



Feel the Rhythm: A Blind-Accessible Rhythm Game Showcasing a Novel Approach to Accessibility

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Over the past few decades, video games have grown from a novelty of entertainment into one of the largest media industries in the world. For blind players or players with significant visual impairment, gaming is an activity which is largely out of reach, particularly for certain genres of game. The focus of this paper is one specific problem in games accessibility, which is the challenge of providing visually impaired players with access to the rhythm game genre. This paper presents a new game, titled Feel the Rhythm, in the rhythm genre developed with accessibility as a core design goal in order to implement novel blind-accessible features. The game serves as proof of concept for implementing solutions to this specific accessibility problem and presents the potential to allow visually impaired players access to a generally unavailable genre of games.

CCS Concepts: • **Human-centered computing** → **Accessibility design and evaluation methods**; *Interaction design process and methods*; • **Software and its engineering** → **Interactive games**;

Additional Key Words and Phrases: Audio games, Rhythm games, Accessibility-driven game development

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1 Introduction

Video games are a medium which have been historically slow to adapt accessibility options. Games are far from necessary for everyday life, and they're so varied that it can be difficult to create robust and elegant solutions to all of their accessibility problems. Yet, the challenge of accessibility in games is not one to be overlooked simply because it is more complicated than its counterparts in other media.

This article aims to provide one solution to a lingering problem in bringing accessibility to games. Rhythm games are a genre which typically rely heavily on music, and therefore their gameplay is usually presented only in the visual format. This paper presents a new game in the rhythm genre which implements novel blind-accessible features, titled Feel the Rhythm. In addition, this paper will provide the results of publishing Feel the Rhythm online to a community of visually

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impaired players. It will also discuss the feedback those players provided and draw some conclusions about the viability of the solutions presented in the game based on this feedback.

2 Background

Until recently, accessibility options were generally not included in most games at all. This has changed in recent years, however, and accessibility in games has improved drastically over the course of the past decade [1, 2]. Within the past few years, certain options are beginning to be more commonly implemented across both high budget and low budget titles. Modern AAA (top budget) game studios are beginning to include colorblind options, difficulty options, alternate control schemes, and larger text fonts [2–5]. But for some, these settings are not enough. Blind gamers in particular have had a difficult time getting accessibility options for most mainstream games, mostly due to the difficulty in translating such a visual medium into something these individuals could meaningfully interact with. The scope of this paper will be focused on discussing blind and visually impaired users, and how developers can work to make their projects more accessible to this demographic.

Accessibility options for the blind are common in digital media apart from video games, but it is clear that there is much greater difficulty in introducing these options to games. Games are uniquely interactive and have an immense diversity of genres, gameplay speeds, gameplay styles, and even hardware. This makes it exponentially more challenging to implement meaningful blind accessibility options for games compared to media like movies or online content. This is probably why most of the mainstream games developed today are still severely lacking in visual impairment accessibility options.

The fact remains that game developers could do more to make their games available to as many people as possible, particularly for the visually impaired demographic. One genre which is severely lacking in visual impairment accessibility options is rhythm games. There is demonstrable need for these options in some online communities of visually impaired players. Some blind gamers even force their way through these games' systems regardless of their lack of accessibility options, playing games like *Guitar Hero* or *Rhythm Heaven* based primarily on trial and error or with the help of another person [6], but this is obviously far from ideal. If anything, it shows that there are players who are invested in these types of games and would benefit greatly from a set of accessibility options that caters to blind players.

3 Design

The primary goal of this project was to develop a prototype game in the rhythm genre which a visually impaired player could interact with effectively without any need for specialized hardware, trial and error, or external help. Secondly, the goal was to then release this game into the hands of real visually impaired users and gather feedback on the validity of the accessibility methods on display to determine whether similar methods could be employed by other rhythm games. To that end, this article showcases a novel game which was developed using an accessibility-focused methodology.

Rhythm games are a genre of games which revolve around the player entering specific inputs in time with a piece of music or a beat, often to make the player feel as though they are producing the music themselves (Figure 1). Because these games are so reliant on audio output being dedicated to music, all of the game mechanics and information are generally present only in visual format. This means that this genre of games is generally inaccessible for blind and visually impaired players. The new game presented in this paper, *Feel the Rhythm*, aims to translate the visual game information of rhythm games into a different format which is fully interactive to blind and visually impaired players.



Fig. 1. A group of players at a convention playing *The Beatles: Rock Band* (2009), a AAA rhythm game where players assume control of several instruments [7]. This particular game even has players assume the role of a specific band. This image is licensed under the Creative Commons Attribution 2.0 Generic license.

