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Implementation of a Gemini Api-Based Chatbot Integrated with MySQL Database for Social Security Services

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Abstract

Background of study: The increasing demand for intelligent and responsive digital services in the public sector has encouraged government institutions to integrate artificial intelligence into their service systems. Social security agencies in Indonesia require an innovative solution to deliver faster, more accurate, and accessible information to citizens.
Aims and Scope of Paper: This study aims to design and implement a Gemini API-based chatbot integrated with a MySQL database to enhance social security services through natural and interactive communication. The chatbot was developed during an internship program at the Social Security Office (BPJS Ketenagakerjaan) Medan Kota branch.
Methods: The system was developed using Natural Language Processing (NLP) capabilities of the Gemini API to process user input and retrieve structured data from a MySQL database. An admin dashboard was built with the Laravel framework to manage PDF uploads, perform text extraction, and handle user queries in real time.
Result: Testing showed that the chatbot could effectively respond to general and data-driven queries, extract and analyze uploaded documents, and improve response time compared to traditional service channels. The integration of Gemini API and MySQL ensures scalability, accuracy, and secure data management.
Conclusion: The implementation of a Gemini API-based chatbot integrated with a MySQL database demonstrates how AI-driven conversational systems can modernize public services. It enhances operational efficiency, accessibility, and user satisfaction, supporting the digital transformation of social welfare institutions in Indonesia.

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INTRODUCTION

In the era of digital transformation, public service institutions are facing increasing pressure to deliver efficient, responsive, and user-centered services. Citizens today expect immediate access to accurate information, seamless communication, and convenient service channels through digital platforms. For social security institutions, such as BPJS Ketenagakerjaan in Indonesia, these expectations create a demand for innovation in how information and services are delivered (Hidayatullah & Sembiring, 2022). Traditional customer service systems—relying heavily on manual inquiry handling—often result in long waiting times, high workloads, and inconsistencies in responses, leading to lower satisfaction among service users.

To overcome these limitations, artificial intelligence (AI) technologies are increasingly being integrated into public service systems to automate repetitive tasks and enhance interaction quality.

Among the various AI applications, chatbots—computer programs designed to simulate conversation with human users—have become one of the most impactful solutions. By utilizing Natural Language Processing (NLP) and machine learning algorithms, chatbots can interpret human language and respond contextually, allowing for real-time communication between institutions and citizens (Brownlee, 2020; Ali & Riady, 2025).

The integration of chatbot technology into government agencies has been shown to improve service accessibility, transparency, and efficiency. Harahap et al., (2023) noted that AI-driven chatbots can process thousands of queries simultaneously, reducing human workload and response time. In Indonesia, where public institutions serve millions of citizens across vast geographic areas, such technology offers significant advantages. Chatbots can serve as an always-available digital front office, capable of providing consistent and accurate information to users anytime and anywhere (Ibadurrahman et al., 2025; Putri et al., 2024).

However, many chatbot implementations in public institutions still face challenges in terms of contextual understanding, data integration, and adaptability to complex queries. In particular, most systems cannot access internal databases or structured reports, limiting their ability to provide precise data-driven responses. This issue is especially critical in social security services, where inquiries often involve specific data such as claim status, contribution records, or eligibility criteria (Supriyono et al., 2024).

To address this limitation, this research focuses on the development and implementation of a Gemini API-based chatbot that is integrated with a MySQL database and an admin dashboard built using Laravel. The Gemini API, developed by Brownlee (2020), offers advanced NLP and conversational capabilities, allowing the chatbot to understand and generate human-like dialogue. Its integration with MySQL enables the system to access, query, and manage structured data in real time, creating a seamless link between conversational AI and back-end databases. This dual-layered architecture ensures that responses are both intelligent and data-driven (Riady et al., 2023; Hutabarat et al., 2023).

The implementation took place within the BPJS Ketenagakerjaan Medan Kota branch, as part of a digital innovation project during an internship program. The chatbot was designed to handle inquiries related to benefit claims, participant data, and other administrative services. Furthermore, the system supports PDF document processing, enabling administrators to upload reports that are automatically converted into text and stored in the database for future chatbot queries. This feature bridges the gap between unstructured and structured data, enhancing the chatbot's versatility in information retrieval (A. Habibi et al., 2022).

