Hamlin

"Guitar Hero and Zelda have a kid, but it's a rat!"

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Hamlin is a music learning game inspired by the legend of the Pied Piper of Hamlin. We continue the legend many years later - but from a rat's perspective! Since the Piper's arrest, music has been banned for its dangerous magical powers and now silence reigns throughout the land of Espero - or so it is believed. But a few brave believers in the power of music have been guarding its secrets, waiting for a hero with enough musical talent to bring melody and joy back to the people of Espero...

Contents

1 Overview

1.1 Main Concept

The game's core concept is to teach music in a fun and engaging manner through exploration of an open world. As they progress through the storyline the player learns musical scales, rhythm, chords and simple melodies, using their computer keyboard as a piano keyboard to play different instruments. The player wins the game by mastering the correct scales and melodies to defeat all the monsters.

1.2 Unique Selling Point

Hamlin's unique selling point is that it combines the simple and fun musical interaction of games such as *Guitar Hero* with a genuine educational aspect: the player learns real music theory through the gameplay, not just how to push buttons in time to cues on a screen! Hamlin enables anyone to learn music theory, whether for personal interest or in preparation for a music exam.

2 References

As part of our initial design process, we carried out market research on existing music games; listed below are a selection of the main available games.

2.1 Piano Wizard Academy

This is a PC game primarily marketed at children, which teaches them how to play the piano using a MIDI keyboard. There is no open-world exploration in the game; a simple animated background is shown for each piece of music, with this background serving as a simpler alternative to standard musical notation. For example, one background is an underwater scene with piano keys at the top and floating bubbles to show the user which key to press when. The game does not support any additional instruments.

2.2 Earmaster

This is an ear training program which trains the player to recognize intervals, notes, scales and chords by ear. It is a purely educational tool with no storyline or game world, but does teach music theory.

2.3 Singstar

In Singstar the user needs to follow a pitch line on the screen and sing correctly. It is similar to karaoke with an achievement system where the player earns points if they sing with the correct pitch. This aspect of the game is similar to Hamlin, but Singstar features no open-world exploration and no keyboard interface; the only instrument is the player's voice. We are however considering implementing microphone pitch detection as used in Singstar as an optional feature in Hamlin (for players with access to a microphone).

2.4 Guitar Hero

In the Guitar Hero series of games players can select from a variety of instruments which are played using external controllers (for example, plastic guitars with touch pads instead of strings). These games teach the basics of rhythm as players must play notes at the correct time (as shown by visual cues on screen). The series is fun to play and immensely popular but doesn't aim to teach music theory; it is primarily about enjoying the music, and the player can succeed in the game by simply learning the right rhythmic patterns whilst never learning about the relations between the chords or melodies.

We have also drawn inspiration from several games unrelated to music:

2.5 Zelda Ocarina of Time

In this game, the player is a hero who fights monsters and can travel in time by playing an ocarina. It features a massive open world with an engaging storyline and soundtrack. It has no educational music aspect to it but was a strong inspiration for Hamlin's open world exploration and narrative.

2.6 Pokémon

In this series the player fights and collects free roaming monsters in an open world. Once collected, monsters can be used in competition with other monsters (the goal famously being to "catch them all"). Like Zelda it has no music teaching element but was an inspiration for Hamlin's open world.

3 Specification

3.1 Target Group

From children to the elderly, interest in music is universal and so we hope that Hamlin will appeal to a wide range of players. The game includes scales of varying complexity so is appropriate for players with a range of skill levels in musical theory.

3.2 Genre

Hamlin is of course a music game! It has a strong educational aspect, challenging the player to develop their knowledge of melody and rhythm, and also an artistic aspect in its emphasis on discovering music and appreciation of the power of music. Thanks to its narrative and large open-world it is also an exploratory adventure game.

3.3 Art Style

Hamlin uses low poly art as its primary artistic style. As its name suggests, low poly art uses 3D models with a relatively low number of polygons to achieve a distinctive visual style which we feel is well suited to the game's mood and narrative (see figures 3.1, 3.2 and 3.3).

The low-poly 3D models for Hamlin and the monk characters were all designed and animated from scratch in 3DS Max, as were all the environmental objects and buildings in the game. This took up a significant proportion of the development time but allowed us to develop our 3D modelling skills and provide the game with a unique artistic style.

