Software Engineering Department

Braude College

Capstone Project Phase A

English Adventure Island: A Speech-to-Talk Fun Learning Game for Kids

Project Number 23-2-D-16

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Content:

Abstract:

English Adventure Island is an educational video game that focuses on English language learning for children aged 4 to 10. It uses a speech recognition feature that helps children improve their English language skills, especially their vocabulary and pronunciation. This feature allows children to practice their speech in an interactive and fun way using their device's microphone to receive helpful feedback on their pronunciation of words and phrases. The game provides correct pronunciation examples to help children develop more accurate pronunciation and learn new words. To make the game more attractive for children, it incorporates adventure-themed elements and exciting challenges that aim to keep them motivated and excited to learn, in addition to a child-friendly interface that ensures a smooth gaming experience. With the use of cloud services and data storage, English Adventure Island also provides an option for parents to monitor their child's progress and identify areas that require more practice.

1. Introduction

Nowadays, many children use smart devices from a young age, spending most of their time on activities that may not be productive at all. Considering the importance of the English language in the world and its uses in many fields, we decided to combine the process of learning the English language with the need to provide children an enjoyable and educational activity. "English Adventure Island" is our proposed video game aimed at children whose first language is not English and children that may find the conventional methods of learning a language too boring or challenging.

English is the most spoken language in the world and learning it can open a wide range of opportunities, including access to higher education, better job opportunities and the ability to communicate with people around the world. Learning a language at a young age has many advantages. Children have a remarkable ability to absorb new information and their brains are highly receptive to learning languages. Starting early allows a longer period of exposure to the language, which can lead to a more natural and fluent understanding of the language. However, it is important to acknowledge that children often face challenges when learning a new language, and lack of interest is one of them.

Our goal is to provide an alternative approach for the language learning process, an approach that is more enjoyable and interactive. By utilizing a speech recognition feature, our game allows children to improve their pronunciation and speaking skills, which can be a significant challenge for many English learners. The adventure themed gameplay makes the learning process more fun and engaging for children, encouraging them to practice and learn in an interactive way.

In English Adventure Island the child must correctly pronounce words in English to complete levels and to earn points. For example, an animal will be displayed on the screen and the child will need to say out loud the name of the animal, then the speech recognition analyzes the pronounced word and feedback will be provided to the child.

The game is developed using the Unity game engine, and the C# programming language is used for scripting. The speech recognition is the main feature of the project, which enables the game to recognize and analyze spoken words. To ensure a personalized experience, the child's progress will be saved in the cloud to generate personalized reports and track the language learning journey. The game is designed with a focus on the target audience: children aged 4 to 10.

2. Related Work

One approach that has been explored in language learning is the use of music activities. In [1], the authors show that music can have a positive impact on language learning, especially for young learners. The study found that incorporating music activities into English language learning for kindergarten students led to significant improvement in their language skills. Music activities can be a valuable tool in foreign language learning for young children and can contribute to a more engaging and effective language learning experience.

Another approach is the use of video games. [2] explores the potential of using video games in eBooks to enhance English vocabulary learning. The authors conducted a study with university students and found that using an eBook with embedded games resulted in higher vocabulary scores compared to traditional study methods. The study suggests that video games can be a valuable tool in enhancing language learning, especially for younger learners who may be more motivated by interactive and engaging content. The article highlights the potential of incorporating game elements into educational materials to make learning more enjoyable and effective.

Video games have also been explored as a tool for treating anxiety in children. [3] shows the development of a biofeedback video game that aimed to teach children relaxation techniques and coping strategies for anxiety. The study found that the game was effective in reducing anxiety symptoms and improving children's ability to manage their anxiety. The game was found to be engaging and motivating to children, encouraging them to try out new relaxation skills to "win" the game. With children as our primary audience, it is crucial to design the game in a way that prioritizes their needs and interests.

Research [4] about development of an English learning application for young children shows the importance of engaging children through interactive and fun learning experiences to promote successful language learning. The application was designed with colorful visuals, animations, and games to attract children's attention and encourage them to participate in language learning activities. The article suggests that the use of technology can provide a valuable resource for early childhood education, allowing for personalized learning experiences and enhancing engagement and motivation. The study emphasizes the potential of technology in language learning and highlights the importance of designing educational applications that are engaging and appealing to young learners.

There are many existing video games that aim to teach children English language skills, one of them is 'Learn English Kids' [5] which is a popular language learning game designed for children. The game aims to teach basic English language skills, including vocabulary, grammar, and pronunciation, through a variety of interactive activities and games. The game includes audio recordings of native speakers, as well as pictures and animations, to help children learn new words and phrases. We aim to improve existing language learning games by incorporating a speech recognition feature that provides real-time feedback on pronunciation and speaking skills, and creating a more interactive and personalized game that can make language learning more fun and effective for children.

