Interactive Storybook for Learning Pronunciation

A tool to provide engaging at-home practise for children undertaking speech therapy.

Oscar Dunstan
Aiden Taylor
Julian Sunde
Theodore Teo
Vanessa Ackermann

The Concept

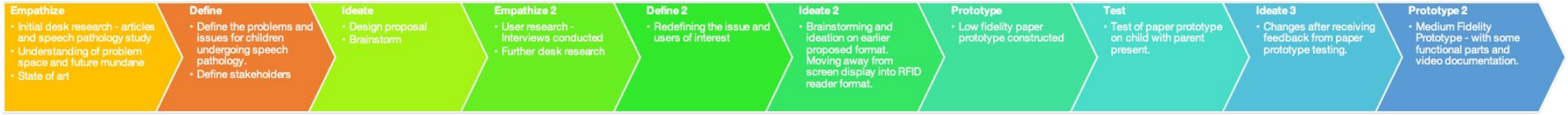
The goal of the Interactive Storybook is to, through play and customised stories, support the child in their practise of pronouncing particular sounds and difficult words. The Storybook consists of a story that is read out to the child, with matching background images and a series of characters to interact with the story with. To complete a page of the storybook the child must place the objects on their correct spots and pronounce a series of spoken sentences correctly. Upon completion a light will light up, guiding the child to the next page of the storybook. The child will then be able to pick up the next page and place that on the storybook device. The book is meant to be used at home with the child's parent to keep up their speech pathology training. After each session data of progress and difficulty in pronunciation of words will be sent to the child's speech pathologist.

The Problem Space From research we found that children often struggle to keep up their speech pathology training at home (D. Theodoros, 2012) The problems found were maintaining interest and tools to measure the exact progress of the child. The users will be children ages 3-5 years old, who are connected to a speech pathology clinic and experience issues pronouncing specific words and/or sounds. The concept addresses the theme of future mundane by suggesting a more interactive and fun way that speech pathology training can be conducted in the future. We suggest that in the future will be normal for a child to have their very own interactive storybook at home perscribed by their speech pathologist.

Related work We found strong support from literature that an interactive game/mobile solution such as the concept proposed enhances the chances of children learning and keeping up their training within speech pathology (Ahmed et.al., 2018) From already existing solutions we found that Google's voice recognition (Google Cloud, 2021) is the closest to what we are trying to achieve when trying to assess whether a sentence is pronounced correctly or not.

Link to video on Youtube: https://youtu.be/wnbkWxYPD18

Design Process



Initial Research

From our initial research, we faced a dilemma on whether to focus on adults or children for speech pathology. We opted for children as there isn't a lot of research material dedicated to speech pathology in adults compared to children. We managed to find several people in the field who were happy to talk to us about the topic.

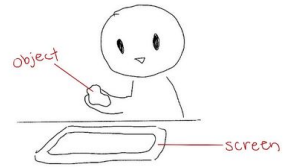
Interviews

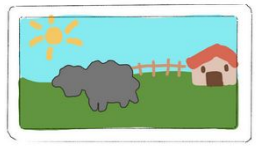
To understand our key users and stakeholders we conducted user research by conducting four semistructured interviews with speech pathologists, researchers and experts within the field. The key findings from our current user research is shown in the figure to the right. Most importantly these insights helped us:

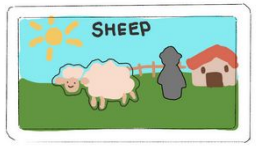
- **Change UI** from screen display to more tangible interactive storybook format
- Focus on children using the book **with their parent**
- Must be a **practising at home** tool, therefore **mobile and light.**
- **Levels** and story **development** is important
- Focus on **pronunciation** of specific sounds and words.

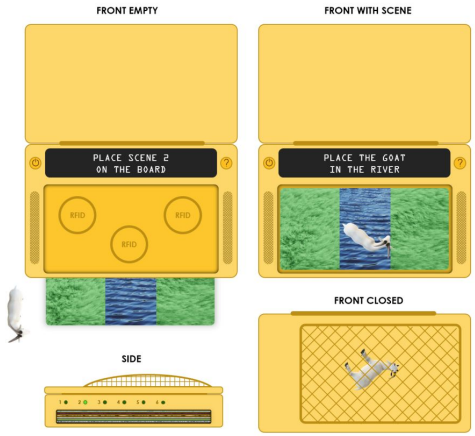
Initial Concept

Our initial concept was to have a visual screen that displays both the backgrounds and the words. We planned to get the user to put the object on the screen. If the screen would recognise the object, the word would be read out. Our target audience was also originally early primary children as the interviews we conducted with a speech pathologist student advised us that preschoolers might not be able to read still and the age was adjusted to the research conducted.