3.4 Forms of Engagement

In terms of the 8 forms of player engagement defined by Hunicke, the game's primary form of engagement is expression ('game as self-discovery'), because the game's main focus is enabling the player to discover different styles of music and express themselves musically. The player also engages with the game's narrative as they find out more about Hamlin's world and meet the world's inhabitants. The game is therefore ideally suited to 'achiever' and 'explorer' player types.

Figure 3.1: Low poly art in Hamlin (in-game screenshot)

Figure 3.2: Hamlin 3D model

Figure 3.3: Monk 3D model

4 Gameplay and Game Setting

The player interacts with the game using the computer keyboard as a piano. When a monster appears the player must play scales, chord transitions or melodies to lure the monster away; the musical complexity depends on the player's current progress through the game, and each monster requires different music.

In terms of the technical implementation, the scales (for example the chromatic, major, minor, harmonic minor, and melodic minor scales) and chords (for example major, minor, diminished, diminished seventh, and half diminished seventh chords) are stored as arrays of integers, which describe sequences of notes in terms of their interval from the key note. The notes played are displayed on a stave in the UI, with correct and incorrect notes clearly distinguished by different colours. Outside of practice areas, the player also loses health if they play the wrong note when fighting a monster.

As an example of how this works, take the C Major scale. In MIDI Reference Notation (see Appendix for details) a C in the 5th Octave has the number 60. So a major scale with offsets 0, 2, 4, 5, 7, 9, 11 from key note C in 5th Octave will result in the required input sequence 60, 62, 64, 65, 67, 69, 71 (which are all mapped to keyboard keys to match a piano keyboard as closely as possible; the player does not need to type in these numbers!).

In story mode the player is gradually introduced to scales, starting with the easiest first; the more flats or sharps are involved then the more difficult the sequence is to play. In the procedural adventure mode the scales are randomly chosen and are significantly more challenging.

4.1 Mood and Emotions

The game is designed to be a fun exploration of music and to also be suitable for children, so although the initial back story is sad we have not created a particularly dark mood in the game. The aim is to provide a friendly learning environment for the player.

4.2 Story

The game's initial narration explains how Espero used to be a happy land, full of singing and life, because a magician known as the Pied Piper fought away all the music-hating monsters with the beautiful sound of his magic flute; no evil could bear to hear such beauty, so he could bend them to his will. But his talent became his downfall, for people grew afraid of his magic and feared that one day he might wield his great musical power for evil. A terrible movement began which denounced music itself as evil, and the people of Espero locked the Pied Piper away.

As the rat Hamlin, the player discovers the Piper's long-lost flute and journeys through Espero to discover the flute's true purpose. Since the Piper's arrest, music has been banned for its dangerous magical powers and now silence reigns throughout the land of Espero -
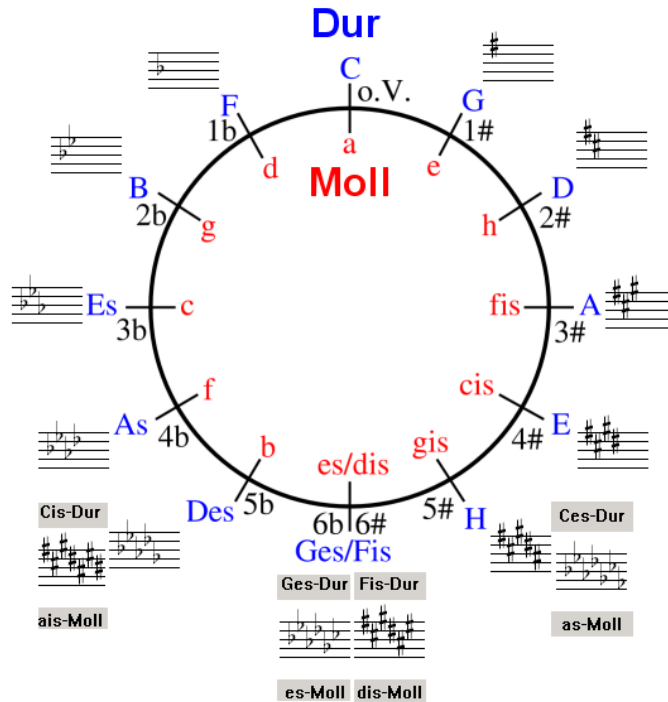
Figure 4.1: The circle of fifths

or so it is believed. But a few brave believers in the power of music have been guarding its secrets, waiting for a hero with enough musical talent to bring melody and joy back to the people of Espero. And heroes can come in the most unusual of forms - sometimes even in rat form! Hamlin's journey takes the player through the whole history of music as he meets the people who still believe in music, from the monks guarding the secrets of choral music to the outlaws and their subversive jazz.

