider()
21             print(collider)
22             if collider.is_in_group("player") or collider.is_in_group("enemies"):
23                 collider.take_damage(damage, damage_type)
24             $CollisionShape2D.disabled = true
25             $AnimatedSprite2D.play("impact")
26             await $AnimatedSprite2D.animation_finished
27             queue_free()

```

fire_projectile.gd

```

1 extends CharacterBody2D
2
3 var damage: int = 1
4 var damage_type: String = "fire"
5 var speed = 120
6 var attacking = false
7
8
9 func _physics_process(delta: float) -> void:
10     velocity.x = speed * cos(rotation)
11     velocity.y = speed * sin(rotation)
12     if not attacking:
13         move_and_slide()
14     #Collisions
15     for i in range(get_slide_collision_count()):
16         if not attacking:
17             attacking = true
18             var collision = get_slide_collision(i)
19             print(collision)
20             var collider = collision.get_collider()
21             print(collider)
22             if collider.is_in_group("player") or collider.is_in_group("enemies"):
23                 collider.take_damage(damage, damage_type)
24             $CollisionShape2D.disabled = true
25             $AnimatedSprite2D.play("impact")
26             await $AnimatedSprite2D.animation_finished
27             queue_free()

```

thunder_projectile.gd

```

1 extends CharacterBody2D
2
3 var damage: int = 1
4 var damage_type: String = "thunder"
5 var speed = 120
6 var attacking = false
7
8
9 func _physics_process(delta: float) -> void:
10     velocity.x = speed * cos(rotation)
11     velocity.y = speed * sin(rotation)
12     if not attacking:
13         move_and_slide()
14     #Collisions
15     for i in range(get_slide_collision_count()):
16         if not attacking:
17             attacking = true
18             var collision = get_slide_collision(i)
19             print(collision)
20             var collider = collision.get_collider()
21             print(collider)
22             if collider.is_in_group("player") or collider.is_in_group("enemies"):

```

```

23             collider.take_damage(damage, damage_type)
24             $CollisionShape2D.disabled = true
25             $AnimatedSprite2D.play("impact")
26             await $AnimatedSprite2D.animation_finished
27             queue_free()

```

ice-area.gd

```

1  extends Area2D
2
3  var damage: int = 1
4  var damage_type: String = "ice"
5
6
7  func _ready():
8      await $AnimatedSprite2D.animation_finished
9      queue_free()
10
11 func _on_body_entered(body: Node2D) -> void:
12     if body.is_in_group("enemies") or body.is_in_group("player"): # If its an enemy or player
13         damages it
14         body.take_damage(damage, damage_type)

```

fire-area.gd

```

1  extends Area2D
2
3  var damage: int = 1
4  var damage_type: String = "fire"
5  var time:int = 1
6
7
8  func _ready():
9      await get_tree().create_timer(time).timeout
10     queue_free()
11
12 func _on_body_entered(body: Node2D) -> void:
13     if body.is_in_group("enemies") or body.is_in_group("player"): # If its an enemy or player
14         damages it
15         body.take_damage(damage, damage_type)

```

thunder-area.gd

```

1  extends Area2D
2
3  var damage: int = 1
4  var damage_type: String = "thunder"
5
6
7  func _ready():
8      await $AnimatedSprite2D.animation_finished
9      queue_free()
10
11 func _on_body_entered(body: Node2D) -> void:
12     if body.is_in_group("enemies") or body.is_in_group("player"): # If its an enemy or player
13         damages it
14         body.take_damage(damage, damage_type)

```

5.2.4 game/worlds**rooms/graph/dungeon_graph.gd**

```

1  extends Node
2
3  class_name DungeonGraph
4
5  var root: DungeonGraphNode
6  var nodes: Array
7  var rooms: Dictionary = {'chest':["res://scenes/game/worlds/rooms/monster/room.tscn"], 
8  'boss':["res://scenes/game/worlds/rooms/monster/room.tscn"], 
9  'monster':[ "res://scenes/game/worlds/rooms/monster/room.tscn", "res://scenes/game/worlds/rooms/
  monster/m_room_1.tscn"], 

```

