

Optimization of Biometric Authentication System Data Update in Old-Age Security Program Case Study in BPJS Ketenagakerjaan

Optimasi Sistem Otentikasi Biometrik Pengkinian Data pada Program Jaminan Hari Tua Studi Kasus di BPJS Ketenagakerjaan

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ABSTRACT

BPJS Ketenagakerjaan added a biometric system to the data update application feature to ensure access security. However, this has raised new discomfort from participants. Participants must come to the BPJS Ketenagakerjaan branch office if there are repeated errors in the system. The purpose of this study is to optimize the biometric authentication system for updating data. This study uses a qualitative descriptive method with a case study approach. The PIECES framework is used as a tool to analyze the biometric authentication system. Interviews, observations, and literature studies are used in data collection. Data triangulation is used to obtain appropriate conclusions and suggestions. The result show that the biometric authentication system is used to update data on the old-age security program. Face recognition is being used in biometric authentication. If the participant fails thrice in the authentication process, they must come to the BPJS Ketenagakerjaan branch office to reopen their authentication access. Optimization can be done by adding variations of biometric authentication such as fingerprints and irises, and automatically re-granting access after a 60-second cooldown without coming to the BPJS Ketenagakerjaan office.

Keywords: *Biometric authentication, optimization, PIECES, systems.*

ABSTRAK

BPJS Ketenagakerjaan menambahkan sistem biometrik pada fitur aplikasi pemutakhiran data untuk menjamin keamanan akses. Namun, hal ini menimbulkan ketidaknyamanan baru bagi peserta. Peserta harus datang ke kantor cabang BPJS Ketenagakerjaan apabila terjadi kesalahan berulang pada sistem. Tujuan dari penelitian ini adalah untuk mengoptimalkan sistem autentikasi biometrik untuk pemutakhiran data. Penelitian ini menggunakan metode deskriptif kualitatif dengan pendekatan studi kasus. Kerangka PIECES digunakan sebagai alat bantu untuk menganalisis sistem autentikasi biometrik. Pengumpulan data dilakukan dengan wawancara, observasi, dan studi pustaka. Triangulasi data digunakan untuk memperoleh simpulan dan saran yang tepat. Hasil yang diperoleh menunjukkan bahwa sistem autentikasi biometrik digunakan untuk pemutakhiran data program jaminan hari tua. Jenis autentikasi biometrik menggunakan *face recognition*. Apabila peserta gagal sebanyak tiga kali dalam proses autentikasi, maka peserta harus datang ke kantor cabang BPJS Ketenagakerjaan untuk membuka kembali akses autentikasi. Optimalisasi dapat dilakukan dengan menambahkan variasi autentikasi biometrik seperti sidik jari dan iris mata, serta memberikan akses kembali secara otomatis setelah cooldown selama 60 detik tanpa harus datang ke kantor BPJS Ketenagakerjaan.

Kata kunci: *PIECES, optimasi, otentikasi biometrik, sistem.*

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INTRODUCTION

In the digital era, the adoption of technology by companies is a compulsion to increase efficiency, productivity, and competitiveness in the global market. Companies that can use technology can adapt to market changes quickly and more effectively. One of the applications of technology is in the field of ICT (Information and Communication Technology). This ICT is a determining factor in the efficiency of processing company data, real-time communication, and automation of complex business processes. In addition, technological developments have driven innovation in company products and services. Companies that conduct research and development of new technologies can create better products and better meet the needs of their business users. This is because technology has advantages in data management, such as capturing data, retrieving data that has been entered, storing data according to the right rules, analyzing data by identifying patterns, and managing data in various ways to produce high-quality information (Bintang & Hendra, 2024). Fast, precise, and accurate information is needed in every decision-making. The continuous development of management information systems is represented by the emergence of new techniques and methods more effective in processing information accurately than the previous, the old management information systems contributed to choosing the best alternative solution, but Modern management information systems provide appropriate information to help identify the real problem, contributes in identifying the real problem more quickly, offer alternatives and solutions to the problems better and enough than the old management information systems and contributes in achieving expected results better than the previous in a high rate (Manesh, 2015). This is not only needed in private companies but also in government institutions.