4.3 World/Environment

The setting of the game is a 3D open world. In story mode the player explores levels which are themed and heavily narrative-driven; the player still has freedom to explore but the size of the world is limited (See Figures 4.2 and 4.3 for screenshots of the monastery world). In adventure mode they have complete freedom to explore as the terrain is procedurally generated and theoretically infinite (in practice, this "infinity" is subject to memory constraints!).

4.3.1 Procedural Generation

We investigated procedural terrain generation techniques to determine the best approach. By far the most popular approach is to use layers ("octaves") of Perlin noise to generate a height map and mesh and then layer textures over this. We follow this approach in the game to generate interconnected terrain chunks, with a set number of monsters spawned randomly within each chunk. There are a wide variety of different terrain generation algorithms so there is potential to develop this much further. For example, some more complex algorithms aim to model real-world features such as biomes and tectonic plates.
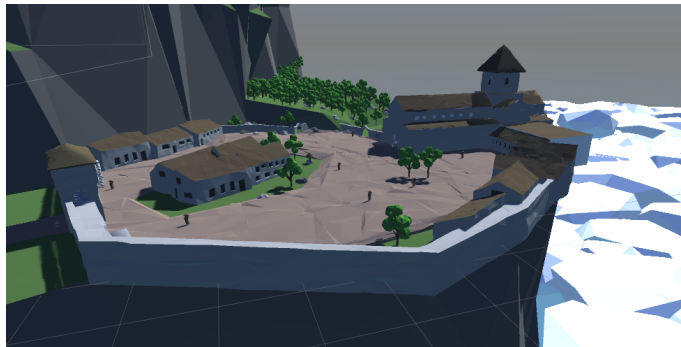
Figure 4.2: The monastery from the first level

Figure 4.3: Overview of monastery area

4.4 Objects in the Game

The core focus of the game is the musical instruments Hamlin discovers as he progresses through the themed musical history levels. The game also features a wide variety of static buildings and environmental objects such as rocks and trees.

4.5 Characters in the Game

The game's main character is the rat Hamlin. The game's world features a variety of monsters (see Figure 4.3), named for their musical weaknesses (for example Pythagorian or F# Dorian monsters). The player also meets a variety of human NPCs, some of whom have been guarding the secrets of music (such as monks, rockers and the jazz outlaws), and others who have only ever known silence and are introduced to the power of music by Hamlin.

4.6 Main Objective

The player's main objective is to defeat all the monsters by playing music so that the joy of music can safely be reintroduced to the people of Espero. In terms of educational objectives, the game teaches the player the basics of musical theory up to a high school level.

4.7 Core Mechanics

4.7.1 Achievement System

We plan to implement an achievement system with instruments as rewards, where the player is rewarded with new instruments (and a corresponding new chapter in the history of music) as they progress through the game levels. These instruments reflect the theme of the current level (for example an electric guitar in the rock-themed level). The player begins the game with Piper's magic flute as their sole instrument.

4.7.2 Levels

The procedurally generated open world is populated by music-hating monsters who roam around. They can be defeated by playing music styles, scales and chords specific to each monster, allowing the player to practice the musical theory they have learnt. In the themed cities (levels), the player learns new aspects of music from the NPCs guarding music's secrets. Once these have been mastered, they must free the city by using what they have learnt to defeat the monsters in the city.

The concept is that each city covers different aspects of musical theory and has a different 'theme' or period of musical history. The original plan for the musical themes of each level was as follows:

Level	Instrument	Learning Aspect
Monk	Flute	Scales
Classic I	Harp	Chords
Classic II	Piano	Chord Arpeggios
Blues	Acoustic Guitar	Chords Progressions
Rock	Electric Guitar/Drums	Rhythms
Pop	Electronics/Synthesizer	Polyrhythms
Jazz	Saxophone	Jazz Scales/Chords

Table 4.1: Level Themes

Given the limited time frame of the project we did not have sufficient time to create all our planned levels. We seriously underestimated the steep learning curve we faced learning 3D modelling and game development in Unity! We therefore focused on creating the initial Monk level featuring the Pied Piper's flute and a curriculum of basic music theory and scales; we plan to add three further levels for the complete base game, and the later levels could be released as separate DLC packs.