Rhythm games usually do not present any of the game information through the audio track, often preserving the audio strictly for the music that is playing. Sometimes, the player will receive extra feedback through the audio track such as the music reflecting the player's game accuracy. The idea is that the player feels more immersed in the music and the most popular rhythm games aim to make the player feel like they are actually producing music with their input, even going as far as to give the player a controller in the shape of a musical instrument (Figure 2). Because maintaining this rhythm and immersion through the audio is so important, all of the mechanical game information is usually only displayed visually on the screen. It is completely logical that these games would be designed in this way, given that their enjoyment is intrinsically linked to their music. However, the heavy reliance on visual information makes it exceedingly difficult for gamers who are visually impaired to interact with this entire genre of games. One could argue that the same design choices that result in immersion for most players result in exclusion for those who are visually impaired. Regardless, some visually impaired players do find their own ways to play these games despite the incredibly high barrier to entry, usually through trial and error or with the help of another person [6]. The fact that some blind gamers would be so interested in rhythm games as to find their own workarounds to play them shows that there is clear interest in the genre from the blind gaming community.

Therefore, *Feel the Rhythm* is not only solving a theoretical problem in games accessibility; it is also solving a real problem for visually impaired users, which could meaningfully impact the way they interact with games in the rhythm genre. Even if *Feel the Rhythm* remains a prototype and does not see a full-scale release, the accessibility solutions this paper proposes may serve as an example for other developers in the rhythm genre.

3.1 Core Mechanics

The accessibility problem of this project is to remove the visual game information and deliver it to the player through other means. While audio output in rhythm games is generally reserved for music, it seemed possible to allow for some of the game information to be relayed to the player



Fig. 2. The primary controller sold alongside Guitar Hero Live (2015) in the shape of a guitar [8]. It is common for rhythm games to use controllers in the shape of musical instruments to increase the player's immersion. This image is licensed under the Creative Commons Attribution-Share Alike 4.0 International license.

using audio cues. This might result in lowered immersion, particularly in a full-scale AAA game. However, in a game of that scale, this feature would certainly be a toggleable option and would not reduce the immersion of most players, while simultaneously allowing visually impaired players access to the game. In addition, tactile feedback seemed to be a good way to provide game information separately from the audio track.

The core design of the game has four lanes of incoming notes, with each one corresponding to a different method of alerting the player (Figure 3). The two outer lanes correspond to audio signals overlaid on top of the music, coming from either the left speaker or right speaker, respectively. This audio signal itself is a brief sound effect of a quickly rising pitch, and is about the same level of volume as the music so that each are distinguishable to the player. Ideally, these volume levels would be independently adjustable by the player, as discussed in Section 3.2.7. The inner two lanes correspond to vibration signals on either the left side or right side of the player's controller respectively, which increase as the note grows closer. Vibration signals are discussed further in Section 3.2.1 below.

The audio or tactile signal from each lane alerts the player to an incoming note, corresponding to one of four different buttons on their controller that they must prepare to hit (Figure 4). For each of the four signals, the player must press the appropriate button on their controller at the appropriate time. All four signals give the same amount of warning time. Normally this timing is very clear in rhythm games as it is delivered through visual information. The audio and tactile signals featured here may be harder to understand, especially for new players. To account for this, a tutorial level is included which clearly explains each of these four types of notes and allows the player to practice with each one independently.

In addition, whenever the player presses an input, they are provided with quick audio feedback corresponding to either a *hit* (a satisfying 'thunk' sound effect) or a *miss* (a 'whoosh' sound effect). The *miss* feedback is also played if the player allows a note to pass without pressing the appropriate input. This allows the player to understand roughly how well they are doing while they are playing. In a full game release, this feedback could be replaced with other sound effects, could change pitch depending on the current song, or could simply be replaced by the player's instrumental track playing or stopping.