Using video games can be a useful tool to enhance language learning, especially for younger learners. Video games are often interactive and engaging, which can motivate children to participate in language learning activities. Additionally, video games can provide opportunities for practice and repetition, which are essential for language acquisition. Moreover, the immediate feedback and rewards, can lead to a positive attitude and encourage children to continue learning. Video games can be a valuable tool in language learning, especially for younger learners, and can contribute to a more engaging and effective language learning experience.

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[1] Liza Lee, Shu-Chuan Lin, “The Impact of Music Activities on Foreign Language, English Learning for Young Children.“
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[3] John Sharry, Matt McDermott, Jim Condron, "‘Relax to Win’ – Treating children with anxiety problems with a biofeedback video game.”
[4] Very Hendra Saputra, Donaya Pasha, Yolanda Afriska, “Design of English Learning Application for Children Early Childhood.”
[5] British Council The United Kingdom's international organization for cultural relations and educational opportunities., 'Learn English Kids'.

3. Background

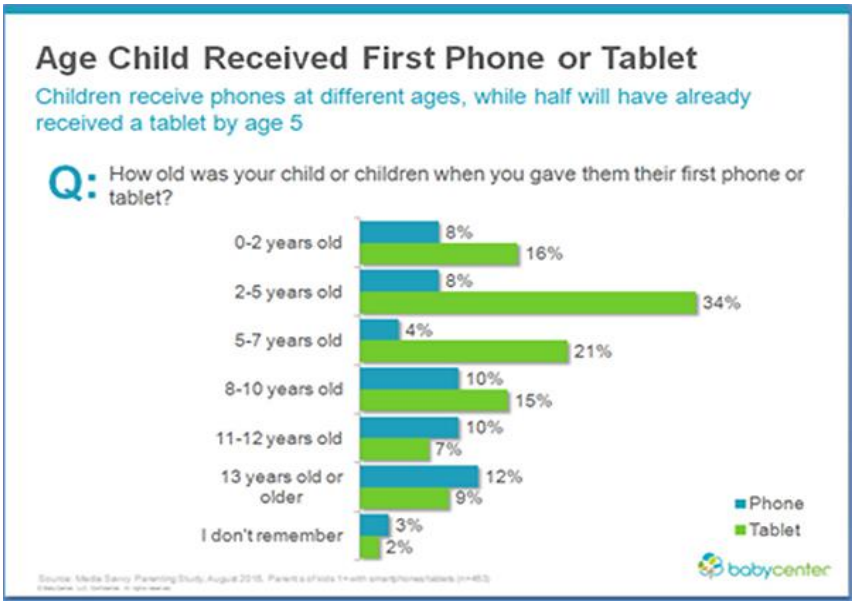
3.1 Video Games and Education

Nowadays, it's common for children to spend their free time playing video games or using smart devices. This trend has only increased during the COVID-19 pandemic, as children have sought entertainment and turned to screens that are easily accessible to them. Why not turn this disadvantage into an advantage?

Learning a new language can be a fun and effective experience when it's combined with video games, which are the most popular activities among children around the world. Video games can be used as a powerful tool for language learning, as they are built around conversations and contextual learning, making it easier to remember concepts and words.

Moreover, video games provide exposure to real-world things, animals, and characters that are not typically taught in classrooms or textbooks. Repetition is essential for retaining concepts and words, and video games provide opportunities for this through mission-based challenges and interactive gameplay. While reading is not a primary focus of video games, players still encounter texts within the game, which can help improve their reading skills. By leveraging the popularity of video games, we can encourage children to learn English in a fun and engaging way, instead of relying on traditional methods that can feel tedious and uninspiring.

According to a recent study in the US [6], 80% of parents allow their children between the ages of 1 and 9 to use smartphones or tablets, with most of them starting before the age of 3. Additionally, over half of the children surveyed have their own phone. The American Academy of Pediatrics has taken notice of this trend and is reconsidering its guidelines because most of the parents are unable to stick to the recommendation of no screen time for children under 2 years old. The study also found that parents are comfortable with their children using technology and are adopting a more balanced approach to their children's technology usage.



[6] "Rise of the Tech-Tots: BabyCenter Uncovers a New Relaxed Attitude About Screen Time Among Millennial Parents."

3.2 Unity Engine

Unity is a cross-platform game engine that was first released in June 2005 at Apple Worldwide Developers Conference as a Mac OS X game engine. It has since been gradually extended to support a variety of desktop, mobile, console and virtual reality platforms. Unity supports both 2D and 3D graphics and scripting through C# and drag-and-drop functionality. It provides developers with built-in features such as 3D rendering, physics, and collision detection. Unity is an all-purpose game engine that is widely used in the field of virtual reality to create scenes and simulations.

Furthermore, Unity has a helpful developer's community and a lot of learning resources available online for free. You can access free tutorials, courses, and guided pathways for mastering real-time 3D development skills to make video games, VR, AR, and more through Unity Learn.