```

10 'corridor':["res://scenes/game/worlds/rooms/corridors/corridor_1.tscn","res://scenes/game/worlds/
   rooms/corridors/corridor_2.tscn","res://scenes/game/worlds/rooms/corridors/corridor_3.tscn","
   res://scenes/game/worlds/rooms/corridors/corridor_4.tscn","res://scenes/game/worlds/rooms/
   corridors/corridor_5.tscn","res://scenes/game/worlds/rooms/corridors/corridor_6.tscn","res:///
   scenes/game/worlds/rooms/corridors/corridor_7.tscn","res://scenes/game/worlds/rooms/corridors/
   corridor_8.tscn","res://scenes/game/worlds/rooms/corridors/corridor_9.tscn","res://scenes/
   game/worlds/rooms/corridors/corridor_10.tscn","res://scenes/game/worlds/rooms/corridors/
   corridor_11.tscn","res://scenes/game/worlds/rooms/corridors/corridor_12.tscn"],
11 'corridor_along':["res://scenes/game/worlds/rooms/corridors/corridor_1.tscn","res://scenes/game/
   worlds/rooms/corridors/corridor_7.tscn"],
12 'corridor_up':["res://scenes/game/worlds/rooms/corridors/corridor_2.tscn","res://scenes/game/
   worlds/rooms/corridors/corridor_8.tscn"],
13 'corridor_corner':["res://scenes/game/worlds/rooms/corridors/corridor_3.tscn","res://scenes/game/
   worlds/rooms/corridors/corridor_4.tscn","res://scenes/game/worlds/rooms/corridors/corridor_5.
   tscn","res://scenes/game/worlds/rooms/corridors/corridor_6.tscn","res://scenes/game/worlds/
   rooms/corridors/corridor_9.tscn","res://scenes/game/worlds/rooms/corridors/corridor_10.tscn",
   "res://scenes/game/worlds/rooms/corridors/corridor_11.tscn","res://scenes/game/worlds/rooms/
   corridors/corridor_12.tscn"]]
14 var opposite_direction = {'north':'south', 'south':'north', 'east':'west', 'west':'east'}
15
16
17 func unordered_equal(list_1, list_2):
18     for i in list_1:
19         if not(i in list_2):
20             return false
21     for i in list_2:
22         if not(i in list_1):
23             return false
24     return true
25
26 func __init__() -> void:
27     root = DungeonGraphNode.new()
28     root.room_type = "monster"
29     nodes.append(root)
30
31 func add_node(onto_index, direction, room_type):
32     var onto = nodes[onto_index]
33     if onto[direction]:
34         return false
35     var new_node = DungeonGraphNode.new()
36     new_node.room_type = room_type
37     onto[direction] = new_node
38     match direction:
39         'north':
40             new_node.south = onto
41         'south':
42             new_node.north = onto
43         'east':
44             new_node.west = onto
45         'west':
46             new_node.east = onto
47     nodes.append(new_node)
48     return true
49
50
51 func gen_room(node, previous_direction = null, previous = null):
52     var room = load.rooms[node.room_type].pick_random().instantiate()
53     add_child(room)
54     if previous_direction:
55         room.set_pos(previous_direction, previous.get_pos(opposite_direction[
56             previous_direction]))
57     else:
58         room.position = Vector2(1920/2,1080/2)
59     for i in ['north', 'south', 'east', 'west']:
60         if node[i] == null:
61             room.cap(i)
62     return room
63
64 func gen_dungeon(node=root, previous_direction = null, previous = null, generated = []):
65     var room = await gen_room(node, previous_direction, previous)
66     generated.append(node)
67     await get_tree().create_timer(0.5).timeout
68     for i in ['north', 'south', 'east', 'west']:
69         if node[i] and node[i] not in generated:
70             generated = await gen_dungeon(node[i], opposite_direction[i], room,
71             generated)
71     return generated

```

rooms/graph/dungeon_graph_node.gd

```

1 extends Node
2
3 class_name DungeonGraphNode
4
5 var north: DungeonGraphNode = null
6 var south: DungeonGraphNode = null
7 var east: DungeonGraphNode = null
8 var west: DungeonGraphNode = null
9 var room_type: String #Chest, Boss, Monster

```

rooms/room.gd

```

1 extends Node2D
2
3 func get_pos(direction):
4     match direction:
5         'north':
6             return $North.global_position
7         'south':
8             return $South.global_position
9         'east':
10            return $East.global_position
11        'west':
12            return $West.global_position
13
14 func set_pos(direction, global_pos):
15     match direction:
16         'north':
17             position += global_pos - $North.global_position
18         'south':
19             position += global_pos - $South.global_position
20         'east':
21             position += global_pos - $East.global_position
22         'west':
23             position += global_pos - $West.global_position
24
25 func cap(direction):
26     match direction:
27         'north':
28             var north_cap = load("res://scenes/game/worlds/rooms/north_cap.tscn").
29                         instantiate()
30             $North.add_child(north_cap)
31         'south':
32             var south_cap = load("res://scenes/game/worlds/rooms/south_cap.tscn").
33                         instantiate()
34             $South.add_child(south_cap)
35         'east':
36             var east_cap = load("res://scenes/game/worlds/rooms/east_cap.tscn").
37                         instantiate()
38             $East.add_child(east_cap)
39         'west':
40             var west_cap = load("res://scenes/game/worlds/rooms/west_cap.tscn").
41                         instantiate()
42             $West.add_child(west_cap)
43
44 func _ready() -> void:
45     if $Slimes:
46         for slime in $Slimes.get_children():
47             slime.health = floor(2*Global.current_level*log(3*Global.difficulty))
48             slime.damage = floor(Global.current_level*log(3*Global.difficulty))
49             print(slime.health,slime.damage)

```

rooms/room_test.gd