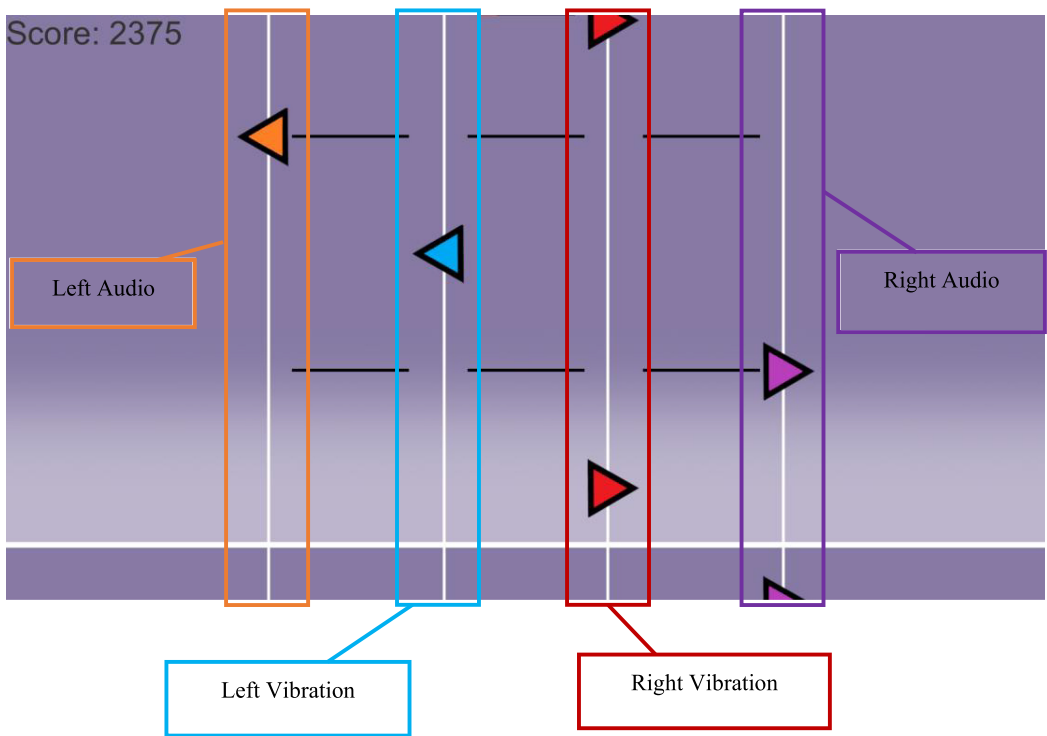


Fig. 3. A screenshot of Feel the Rhythm with each blind-accessible cue labeled. Cues are triggered when notes come within a certain distance of the bottom line. This figure was created by the author.

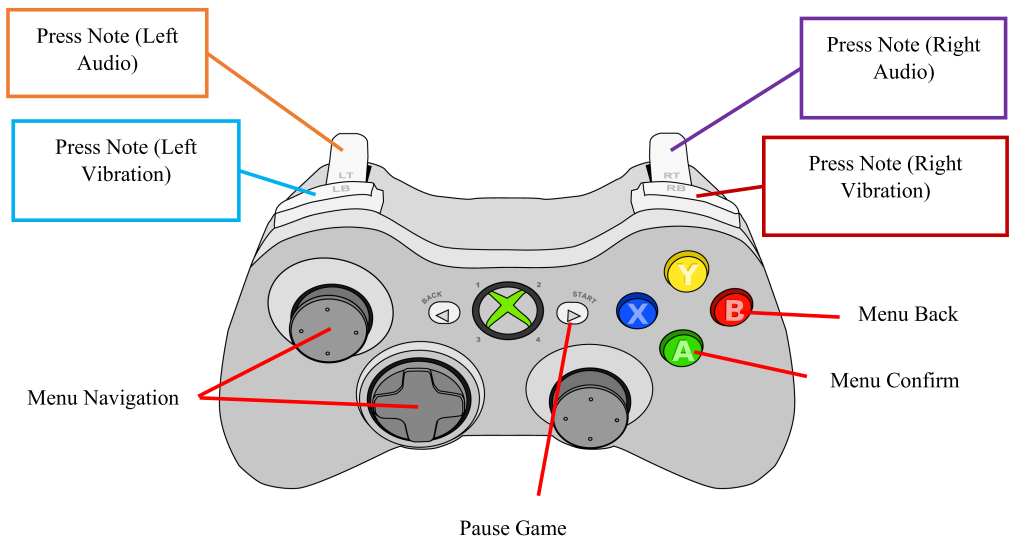


Fig. 4. The control scheme for Feel the Rhythm. The triggers and bumpers on the top of the controller serve as the primary input buttons for gameplay while buttons on the front of the controller are reserved for menu navigation. This image from the public domain was modified by the author.

Lastly, the player's score is read out verbally in audio format at the end of each level. While overall score is usually always visible on-screen in standard rhythm games (as in Figure 1), it seemed unnecessary and inelegant to repeatedly interrupt the player with their score during gameplay. This would add another layer of audio information which would potentially overcrowd the game-essential information already being audibly provided to the player. So, the score is read aloud to the player at the end of each level, and they are also alerted as to whether this score is a new record compared to their previous best.

Using this design, all of the game information can be given to the player alongside the level's music without any need for visual representation, specialized hardware, or external help. However, the game does still have visuals and can still be played using only visuals and music similar to any standard rhythm game, indicating that these accessibility solutions could be offered as toggleable options in a fully realized rhythm game.

3.2 Design Decisions

3.2.1 Peripheral Selection. Peripheral selection was a vital decision in creating this project. A lack of visual feedback means it is necessary to maximize any other means of providing feedback to the player. Research shows that audio and haptic feedback are both incredibly useful tools in implementing accessibility in games [9], and it was clear that they would both be necessities for this project in particular. Since the game would need to provide tactile feedback to the player, a controller called the Steam Controller [10] seemed to be a good option; it contains haptic motors capable of giving very precise tactile feedback. Valve, the controller's creator, describes them as having "a new generation of super-precise haptic feedback" thanks to the use of dual linear resonant actuators. "These small, strong, weighted electro-magnets are attached to each of the dual trackpads" and "are capable of delivering a wide range of force and vibration, allowing precise control over frequency, amplitude, and direction of movement." [11]. However, there were a number of problems that arose when trying to develop the game for use with this controller.

