NEA

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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 alot 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 alot 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 where 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
- ${\it 3. \ Procedurally \ Generated \ Dungeons.}$
- 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	18 year old Male Sixth Form Computer	Sam will use my solution for
Vanderstelt-Hook	Science Student, Casual Gamer who	casual gaming for fun as a break
	enjoys a wide range of games.	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	18 year old Male A Level Computer	Daniel will use my solution as a
Scheper	Science Student	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 Sixth Form Student	Peter will use my solution as a
1 over Builli	and aspiring hobbyist game developer.	form of entertainment after
		studies and as he loves Dungeon
		Crawl Style games. He needs a
		replayable game with an
	115	intuitive combat system.
Sadiya Shorkar	17 year old Female Student and	Sadiya will use my solution as a
v	Casual Video Game Enjoyer	form of casual entertainment for
		short sessions. Sadiya has seizures and so needs
		accessibility options like volume
		control and options for less
	18 year old Female Sixth Form	vibrancy. Penny will use my product for
Penelope Castiau	Student, Avid Computer Gaming	entertainment purposes and to
	Enjoyer and Hobbyist Streamer.	play on stream. Because of this
	Enjoyer and Hobbytst bucamer.	Penny needs subtitles to make
		the game easy to follow for
		viewers.
CL C	17 year old Female College Student	Steff will use my product to
Steff	and Game Developer	relax from studies. Steff needs a
	_	replayable game but also want it
		to be engaging.
	1	

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 reccuring theme/difficulty which allows for lots of replay oppurtunity. This would be an appropriate way for me to fix the replayabilty 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.

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.



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.

However due to the game being aimed at more hardcore gamers with it being part of the rouguelike genre it can often appear complex and offputting to newer players who dont 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.

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 and allows for alot 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 increase replayability as well as its approach to tutorials in order to make the learning curve steeper. Ontop 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.

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. Ontop 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. Alternatively they will use the left control stick of a controller.	This will be used tp navigate around the Dungeon environment and WASD was the most popular control mechanism for the stakeholders with controller close behind. I will also include mouse buttons as a non-mandatory addition.
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 sheild 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.
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.
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.
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 lets you know where your character is on screen aswell as giving life to the actions the player is performing.
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.
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 give them the necessary information.

1.6.2 Desireable Features

Feature#	Feature	Description	Justification
8	Weapons and a more Advanced	A system of weapons where you can get them from boss drops	Different weapons will allow each player to have a playstyle
	Combat System.	and potentially shops and a	more customized to them and
	Compat System.	combat system with normal,	will allow for the player getting
		charged (based on how long you	stronger as they progress more.
		hold down) and special attacks	An advanced combat system
		(using a special key).	will allow for a more smooth
			and enjoyable fighting
			experience.
9	Skill Tree	A skill tree to unlock unique	This would further allow the
		skills/abilities and get better at	player to choose their own play
		using existing skills/weapons.	style and add an element of
		You would gain points from	replayability where you can try
		playing the game and can then put them into different areas in	going for a different build each
		order to create a customized	time you play. This was also requested by the stakeholders.
		character build	requested by the stakeholders.
10	Procedurally	The Dungeons would be	This would create a more
	Generated	procedurally generated whilst	engaging game which is different
	Dungeons	keeping some amount of	each time you play it and
		structure (e.g. the same amount	therefore increase replayability
		of distance between posses and	exponentially as the different
		key rooms). This would happen	combinations of room increases.
		through many similar small	This was also requested by the
		room sections that can be	stakeholders.
		slotted together in order to	
11		make a full dungeon.	
11	Hidden Areas	Secret areas that can be	This feature was highly
		unlocked through wasy such as progressing further in the game	requested by the stakeholders and would allow for more time
		and coming back or through	spent having fun in the game
		puzzles/fake walls. Could have	through finding these areas.
		secret loot or bosses.	unrough midnig these areas.
12	T	An Inventory to be opened with	An Inventory System is an
-	Inventory Sysetm	the E key or the + button	essential feature if we want to
		through which you will manage	add more weapons/weapon
		equipped weapons, key items,	types and a skill tree.
		skills and more.	
13	Settings and	A settings page to control the	One of the Stakeholders has
	Volume Control	volume of noises aswell as the	requested this as a feature to
		vibrancy of colours.	help the game be more
	Dim 1: 7	A D. (6)	accessible to them.
14	Difficulty Levels	A Difficulty level selector which	50% of the stakeholders are
	and Hardcore	allows the user to up the	experienced with Dungeon
	Mode	difficulty(damage the enemies	Crawlers so in order to help the
		do etc) and a Hardcore Mode	game still be reasonably
		which switches the game to a	challening for them I will add a
		roguelike format with seperate	difficulty toggle.
	Candidate No. 1209	save state to the normal game.	

