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DIGITIZING LOCAL LANGUAGES THROUGH AUDIO: AN APPLICATION FOR TRANSLATING INDONESIAN INTO THE PAPUAN MEE TRIBE LANGUAGE

DIGITALISASI BAHASA LOKAL MELALUI AUDIO: APLIKASI TERJEMAHAN BAHASA INDONESIA KE BAHASA SUKU MEE PAPUA

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ABSTRACT
The preservation of local languages is a significant challenge in the face of globalization and the dominance of national languages. One practical effort that can be undertaken is the utilization of digital technology to document and disseminate indigenous languages. This study aims to develop a web-based application capable of translating text from Indonesian into the Mee language of Papua, complemented by audio features using native speaker recordings. The system was developed using the Waterfall model, starting from requirements analysis, system design, implementation, and testing. The use case diagram illustrates the interaction between users and the system, consisting of two main actors: general users and administrators. Users can input Indonesian words to receive translations in Mee, along with audio output. Administrators have the authority to manage vocabulary data, upload audio files, and synchronize text with the corresponding recordings. The user interface design emphasizes simplicity while reflecting the cultural values of Papua. System testing, performed using black-box methods, confirms that all functional features operate correctly. Evaluation results also indicate the system is user-friendly and holds great potential in supporting the digital preservation of the Mee language.
Keywords: Local Language Digitization, Web Translation Application, Papuan Mee Language, Language Preservation, Audio Text-to-Speech

ABSTRAK
Pelestarian bahasa lokal merupakan tantangan signifikan di tengah globalisasi dan dominasi bahasa nasional. Salah satu upaya praktis yang dapat dilakukan adalah pemanfaatan teknologi digital untuk mendokumentasikan dan menyebarluaskan bahasa pribumi. Penelitian ini bertujuan untuk mengembangkan aplikasi berbasis web yang mampu menerjemahkan teks dari Bahasa Indonesia ke Bahasa Mee Papua, dilengkapi dengan fitur audio menggunakan rekaman penutur asli. Sistem ini dikembangkan menggunakan model Waterfall, dimulai dari analisis kebutuhan, perancangan sistem, implementasi, dan pengujian. Diagram kasus penggunaan menggambarkan interaksi antara pengguna dan sistem, yang terdiri dari dua aktor utama: pengguna umum dan administrator. Pengguna dapat memasukkan kata-kata Bahasa Indonesia untuk menerima terjemahan dalam Bahasa Mee, beserta keluaran audio. Administrator memiliki wewenang untuk mengelola data kosakata, mengunggah file audio, dan mensinkronkan teks dengan rekaman yang sesuai. Desain antarmuka pengguna menekankan kesederhanaan sambil mencerminkan nilai-nilai budaya Papua. Pengujian sistem, yang dilakukan menggunakan metode black-box, mengkonfirmasi bahwa semua fitur fungsional beroperasi dengan benar. Hasil evaluasi juga menunjukkan bahwa sistem ini ramah pengguna dan memiliki potensi besar dalam mendukung pelestarian digital Bahasa Mee.
Kata Kunci: Digitalisasi Bahasa Lokal, Aplikasi Terjemahan Web, Bahasa Mee Papua, Pelestarian Bahasa, Audio Text-to-Speech

1. INTRODUCTION

Language serves as a fundamental pillar of identity and cultural reflection in society, playing a vital role in communication, preservation of knowledge, and national identity. It encapsulates the values, beliefs, and worldviews of a community, acting as a medium through which cultural heritage is transmitted. In Indonesia, the diversity of regional languages is very

high, but many of them are threatened with extinction due to the dominance of the national language and globalization [2][3]. One of the regional languages that is at risk of extinction is the Mee Tribe language spoken in the Central Papua region, especially Nabire Regency [4][5].