Firstly, it became clear that this controller's haptic motors were not intended to be reprogrammed as easily as hoped. But there is another, more obvious problem with this choice of controller. For a project with the primary goal of accessibility, choosing a controller which is so niche is counterintuitive. Not only is this controller unpopular, but it is actually discontinued as of this writing. Accessibility research generally agrees that using specialized interfaces only serves to further isolate disabled players [2] and one improvement to make over past work was to avoid players needing to seek out specialized hardware.

To solve these issues, we decided to create the game for use with a standard Xbox controller. This controller does not support the same precise level of haptic feedback, but it does have two separate vibration motors that can be used to provide tactile feedback. The entire Xbox brand of controllers has featured a dual-motor rumble system since the original Xbox controller was released in 2001. Figure 5 shows the internal workings of a more modern Xbox controller, with both vibration motors circled. In addition to the motors being separated to the left and right sides of the controller, the left motor has a much higher weight than the right motor. This produces a different feeling of vibration from each motor, so it is relatively easy to differentiate which motor is vibrating or even to differentiate when both are vibrating. This dual-motor design with different weights is particularly useful for *Feel the Rhythm*, where vibration cues need to be distinguishable between the left and the right. Due to these rumble motors being physical rotating weights, they need to rev up in order to rumble whereas the Steam Controller's haptic motors do not. However, this effect is negligible in *Feel the Rhythm* because the desired effect of incoming vibration cues is that the vibration gradually increases as the note approaches. Therefore, the feeling of increasing strength of the vibration fits the intended design in *Feel the Rhythm*.



Fig. 5. The internal hardware of an Xbox controller with two different vibration motors circled [12]. The left motor's weight is much larger than the right motor's weight (the controller is face-down in this image). This image is licensed under the Creative Commons Attribution-Share Alike 4.0 International license and was modified by the author to draw attention to the motors.

In addition, the Xbox controller is easier to work with than most other controllers on the market. It is also the most commonly owned controller by PC users according to a Steam hardware survey from 2018, with about 64% of all PC-connected controllers being Xbox controllers [13]. Since the game is to be distributed online via PC, developing for an Xbox controller means this project will have the best chance of reaching the widest audience. In addition, Xbox sells adaptive accessibility controllers that function identically to standard Xbox controllers, meaning any disabled users who use these controllers would have automatic controller support for this game [14].

Other than the controller, the only additional peripherals that the game requires are a set of headphones or two separate speakers so that audio can be tracked from either the left or right.

3.2.2 Control Scheme. Due to the game having a symmetrical nature, with lanes of notes corresponding to signals on both sides of the player, it made sense for the control scheme to be equivalently symmetrical. It was decided to make use of the two bumpers and the two triggers on the back of the controller as this allows for symmetrical input. This control scheme mirrors the information provided by the game, with left/right signals corresponding to left/right input buttons, and audio or vibration corresponding to trigger or bumper respectively. Figures 3 and 4 show this similarity. A project of larger scope would include customizable controls for the best accessibility.

3.2.3 Note Timing. In order for the game to function well, both the audio notes and the vibration notes must provide a roughly equal prediction time (i.e., an audio cue should give just as much warning as a vibration cue). Through personal playtesting, it was determined that a feedback time of approximately 0.2 seconds was sufficient to allow the player to understand where a note was incoming, and to give them enough forewarning to be able to time their input rather than simply reacting as quickly as possible.

Ultimately, a better solution would be to have the warning time of the notes adjust appropriately to the tempo of the current song, or at least to allow the player to adjust the warning time as is necessary for them. However, as proof of concept and to meet the design goals of this specific project (allowing a blind person to accessibly interact with rhythm games), the above solution was used in *Feel the Rhythm*.

3.2.4 Music Selection. Since this game will not be returning any profit, it was decided to use licensed music even without any legal rights to it. Initially, unlicensed music which is freely available was going to be used. However, during the level creation and testing process, it became clear that more recognizable music with an obvious rhythm would enhance the player experience. In addition, one aspect of this project was to replicate a normal rhythm game as closely as possible and using ‘real’ music seemed like the best way to accomplish that.

The two levels present in the game are the songs ‘Barracuda’ by Heart and ‘Harder Better Faster Stronger’ by Daft Punk. They were selected mainly due to their standard, easily identifiable rhythm that persists through the full song.

3.2.5 Tutorial and Level Creation. The current version of the game has a tutorial and two playable levels.

The tutorial consists of a spoken explanation for how the game functions, and slowly guides the player through an explanation of each of the four types of notes. It provides them with room to practice each of these four types individually, and provides an option for repeating the tutorial at the very end if they still do not feel comfortable with the timing of each note.

The first level was created to be a relatively medium difficulty, while the second is a little more challenging. The initial plan was to chart almost every note in each song, but in testing it became obvious that this would lead to levels being far too crowded. Not only would the difficulty be incredibly high, but more importantly, the audio or vibration feedback to the player from each note would bleed into each other, making the game essentially unreadable. To combat this, the number of notes on each level were cut back drastically.