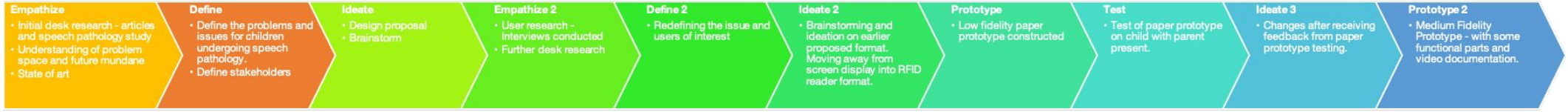






We then opted not to use a screen, as we wanted to increase tactile interaction, and reduce the amount of screentime for children as this was mentioned to be important by both parents and experts. By not using a screen we also challenge modern toys of today such as iPads and gaming consoles on how a traditional format of a book can be transformed into a technology- supported interactive training and storytelling device suitable for the future mundane.

Design Process



Paper Prototype

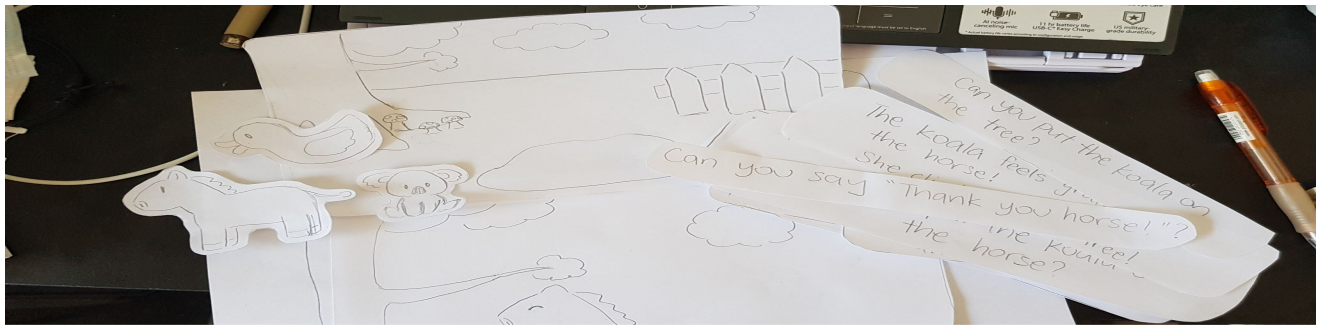
We did a paper prototype in order to visualise our end product and test with our target demographic on its engagement. Due to the very short time frame in which our selected user was free to test with us, we had to rush the prototype and test with them within a few hours.

The prototype consists of backgrounds, cutouts of animals for the child to place on appropriate positions of the background and engage with the story, and words for the tester to change when reading the story for the child to see.

Paper Prototype User Testing

User Testing was done using our paper prototype, and conducted with a child (not associated with speech therapy) to find out about the level of engagement our device could bring to our target demographic.

Interviews were also conducted with this child's parent to find out more about the activities they do with children to engage with their learning.



Paper Prototype Key Outcomes

The child initially was engaged with the story and put all the animals in the correct position, but as time went on, the child was hesitant on answering the questions and placing the animals, only answering them when the parent prompted them to do so. We concluded that it was due to the type of prototype we tested them with, as children usually have short attention spans and don't respond as well to dull colours.

The parent in particular felt that the story was a little simple for 5 year olds to read, which contradicts one of our interviews where the student claimed that preschoolers might not be able to read still.

We also changed our target audience to be between 3-5 years old, since the parent said that children at that age range can engage with a simple story like this more so than compared to older children.

Current Prototype (Medium Fidelity)

