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**Submission date:** 20-Dec-2024 03:11AM (UTC+0900)

**Submission ID:** 2555896969

**File name:** JURNAL-ASR-JURTEKSI-EN.doc (179.32K)

**Word count:** 2037

**Character count:** 12047

# **AUTOMATIC SPEECH RECOGNITION (ASR) AS A DEVELOPMENT OF PRONUNCIATION LEARNING MEDIA BASED ON PROGRESSIVE WEB APPS (PWA)**

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**Abstract:** Pronunciation is a crucial aspect of English language learning, influencing students' fluency and confidence in communication. This study aims to enhance students' pronunciation fluency and develop a digital learning media using Automatic Speech Recognition (ASR) technology. The method involves developing Progressive Web Apps (PWA) integrated with ASR from app.lumi.education, supported by manual labeling for pronunciation validation. This study was conducted at LKP Vijaya Learning Centre, Tanjungbalai City. The results demonstrate that ASR-based media significantly improves students' pronunciation accuracy and confidence. In conclusion, integrating ASR technology into PWA effectively supports innovative and efficient pronunciation learning.

**Keywords:** accuracy; automatic speech recognition; language learning; pronunciation; web-based application.

**Abstrak:** Pengucapan merupakan aspek penting dalam pembelajaran bahasa Inggris yang memengaruhi kelancaran dan kepercayaan diri siswa dalam berkomunikasi. Penelitian ini bertujuan untuk meningkatkan kelancaran pengucapan siswa serta mengembangkan media pembelajaran digital dengan menggunakan teknologi Automatic Speech Recognition (ASR). Metode yang digunakan adalah pengembangan Progressive Web Apps (PWA) yang terintegrasi dengan ASR dari aplikasi app.lumi.education, didukung oleh pelabelan manual untuk validasi pengucapan. Penelitian ini dilaksanakan di LKP Vijaya Learning Centre, Kota Tanjungbalai. Hasil penelitian menunjukkan bahwa media berbasis ASR secara signifikan meningkatkan akurasi pengucapan dan kepercayaan diri siswa. Kesimpulannya, integrasi teknologi ASR ke dalam PWA secara efektif mendukung pembelajaran pengucapan yang inovatif dan efisien..

**Kata kunci:** akurasi; aplikasi berbasis web; pengenalan suara otomatis; pembelajaran bahasa; pengucapan

## **INTRODUCTION**

English holds significant importance in the international context, especially in the current era of globalization. As a language widely used in the global community, English serves as a communication tool among individuals from various countries. One of the critical aspects of learning English is pronunciation.

Learning proper pronunciation is one of the most crucial steps an individual can take to enhance their communication skills[1].

Pronunciation in English becomes complex due to the lack of clear guidelines and contradictory practices[2]. In practice, pronunciation learning has not been given priority, as most teachers believe that teaching pronunciation is too challenging and unengaging for students[3]. Therefore, the

aim of this study is to enhance students' fluency in pronunciation and develop digital-based English learning media utilizing Automatic Speech Recognition (ASR) technology. Additionally, the research seeks to optimize learning time, considering the large number of students in a class, which requires extensive time for individual assessment. Given the limited instructional time, additional sessions are often needed, leading to increased operational costs. This research was conducted at LKP Vijaya Learning Centre, which focuses on English and Computer learning in Tanjungbalai City. Automatic Speech Recognition (ASR) is a technology that enables computers to interpret and understand human speech automatically. Meanwhile, Progressive Web Apps (PWA) represent a new architecture for mobile application development, offering advantages over their predecessors (websites). These applications can function with weak or no internet connection, run in the background, and support push notifications.[4].

PWA is supported by most major browsers, particularly on Android and Chromium-based browsers, except on iOS, where only Safari provides support for PWA-related functionalities[5]. This technology enables the creation of applications that can be accessed like native apps, interact with device features, run offline, and be accessed directly through a browser, allowing for a broader reach. On the other hand, conventional mobile application development requires significant financial investment for implementation and demands greater resources[6].

The research problem formulation includes how to design a learning media application based on Progressive Web Apps integrated with the open-source ASR from lumi.education, and how to implement the Automatic Speech Recognition

application at Vijaya Learning Centre.

## METHOD

The problem-solving method employed includes needs analysis through surveys and interviews to understand the characteristics and needs of students in pronunciation learning. Information is gathered about ASR technology, pronunciation teaching methods, and PWA application development. An initial prototype of the learning media based on PWA integrated with ASR technology is created. The prototype is tested involving students and teachers to evaluate its effectiveness, and feedback from the testing is used to refine the prototype to improve its quality and alignment with the needs of the partners.

The strategies implemented for problem-solving involve forming a multidisciplinary team consisting of language experts and software developers. Students and teachers are engaged in every development stage, from needs analysis to prototype evaluation. ASR technology from lumi.education is utilized and embedded into the PWA to create responsive and interactive learning media. Training and mentoring are provided to teachers and students on how to use the application, and the use of the application and learning outcomes are closely monitored..

This research utilizes the Automatic Speech Recognition (ASR) from the lumi education application through the "Speak the Word Set" to enhance the features and development of digital pronunciation learning via an embedded system displayed using a Progressive Web App (PWA). Several measurable variables are used to assess the success of the research, including the ASR performance, which can be seen in Table 1.

