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JITK (JURNAL ILMU PENGETAHUAN DAN TEKNOLOGI KOMPUTER)

WEB APP FOR BANSOS DISTRIBUTION USING FINGERPRINTS AND PHOTO TIMESTAMPS FOR VERIFICATION AND MONITORING

Miri Ardiansyah[1*]; Aria Armada D.J[1]; Farhan Hamdallah[1]; Khoiriyah[1]

Information Systems[1]
Universitas Sains Indonesia, Bekasi, Indonesia[1]
https://sains.ac.id[1]
miri.ardiansyah@lecturer.sains.ac.id[*], aria.armada@lecturer.sains.ac.id,
farhan.hamdallah@lecturer.sains.ac.id, khoiriyah71@gmail.com

(*) Corresponding Author
(Responsible for the Quality of Paper Content)

Abstract— *The implementation of fingerprint biometric sensors as a substitute for identity cards in the process of distributing social assistance is important because the requirement to bring an original or photocopy of an electronic identity card (E-KTP) is inconvenient for recipients. In addition to being inefficient, this method is also not in line with the government's digitalisation initiatives. Furthermore, the distribution of social assistance is often perceived as slow in reaching beneficiaries. This study aims to develop a web-based information system for social assistance distribution that utilises fingerprint biometrics for recipient verification as a replacement for E-KTP, and incorporates a photo documentation feature with timestamps to record the time and location of distribution activities. The method used in this research is Research and Development (R&D). The novelty of this study lies in the integration of fingerprint authentication, photo timestamp evidence, and web-based monitoring within a single system for social assistance distribution. The results show that the developed system can validate recipient identities using fingerprints, provide timestamped photo evidence, support monitoring of distribution activities, and enhance transparency and efficiency in line with the government's digitalisation programme.*

Keywords: *Biometric, Fingerprint, Information System, Social Assistance Distribution, Time Stamp.*

Intisari— *Penerapan sensor biometrik sidik jari sebagai pengganti kartu identitas dalam proses distribusi bantuan sosial menjadi penting karena persyaratan membawa Kartu Tanda Penduduk elektronik (E-KTP) asli atau fotokopi dinilai kurang praktis bagi penerima. Selain kurang efisien, metode ini juga belum sejalan dengan program digitalisasi yang dikembangkan pemerintah. Selain itu, proses distribusi bantuan sosial seringkali dianggap lambat dalam menjangkau masyarakat. Penelitian ini bertujuan untuk mengembangkan sistem informasi berbasis web untuk distribusi bantuan sosial yang memanfaatkan biometrik sidik jari sebagai verifikasi penerima pengganti E-KTP, serta dilengkapi fitur dokumentasi foto dengan penanda waktu untuk merekam waktu dan lokasi penyaluran. Metode yang digunakan dalam penelitian ini adalah Research and Development (R&D). Kebaruan penelitian ini terletak pada integrasi autentikasi sidik jari, bukti foto bertanda waktu, dan monitoring berbasis web dalam satu sistem distribusi bantuan sosial. Hasil penelitian menunjukkan bahwa sistem yang dikembangkan mampu memvalidasi identitas penerima menggunakan sidik jari, menyediakan bukti foto bertanda waktu, mendukung pemantauan proses distribusi, serta meningkatkan transparansi dan efisiensi sesuai dengan program digitalisasi pemerintah*.

Kata Kunci: *Biometrik, Distribusi Bantuan Sosial, Fingerprint, Sistem Informasi, Time Stamp.*

INTRODUCTION

The government's efforts to improve the welfare of the community include providing social assistance (Bansos). Social assistance or social aid (*bantuan sosial*), which is a payment scheme from the government to the people (G2P), is one of the most important instruments of social welfare policy

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in Indonesia [1]. During the distribution of social assistance, members of the public must bring their original or photocopied identity card or family card [2][3]. This identity document is used as proof of identity for the recipient data verification process. This method is quite inconvenient for social assistance recipients, as they must prepare the necessary documents. In addition to being inconvenient, this method is also not in line with the digitalisation or digital transformation programme being developed by the government itself.

