MESTRO JURNAL ILMIAH
Journal homepage: http://jurnalmestro.untag.ac.id

A Mobile Sign Language Dictionary: Enhancing Communication for the Deaf and Mute

*Aris Rakhmadi[1], Novita Desi Wulandari[1], Safiq Rosad[2], Muhammad Syukri[3]

[1)]Department of Informatics Engineering, Faculty of Communication and Informatics, Universitas Muhammadiyah Surakarta, Jawa Tengah, INDONESIA.
[2)]Department of Informatics, Faculty of Mathematics and Natural Science, Fakultas Teknik, Universitas Nahdlatul Ulama Al Ghazali Cilacap, Jawa Tengah, INDONESIA
[3)]Department of Informatics Engineering, STMIK Mardira Indonesia, Bandung, Jawa Barat, INDONESIA

INFORMASI ARTIKEL

NASKAH DITERIMA : 15 Februari 2025
DIREVISI : 17 Maret 2025
DISETUJUI : 22 Mei 2025

***KORESPODENSI PENULIS :**
aris.rakhmadi@ums.ac.id

DOI: 10.47685/mestro.v7i1.617

Abstract

Communication is fundamental to human interaction, yet individuals who are deaf or speech-impaired often face barriers due to limited accessibility to sign language resources. This study presents the development of a mobile sign language dictionary designed to enhance communication and learning. Traditional sign language dictionaries, whether in printed or video formats, present challenges in accessibility, usability, and portability. In contrast, a mobile application offers an interactive, efficient, and user-friendly solution. The proposed application integrates gesture recognition, video demonstrations, and text-based explanations to facilitate sign language learning. By leveraging artificial intelligence (AI) and cloud-based storage, the app ensures accurate sign recognition and provides a comprehensive database of gestures, including letters, numbers, root words, prefixes, suffixes, and commonly used phrases. A structured methodology involving requirement analysis, data collection, design, development, testing, and revision was applied to develop a functional and accessible tool. User testing demonstrated high engagement and learning effectiveness, with 85% of participants reporting increased comfort with mobile learning tools, 82.5% finding the app beneficial for sign language acquisition, and 90% improving their familiarity with sign words. These results confirm that a mobile sign language dictionary is an efficient educational tool that fosters inclusivity and communication accessibility. Future enhancements, including database expansion, additional sign language dialects, and interactive exercises, can further improve the application's impact.

Keywords: *Sign Language, Mobile Application, Deaf and Mute Communication, Digital Accessibility, Sign Language Recognition*

Abstrak

Komunikasi merupakan aspek fundamental dalam interaksi manusia, namun komunitas tunarungu dan bisu sering menghadapi hambatan akibat keterbatasan akses terhadap sumber belajar bahasa isyarat. Penelitian ini membahas pengembangan kamus bahasa isyarat berbasis mobile yang dirancang untuk meningkatkan komunikasi dan pembelajaran bagi individu dengan gangguan pendengaran dan bicara. Kamus bahasa isyarat tradisional, baik dalam bentuk cetak maupun video, memiliki keterbatasan dalam aksesibilitas dan kemudahan penggunaan. Sebagai alternatif, aplikasi mobile menawarkan solusi yang lebih praktis, interaktif, dan ramah pengguna. Aplikasi ini mengintegrasikan pengenalan gerakan, demonstrasi video, dan penjelasan berbasis teks untuk memfasilitasi pembelajaran bahasa isyarat yang lebih efektif. Dengan memanfaatkan kecerdasan buatan (AI) dan penyimpanan berbasis cloud, aplikasi ini memastikan akurasi pengenalan isyarat dan menyediakan basis data bahasa isyarat yang komprehensif, mencakup huruf, angka, kata dasar, prefiks, sufiks, serta frasa yang sering digunakan. Pengembangan aplikasi mengikuti metodologi yang terstruktur, termasuk analisis kebutuhan, pengumpulan data, desain aplikasi, pengembangan, pengujian, dan revisi untuk memastikan aplikasi yang fungsional dan mudah diakses. Pengujian pengguna menunjukkan bahwa aplikasi ini efektif, dengan 85% pengguna merasa lebih nyaman menggunakan alat

pembelajaran digital, 82,5% menemukan aplikasi ini bermanfaat untuk belajar bahasa isyarat, dan 90% menjadi lebih akrab dengan kata-kata dalam bahasa isyarat. Hasil ini menegaskan bahwa kamus bahasa isyarat berbasis mobile merupakan alat pembelajaran yang efisien untuk mendorong inklusivitas dan integrasi sosial. Pengembangan lebih lanjut, termasuk perluasan database bahasa isyarat dan penambahan latihan interaktif, dapat semakin meningkatkan keterlibatan pengguna serta aksesibilitasnya

