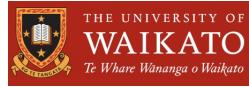


**University of Waikato
Faculty of Computing and Mathematical Sciences**



Report of final prototype - CSMAX570-23A

Whakatōhea's eBook prototype

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Background and requirements

The Whakatōhea are a Māori tribe located in the Eastern Bay region on the east coast of New Zealand's North Island. However, in the past, the tribe has faced challenges such as land loss. The tribe is committed to preserving and maintaining its traditional values and way of life(whakatohea, 2023). Our aim in creating the digital library is to preserve the tribe's history, traditional knowledge, and cultural heritage to prevent these valuable resources from being lost or forgotten over time. The digital library will help pass on the culture by allowing the younger generation to better understand and learn about their traditional culture and history.

The digital library will provide a curriculum for young people (aged 13-18 years old) that integrates Māori language learning materials into textbooks and provides a Māori language learning environment. For this digital library, the basic requirements include converting e-books, entering them into the back-end database, and displaying them on the front-end to enable deletion, change, and search functions. The e-books will be categorized by age group and relevant historical topics to aid in the search process.

Prototype Design

The aim of this project is to design and develop a prototype digital library for Māori language users to meet the needs of Māori language users for book retrieval, borrowing and return functions, and to improve the library experience for Māori language users. The prototype library is aimed at the Maori speaking community around the world, including Maori teachers, students, parents and general users(Pixso, 2022).

Māori language is one of the official languages of New Zealand's indigenous Maori people and is an important part of New Zealand's cultural and social development. In order to promote the heritage and development of the Maori language, the prototype digital library will provide Maori language users with rich and diverse Maori language book resources to facilitate their online reading and learning, and will also make a positive contribution to Maori language education and cultural heritage(newzealand.com, 2023).

2.1 Design principles and methodology

The design of the digital library prototype will follow the following principles:

User-centered: The project will focus on user needs, user experience and satisfaction, to provide users with efficient and convenient humanized services.

Diversity and inclusion: The digital library prototype will provide a variety of resources from the rich and diverse Māori language culture, covering different areas and topics, embracing a variety of cultures and ideologies, and reflecting the diversity of Māori culture.

2.2 Prototype introduction

2.2.1 Main interface

After the user logs in, the main interface will show the Māori cultural background (Fig 2.1), the address of the Maori cultural community, the pictures of the introduction of Maori cultural activities, the links of E-books and multimedia, and the search function of the whole network. Here you can find all the resources we upload and provide, and you can also ask for help to carry out Māori language practice in the community and communicate with other Maori language learners.

2.2.2 User interface

After the user logs in, The system will record user information, users can modify information through the user interface, view browsing history and like the collection of E-books or multimedia, also can communicate with friends here and view the comments of E-books or multimedia(Fig 2.2).

2.2.3 Māori cultural interface

We add a Māori culture interface where users can find all about the development process of Māori culture(Fig 2.3), migration history and distribution changes, as well as the existing Māori cultural products, which will provide more research channels for current and future learners of Māori culture, from buildings, objects to custom products to show the development process of Māori culture in all aspects(New Zealand Tourism Guide, 2022).

MĀORI Culture Digital Labiry

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Māori Language Centre
The World's Largest Māori Language
Digital Library

