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IMPLEMENTATION OF FACIAL RECOGNITION TECHNOLOGY AS A SERVICE INNOVATION FOR TRAIN PASSENGERS AT TUGU STATION, YOGYAKARTA

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Abstract

Face Recognition (FR) is a facial recognition technology used for check-in upon train departure. This study aims to determine the implementation of facial recognition technology in the passenger service system and identify the technical and non-technical challenges encountered. This study employed qualitative methods, collecting data using observation, documentation, and interviews. The interview method used was followed by data analysis and development using observations conducted by the author at the Face Recognition Unit at Yogyakarta Main Station during the research period of March-August 2025. The results show that the implementation of Face Recognition (FR) involves registration and data verification in the Access By KAI application or by visiting the departure station directly. Customers can then board directly through face recognition access by scanning their faces with a camera. Implementation of supporting systems and infrastructure with high-resolution cameras for facial scanning and ISO27001-certified cyber protection systems. Technical constraints include lack of stability and performance in the real-time data verification process, lack of accuracy in the lighting system, and the system's lack of sensitivity in recognizing customer data. Non-technical constraints include lack of customer trust, lack of socialization and education, and limited use, especially for toddlers, the elderly, and foreign nationals.

Keywords: Yogyakarta Station, Face Recognition, Boarding.

INTRODUCTION

The emergence of digital transformation systems has become a fundamental foundation in global development in the 21st century. Amidst the wave of the Fourth Industrial Revolution, marked by the integration of advanced technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), Big Data Analytics, and Machine Learning, various sectors of life have undergone fundamental changes, including the transportation sector. The world is now moving collectively toward the development of intelligent transportation systems (ITS), enabling stakeholders to manage traffic and passenger services in real time, efficiently, and adaptively to societal needs. One breakthrough within this framework is the application of biometric technology, particularly facial recognition, which has been widely adopted in identification, authentication, and surveillance processes across many countries.

Facial recognition technology is a biometric verification method that employs computer algorithms to analyze individual facial features and match them with stored data, particularly in relation to passengers' ticketing data. Compared to conventional methods such as manual ticket inspection requiring physical identity cards for validation or verification, this system accelerates the verification process without the need to present identification documents, reduces queues, and significantly enhances service efficiency. In the transportation sector, this technology has been comprehensively implemented in several major cities such as Beijing, Tokyo, Seoul, and London to support contactless services, proactive security, and personalized service for public transport users.

At the national level, Indonesia, as a developing country, has also begun adopting advanced technologies to address challenges in managing a safe, efficient, and equitable public transportation system for its population of over 270 million people. In line with the national digital transformation agenda, the government, supported by the Ministry of Transportation, the Ministry of Communication and Informatics, as well as various state-owned transportation enterprises such as PT Kereta Api Indonesia (Persero), has initiated and promoted the digitization of services based on data and intelligent technologies. This initiative is not only aimed at improving the quality of services for public transport users but also at responding to challenges of urbanization, high mobility, and the need for transparency and accountability in system implementation.

One of the public transportation modes that serves as the backbone of interregional connectivity in Indonesia is the railway. In this context, supporting facilities such as stations play a crucial role, particularly the implementation process at Tugu Yogyakarta Station. As a major type-A station located in the heart of Yogyakarta, this station not only accommodates a large number of passengers daily but also serves as a central hub for tourists, students, and economic actors from various regions. Data from PT KAI show that under normal conditions, Tugu Station serves more than 15,000 passengers per day, with significant increases during holiday seasons, long weekends, and religious celebrations. With passenger flows continuing to increase over time, challenges related to service, security, and passenger traffic management have become increasingly critical.

The application of facial recognition technology at Tugu Yogyakarta Station can be considered a strategic step in addressing these challenges. This technology enables an automatic check-in process integrated with the electronic ticketing system, eliminating the need for physical ticket printing and manual ID verification. It also allows for real-time monitoring of passenger entry and exit, as well as early detection of potential security threats. Moreover, the system supports the principle of minimal physical contact, which has become particularly relevant in the post-COVID-19 context, and contributes to the development of adaptive public transportation services in the face of public health crises. Furthermore, the use of this technology aligns with operational efficiency efforts, whereby the role of manual ticket inspection officers can be shifted from verification tasks to more strategic functions of monitoring and management.

However, the implementation of this advanced technology at Tugu Yogyakarta Station also faces complex challenges. Technically, the facial recognition system requires supporting infrastructure such as high-resolution cameras capable of accurately detecting passenger faces, stable data communication networks, large-capacity servers, and AI-based software that can operate under various environmental conditions. Problems such as reduced accuracy due to poor lighting or changes in facial expression, as well as technical disruptions such as the synchronization of newly purchased ticket data at the counter, can hinder the effectiveness of the system. On the other hand, non-technical issues such as passenger privacy and personal data protection have become important debates in

implementing such advanced systems. Concerns remain regarding the misuse of biometric data, especially in the context of the limited dissemination of strict personal data protection regulations in Indonesia, given the requirement to use national ID data during registration. In addition, resistance to new technologies, disparities in digital literacy among users, and limited human resources capable of mastering the new system in operations also represent significant obstacles that must be carefully addressed.