```

1 extends Node2D
2
3
4 func _ready():
5     await dungeon_1()
6     #self.scale = Vector2(0.5,0.5)
7     #self.position = Vector2(1920/4,1080/4)
8     var player = load("res://scenes/game/player/player.tscn").instantiate()
9     player.position = Vector2(1920/2,1080/2)
10    add_child(player)

```

```

11
12
13 func dungeon_1():
14     var graph = load("res://scenes/game/worlds/rooms/graph/dungeon_graph.tscn").instantiate()
15     add_child(graph)
16     graph.add_node(0, 'north', 'corridor_along')
17     graph.add_node(0, 'east', 'corridor_corner')
18     graph.add_node(1, 'west', 'monster')
19     graph.add_node(2, 'north', 'corridor_up')
20     graph.add_node(4, 'north', 'monster')
21     graph.add_node(2, 'east', 'monster')
22     graph.add_node(0, 'south', 'corridor_corner')
23     graph.add_node(7, 'south', 'monster')
24     graph.add_node(6, 'south', 'corridor')
25     graph.add_node(9, 'south', 'monster')
26     await graph.gen_dungeon()
27
28 func dungeon_2():
29     var graph = load("res://scenes/game/worlds/rooms/graph/dungeon_graph.tscn").instantiate()
30     add_child(graph)
31     graph.add_node(0, 'north', 'corridor_corner')
32     graph.add_node(1, 'east', 'corridor_corner')
33     graph.add_node(2, 'east', 'corridor_corner')
34     graph.add_node(3, 'east', 'corridor_corner')
35     graph.add_node(1, 'north', 'monster')
36     graph.add_node(2, 'north', 'monster')
37     graph.add_node(2, 'south', 'monster')
38     graph.add_node(3, 'north', 'monster')
39     graph.add_node(3, 'south', 'monster')
40     graph.add_node(4, 'north', 'monster')
41     graph.add_node(4, 'south', 'monster')
42     graph.add_node(11, 'east', 'corridor_corner')
43     graph.add_node(12, 'south', 'monster')
44     graph.add_node(12, 'east', 'corridor_up')
45     graph.add_node(14, 'north', 'boss')
46     await graph.gen_dungeon()
47
48 func dungeon_3():
49     var graph = load("res://scenes/game/worlds/rooms/graph/dungeon_graph.tscn").instantiate()
50     add_child(graph)
51     graph.add_node(0, 'north', 'corridor_corner')
52     graph.add_node(0, 'east', 'corridor_corner')
53     graph.add_node(0, 'south', 'corridor_corner')
54     graph.add_node(0, 'west', 'corridor_corner')
55     graph.add_node(1, 'north', 'monster')
56     graph.add_node(2, 'east', 'monster')
57     graph.add_node(3, 'south', 'monster')
58     graph.add_node(4, 'west', 'monster')
59
60     await graph.gen_dungeon()

```

chest.gd

```

1 extends StaticBody2D
2
3 @export var item_pool: Dictionary
4 @export var item_number: int
5 @export var key_path: String
6 @export var locked: bool
7 var item_list: Array
8
9
10
11 func _ready() -> void:
12     for item in item_pool:
13         var add_list = []
14         for x in item_pool[item]:
15             add_list.append(item)
16             item_list.append_array(add_list)
17
18 func _input(event):
19     if event.is_action_pressed("interact"):
20         for i in $Area2D.get_overlapping_bodies():
21             if i.name == "Player": # Check the player is within range
22                 if not(locked) or Inventory.remove_item(key_path,1) is bool: #
23                     Check if the player has the key and removes it if the door

```

```
23             isn't locked
24                 for j in range(item_number):
25                     Inventory.add_item(item_list[randi_range(0,len(
26                                     item_list)-1)],1)
27             print(item_list)
28             queue_free()
```

door.gd

```
1 extends StaticBody2D
2
3 @export var change_scene: bool
4 @export var scene_path: String
5 @export var key_path: String
6 @export var locked: bool
7
8 func _input(event: InputEvent) -> void:
9     if event.is_action_pressed("interact"): # Check pressed button
10         for x in $Area2D.get_overlapping_bodies():
11             if x.name == "Player": # Check the player is within range
12                 if not(locked) or Inventory.remove_item(key_path,1) is bool: #
Check if the player has the key and removes it if the door
isn't locked
13                     if change_scene:
14                         get_tree().change_scene_to_file(scene_path) #
Change Scene
15                 else:
16                     queue_free()
```

5.2.5 menu

login_form.gd

```
1 extends Node2D
2
3
4
5 func _on_sign_in_button_pressed() -> void:
6     var username = $Input/UsernameInput.text
7     var password = $Input>PasswordInput.text
8     var success = Database.login(username, password)
9     if not (success is bool and success == true):
10         if success == "InvalidUsernameError":
11             $Labels/ErrorLabel.text = "Invalid Username"
12         elif success == "IncorrectPasswordError":
13             $Labels/ErrorLabel.text = "Incorrect Password"
14     else:
15         get_tree().change_scene_to_file("res://scenes/menu/save_menu.tsfn")
16
17
18 func _on_forgot_password_button_pressed() -> void:
19     get_tree().change_scene_to_file("res://scenes/menu/reset_password_form.tsfn")
20
21
22 func _on_create_account_button_pressed() -> void:
23     get_tree().change_scene_to_file("res://scenes/menu/create_account_form.tsfn")
24
25
26 func _on_quit_button_pressed() -> void:
27     Global.quit()
```

create-account-form.gd