Digitizing local languages serves as an important strategy for documenting, preserving, and promoting regional languages among younger generations and the wider public. This approach leverages technology to create accessible platforms for language learning and cultural engagement, ensuring that these languages do not fade into obscurity [6]. The development of web-based technologies can be a bridge to integrate local languages into easily accessible digital media [7]. Translation web applications can serve as interactive media in the process of preserving and learning regional languages [8].

Currently, there is no digital platform specifically providing translation services from the Mee Tribe into Indonesian. The lack of documentation and limited access to Mee language resources complicate the process of learning and preserving the language. Lack of attention to Mee language preservation has the potential to result in the loss of Papuan cultural richness and local wisdom.

The development of local language translation web applications is a solution-oriented approach that enables the digitalization and sustainable use of regional languages [9]. Information technology enables the creation of database systems for languages, vocabulary, and sentence structures that are accessible to the wider community [10] [11]. Previous studies have focused more on more widely known regional languages, such as Javanese, Sundanese, and Batak, while digital documentation for the Mee language is still very minimal. There has been no previous research that specifically designs translation web applications for the Mee language using a local, community-based approach.

Several regional language translation applications have been developed in Indonesia, but they are generally limited to digital dictionaries or are static in nature. A study by Fadel Razsiah, Ahmat Josi, and Sari Mubaroh (2023) emphasized the digitization and preservation of local languages through web-based translators using RNN models [12]. Meanwhile, a study by Dewi Christa Kobis (2023) focused on the preservation of the Minahasa language through manuscript translation and digitization efforts by various stakeholders [13]. Previous research has demonstrated the effectiveness of web technology in supporting language preservation, but it has not been widely applied in the Papuan language context. Advances in web frameworks and databases enable the development of more dynamic and interactive applications for language preservation.

This research presents a new approach to preserving the Mee language through the development of a web application that can translate vocabulary and phrases into Indonesian. This application is designed by considering the local cultural context, the involvement of the Mee community, and the aspect of ease of web-based access. Designing and building a web application for translating the Mee language into Indonesian as an effort to digitize and preserve the local language. Developing a Mee vocabulary database that can be used for learning and preservation. Testing the application's functionality in the context of use by the local community and academics.

This research is important to prevent the extinction of the Mee language while simultaneously empowering technology as a means of preserving local culture. The results of this research are expected to serve as a reference for the development of applications for preserving other regional languages in Indonesia. With this digital system, it is hoped that the younger generation of Papua will continue to have access to and care for their ancestral language. Young Papuans are actively involved in preserving their ancestral language, although challenges remain due to modernization and external influences [14]. Various initiatives have been implemented to revitalize and teach local languages, ensuring that the younger generation maintains their cultural identity [15].

2. METHODS

The Waterfall method is a structured software development approach characterized by sequential phases, including requirements analysis, design, coding, testing, and maintenance [16]. This methodology is particularly effective in projects where requirements are well defined from the outset, allowing systematic progress through each phase [17]. The Waterfall software development model is one of the most traditional and commonly used approaches in software development. In this model, the development process is carried out sequentially, where each phase must be completed before proceeding to the next phase [18].

2.1. Stages of the Waterfall Method in Research

The analysis phase focuses on gathering user and system requirements through interviews with tribal chiefs in the Nabire region to add to or update the vocabulary the author has collected [19]. In this needs analysis stage, the functional and non-functional requirements of the application are identified. Functional Requirements: Users can select the source language (Bahasa Indonesia). Users can enter or type words in Bahasa Indonesia. The system can convert text to audio (text-to-speechThe system translates Indonesian text into the Papuan Mee Tribe language. The system displays the translation results in text and audio. Non-functional requirements: The application must be web-based and responsive, with a maximum translation processing time of 5 seconds. The application only supports desktop devices.

This stage includes designing the application architecture, user interface (UI/UX), and audio translation process flow. The main components are a text recognition module (Indonesian), a machine translation module to the Suku Mee language (based on a local dataset), and a translation module.text-to-speech(Mee Tribe Language). The process flow: Indonesian text is recorded, translated using the Mee Tribe Language vocabulary database, and then the translated text is converted back into audio.