Fingerprint-based biometric authentication utilizes unique and permanent human biological characteristics for identity verification by capturing fingerprint patterns, extracting features such as minutiae points, and matching them with stored biometric templates. This method offers higher accuracy, reduces the risk of identity fraud, and eliminates dependency on physical documents such as E-KTP. Furthermore, fingerprint recognition remains one of the most widely used biometric modalities due to its balance between accuracy, cost, and usability in real-world applications [4]. This method has been widely adopted in digital systems due to its high accuracy, reliability, and resistance to identity fraud [5]. According to Goh et al. [6], biometrics has proven to be one of the best methods for recognising a person's identity based on biological characteristics such as facial recognition, fingerprint scanning, iris scanning, etc.

Biometric credentials, offering significant advantages over traditional methods, have emerged as a preferred solution [7]. This was confirmed by Kakade and Raut [8], who demonstrated that human biological characteristics can be utilized in authentication processes across various systems, including device access, surveillance, forensic analysis, and as substitutes for identity documents such as ID cards and passports. Additionally, there are other issues that frequently arise in the distribution of social assistance, particularly delays in delivery to beneficiaries. Based on research [9] found that the distribution of social assistance has not been running optimally due to misalignment with scheduled distribution periods.

Similar research has also been found [10] highlighted that delays remain one of the key challenges in social assistance implementation. This indicates the need for improved monitoring of distribution time and processes by responsible authorities. Several previous studies have explored the application of digital technologies in public services and social assistance systems. Research by [6] developed a multimodal biometric authentication system for user verification, while Alotaibi (2025) [11] reviewed recent authentication technologies, including biometric authentication, and highlighted their role in improving security and identity verification in digital systems. These studies demonstrate the effectiveness of biometric authentication in enhancing system security and efficiency. However, most existing research focuses on authentication or system functionality separately, without integrating biometric verification with monitoring and documentation mechanisms in social assistance distribution. This gap highlights the need for a more integrated approach. While previous studies have explored biometric authentication in public service systems, web-based social assistance platforms, and communication protocol performance such as gRPC versus REST, these approaches are typically addressed independently.

This study differs by proposing and implementing an integrated system that combines biometric verification, real-time visual evidence through timestamped photo documentation, and monitoring mechanisms within a unified architecture specifically designed for social assistance distribution. In addition, this study evaluates the system through real-world implementation and user-based assessment, providing empirical evidence of usability, acceptance, and practical effectiveness in a public service context. This study does not propose a new algorithm at the computational level; instead, it introduces a system-level model for social assistance distribution that integrates biometric authentication, timestamp-based visual verification, and real-time monitoring within a unified architecture. The proposed model emphasizes the orchestration of multiple components into a coherent workflow designed specifically for public service applications, particularly in improving transparency and accountability.

The urgency of this research lies in the need to integrate verification and monitoring processes into a unified system to improve efficiency, transparency, and accountability in public services. Previous studies have implemented various biometric methods in digital systems, including fingerprint recognition, face recognition, and iris recognition, to enhance identity verification [12], [13], [14], [15]. However, these approaches generally focus on authentication aspects only and are not specifically designed for social assistance distribution scenarios. Therefore, this study proposes an integrated system for social assistance distribution that combines fingerprint-based authentication, timestamped photo documentation, and web-based monitoring within a single platform.

The novelty of this research lies in the integration of biometric verification with real-time monitoring and distribution traceability in a specific public service context, which has not been comprehensively addressed in previous studies. To highlight the contribution of this study, a comparison with existing approaches in social assistance systems, biometric authentication, and monitoring mechanisms is presented in Table 1.