Kata kunci: Bahasa Isyarat, Aplikasi Mobile, Komunikasi Tunarungu dan Bisu, Aksesibilitas Digital, Pengenalan Gerakan

I. INTRODUCTION

Communication is an essential aspect of human interaction, enabling individuals to express thoughts, emotions, and ideas [1]. However, for the deaf and mute communities, communication barriers often limit their ability to engage with society effectively. Sign language serves as a vital medium for these individuals, allowing them to convey messages through hand gestures and facial expressions. Despite the importance of sign language, many people outside the deaf and mute communities are unfamiliar with its structure, leading to challenges in social inclusion and accessibility.

The advent of digital technology has opened new opportunities for improving accessibility and communication for individuals with disabilities [2]. Mobile applications have revolutionized various aspects of life, including education, healthcare, and social interaction [3]. In particular, mobile applications for sign language learning and translation have gained significant attention as tools to bridge communication gaps. These applications not only help the deaf and mute individuals communicate with the hearing population but also provide an avenue for the general public to learn and understand sign language [4].

Traditional sign language dictionaries exist in printed and video formats, but they have limitations in terms of accessibility, searchability, and ease of use [5]. Printed dictionaries can be cumbersome to carry, while video-based dictionaries may require specific platforms or internet access. An interactive mobile application, on the other hand, offers a more convenient and efficient solution [6]. With the growing number of smartphone users worldwide, mobile applications can serve as an effective medium to disseminate sign language knowledge and improve communication experiences [7].

This study focuses on the development of a mobile sign language dictionary that enhances communication for the deaf and mute communities. By utilizing mobile technology, this application aims to provide an interactive and user-friendly platform for learning and using sign language. The app incorporates features such as gesture recognition, video demonstrations, and text-based explanations to facilitate better understanding and usage of sign language.

One of the primary motivations behind developing this application is the need for an inclusive and accessible communication tool. Many existing sign language learning resources are either limited in scope or lack interactive elements that enhance user engagement [8]. A mobile dictionary application addresses these challenges by offering an easily accessible, real-time, and structured way for users to learn and practice sign language efficiently [9].

Another significant challenge faced by the deaf and mute communities is the lack of widespread sign language literacy among the general population [10]. Most individuals who do not have direct interaction with deaf or mute people may not feel the necessity to learn sign language. However, fostering an inclusive society requires a mutual effort to break communication barriers. By providing an easy-to-use mobile dictionary, this application encourages more individuals to familiarize themselves with sign language and promotes better social integration [11].

In addition to fostering inclusivity, a mobile sign language dictionary can contribute to educational settings, enabling teachers, students, and caregivers to learn and teach sign language more effectively. Schools and institutions that cater to special needs students can benefit from digital tools that facilitate sign language learning, making education more interactive and engaging for students with hearing and speech impairments [12].

As the world moves toward a more digitally connected society, accessibility tools such as mobile sign language dictionaries become increasingly crucial in empowering individuals with disabilities. This application aims to serve as a bridge between the deaf and mute communities and the wider population, fostering a more inclusive and understanding society.

II. METHODOLOGY

The development of the mobile sign language dictionary application follows a structured research methodology consisting of several key steps: requirement analysis, gathering data, application design, application development, application testing, and application revision, as shown in Figure 1. These steps ensure a systematic and iterative approach to building a functional and user-friendly application that enhances communication for the deaf and mute communities.

