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Enhancing the learning experience- Use of video game technology for teaching Japanese language

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Enhancing the Learning Experience -- Use of Video Game Technology for Teaching Japanese Language

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PUBLIC PRESENTATION

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Abstract

The Japanese language is challenging to learn, especially for native speakers of Indo-European languages. The three components of written Japanese -- Hiragana, Katakana, and Kanji – include 2,136 Kanji characters, and 46 each for Katakana and Hiragana. Teaching Japanese – generally through repetition – can lead to student boredom and affect success. Research shows that video games can at least provide a more enjoyable learning experience. Despite this fact, there are a lack of video games for teaching Japanese characters.

Using the Unity game engine and the C# programming language, a video game for enhancing the learning of students studying Japanese as a second language was created. Users must identify the Japanese characters as they trickle from top to bottom on the screen. The more times the user identifies a particular Japanese character, the less that character will appear. The reverse applies to incorrect answers – the character will appear more often. This is a key learning technique as the user is forced to repeat those characters he/she does not know.

This project demonstrates that the dearth of available, effective video games to complement foreign language learning can be overcome. Basic programming skills combined with some creative design, and a strong desire to help others learn, can result in simple but effective video games. The interactive experience will certainly improve students' ability to learn this challenging language.

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Introduction

The Japanese language is challenging to learn, especially for native speakers of Indo-European languages. Indo-European languages, in particular, have little in common with the Japanese language. There are no linguistic points in which someone can relate his language with Japanese. Of course, it is a bit easier for native Asian speakers as most of their native languages rely on characters somewhat related to those of Chinese.

Written Japanese has three components: two syllabaries (a set of written characters representing syllables serving the purpose of an alphabet) and a collection of pictogram type characters. These components are known as *Hiragana*, Katakana, and *Kanji*. Respectively, Hiragana characters are phonetic and are generally used for various grammatical and function words. Katakana characters are also phonetic; however, Katakana is generally used to write foreign words for which the phonetics may not exist in the Japanese language. Kanji is a collection of characters that represent meaning as opposed to phonetics. Kanji was originally introduced in Japan by the Chinese.

There are officially 2,136 Kanji characters used in the Japanese language as established by the Japanese government's Jōyō list (Japanese Agency of Cultural Affairs, 2015). In addition, there are 46 katakana characters and 46 hiragana characters. Learning all these characters can be very difficult, because one must memorize the character, the meaning(s), its sound, and its corresponding Japanese word. Additionally, Kanji characters can take on different meanings depending on context. For example: the symbol 東 (higashi) means east by itself, but when combined with the symbol 京 (kyo) , meaning capital, it takes on the name of the city "Tokyo" 東京.

For instructors, teaching Japanese to beginners has always been a challenge. The typical approach is to teach in a similar way children are taught in Japanese schools. This involves teaching these characters through intensive repetition (MEXT, 2016). Students are taught to practice writing the characters repeatedly. At the same time, students must be able to identify the meaning and/or sounds of these characters. This repetition will eventually lead to students being able to both read and write the characters. However, this method of teaching and learning can be very boring to students learning Japanese as a second language. Given the volume of characters that need to be mastered, and the time it takes to do this, enthusiasm and motivation can be negatively affected. Many students enter the classroom excited about the opportunity to learn Japanese, but soon find themselves overwhelmed. The rote learning becomes drudgery.

Objective

The principal objective of this project is to create a video game that will be used by students learning Japanese as a second language as an educational tool which can be used along with more traditional learning methods. In their preliminary research entitled “User Testing of a Language Learning Game for Mandarin Chinese,” Lindsay Grace, Dr. Martha Castaneda, and Dr. Jeannie Ducher posit that traditional or current educational software is not effective for language training. However, this study based upon the use of a video game, concluded that 71% of students gained significant confidence after just one round of a learning game and that 90% enjoyed the experience (Grace, 2012).

Video game technology has the potential to enhance Japanese learning by creating a visually appealing, interactive, and stimulating experience. This can complement traditional learning methods and potentially result in a more rapid pace of learning, along with a greater appreciation for the challenges that learning Japanese presents. Students will experience progress while having fun. Video game technology can take the drudgery out of learning by traditional methods!

Related Work

In her game called “Kana Warrior” Stubbs used zombies as the central character. The learner had to read Japanese rapidly and type it into the game to slow down the zombie. As the learner got better at playing, the zombies moved faster. Learners were judged on their accuracy with the Japanese language and how fast they could move and type the Japanese words. This created excitement and fun for the learners. In her pilot study, Stubbs concluded that learners had more fun using the game interface but that it also provided more benefit than just pure entertainment value. The students learned the language.