Table 1. Comparison Between Existing Approaches and Proposed System

Aspect	Existing Systems	Proposed System
Identity Verification	Manual (E-KTP)	Fingerprint biometric
Monitoring	Limited	Real-time monitoring
Proof of Distribution	Not documented	Timestamped photo
Integration	Separate systems	Fully integrated
Transparency	Low	High

Source: (Research Result, 2025)

The comparison shows that the proposed system uniquely integrates identity verification, monitoring, and documentation features within a single platform, which are typically implemented separately in existing systems.

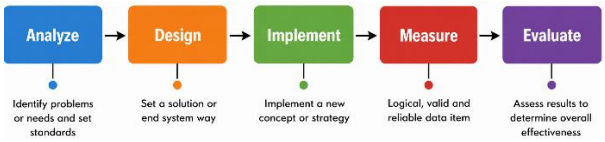
MATERIALS AND METHODS

The contribution of this study lies not in proposing a novel algorithm, but in developing and validating an integrated system model that combines multiple technological components into a unified framework. This model is specifically designed to address challenges in social assistance distribution, particularly identity verification, monitoring, and documentation. The method used in this study is Research and Development (R&D) based on the ADDIE model, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation. The ADDIE model was selected because it provides a systematic framework for developing and evaluating information systems in real-world contexts.

In the Analysis stage, problems related to manual identity verification and lack of monitoring in social assistance distribution were identified through field observation and literature review. In the Design stage, the system architecture, data flow, and main features such as fingerprint verification and timestamped photo documentation were defined. In the Development stage, the system was implemented using web technologies, middleware integration, and biometric devices. In the Implementation stage, the system was deployed and tested with users in a real-world environment. Finally, in the Evaluation stage, system performance and user acceptance were assessed using questionnaires and descriptive analysis.

Research and Development (R&D) is a process for developing a product or improving an existing product [16][17][18]. According to Rumetna et al. 2020 [19], Research and Development (R&D) Method is one of the best model designs. This study was conducted to develop an identity verification system that uses fingerprint biometric authentication as a method of validating the identity of social assistance recipients, as biometrics have unique and permanent characteristics that are effective for digital identification systems. Various studies show that biometric technology, whether fingerprint-based or multimodal, is widely used in security systems and digital services to improve authentication accuracy and strengthen identity verification mechanisms [20].

This system was developed using a Research and Development (R&D) approach in the form of a web-based application that integrates fingerprint verification with time- and location-stamped photo documentation to support distribution traceability. The system is designed as an independent verification and monitoring mechanism for social assistance distribution without relying on the integration of a centralized digital identity platform. The overall research process based on the ADDIE model is illustrated in Figure 1.



Source: (Research Result, 2025)

Figure 1. R&D Process Based on ADDIE Model

The development of this web-based information system was carried out using the Hypertext Processor (PHP) programming language and utilizing the Bootstrap framework to implement the pre-designed display. Meanwhile, the additional tools for fingerprint input that will be used are the U Are 4500 fingerprint sensor, as well as an additional webcam and tripod for the handover photo process. The system was developed in the form of a web-based application integrated with fingerprint biometric devices. The creation of this web-based system requires a middleware mechanism because server-side programming languages such as PHP cannot interact directly with hardware. The middleware mechanism can be used as a link between the fingerprint device and the web

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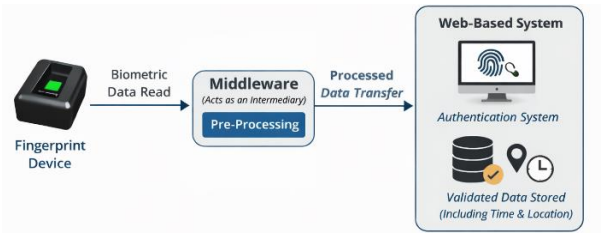
server, which functions to capture biometric data from the device and then send it to the web-based system for authentication and data storage. This architecture enables the fingerprint verification process to run effectively in a web application environment while maintaining system integrity and reliability [5], [21], [22].

Server scripting languages need RESTful or WebSocket services created with native languages to access device drivers [23]. Middleware acts as an intermediary that reads biometric data from devices, performs pre-processing, and then sends the data to the server for validation and storage. This approach is implemented to ensure stable, reliable, and structured communication between hardware and web-based systems.