1.7 Success Criteria

Criteria #	Abstraction	Success Criteria	Justification
1	Players to	1.1 W key - Forward	These Criteria need to be
	be able to	1.2 A key - Left	met for the character to
	control and move the	1.3 S key - Backward 1.4 D key- Right	be controllable by the player. These specific
	player using	1.5 Left Control Stick directional	controls where preffered
	both the	movement corresponds to player	by the stakeholders.
	WASD keys	movement.	by the stancholders.
	and a		
	controller.		
2	Players to be	2.1 mouse-1/1 key/X button - Primary	These criteria need to be
	able to have	Attack	met for a basic combat
	different	2.2 mouse-2/2 key/Y button -	system to create the main
	weapons and	Secondary Attack	difficulty and
	attack with	2.3 Add a basic melee sword	entertainment throughout
	them.	2.4 Add a basic ranged bow and	the game
		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 Add the ability to lock facing an	
		enemy	
		2.10 Make sure all attacks go in the	
		correct direction	
3	A Dungeon	3.1 Walls that you cannot walk	These Criteria will
	environment	through	provide the environment
	for the	3.2 Floor of the Dungeon	within which the game is
	character to	3.3 Interactive chests for loot	played.
	walk around	3.4 Seperate Boss, Chest, Monster and	
	and different	Shop Rooms	
	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	
4	Different	4.1 Enemy Sprites	These Criterie need to be
	Enemies for	4.2 Enemy Pathfinding Abilities	met in order to provide
	the player to	4.3 Enemy sight range	enemies in order to
	face	4.4 Enemy hitbox	provide the challenge
	including	4.5 Enemy health tracking	throughout the game.
	bosses	4.6 Melee Enemies	
		4.7 Projectile Enemies	
		4.8 Boss Enemies with different attack	
		combinations	

5	Appearance	5.1 Player Sprite	These Criteria will
	and	5.2 Walking Animation	provide the visual
	Animations	5.3 Player sprite turns to face the	animations so the player
	of the Player	direction of movement	knows where they are
	5.4 Melee Animation		attacking and moving
		5.5 Magic Animation	
		5.6 Bow Animation	
6	Login	6.1 Password Hashing Algorithm	These Criteria will
	System	6.2 SQL Table to store username and	provide a Login system in
		hashed password pairs	order to allow multiple
		6.3 Ability to create a new account	users to login whilst
		with unique username	keeping user data secure
		6.4 Validation of Usernames	and accessible by that
		$(1 \le \text{chars} < 15)$	user.
		6.5 Validation of passwords (One	
		Special Character, One Number, At	
		least 8 Characters, One upper and	
		lower case character)	
		6.6 Input Sanitisation (Removing any	
		escape chars for SQL before sending	
		the command)	
		6.7 Ability to log in with an exisiting	
		account and correct password	
		6.8 Ability to reset password (If admin	
		account)	
		6.9 A general login form which links	
		the other forms	
7	User	7.1 Health Bar	These Criteria allow the
	Interface	7.2 Magic Points Bar	key information to be
		7.3 Display of the weapon being used	displayed to the user
		7.4 Popup display with enemy health	aswell as the user being
		over their head when they get	able to change what
		damaged	weapon they have
		7.5 ability to switch between weapons	equipped