In the implementation stage, the application is built using frontend technology (HTML, CSS, JavaScript (React.js)), backend (PHP), Database (MySQL) to store Indonesian–Mee word pairs, External API (custom Text-to-Speech module (Mee Language)).

At the testing level (Testing) functional testing is performed using Black Box Testing which focuses on the functional specifications of the system without examining its internal code. Black Box testing is performed through the following steps, including analyzing system requirements and specifications; selecting input and output variables; defining test scenarios; executing test cases; evaluating the results to identify system defects or problems.

The last stage is maintenance (Maintenance). Maintenance is focused on adding new vocabulary based on user and native speaker input. Adjusting pronunciation (audio output) to make it more natural. Fixing minor bugs found during the testing phase [20].

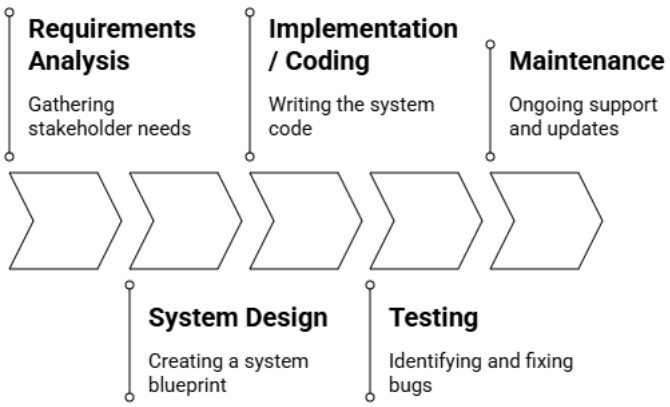

Figure 1. Waterfall Development Model

The Waterfall model offers several advantages that keep it relevant in software engineering discussions [21][22]. First, it provides good project control because its phases are sequential and structured, making it easier for project managers to monitor progress and allocate resources. Second, the documentation produced in each phase is very detailed, such as requirements specifications and architectural designs, which is useful for long-term maintenance or audits. Third, the model is simple and easy to understand, making it a good choice for projects with stable requirements or teams unfamiliar with complex methodologies [23].

However, the Waterfall model also has a number of significant challenges. One of these is its lack of flexibility, where changing requirements are difficult to accommodate after the analysis phase is complete, risking product mismatch with user needs [24]. Furthermore, its sequential process requires a long time before the product can be tested or used, in contrast to the iterative model which allows for earlier testing. Errors made in early phases, such as analysis or design, can be carried over to later phases, significantly increasing the cost of remediation. An understanding of Waterfall remains important as a foundation in the study of software engineering [25].

3. RESULT AND DISCUSSION

This section presents the results of the design and development of a web application for translation from Indonesian to Suku Mee. It also discusses the application's effectiveness and functionality in supporting local language digitization and preservation efforts. The analysis is based on testing of key features and evaluating the accuracy of the resulting translation.