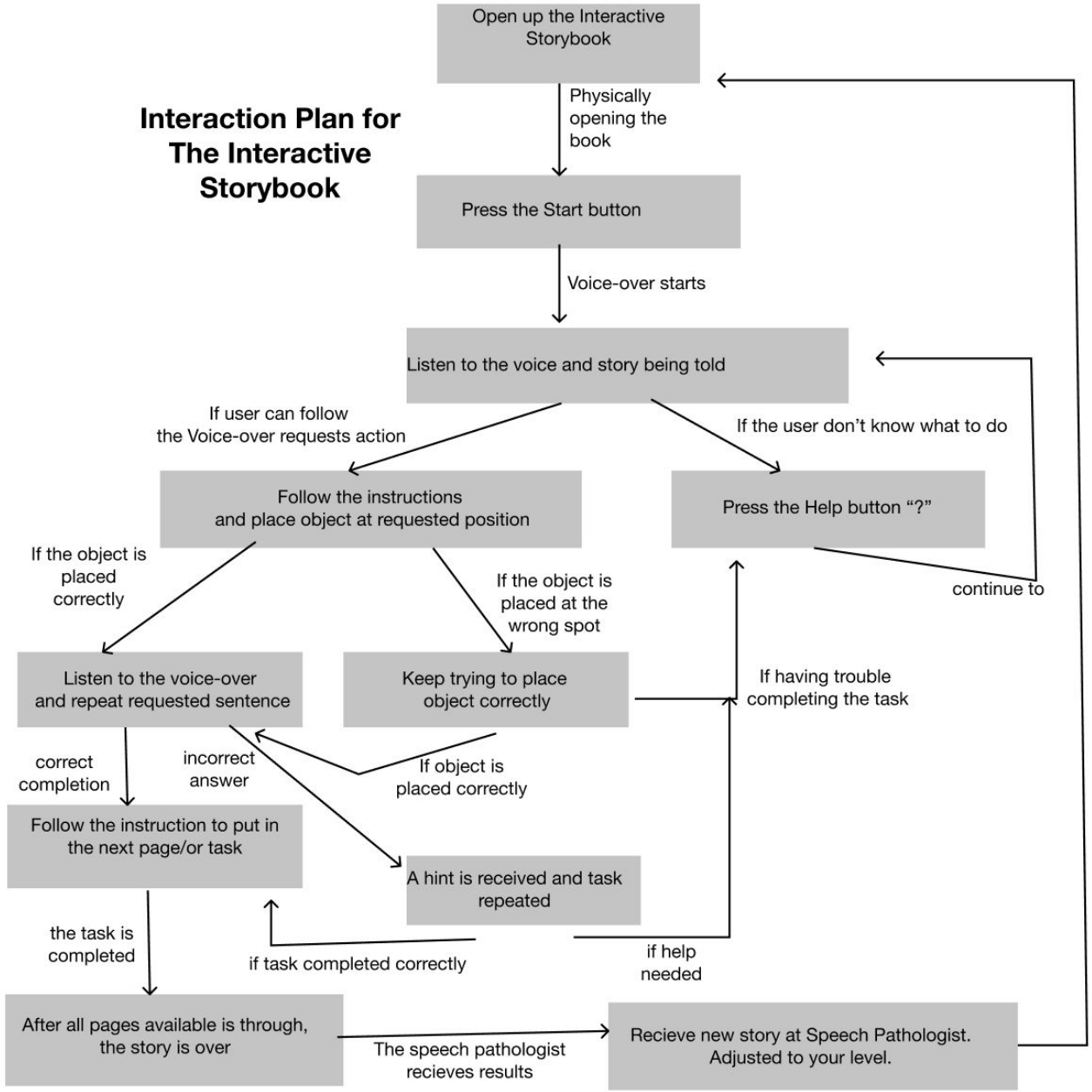
Based on key outcomes of the paper prototype, we built upon our initial paper prototype interaction by creating a physical story box for wizard of oz testing (shown on Slide 1). We have also begun to incorporate RFID sensors and the Google Voice API to demonstrate actual functionality.

Our story box houses all artifacts necessary to tell our story. All individually drawn characters live in a convenient mesh pouch for easy storage. Each page background lives in the bottom of the box which provides a convenient location to pull out the necessary page for the story.

Once the user opens the box they will be prompted to place the opening page on the designated area. At the bottom of the page will be three RFID sensors. Once the story begins the prototype will begin to read the story. At selected intervals the user will be prompted to interact with the story by placing the characters onto a specific location on the storyboard. There will be three locations that the user can place the character. If the user places the character in the correct location they will be prompted to say a particular word. This word will be relevant to their therapy and directly link to the story. If the user has any trouble pronouncing the phrase they can either try again or opt for hints to give them a helping hand. If the user then pronounces the phase correctly they will progress through the story as their reward for completing the pronunciation challenge. This reward system will keep children engaged with their therapy by providing a fun stress free environment that rewards correct pronunciation.

Interaction Plan

On this slide the Interaction Paradigm is illustrated through the use of an interaction diagram, showing the flow of action and interactions performed by users. The interaction itself with the Interactive Storybook is started upon the user pressing the start button. The interaction for the main user end as the story is finished but the overall interaction does not end until the clinician in charge of results receives the results of the exercises.



Interaction Plan

In this slide the **User Journey** for a Persona John is shown. This represents the ideal interaction we would like to achieve with our solution.

Persona

John
6 years

Speech pathology for one year.

Trouble with "S" sounds

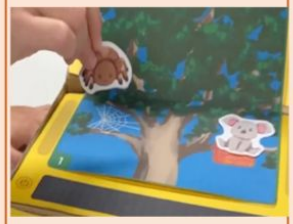
Scenario

The scope of this user journey is to show a high-level interaction between a child user (John) and the Interactive Storybook.

John has been given the storybook home by his speech pathologist. It is now time for John to practise his "S" sounds at home with his mom.