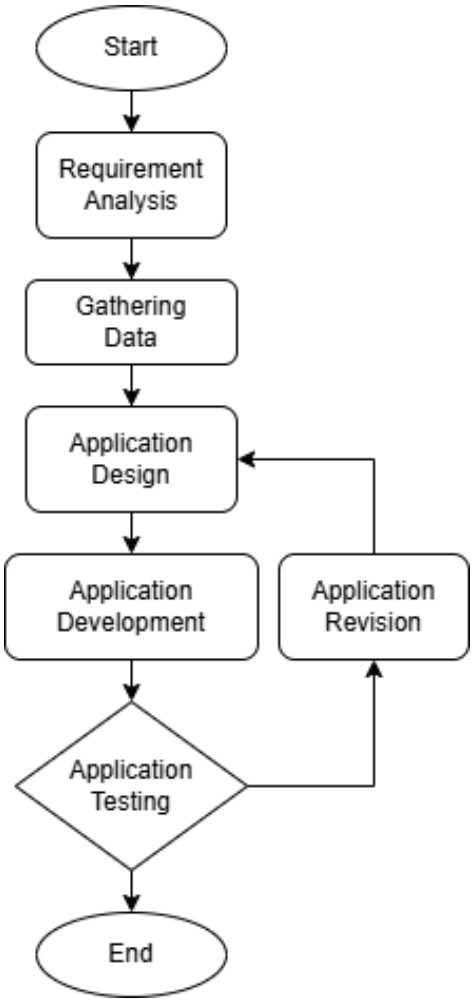

Fig. 1. Research Methodology for the Development of a Mobile Sign Language Dictionary

The first step in this methodology is identifying the fundamental requirements needed to develop the application [13]. This phase involves understanding the needs of the target users, including individuals who are deaf and mute, educators, and the general public interested in learning sign language. To ensure the application's effectiveness, consultations with sign language experts, special education teachers, and potential users were conducted. Functional requirements such as gesture recognition, a comprehensive sign language dictionary, and multimedia support (text, images, and videos) were determined [14]. Non-functional requirements, including user accessibility, performance, and data security, were also considered to enhance the user experience.

Once the requirements were established, the next step involved gathering data to support the application's content and features [15]. This included collecting sign language datasets, recording sign language gestures, and structuring an organized dictionary database. Sign language data was gathered from multiple sources, including educational institutions for the deaf, sign language books, video resources, and expert consultations [16]. The dataset consisted of both alphabetic sign language gestures and commonly used words and phrases to ensure comprehensive coverage. Ethical considerations were taken into account to respect cultural variations in sign language and obtain consent from participants in recorded videos.

In this phase, the structure and user interface of the mobile sign language dictionary were designed. The design process focused on usability, accessibility, and efficiency [17]. Prototypes and wireframes were developed to visualize how users would interact with the application. The user interface was designed to be simple and intuitive, incorporating large buttons, clear text, and interactive elements to accommodate users with various accessibility needs [18]. A database schema was also designed to store sign language entries efficiently, ensuring quick retrieval and smooth navigation. Additionally, the design phase considered cloud-based storage for scalability and potential future enhancements.

With the design finalized, the application was developed using suitable programming languages and development tools [19]. The mobile application was built on the Android platform, utilizing Android Studio, Kotlin/Java for development, and Firebase for cloud storage and database management. The core components implemented in this phase included the sign language dictionary module, which contained words, images, and videos for sign language representation. A search and navigation system was integrated to allow users to find signs based on keywords or categories. Multimedia elements, such as video demonstrations alongside text descriptions, were incorporated to aid comprehension [20]. In addition, gesture recognition models were explored for real-time sign detection, ensuring a dynamic and interactive experience for users. The development process followed an iterative approach, allowing continuous improvements and debugging throughout the coding phase.

Once the development phase was completed, rigorous testing was conducted to ensure the application's functionality, accuracy, and usability [21]. Unit testing was performed to check individual components, such as the search feature, video playback, and database retrieval. Integration testing was conducted to verify that all modules interact correctly, particularly linking gestures with their corresponding video demonstrations. User acceptance testing was carried out with a group of deaf

and mute users, teachers, and sign language experts who tested the application and provided feedback on usability, content accuracy, and overall effectiveness. Additionally, performance testing was conducted to evaluate the application's speed, responsiveness, and stability under different network conditions and device models.

Based on feedback and testing results, revisions and refinements were made to improve the application. This included fixing bugs, enhancing user interface and experience elements, optimizing performance, and adding missing sign language entries. User feedback played a crucial role in making necessary adjustments to ensure that the final version of the application meets user expectations and provides an effective learning and communication tool.

III. RESULT AND DISCUSSION

The research resulted in the development of an Android-based sign language dictionary application specifically designed for the deaf and speech-impaired community. The application serves as a comprehensive tool for learning sign language, incorporating a dictionary that includes various categories of sign language representation. The dictionary menu consists of letter signs, number signs, basic word signs, prefix signs, suffix signs, and particle signs. Each category contains a structured list of signs accompanied by corresponding videos demonstrating the gestures, making it an interactive and educational tool for users.