BPJS Ketenagakerjaan as one of the government institutions established through Act 40 in 2004 and 24 in 2011 to provide employment social security services in Indonesia. Based on data from <https://satudata.kemnaker.go.id/> the number of participants registered as BPJS Ketenagakerjaan participants until January 2024 was 60.64 million people. BPJS Ketenagakerjaan has provided various conveniences to obtain information and access various programs through the website and application, so that participants do not need to come to the office. The JMO application makes it easy for users to interact anywhere and anytime with BPJS Ketenagakerjaan (Hanifa & Handayani, 2024). With this application, it is hoped that participants can manage data and claims from anywhere and anytime without having to come to the BPJS Ketenagakerjaan office.

To ensure the accuracy of participant data, BPJS Ketenagakerjaan provides a "Data Update" feature to update participant data on the JMO application. On the other hand, technology poses challenges for the "Data Update" feature, one of the problems is about security. "Dependence on technology makes countries more vulnerable to disruption, sabotage, or attacks on critical technological infrastructure. (Darumaya *et al.*, 2023). To protect data security in the data update process, BPJS Ketenagakerjaan added a biometric authentication feature. In the implementation of biometric authentication, if a participant makes three repeated errors, the participant must follow the manual procedure by coming to the BPJS Ketenagakerjaan branch office to get access to biometric authentication. This is one of the causes of queues at the BPJS Ketenagakerjaan office. Some participants also complain about the hassle of having to come to the BPJS Ketenagakerjaan office if their biometric authentication system fails. Using the PIECES framework, the biometric authentication system can be optimized to

improve BPJS Ketenagakerjaan performance and participant satisfaction. PIECES has a comprehensive framework for analyzing a system. Where this can be used before developing an information system and evaluating an existing information system (sya'bania *et al.*, 2022).

Literature Review

Biometric Authentication

According to Awasthi *et al.* (2021), Biometric systems are technologies that use an individual's biological/behavioral characteristics for identification and identity verification. In Industry 4.0, this system utilizes artificial intelligence to improve accuracy and efficiency in various security and operational applications. Cahyani (2024), Biometric technology provides advantages and challenges. The main advantage is that it can reduce the risk of unauthorized access to sensitive systems/data. Only authorized users can access with registered biometrics (fingerprints/facial recognition). And the challenges lie in systems with low and high accuracy. For low accuracy, the challenge lies in the issue of user privacy, because biometric data is sensitive and can pose a risk of privacy violations and misuse of information. And for highly accurate systems, the challenge is the risk of failing to recognize authorized users.

The characteristics of each individual in biometrics cannot be forgotten and are not easily faked (such as passwords) because their existence is inherent in humans and will not be the same as one another (Sumijan *et al.*, 2021). According to Alsaadi (2015), biometric authentication is divided physiologically and behaviorally.

a. Physiological Biometric Authentication

1. Fingerprint Recognition: fingerprints are one of the most commonly used physiological biometrics for authentication and identification. This technology utilizes the unique pattern on a person's fingerprints to identify their identity.
2. Hand Geometry: this type of authentication is done by measuring the shape and size of a person's hand. This method is often used in environments that require high security such as access to important facilities.
3. Iris Recognition: this type of authentication uses a unique pattern on a person's iris. The iris has a very complex and unique pattern for each individual, making it very reliable for authentication.
4. Face Recognition: this type uses an individual's face to identify. This technology is often used in security systems and consumer devices such as smartphones.
5. Signature Recognition, based on the dynamics of signing, such as pressure, direction, and speed of pen strokes. This makes the forgery of signatures very difficult.
6. Vein Recognition: this technique utilizes the unique blood vessel pattern in the hand or finger. It is very safe because blood vessels are difficult to fake.
7. Retina Recognition: this technology uses the blood vessel pattern in the retina of the eye. It requires infrared lighting and is very accurate because the retina pattern is very difficult to fake.

b. Behavioral Biometric Authentication

1. Typing Rhythm: this type of authentication uses a person's unique typing pattern, including the speed and interval between different keystrokes.
2. Gait Analysis: this type of authentication is related to analyzing the way a person walks. This technology is used in surveillance and access to restricted areas.