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Figure 2.1 – Main interface

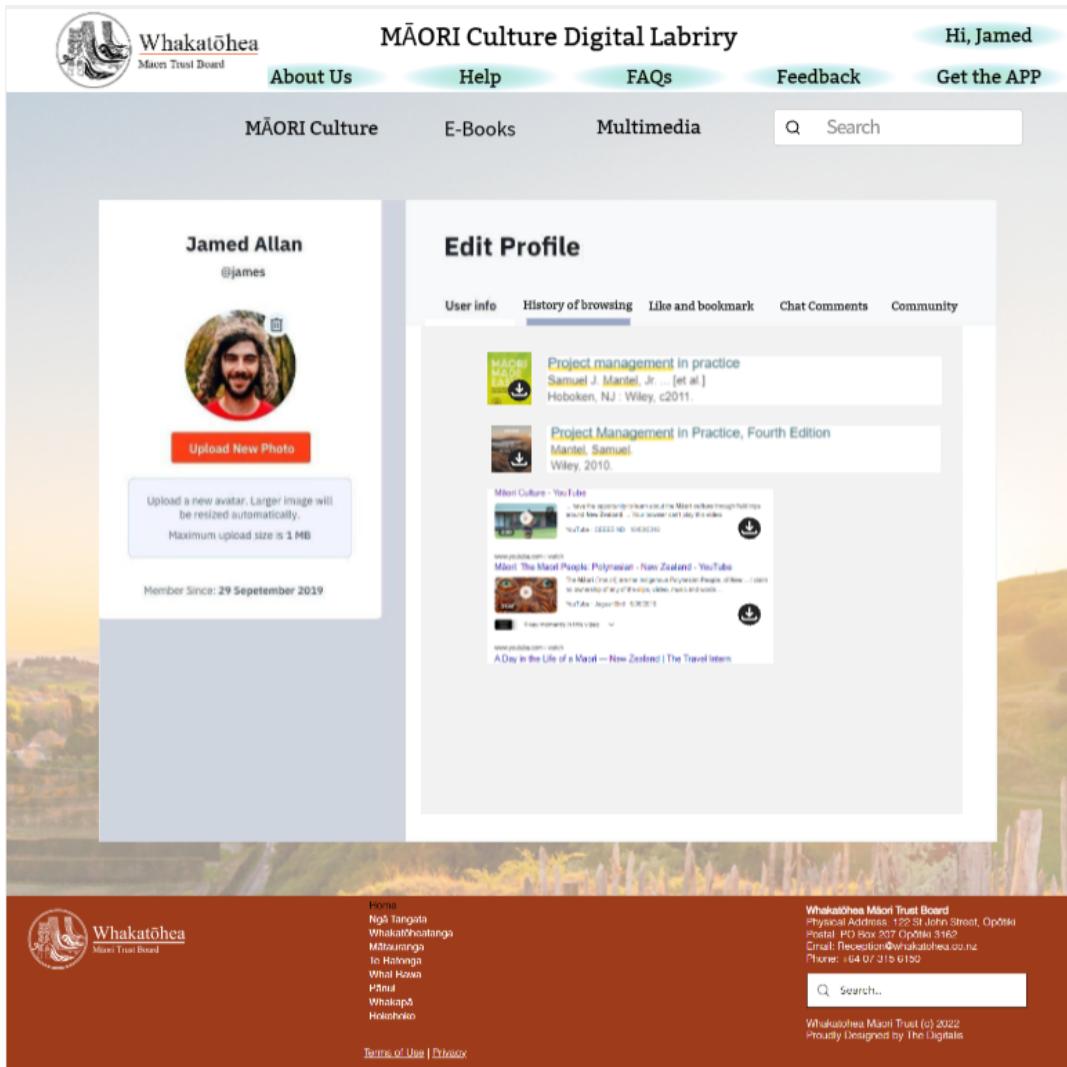


Figure 2.2 – User interface

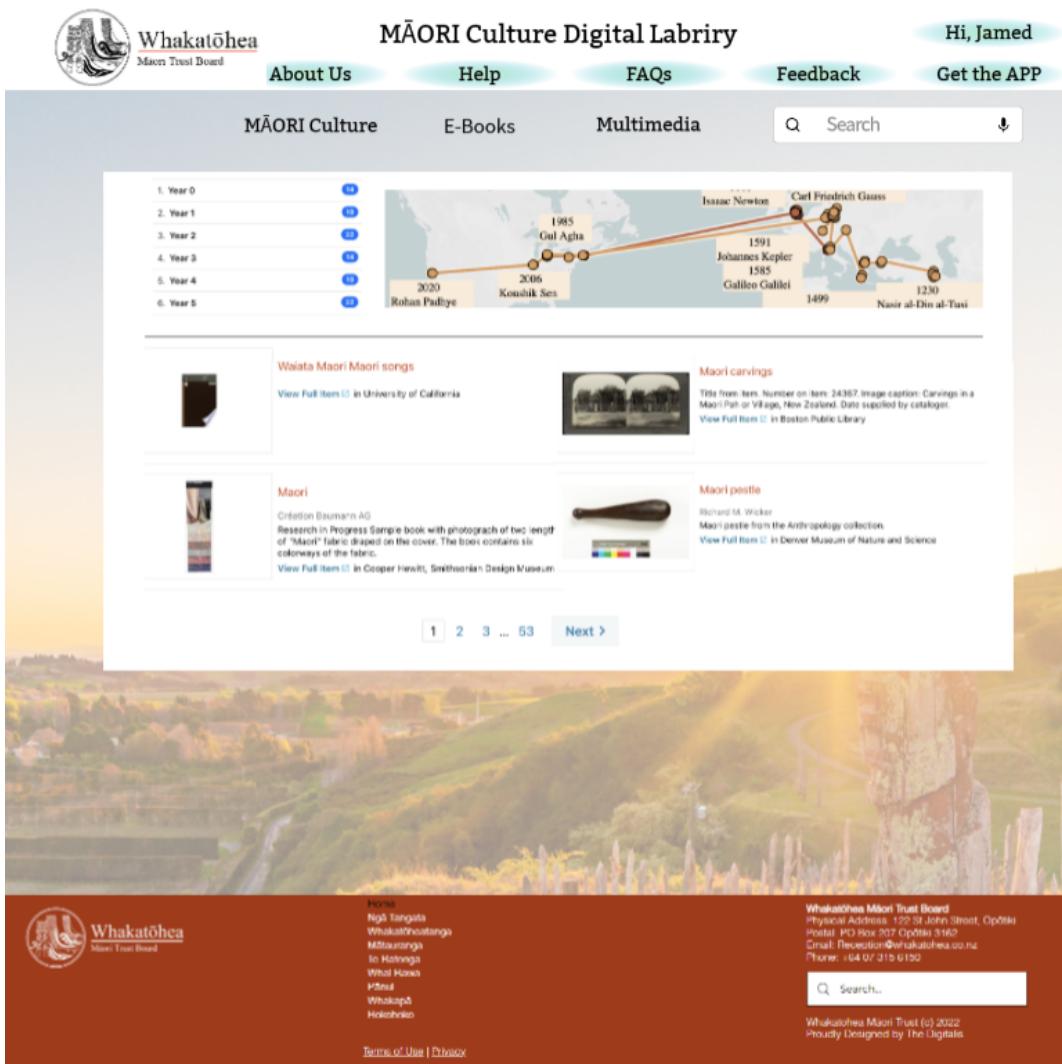


Figure 2.3 – Māori cultural interface

2.2.4 E-books browsing interface

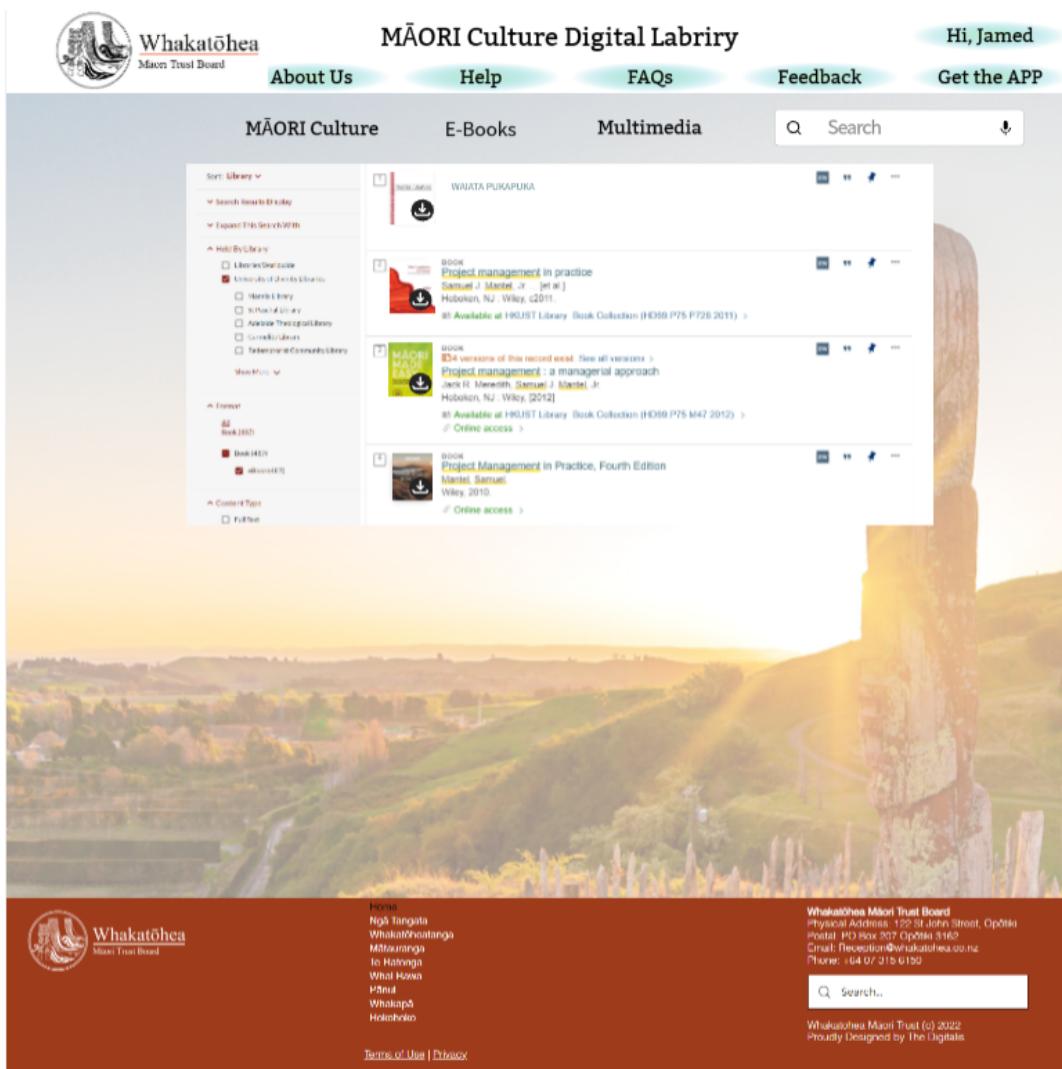


Figure 2.4 – E-books browsing interface

In the E-books browsing interface(Fig 2.4), users can search related E-books through filters, and all filters we designed include the function of voice input, which can provide convenience for some disabled learners. Typing a keyword in the filter or filtering in the left toolbar will display the relevant E-books.

2.2.5 The E-book interface

In the E-books interface(Fig 2.5), users can read text or listen to E-books through the voice playback function, and provide translation functions for other languages. All resources provided by the e-library are downloadable.

2.2.6 Video interface

In the video interface(Fig 2.6), users can search related videos by keywords or related words. The filter provides many options such as upload time, picture quality, video duration, and subtitles in other language to facilitate Māori learners to view.

The screenshot displays the Māori Culture Digital Library website. At the top, there is a navigation bar with links for 'About Us', 'Help', 'FAQs', 'Feedback', and 'Get the APP'. A user profile 'Hi, Jamed' is also visible. Below the navigation bar, there is a search bar with a magnifying glass icon and a download icon.

The main content area features a large image of a landscape with hills and a body of water. Overlaid on this image is a white box containing text about Tarawa's arrival from Hawaiki. The text describes Tarawa's journey across the Pacific Ocean, his arrival at Waiotahere Beach, and the naming of Opōtiki township. It also mentions the Tahanahana fish as spiritual guardians.

