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INTELLIGENT CHATBOT FOR ENHANCING ACADEMIC CONSULTATION SERVICES IN VOCATIONAL SCHOOLS USING NATURAL LANGUAGE PROCESSING

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Abstract

Academic consultation is essential in supporting students' learning, personal development, and career planning in vocational schools. Traditional consultation services, however, often face challenges such as limited advisor availability, time constraints, and inefficient record-keeping, which reduce service effectiveness and accessibility. This study proposes the development of an intelligent chatbot to enhance academic consultation services at Vocational High School (SMK) Multi Karya using Natural Language Processing (NLP). The chatbot serves as a virtual assistant capable of understanding students' queries in natural language, providing real-time guidance, and recording consultation history for further analysis. The system integrates modules for user authentication, account management, class and subject management, schedule organization, consultation history, and interactive chat. Evaluation results demonstrate that the chatbot improves accessibility by enabling students to consult anytime, enhances efficiency through automation of administrative tasks, and delivers context-aware, personalized responses. Interaction logs allow administrators to monitor and evaluate service quality, facilitating data-driven improvements. Despite limitations in handling ambiguous or complex queries, and the need to address ethical considerations such as data privacy and algorithmic bias, the chatbot represents a practical and innovative solution for modernizing academic consultation in vocational education. This study highlights the potential of AI-driven chatbots to provide inclusive, responsive, and effective student support, establishing a foundation for future advancements in educational technology and intelligent learning systems.

Keywords: intelligent chatbot; academic consultation; vocational schools; natural language processing; student support.

1. INTRODUCTION

Academic consultation services are a crucial element in supporting the success of the educational process within schools, particularly at the Vocational High School (SMK) level. Such consultations involve interactions between students and academic advisors or homeroom teachers to discuss various academic issues, including major selection, learning difficulties, potential development, and post-graduation career planning. The availability of responsive, personalized, and well-structured consultation services significantly influences students' motivation to learn as well as their readiness to face academic and professional challenges in the future. However, in practice, these services are often constrained by limited time, a disproportionate number of educators relative to students, and the lack of efficient information recording and management systems [1]–[5].

In the context of educational digitalization, the utilization of information systems becomes a strategic approach to address these challenges. Information systems are not merely software; they represent a combination of technology, procedures, data, and human resources that interact to manage and present information effectively. By implementing information systems, educational institutions can automate various service processes, including academic consultations, thereby making services faster, more accurate, and well-documented [6]. Such systems enable the storage of consultation history, analysis of student needs, and provision of personalized recommendations. Therefore, the integration of information technology in guidance and consultation activities not only facilitates access but also enhances the overall quality of services [7].

Nevertheless, the implementation of effective academic consultation services still faces several challenges, particularly regarding natural and flexible communication. Many students are reluctant to consult due to feelings of awkwardness, fear of judgment, or insufficient time to meet with advisors in person. Additionally, educators are often burdened with administrative tasks that hinder the optimal delivery of guidance. One of the main issues is the predominantly manual consultation system, from scheduling, question-and-answer processes, to documenting consultation results. This manual approach not only complicates the tracking of student consultation histories but also slows responses to urgent student needs.

Related research conducted by [8] developed a hotel recommendation chatbot using Natural Language Processing (NLP) capable of understanding users' natural language and providing relevant answers quickly. The system proved effective in recognizing user requests, even in the presence of typos or non-standard sentence structures. Trials showed that the chatbot could respond promptly and provide hotel recommendations according to user needs, achieving high accuracy and satisfaction levels.

As a solution to these challenges, this study proposes the design of an NLP-based chatbot integrated into the school's information system. This chatbot acts as a virtual assistant capable of providing automated, real-time academic consultation services using natural language text aligned with students' communication styles. By leveraging NLP technology, the chatbot can comprehend the context of questions, respond appropriately, and record interaction histories for further analysis[9]–[13]. It is expected that the presence of this chatbot will make academic consultation services more inclusive, accessible at any time, while maintaining the quality and confidentiality of student information. This study not only addresses service efficiency challenges but also introduces a novel approach to enhancing interactions between students and the educational system in a smarter and more human-centered manner [14].