The study stated that video games are at least as equally effective as traditional programs for language learning (Stubbs, 2003). Stubbs says that students also find the video game more entertaining. Stubbs considered the idea that same-style technology interfaces may benefit the learner outside of the entertainment value. Stubbs noted that there was little work at the time to determine the value of computer games for foreign language instruction, especially the learning of foreign characters. Her research found that the programs available at the time (not games) gave the learner too much time to answer the questions, and did not emphasize reading the characters quickly.

Given the available technology and the fact that video games can be effective teaching tools, utilization of a video game to enhance learning the Japanese language makes sense. The sheer number of characters that need to be learned presents an unusual challenge. A video game can provide the beginning learner with an effective way to learn these basic characters without becoming demotivated by the rote memorization commonly required to master the language. This project, an entry-level video game for beginning Japanese language students, will help to keep students enthused while they learn the language fundamentals. This project is similar to

Stubbs' work in that it is a video game which requires users to identify Japanese characters within a time constraint.

Development Process

This project was developed using an agile style methodology. An initial list of functional software requirements was written based on the project's core goal of creating a Japanese learning game. For example: the system must be able to display Hiragana characters in timed intervals.

The development process was broken down into five, two-week iterations. The goal of each iteration was to complete a working prototype with some of the features from the original game requirements. At the beginning of each development phase, 2-3 requirements were chosen from the initial list of functional software requirements. These requirements would then be implemented over the course of the phase. At the end of each phase, an informal self-evaluation of the iteration was performed to improve the quality of the next iteration's workflow. Additionality, the project advisor was consulted between phases to ensure an acceptable level of quality and progression. These self-evaluations looked at what was accomplished over the two-week iteration to better select what functional requirements to implement in the next iteration. Any functional requirements that were not completed were moved to the next iteration or scrapped if deemed unnecessary or too complex for the scope of the game. Development concluded at the end of the fifth and final phase.

How It Works

Users can access this video game by navigating to http://craigdecampli.com/jpedu.html This video game is compiled from C# source code completely into JavaScript. As a result, only an OpenGL compatible web browser is needed to play. Most modern web browsers such as Mozilla Firefox and Google Chrome meet this requirement out of the box.

Users are greeted with a simple menu of three main game modes: Kanji, Katakana, and Hiragana. Additionally, users must select a difficulty level and an amount of time they would like to play. For Katakana and Hiragana game modes, characters trickle slowly down the screen and users must type the phonetic pronunciation of the character before it reaches the bottom of the screen. Users are awarded one point for a correct answer, but are not penalized for incorrect or missing answers. A short ringing sound is played when a user correctly identifies a character. In the Kanji game mode, users encounter a similar scenario, but must type the English meaning of the Kanji characters before they reach the bottom of the screen. Once time runs out, the game is over and the user's score is displayed. The user is then given the option to return to the main menu. Although characters are randomly selected from a pool, as the student plays the game and correctly identifies a character, that character will appear on a less frequent basis. Those the user answers incorrectly, will be shown more frequently. This is a key learning element – the user will be forced to repeat those characters he/she does not know. The more the user plays the game, the more the game will adjust itself to the user's habits. Users have the option to reset their data from the main menu.

Program Structure:

The video game was designed and programmed using an object-oriented approach. At the core of the video game is a game manager object. This object contains methods for controlling the various states of the video game, including: transitioning between the main menu, Hiragana gameplay, Katakana gameplay, Kanji gameplay, and the game over state. The game manager object enables and disables components of the game coordinating the various aspects of gameplay. Japanese characters are represented as objects of one of three different “controller” classes (kanji, katakana, hiragana). These objects contain properties such as an image file of the character, an xyz position, and C# code which dictates their behavior.

Three separate “spawn controller” objects manage the spawning of new characters onto the screen. An input controller object manages user input and performs the logic for whether the user correctly identified a character. A score manager object keeps track of the user’s score, the total number of characters spawned, and updates the onscreen text. A time manager object keeps track of how much time the user has left and sends a game over signal to the game manager object. A sound manager object controls when music and sounds are to be played. A canvas object manages all components of the main menu’s GUI and user interaction with the GUI. Lastly a camera object controls the view the user has of the video game’s canvas.