```
1 extends Node2D
2
3
4
5
6 func _on_sign_up_button_pressed() -> void:
7     var username = $Input/UsernameInput.text
8     var password = $Input/PasswordInput.text
9     var answer = $Input/QuestionInput.text
10    var success = Database.add_user(username, password, answer)
11    if $Input/PasswordInput.text == $Input/ConfirmPasswordInput.text:
```

```

12         if not (typeof(success) == TYPE_BOOL and success == true):
13             if success == "InvalidUsernameError":
14                 $Labels/ErrorLabel.text = "Invalid Username"
15             else:
16                 get_tree().change_scene_to_file("res://scenes/menu/login_form.tscn")
17         else:
18             $Labels/ErrorLabel.text = "Passwords Don't Match"
19
20
21 func _on_cancel_button_pressed() -> void:
22     get_tree().change_scene_to_file("res://scenes/menu/login_form.tscn")

```

reset_password_form.gd

```

1 extends Node2D
2
3
4
5
6
7 func _on_reset_button_pressed() -> void:
8     var username = $Input/UsernameInput.text
9     var answer = $Input/QuestionInput.text
10    var password = $Input>PasswordInput.text
11    var confirm_password = $Input/ConfirmPasswordInput.text
12    if password == confirm_password:
13        var success = Database.reset_password(username, answer, password)
14        if not (typeof(success) == TYPE_BOOL and success == true):
15            if success == "InvalidUsernameError":
16                $Labels/ErrorLabel.text = "Invalid Username"
17            elif success == "IncorrectAnswerError":
18                $Labels/ErrorLabel.text = "Incorrect Answer"
19            else:
20                get_tree().change_scene_to_file("res://scenes/menu/login_form.tscn")
21        else:
22            $Labels/ErrorLabel.text = "Passwords Don't Match"
23
24
25
26 func _on_cancel_button_pressed() -> void:
27     get_tree().change_scene_to_file("res://scenes/menu/login_form.tscn")

```

save_meu.gd

```

1 extends Node2D
2
3 #Function to load the list
4 func _load_list():
5     for child in $SavesScroller/VBoxContainer.get_children():
6         child.queue_free()
7     var save_data_list = Database.get_user_save_data()
8     for save_data in save_data_list:
9         var button = Button.new()
10        var hardcore
11        if save_data["hardcore"] == 1:
12            hardcore = "True"
13        else:
14            hardcore = "False"
15        print(save_data)
16        button.text = "Name: %s\nLevel: %s \t Difficulty: %s\nHardcore: %s" % [save_data[
17            "name"], save_data["level"], save_data["difficulty"], hardcore]
18        button.connect("pressed", _on_save_selected.bind(save_data))
19        $SavesScroller/VBoxContainer.add_child(button)
20
21 # Called when the node enters the scene tree for the first time.
22 func _ready() -> void:
23     _load_list()
24
25 func _on_save_selected(save_data):
26     Database.current_save_id = save_data["save_id"]
27     Global.difficulty = save_data["difficulty"]
28     get_tree().change_scene_to_file("res://scenes/game/worlds/tutorial.tscn")
29
30 func _on_difficulty_drag_ended(value_changed: bool) -> void:
31     $Difficulty/DifficultyLabel.text = "Difficulty: " + str($Difficulty.value)
32

```

```

33
34 func _on_new_save_button_pressed() -> void:
35     Database.add_new_save_data($Name.text,$Difficulty.value,$HardcoreButton.button_pressed)
36     _load_list()
37
38
39
40 func _on_log_out_button_pressed() -> void:
41     get_tree().change_scene_to_file("res://scenes/menu/login_form.tscn")

```

5.3 src

database.gd

```

1 extends Node
2
3 var db = SQLite.new()
4 var current_user_id: int
5 var current_save_id: int
6
7 #region Prepared Statements
8
9 var _create_table_users = """
10 CREATE TABLE IF NOT EXISTS users (
11     user_id INTEGER PRIMARY KEY AUTOINCREMENT,
12     username VARCHAR(15) UNIQUE NOT NULL,
13     password VARCHAR(64) NOT NULL,
14     salt VARCHAR(64) NOT NULL,
15     answer VARCHAR(64) NOT NULL
16 );
17 """
18
19 var _get_user_data = """
20 SELECT * FROM users
21 WHERE username = ?;
22 """
23
24 var _add_new_user = """
25 --Assume hashed password and answer
26 INSERT INTO
27 users(username,password,answer,salt)
28 VALUES (?, ?, ?, ?);
29 """
30
31 var _delete_user = """
32 DELETE FROM users
33 WHERE username = ?;
34 """
35
36 var _reset_password = """
37 --Assume hashed password and answer
38 UPDATE users
39 SET password = ?
40 WHERE username = ?
41 """
42
43 var _create_table_save_data = """
44 CREATE TABLE IF NOT EXISTS save_data (
45     save_id INTEGER PRIMARY KEY AUTOINCREMENT,
46     user_id INTEGER,
47     name VARCHAR(32),
48     difficulty INTEGER,
49     hardcore INTEGER,
50     level INTEGER,
51     head VARCHAR(32),
52     chest VARCHAR(32),
53     legs VARCHAR(32),
54     weapon VARCHAR(32),
55     charm_1 VARCHAR(32),
56     charm_2 VARCHAR(32),
57     FOREIGN KEY(user_id) REFERENCES users(user_id) ON DELETE CASCADE
58 );
59 """
60
61 var _add_new_save_data = """
62 INSERT INTO

```