2. RESEARCH METHOD

2.1. Chatbot

A chatbot is a computer program based on artificial intelligence (AI) designed to simulate human conversation through text or voice interfaces. Chatbots aim to automatically understand, process, and respond to user requests as if interacting with a human. In scientific contexts, chatbots are developed using Natural Language Processing (NLP) techniques to comprehend the context of language used. Modern chatbots consist of several main components, including a user interface, a natural language processing module, a knowledge base, and a logical inference engine. The technologies used to build chatbots include NLP, machine learning, and, in some cases, deep learning. Large Language Models (LLMs) such as GPT further enhance chatbots' capabilities in understanding and generating text in a more contextual and natural manner. In general, chatbots can be classified into two types: rule-based chatbots and AI-based chatbots. Rule-based chatbots respond only to pre-programmed inputs and have limitations in understanding conversational context. In contrast, AI-based chatbots are more sophisticated, as they can learn from data, recognize patterns, and provide adaptive responses that are more varied and complex [8].

Chatbots have been widely applied across various sectors, such as customer service, education, healthcare, finance, and e-commerce. In business, chatbots serve as virtual agents available 24/7 to answer customer inquiries, process requests, and even perform simple transactions. This enhances service efficiency and reduces dependence on human personnel for routine tasks. In the field of artificial intelligence, chatbots represent one of the applications that require integration across multiple sub-disciplines, particularly NLP, information retrieval, and machine learning. Modern chatbots are trained using large-scale conversational data to understand syntax and semantics. Their ability to interpret user meaning and emotions is also enhanced through techniques such as sentiment analysis and context-aware response generation [8], [15].

Despite significant advancements, chatbots still face various challenges, including limitations in understanding complex contexts, language ambiguity, and inability to handle questions outside their training scope. Moreover, ethical aspects such as user data privacy, algorithmic bias, and system transparency remain critical concerns in real-world chatbot development and deployment. With the ongoing development of AI and NLP technologies, chatbots are projected to become increasingly sophisticated, potentially replacing many forms of human-computer interaction. Future chatbot development is expected to include integration with augmented reality (AR), virtual assistants, and robotic process automation (RPA). Further research focuses on enhancing artificial empathy, multimodal adaptation (voice, text, and visual), and improving system autonomy in contextual decision-making [14].

2.2. Natural Languange Processing

Natural Language Processing (NLP) is a branch of computer science and artificial intelligence concerned with the interaction between machines and human language. NLP focuses on how computers can be programmed to process and analyze data in natural language, whether in text or speech form. The primary goal of NLP is to enable computers to understand, interpret, and generate human language in a meaningful and contextual manner. NLP involves several stages of language processing, ranging from pre-processing tasks such as tokenization, stemming, and lemmatization, to syntactic and semantic analysis [11]. This process also includes Named Entity Recognition (NER), dependency parsing, and Natural Language Generation (NLG). All these components contribute to building systems capable of understanding the structure and meaning of sentences in natural language.

Various approaches are used in NLP system development, including rule-based, statistical, and machine learning methods. Early statistical models have now evolved into deep learning approaches using neural network architectures such as Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), and the most recent

Transformer models, such as BERT and GPT. These approaches have significantly advanced NLP's ability to comprehend context and generate more natural responses [16].

NLP has numerous practical applications across multiple domains, including information retrieval systems (search engines), machine translation, virtual assistants (chatbots), spam detection, sentiment analysis, and automatic document summarization. In healthcare, NLP is used to process electronic medical records, while in business, it assists in analyzing customer opinions and automating customer service. In other words, NLP is a critical technology in processing text-based big data. Despite significant progress, NLP still faces many challenges. Human language is highly complex, ambiguous, nuanced, and contextual, making it difficult for machines to process fully. Other challenges include language variation, idioms, irony, and cultural differences in expression. Therefore, models are required that not only understand grammatical structures but also the pragmatic meaning behind human utterances. NLP plays a crucial role in supporting AI systems capable of interacting naturally with humans. Integrating NLP with other technologies such as computer vision, speech recognition, and knowledge representation enables the development of more sophisticated multimodal AI systems. NLP is also employed in developing conversational AI that approaches human-like communication intelligence, including teaching machines to understand and use language adaptively and contextually [17].