3.2.6 Player Scoring. Many rhythm games grant a bonus score multiplier for hitting multiple correct inputs in a row without making any mistakes. In this particular game, due to the goal being accessibility to a wide range of players and the precise note positioning being harder to judge when compared to visual information, it felt too punishing to expect players to achieve this multiplier and maintain it through a level. Therefore, scoring is linear with a fixed amount awarded for hitting a note and a fixed amount withdrawn for missing a note or entering bad input. Adding a higher skill-based system like a combo multiplier would likely only serve to further ostracize and aggravate players and would be counter to the goals of this project.

3.2.7 Customization. Many elements of the game, while not available to change by the player in this particular prototype, can be changed relatively easily in the game editor. These include the volume of audio tracks, the strength of vibration, the speed of the game, the warning time that notes provide, and so on. With the goal of accessibility in mind, it would be ideal for players to be able to edit these things themselves. For a more polished game experience, the implementation of an additional menu for players to adjust these values would create a better sense of rhythm and

synchronization. Another menu which is common in rhythm games is a general synchronization test screen, so that players can configure the input and output delays in a way that accounts for any delay in their personal hardware. Both of these additions are highly recommended for any future project in order to create a better sense of rhythm during gameplay, but ultimately fell outside of the scope of this project.

4 Results

The goals outlined at the start of Section 3 were met in this project. *Feel the Rhythm* grants players with limited vision the ability to access the genre of rhythm games in an easier way than ever before. In addition, *Feel the Rhythm* was published online to a community of visually impaired players and feedback was collected on the game which could inform future projects.

4.1 Progress and Comparison to Past Work

First and foremost, the game itself pushes the existing boundaries of accessibility in rhythm game design. The last and most meaningful research on blind accessibility in rhythm games was a game and accompanying research paper published in 2008 titled *Blind Hero* (Figure 6) [15].

Blind Hero was not technically a new game but rather a modified control scheme for a Python-based clone of *Guitar Hero*. The developers had a specific focus on replacing the visual stimuli delivered to the player with tactile feedback. Audio feedback was not included as they felt that altering game audio by any amount would compromise the integrity of the game, but noted that further research was needed on this topic. Instead of altering game audio, they used a specialized handheld glove device which provides haptic feedback to the player on each finger, corresponding to the four lanes of notes in the game.

At the time when *Blind Hero* was created, game accessibility was a relatively neglected issue. The developers were not working with specific guidelines, goals, or restraints, but rather simply wanted to experiment with possible options for adding blind accessibility to rhythm games. They created a functional prototype and succeeded in that regard, but by modern standards their project had several drawbacks which *Feel the Rhythm* improved upon.

The primary improvement is that their game required very specific hardware (the tactile glove controller seen in Figure 7) which costs around \$1,500 total as a prototype [15]. This haptic glove was used in conjunction with a standard *Guitar Hero* guitar controller as seen in Figure 6. As mentioned in Section 3.2.1, specialized hardware is proven to be opposite to the goal of accessibility and generally only serves to divide players [2]. *Blind Hero* was created as a method for disabled individuals to play rhythm games using an additional apparatus built around an existing game. *Feel the Rhythm* implements accessibility solutions which do not require any specialized hardware, which was in part due to the fact that the game itself was built with accessibility as a core design goal.

In their paper, the *Blind Hero* developers specifically mention that “replacing visual stimuli by audio is not an option”, though they do admit later that audio feedback is something that should be considered in further research [15]. *Feel the Rhythm* does use audio stimuli, and thanks to this it does not require any specialized hardware. While players did have some issues with the current state of *Feel the Rhythm*, they did not report any problem with the inclusion of audio feedback and therefore the solution of including audio feedback in rhythm games can be considered viable or at least worth exploring further.

4.2 Player Statistics

One goal for this game was to be able to publish it online and put it in the hands of visually impaired players who would actually be able to use it. In March of 2021, the game was made available via



Fig. 6. A blind user wearing the custom haptic glove created for Blind Hero to play using a Guitar Hero guitar controller [15]. This image has been modified by the author to remove identifying features of the player.



Fig. 7. The haptic glove controller that was custom engineered for Blind Hero. At the time, this device cost around \$1,500 total to develop and allowed the user to feel incoming notes on each fingertip with the use of haptic motors [15].

free download on Itch.io, an indie game site [16]. A link to the game was also posted on an audio games forum so that people with visual impairments would be able to find it and provide feedback [17]. As of this writing, the forum post [18] has about 1,500 views, and the game itself has acquired approximately 450 views and 130 downloads.

4.3 Player Feedback

Alongside posting the game link on the audio games forum [17], a link to an anonymous survey was also posted. This would allow for collection of honest feedback from real users who are visually impaired. This survey accrued seven responses from visually impaired players.

Feel the Rhythm is a prototype game project which has the intention of exploring possible solutions for bringing blind accessibility to rhythm games. It is not a fully polished game experience and further development would be required to bring it to that level. However, informal survey feedback was important to gather at this stage of development to ascertain whether the presented accessibility solutions were worth pursuing at all. While the survey itself was informal and only obtained seven responses, the data within those responses fully indicates that the accessibility solutions presented in Feel the Rhythm are worth pursuing.