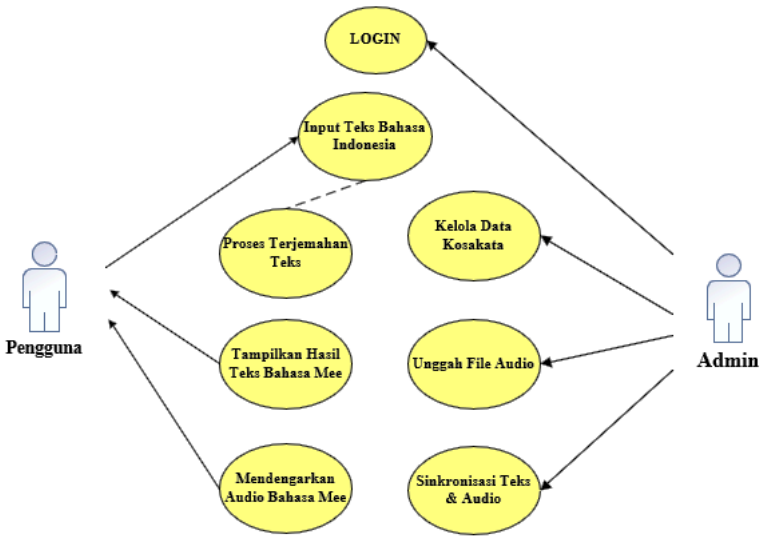

Figure 2. Usecase Diagrams

Figure 2 above is a use case diagram of a web-based translation application system that converts Indonesian text into the Papuan Mee language with audio (text-to-speech). This diagram illustrates the interaction between actors (Users and Admins) and the system's core functionality.

System Requirements Analysis

A requirements analysis was conducted to identify the main functions that must be available in the system and the user roles involved. To obtain a comprehensive overview of the

interactions between actors and the system, a use case diagram modeling approach was used. Figure 2 shows the system's use case design, which consists of two main actors: Users and Admins.

Actors and Roles

Users are individuals who utilize the system to input Indonesian text and obtain translations into the Suku Mee language, either in text or audio format. Admins are responsible for managing the vocabulary database, uploading original audio files in the Mee language, and ensuring proper synchronization between text and audio.

System Functions

From the analysis of user needs and system operations, the following functional requirements were determined: (1) Login, actors must authenticate first to access system features according to their access rights; (2) Input Indonesian Text, users enter text as translation material; (3) Text Translation Process, the system automatically translates Indonesian text into Mee using the available vocabulary database; (4) Display Mee Text Results, after the translation process, the results are displayed to users in Mee text format; (5) Listen to Mee Audio, the system provides audio facilities so that users can hear the translation results in voice form; (6) Manage Vocabulary Data, admins can add, update, and delete vocabulary entries so that the translation process is more accurate and dynamic; (7) Upload Audio Files, admins upload Mee sound files to be used in the audio feature; (8) Text and Audio Synchronization, admins match the text translation results with audio files so that the voice feature can work according to context.

Non-Functional Needs

In addition to the main functional needs, this system is also designed by paying attention to a number of non-functional aspects, including (1) Access security, with a login system that differentiates user and admin access rights; (2) Accessibility, because the application is designed to be web-based, it can be accessed via various devices with an internet connection; (3) Data reliability, especially in vocabulary and audio management to avoid misinterpretation in the translation results; (4) System responsiveness, where the translation and audio playback processes must be fast and not cause delays.

System Design

The system design stage is carried out after the requirements analysis process is completed and is the initial step in designing the system's logical and visual structure. This design refers directly to the developed use case model, which reflects the interactions between users and the system and the main functions that must be provided. The system design focuses on modeling the relationships between actors and use cases, which describe the main functionality of the Indonesian to Suku Mee translation system, both in text and audio form.

Use Case Description

Figure 2 shows two main actors: Users and Admins. Each has a different role and responsibility in accessing system features. Users interact with features, inputting text in Indonesian, viewing translations in Mee, and listening to Mee audio. Admins interact with the Login feature, managing translated vocabulary data, uploading Mee audio files, and synchronizing translated text and audio files.

This design reflects the separation of access rights and system interaction flows, tailored to each actor's responsibilities. This is essential for maintaining data integrity and efficiency in system management.

System Interaction Structure

From the use case diagram, it can be concluded that the main flow of the system process includes: Text Input → Translation Process → Display Text Results → Audio Playback. This sequence is accessed by general users to obtain translation results. Manage Vocabulary → Upload Audio → Text & Audio Synchronization. This flow is specifically for admins who are tasked with maintaining the accuracy of content and TTS (text-to-speech)-based audio functions.

This design also illustrates that the success of the translation process depends heavily on the administrator's management of vocabulary data and audio files. Therefore, the system must be supported by an efficient and easy-to-use vocabulary and audio management interface.