4.8 Controls

The player controls Hamlin using the arrow keys to run around in the world and uses the mouse to rotate the camera to look around. To play instruments in the game the player uses their computer keyboard using a standard computer keyboard to piano keyboard mapping shown in the figure below (as used in audio production software). This is designed to be as close to the experience of using a real piano keyboard as possible. Obviously this approach is less realistic for instruments other than piano; the keys still map to the same notes, but they do not correspond to the button combinations / strings used to play that note on

the given instrument. The game also supports MIDI keyboards for players with access to them.

Figure 4.4: Monster 3D model

Figure 4.5: Computer keyboard to piano keyboard mapping

5 Front End

The UI during play has been developed with a very simple and unobtrusive design so that the player can be completely immersed in the game, and the game plays by default in fullscreen.

5.1 Start Screen and Menus

The start screen presents the standard PC game menu buttons of "Play", "Options" (featuring audio, input and graphical settings), "Credits" and "Exit", all leading to further menu screens. "Play" allows the player to choose between the Story and Adventure modes; selecting Story mode shows an optional introduction to the story featuring audio narration and game concept art.
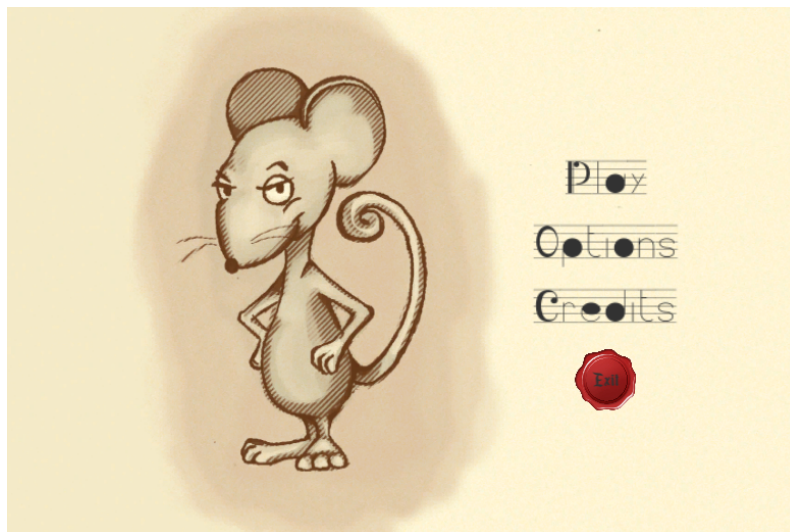
Figure 5.1: The main menu screen

The UI theme has a medieval style with musical details, for example a musical stave font, wax stamps as buttons, "Abrazado a la tristeza" as background music and an antique-looking background image featuring the main character Hamlin.

5.2 End Screens

The win screen consists of a happy image of the main character surrounded by music to congratulate the player on completing a level; after the final level this is followed by the credits with the names and photos of the game developers. In contrast, if the player loses they are met with a sinister Game Over screen before returning to the main menu.

Figure 5.2: The game over screen shown when the player runs out of health

Figure 5.3: Win screen shown on completing a level

Figure 5.4: Credits screen shown at the end of the game

6 Technology

6.1 Target Systems

The target platform is desktop PCs (Windows, Mac, Linux). We currently have no plans to develop the game on mobile platforms as they are not well suited to realistically simulating a piano keyboard.

6.2 Hardware

The game supports MIDI controllers for playing the instruments, but we expect most users to play the game using a standard computer keyboard.

The keyboard to piano mapping uses the standard layout common in audio production software (see Section 4.8).

6.3 Development Systems/Tools

Our primary development tools are Unity and Visual Studio, which we used to design and script the game's levels. Other software tools include Reaper for creating the game's music, 3DS Max for 3D modeling and Photoshop CC for graphics design.

7 Topic and Inclusion

7.1 Main Theme

Our game is themed around the GDD course's Topic A: "a different perspective". Hamlin provides the player not only with a different perspective on the Pied Piper story (by continuing the story from the perspective of a rat rather than a human) but most crucially with a different perspective on the world of music. By enabling the player to discover musical concepts interactively, we hope to provide a far more engaging learning experience than the traditional context of school music lessons.

