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PKS IVAStar - An Overview of Chatbot Development

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Abstract

Over the past decade, the advancements in technologies such as artificial intelligence (AI), big data, and internet of things (IoT) have greatly influenced various industries. Among these applications, chatbots have emerged as a notable example. Chatbots like intelligent virtual assistants (IVAs) are becoming increasingly popular in various fields such as healthcare, education, and customer service. IVAs are software assistants that are able to interact with users to support meaningful tasks, identify information needs, provide relevant information, and improve their performance based on user feedback. It's like a robot that answers questions or provides information needed by users in the form of conversations or text messages. The use of artificial intelligence in chatbot enables users to quickly and easily obtain relevant information based on the information provided. PKS IVAStar is a computer chatbot programme that uses artificial intelligence and natural language processing. It was created to make it simpler for the Student Affairs Department to provide feedback to users. A research model based on rules-based chatbot that sets information and provides responses based on a set of predefined rules with the use of pattern matching algorithms. The effectiveness of a chatbot depends on several factors, such as the quality of the natural language processing algorithms. It is important to consider the level of human oversight and intervention that is necessary. In future, PKS IVAStar could involve exploring advanced machine learning techniques, such as deep learning and reinforcement learning, to enhance the performance and adaptability of AI chatbots in delivering an improved online customer experience.

Keywords: - Factory I/O, PLC programming, simulator

1. Introduction

Traditionally, two-way communication is interpreted as face-to-face human conversation. Technological changes leading to the 4th Industrial Revolution (4IR) also changed the way of communication, which now involves humans and machines in a more effective form.

The proliferation of smart devices, social media platforms, and messaging applications has contributed to the widespread adoption of chatbots. These intelligent systems can be integrated into various applications, including customer service, e-commerce, healthcare, education, and more. Chatbots offer a range of benefits, such as round-the-clock availability, scalability, cost-effectiveness, and the ability to handle multiple user interactions simultaneously.

In general, a bot refers to a computer system capable of executing automated tasks, and when integrated into messaging platforms, it is known as a chatbot. Chatbots function similarly to conventional messaging applications, with the distinction that one of the message recipients is a robot or computer. Essentially, it involves human interaction with a computer through conversation. This communication can occur via voice commands, text chats, graphical interfaces, or graphical widgets. Presently, chatbots have gained significant attention and are employed to assist humans in various tasks (Kumar et al., 2018). They offer numerous advantages, such as providing round-the-clock inquiry support and feedback,

as well as enhancing efficiency by handling non-essential tasks. They have found applications in diverse industries, including weather updates, flight reservations, answering educational queries (Kumar et al., 2018), and facilitating product purchases.

Regarding chatbot system development, creating a conversational interface between humans and computers involves the utilization of various design techniques. Developers commonly employ pattern matching, Cleverscript, ChatScript, Artificial Intelligence Markup Language (AIML), or language tricks (Masche & Le, 2018). Among these techniques, pattern matching is the most popular, where the bot matches phrases to keywords in a pre-specified dictionary (Masche & Le, 2018).

In line with the changes, Politeknik Kuching Sarawak (PKS) took the initiative to introduce PKS IVAStar. PKS IVAStar is a chatbot, which is a computer programme that uses artificial intelligence (AI) and natural language processing (NLP). PKS IVAStar works like a robot that answers questions or provides information needed by users in the form of conversations or text messages.

Therefore, PKS IVAStar was created specifically to make it simpler for the Student Affairs Department (JHEP) to provide feedback to users. It is more focused on common questions that users frequently ask of the management, as opposed to before, when users had to meet with JHEP during an office hour or obtain information from the frequently asked questions (FAQ) section of the PKS website. Although there is a FAQ section, occasionally the FAQ items are not updated, and occasionally the inquiries go beyond what the FAQ can answer. Most of the items asked are requirements for admission to polytechnics.

Based on that problem, a study has been carried out to replace customer service in providing responsive information, and the focus is on chatbot development. The objectives of PKS IVAStar are:

1. Develop an AI chatbot that can help users get relevant information, especially related to the affairs of the Student Affairs Department.
2. Assisting with administrative tasks in the office, such as responding to customer inquiries and making recommendations based on the guidelines set.
3. Testing the effectiveness of a chatbot against users.

The target users of PKS IVAStar generally consist of the public, especially prospective students. With this PKS IVAStar, users can ask questions related to JHEP at any time, regardless of time or location.The findings will be discussed, and conclusions will be drawn accordingly.