8	Weapons	8.1 Different Styles of melee, magic	These Criteria would
	And a More	and ranged weapons	allow for a more complex
	Advanced	8.2 Item pick up	combat system to
	Combat	8.3 Boss Drops	increase differences in the
	System	8.4 Shop System that appears	way you play
		throughout levels	
		8.5 Charged Attacks (based on how	
		long you hold down)	
		8.6 Special attacks	
9	Skill Tree	9.1 UI Menu for the skill tree (Some	These Criteria will fulfill
	Skiii 11ee	skills required before others unlocked).	a stakeholder desire and
		9.2 Different Branches (Melee,	will allow the game to
		Ranged, Magic, Defense)	have more complexity
		9.3 Experience system.	and replayability
		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	
10	Procedurally	10.1 Creating requirements for each	These criteria will help to
	Generated	level to satisfy	add a ton of replayability
	Dungeons	10.2 Creating differnt room	to the game aswell as
		sections/rooms to peice together	being requested by
		10.3 Creating the algorithm to	stakeholders
		generate which room sections are	
		slotted together where.	
		10.4 Create an algorithm to peice the	
		sections together to create a fully	
		playable level.	
		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.)	
11	Hidden	11.1 Add mechanics to get into the	These Criteria will make
	Areas	secret rooms (breakable walls, climbing	the game more engaging
		vines, keys, etc.)	as well as being requested
		11.1.1 Add a hammer to break	by the stakeholders
		walls with	
		11.1.2 Add climbing gloves which	
		you need in order to climb vines	
		11.2 Add secret Boss and Treasure	
10	T .	rooms for behind these obstacles.	(77)
12	Inventory	12.1 UI for Inventory	These criteria will allow
	System	12.2 Storage of Extra weapons and key	for more complexity in
		items (keys, armour, charms, etc)	the game and more
		12.3 E key to open up the inventory	customized and diverse
		12.4 Ability to switch out what	playthrough options
		Weapons, Armour and charms are	which allows for more
		equipped.	replayability

13	Settings and	13.1 Settings UI with buttons for each	These criteria have been
	Volume	setting	requested by stakeholders
	Control	13.2 Ability to control the volume	as a way to increase the
		13.3 Ability to control the vibrancy of	accessibility of the game
		colours in the game.	to them
14	Difficulty	14.1 A slider for difficulty in the	These criteria will allow
	Levels and	settings menu	those of the stakeholders
	Hardcore	14.2 Increasing difficulty based on the	who have more
	Mode	slider	experience in dungeon
		14.2.1 Increasing enemy health	crawlers as well as those
		14.2.2 Decreasing player health	that have played the
		14.2.3 Increasing number of	game more to up the
		enemies	difficulty and it increases
		14.3 A Hardcore mode at maximum	the replayabilty through
		difficulty with a seperate save state to	different challenges.
		the normal game.	
		14.3.1 roguelike features	
		(permadeath, resource	
		management, etc)	

1.8 Computational Methods

2 Design

2.1 Database Design

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

2.1.1 ERD

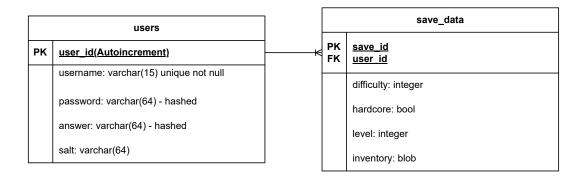


Figure 2: Database Design

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.