3. RESULTS AND DISCUSSION

3.1. Chatbot Interface Design

After the completion of the research, the next step involves the system implementation. The designed system consists of several pages, each with its own specific function and role.

1. Login Page

   The displayed page is a system authentication form that serves as the main entry point for users. The components include Email Address and Password input fields, which are used to verify user identity. Once the data is correctly entered, the Login button can be pressed to access the system. Additionally, a Registration link is provided for new users who do not yet have an account.

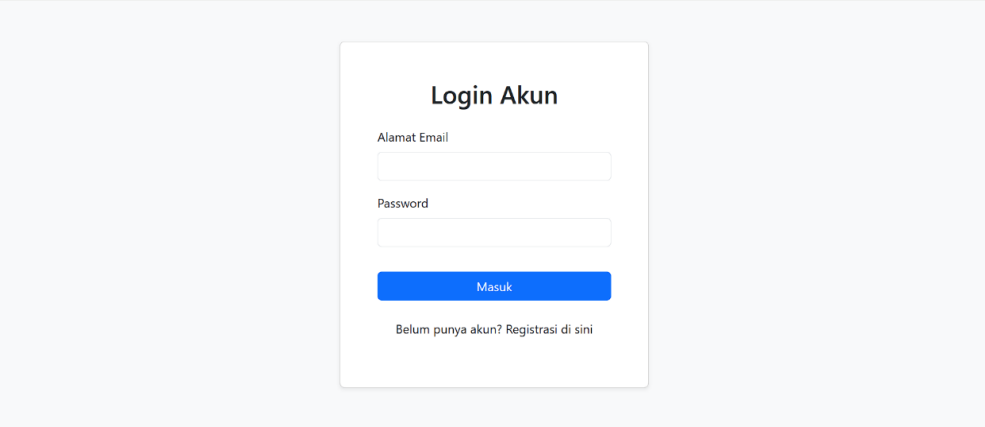

Figure 1. Login Page

2. Registration Page

   This page presents an account registration form used to add new users to the system. The main components consist of input fields for Full Name, Email Address, and Password, which serve as user identity and credentials. After filling in the data, the Register button is used to save the information and create a new account. A link to the login page is also provided for users who already have an account.

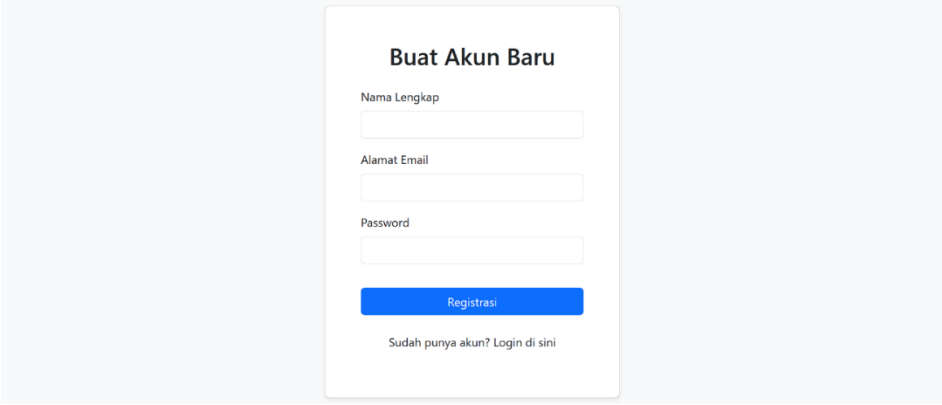

Figure 2. Registration Page

3. User Management Page
   This page serves as the user management module for managing account data within the system. Administrators can view a complete list of users, including their name, email address, and role (e.g., administrator, teacher, or student). The system provides a search feature for easier data identification, as well as an Add User button to create new accounts. Options for Edit and Delete allow administrators to update or remove user data.