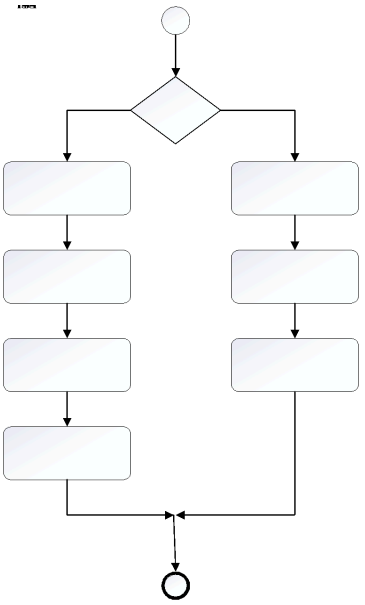

Figure 3. Activity Diagram

Technical Design Considerations

In designing this system, there are several technical considerations derived from the use case model and activity diagram (1) Authentication and Access Rights, the login system is only carried out by the admin to strictly regulate access rights; (2) Dynamic Vocabulary Management, the system must allow the admin to add, update, and delete vocabulary in real-time so that the translation process is adaptive to language changes; (3) Text-to-Speech (TTS) Integration, audio playback must be in line with the text translation results and can be accessed by users in an intuitive interface; (4) Responsive and Web-Based, the system is designed to be web-based to reach more users, including local communities in the Central Papua region, even with limited internet access.

Design Goals

The system design based on this use case aims to improve user understanding of the application's work process, become the basis for designing the interface and system architecture, ensure all functional needs are accommodated in the implementation stage, and support the preservation and digitalization of the Mee language systematically through technological media.

System Implementation

System implementation is the final stage in the Waterfall-based software development method, which translates all analysis and design results into a tangible application that can be used by users. This stage aims to ensure that the functions designed in the use case diagram are actually operationally realized within the system.

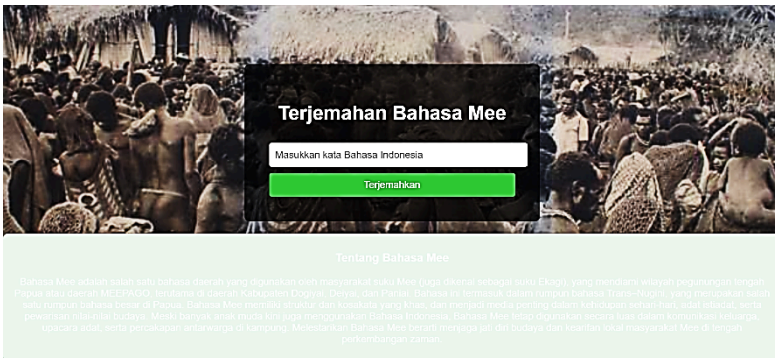

Figure 4. User Home Page

The results of the system implementation can be seen in Figure 4, which shows the main page of the web-based application "Terjemahan Bahasa Mee". This display represents the main function of the system, namely the translation of words or phrases from Indonesian into Mee, which is then displayed in text form and supported by audio features. The interface is designed to be simple and focused, with a visual background that displays the local Mee community, as a form of respect for their culture and identity.

The main components on this homepage are an input field for entering words or phrases in Indonesian. A "Translate" button directs the system to process the input and generate a translation in Mee. An informative description of Mee at the bottom of the page serves to educate users about the linguistic and cultural context of the language.

Overall, the implementation of this interface refers to the results of the previous use case design, where users can input Indonesian text, receive translation results in Mee, and listen to the translation results in audio form.

As for vocabulary management, audio file upload, and synchronization features, access is only available to admin actors through a separate panel not displayed on the main page. This aligns with the principles of role-based access control (RBAC), as outlined in the use case model.