Overall, feedback was positive and encouraging on the game, with most users asking for further updates to be completed. The average overall rating of the game was 3.4/5. None of the responses hinted at any problems intrinsic to the accessibility solutions presented in the game.

The primary criticisms of the game were not intrinsic to the game's mechanics or its accessibility solutions. The most common criticism was the feeling of the rhythm in the game. This could be improved by adjusting note placement in levels, ensuring level speed matches the song, matching note warning signals to the tempo of the song rather than giving them a static timer, and providing the player with a synchronization option so that they can account for any hardware delay. Additionally, difficulty options would be a welcome addition. Most of these improvements are relatively common in polished rhythm games and could be addressed with further development. However, none of them involve changing the accessibility solutions or core mechanics of the game which suggests that, while imperfect, Feel the Rhythm met its primary design goals.

For survey responses, please see the Appendix.

5 Conclusion

As a prototype with limited scope, Feel the Rhythm completed its design goals and can hopefully serve as proof of concept for any rhythm game developers wanting to add accessibility features to their games. However, there are multiple improvements to be made on the game's design. Its accessibility can be heavily improved with the addition of customizable controls and perhaps support for additional controller models. Difficulty should also be reworked according to user feedback and a dynamic, customizable difficulty system would make the game accessible to more users. This customization could include being able to scale difficulty up or down based on number of notes per level, ability to fine-tune the timing of feedback to the player, or even to remove lanes from the game altogether to simplify the experience.

The game mechanics themselves could be improved in some ways. Tuning of the sound effects of the game to be better suited to play over music, for example matching the audio cues to the key of the current song, would likely be a welcome change. Additionally, the improvements mentioned in Section 4.3 above should be heavily considered if this game is to continue development or if any other developers are looking to improve upon this game's design. Ultimately, these features fell outside of the scope of this project but could be implemented in the future or on a higher budget version of the game.

Despite these possible improvements, *Feel the Rhythm* still stands as a successful design experiment in visual impairment accessibility for rhythm games. The real value to be found in this project is the glimpse that it may provide for the future of accessibility in games. Blind accessibility in rhythm games has not been addressed in any mainstream title and has only been accomplished with mixed results in published research. This project, having been developed with accessibility as a core design pillar, offers potential solutions for rhythm game developers looking to allow access to as many people as possible.

Appendix

A Player Survey Results

Listed below are the full unedited questions and responses from the player testing survey. The survey was conducted anonymously via a Google Forms link posted alongside a link to download the game on an audio games forum [36]. It accrued a total of seven responses.

What type of controller did you use (or attempt to use)?

3 responses: Xbox 360
4 responses: Xbox One/Series X

What operating system are you on?

7 responses: Windows

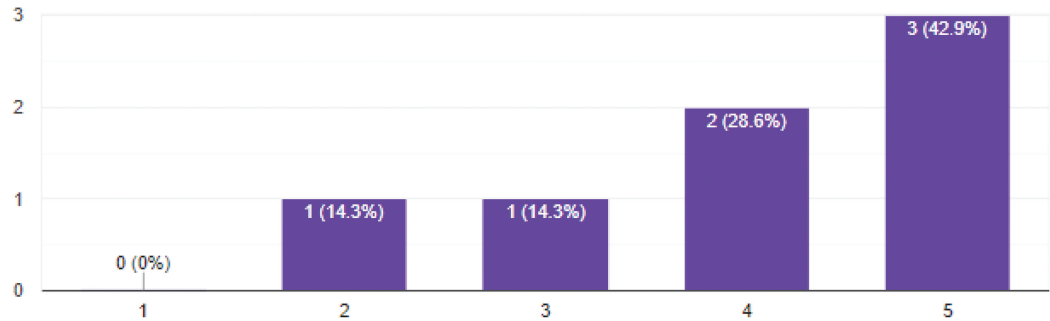
Are you visually impaired?

7 responses: Yes

Were you able to get the game to work as intended, including audio and vibration functions?

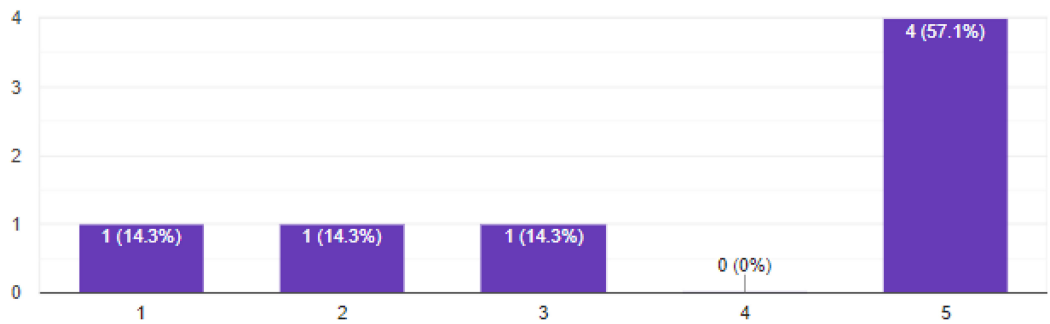
7 responses: Yes

How well did you feel you understood the game? (1 = not at all; 5 = perfectly)