Fig. 2. Main Menu Structure of the Sign Language Dictionary Application (Indonesian Users)

The dictionary page, as shown in Figure 2, is structured with seven main buttons labeled Letters, Numbers, Root Words, Prefixes, Suffixes, Particles, and Everyday Words. These buttons allow users to navigate the application efficiently and access the required sign language content. The intuitive layout ensures ease of use, particularly for users who may not be familiar with digital learning platforms.

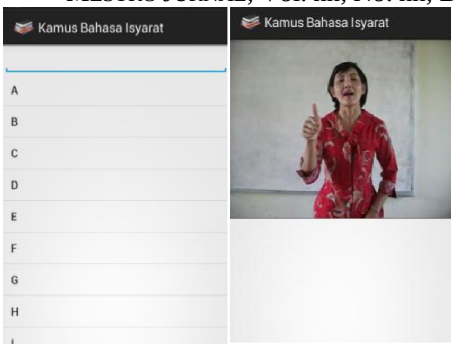

Fig. 3. Letter and Number Selection Page in the Mobile Sign Language Dictionary (Indonesian Users)

When accessing the Letter List and Video page, as shown in Figure 3, users can view a complete list of letters from A to Z. By selecting a specific letter, a video demonstration of the corresponding sign language gesture is displayed. This feature facilitates the learning of the alphabetic representation in sign language. Similarly, the Number List and Video page contain a list of numerical signs, allowing users to tap on a number and view its corresponding sign language gesture in video format.

The Basic Word List and Video page, as shown in Figure 4, contain commonly used root words, where each word is linked to a demonstration video showcasing the proper signing technique. This feature helps users expand their sign language vocabulary and learn essential words for communication. The Daily List and Video page extends this functionality by providing access to everyday words and phrases commonly used in daily interactions. Users can select a word from the list and watch a video that demonstrates the correct sign language gesture, making it an effective tool for both beginners and advanced learners.

Fig. 4. Basic and Everyday Word Selection Page with Sign Language Videos (Indonesian Users)

To evaluate the effectiveness of the application, a user testing phase was conducted involving a group of respondents. The testing aimed to measure user experience, familiarity with mobile applications, and the

impact of the application on learning sign language. The results of the user testing provided quantitative insights into the effectiveness of the application in facilitating sign language learning.

The first evaluation statement examined whether users became more familiar with mobile applications through their interaction with the sign language dictionary, as shown in Figure 5. The findings indicated that four respondents strongly agreed, while six respondents agreed, leading to an overall percentage of 85% of users feeling more comfortable with mobile applications after using the platform. This suggests that the application interface is accessible and user-friendly, even for individuals with minimal prior experience with digital tools.

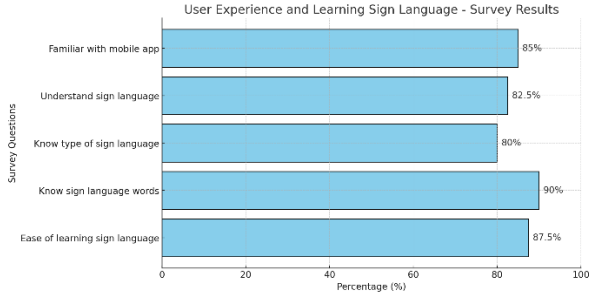

Fig. 5. User Experience: Familiarity with Mobile Applications After Application Usage

The second evaluation focused on whether the application increased users' familiarity with sign language. The results showed that four respondents strongly agreed, five respondents agreed, and one respondent disagreed, with an overall percentage of 82.5%. This indicates that the majority of users found the application effective in introducing them to sign language concepts.

The third evaluation assessed users' understanding of the different types of sign language. The results revealed that five respondents strongly agreed, three agreed, one disagreed, and one strongly disagreed, leading to a total percentage of 80%. Although the majority of users benefit from the application, the presence of disagreement suggests that additional instructional content or an expanded range of sign language variations could improve learning outcomes.

The fourth evaluation analyzed whether users became more familiar with sign words through the application. The results indicated that six respondents strongly agreed, and four respondents agreed, with an overall percentage of 90%. This suggests that the structured presentation of sign words and accompanying videos significantly enhanced users' ability to recognize and learn sign words effectively.