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	$users, save_data$	SQL is case insensitive so
Fields	Singular snake_case	inventory_content, username	with CamelCase it cann't tell the difference between undervalue and
Keys	singular snake_case_table_id	user_id, save_data_id	underValue

2.2.1 SQL Queries

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

	or each of the actions I want	
Name	Description/Justification Create's a table for	SQL
${\it create Table Users}$	Users if it does not exist.	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);
${ m getUserData}$	Returns the user data assuming it exists. If it doesnt it will return null.	SELECT * FROM users WHERE username = ?;
${\rm addNewUser}$	Inserts a new user into users with username, password, challenge question answer and salt	Assume hashed password and answer INSERT INTO users(username,password,answer,salt) VALUES (?,?,?,?);
${\it resetPassword}$	Changes a users password	Assume hashed password and answer UPDATE TABLE users SET invalidCount = 0 WHERE username = ?
$create Table Save_Data$	Create's a table for save_data if it does not exist.	CREATE TABLE IF NOT EXISTS save_data (save_id INTEGER AUTOINCREMENT, user_id INTEGER, difficulty INTEGER, hardcore INTEGER, level INTEGER, inventory BLOB DEFAULT x'7b7d');x'7b7d' is the representation of ''
$add New Save_Data$	Add's new save data for a user.	INSERT INTO save_data(user_id,difficulty,hardcore,level) VALUES (?,?,?,?)
getSave_Data	Get's the save data with a specific user_id and save_id	<pre>SELECT * FROM users WHERE user_id = ? AND save_id = ?</pre>
userSave_Data	Get's the save data for all entries with a specific user_id	SELECT * FROM users WHERE user_id = ?
updateSave_Data	updateSave	<pre>UPDATE save_data SET inventory = ?, level = ? WHERE user_id = ? AND save_id = ?</pre>

2.3 Login System

2.3.1 Activity Diagram

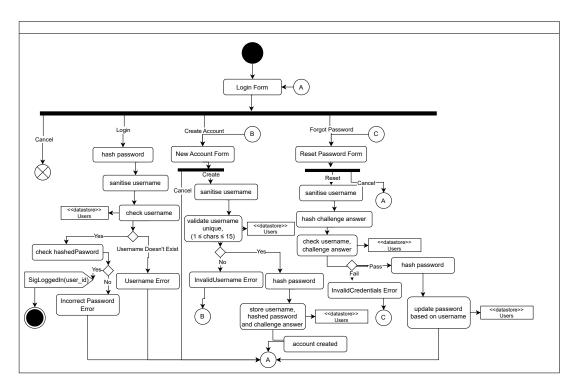


Figure 3: Activity Diagram for login forms

The login form will allow users to create accounts as well as login with an existing account and reset a password.

Upon successful login the user will be redirected to the GAME system.

2.3.2 Mockup Forms







Figure 4: Login Form

Figure 5: New Account Form Figure 6: Reset Password Form

These forms would be used in order to create an account, reset your password and login.

3 References

REF#	Date	Topic/Abstract	Type	URL or BOOK reference	How I used this
1	1/6/24	Research/Existing	video games	https://store.steampowered	One of the
		Solutions	store, online	.com/app/113200/	exisiting solutions I
				The_Binding_of_Isaac	researched.
2	15/6/24	Research/Existing	video games	https://store.steampowered	One of the existing
		Solutions	store, online	.com/app/588650/	solutions I
				Dead_Cells	researched
3	15/6/24	Research/Existing	youtube	https://www.youtube.com	A dev log for an
		Solutions	video, online	/watch?vtyMrRWLi_I	existing solution.
4	15/6/24	Research/Existing	blog, online	https://robertheaton.com	An existing
		Solutions	blog, offiffie	/2018/12/17/wavefunction-	algorithm I
				collapsealgorithm/	researched.
5	25/11/24	Research/	video games	https://store.nintendo.co	One of the existing
		Exisiting Solutions	store, online	.uk/en/the-legend-of-	solutions I
		Existing Solutions		zelda-breath-of-the-wild-	researched
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