Some of the main features Unity provides are:

- Cross-platform development: Unity allows developers to build games for multiple platforms such as Windows, Mac, Linux, iOS, Android, and many more.
- Scripting: Unity uses C# as its primary scripting language, which allows developers to create custom behaviors and interactions for game objects.
- Audio: Unity includes a comprehensive audio system that allows developers to add sound effects, music, and voiceovers to their games.
- Physics simulation: Unity includes a robust physics engine that enables realistic simulation of physical behaviors such as collisions, gravity, and forces.
- Networking: Unity includes networking capabilities that enable multiplayer games and online game features.
- Developers can rapidly assemble scenes in an intuitive editor workspace with an easy workflow.
- Quality game creation, such as AAA visuals, high-definition audio, and full-throttle action, without any glitches on screen.
- 2D and 3D graphics support: Unity provides powerful graphics rendering capabilities, including support for both 2D and 3D graphics. It includes a wide range of tools and features for creating and animating 2D and 3D graphics.
- A unique and flexible automation system to create natural animations in very less time.
- Smooth frame rate with reliable performance on all the platforms developers publish their games.
- Developers can reduce the time of development by using existing reusable assets available on the huge Asset Store.

In conclusion, Unity is a game engine that stands out from the rest due to its developer-friendly nature, ease of use, and feature-richness. It's also free for independent developers.

[7] Unity (game engine) , Wikipedia.

3.3 Speech Recognition

Speech recognition technology is a type of artificial intelligence that enables a program, a machine, or a device to process human speech into a text. Usually this is done by looking at the words being said and comparing them to a list of acceptable phrases or commands. Speech recognition can be used for various applications, such as hands-free control, automatic translation, and dictation.

Speech recognition technology can be a useful tool for learning a new language. Learners can practice speaking and listening skills in a more natural and interactive way, as they can receive immediate feedback on their pronunciation. In addition, speech recognition can help learners develop their vocabulary and grammar skills by allowing them to practice speaking in context. Speech recognition technology can be a valuable addition to the language learning resources, helping learners improve their proficiency and confidence in speaking a new language.

3.4 Cloud Technology

Cloud technology offers the convenience of deploying software applications and storing data in a virtual environment that is managed by third-party service providers. These providers take care of the necessary hardware and software infrastructure, such as servers, storage, networking, and security. Using cloud technology brings several advantages, including easy accessibility, enough data storage, and support for speech recognition feature. With cloud technology, users can access the game from anywhere if they have an internet connection, by using a web browser or mobile app. The technology provides a large amount of storage space for the game's data, including user progress and data, while providing advanced security features to protect the data. Cloud-based speech recognition services can be used to power the game's speech recognition feature.

4. Expected Achievements

4.1 Outcomes

The expected outcome for this project is creating an interactive and engaging game that improves children's English language skills, particularly in areas such as vocabulary, pronunciation, and speaking skills in an interactive and engaging way. The game will include problem-solving, critical thinking, and decision-making elements which can help children develop their cognitive skills. With its speech recognition feature, children can practice and improve their pronunciation and speaking skills. By utilizing cloud technology, the game can be easily accessed from anywhere with an internet connection, providing access to the game for children around the world and gather valuable information about a child's progress in the game. Seeing their progress and improvement over time can be incredibly motivating, particularly for children, this feature also allows parents to monitor their child's progress and identify specific areas where they may need to focus to enhance their skills.

4.2 Unique Features

4.2.1 Gamification

In our educational game, gamification is reflected through various features and elements designed to make learning more engaging, fun, and rewarding for children. These features include:

- Game points and rewards: The game offers in-game points and rewards for completing levels, answering questions correctly, and achieving specific goals. These points and rewards serve as motivators for children to continue playing and learning.
- Challenges and levels: The game incorporates challenges and levels that gradually increase in difficulty, providing a sense of accomplishment and progression as children learn and improve their language skills.

- Interactive gameplay: The game utilizes interactive gameplay elements that keep children engaged and motivated, such as speech recognition features that encourage them to practice their pronunciation and speaking skills.
- Progress tracking: The game allows children to track their progress and see their improvement over time, which helps to build confidence and motivation.
- Fun and engaging visuals: The game uses fun and engaging visuals, animations, and sound effects that make learning more enjoyable and immersive for children.

4.2.2 Speech Recognition

The utilization of the speech recognition feature in the game provides an interactive and engaging experience for children that can help them improve their pronunciation and speaking skills. This feature allows children to practice their English language skills by speaking into a microphone, which is then processed by the game's speech recognition software. The software can detect their pronunciation and provide feedback on whether the answer is correct or not. It also provides an extra layer of engagement and interactivity to the game, as children are actively participating in the learning process by speaking out loud, making it easier for them to retain what they have learned.

4.2.3 Progress Tracking

The progress tracking feature using cloud technology in the game allows children to monitor their learning progress and their improvement over time. This feature helps build their confidence and motivation to continue learning and achieving their goals in the game and provides children with a sense of accomplishment and encourages them to keep practicing and improving their English language skills. Furthermore, the progress tracking feature provides parents with insights into the child's learning process, enabling them to identify areas where the child needs further support and guidance.