```
63 save_data(user_id,name,difficulty,hardcore,level)
64 VALUES (?,?,?,?,?,?);
65 """
66
67 var _get_save_data = """
68 SELECT * FROM save_data
69 WHERE user_id = ?
70 AND save_id = ?;
71 """
72
73 var _get_user_save_data = """
74 SELECT name, level, hardcore, save_id, difficulty FROM save_data
75 WHERE user_id = ?;
76 """
77
78 var _update_save_data = """
79 UPDATE save_data
80 SET
81 head = ?,
82 chest = ?,
83 legs = ?,
84 weapon = ?,
85 charm_1 = ?,
86 charm_2 = ?,
87 level = ?
88 WHERE
89 user_id = ?
90 AND save_id = ?;
91 """
92
93 var _create_table_stored_items = """
94 CREATE TABLE IF NOT EXISTS stored_items (
95 item_id INTEGER NOT NULL,
96 save_id INTEGER NOT NULL,
97 amount INTEGER NOT NULL,
98 PRIMARY KEY(item_id,save_id),
99 FOREIGN KEY(save_id) REFERENCES save_data(save_id) ON DELETE CASCADE
100 );
101 """
102
103 var _update_stored_item_amount = """
104 UPDATE stored_items
105 SET amount = amount + ?
106 WHERE item_id = ?
107 AND save_id = ?;
108 """
109
110 var _get_stored_items = """
111 SELECT * FROM stored_items
112 WHERE save_id = ?;
113 """
114
115 var _get_stored_item_amount = """
116 SELECT amount FROM stored_items
117 WHERE save_id = ?
118 AND item_id = ?;
119 """
120
121 var _add_stored_item = """
122 INSERT INTO
123 stored_items(save_id,item_id,amount)
124 VALUES (?,?,?);
125 """
126
127 var _count_stored_items = """
128 SELECT COUNT(*)
129 FROM stored_items
130 WHERE save_id = ?;
131 """
132
133 var _remove_stored_item = """
134 DELETE FROM stored_items
135 WHERE save_id = ?
136 AND item_id = ?;
137 """
138
139 var _get_slot_values = """
140 SELECT * FROM save_data
```

```

141 WHERE save_id = ?;
142 """
143
144 var _set_head_value = """
145 UPDATE save_data
146 SET head = ?
147 WHERE save_id = ?;
148 """
149
150 var _set_chest_value = """
151 UPDATE save_data
152 SET chest = ?
153 WHERE save_id = ?;
154 """
155
156 var _set_legs_value = """
157 UPDATE save_data
158 SET legs = ?
159 WHERE save_id = ?;
160 """
161
162 var _set_weapon_value = """
163 UPDATE save_data
164 SET weapon = ?
165 WHERE save_id = ?;
166 """
167
168 var _set_charm_1_value = """
169 UPDATE save_data
170 SET charm_1 = ?
171 WHERE save_id = ?;
172 """
173
174 var _set_charm_2_value = """
175 UPDATE save_data
176 SET charm_2 = ?
177 WHERE save_id = ?;
178 """
179
180 #endregion
181
182
183
184
185 #test
186 func test() -> void:
187
188     #Open or Create a database
189     db.path = "res://game_data.db"
190     db.open_db()
191     db.drop_table("users")
192     if not db.query(_create_table_users):
193         print("Error: users table unable to be created")
194         return
195
196
197
198     if db.query_with_bindings(_add_new_user,[ "user", "pass", "ans", "salt"]):
199         print("success")
200
201     db.query_with_bindings(_get_user_data,[ "user"])
202     print(db.query_result)
203     db.close_db()
204
205 #Function for generating salt
206 func gen_salt() -> String:
207     var salt = "string"
208     var x = randi_range(5,10)
209     for i in range(2**x):
210         salt = j_hash(salt,str(i*randi_range(1,10)))
211     return salt
212
213 #Function for hashing a password or challenge answer
214 func j_hash(string, salt):
215     var hashedString = string
216     #Repeating a consistent but unpredictable amount of times
217     #On even rounds the password is sandwiched on odd rounds the salt is sandwiched

```