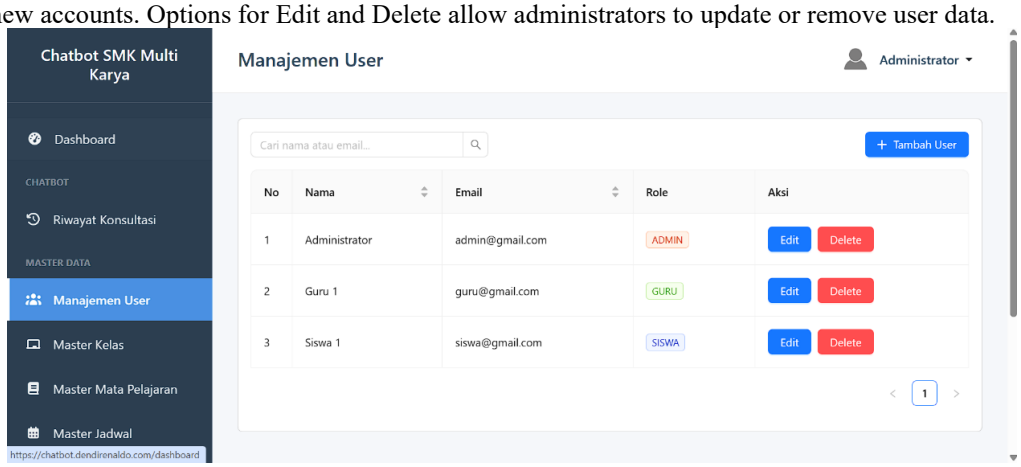

Figure 3. User Management Page

4. Class Management Page
   This page serves as the master class module used to manage class data within the system. Displayed information includes class name, academic year, and the assigned homeroom teacher. Administrators have the authority to add new class data via the Add Class button and can update or delete existing data through Edit and Delete options. A search feature also facilitates quick identification of class data.

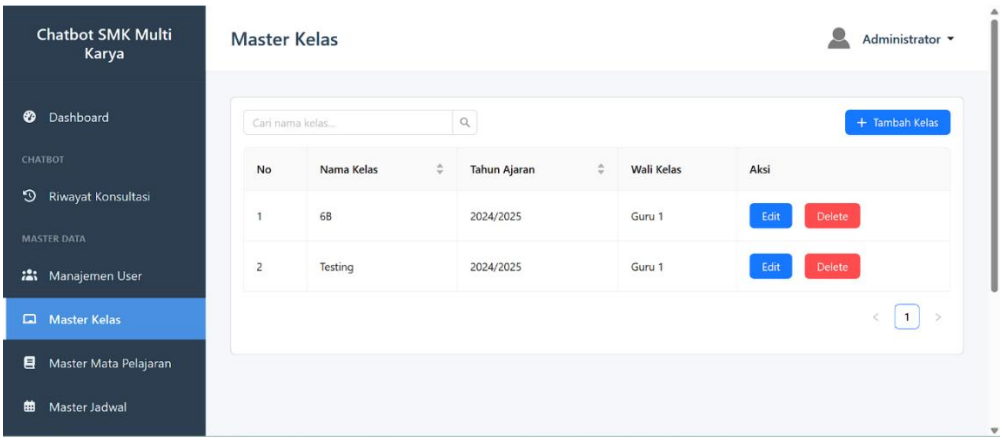

Figure 4. Class Management Page

5. Subjects Page
   This page functions as the master subjects module, designed to manage information related to the list of subjects within the system. Recorded data includes subject codes and names, enabling easier identification and curriculum organization. Administrators can add new subjects through the Add Subject button, make modifications using Edit, or delete data with the Delete button.