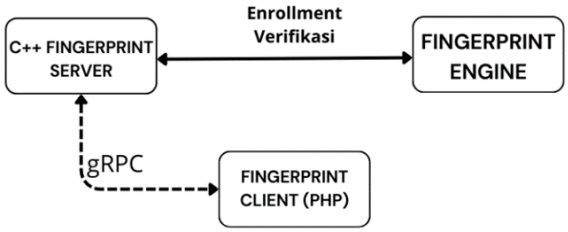


Source: (Research Result, 2025)
Figure 2. Communication Flow Between Devices and Systems

To provide a clearer understanding of the system structure, the proposed system architecture consists of several main components, namely: (1) client-side web application (PHP-based interface), (2) middleware service developed using C/C++, (3) fingerprint device integrated through SDK, (4) gRPC communication layer for data exchange, and (5) database server for storing user and transaction data. Each component is designed to handle specific tasks in the fingerprint verification and social assistance distribution process, ensuring modularity and system scalability. To connect PHP to the fingerprint system, a gateway or API can be used. The workflow established in this system is that the middleware is responsible for communicating with the Fingerprint SDK, then sending data via HTTPS/REST to the server using PHP. In terms of communication, research conducted by Yanuardi et al., 2024, proves that gRPC offers significant advantages over RESTful API in key performance metrics. gRPC demonstrates higher consistency and faster response times, ranging from 20-22 seconds for various data sizes, while RESTful API shows greater response time variation, ranging from 30-90 seconds [24]. Therefore, the system implementation in this study uses gRPC in communication between servers and clients that are cross-language, namely C++ and PHP. gRPC is a Remote Procedure Call (RPC) developed by Google. It allows client programs to call functions on the server as if those functions were in the same process. The role of gRPC in this project is:

A. Provides a network interface between the client side, in this case PHP, and the server side, in this case C++.
B. Enables synchronous (unary call) invocation of the EnrollFingerprint, VerifyFingerprint, and CheckDuplicate methods via the HTTP/2 protocol from the fingerprint server.
C. Ensures efficient communication and streaming support.

The workflow of the developed system can be seen in the following figure:

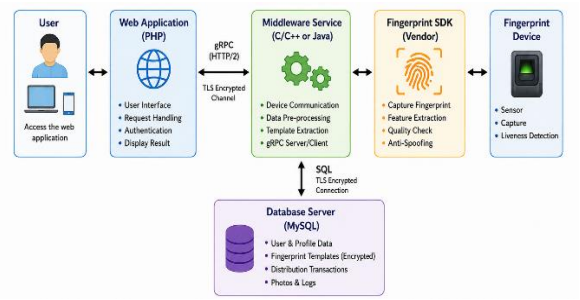


Source: (Research Result, 2025)
Figure 3. System Workflow

The data flow in the gRPC communication process begins when the client application sends a request to the middleware service to perform fingerprint verification. The middleware interacts with the fingerprint SDK to capture and process biometric data. The processed data is then transmitted via gRPC using HTTP/2 protocol to the server for validation. The server compares the received fingerprint template with stored data in the database and returns the verification result to the client application. This mechanism ensures efficient and low-latency communication between system components. In terms of security, the system implements secure communication using HTTPS and supports Transport Layer Security (TLS) to protect data transmission between client and server. Fingerprint data is not stored as raw images but as encrypted biometric templates to ensure user privacy. Additionally, basic anti-spoofing measures are applied through device-level verification provided by the fingerprint SDK to prevent the use of fake fingerprints. These mechanisms are essential to maintain data integrity, confidentiality, and system reliability.