```

218     #Alternating the use of sha256 and md5 but making sure to end on sha256 so the hash is a
219     #predictable length.
220     for x in range(1,6*len(string)+1):
221         if x % 2 == 0:
222             hashedString = (salt.substr(x,hashedString.length()-x)+hashedString+salt.
223                             substr(0,x)).md5_text().sha256_text()
224         else:
225             hashedString = (hashedString.substr(0,x)+salt+hashedString.substr(x,
226                             hashedString.length()-x)).sha256_text().md5_text()
227     return hashedString
228
229 #Function for creating a user
230 func add_user(username, password, answer):
231     var salt = gen_salt() #Generating new salt
232     var hashedPassword = j_hash(password, salt)
233     var hashedAnswer = j_hash(answer, salt)
234     if not db.query_with_bindings(_add_new_user,[username,hashedPassword,hashedAnswer,salt]):
235         #Tries to add user with hashed password and answer
236         return "InvalidUsernameError" #If user cannot be added then the username must be
237         invalid
238     return true
239 #Function for deleting a user
240 func delete_user(username, password):
241     db.query_with_bindings(_get_user_data,[username])
242     if len(db.query_result) == 0: # If user doesnt exist
243         return "InvalidUsernameError"
244     var user_data = db.query_result[0]
245     var hashed_password = j_hash(password,user_data["salt"])
246     if hashed_password == user_data["password"]: # Checking password hash against stored hash
247         db.query_with_bindings(_delete_user,[username]) # Deleting User
248         return true
249     return "IncorrectPasswordError" # If password doesnt match
250 #Function for logging in
251 func login(username,password):
252     db.query_with_bindings(_get_user_data,[username]) # Getting user data
253     if len(db.query_result) == 0: # If user doesnt exist
254         return "InvalidUsernameError"
255     var user_data = db.query_result[0]
256     var hashed_password = j_hash(password,user_data["salt"])
257     if hashed_password == user_data["password"]: # Checking password hash against stored hash
258         current_user_id = user_data["user_id"]
259         return true
260     return "IncorrectPasswordError" # If password doesnt match
261 #Function for resetting the password
262 func reset_password(username, answer, password):
263     db.query_with_bindings(_get_user_data,[username]) # Getting user data
264     if len(db.query_result) == 0: # If user doesnt exist
265         return "InvalidUsernameError"
266     var user_data = db.query_result[0]
267     var hashed_answer = j_hash(answer,user_data["salt"])
268     var hashed_password = j_hash(password, user_data["salt"])
269     if hashed_answer == user_data["answer"]: # Checking the answer hash against the stored
270         hash
271         db.query_with_bindings(_reset_password,[hashed_password,username])
272         return true
273     return "IncorrectAnswerError" # If answer doesnt match
274 #Function for counting the stored_items in the save
275 func count_stored_items():
276     db.query_with_bindings(_count_stored_items,[current_save_id])
277     return db.query_result[0]["COUNT(*)"]
278 #Function for getting the stored items in the save
279 func get_stored_items():
280     db.query_with_bindings(_get_stored_items,[current_save_id])
281     return db.query_result
282 #Function for getting the amount of a stored item in the save
283 func get_stored_item_amount(item_id):
284     db.query_with_bindings(_get_stored_item_amount,[current_save_id, item_id])
285     return db.query_result
286 #Function for updating the amount of a stored item in the save by adding an amount
287 func update_stored_item_amount(amount, item_id):
288     db.query_with_bindings(_update_stored_item_amount, [amount, item_id, current_save_id])
289     return db.query_result
290 #Function for adding a stored item into the save
291 func add_stored_item(item_id, amount):
292     db.query_with_bindings(_add_stored_item, [current_save_id, item_id, amount])
293     return db.query_result
294 #Function for removing a stored item from the save
295 func remove_stored_item(item_id):

```

```

290         db.query_with_bindings(_remove_stored_item, [current_save_id, item_id])
291     return db.query_result
292 #Function for getting a slot value from the save
293 func get_slot_value(slot):
294     db.query_with_bindings(_get_slot_values,[current_save_id])
295     if len(db.query_result) == 0:
296         return null
297     return db.query_result[0][slot]
298 #Function for setting a slot value in the save
299 func set_slot_value(slot, item_id):
300     match slot:
301         "head":
302             db.query_with_bindings(_set_head_value, [item_id, current_save_id])
303         "chest":
304             db.query_with_bindings(_set_chest_value, [item_id, current_save_id])
305         "legs":
306             db.query_with_bindings(_set_legs_value, [item_id, current_save_id])
307         "weapon":
308             db.query_with_bindings(_set_weapon_value, [item_id, current_save_id])
309         "charm_1":
310             db.query_with_bindings(_set_charm_1_value, [item_id, current_save_id])
311         "charm_2":
312             db.query_with_bindings(_set_charm_2_value, [item_id, current_save_id])
313     return db.query_result
314 #Function for getting the save data entries for the current user
315 func get_user_save_data():
316     db.query_with_bindings(_get_user_save_data,[current_user_id])
317     print(db.query_result)
318     return db.query_result
319 #Function to add a new save file for the current user
320 func add_new_save_data(name, difficulty, hardcore):
321     db.query_with_bindings(_add_new_save_data,[current_user_id, name, difficulty, hardcore,
322         1])
323     return db.query_result
324
325
326
327 #Function for setting up the database
328 func setup(path):
329     db.path = path
330     db.open_db()
331     if not db.query(_create_table_users):
332         print("Error: users table unable to be created")
333         return
334
335     if not db.query(_create_table_save_data):
336         print("Error: save_data table unable to be created")
337         return
338
339     if not db.query(_create_table_stored_items):
340         print("Error: stored_items table unable to be created")
341         return
342
343     db.query("PRAGMA foreign_keys = ON;") # Activates foreign key
344
345 func _ready() -> void:
346     setup("res://game_data.db")
347
348
349 func _exit_tree() -> void:
350     db.close_db()

```

inventory.gd