Challenges

Several key challenges arose during game development. The Unity game engine was selected based on its positive reputation and history as a widely-used tool for developing video games on platforms such Windows, Mac, Xbox, and PlayStation over the last decade. The Unity game engine is built around the C# programming language (originally developed by Microsoft).

To address a lack of personal experience with the C# programming language and the Unity game engine, roughly two weeks were spent studying C# using reading materials and examples from Microsoft's official website. An additional two months were spent training with Unity using a variety of resources such as the official Unity Application Program Interface (API) and official Unity-guided tutorials provided through Unity's website.

Video graphics proved to be another challenge. The game must be visually appealing. The use of open source game art was considered, but this quickly fell through due to a lack of applicable Japanese related game art. Consequently, several days were spent studying basic drawing techniques and Adobe Photoshop. A simple cartoon image of two mountains with some clouds was produced in Adobe Photoshop and would go on to serve as the main background of the game. While the game needed to be visually appealing, it was equally important to make certain the user focused on the Japanese characters. Images containing all the Japanese characters within the scope of the project were also produced within Adobe Photoshop. These Japanese character images were imported into Unity and converted into sprites which could be manipulated by the game engine.

Similar to the problem of original game art, was the issue of creating original music and sounds for the video game. An open source classical music track was chosen as the video game's

main menu music. This genre of music was selected as it provides a calm, relaxing setting which contributes to the learning experience. A simple open-source sound clip was selected to play when the user selects the correct answer.

Lastly, and perhaps most important, was the challenges associated with performance and efficiency. At the third development phase, as the game's complexity increased, load times and input lag became an issue. This performance reduction was caused in part by the use of simulated physics to move game objects as opposed to simply manipulating a game object's xyz coordinates. Several days were spent studying strategies for optimization in Unity, reviewing the code, and then rewriting or restricting it so that efficiency increased.

Accomplishments

During the development period, a considerable amount of time was spent pondering the fact that the final product would not be fully leveraged unless it was accessible and available to potential users. After all, the goal of this project was to develop a simple, easy to use video game for students of introductory Japanese. This video game was originally developed for the Windows platform, but was determined to be too limited in scope. Research was conducted to find a method or technology that would allow for the video game to be playable on almost any platform. The optimal solution was to implement the video game as a web application that could be played through almost any web browser.

Web Graphics Library (WebGL) served as the technology with which to render the video game in web browsers. WebGL is a JavaScript API for rendering interactive 3D and 2D graphics within any compatible web browser without the use of plug-ins. During compilation time, the Unity game engine can convert the video game's C# code completely into JavaScript which can run on compatible web browsers. Running the game is a matter of integrating the newly produced JavaScript code into an HTML file which is then ready for online hosting.

Hosting this WebGL video game proved to be a learning experience. With many commercial hosting options, it was difficult to determine which one to choose. After conducting further research, Amazon Web Services S3 was selected for hosting this application as it features a very flexible pay as you go system. Amazon Web Services S3 is cloud-based, scalable, object hosting solution. The WebGL variant of the video game is publically available worldwide through http://craigdecampli.com/jpedu.html and playable within the browser without the need for any plugins.

Conclusion

This project proved to be a hard-fought journey. I stepped in to this without having all of the knowledge, skills or experience to develop a video game. Starting from scratch, working many hours (approximately 230), overcoming stubborn challenges, and experiencing the thrill as the game progressed made this a fulfilling experience. This project, while having tested my patience, proved to be an invaluable learning experience.

Inspiration for this project came from my passion for technology, and from a keen interest in learning about other cultures and societies. My studies in the Honors Program's Global Leadership track fueled my interest in doing a project that would advance my computer science skills and that would also contribute something, albeit small, to the education community. I studied Japanese at JMU and learned firsthand how routine and at times boring it can be to memorize hundreds of Japanese characters. There had to be a way to make it more enjoyable while maintaining learning effectiveness. Technologies are readily available to develop a basic video game. Prior studies support the idea that video games can enhance the learning experience. This project demonstrates that the lack of available, effective video games to complement foreign language learning can be overcome. Basic programming skills combined with some creative design, and a strong desire to help others learn, can result in simple but effective video games. The interactive experience will certainly improve students' ability to learn this challenging language. Learning Japanese can certainly be fun!

Future Work

This video game has been successfully deployed online and is ready for distribution. It can be offered to foreign language learning websites, K-12 schools and colleges, cultural organizations, and others where there is interest in Japanese language learning.