2. Literature Review

2.1 Overview

This section provides an overview of the research conducted on chatbot technology. The literature review focuses on the design of chatbots and the extent to which they incorporate AI and NLP elements.

2.2 Terminology

a) *Chatbot*

Chatbots have become increasingly popular in recent years, with various studies exploring their use in different domains. A chatbot (or chatterbot) is software (machine) that talks with a user (human); it is a virtual assistant able to answer several user questions, providing the correct responses (Colace et al., 2018).

Based on Khante & Hande (2019), the chatbot is divided into three (3) parts: responder, classifier, and graphmaster. The responder is the part that connects the bot with the user. The task of the responder is to transfer data from the user to the classifier and control the input and output. Classifier as well as controlling input and output. The classifier is the part that filters and normalizes the input and performs segmentation of the sentences that have been input. Graphmaster is the part that matches the input pattern to the facts that have been created against the facts that have been created.

There are many applications that consolidate a human appearance and are trying to reproduce human exchange, but in most cases, the information used for conversation in a bot is put in a database created by a human specialist.

Designing effective chatbots is an important area of research, and several studies have examined different aspects of chatbot design. Chatbots these days are AI-driven and powered by natural language processing (NLP) technologies that can offer sophisticated solutions to meet the language and content expectations of end-users (Jonathan Grudin & Richard Jacques, 2019). Users prefer chatbots that are easy to use, provide clear and concise responses, and have a natural conversational style.

b) Artificial Intelligence (AI)

Artificial intelligence (AI) is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings (Jean, Sihombing & Wirapraja, 2018).

Chassignol et al. (2018) defined AI as a theoretical framework guiding the development and use of computer systems with the capabilities of human beings, more particularly, intelligence and the ability to perform tasks that require human intelligence, including visual perception, speech recognition, decision-making, and translation between languages. This involves developing systems with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience (Copeland, 2023).

AI can be classified into four groups, as outlined by Alfareza (2020): thinking humanly, which involves developing AI technology that imitates human thinking; acting humanly, where AI performs tasks typically done by humans; thinking rationally, which entails problem-solving through logical reasoning; and acting rationally,

which pertains to the creation of AI systems that systematically achieve specific goals.

By leveraging AI capabilities, chatbots can deliver more intelligent, context-aware, and personalized interactions with users. They can understand user intent, process natural language, and provide relevant and helpful responses, enhancing user satisfaction and improving overall user experience.

c) Natural Language Processing (NLP)

Natural Language Processing (NLP) has been a rapidly developing field in the past few years. Natural language processing (NLP) is a subfield of computer science that employs computational techniques for learning, understanding and producing human language content (Aleedy et al., 2019).

The use of NLP has been applied in various areas of human life. This is because NLP is easier to use as a computer interface display than learning the language of computer commands. Fig. 1 shows elements in natural language processing.

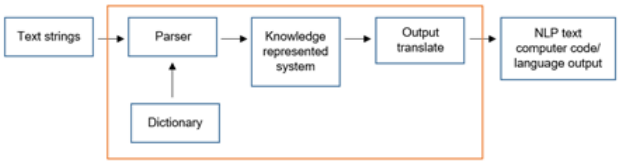

Fig. 1. Natural Language Processing (NLP) element

Based on Fig. 1, we can see that Natural Language Processing (NLP) involves a range of techniques and tools that are used to analyze, process, and understand human language using the specific elements of NLP that were mentioned by Oo (2019) in the query: parser, lexicon, understander, knowledge base, and generator.

3. Methodology

The development of PKS IVAStar uses the agile methodology. The choice of methodology is made based on the most important value of agile development, which is that it enables the team to make decisions quickly with good quality and predictability and has good potential to handle any changes.

The agile methodology is a software development approach that emphasizes iterative and incremental delivery of working software, with a focus on flexibility and adaptability to changing requirements. It involves various phases of system development life cycle (SDLC) in Fig. 2 such as planning, design, development, testing, deployment, review, and launch, which enable rapid and efficient software development within a short period of time (Valpadasu Hema et al., 2020).