4.2.4 Design

The use of fun and engaging visuals, animations, and sound effects in the game enhance the learning experience for children. These elements create an immersive environment that keeps children engaged, motivated and make it easier for children to understand and remember new words. This approach makes learning more enjoyable and helps children stay motivated as they interact with the game.

4.3 Criteria for Success

The primary goal of our project is to develop an interactive and engaging game for children to learn English language skills. With a focus on improving vocabulary and pronunciation, our game incorporates a speech recognition feature that enables children to practice and improve their speaking and listening skills in a natural and interactive way.
The success relies on several criteria:

- The speech recognition feature must accurately recognize and analyze spoken words, providing real time feedback on pronunciation and accent.
- The game must provide age-appropriate content and cover a wide range of English language skills, including vocabulary and pronunciation.
- The game's performance must be flawless, ensuring a seamless learning experience.
- The game's interface must be intuitive and user-friendly to allow an easy navigation experience for children.
- The game must incorporate fun and engaging gameplay elements that keep children motivated and interested in learning, ensuring that they remain engaged throughout their learning journey.

These criteria are essential for the success of the project, as they ensure that the game is effective in helping children to learn English language skills and it is user friendly, engaging, and enjoyable for the target audience.

5. Research/Engineering Process

5.1 Research - Children's Language Learning

The research and engineering process of developing a language learning application for children involved extensive information gathering and analysis. Our first step was to establish a theoretical background and gain a deeper understanding of children's language learning needs, including their preferences and motivations. We also explored the benefits of using video games to teach English, as well as the most effective and appropriate strategies for language acquisition.
We specifically chose to target children between the ages of 4 and 10 because research indicates that introducing a new language at an early age significantly enhances language learning effectiveness.
To ensure overall understanding of the subject, we used a range of resources, such as articles, studies, videos, and existing English learning games. We reviewed these resources and used our findings to identify key points to prioritize during the application's development phase. Our goal was to create an enjoyable and practical tool that would engage young learners and provide them with a solid foundation for language learning.

5.1.1 Constraints and Challenges

- Limited attention span and cognitive abilities of young children may pose a challenge in designing engaging and effective learning activities.
- The need to adhere to safety and privacy regulations when developing an application targeted at children can limit data collection and personalization features.
- Ensuring that the application strikes the right balance between entertainment and educational value.
- Designing effective feedback mechanisms to motivate children and provide them with a sense of progress.

5.1.2 Conclusions from Research

- A combination of fun, challenging, and practical learning activities can help to sustain children's interest and maximize their language learning outcomes.
- Personalization features, such as adapting the application to the child's language level and progress, can improve the effectiveness and engagement of the learning experience.
- Collaboration with parents and children themselves can be an effective way to ensure that the language learning application meets the needs and expectations of young learners.

5.2 Research - Game Development with Speech Recognition

The advancement of speech recognition technology in games has revolutionized the gaming experience, offering players a more immersive way to interact with their favorite games. However, the development process comes with significant challenges that must be overcome to ensure the seamless integration of this technology into gameplay. In addition to understanding the hardware and software components involved, evaluating the effectiveness of different text-to-speech technologies, and researching the compatibility of various tools and technologies for creating game environments are crucial steps in the development process. Additionally, best practices for bug tracking and performance optimization must be considered when implementing voice control in games.

5.2.1 Constraints and Challenges

- The main challenge is to ensure that the game accurately recognizes and responds to the player's speech. This requires a high level of accuracy in the speech recognition technology, which can be difficult to achieve.
- Speech recognition requires significant processing power and memory, which can be a constraint for some devices. This can limit the complexity of the game and the number of features that can be included.
- Integrating speech recognition with game mechanics can be a challenge. The game must be designed in a way that the speech recognition technology is seamlessly integrated into the gameplay, and it should not feel like an add-on feature.

- Speech recognition technology may work differently depending on the language and accent of the speaker.
- Speech recognition technology may collect and store user data, which raises privacy concerns.

5.3 Methodology and Development Process

In our development process we will be using the Agile methodology. This will enable us to work in sprints, where we will deliver small, incremental features that can be tested and evaluated. During each sprint, we will have meetings to discuss progress, issues, and any changes that need to be made. To ensure an effective development process, we have divided it into several key stages:

1. Building the scene and basic gameplay mechanics using Unity engine.
2. Integrating the speech-to-talk feature, to recognize and analyze spoken words.
3. Testing the speech-to-talk feature and optimizing it for accuracy and responsiveness.
4. Incorporating engaging gameplay elements and challenges to keep children motivated and excited to learn.
5. Conducting user testing with children and parents to gather feedback and make improvements.
6. Implementing cloud technology to allow for data storage and sharing, as well as for remote updates and bug fixes.
7. Continuously iterating and improving the game based on user feedback and analytics.
8. Conducting user acceptance testing to ensure that the game meets all requirements and functions properly.