The final evaluation statement measured whether the application made learning sign language easier for users. The results showed that five respondents strongly agreed and five respondents agreed, resulting in a total percentage of 87.5%. This high percentage confirms that the application successfully serves its purpose as a learning aid for sign language, improving accessibility and comprehension among users.

The results indicate that the Android-based sign language dictionary is an effective tool for enhancing sign language learning and communication for the deaf and speech-impaired community. The application's structured categorization, interactive video demonstrations, and user-friendly interface contribute to its high usability and learning impact. However, further improvements, such as expanding the database with additional sign variations and incorporating interactive exercises, could enhance its effectiveness even further. The positive feedback from user testing confirms that the application plays a significant role in promoting digital accessibility and inclusivity for individuals with hearing and speech impairments.

IV. CONCLUSION

The development of a mobile sign language dictionary marks a significant advancement in improving communication accessibility for deaf and speech-impaired individuals. By utilizing digital technology, this application provides an interactive, structured, and user-friendly platform for learning sign language. Traditional sign language dictionaries, whether printed or video-based, face accessibility challenges, whereas a mobile application offers real-time access to an extensive database of signs. Features such as gesture recognition, video demonstrations, and structured categorization enhance usability, making sign language learning more effective and engaging.

User testing results confirm that the application positively impacts sign language learning, with a majority of participants reporting improved familiarity with sign words and increased ease of learning. These findings highlight the app's potential as an educational tool for schools, caregivers, and individuals seeking to bridge communication gaps. However, despite its success, further enhancements—such as expanding the sign language database, integrating regional dialects, and developing interactive exercises—can improve learning outcomes. Future updates should also explore cross-platform compatibility and AI-driven improvements for enhanced gesture recognition accuracy.

As society progresses towards greater digital inclusivity, mobile tools like sign language dictionaries play a crucial role in fostering accessibility and social integration. By encouraging broader participation in learning sign language, this application promotes an inclusive environment where communication barriers are reduced. Continuous advancements in mobile technology, AI integration, and collaboration with language experts can further strengthen the impact of this initiative, ensuring that sign language learning remains accessible, engaging, and widely adopted.

REFERENCES

[1] M. A. Hassan, A. H. Ali, and A. A. Sabri, "Enhancing communication: Deep learning for Arabic sign language translation," *Open Engineering*, vol. 14, no. 1, Jan. 2024, doi: 10.1515/eng-2024-0025.

[2] A. Rakhmadi and A. Yudhana, "Virtual Reality and Augmented Reality in Sign Language Recognition: A Review of Current Approaches," *International Journal of Informatics and Computation (IJICOM)*, vol. 6, no. 2, 2024, doi: 10.35842/ijicom.

[3] S. C. Ke, Abd. K. Mahamad, S. Saon, U. Fadlilah, and B. Handaga, "Malaysian Sign Language Translator for Mobile Application," in *Proceedings of the 11th International Conference on Robotics, Vision, Signal Processing and Power Applications*, N. M. Mahyuddin, N. R. Mat Noor, and H. A. Mat Sakim, Eds., Singapore: Springer Singapore, 2022, pp. 909–914.

[4] A. Rakhmadi and A. Yudhana, "A Study of Worldwide Patterns in Alphabet Sign Language Recognition Using Convolutional and Recurrent Neural Networks," *Jurnal Teknik Informatika (JUTIF)*, vol. 6, no. 1, pp. 187–204, Feb. 2025, doi: 10.52436/1.jutif.2025.6.1.4202.

[5] D. Tresnawati, R. Algani, and S. Mubaraq, "The Introduction of Hijaiyah Letters in Sign Languages using Augmented Reality Technology," *Jurnal Teknik Informatika (Jutif)*, vol. 3, no. 4, pp. 907–913, Aug. 2022, doi: 10.20884/1.jutif.2022.3.4.368.

[6] R. R. Agustin, H. Maulana, and E. P. Mandyartha, "Detection of Actions BISINDO (Indonesian Sign Language) into Text-to-Speech using Long Short-Term Memory with MediaPipe Holistics," *Jurnal Teknik Informatika (Jutif)*, vol. 5, no. 4, pp. 1051–1061, Nov. 2023, doi: 10.52436/1.jutif.2024.5.4.1492.