7.2 Inclusion

7.2.1 Diversity

Hamlin is designed to be an inclusive video game enjoyable for anyone interested in music, regardless of their age or background. In addition, playing as a rat places all players on a level footing - we deliberately chose a non-human main character, as any human character would inevitably be from a specific background and so would be relatable for some players but not others.

Currently we are focusing on Western music styles; these are the styles we feel most confident teaching to others due to our own musical backgrounds. However, we are aware of the Western cultural bias in the game's music curriculum and are keen to extend the content to cover music from other world regions in the future.

7.2.2 Accessibility

We developed the game aiming to cater to as broad an audience as possible. The game is non-violent with no gore or extremely dark plot elements, so is appropriate for all ages. We hope its creative and playful approach to learning will support players who find traditional classroom settings difficult, for example players with learning disabilities.

7.2.3 Humanity

Humanity is a core value in the game: the objective of the game is bringing happiness to the world by playing music! The hero also avoids violence by simply luring the monsters away from the cities rather than killing them.

8 Marketing and Publishing Strategy

At the end of the course we will release the game on *itch.io*. We hope to continue developing the game to provide more levels and music curriculum content. We will also look for events where we could present our game for further publicity, such as the GameDevDays in Graz. At these events we will gather user feedback in order to further improve the game. We are very keen to see the game used in educational settings to complement existing music teaching, so if there is sufficient interest we will also seek to form collaborations with schools.

Once we have developed the game further we have many ideas for how to market the final release, starting with building a Twitter presence with early prototypes and then keeping fans up-to-date on current progress on the game. Encouraging newsletter sign-ups through promotions (for example by offering early access to the game) will increase the reader base for email marketing campaigns immediately prior to the game's release and afterwards (for example for DLC). Around the university, promotional stickers can be used to market the game; these are inexpensive, long-lasting and have the potential to reach a large target audience.

9 Timeline

Our project timeline is as follows:

Milestone	Description	Date
	Initial concept and design	22.11.17
	Prototypes of procedural terrain and music input system	05.12.17
0	First release of Game Design Document	08.12.17
	Sound recording	09. - 10.01.18
1	First game prototype (without motion capture)	12.01.18
2	QA Feedback	26.01.18
3	End of project - game release	12.03.18

Table 9.1: Project Timeline

10 Team and Credits

10.1 Team Members

- **Graphics and Modelling** - Jan Lanz, Andrea Saba

- **Game Programming** - Catherine Easdon **(Project Coordinator)**, Pablo Borreguero, Michael Romanov, Christian Walter

- **Audio and Sound Design** - Michael Romanov, Christian Walter

10.2 Additional Credits

- *Book Page Turning* by SmartWentCody. Available at: https://freesound.org/people/SmartWentCody/sounds/179007/.

- *Sealing Wax Stamp* by Alex. Available at: https://pngtree.com/freepng/sealing-wax-stamp_63448.html.

- *EasyScatter Prefab Brush* by Hedgehog Team. Available at: https://assetstore.unity.com/packages/tools/terrain/easy-scatter-prefab-brush-51269.

- *Infinite Terrain Tutorials* by Seb Lague. Available at: https://www.youtube.com/watch?v=wbpMiKiSKm8.

- *Free Skybox - Cubemap Extended* by Boxophobic. Available at https://assetstore.unity.com/packages/vfx/shaders/free-skybox-cubemap-extended-107400.

10.3 Appendix

10.3.1 MIDI Note Numbers for Different Octaves

Octave	C	C#	D	D#	E	F	F#	G	G#	A	A#	B
0	0	1	2	3	4	5	6	7	8	9	10	11
1	12	13	14	15	16	17	18	19	20	21	22	23
2	24	25	26	27	28	29	30	31	32	33	34	35
3	36	37	38	39	40	41	42	43	44	45	46	47
4	48	49	50	51	52	53	54	55	56	57	58	59
5	60	61	62	63	64	65	66	67	68	69	70	71
6	72	73	74	75	76	77	78	79	80	81	82	83
7	84	85	86	87	88	89	90	91	92	93	94	95
8	96	97	98	99	100	101	102	103	104	105	106	107
9	108	109	110	111	112	113	114	115	116	117	118	119
10	120	121	122	123	124	125	126	127				

Table 10.1: MIDI Note Numbers