By following these stages and continuously improving the game based on user feedback, we can ensure that our game is not only fun and engaging for children but also effective in helping them improve their English language skills.

6. Product

6.1 Requirements

Functional:

1	The game should have a speech-to-talk feature that recognizes and analyzes spoken words
2	The game provides real-time feedback on pronunciation
3	The game should have an adventure-themed gameplay
4	The game should have engaging gameplay elements and challenges
5	The game stores user’s data on the cloud

6	The game analyzes user's data and produces an analysis report
7	The game displays guidance dialogs

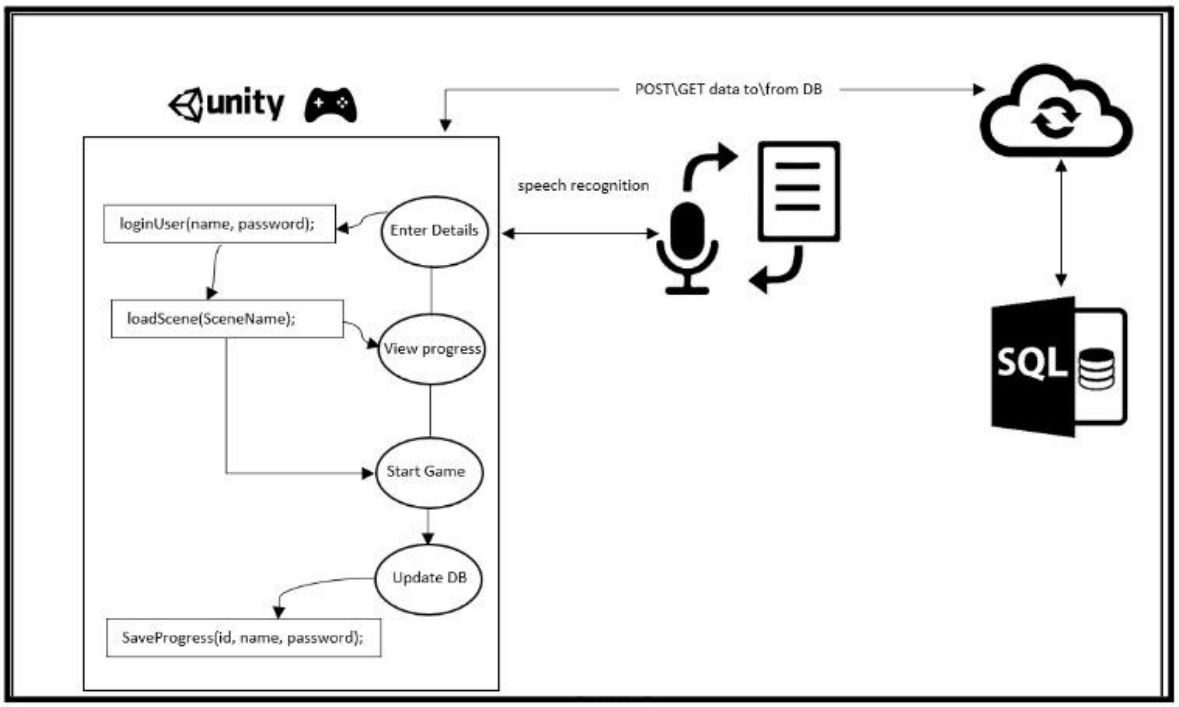
Non-functional:

1	The speech-to-talk feature should be highly accurate and responsive
2	Smooth performance
3	Compatible with a variety of devices
4	Intuitive user interface and easy-to-use controls suitable for children

6.2 Architecture Overview

Our architecture consists of several components working together to provide a seamless and interactive experience for the user:

- Unity engine for game development.
- Speech recognition feature to allow the game to recognize and analyze spoken words.
- Cloud technology to store user's data.
- SQL will be used as the database management system to maintain and organize user data and progress.



6.2.1 Unity-Application

Our Unity application will be using the Model View Controller (MVC) architecture.
This architecture separates the game's components into three main parts:
Model: contains the data and logic of the game, such as the game state, player progress, and speech recognition algorithm. It is responsible for updating and maintaining the game state.
View: contains the user interface and presentation layer of the game, including the graphics, animations, and sound effects. It displays the game state to the user and handles user input.
Controller: The mediator between the Model and View, receiving input from the user and updating the Model and View accordingly. It is responsible for game flow and logic, such as transitioning between game stages, managing player progress, and handling user input validation.

6.2.2 Scenes

Our scenes represent different social scenarios.
We want to create interesting and exciting scenes to create the feeling of an attractive video game that the child will want to continue playing.
For better optimization we will be using Skyboxes. Skybox is a method of creating backgrounds to make a video game level appear larger than it really is. Skyboxes combine a series of static or dynamic images rendered onto a cube's inner surface surrounding the game world. Each scene can have its own unique environment, characters, and challenges that the child must overcome in order to progress. The scenes can be designed to be both engaging and educational, incorporating gameplay elements that encourage the child to learn and practice their English language skills. For example, a scene could feature a virtual market where the child must interact with vendors and customers to buy and sell things. Another scene could take place in a virtual classroom, where the child must complete language exercises and interact with the teacher and other students to improve their speaking and listening skills.