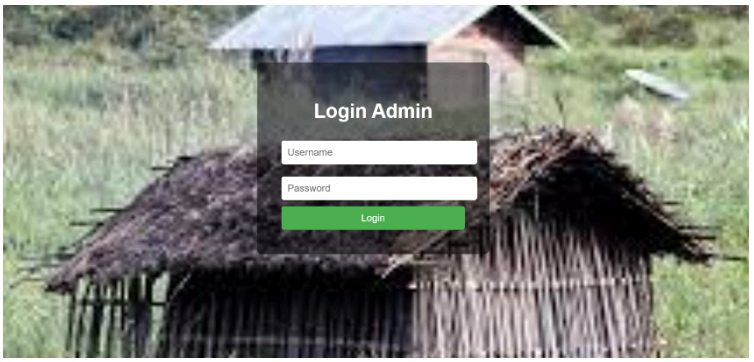

Figure 5. Admin Login Page

Figure 5 displays the Admin login page, which is an integral part of the role-based access control system implementation. This interface is designed as a dedicated gateway for system administrators, who have the authority to manage translation vocabulary, upload Mee

audio files, and synchronize text and audio. These features are not available to general users and can only be accessed after successfully authenticating through this page.

The login form consists of two main components: a username field, which is used to identify the admin account, and a password field, which provides an additional layer of security to prevent unauthorized access. After successful authentication, the admin will be directed to a dedicated dashboard containing data management features, as outlined in the previous use case and activity diagrams.

Visually, the admin login page uses a traditional house background typical of the Papuan Highlands, reflecting the cultural context of the app. This background choice is not only aesthetic but also serves as a visual reminder of the system's primary mission: supporting the preservation and digitization of the Mee language as part of the local cultural heritage.

The implementation of this login page adheres to the principle of system security in software development, where each actor can only access features appropriate to their role. This allows the system to clearly separate public (user) and administrative (admin) functions, while maintaining the integrity and consistency of the managed language data.

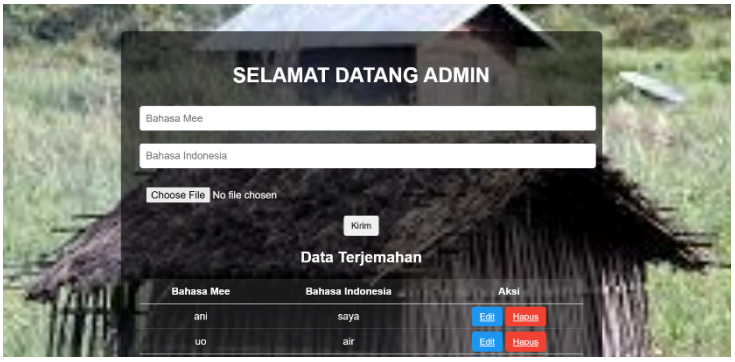

Figure 6. Admin Home Page

After successfully completing the authentication process through the admin login page, administrators are directed to the main dashboard. This page serves as the system's control center, providing various critical functions to ensure the quality, accuracy, and continuity of the system's translation results. Based on the requirements analysis and use case model described previously, the admin dashboard's key features include vocabulary data management, Mee audio file uploads, text and audio synchronization, security, and auditing.

Vocabulary Data Management

This feature allows admins to add, edit, and delete vocabulary entries in the Indonesian – Mee bilingual database. This function is very important because the quality of the translation results is highly dependent on the accuracy of the equivalent words stored in the system. Each vocabulary entry has the structure (1) Indonesian word; (2) Equivalent in Mee; (3) Word category (verb, noun, adjective, etc.). This vocabulary update is dynamic so that the system can continue to adapt to the contextual and evolving use of Mee in society.

Upload Mee Language Audio File

Admins can upload audio recordings from native speakers for each Bahasa Mee entry. These files form the basis for the text-to-speech feature available to general users. The system only accepts standard audio formats (.mp3 or .wav) with limited file sizes to maintain speed.