This database design consists of several key entities, including citizens, fingerprint templates,

and social assistance transactions. The population table stores personal information such as ID numbers and names. The fingerprint table stores biometric templates linked to each resident's ID number. The transaction table records every social assistance distribution activity, including the time stamp, distribution location, and photographic evidence. This relational structure supports efficient data retrieval and ensures the traceability of distribution activities. Fingerprint data in this system is stored in the form of encrypted biometric templates before being saved in the database to ensure user privacy and compliance with data protection principles.



Source: (Research Result, 2025)

Figure 4. System Architecture Diagram

RESULTS AND DISCUSSION

Data collection was carried out by interviewing the village government and 28 residents involved in the information system testing process. Data collection was assisted by field officers. The summary of the work, age and education of the participants involved in the trial process is as follows:

Table 2. Recap of Test Participants

PEKERJAAN/ UMUR	PENDIDIKAN			
	elementary school	Junior High School	High School	Grand Total
IRT			**5**	**5**
26			1	1
32			1	1
39			1	1
45			1	1
52			1	1
SWASTA			**3**	**3**
30			1	1
33			1	1
37			1	1
TANI	**8**	**2**	**10**	**20**
30		1		1
34			1	1
36			2	2
37			1	1
39			1	1
40	1		2	3
45			2	2
46	1		1	2
47	1	1		2
48	1			1
56	1			1
60	2			2
65	1			1
Grand Total	**8**	**2**	**18**	**28**

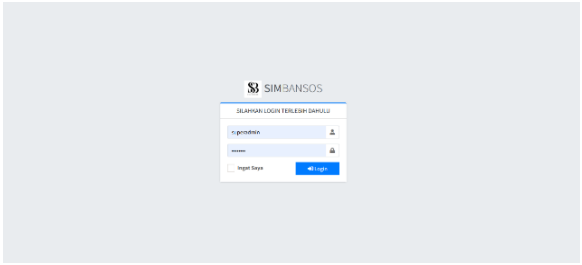
Source: (Research Result, 2025)

1. The appearance of the information system

The appearance of the information system that has been developed is as follows:

a. Login Page

The login page is the first page encountered when accessing the information system for the admin access rights authentication process.

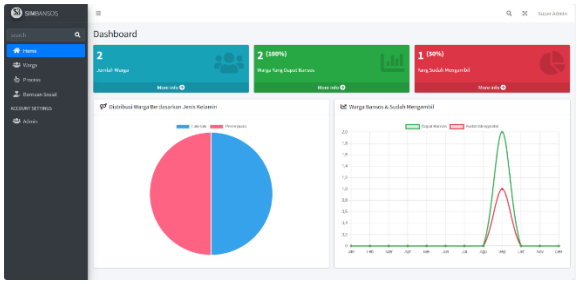


Source: (Research Result, 2025)

Figure 5. Login Page

b. Home Page

The home page is the page that appears after a successful login process. The home page is the main page of the information system that contains various information for administrators.



Source: (Research Result, 2025)

Figure 6. Home Page

c. Residence Page

The resident data page is used by administrators to manage data on all residents. The table on this page shows the social assistance status. If the status is "yes", then the resident receives social assistance, but if it is "no", then the

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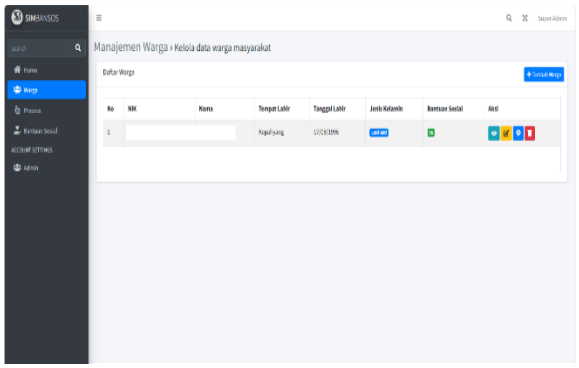
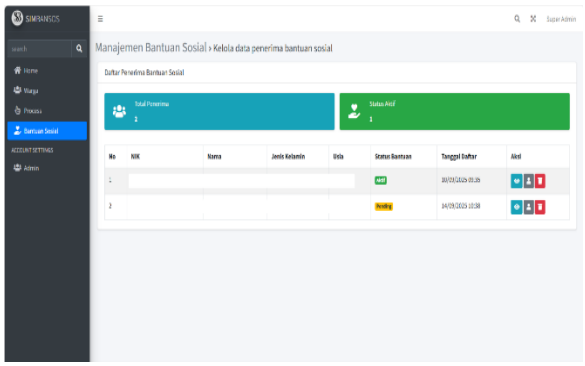
resident is not a recipient of social assistance. This is so that officers do not need to input data on residents who receive social assistance, but only need to change the resident's status, and the resident's data will be entered into the page for residents who receive social assistance.