At the bottom of the page, there are 'Previous' and 'Next' navigation buttons, along with a footer containing the Whakatōhea logo, contact information for the Māori Trust Board, and a search bar.

Figure 2.5 – The E-book interface

Figure 2.6 – Video interface

2.2.7 Audio interface

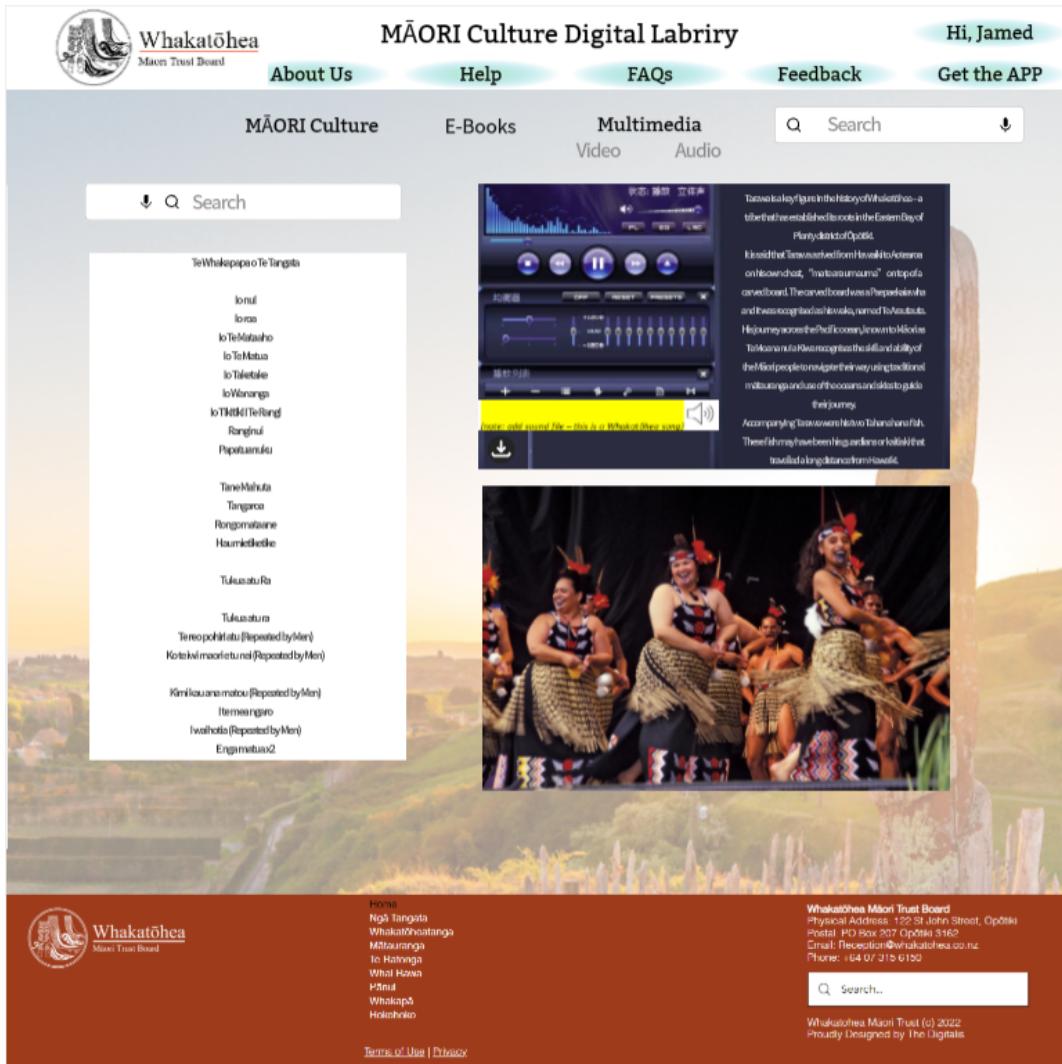


Figure 2.7 – Audio interface

In the audio interface(Fig 2.7), users can search related audio by the keywords or related words. When playing audio files, subtitles in other languages will be displayed synchronously in the player, and the audio content will be displayed on the left side, which can provide learning convenience for Māori language learners. Audio related videos or pictures are displayed below, which provides a good learning environment for audio learning and deafies learners' memory(britannica, 2023).