Text and Audio Synchronization

Once the audio is uploaded, the administrator needs to match each recording with the corresponding Bahasa Mee text. This process ensures that when a user inputs Indonesian, the system not only displays the translated text but also plays the correct audio. This feature is at

the heart of a multimodal approach to local language digitization, combining text and audio elements in a single system.

Security and Audit

The admin dashboard also features a logging and auditing system to record any data changes. This is essential for maintaining accountability and tracking vocabulary or audio revisions made by admins.

Integration with the Concept of Language Preservation

The functions in the admin dashboard are not only technical but also strategic in supporting the preservation of the Mee language. Through this feature, native speakers and local linguists can participate in the digitization process by reviewing and enriching vocabulary and ensuring the quality of audio recordings matches the appropriate dialect and cultural context.

Thus, the implementation of the admin dashboard in this system has been designed to not only serve the technical needs of the application, but also support the principles of collaboration, cultural conservation, and empowerment of local communities through technology.

Application System Testing

System testing is conducted to ensure that all designed and implemented functionality meets user needs and does not introduce errors during execution. This stage is the final part of the waterfall method, which aims to evaluate system performance based on specific test scenarios.

The testing method used in this study was Black Box Testing, which focuses on functional testing without examining the internal structure of the program code. Testing was conducted on all key features from both the user and admin perspectives, based on previously designed use cases.

Table 1. System Feature Test Results

No	Tested Features	Given Input	Expected Output	Status
1	Login (User/Admin)	Username & password valid	Log in to the system according to your role	Succeed
2	Indonesian text input	Word: "Eat"	Translation: "Boga" (in Noodles)	Succeed
3	Show translation results	Text translation system	Mee Language text is displayed	Succeed
4	Play translated audio	Click the play button	Mee Language Audio is heard	Succeed
5	Manage vocabulary data (Admin)	Add/edit/delete vocabulary	Changes are saved and reflected in the system.	Succeed
6	Upload audio files (Admin)	.mp3 file according to entry	File is saved and can be played	Succeed
7	Text and audio synchronization (Admin)	Link text with audio file	Text and audio appear simultaneously	Succeed

Based on the system testing results, it can be concluded that the Indonesian to Suku Mee translation application performed well, meeting user needs. All core features were usable without technical errors, including translation, text presentation, and audio playback. The evaluation also covered the following non-functional aspects

Table 2. Evaluation of Non-Functional Aspects

Non-Functional Aspects	Evaluation
Security	The login system properly differentiates between user and admin access. No unauthorized access was detected during testing.
Performance	The system's response time to user input is relatively fast, both when translating text and playing audio.
Accessibility	The web-based system can be accessed through various devices (PC and mobile).
Cultural Fit	The interface uses typical Papuan visual elements and the Mee language is used according to the community's native context.

Evaluation from early users (limited trials) shows that the system is easy to use, informative, and makes a real contribution in helping people get to know and learn Bahasa Mee digitally.

The implementation of this web-based system has proven that the use of technology can support the preservation of regional languages [26] [27], especially in the context of the Mee tribe in Papua. With a text- and audio-based approach, this application becomes an interactive media that bridges the younger generation and the general public to stay connected with their local cultural identity through language [28] [29].

4. CONCLUSION

This research successfully designed and implemented a web-based translation system from Indonesian to the Mee language, integrated with audio support. The structured application of the Waterfall method facilitated a systematic development process, from initial analysis to final evaluation. Based on testing results, all core features—both from user and admin perspectives—were shown to function optimally.

Beyond its technical achievements, the system carries cultural significance as a tool to preserve the local language of the Mee community in Papua. By combining text and audio in a single digital platform, the application serves as a medium for learning, documentation, and revitalization of the indigenous language amidst modernization challenges. The interface, embedded with local cultural elements, further reinforces the system’s mission of cultural preservation.

Future developments may include integration with AI-based Text-to-Speech (TTS) technologies, involvement of native speakers for vocabulary curation, and broader user testing through a user experience (UX) approach to ensure the system effectively meets real-world needs for language conservation.

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