```

1 extends Node
2
3 var max_inventory_size = 100
4
5
6 func item_amount(item_id: String):
7     var query = Database.get_stored_item_amount(item_id)
8     if len(query) == 0:
9         return 0
10    return query[0]["amount"]
11
12
13

```

```

14 func add_item (item_id, amount):
15     if amount == 0:
16         return true
17     var item = load(item_id) # Loads the item
18     if Database.count_stored_items() >= max_inventory_size and not(item.stackable and
19         item_amount(item_id) != 0): # Full Inventory
20         return "FullInventoryError"
21     else :
22         # Checks if you can stack the item and either adds a new entry or stacks it
23         if item_amount(item_id) != 0 and item.stackable: # If the item is in the database
24             Database.update_stored_item_amount(amount, item_id)
25         else:
26             Database.add_stored_item(item_id, 1)
27             add_item(item_id,amount-1)
28     return true
29
30 func remove_item(item_id, amount):
31     var amount_stored = item_amount(item_id)
32     if amount_stored != 0: # If the item is in the database
33         if amount_stored < amount: # Not enough items
34             return "ItemQuantityError"
35         elif amount_stored == amount: # Exactly enough items
36             Database.remove_stored_item(item_id)
37         else :
38             Database.update_stored_item_amount(-amount, item_id) # Removes the
39             amount of that item
40     return true # Indicates that it was successful
41     return "ItemQuantityError"
42
43 func unequip_item(slot):
44     # Gets the slot value
45     var value = Database.get_slot_value(slot)
46     # Checks if there is an item to unequip
47     if value != null:
48         var success = add_item(value, 1)
49         if (not(success is bool) and success == "FullInventoryError"): # Adds the item
50             back to the stored_items/checks if the inventory is full
51             return "FullInventoryError"
52         Database.set_slot_value(slot, null) # Sets the slot back to null
53     return true
54
55
56 func equip_item(item_id):
57     var slot: String
58     var item = load(item_id) # Loads the item
59     # Checks if the item is Equipable
60     if not(item is Equipable):
61         return false
62     # Gets the slot to equip it into
63     if item is Armour:
64         slot = item.body_part
65     elif item is Weapon:
66         slot = "weapon"
67     else:
68         if Database.get_slot_value("charm_1") == null:
69             slot = "charm_1"
70         else:
71             slot = "charm_2"
72     remove_item(item_id,1)
73     var success = unequip_item(slot) # Checks the success of unequipping the item
74     if not(success is bool) and success == "FullInventoryError":
75         add_item(item_id,1)
76         return "FullInventoryError"
77     Database.set_slot_value(slot, item_id) # Equips the item
78     return true
79
80
81 func _ready() -> void:
82     equip_item("res://resources/equipable/weapon/test_weapon_magic_area.tres")

```

global.gd

```

1 extends Node
2 var difficulty: int = 1
3 var current_level: int = 1

```

```

4
5 func await_call(n:int,f:Callable):
6     await get_tree().create_timer(n).timeout
7     f.call(1)
8
9 func quit():
10    get_tree().quit()
11
12 func _input(event: InputEvent) -> void:
13     if event.is_action_pressed("help"):
14         var help_menu = load("res://scenes/menu/help_menu.tscn").instantiate()
15         add_child(help_menu)
16         get_tree().paused = true
17         await get_tree().create_timer(0.2).timeout
18         while not Input.is_action_just_pressed("help"):
19             await get_tree().process_frame
20             help_menu.queue_free()
21             get_tree().paused = false
22         elif event.is_action_pressed("inventory"):
23             var inventory_ui = load("res://scenes/game/player/inventory_ui.tscn").instantiate()
24                 ()
25             var player = get_tree().get_first_node_in_group("player")
26             player.get_child(3).visible = false
27             add_child(inventory_ui)
28             get_tree().paused = true
29             await get_tree().create_timer(0.2).timeout
30             while not Input.is_action_just_pressed("inventory"):
31                 await get_tree().process_frame
32             inventory_ui.queue_free()
33             player.get_child(3).visible = true
34             get_tree().paused = false

```

5.4 utils

dummy.gd