2.3 Conclusion and Prospect

Through the design and implementation of this project, the prototype of digital library for Maori users has realized the main functions such as book and multimedia retrieval. The library prototype can provide rich and diverse Maori cultural resources to facilitate users to read and learn online(Teara, 2023).

The designed prototype still has some limitations and shortcomings, including the process of user interface design and interaction can be further optimized, the function of multimedia interface can be more humanized, and the front-end visualization of the library can be more

abundant to meet all Maori culture learners for learning.

As technology continues to advance and the Maori language community continues to grow, the digital library prototype needs to be constantly updated and upgraded to meet the changing needs and expectations of its users. At the same time, the digital library will also make greater contributions to the Maori language education and cultural inheritance, promote the inheritance and development of the Maori language, and promote the communication and integration of multiple cultures. We look forward to the Maori Digital library becoming an important learning and communication platform for Maori language users and making greater contributions to the future development of the Maori language community(lovenewzealand, 2023).

Backend design

3.1 Introduction

In our previous report, we examined the organizational structure of historical ebooks. However, for this particular report, our primary focus shifts towards exploring the application of artificial intelligence (AI) in this domain.

To begin, we have provided a brief overview of our prior research, which primarily centered on the organization of ebooks. It became apparent that different versions and adaptations were necessary to cater to diverse age groups. Consequently, we delved into two main approaches aimed at effectively structuring the content.

The first approach involved organizing the material around critical historical events and notable figures, with the objective of offering readers a comprehensive understanding of Māori history. This method sought to enrich readers' knowledge of Māori history by delving into the intricacies of historical events and significant personalities.

The second approach focused on aligning the content with local primary and secondary school curricula to ensure its relevance in the education of younger readers. Recognizing the importance of addressing the specific needs and developmental stages of these readers, we tailored the content accordingly to resonate with their educational framework.

Building upon our previous research, the forthcoming report will primarily delve into the application of AI techniques within Māori historical ebooks. Specifically, we will explore how AI tools can effectively address the challenges associated with collecting images, audio, and textual resources for these books. However, it is imperative to acknowledge the current limitations of AI tools, necessitating caution in their utilization, particularly in critical areas. To ensure the appropriateness of materials, comprehensive guidelines on the effective use of AI tools will be provided. Moreover, continuous review and updates of the materials will be conducted to ensure their accuracy and relevance.

This section of the report will focus on how to utilize AI-related tools in the context of the previously mentioned significant prototypes. The aim is to facilitate the generation of relevant materials for ebooks production in the administration backend. Furthermore, this section will delve into the techniques involved in generating images, audio, and text.

3.2 How to generate images

Currently, generative AI is rapidly advancing, and there are numerous options available for utilizing AI-generated images as tools. When using AI to generate images, it is important to note that there is no definitive numerical measure to evaluate the similarity between generated images and the training set images in the context of generating adversarial images. Objective and subjective criteria are often required to assess the diversity of the images and determine if they are free from obvious inaccuracies. Nevertheless, with human intervention, highly acceptable images can be obtained.

This prototype clearly highlights the issue of a shortage of resources for backgrounds, covers, and illustrations in ebooks. This undoubtedly provides ample opportunities for generative AI to be utilized effectively, significantly reducing the production costs associated with generating ebooks for staff members.

3.2.1 Prototype

In the prototype shown in Fig 3.1, a backend administrator has the ability to generate new books using an editor provided in the backend. The administrator can extract a portion of text from the editor, which can be in either Māori or English, to serve as the content for generating images. Upon clicking a button, the backend system will attempt to generate multiple images in different styles. It is then up to the administrator to manually select the best image. This design approach helps to mitigate the issue of instability in generative networks' results. Furthermore, the manually selected data can be collected and analyzed for statistical purposes. In future training iterations, this data can serve as feedback, contributing to a system that better aligns with the desired Māori style.