3. Mouse Dynamics: this type of authentication analyzes the way people move their mouse. This includes factors such as the speed and direction of mouse movement as well as the way individuals click and scroll.
4. Keystroke Dynamics: this type of authentication refers to the way individuals type on the keyboard. The factors that influence this are speed, rhythm, and time. By analyzing these patterns, this authentication can be used for identification with high accuracy.
5. Voice Recognition: using a person's unique voice characteristics for authentication. This technology is often used in automated calling systems and virtual assistants.

Pieces Framework

According to Septiani et al. (2023), PIECES analysis is a method used to determine whether the variables applied are good or not and their role in helping service quality. The PIECES method can be a reference for evaluating various operational procedures in a company and can be a tool for analyzing problems to be more specific. The PIECES framework offers a thorough method for evaluating the performance of such systems. It consists of Performance, Information, Economics, Control and Security, Efficiency, and Service (Handoko *et al.*, 2024). According to Zufria (2022), PIECES analysis is used to identify problems. From this analysis, the main problem is usually obtained. This is considered important because usually what is seen is not the main problem, but only the symptoms of the main problem. So it can be concluded that PIECES analysis is a method used to analyze problems and determine whether the variables applied are good or not. From PIECES analysis, the main problems that are usually not analyzed are also obtained. "To identify problems, an analysis of performance, information, economy, application security, efficiency, and customer service must be carried out. This guide is known as PIECES analysis (Performance, Information, Economy, Control, Efficiency, and Service)" (Zufria, 2022).

1. Performance: performance problems occur when work in a company does not reach its target. This is related to the amount of production and response time.
2. Information: the company's ability to control information will have an impact on producing useful information. In this PIECES, the analysis that is being improved is: Lack of information regarding current decisions or situations, lack of relevant information regarding current decisions or situation information, lack of timely information, too much information, inaccurate information.
3. Economy: things that need to be explained in this area are costs & benefits. Costs include unknown costs, costs that cannot be traced to the source, and costs that are too high. While the benefits include new markets that can be explored, current marketing can be improved, orders can be increased.
4. Control: control needs to be considered because it is to prevent and detect system errors, and ensure the security of data, information, and requirements. What needs to be considered is 1) weak security or control including data input that is not edited sufficiently, crimes (eg embezzlement or theft) against data, ethics are violated on data or information - refers to data or information accessed by unauthorized persons, data is stored excessively, inconsistently across different files or databases, data privacy regulations or guidelines are violated (or can be violated), processing errors occur (by humans, machines or software), decision-making errors occur. 2) excessive control or security includes bureaucratic procedures that slow down the system,

controls that interfere with customers or employees, and excessive controls that cause downloading.

5. Efficiency: efficiency includes how to produce the most output with the least possible input. Indicators of system efficiency are people, machines, or computers wasting time, excessive data input or transmission, excessive data in the process, excessive information generated, excessive effort required for tasks, and excessive materials required for tasks.
6. Service: analysis of the quality assessment of a system can be seen from the following criteria, namely the system produces inaccurate products, the system produces inconsistent products, the system produces unreliable products, the system is not easy to learn, the system is not easy to use, the system is awkward to use, the system is not flexible.

RESEARCH METHOD

This study uses a qualitative descriptive method with a case study approach to optimize the biometric authentication system and procedures in the BPJS Ketenagakerjaan application. The qualitative approach was chosen because it allows researchers to deeply understand the experiences, perceptions, and interpretations of individuals or groups of the phenomena being studied (Creswell, 2014). The use of this method is expected to provide in-depth insights that not only explain how the biometric authentication system is implemented and operated, but also how the system is received and perceived by users, as well as its implications for the performance and security of the BPJS Ketenagakerjaan JMO application. This study can provide appropriate and effective recommendations for future system improvements. (Denzin & Lincoln, 2017; Creswell, 2014).