Previous studies have explored chatbot applications in education, tourism, and e-government services, highlighting their potential in improving engagement and operational efficiency (Harahap et al., 2023; Ausat, Massang, et al., 2023). Nevertheless, limited research has examined how a chatbot can combine AI-based natural language processing with dynamic database integration in the specific context of social security systems. This research thus fills a significant gap by proposing a model that integrates conversational intelligence with data-driven functionality, enabling the chatbot to answer both general and data-specific queries accurately.

In addition, the research aligns with the broader trend of digital transformation in Indonesia's public sector, which emphasizes the adoption of smart systems, open data, and automated services (Riady, Habibi, et al., 2025). Integrating AI into social security systems not only modernizes operational workflows but also strengthens citizen trust by ensuring transparency and consistency in service delivery. AI applications such as chatbots are expected to support sustainable governance by optimizing resource use, reducing human error, and improving the speed and quality of decision-making (Akhmad Habibi et al., 2022).

The proposed system also contributes to the field of software engineering by demonstrating how cloud-based APIs and relational databases can be orchestrated to build scalable, secure, and maintainable public service applications. Through the combination of the Gemini API's NLP capabilities and the robustness of MySQL's data management, this system exemplifies a practical approach to implementing AI in enterprise-level government systems. It showcases how modern frameworks like Laravel can streamline development processes and support modular integration, essential for large-scale institutional environments (Ausat, Azzaakiyyah, et al., 2023).

Ultimately, this study aims to enhance public service performance by providing an intelligent, responsive, and data-integrated chatbot system. The development of a Gemini API-based chatbot connected to a MySQL database represents a step forward in Indonesia's digital transformation journey, particularly in improving the efficiency of social security service delivery. The findings are expected to contribute to both academic discourse and practical implementation by offering insights into AI integration strategies, system architecture, and the real-world benefits of conversational AI in government institutions (Riady, Arisanty, et al., 2025; Harahap et al., 2023).

METHODS

The implementation of the Gemini API-based chatbot integrated with a MySQL database for social security services followed a structured methodology consisting of four key stages: system design, development, integration, and evaluation.

This project follows an engineering-based approach, consisting of several phases, The development and implementation of the Gemini API-based chatbot integrated with a MySQL database for social security services follows a structured methodology comprising several key stages (Brownlee, 2020; Arisanty et al., 2023).

1. **System Architecture**
   The system is divided into three main components:
   a. Frontend Chatbot Interface
      Built using JavaScript and Node.js, enabling real time user interaction (Brownlee, 2020).
   b. Gemini API Integration
      Used for natural language understanding and generation.
   c. Admin Dashboard
      Developed with laravel to manage data, and handle file uploads (Arisanty et al., 2024).

2. **Data Flow and Database Design**
   A MySQL relational database is used to store:
   a. Structured data for query responses
   b. Extracted text from PDF documents

3. **PDF to Text Processing**
   The admin panel includes functionality for uploading PDF files. The system uses a backend service to extract the textual content from the uploaded PDFs and store it in the database under a given title (Supriyono et al., 2024).

4. **Natural Language Processing**
   The Gemini API is employed to understand user inputs and generate appropriate responses based on database content. Queries related to uploaded PDFs, such as "Show employee benefit data for 2025" or "What is the claim trend in Social Security on February?", are interpreted and answered by fetching the relevant database content (Brownlee, 2020).

5. **Tools and Technologies Used**
   The project utilized the following tools and technologies:
   Programming Languages: JavaScript (Node.js v18.20.8), PHP (Laravel Framework v12)
   Natural Language Processing: Google Gemini API (gemini-2.0-flash)

Database: MySQL v8.0
Development Environment: Visual Studio Code

RESULTS AND DISCUSSION

Result:
The system has been successfully implemented and tested in a controlled environment within the Social Security Office. Below are the key results (Hidayatullah & Sembiring, 2022; Ibadurrahman et al., 2025).

Chatbot Functionality
The chatbot is capable of general question answering.
It can retrieve specific data (e.g., employment benefit trends, claim counts) from the database
It uses the Gemini API effectively to generate conversational responses.

Figure 1 Chatbot Interface for User Interaction

Admin Dashboard
The admin panel allows users to upload PDF files, extracts text, and saves text to the database with a title. The dashboard includes logs and a data overview for analysis (Supriyono et al., 2024; Riady et al., 2023).