Source: (Research Result, 2025)
Figure 7. All Residents Data Page

d. Page for Residents Eligible for Social Assistance

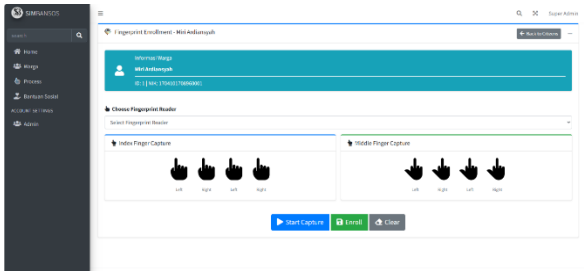
The page for residents eligible for social assistance contains residents who are only eligible for social assistance. The table contains a social assistance status of "Active," which means that the resident has already received social assistance, while a status of "Pending" means that the resident has not yet received social assistance. If it turns out that the resident is no longer eligible for social assistance, the administrator simply deletes the resident's data from the list of social assistance recipients.



Source: (Research Result, 2025)
Figure 8. Display of Residents Eligible for Social Assistance

e. Fingerprint Registration Page

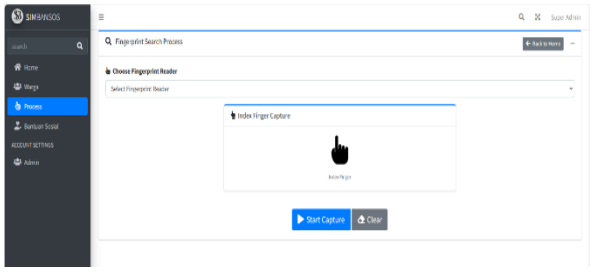
The registration page is a page for registering fingerprints for verification purposes. This page can be found after the administrator inputs resident data.



Source: (Research Result, 2025)
Figure 9. Fingerprint Registration Page Display

f. Process Page

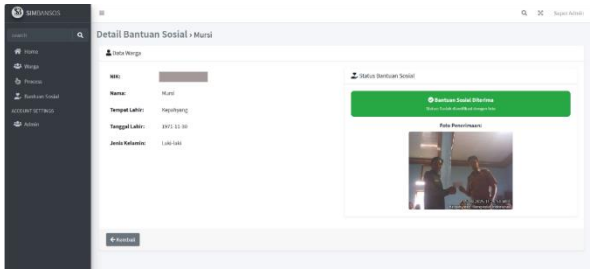
The process page is the page for collecting social assistance. The process for collecting social assistance is as follows: residents simply touch the fingerprint that was previously registered, then the system will detect the resident's data. When the resident's data is detected, the system will automatically switch to the resident's data details page and activate the camera to take a photo of the handover.



Source: (Research Result, 2025)
Figure 10. Process Page Display

g. Camera Page

This page displays the resident's details and activates the camera to take a photo of the social assistance handover.



Source: (Research Result, 2025)
Figure 11. Resident Details Page and Social Assistance Handover Photo Display

The developed system simplifies the verification process compared to conventional methods by reducing dependency on physical documents and minimizing user interaction steps. The integration of fingerprint verification and

automated photo capture with timestamps enables faster processing and improves the accuracy of distribution records. This contributes to increased efficiency and transparency in the social assistance distribution process.