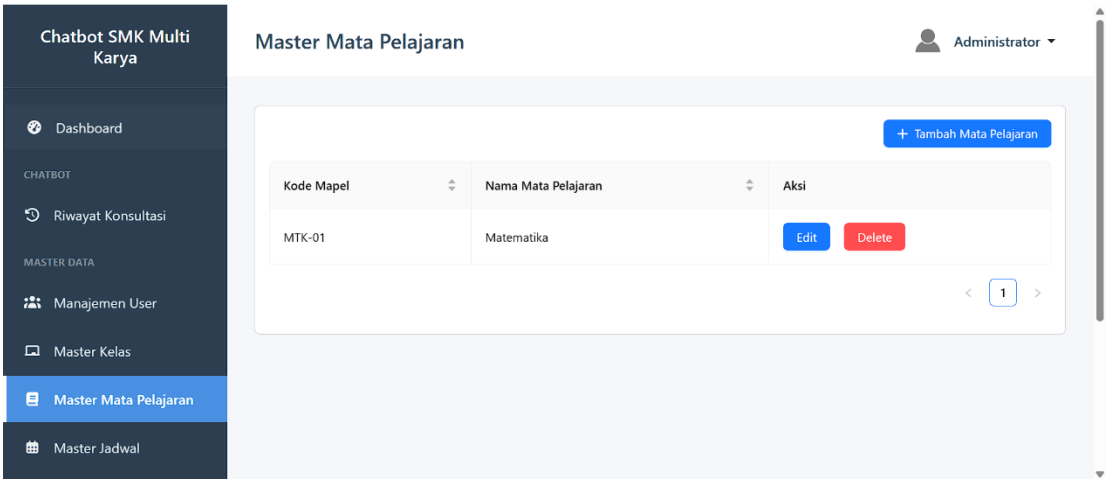

Figure 5. Subjects Page

5. Schedule Page

This page serves as the master schedule module, used to organize and manage learning schedules within the system. Recorded information includes the day, lesson time, class, subject, and the assigned teacher. Administrators can add new schedules via the Add Schedule button and update or delete schedules using Edit and Delete options. Additionally, filter features by day, class, or teacher are provided to facilitate data searching.

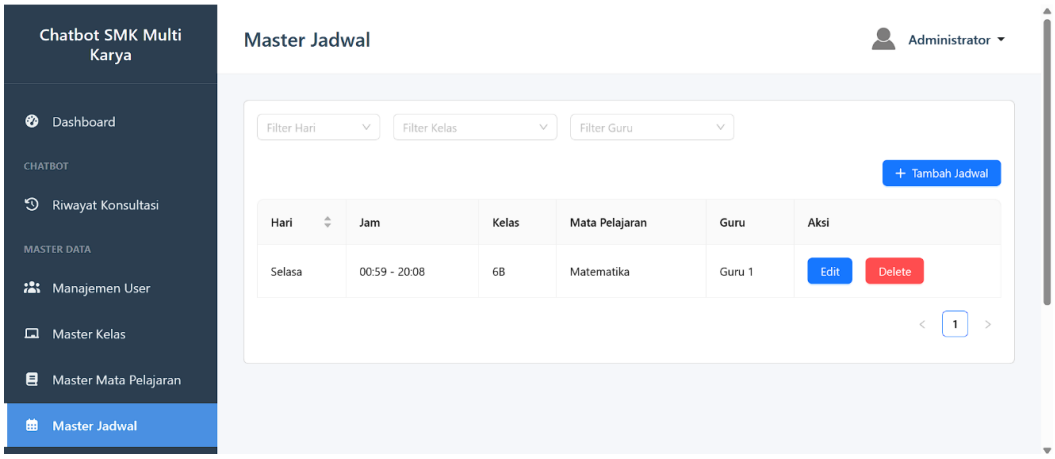

Figure 6. Schedule Page

6. Consultation History Page

This page represents the consultation history module, used to record and display the conversation logs between users and the chatbot system. Displayed information includes the conversation number, user identity (e.g., student), session start time, and conversation status, which can be active or closed. This feature allows administrators and relevant parties to monitor consultation activities more systematically, supporting service evaluation and improving the quality of interaction between the system and users.

Figure 7. Consultation History Page

7. Chat Consultation Page
   This page functions as the chatbot consultation module, serving as a medium for direct interaction between users and the system. In this module, users can type questions or statements into the message input field, and the system responds automatically based on pre-defined data and programs. Each conversation is recorded and displayed in text bubbles to facilitate communication flow.