Goals and expectation

The goal of the user journey is for John to complete a story in the storybook, with help from his mom. The goals would also be to improve upon his pronunciation of "S" sounds and have fun while being motivated to continue practicing. The expectations from John would be to have fun as the speech pathologist said he was given a fun new toy (the storybook) to bring home. Another expectation would be doing the activity with his mom and showing it to the speech pathologist next week.

Touchpoint	At the Speech Pathologist	Introducing the book	Preview of tool and accept	Journey home with book	At home in room
					
Description	John and his mom shows up at the speech pathologist. He comes here once a week. And has a special issue with "S" sounds. He is a bit annoyed coming here every week.	The speech pathologist introduces John to the Interactive Storybook. She explains it is going to help him practise at home and that he can play it with his mom.	She opens the book for him and shows him the features. She let him know that next time he will get a new story! She tells him he should practise everyday!	John and his mom leaves the clinic. On the way home John is happy and exited about his new toy.	At home the next day, John and his mom picks up the book. They sit together in John's room. John is happy to spend time with his mom.
Touchpoint	Starting story	Finding object and place	Pronounce and repeat	Results reviewed	Next consultation
					
Description	John does what he was told at the clinic and opens up the book to press the start button. A sound greets him and the story starts reading out loud.	The story now asks Joh to find the Koala and put her in the correct spot. John find the Koala in the mesh and puts it on the correct spot. This prompts the story to continue.	Now the story asks John to repeat a sentence. John is struggling to say the "S" sound and the reader asks him to repeat again. This time John succeeds.	After completing the story John and his mom puts the book away. Meanwhile the results are send to John's speech pathologist and she can now see what he struggles with.	At the next consultation John brings his book and is excited to receive a new story. She says he did really well and that the next story is brand new and will focus on new sounds!

Project Objectives & Success Criteria

In this section our chosen project objectives are described using the diagram below and S.M.A.R.T goal setting.

Objective 1	**The final product must be able to decide whether the user is pronouncing the sentence correctly or not.**
Specific success criteria	To be successful the Google API must function and be correctly implemented. Ideally a percentage in correctness will be returned as data following the session.
How to measure?	Measured by amount of times the API correctly accepts a spoken sentence and other way around accepts false. Can be measured as amount of correct readings registered out of total of correct inputs.
Achievable?	The API is currently being linked to Unity. Will be achieved by constant testing of system.
Relevant?	Key component to make system functional and fulfill the future mundane criteria
Time?	Can be done within two weeks
Objective 2	**Recognition of objects to RFID scanner**
Specific success criteria	To be successful each of the objects (e.g., animals in the mesh) will have to be assigned a specific value and position wanted. To be successful the RFID scanner has to recognize and distinguish between different objects providing an output that leads user to next verbal clue by the storybook.
How to measure?	Measured by testing the assignment of objects and testing how and if they are registered by the RFID scanner. Tested by test placements of object on both the right and wrong positions of story pages.
Achievable?	Currently the different sensors are registered by the RFID scanner, it is therefore achievable to program and assign a given sensor to a given object instance.
Relevant?	Yes, essential for function of the objects used to tell the story and create interaction with the story.
Time?	Can be done within the week.

Objective 3	**Withholding attention of the child practising**
Specific success criteria	To be successful the story must be engaging and functioning enough for a child to complete the story without losing interest. Success is therefore engagement with the story from start to finish. Another success criteria would be the child wanting to repeat the exercise and story. Lastly a success when the child remembers and/or improves the pronunciation of a given sentence.
How to measure?	From interviews with experts in the field we found that the MARS method (Moss Intentional Rating Scale) can be used to measure the attention level of a child interacting with a speech pathology tool. Will also be measured through % success rate in completing the story and requesting a second try.
Achievable?	Is achievable if the technical aspects of the storybook are working and the story matches the age and skill level of the child.
Relevant?	Highly relevant as this tool is to be used at home and requires a motivated child to complete.
Time?	Continuous process of iterations to improve the story and technicalities - iterations to be finished before Week 13.
Objective 4	**User is able to progress through a story and finally complete it with a output of results**
Specific success criteria	The code must be implemented so that the user can either pass or fail a given task (pronounciation or sentence and placement of objects) to be successful, measurements must be implemented so that the user cannot continue until this is done correctly. Other criteria for success is the analysing and compiling of results data from the session just completed. The system must be able to provide an output measuring the skills of the user.
How to measure?	Measured through output code and data present or not.
Achievable?	Will be achieved by using the Google API function to generate how much of the voice input that was said correctly.
Relevant?	Highly - This is a critical function and the user will not be able to have success without this objective in mind.
Time?	Implemented continuously throughout development, must be done before Week 13.