The agile methodology deviates from traditional software development approaches and follows a set of practices to manage software products effectively. Agile development is a flexible and iterative approach to software development, which also applies to AI chatbot development. It emphasizes collaboration, adaptability, and delivering incremental value to users. Applying agile principles to AI chatbot development involves the following:

1. User-centric approach: prioritizing user needs and designing the chatbot to address them effectively.
2. Iterative development: breaking the development process into smaller iterations allows for early feedback and continuous improvement.
3. Cross-functional collaboration: collaborating with individuals from different disciplines to ensure a holistic development process.
4. Continuous integration and deployment: regularly integrating new features and improvements into the chatbot and deploying them for testing.
5. Embracing change: adapting the chatbot's capabilities to evolving user needs and new scenarios.

By following these agile principles, AI chatbot development becomes a collaborative, iterative, and user-focused process that continually improves and meets user requirements.

Fig. 2. Agile development

As shown in Fig. 2, there are five (5) phases involved: brainstorm, design, development, quality assurance and deployment. The brainstorming phase involved the system development team, JHEP representatives, and Information Technology and Communication Unit (UICT) representatives. The brainstorming phase involves discussing development objectives, the system development schedule, system architecture, and a preliminary system overview. System architecture as shown in Fig. 3.

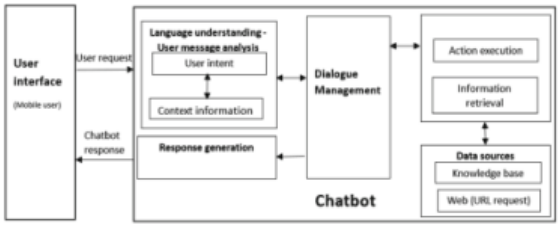

Fig. 3. General chatbot architecture (Adamopoulou and Moussiades, 2020)

Through the system development schedule, the JHEP representatives provide relevant documents, and the document analysis process begins. The draught proposal is presented, and the initial data given is divided into several parts and functions to facilitate data retrieval. The proposed flow chart is as follows:

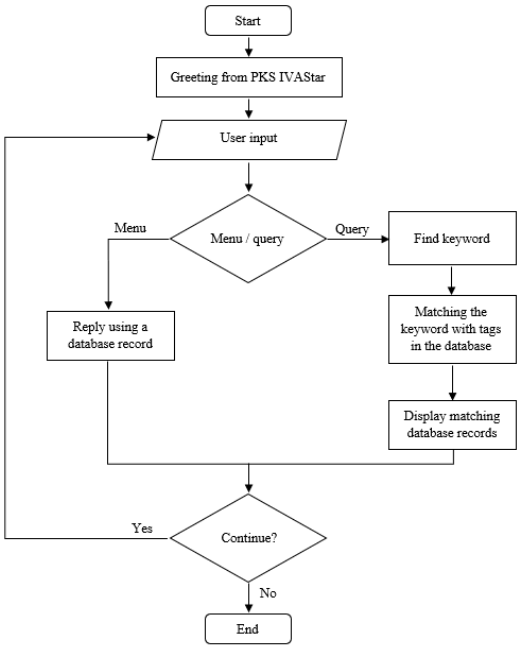

Fig. 4. PKS IVAStar flowchart

Based on Fig. 4, PKS IVAStar uses a rules-based chatbot. A rule-based chatbot processes information and provides responses based on a set of predefined rules with the use of pattern matching algorithms (Xufei Huang, 2021). Within PKS IVAStar, these rule-based chatbots can be viewed through the use of menu options, buttons and keyword recognition.

Rules-based chatbots are chosen because they are easier to build, use simple true-false algorithms to understand user questions, and provide only relevant answers. However, it has disadvantages when the questions asked are outside the scope.

Once the design phase is complete, the development phase begins and each function is tested for effectiveness. Throughout the development process, it's important to continuously test and refine the chatbot. Collect user feedback, conduct usability testing, and track key metrics to identify areas for improvement and iterate on the chatbot's features and functionality are items implemented in quality assurance.

PKS IVAStar is placed on a temporary website and tested by JHEP representatives. The temporary placement aims to evaluate its effectiveness, the accuracy of each query's result, and verify that it meets the needs and expectations of the user. This process is also known as user acceptance testing. Representatives are given an overview of the functions involved, the test scenario, and the expected test results. Every element that meets the requirements will be marked as completed. Additionally, there is a section for comments and suggestions for improvement. Several improvements were made before the final product of PKS IVAStar was placed on the PKS website.

4. Finding and Analysis

PKS IVAStar can be accessed through the PKS website at www.poliku.edu.my. As shown in Fig. 5, PKS IVAStar is located at the bottom right of the website.