[7] U. Fadlilah *et al.*, "Android Application Prototype of Basic BISINDO Introduction and Practice for General People," in *Proceeding of International Conference on Special Edcation in South East Asia Region (ICSAR 2022)*, Sep. 2022.

[8] N. Adaloglou *et al.*, "A Comprehensive Study on Deep Learning-Based Methods for Sign Language Recognition," *IEEE Trans Multimedia*, vol. 24, pp. 1750–1762, 2022, doi: 10.1109/TMM.2021.3070438.

[9] A. Hekmat, M. Ali, H. H. Abbas, and I. Shahadi, "Sign Language Recognition and Hand Gestures Review," vol. 02, no. 04, 2022, [Online]. Available: https://kjes.uokerbala.edu.iq/

[10] B. Joksimoski *et al.*, "Technological Solutions for Sign Language Recognition: A Scoping Review of Research Trends, Challenges, and Opportunities," 2022, *Institute of Electrical and Electronics Engineers Inc.* doi: 10.1109/ACCESS.2022.3161440.

[11] P. B.V. and S. S., "A Comprehensive Review on Indian Sign Language Recognition System using Vision based Approaches," *Int J Comput Appl*, vol. 184, no. 43, pp. 52–58, Jan. 2023, doi: 10.5120/ijca2023922548.

[12] D. Bragg, A. Glasser, F. Minakov, N. Caselli, and W. Thies, "Exploring Collection of Sign Language Videos through Crowdsourcing," *Proc ACM Hum Comput Interact*, vol. 6, no. CSCW2, Nov. 2022, doi: 10.1145/3555627.

[13] W. Kartika, M. M. A. Hafida, and S. Widadi, "Simple Patient Registration with The Waterfall Method," in *Proceedings - 2022 2nd International Conference on Electronic and Electrical Engineering and Intelligent System, ICE3IS 2022*, Institute of Electrical and Electronics Engineers Inc., 2022, pp. 237–241. doi: 10.1109/ICE3IS56585.2022.10010117.

[14] S. Shania, M. F. Naufal, V. R. Prasetyo, and S. B. Azmi, "Translator of Indonesian Sign Language Video using Convolutional Neural Network with Transfer Learning," 2022.

[15] M. S. Rumetna, T. N. Lina, I. S. Rajagukguk, F. S. Pormes, and A. B. Santoso, "Payroll Information System Design Using Waterfall Method," *International Journal of Advances in Data and Information Systems*, vol. 3, no. 1, Apr. 2022, doi: 10.25008/ijadis.v3i1.1227.

[16] A. Abdalla, A. Alsereidi, N. Alyammahi, F. B. Qehaizel, H. A. Ignatious, and H. El-Sayed, "An Innovative Arabic Text Sign Language

Translator," in *Procedia Computer Science*, Elsevier B.V., 2023, pp. 425–430. doi: 10.1016/j.procs.2023.09.059.

[17] R. Mokhtar and M. Khayyat, "A Comparative Case Study of Waterfall and Agile Management," *SAR Journal - Science and Research*, pp. 52–62, Mar. 2022, doi: 10.18421/sar51-07.

[18] B. Natarajan *et al.*, "Development of an End-to-End Deep Learning Framework for Sign Language Recognition, Translation, and Video Generation," *IEEE Access*, vol. 10, pp. 104358–104374, 2022, doi: 10.1109/ACCESS.2022.3210543.

[19] T. Natarajan and S. Pichai, "Transition from Waterfall to Agile Methodology: An Action Research Study," *IEEE Access*, vol. 12, pp. 49341–49362, 2024, doi: 10.1109/ACCESS.2024.3384097.

[20] U. Fadlilah, R. A. R. Prasetyo, A. K. Mahamad, B. Handaga, S. Saon, and E. Sudarmilah, "Modelling of basic Indonesian Sign Language translator based on Raspberry Pi technology," *Scientific and Technical Journal of Information Technologies, Mechanics and Optics*, vol. 22, no. 3, pp. 574–584, 2022, doi: 10.17586/2226-1494-2022-22-3-574-584.

[21] M. Al Fajar, M. H. Dar, and R. Rohani, "Application of Waterfall model in development of family planning participants information system," *Sinkron*, vol. 7, no. 2, pp. 679–686, May 2022, doi: 10.33395/sinkron.v7i2.11387.