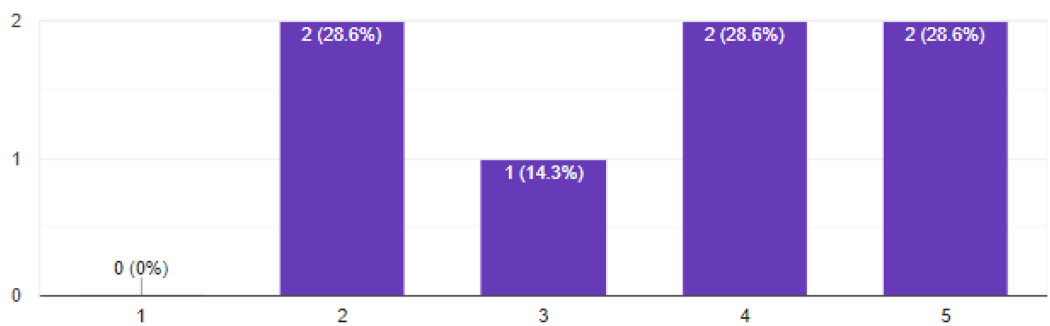
1 response: 2
1 response: 3
2 responses: 4
3 responses: 5
Average = 4

How sufficient do you feel the tutorial was for you to play the rest of the game? (1 = not sufficient at all; 5 = perfectly sufficient)



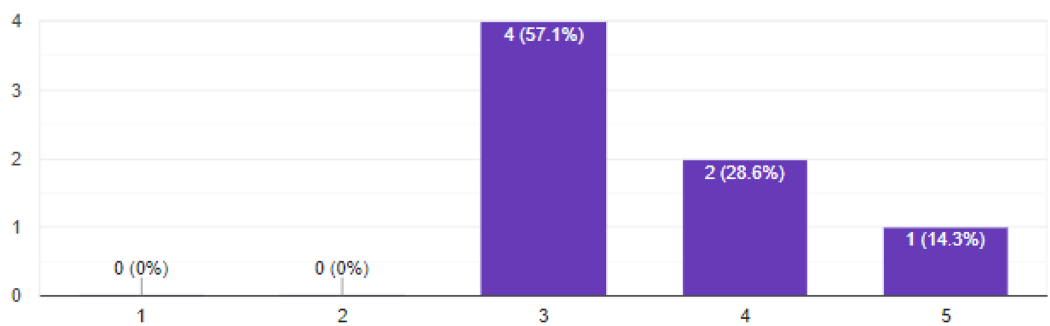
1 response: 1
1 response: 2
1 response: 3
4 responses: 5
Average = 3.71

For Barracuda, how did you feel about the difficulty? (1 = too easy; 5 = too difficult)



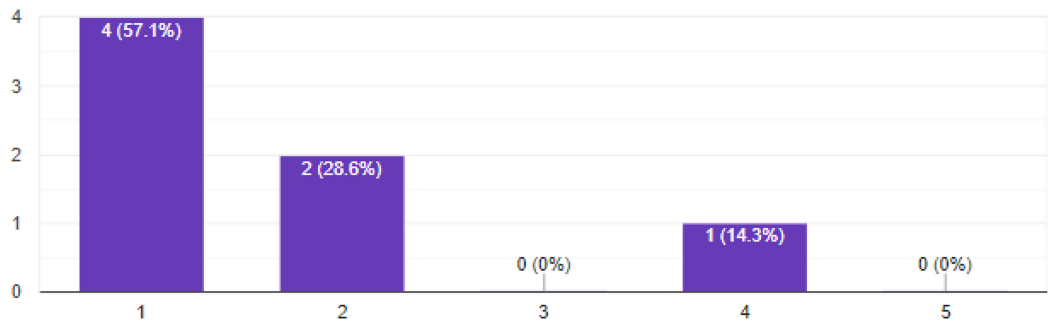
2 responses: 2
1 response: 3
2 responses: 4
2 responses: 5
Average = 3.57

For Barracuda, how did you feel about the number of notes? (1 = too few; 5 = too many)



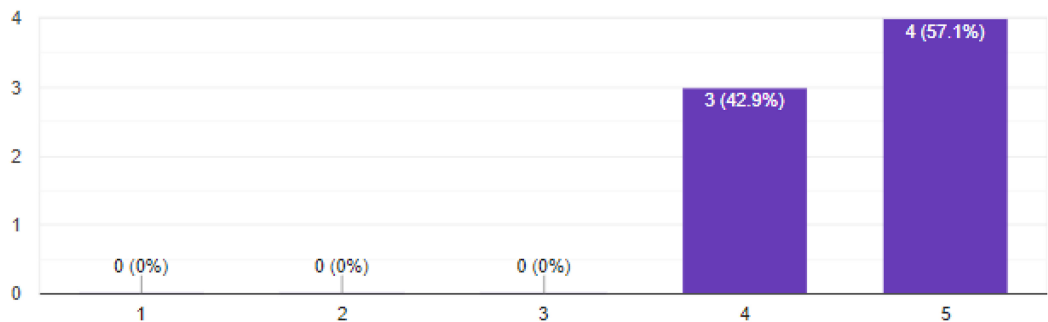
4 responses: 3
2 responses: 4
1 response: 5
Average = 3.57