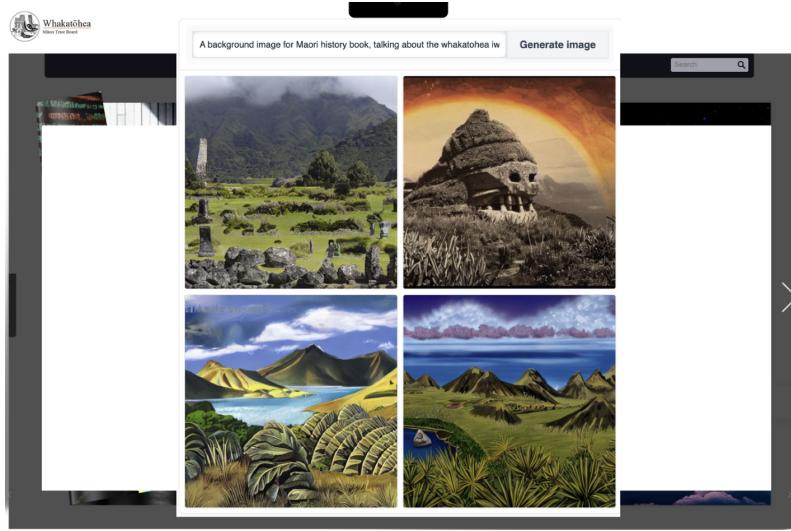


Figure 3.1 – Generate images by a backend administrator

3.2.2 Resources

Regarding methods for generating meaningful images using generative AI, there are already several excellent commercial services available on the market. Among them, DALL-E (openai, 2023) from OpenAI and Stable Diffusion (Stable Diffusion, 2023) are particularly well-known. Additionally, it is also possible to train such models independently. Although this may incur high hardware costs, leveraging cloud computing could potentially be more cost-effective compared to directly using third-party commercial services. If choosing to manually train such models, it is advisable to consider working based on the open-source project mentioned in this paper (Rombach et al., 2021).

It is important to note that Māori, being a minority language, may not receive extensive support from many commercial models. Additionally, when training models independently, it can be challenging to find sufficient training data for Māori language. However, there are some companies that offer models specifically designed for minority languages like Māori. For instance, Microsoft claims that their translator provides excellent support for Māori language (Lynch, 2019).

3.3 How to generate audio

The main scenarios where AI-generated speech is utilized include enabling individuals with visual impairments to navigate through ebooks using voice commands and directly play-

ing the content of the book. In this prototype, the envisioned languages include Māori and English. This essentially involves the application of text-to-speech and speech-to-text technologies. With the continuous advancements in neural networks, these technologies have already achieved remarkable accuracy in addressing English language requirements. However, for minority languages, the lack of sufficient accurate resources has posed challenges in finding viable solutions to complete this prototype. Fortunately, thanks to the recent release of a new version of a project by Facebook (Facebook, 2023), which utilized voice data from over 1,100 different languages reading the Bible, highly favorable results have been achieved.

3.3.1 Prototype

The prototype depicted in Fig 3.2 illustrates a scenario where a visually impaired user is reading an e-book. The ebook can be in either Māori or English. Through voice commands, the user is able to navigate through the pages and have the book's content played aloud. Due to the high accuracy of current models, these operations can be directly performed in the frontend without the need for administrator intervention.



Figure 3.2 – Play audio by a enabling individuals

3.3.2 Resources

Due to the rapid advancements in AI, timeliness is crucial in selecting appropriate technologies. Currently, Facebook's solution appears to be the best option as it can support both Māori and English. However, other companies' technologies can also be considered, such as OpenAI's open-source Whisper (Whisper, 2023) or Mozilla's TTS (Mozilla, 2021). It may require collaboration among multiple models to meet the requirements of the prototype, and further research is needed to assess the support for Māori language.