Figure 8. Chatbot Consultation Page

3.2. Discussion

The implementation of the NLP-based chatbot for academic consultation in Vocational High School (SMK) Multi Karya demonstrates a promising solution to the challenges faced in traditional consultation services. The system design incorporates multiple modules, including user authentication, registration, user management, class and subject management, schedule management, consultation history, and real-time chatbot interaction. Each module has been designed to streamline administrative processes and enhance the accessibility and efficiency of academic services.

The login and registration modules provide secure and structured user authentication, ensuring that only authorized users can access the system. This feature reduces administrative workload and maintains the confidentiality of student data. The user management module allows administrators to monitor and control user accounts effectively, providing functionalities for adding, updating, or deleting user data. This centralized management system contributes to better oversight and operational efficiency.

The class, subject, and schedule management modules facilitate the organization of academic resources and timetables, ensuring that data is well-structured and easily accessible. The inclusion of search and filter functions enhances usability, allowing administrators to quickly locate specific information. These modules help reduce manual errors and administrative delays, supporting more efficient academic planning.

The consultation history module provides detailed records of all interactions between students and the chatbot, including session timestamps and conversation status. This functionality allows for performance monitoring, service evaluation, and the identification of recurring student inquiries. By maintaining a comprehensive record of interactions, the system supports data-driven improvements in consultation services.

The chatbot consultation module demonstrates the system's ability to engage in natural language interactions with students. Leveraging NLP, the chatbot can understand user queries, provide relevant responses, and adapt to different conversation contexts. This functionality addresses key challenges in traditional consultation, such as limited advisor availability, students' reluctance to approach teachers directly, and delays in responding to urgent inquiries. The conversational interface, displayed through message bubbles, ensures a user-friendly and intuitive experience that aligns with students' communication habits.

Overall, the integration of AI-based chatbots into academic consultation services presents several advantages:

1. Accessibility: Students can access consultation services anytime and from anywhere, overcoming constraints of time and physical presence.
2. Efficiency: Automation of repetitive administrative tasks reduces the workload of educators and accelerates service delivery.
3. Personalization: NLP enables context-aware responses, enhancing the relevance of guidance provided to individual students.
4. Data-driven evaluation: Recorded interaction histories facilitate analysis, enabling continuous improvement of service quality.

Despite these benefits, some limitations remain. The chatbot's performance is highly dependent on the quality and scope of training data. Ambiguous questions, complex academic inquiries, or requests outside the system's knowledge base may reduce response accuracy. Moreover, ethical considerations, including data privacy and algorithmic bias, must be carefully addressed to maintain trust and transparency.

Future improvements could involve incorporating multimodal interactions, such as voice input, visual aids, and integration with learning analytics systems, to enhance the chatbot's adaptability and engagement. Additionally, the development of sentiment analysis and context-aware reasoning can improve the chatbot's capability to provide more empathetic and supportive guidance.

4. CONCLUSION

This study successfully designed and implemented an NLP-based chatbot to support academic consultation services at Vocational High School (SMK) Multi Karya. The system integrates multiple modules, including user authentication, account management, class and subject management, schedule organization, consultation history, and real-time chatbot interaction. The chatbot demonstrates the ability to engage in natural language conversations, provide relevant responses, and maintain records of interactions for further analysis.

The implementation of the chatbot offers several significant benefits: it increases accessibility by allowing students to consult at any time, improves efficiency by automating administrative tasks, enhances personalization through context-aware responses, and supports data-driven evaluation of consultation services. Furthermore, the system addresses common challenges in traditional academic consultation, such as limited advisor availability, students' reluctance to engage directly with teachers, and delays in providing guidance.

Despite its advantages, the chatbot's performance depends on the quality and coverage of training data, and limitations remain in handling complex or ambiguous queries. Ethical considerations, including data privacy and algorithmic fairness, must also be carefully managed.

Overall, the proposed NLP-based chatbot provides an effective, innovative, and practical solution for enhancing academic consultation in vocational education. It serves as a foundation for future research on AI-assisted student support systems, with potential developments including multimodal interactions, sentiment-aware responses, and more adaptive guidance to further improve the quality and inclusivity of educational services.

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