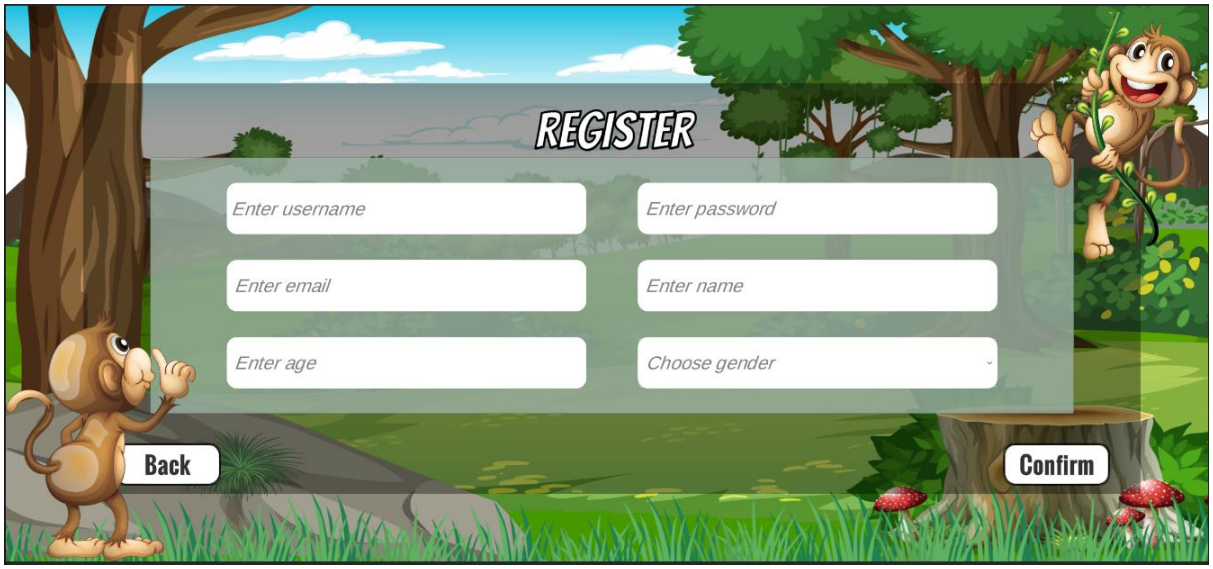
[7] "Skybox (video games) - Wikipedia."
[8] "2D & 3D Skyboxes - Asset Store – Unity."

6.2.3 Interfaces and Game Flow

Creating a visually engaging game is essential to capture the attention and imagination of children. Our goal is to create an immersive and interactive adventure-themed game that incorporates bright colors and fun characters to make it appealing and enjoyable for children.

The game begins with a welcome screen that gives the user the option to either register or login. If the user doesn't have an account, they can press the "Register" button.

After pressing "Register" the user will be prompted to enter their username, password, email, name, age, and gender. Once they have created an account, they can proceed to the login screen.



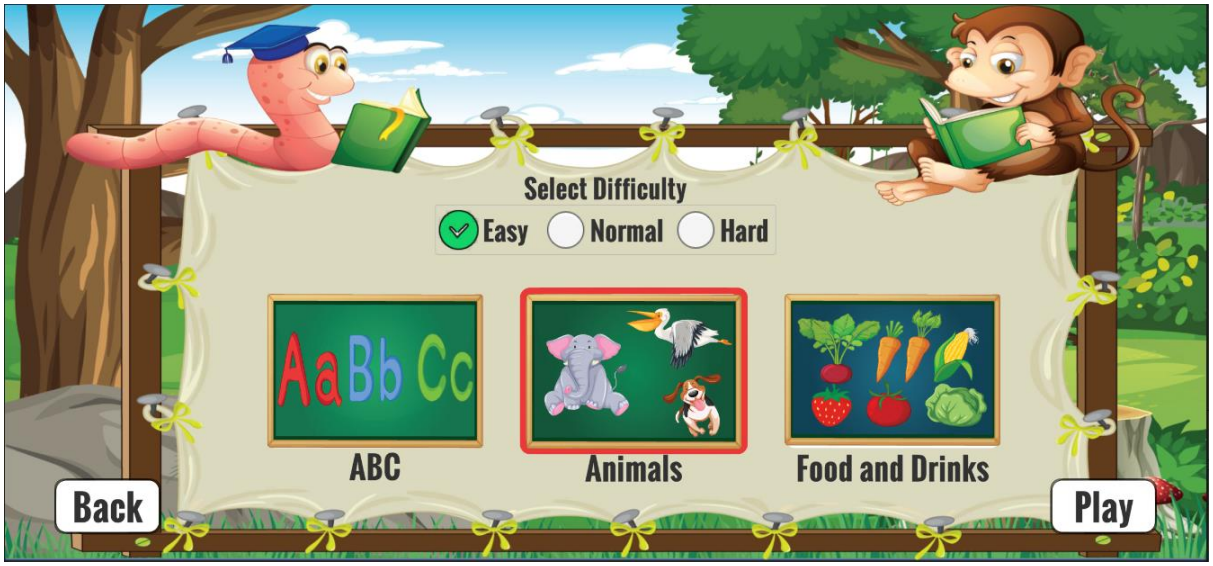
[10] Visual content, "Freepik Company – brgfx."