For Barracuda, how well were the notes mapped to the music (did you feel like you were really playing the song)? (1 = not well at all; 5 = very well)



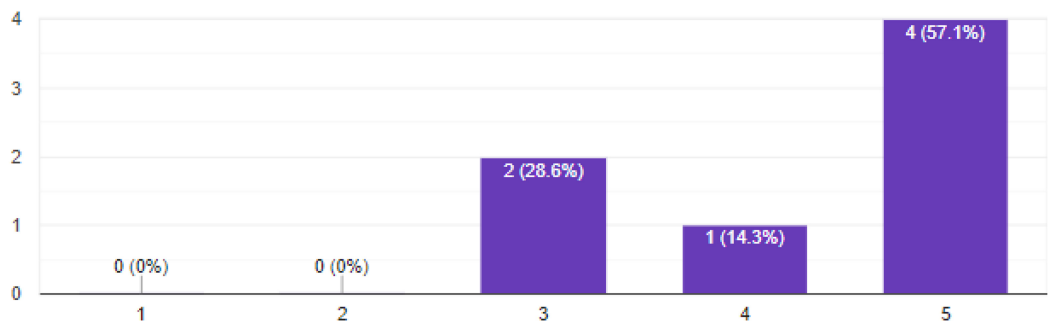
4 responses: 1
2 responses: 2
1 response: 4
Average = 1.71

For Harder Better Faster Stronger, how did you feel about the difficulty? (1 = too easy; 5 = too difficult)



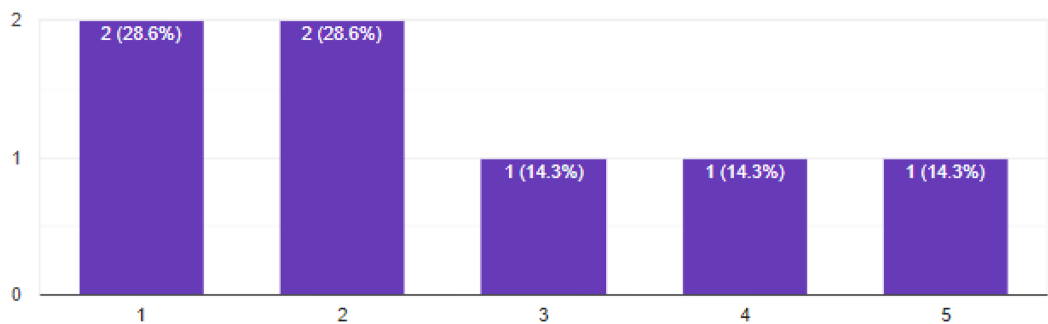
3 responses: 4
4 responses: 5
Average = 4.5

For HBFS, how did you feel about the number of notes? (1 = too few; 5 = too many)



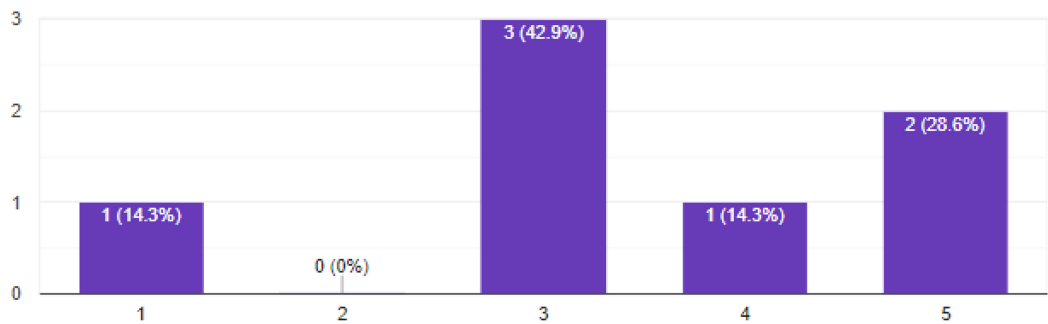
2 responses: 3
1 response: 4
4 responses: 5
Average = 4.28

For HBFS, how well were the notes mapped to the music (did you feel like you were really playing the song)? (1 = not well at all; 5 = very well)



2 responses: 1
2 responses: 2
1 response: 3
1 response: 4
1 response: 5
Average = 2.57

Overall, did you enjoy the game/have fun? (1 = It was bad!; 5 = It was great!)



1 response: 1
 3 responses: 3
 1 response: 4
 2 responses: 5
 Average = 3.42

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