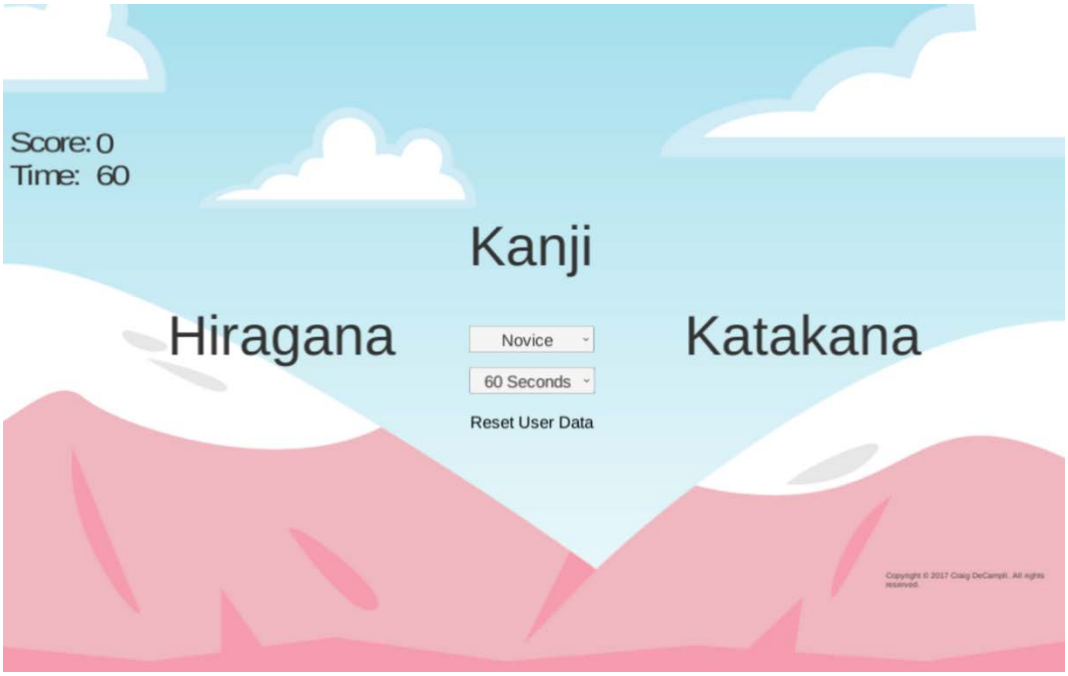
Enhancements to the quality of the game's art can be made. While not "learning-critical," the visual appeal may make it more attractive to a potential user and cause them to select and use the game.

Due to the modular structure of the video game it would be easy to add additional Japanese characters. Assuming a user masters the current set of characters, these could be swapped out to present the next set as the student progresses through the language learning process. This feature can be built into the game. Additionally, scaling out this platform into other languages that do not use the Latin alphabet (e.g., Chinese, Korean, Russian) and that rely on rote memorization, would be a great step forward to expand the breadth of the game.

Lastly, a 3D virtual reality implementation of this video game using a technology such as the HTC Vive would allow for a much more immersive and intense experience. Users would wear a movement-tracking virtual reality headset with a built-in microphone. 3D models of Japanese characters would spawn around the user in 360 degrees and slowly float towards the user. Utilizing Unity's voice-to-text API users would have to speak the phonetic pronunciation of characters before said characters' reach them.