3.4 How to generate text

Today, large language models have gained tremendous popularity. Harnessing the power of these models, we can consider utilizing their summarization capabilities to generate test questions and answers of varying difficulty levels for our book. These can be used as quizzes following the study of the material in the course.

3.4.1 Prototype

The prototype shown in Fig 3.3 consists of a text excerpt derived from the corresponding book. Through this text, the most crucial information can be summarized, and a batch of possible questions and answers can be generated.

Firstly, the administrator can define the difficulty level, grade level, and the desired number of questions for the current quiz. Subsequently, due to the instability of AI model results, it requires backend confirmation by the administrator before saving the questions as test items. In this process, the administrator has the ability to modify and delete questions and answers, making the generated quiz more targeted. During this process, support for both Māori and English languages should be available, but not all large language models can provide this capability. Careful consideration should be given when selecting a model to ensure it meets these requirements.

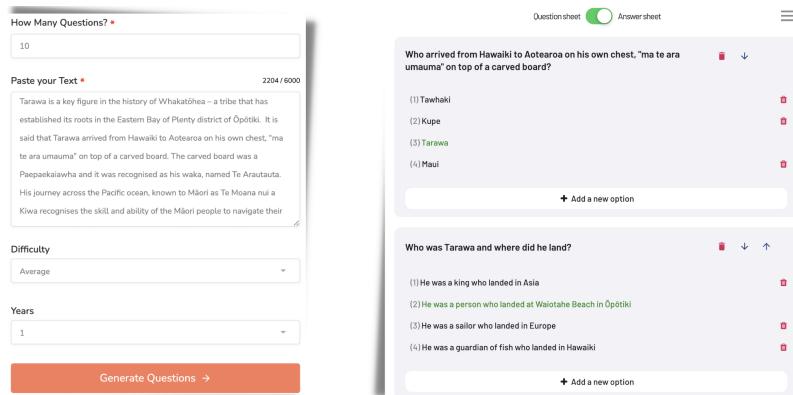


Figure 3.3 – Generate quizzes by AI

3.4.2 Resources

There are abundant resources available for this task. Firstly, one option is to directly utilize the commercial API of ChatGPT, which provides an excellent user experience. So far, it is the only system that has achieved comprehensive text summarization and abstraction tasks. Secondly, if the chosen solution lacks support for Māori language, Microsoft's Māori language translation mentioned earlier can be integrated. This allows for translation into English, followed by question generation. Additionally, open-source projects such as Google's T5 model (Roberts et al., 2022) can also be considered.

3.5 Conclusion

This section of the report focuses on conducting research on the application of AI in the backend and, in conjunction with the prototype, collecting resources to effectively utilize AI in the frontend and particularly in the backend processes of ebook and test questions generation. This simplifies the ebook generation process and provides significant convenience in accurately presenting Māori-related content. In the preparation process of ebook materials in collaboration with Whakatōhea iwi, it is believed that this logic will play a crucial role in rapidly establishing the entire framework of Māori history-related content and testing system.

All prototypes mentioned in this section have been implemented and can be accessed through the following URL(Figma, 2023).

Feedbacks

Based on the feedback from the previous presentation, we realized that our focus on the digital library was misplaced and that we should concentrate on the ebook. As a result, we will be implementing a map function to showcase Māori culture. We also received feedback during our weekly meetings that the digital library would benefit from a feature that allows for searching in various formats such as songs, making it easier for users to access information. To address this, we have improved the search function to support audio searches. Additionally, we recognize the importance of developing a community culture that facilitates cultural exchange between different tribes and the international community. This will promote cultural diversity and cross-cultural understanding.

Conclusion&next steps

At present, we have developed a basic model for integrating the front-end and back-end of our system. We plan to add more functions in the future, including intelligent features that could assist users who face accessibility challenges. For example, we may explore the possibility of implementing an assistance function on the desktop to help blind users interact with the system. Additionally, we plan to develop testing functions to support learning about Maori culture for students, among other educational goals.

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