Data were collected through semi-structured interviews, participant observation, and document analysis. Semi-structured interviews allow researchers to explore subjects' views and experiences in depth, providing flexibility in asking additional relevant questions during the interview process (Creswell & Poth, 2016). Participant observation is conducted to observe the social interactions and behaviors of subjects in their natural context, helping researchers understand phenomena from the perspective of the subjects (Merriam & Tisdell, 2016). In addition, document analysis is used to examine written materials relevant to the research topic, such as reports, notes, and archives that provide additional context and information (Bowen, 2017). This study used 15 respondents consisting of staff and participants of the Old Age Security program who accessed the BPJS Ketenagakerjaan application. Eighteen different questions were given to staff and participants of the Old Age Security program. That is a data triangulation used to obtain conclusions and appropriate suggestions by comparing and analyzing answers from staff and participants of the Old Age Security program.

RESULTS AND DISCUSSION

Updating data on the BPJS Ketenagakerjaan Jamsostek Mobile (JMO) application is an important process for participants to ensure that their information is always accurate and up-to-date. This is done only once. This data update covers several aspects, including personal data, employment data, and other information relevant. This is

important because it is used as a basis for the claims process including disbursement of funds.

The data update process on the BPJS Ketenagakerjaan Jamsostek Mobile (JMO) application begins with:

1. Participants log in to the BPJS Ketenagakerjaan JMO application and access the data update feature;
2. Participants input data according to the latest and actual conditions;
3. Participants are directed to biometric authentication. The biometric uses face recognition that is adjusted to the data in the Dukcapil (Population and Civil Registration Service) portal. If appropriate, participants will immediately fill in further data such as contact data, additional data, and emergency contacts.
4. If the biometric is not appropriate, participants will be given three opportunities to repeat biometric authentication. After that, the application will be automatically blocked and will be directed to confirm directly to the BPJS Ketenagakerjaan office.

The procedure when the application is blocked and the participant comes to the BPJS Ketenagakerjaan branch office is as follows:

1. Participants show identity card and JMO applications. In addition, participants will also be verified with questions in the form of the name of the company where the participant works and their biological mother;
2. After the verification process by the customer service officer, participants will immediately get access to perform biometric authentication;
3. Participants who want to perform biometric authentication again must log in and follow the data update procedure from the beginning.

The data updating system carried out by JHT (Old Age Security) program participants is good. This can be seen from the biometric authentication applied in the data updating process. The system shows that there is special attention to data accuracy and security. Data owned by participants in the JHT (Old Age Security) program is more secure and cannot be accessed by strangers. However, there are still inefficiencies of the data update system. In the data update system, there is a process that requires participants come to the BPJS Ketenagakerjaan branch office if there is a biometric authentication failure. Participants must sacrifice time and money to confirm the biometric failure to the BPJS Ketenagakerjaan branch office.

Pieces Analysis of Biometric Authentication System Data Updates

Data updating aims to ensure that the data in the database is accurate and there are no problems when disbursing funds. However, in reality, the authentication system used is not effective enough in the data updating process. One of the analysis tools used to measure the level of effectiveness of a system is PIECES analysis. PIECES analysis has 6 characteristics that must be analyzed, namely performance, information, economy, control, efficiency, and service. These characteristics are used in analyzing the effectiveness and efficiency of the BPJS Ketenagakerjaan JHT data updating biometric authentication system. Questions related to performance, information, economy, control, efficiency, and service were given to BPJS Ketenagakerjaan participants and staff. The results of the questionnaire are presented in Table 1.

