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Capstone Project: Milestone I

Accessible Minesweeper

Introduction

This project aims to develop an accessible version of Minesweeper that caters to the needs of visually impaired players. Through this website, the project intends to provide an inclusive gaming experience where all players, regardless of visual ability, can enjoy the challenge and excitement of Minesweeper. The goal is to promote accessibility and inclusivity in digital gaming and demonstrate the importance of designing games with diverse user needs in mind.

Target Audience

The primary audience for the website is visually impaired individuals, including individuals with low vision, legally blindness, partially sighted, color blindness, and etc, who are also interested in playing Minesweeper but face barriers due to the lack of accessible options.

Motivation

The motivation behind our proposal is rooted in the imperative to ensure equitable access to gaming experiences for visually impaired users, with a particular emphasis on addressing technical barriers that hinder their participation. As highlighted in recent studies, the prevalence of "technical barriers, such as the incompatibility with assistive technology (e.g., screen

readers),"[1] underscores the pressing need for accessible gaming solutions. In response to this challenge, our project seeks to compensate for the absence of visual experience by leveraging auditory feedback, aligning with research that emphasizes the importance of "replace[ing] visual feedback with a form of feedback that the player is still able to perceive, such as auditory or haptic."[2] Through features such as auditory feedback, customized alerts, and proper color contrast, our project aims to provide visually impaired users with an immersive and inclusive gaming experience that mirrors the gameplay enjoyed by sighted users. By prioritizing screen reader compatibility and intuitive keyboard navigation, we endeavor to ensure that visually impaired players can easily navigate the game interface and engage with the game content on an equal footing with their sighted counterparts. Through these measures, our project endeavors to bridge the gap between visually impaired and sighted gamers, fostering inclusivity and empowerment within the gaming community.

Accessible Functionalities and Benefits

As targeting on assisting visually impaired users, the main accessible functionalities will include auditory feedback, customized alerts, keyboard navigation, screen reader compatibility, and proper color contrast.

- Auditory feedback: auditory feedback is the essential part for visually impaired users. This functionality will provide users with real time information about the game state, including whether the cell is flagged, the number or adjacent mine around the cell, or the cell is unknown.

[1] David Gonçalves, André Rodrigues, and Tiago Guerreiro, "Playing With Others: Depicting Multiplayer Gaming Experiences of People With Visual Impairments," October 26, 2020, https://doi.org/10.1145/3373625.3418304.
[2] Bo Yuan, Eelke Folmer, and Frederick C. Harris, "Game Accessibility: A Survey," *Universal Access in the Information Society* 10, no. 1 (June 25, 2010): 81–100, https://doi.org/10.1007/s10209-010-0189-5.

- Customized alerts:
    - Cells around the selected cell: users with normal vision would focus their view on a 3x3 grid to determine whether there are unknown cells around a selected cell and the number of unknown cells to infer if the unknown cells should be mines or safe cells. However, this would be very difficult for visually impaired users if they could only access the information of one cell at the time. Thus, this project intends to achieve the functionality that by pressing a certain key, the users could activate the alerts on the numbers of undetermined cells around a selected cell and their location.
    - Pattern alert: additionally, there are many patterns of minesweeper games that allow users to identify the location of mine or safe cell quickly if they can view the game visually. To achieve this for the target group of this project, the users would be able to receive hints on the pattern that the selected cell is involved in if there is any.
- Keyboard navigation: To help the targeting users navigate through the game and websites accessible, a keyboard would be the main way for the users to interact with the websites. The users will be able to use the keyboard to move around to select a cell, or by typing specific cell location to navigate to the cell. The user will also be able to navigate around the menu, to activate alerts, hint, start, end, restart the game, and etc.
- Screen reader compatibility: Screen readers convert on-screen elements into speech or braille output, allowing users to navigate and interact with digital content. By labeling game elements with descriptive text and optimizing navigation, visually impaired players can easily identify and interact with cells using screen reading software. For instance,

labeling each cell with coordinates and state. By ensuring screen reader compatibility, the Minesweeper game interface becomes fully accessible to visually impaired individuals, enabling them to enjoy the gaming experience independently.

- Proper color contrast: Ensuring proper color contrast is essential for making the Minesweeper game accessible to users with low vision or color vision deficiencies. By selecting color combinations that provide sufficient contrast, important game elements become more distinguishable and easier to perceive. For example, avoiding color combinations that may cause confusion, such as red-green, helps prevent misinterpretation of game information. implementing proper color contrast ensures that visually impaired users can effectively navigate and interact with the game interface, promoting inclusivity and usability for all players.

Integration of Functionalities

The various facets of accessibility functionalities, including auditory feedback, customized alerts, keyboard navigation, screen reader compatibility, and proper color contrast, synergistically complement each other to create a more accessible user experience in the Minesweeper game. Auditory feedback provides real-time information about the game state, while customized alerts, such as alerts for cells around the selected cell and pattern alerts, assist users in making strategic decisions and navigating the game grid effectively. Keyboard navigation facilitates seamless interaction with the game interface, enabling users to navigate, explore, and interact with game elements using keyboard shortcuts. Screen reader compatibility ensures that all game elements are accessible to users relying on screen reading software, while proper color contrast enhances visibility and improves gameplay comprehension for users with

low vision or color vision deficiencies. Together, these functionalities work harmoniously to remove barriers to accessibility, promoting inclusivity and ensuring that all players can enjoy a fully accessible Minesweeper experience.