Fig. 5. PKS IVAStar embedded into the website

As shown in Fig. 6, by clicking the PKS IVAStar icon, it greets the user and requests their names to start a conversation.

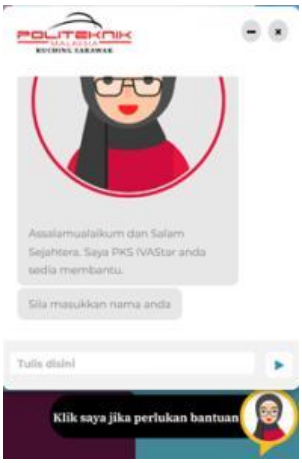

Fig. 6. Using input text to start conversation

Next, PKS IVAStar gives users the option to either choose a menu from the ones listed or click other buttons. If the other button is selected, the user can enter the question to be asked. Fig. 7 shows the initial options menu, whereas Fig. 8 shows the options menu related to the categories that were chosen in Fig. 7.

Fig. 7: Initial option menu

Fig. 8: Option menu based on category

The user's input will be analyzed by PKS IVAStar to determine intent behind the message. Intent recognition involves mapping the input to predefined categories or actions based on the patterns or keywords present in the user's message. Fig. 9 shows the backend code of the initial options menu. Once the intent is recognized, PKS IVAStar will match it with data storage. Based on the matched rule, PKS IVAStar generates a response shown in Fig. 10.

```
<select data-conv-question="Hai, {name}! Sila pilih kategori soalan atau pilih
lain-lain untuk bertanyakan soalan" name="kategori" data-callback="storeState"
id="kategori">
   <option value="info">Info Korporat</option>
   <option value="ambilan">Ambilan</option>
   <option value="pengajian">Pengajian & Yuran</option>
   <option value="asrama">Asrama</option>
   <option value="panduan">Panduan Pelajar</option>
   <option value="lain">Lain-lain</option>
 </select>
<!--main menu-->
<div data-conv-fork="kategori">
   <div data-conv-case="info">
     <select data-conv-question="Sila pilih kategori info"
     name="pilihan_info">
       <option value="info_am">Info Am</option>
       <option value="visi">Visi dan Misi</option>
       <option value="piagam">Piagam Pelanggan</option>
       <option value="hubungi">Hubungi kami</option>
       <option value="mainMenu" data-callback="rollbackMain">Tetapan
       Semula</option>
     </select>
   </div>
```

Fig. 9: Backend code of the initial options menu

Fig. 10: Search results

Once the results are displayed, there will be two buttons that the user can select. If the user has any additional inquiries, they can do so by selecting the "Ya, teruskan" button, and an option menu based on category will appear. The cycle will continue until the user selects the "Tidak, tamatkan" button, which will end the conversation.

4. Conclusion

Having a chatbot function on the website is an effective way we can use in communication with customers. In line with the rapid development of communication technology with the existence of revolution 4.0, the need to adapt human expertise and applications should be taken into consideration. The use of artificial intelligence (AI) in applications is one of the best ways to overcome this issue.

PKS successfully developed its own chatbot where it aligns with development objectives and goals. When implemented correctly, PKS IVAStar can offer a range of benefits to businesses, including increased efficiency and cost savings, improved customer satisfaction, and enhanced customer engagement. However, it is important to approach the implementation of this chatbot with care and attention to ensure that it meets the needs of both the organizations and their customers.

Overall, the effectiveness of a PKS IVAStar chatbot depends on several factors, such as the quality of the NLP algorithms, the amount and quality of training data, and the level of customization and personalization that the chatbot can provide. Additionally, it is important to consider the level of human oversight and intervention that is necessary to ensure that the chatbot is providing accurate and helpful responses. In the future, this chatbot can be enhanced with the following features:

1. Multilingual support: Users will be able to interact with the chatbot in different languages, accommodating students and parents from various regions.
2. Speech-based interaction: The chatbot will enable users to ask questions and receive responses through voice commands, making it accessible for those who cannot read or type.
3. Problem-solving capabilities: The chatbot will not only provide answers but also offer solutions to the challenges faced by students and parents. It will provide information on admission, college achievements, placements, and scholarships, helping users find appropriate solutions to their specific needs.
4. These enhancements aim to create a more inclusive and user-friendly experience for individuals seeking information and assistance from the chatbot.

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