METHOD

This study employed a descriptive qualitative method to examine the implementation of face recognition technology at Tugu Yogyakarta Station, with a focus on informants lived experiences. This method is consistent with the nature of qualitative inquiry, which emphasizes natural settings without external intervention, where the researcher serves as the primary instrument (Sugiyono, 2022). Data were collected through observation, in-depth interviews, and documentation, with informants selected using purposive sampling and further expanded through snowball sampling when necessary. Primary data were obtained directly from interviews and observations with face recognition operators, boarding staff, and unit supervisors, while secondary data were drawn from supporting documents and policy frameworks related to the system (Sugiyono, 2022).

To ensure the validity and reliability of the findings, this method applied triangulation of both techniques and sources, thereby enhancing the consistency and trustworthiness of the data (Sugiyono, 2022). Data analysis was conducted using the Miles and Huberman method as cited in Sugiyono (2022), which includes data collection, data reduction, data display, and conclusion drawing/verification. Reduction was applied to filter and focus the data according to the research objectives, while the display phase presented the information in narrative form for clarity. Conclusions were initially tentative and later refined through continuous verification based on empirical evidence. This methodological framework thus provides a comprehensive understanding of the constraints and practical implementation of face recognition technology within the operational context of PT KAI.

RESULTS AND DISCUSSION

Results

This research was conducted in the face recognition (FR) unit at Tugu Yogyakarta Station, focusing on the implementation concept of face recognition technology in passenger service systems and identifying both technical and non-technical challenges in its application. Based on the results of observations, interviews, and documentation, the following findings were obtained:

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The Concept of Implementing Face Recognition Technology in the Passenger Service System at Tugu Yogyakarta Station

1. The registration and verification process is divided into two options, namely direct registration at the station or through the railway application, which is then followed by the implementation of the usage process as well as the provision of supporting facilities and systems.
2. The boarding process using face recognition begins with ID verification as the main requirement, followed by the possession of a valid departure ticket, after which passengers can directly proceed to boarding by scanning their face on the recognition camera system.
3. The supporting systems and infrastructure include the integration of facial recognition technology with passenger data and the ticketing system, which allows automatic synchronization with the passenger's ID number and name to ensure accuracy and reliability.

Technical and non-technical constraints encountered in the implementation of face recognition technology at Tugu Yogyakarta Station

1. The technical constraints are insufficient lighting, unsynchronized departure ticket data with the go-show ticketing system, and outdated passenger data.
2. The non-technical constraints are passengers' lack of trust in providing personal data, limited education and socialization, and restricted access for certain users.

Discussion

The Concept of Implementing Face Recognition Technology in the Passenger Service System at Tugu Yogyakarta Station

1. Registration and Data Verification Process (Implementation Concept)

The integration process undertaken by PT Kereta Api Indonesia (KAI) has progressively advanced in line with technological developments, most notably through the adoption of a face recognition system for passenger departure verification. This innovation has been implemented in several major stations across Indonesia, particularly those serving long-distance passenger trains. Fundamentally, the registration and verification process is designed to be conducted only once, enabling passengers to consistently utilize the face recognition facility for subsequent journeys without the need for repeated registration.

The initial registration method is facilitated through the Access by KAI application, where passengers who have registered their accounts may directly access the face recognition feature in the profile section. This process requires the input of the National Identity Number (NIK) and the passenger's full name as stated on the national ID card, followed by facial verification through a real-time selfie capture or recent photograph. Once validated, the system integrates the biometric

and personal data into the central database, allowing synchronization with ticketing information and enabling seamless verification at the station.

Alternatively, registration may also be conducted on-site at departure stations equipped with face recognition infrastructure. In this procedure, passengers are assisted by station personnel, presenting their original ID card for authentication using a card reader, followed by fingerprint verification. Upon successful verification, the biometric data is securely stored and linked to the passenger's active departure ticket, thereby allowing the immediate use of the face recognition system while ensuring both operational efficiency and data security.

2. Boarding Process Using Face Recognition (Implementation Concept)

After passengers complete the facial registration process either through the Access by KAI application or directly at the station, biometric information such as facial images, full name, and National Identification Number (NIK) is stored in PT Kereta Api Indonesia's passenger service system. This system is integrated with the national civil registry (Dukcapil), ensuring that all submitted data undergoes legal verification for authenticity. Importantly, registration is a one-time process, as the system can recognize the stored biometric data for subsequent journeys, provided that the identity used during ticket purchases remains consistent with the registered information.

On the day of departure, passengers are not required to print physical tickets or display QR codes via the mobile application. Instead, they can proceed directly to the automated boarding gates equipped with high-resolution cameras and face recognition (FR) technology connected to the central server. When positioned in front of the device, passengers must ensure proper alignment, remove any face coverings such as masks or hats, and maintain the recommended distance from the camera. The system scans the face in real time, matching it against the stored biometric database. Within 1 to 3 seconds, the system not only verifies the facial data but also confirms whether the passenger holds a valid ticket for the corresponding schedule and whether boarding occurs within the permitted timeframe (typically from 2 hours to 10 minutes before departure).