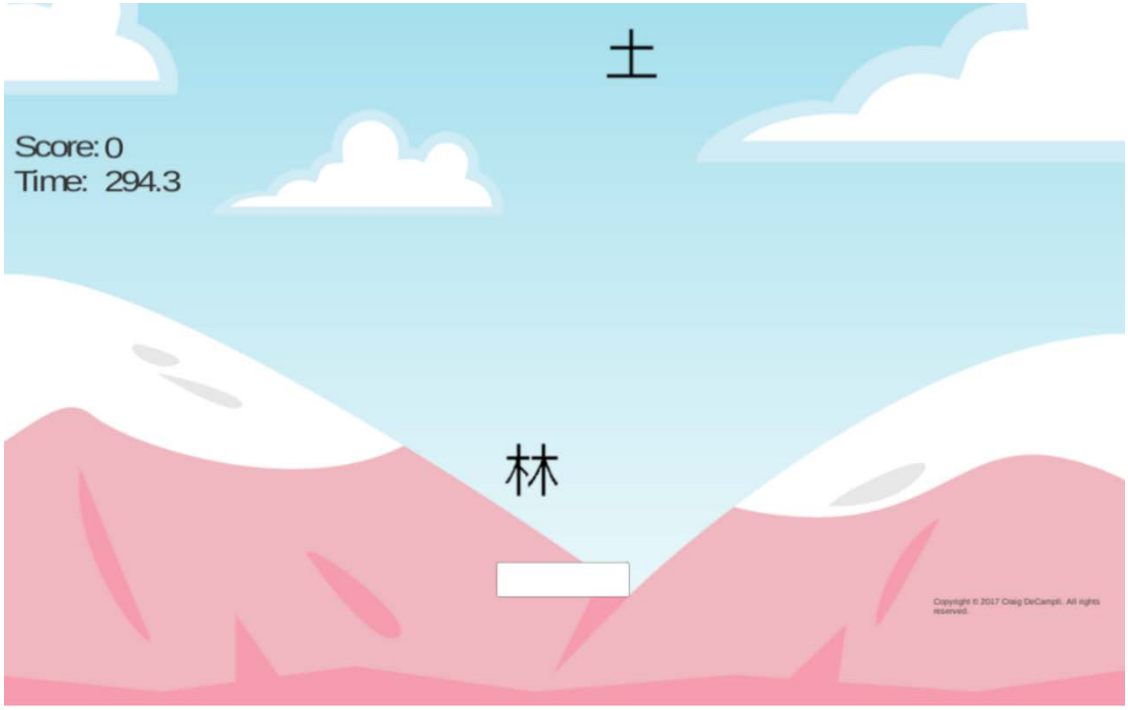
Appendix

Main Menu featuring Hiragana, Kanji, and Katakana game modes

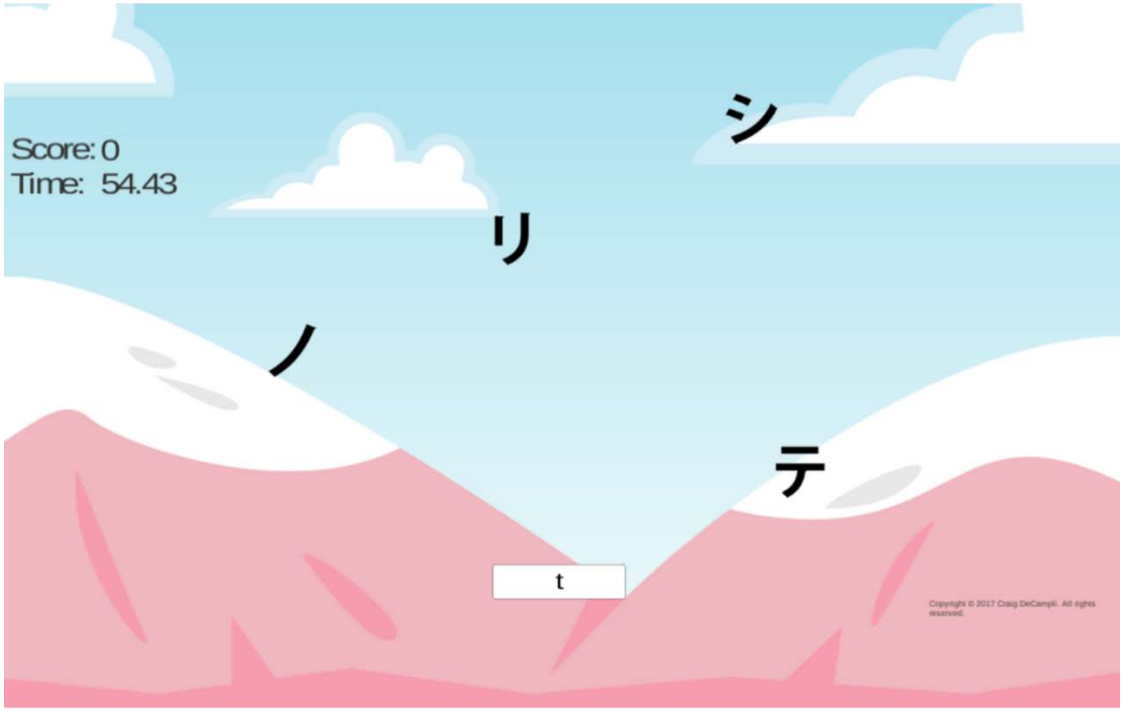


Hiragana Gameplay mode featuring input box and Hiragana characters

Kanji Gameplay mode featuring input box and Kanji characters



Katakana Gameplay mode featuring input box and Katakana characters



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