Table 1. Variables to Measure the Success of the Research

No.	Variable	Description
1	Accuracy (%)	Percentage of total speech correctly recognized by the system
2	Response Time (Seconds)	The time required by the system to detect and transcribe speech
3	Error(%)	Percentage of total speech incorrectly recognized by the system.
4	Dialek (%)	Persentase keberhasilan sistem dalam mengenali dan men-transkripsi ucapan dalam variasi dialek atau bahasa

In achieving the research objectives, the researcher outlines the research steps as shown in Figure 1.1:



Figure 2. Framework

### Problem Identification

The problem identified in this study is the limited ability of teachers and students to provide feedback on pronunciation, making it difficult for students to correct their pronunciation errors. Subsequently, the Principal Investigator and Research Team members conducted a literature review aimed at gaining an understanding of the issues to be investigated related to Pronunciation, Automatic Speech Recognition, and the design of learning media based on Progressive Web Apps, as well as the methods used as solutions..

### Data Collection

The data collection techniques used in this study include interviews, observations, and documentation.

### Application Design

In this phase, the database design and the user interface/user experience (UI/UX) design are developed to ensure an intuitive and responsive interface, assisted by team members. The application design includes features for creating learning materials, quizzes, and discussions that align with the curriculum at Vijaya Learning Centre, which are input by the team members. Additionally, the integration of the Automatic Speech Recognition (ASR) technology from lumi.education, accessible via the Progressive Web App (PWA), is implemented. The mechanism of ASR from lumi.education is illustrated in Figure 2.

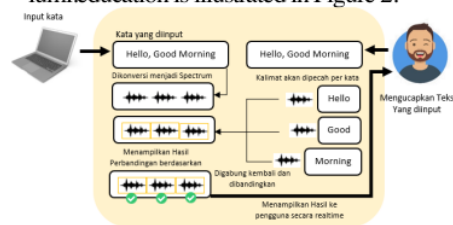


Figure 2. Illustration of ASR Application via Lumi.education

### Testing

In this phase, the team conducts application testing to ensure that the system responds accurately to students' pronunciation and provides precise and help-

ful feedback to aid students in improving their pronunciation.

### Implementasi dan Pelatihan

The implementation involves the project leader and team members in deploying the ASR application using PWA at Vijaya Learning Centre. Instructors and students will receive training on how to use the application. During the training sessions, users will be provided with knowledge about the application's features, how to correct pronunciation, and how to interpret the feedback provided and documented by the research team members.

### Evaluation of Results

This evaluation is conducted by the lead researcher to assess the effectiveness of the ASR application using PWA in improving students' pronunciation skills. Instructors collect data and observe the progress of students' pronunciation after using the application. The method used to measure success is through the System Usability Scale (SUS) questionnaire. When calculating the SUS score, there are several rules for scoring. For questions with odd numbers, the score for each question is obtained by subtracting 1 from the user's score. For even-numbered questions, the final score is derived by subtracting the user's score from 5. The SUS score is obtained by summing the scores of all questions and then multiplying the result by 2.5.

## RESULTS AND DISCUSSION

This study obtained data presented in Table 2, which shows the results of ASR testing based on several measured variables, namely Accuracy (%), Response Time (Seconds), and Error Rate (%).

Table 2. ASR Performance

No.	Users	Accuracy (%)	Response Time	Error (%)
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(Seconds)				
1	A	92	1.2	8
2	B	87	1.5	13
3	C	95	1.0	5
4	D	89	1.3	11
5	E	93	1.1	7
Rata-rata		91.2	1.22	8.8

From Table 1, it can be observed that the average accuracy of speech recognition reached 91.2%, with an average response time of 1.22 seconds and an average error rate of 8.8%. The relatively high accuracy level indicates that ASR is capable of recognizing speech well in most cases. The accuracy ranged from 87% to 95%, demonstrating consistent performance in recognizing correctly pronounced words. The highest accuracy was achieved by user C (95%), while the lowest was by user B (87%). The response time ranged from 1.0 to 1.5 seconds, with the fastest response at 1 second (user C) and the slowest at 1.5 seconds (user B). The average response time of 1.22 seconds is still within acceptable limits for educational applications, where speed is important but can be compromised if accuracy is maintained. The error rate ranged from 5% to 13%, with user C showing the lowest error rate (5%) and user B recording the highest (13%). These errors could be attributed to variations in dialect or the clarity of speech.

### Presentation of Data on PWA Usability

The usability of the PWA was measured using the System Usability Scale (SUS), which provides a score based on users' perceptions of the system's ease of use.

Table 3. System Usability Scale (SUS) Scores for PWA

No.	Users	SUS Score (0-100)
1	A	82
2	B	76

3	C	85
4	D	78
5	E	80
Rata-rata		80.2

Based on the results in Table 2, the average SUS score reached 80.2, indicating that users generally perceive the PWA-based application as easy to use and intuitive. This score exceeds the common SUS benchmark, where a score of 68 is considered the threshold between acceptable and unacceptable usability. User C provided the highest score of 85, reflecting a highly positive user experience, while User B recorded the lowest score of 76. Despite this, the score remains within the range considered good, signifying that the PWA application features a user-friendly interface and strong performance.

## CONCLUSION

The performance of the ASR demonstrates exceptional capability with a high accuracy rate of 91.2%, indicating superior proficiency in recognizing users' pronunciation. Furthermore, the fast response time of 1.22 seconds enhances the ASR's ability to provide real-time feedback effectively. However, the error rate of 8.8%, while still within acceptable limits, suggests potential improvement in recognizing dialects or variations in pronunciation. In parallel, the usability of the PWA is validated by an average SUS score of 80.2, signifying positive user reception of the application as a learning medium. The implementation of the PWA as a pronunciation learning platform is deemed effective in delivering an intuitive and easily accessible user experience. Thus, the findings of this study indicate that the combination of ASR and PWA holds significant potential to advance digital-based pronunciation learning media.

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