Table 1. Results of PIECES Analysis of Biometrics Authentication System Data Updates

Pieces Framework	Results of Analysis
Performance	<p>Velocity and Efficiency: The data updating process in the JMO application is quite fast, taking around 10-15 minutes per participant and 30 minutes including verification. However, technical obstacles such as biometric authentication errors and delays due to network problems or server overload still occur. This happens because a lot of data are being used, thus increasing the server load.</p>
Information	<p>Accuracy and Accessibility: Data generated by the system is generally accurate and easily accessible to staff through a user-friendly dashboard. Data input errors occurred in approximately 5% of the updated data, usually due to manual mistakes by participants or staff.</p> <p>Information Support: The system provides comprehensive reports and data analysis, which greatly assists in management's strategic decision-making.</p>
Economy	<p>Cost Efficiency: The data updating process with the JMO app is efficient because it reduces costs for paper. However, transportation costs can be a problem for participants when they must come to the BPJS office if they are unsuccessful in biometric authentication three times.</p> <p>Time-Saving: The data updating process with the application is beneficial in saving time. However, participants must come to the BPJS office if they are unsuccessful in biometric authentication three times.</p>
Control	<p>Data Security: Access control and data security are implemented through multi-factor login systems such as data encryption, and access restrictions based on staff roles and responsibilities. Audits are conducted quarterly to ensure the integrity and accuracy of data stored in the system.</p> <p>Error Detection: There needs to be an audit trail and data validation mechanism that helps detect and prevent errors or data manipulation.</p>
Efficiency	<p>Process Efficiency: The automation system helps speed up the process. However, participants must come to the BPJS office if they are unsuccessful in biometric authentication three times.</p>
Service	<p>Quality of Services: The quality of BPJS Ketenagakerjaan customer support in assisting the data update process is considered very good with a fast response. Participants are satisfied with the services provided during the data update process.</p>

Based on the analysis of the PIECES framework, the problems in the system are related to 1) Performance, related to overloaded servers: technical constraints such as biometric authentication errors and delays due to network problems or server overload still occur. 2) Economic & Efficiency: additional costs and time. Participants must come to the BPJS Ketenagakerjaan office if there is a biometric authentication failure. Staff also feel that the confirmation process to the office when an authentication failure occurs adds extra effort and time for workers.

Based on the analysis with the PIECES framework, optimization can be done in the following ways:

1. Biometric authentication recognition provides access again after a 60-second cooldown

The JMO system can be added with a 60-second cooldown after the failure of the biometric authentication. There are three main purposes for which the authentication system is given a cooldown:

- a. Security: Cooldown helps prevent repeated or automated attacks, such as brute force or DDoS (Distributed Denial of Service) attacks. By providing a pause, the system can limit the number of attempts that can be made in a short time.
- b. Data Protection: A time delay can help protect sensitive data from unauthorized access. This gives time to verify the user's identity or check for suspicious activity.
- c. Resource Management: By providing a pause, the system can manage resources more efficiently, preventing overload that can cause system performance to decrease or crash.

The ideal cooldown length for a biometric authentication system failure depends on several factors, including the desired level of security, frequency of use, and the risks associated with authentication failure.

2. BPJS Ketenagakerjaan adds variations of biometric authentication such as fingerprints and iris recognition

In addition to facial recognition, BPJS Ketenagakerjaan can provide variations of biometric authentication to participants to make it easier for participants. This is because faces can change at any time. BPJS Ketenagakerjaan can add biometric authentication such as fingerprints and iris recognition that are not easily changed.

CONCLUSION

The conclusion that can be established from the discussion of the biometric authentication system in data updating is that the biometric authentication system for updating the Old Age Security program data in the BPJS Ketenagakerjaan JMO application, based on the analysis of pieces, is inefficient and less effective. By using the current biometric authentication system flow, the data updating activity takes longer, costs more, adds work, and can be overloaded at any time in the BPJS Ketenagakerjaan system. The biometric authentication system should be able to provide access again after a 60-second cooldown after 3 failed attempts. The variations of the biometric authentication system can be added more such as fingerprints and iris recognition.

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