```

1 extends StaticBody2D
2 var damage_taken = 0
3
4 func _ready() -> void:
5     add_to_group("enemies")
6
7 func take_damage(damage, damage_type):
8     print("AAAAAAAAAAAA")
9     print(damage)
10    print(damage_type)
11    damage_taken -= damage
12    print(damage_taken)

```

test.gd

```

1 extends Node2D
2
3
4 var db = preload("res://src/database.gd").new()
5
6 func _ready() -> void:
7     if Engine.is_editor_hint():
8         print("yay")
9     print(Engine.get_singleton_list())
10    var path = "res://utils/test.db"
11    var dir = DirAccess.open("res://utils")
12
13    if dir.file_exists("test.db"):
14        var err = dir.remove("test.db")
15
16    db.setup(path)
17    test_database()
18    db.db.close_db()
19    test_inventory()
20    Database.db.close_db()
21
22 func test_database():
23     #Criteria 6.
24     print("6.1:")

```

```

25     print((len(db.gen_salt()) == 64) and (db.gen_salt() != db.gen_salt())) # Test 6.1.1
26     print(len(db.j_hash("password", "salt")) == 64) # Test 6.1.2
27     print(db.j_hash("password", "salt") == db.j_hash("password", "salt")) # Test 6.1.3
28     print(db.j_hash("password", "salt") != db.j_hash("Password", "salt")) # Test 6.1.4
29
30     print("6.3")
31     print(db.add_user("Hyrule", "Password", "Answer")) # Test 6.3.1
32     print(db.add_user("Hyrule", "Password", "Answer") == "InvalidUsernameError") # Test 6.3.2
33
34     print("6.7,6.8,6.10")
35     print(db.login("Hyrule", "Password") == "InvalidUsernameError") # Test 6.7.1
36     print(db.login("Hyrule", "Password")) # Test 6.7.2
37     print(db.reset_password("Hyrule", "Answer", "password") == "InvalidUsernameError") # Test
38         6.8.1
38     print(db.reset_password("Hyrule", "answer", "password") == "IncorrectAnswerError") # Test
39         6.8.2
39     print(db.reset_password("Hyrule", "Answer", "password")) # Test 6.8.3
40     print(db.login("Hyrule", "Password") == "IncorrectPasswordError") # Test 6.7.3
41
42     print(db.delete_user("Hyrule", "Password") == "IncorrectPasswordError") # Test 6.10.1
43     print(db.delete_user("Hyrule", "password")) # Test 6.10.2
44     print(db.reset_password("Hyrule", "Answer", "password") == "InvalidUsernameError") # Test
44         6.7.4
45
46
47 func test_inventory():
48     Database.add_user("test", "password", "answer")
49     Database.login("test", "password")
50     Database.add_new_save_data(1, true)
51     Database.current_save_id = Database.get_user_save_data()[0]["save_id"]
52     Inventory.max_inventory_size = 1
53     #Criteria 12
54     print(Inventory.add_item("res://utils/test_item.tres", 2)) # Test 12.5.1
55     print(Inventory.item_amount("res://utils/test_item.tres") == 2)
56     print(Inventory.add_item("res://utils/test_item.tres", 3)) # Test 12.5.2
57     print(Inventory.add_item("res://utils/test_weapon.tres", 1) == "FullInventoryError") #
57         Test 12.5.3
58     print(Inventory.item_amount("res://utils/test_item.tres") == 5)
59     print(Inventory.remove_item("res://utils/test_item.tres", 2)) # Test 12.5.4
60     print(Inventory.item_amount("res://utils/test_item.tres") == 3)
61     print(Inventory.remove_item("res://utils/test_item.tres", 10) == "ItemQuantityError") #
61         Test 12.5.5
62     print(Inventory.remove_item("res://utils/test_item.tres", 3)) # Test 12.5.6
63     print(Inventory.item_amount("res://utils/test_item.tres") == 0)
64     print(Inventory.remove_item("res://utils/test_item.tres", 2) == "ItemQuantityError") #
64         Test 12.5.7
65     print(Inventory.unequip_item("head")) # Test 12.4.1
66     Inventory.add_item("res://utils/test_helmet.tres", 1) #Test 12.4.2
67     print(Inventory.equip_item("res://utils/test_helmet.tres"))
68     print(Database.get_slot_value("head") == "res://utils/test_helmet.tres")
69     print(Inventory.item_amount("res://utils/test_helmet.tres") == 0)
70     Inventory.add_item("res://utils/test_helmet2.tres", 1) # Test 12.4.3
71     print(Inventory.equip_item("res://utils/test_helmet2.tres"))
72     print(Inventory.item_amount("res://utils/test_helmet.tres") == 1)
73     print(Inventory.unequip_item("head") == "FullInventoryError") # Test 12.4.4
74     Inventory.remove_item("res://utils/test_helmet.tres", 1) # Test 12.4.5
75     print(Inventory.unequip_item("head"))
76
77
78     Database.delete_user("test", "password")

```