2. Testing

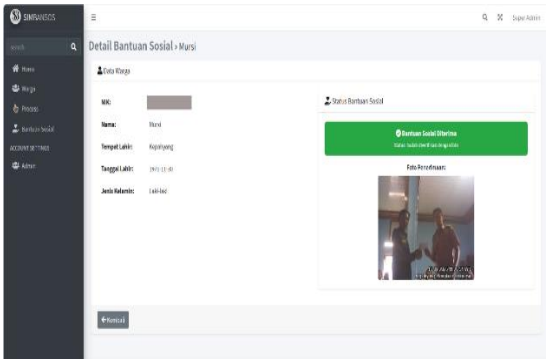
System testing was conducted to ensure that the information system was functioning properly and as expected. The information system testing was carried out in Kepahyang Village, Luas District, Kaur Regency. The results of the testing are as follows:

a. The fingerprint scanner can recognize the fingerprint patterns of each resident participating in the information system testing. The following is an overview of the verification process carried out.

Source: (Research Result, 2025)

Figure 12. Fingerprint Verification Process

b. An additional webcam can detect system commands to activate the camera and take photos during the handover.



Source: (Research Result, 2025)

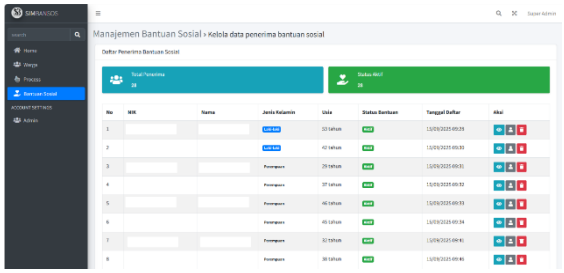
Figure 13. Webcam Taking Handover Photos

c. The information system can capture images and add timestamps in real time to the generated images.

Source: (Research Result, 2025)

Figure 14. Photo Results by the System

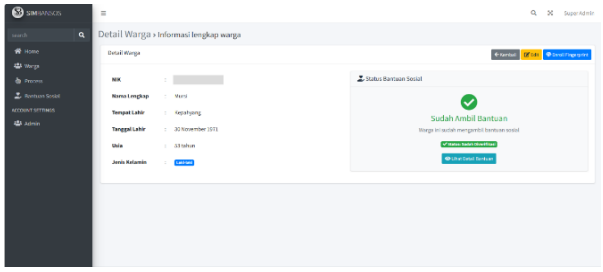
d. The information system is also capable of recording social assistance handover activities in a database and visualising them in the system.



Source: (Research Result, 2025)

Figure 15. Data Visualization

Details of residents' information related to social assistance collection can be seen in the following image:



Source: (Research Result, 2025)

Figure 16. Social Assistance Status Information

3. Data Processing

a. Questionnaire

A questionnaire was distributed to 28 residents involved in the system testing to evaluate user satisfaction and system acceptance. The analysis in this study is primarily descriptive, focusing on response distribution to reflect user perceptions in real implementation conditions. Due

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to the limited sample size and non-random sampling (restricted to one village), inferential statistical analysis was not applied. This study emphasizes practical system evaluation rather than statistical generalization. Although reliability testing such as Cronbach's alpha was not conducted, the questionnaire items were designed to capture key aspects of usability, efficiency, trust, and transparency. Some questions are formulated in a direct manner to ensure clarity for respondents with varying educational backgrounds. Future studies are recommended to apply standardized Likert-scale instruments, perform reliability and validity testing, and involve larger and more diverse samples to improve generalizability.