If verification is successful, the boarding gate opens automatically, completing the check-in process. This contactless procedure eliminates the need to present physical identification or electronic tickets and records the data directly in the KAI system. By reducing queuing times, expediting passenger flow, and minimizing physical interactions, the face recognition boarding system enhances operational efficiency and provides a more convenient travel experience, particularly during peak travel periods such as holiday seasons or mass departures.

3. Supporting Systems and Infrastructure (Implementation Concept)

The implementation of the face recognition system, designed to facilitate passenger boarding for long-distance train services, requires the integration of both infrastructure and

software within designated stations that have been equipped to operate this technology. A central component of this infrastructure is the automated boarding gate, which is fitted with high-resolution cameras and facial recognition sensors that serve as the primary tools for identity verification. In addition to the boarding gate, the system is capable of conducting real-time verification by cross-referencing passenger facial data with ticketing information stored in PT Kereta Api Indonesia's central server, which is further integrated with the national civil registry (Dukcapil). This ensures that only passengers with valid tickets for the scheduled departure are granted access to the platform.

Beyond the physical infrastructure, PT Kereta Api Indonesia has also emphasized data security and privacy protection through the implementation of a centralized monitoring system and cybersecurity measures. The system has obtained ISO 27001 certification for information security management, ensuring compliance with international standards for customer privacy. Passenger data, submitted through National Identification Numbers (NIK) or ID cards, is encrypted and stored for a maximum of one year in accordance with PT KAI's privacy policies. To further guarantee system reliability, station staff actively monitor system performance and address any potential errors or malfunctions that may occur during operation. This combination of advanced infrastructure, secure data management, and real-time monitoring provides both efficiency and assurance in the application of face recognition technology within the railway boarding process.

Constraints in the Implementation of Facial Recognition Technology at Tugu Yogyakarta Station

The application of facial recognition technology at Tugu Yogyakarta Station faces several constraints during daily operation, both from the passengers' side and the system itself. These constraints are categorized into two types: technical constraints and non-technical constraints, each reflecting specific barriers identified during the trial and actual use of the system.

a. Technical Contraints

1) System Stability and Performance

A primary technical constraint in the implementation of face recognition at Tugu Station concerns system stability and overall performance. Several passengers reported failures in verification despite prior registration, necessitating repeated data confirmation with station staff. Additionally, go-show ticket transactions purchases made within two hours prior to departure often experience delays of 15–20 minutes before synchronization with the recognition system. These limitations indicate insufficient real-time data integration between the ticketing system and the face recognition platform, thereby undermining operational efficiency and reducing passenger satisfaction.

2) Incomplete Accuracy

Another critical constraint relates to the system's limited accuracy in recognizing passenger identities. Instances of unsuccessful scans, where data are either mismatched or not detected, remain prevalent even among passengers who completed biometric enrollment. Environmental factors such as poor lighting conditions, backlighting, and inadequate device positioning further exacerbate these challenges. Consequently, passengers are often required to repeat the scanning process multiple times, frequently with staff intervention. This lack of accuracy not only disrupts boarding efficiency but also highlights the necessity for technological refinement to ensure reliable and consistent system performance.

b. Non-Technical Contraints

1) Customer Trust

   Trust-related issues remain a major barrier in the implementation of face recognition systems. A considerable proportion of passengers express reluctance to submit personal information, such as national identification data, due to heightened concerns over privacy, data security, and potential misuse. This skepticism undermines the adoption rate of the technology and diminishes user confidence in its reliability.

2) Limited Socialization and Public Awareness

   The lack of comprehensive socialization and public education initiatives by PT KAI has further constrained the effectiveness of the system. Many passengers remain insufficiently informed about the operational procedures and benefits of face recognition technology, leading them to prefer conventional methods such as physical ticket verification. Insufficient outreach efforts exacerbate perceptions of risk regarding data protection and limit broader acceptance of the system.

3) Accessibility Challenges

   The inclusivity of the system is also challenged by user accessibility constraints. Elderly passengers frequently encounter difficulties due to discrepancies between outdated identification photographs and their present appearance, reducing recognition accuracy. Children, who often lack valid biometric-linked identification, and foreign tourists, who are required to use passports not yet integrated into the system, are similarly disadvantaged. These limitations necessitate reliance on manual verification processes, thereby reducing the efficiency and inclusiveness of the boarding experience.

CONCLUSION

Based on the findings of this study on the implementation of face recognition technology at Tugu Station Yogyakarta, it can be concluded that the system is applied through a registration and data verification process via the Access by KAI application or directly at the station, after which

passengers can board by scanning their faces using high-resolution cameras supported by ISO27001-certified cybersecurity systems. However, its implementation still faces challenges, both technical such as lack of stability and performance in real-time verification, limited accuracy due to lighting and system sensitivity and non-technical, including low customer trust in sharing personal data, limited socialization and education, as well as restrictions in use particularly for toddlers, the elderly, and foreign nationals.

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