On the login screen, the user will need to enter their username and password to access the account.

After successfully logging in, they will be taken to the main menu, where they will have the option to start the game or view their progress.

In the 'View Progress' section, there's an option to enter 'Parent Mode', where parents can keep track of their child's progress and identify areas in which the child finds more difficult.

If the user selects "Start", they will be taken to a category and difficulty selection screen. Here, they can choose the category and the difficulty level of the game. For example, they may choose to play the "Animals" category at the easy level.



Once the user starts the level, they will be presented with a series of words that they must pronounce correctly using the speech recognition feature. The speech recognition feature will analyze their pronunciation and provide feedback on whether they pronounced the word correctly or not. The user will continue to play the level until they have completed all the tasks.

When the user finishes the level, the points they earned and any mistakes they made will be stored in the database on the cloud. This data will be used to generate a personalized report on the user's progress in the game. The user will then be taken back to the main menu, where they can choose to start a new level, view their progress, or logout.

6.2.4 Data Storing

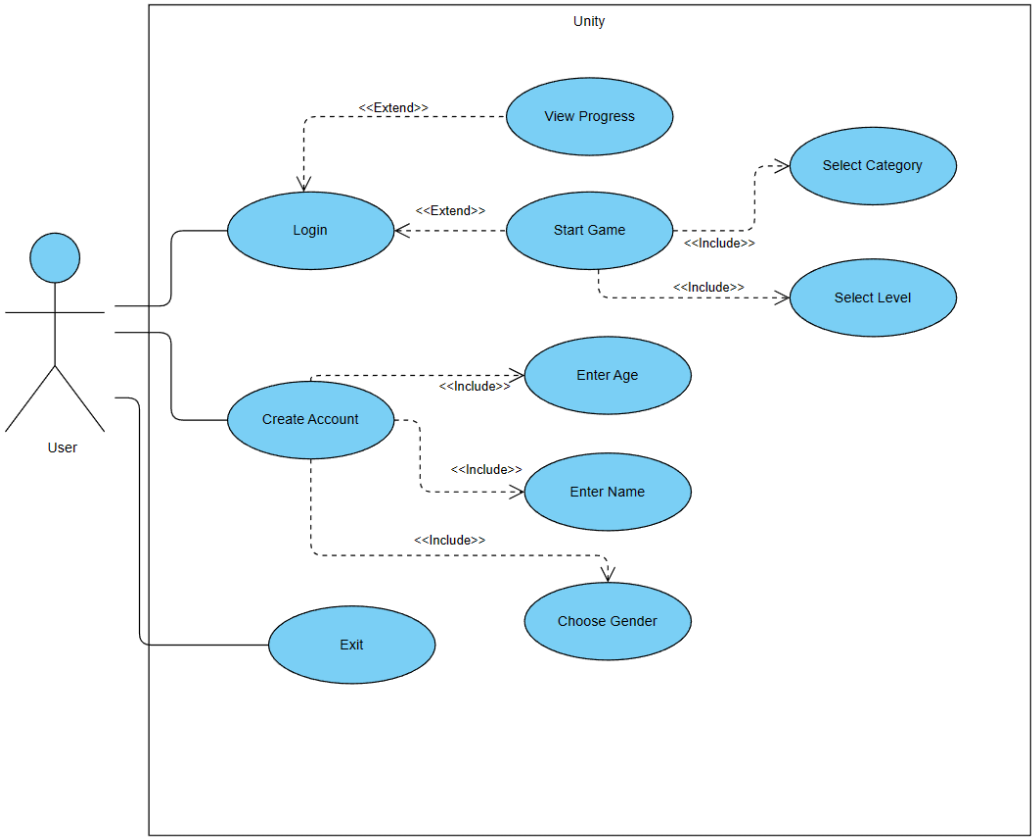
Once a child completes a level in the game, the progress is automatically saved on the cloud. The stored game progress data include information such as the child's current level, points earned, and achievements unlocked. The user's data is synced across devices to allow them to continue the game from where they left, without losing the progress. The data which stored on the cloud will be used to produce personalized reports of the child's progress and suggestions of the areas that need more practice. The reports can be viewed in the game by the child or their parents.