Question 1:

Table 3. Response to Question 1

Question	Response	Number	%
What is your response to this system?	Easy to use	9	32%
	Very easy to use	14	50%
	Very helpful when applied	5	18%
Total		**28**	**100%**

Source: (Research Result, 2025)

Question 2:

Table 4. Response to Question 2

Question	Response	Number	%
How easy was it for you to understand this system when you first tried it?	Very Difficult	0	0%
	Quite Difficult	0	0%
	Fairly easy	4	14%
	Very easy	24	86%
Total		**28**	**100**

Source: (Research Result, 2025)

Question 3:

Table 5. Response to Question 3

Question	Response	Number	%
In your opinion, which is faster: fingerprint verification or physical documents?	Fingerprint is faster	28	100%
	Physical documents are faster	0	0
	Equally Fast	0	0
	Don't know	0	0
Total		**28**	**100%**

Source: (Research Result, 2025)

Question 4:

Table 6. Response to Question 4

Question	Response	Number	%
Is this system more convenient to use than the previous system?	More convenient	28	100%
Total		**28**	**100**

Source: (Research Result, 2025)

Question 5:

Table 7. Response to Question 5

Question	Response	Number	%
Do you believe that this system prevents others from taking your social assistance?	Quite confident	4	14%
	Very confident	24	86%
	Not very confident	0	0%
	Do not trust	0	0%
Total		**28**	**100%**

Source: (Research Result, 2025)

Question 6:

Table 8. Response to Question 6

Question	Response	Number	%
Any suggestions for this system?	No	28	100%
Total		**28**	**100%**

Source: (Research Result, 2025)

Question 7:

Table 9. Response to Question 7

Question	Response	Number	%
Does using this make the social assistance distribution process more transparent?	Quite transparent	15	54%
	Very transparent	13	46%
	Less transparent	0	0%
	Not Transparent	0	0%
Total		**28**	**100%**

Source: (Research Result, 2025)

Question 8:

Table 10. Response to Question 8

Question	Response	Number	%
Would you recommend this system for implementation?	Highly recommend	28	100
	Somewhat recommend	0	0
	Less likely to recommend	0	0%
	Not Recommended	0	0
Total		**28**	**100**

Source: (Research Result, 2025)

Overall, the questionnaire results indicate a strong positive response toward the system. Most respondents perceived the system as easy to use and helpful, with 100% of participants indicating that fingerprint verification is faster than manual document-based methods. In terms of usability, 86% of respondents reported that the system was very easy to understand during initial use. Additionally, all respondents agreed that the system is more convenient than previous methods and recommended its implementation. From a transparency perspective, 100% of respondents perceived the system as either quite transparent or very transparent. Trust in the system is also high, with 86% expressing strong confidence that the system can prevent misuse of social assistance. These findings suggest that the integration of

biometric verification and timestamp-based documentation contributes positively to user acceptance and perceived system reliability. It is acknowledged that several questionnaire items tend to reflect positive user perception. This is due to the study's focus on evaluating user acceptance in a real-world implementation setting rather than conducting controlled experimental testing. Future studies should include more balanced and neutral question formulations to reduce potential response bias.

CONCLUSION

This study has developed a web-based application for social assistance distribution that integrates fingerprint biometric authentication as a substitute for electronic identity cards, along with timestamped photo documentation for monitoring the distribution process. Unlike previous studies that primarily focus on biometric verification or digital service systems separately, this study proposes an integrated approach that combines identity validation, real-time visual evidence, and monitoring mechanisms within a single platform specifically designed for social assistance distribution. This integration represents a system-level novelty and contributes to improving transparency, accountability, and traceability in public service digitalization. The implementation results demonstrate that the system can effectively validate recipient identities, record distribution activities with timestamped evidence, and support monitoring processes. Based on the questionnaire results, users positively accepted and recommended the system due to its convenience, improved trust, and reduced dependence on physical documents.

However, this study has several limitations, including a relatively small sample size and a non-random sampling approach limited to a single location, which restricts the generalizability of the findings. Future research should involve larger and more diverse samples, apply statistical analysis methods, and conduct reliability and validity testing to strengthen the evaluation results and enhance the robustness of the proposed system. Furthermore, this study contributes not only as a system implementation but also as an empirically evaluated model that demonstrates measurable improvements in user acceptance, perceived efficiency, and transparency in social assistance distribution.

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