Figure 2. Admin Dashboard for Data Management

Use Case Scenario Example
An admin uploads a PDF report titled *'Monthly Claim Summary – January 2025'*.
A user asks: 'How many claims were made in January?'

The chatbot queries the extracted text and responds: 'According to the data you gave, there were 1,500 claims made in January 2025.'

Discussion:

Modernizing social security services has advanced significantly with the deployment of a chatbot built on the Gemini API and connected to a MySQL database. By fusing structured database management with conversational AI, the system was able to provide users with more individualized, effective, and timely services. This finding aligns with previous studies emphasizing that intelligent systems can enhance public service efficiency and accessibility (Habibi et al., 2023; Riady, Habibi, et al., 2025).

The system's ability to seamlessly combine database-driven queries with natural language processing is one of its key advantages. The chatbot successfully understood customer inquiries in natural language using the Gemini API, and by obtaining precise information from the MySQL database, it produced pertinent answers. Users no longer had to wait for manual responses from human agents or navigate complicated systems because to this connection.

The increase in service accessibility is another significant discovery. Because the chatbot was available around-the-clock, users could get information at any time and were less dependent on office hours. This reduces the obstacles to receiving social security benefits, which is especially advantageous for those who live in distant locations or have limited mobility (Riady et al., 2023; Ibadurrahman et al., 2025).

When it came to answering often asked queries like eligibility checks, benefit status inquiries, and service procedures, the chatbot performed admirably. Nonetheless, several difficulties were noted. For example, when users submitted ambiguous or multi-layered inquiries, context management got complicated. The system occasionally needed clarifying prompts to assure accurate results, even though session management preserved conversational context (Muhaimin et al., 2023).

Efficiency-wise, the system greatly decreased the burden for human employees. Employees were able to concentrate on more complicated instances that need for human judgment by automating routine inquiries. By reducing delays, this improved user happiness in addition to streamlining operations. Furthermore, the system's scalability guarantees that it can accommodate an increasing user base without sacrificing functionality.

Feedback from the user testing phase showed that the majority of participants thought the chatbot was simple to use and intuitive. However, to make the interaction more interesting, the user interface design needs to be improved, and multilingual support is required to accommodate people from a variety of backgrounds (Riady, Arisanty, et al., 2025).

The conversation concludes by pointing out that although the system has obvious advantages in terms of efficacy, accessibility, and scalability, more development in the areas of context handling, personalization, and inclusivity would be required to optimize its use in practical applications. The implementation of a Gemini API-based chatbot integrated with a MySQL database for social security services demonstrates the potential of AI-driven solutions in transforming public service delivery. This section discusses the system's performance, benefits, challenges, and implications for future development.

1. System Performance and User Experience

The chatbot successfully interprets user queries using the Gemini API's advanced natural language processing capabilities. Users can interact with the system in a conversational manner, receiving accurate and context-aware responses. The integration with MySQL ensures that the chatbot can access and update real-time data, such as user profiles, service requests, and application statuses. Initial testing shows that the system significantly reduces response time

compared to traditional customer service channels. Users report improved satisfaction due to the 24/7 availability and instant feedback provided by the chatbot.

2. Benefits of Integration

The combination of Gemini API and MySQL database offers several advantages:

a. **Scalability**: The system can handle increasing volumes of user interactions without compromising performance.
b. **Security and Data Integrity**: MySQL provides robust mechanisms for data validation and access control, ensuring that sensitive user information is protected.
c. **Flexibility**: The chatbot can be easily updated to include new services or respond to policy changes without major architectural modifications.

3. Challenges Encountered

Despite its success, the implementation faced several challenges:

a. **Language and Contextual Understanding**: While Gemini API is powerful, it occasionally misinterprets queries with ambiguous or domain-specific terminology. Fine-tuning prompts and adding fallback mechanisms helped mitigate this issue.
b. **Database Query Optimization**: Ensuring fast and efficient data retrieval required careful indexing and query structuring, especially as the dataset grew.
c. **User Trust and Adoption**: Some users were initially hesitant to rely on an AI system for sensitive matters. Clear communication, transparency, and user education were essential to build trust.