6.3 Data Analysis and Classification

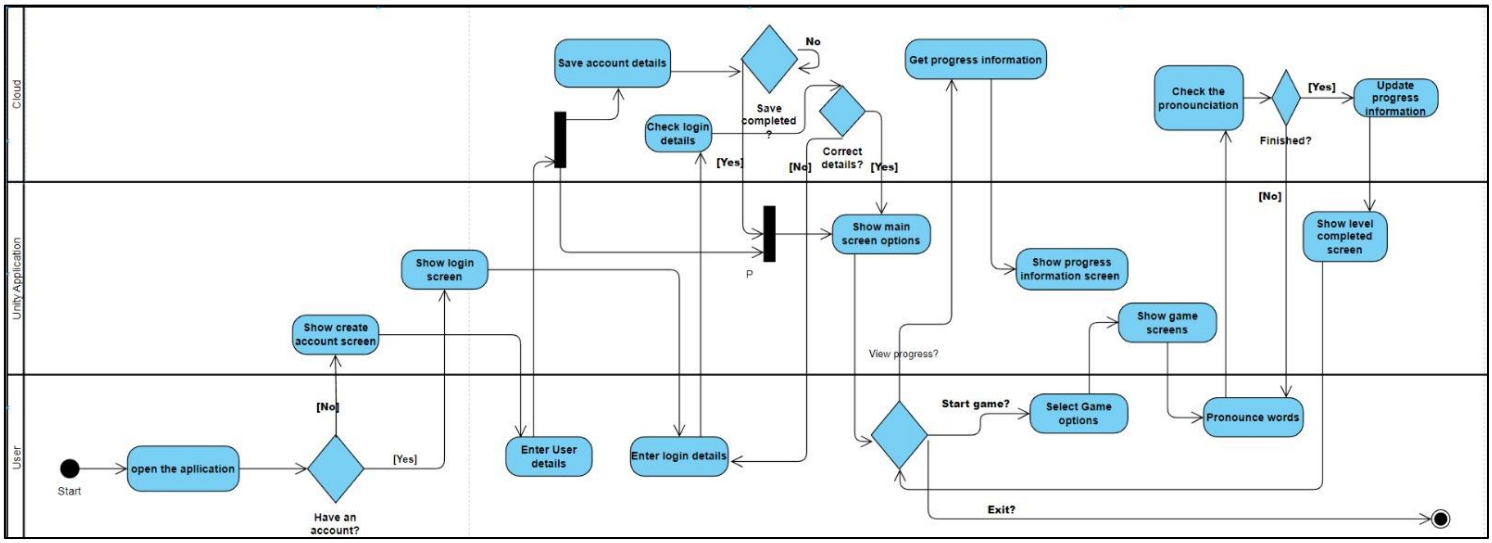
To create personalized reports on the child's progress, we will analyze each category separately, such as pronunciation and vocabulary. The child's current level in each category will be used to classify them as a beginner, intermediate, or advanced learner. Additionally, we will keep track of the number of mistakes made to identify words that they may be struggling to pronounce correctly.

6.4 Diagrams

6.4.1 Use Case Diagram



6.4.2 Activity Diagram



7. Verification and Evaluation

In order to ensure that our educational game is effective in improving children's English language skills, and that the speech-to-talk feature recognizing correctly the pronunciation, we will implement the following evaluation and verification plan:

7.1 Testing Plan

The testing plan is designed to ensure the quality and effectiveness of the application, speech-to-talk feature, and cloud storage. By thoroughly testing each of these elements, we can identify any potential issues or areas for improvement.

Test No.	Module	Tested Function	Expected Result
1	Unity Application	Scene Loading	The scene should load correctly and without any errors
2	Unity Application	Scene Transitioning	The transition between scenes should be smooth
3	Unity Application	3D Objects Positioning	The 3D objects should be positioned in the correct locations
4	Unity Application	3D Objects Proportions	The 3D objects should have the correct proportions
5	Unity Application	Data storage	The game should be able to store and retrieve data correctly
6	Speech-to-Talk	Correct Recognition	The speech-to-talk feature should be able to recognize and respond correctly to spoken words and phrases
7	Speech-to-Talk	Pronunciation Feedback	The speech-to-talk feature should provide accurate feedback
8	Cloud Storage	Data Retrieval	The game should be able to retrieve data from the database correctly
9	Cloud Storage	Data Storage	The game should be able to store data in the database correctly
10	Cloud Storage	Data Accessibility	The child should be able to access their progress data from any device
11	Data Analysis	Progress Classification	The child's progress data should be correctly analyzed and classified
12	Personalized Reports	Generate Reports	The game should be able to generate personalized reports on the child's progress
13	Personalized Reports	Data Visualization	The reports generated should be presented in an easy-to-understand way

7.2 Usability Testing

We will invite a group of children in the desired age range to play the game and provide feedback on their experience. We will observe their interactions with the game and record any issues that arise. Based on this feedback, we will make necessary adjustments to improve the game's usability.

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