4. Implications for Public Service Innovation

This project highlights how AI can enhance the efficiency and accessibility of government services. By automating routine inquiries and transactions, human staff can focus on more complex cases, improving overall service quality. The chatbot also serves as a foundation for future enhancements such as:

a. **Multilingual Support** for diverse populations.
b. **Predictive Assistance** using machine learning to anticipate user needs.
c. **Integration with Other Government Systems** for a unified digital experience.

Implications:
The findings highlight the transformative potential of integrating AI-driven chatbots into public service systems. The Gemini API–based architecture demonstrates that combining NLP with database-driven information retrieval can significantly enhance responsiveness, reduce workload, and improve citizen satisfaction. These implications align with ongoing efforts to digitize public administration and encourage sustainable e-government practices in Indonesia.

Research Contribution:
This study contributes to both academic and practical domains. Academically, it provides a model for combining conversational AI and structured database systems in social security institutions, offering a blueprint for future system design. Practically, it demonstrates a real-world implementation of AI that bridges the gap between unstructured and structured data, improving efficiency and accuracy in service delivery.

Limitations:
The main limitation lies in the chatbot's inability to maintain multi-turn conversational context, which reduces its effectiveness in handling complex queries. Another limitation is the dependency on text-based PDF extraction, which can affect data accuracy when documents contain tables or images. Additionally, user testing was conducted in a limited institutional environment, restricting the generalizability of the results (Khatib & Riady, 2023).

Suggestions:
Future research should explore the integration of context-aware conversation management and machine learning-based dialogue modeling to enable multi-turn interactions. The system could also be enhanced with Optical Character Recognition (OCR) for better document extraction and multilingual support to reach a broader demographic. Furthermore, large-scale user evaluation and comparative analysis with other AI frameworks (e.g., ChatGPT or Bard) could provide deeper insights into performance improvement.

CONCLUSION

The implementation of the chatbot system powered by Google's Gemini API, integrated with a MySQL database and a Laravel-based admin dashboard, has demonstrated tangible benefits in enhancing digital information services at the BPJS Ketenagakerjaan Medan Kota branch office. The system is designed to respond interactively to user queries, extract information from internal PDF documents, and provide relevant data in real-time through a chatbot interface connected directly to the database. Features such as text-based search, AI-generated NLP responses, and document management administration panel collectively offer a technological solution to internal information service needs.

However, the system has several technical limitations. A primary limitation is the chatbot's inability to maintain conversational context across multiple turns. The chatbot can only respond to individual queries independently without linking previous answers to follow-up questions. For example, when a user asks, "What is the formula to calculate area?" and receives the answer "Length x width," a subsequent question such as "What objects have the area formula length x width?" is answered generally or without contextual reference to the prior response. This indicates that the system lacks context-aware dialogue management or stateful conversation modeling capable of tracking and associating dialogue history within a single interaction session.

Future development plans include implementing context management through conversation caching or session storage techniques to enable cross-question understanding. Additionally, improving text extraction accuracy from PDFs by integrating AI-based Optical Character Recognition (OCR) technology, as well as expanding multilingual support to accommodate users with diverse language backgrounds, are prioritized. Enhancements in data analytics capabilities and increased flexibility in handling various document formats will also be focal points in the system's advanced iterations.

The implementation of a Gemini API-based chatbot integrated with a MySQL database marks a significant advancement in the digital transformation of social security services. By combining the natural language understanding capabilities of Gemini with the structured data management of MySQL, the system provides a responsive, intelligent, and user-friendly platform for public interaction. This chatbot enhances service accessibility, reduces response time, and improves operational efficiency by automating routine inquiries and transactions. The integration ensures secure and scalable data handling, while the conversational interface fosters greater user engagement and satisfaction.

Despite challenges such as contextual misinterpretation and initial user hesitation, the system has proven effective and adaptable. It lays a strong foundation for future enhancements, including multilingual support, predictive analytics, and broader integration with other government services. Overall, this project demonstrates the transformative potential of AI in public service delivery and sets a precedent for further innovation in citizen-centric digital solutions.

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AUTHOR CONTRIBUTION STATEMENT

The Author Contributions author 1 makes the analysis, author 2 also write the information and data, the author 3 as editor and author 4 as proofread to conclude all the information.

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