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Self-Medication Chatbot Application Using Natural Language Processing Method

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Abstract

Health is a fundamental need that cannot be ignored by any individual. One common health issue is coughing, which requires appropriate treatment depending on the type—such as antitussives for dry coughs and expectorants or mucolytics for productive coughs. However, many people still engage in irrational self-medication due to a lack of understanding regarding medication and health information. To address this issue, this study aims to design a web-based self-medication chatbot application capable of providing information related to self-treatment by utilizing the Natural Language Processing (NLP) method. The system is built using the Recurrent Neural Network (RNN) approach and the model is trained with augmented data to improve its accuracy in understanding user input. The developed chatbot is capable of recognizing the context of user queries and automatically delivering relevant responses. Test results show that the implemented model achieves high validation accuracy, making it effective in helping users quickly and independently obtain drug-related information. This application is expected to serve as a practical solution to increase public awareness of rational medication use.

Keywords: *Chatbot, Self-Medication, NLP, RNN, Drug Information*

1. Introduction

Health is a fundamental need for every individual across various aspects and levels of life, regardless of gender, age, ethnicity, or social group [1]. When someone experiences health problems, they tend to seek treatment as a response in an effort to receive appropriate care [2]. One common health issue is coughing. A cough is a bodily reaction, either reflexive or intentional, that serves to protect the respiratory tract by clearing it of foreign substances such as phlegm, dust, irritants, or infectious elements. Medically, the type of cough medicine varies according to the type of cough experienced. Dry coughs are generally treated with antitussive medications that work by suppressing the cough reflex. In contrast, productive (phlegmy) coughs can be treated with mucolytics and expectorants that help break down and expel mucus from the respiratory tract [3].

One method of treatment that can be undertaken is through medication. In its use, consumers need to pay attention to several important aspects, such as the product name, active ingredients, drug category, usage instructions, recommended dosage, possible side effects, and expiration date. However, many cases of irrational drug use still occur, likely due to a lack of understanding regarding medications and health [4]. Errors in medication can be interpreted as failures in the therapeutic process, which carry the risk of harmful effects for the patient. In fact, such errors can become a factor that necessitates hospitalization [5].

Natural Language Processing (NLP) is a branch of computer science that focuses on the interaction between computers and human language. One application of NLP is in chatbots, which are capable of converting human language into computational data and retrieving the necessary information. In a study titled "Designing Chatbots Using Dialogflow Natural Language Processing," chatbots were used as tools for information delivery and transactions in the MSME sector to improve service efficiency. With their ability to convey information and process transactions automatically and in real-time, chatbots help make service management more effective [6]. Meanwhile, a study titled "Implementation of Chatbots in New Student Enrollment Using Recurrent Neural Network" revealed that chatbots are software capable of communicating with users in natural language. By utilizing artificial intelligence, chatbots can understand user questions and provide responses that are appropriate to the context of the conversation [7].

There are three main methods commonly used in NLP model development, one of which is the Recurrent Neural Network (RNN). RNN is an artificial neural network designed to handle sequential data, such as text, by retaining information from previous inputs. Its ability to understand context makes it highly effective in natural language processing. Another commonly used method is Bag of Words (BoW), which only considers word frequency without taking word order into account. Although this method is simple and easy to implement, its drawback is the loss of context because it doesn't consider the relationships between words in a sentence. The next method is n-grams,

which considers the order of words in small groups, usually two or three words. This approach is better than BoW in preserving some context, but still has limitations in understanding more complex sentence structures and long-term relationships in text. Compared to the two previous methods, RNN has the advantage of being able to process text in a more natural sequential form, allowing for a better understanding of the overall sentence context.

Based on this background, the researcher is interested in conducting a study on a chatbot application that utilizes the NLP method, entitled: "SELF-MEDICATION CHATBOT APPLICATION USING NATURAL LANGUAGE PROCESSING METHOD."

2. Theoretical Review

Etymologically, the term application comes from the English word “application,” which means implementation or usage. In the context of technology, an application refers to a computer program that focuses on data processing [8].

Furthermore, an application can be defined as the use or implementation of a well-developed program to meet user needs in achieving specific targets. An information system, for example, is a collection of applications that support organizational operations through the installation and maintenance of hardware and software, as well as data management. Thus, an application functions as a tool designed to carry out various tasks for users in accordance with predetermined objectives [9]. When multiple applications are combined into one, using similar user interface designs across different applications makes each one easier to use or learn [10].
A chatbot is an artificial intelligence-based application designed to mimic human conversation patterns by relying on programmed knowledge. With its ability to imitate how humans communicate through text, a chatbot acts as an intelligent agent that provides responses based on user input [11].

Natural Language Processing (NLP) is a branch of artificial intelligence that focuses on developing computers to interact with humans using everyday language, such as Bahasa Indonesia. The main goal of NLP is not only to convert received language—whether in the form of text or speech—into digital data (or vice versa), but also to understand the meaning behind the sentences delivered in natural language and provide appropriate responses, such as executing a command or displaying specific information.

Natural language processing involves more than just speech analysis, using a variety of approaches, including [12]:

a. Symbolic Approach: Based on linguistic rules and lexicons compiled by experts, this approach applies recognized language rules to computer systems.
b. Statistical Approach: Relies on empirical data and observable examples of linguistic phenomena.
c. Connectionist Approach: A combination of the symbolic and statistical approaches to optimize processing results.

The parsing process is not only applied in NLP but also used in other fields such as compiler construction. The parsing method discussed here is specifically implemented in the context of NLP. Before proceeding, it is important to understand the term constituent, which refers to sentence elements that can stand alone (e.g., noun phrases or verb phrases), and the term parser, which refers to the program that performs this analysis [13].

Recurrent Neural Network (RNN) is one of the algorithms in machine learning based on deep learning. RNN retains patterns of past information through a recurrent mechanism in its structure, allowing that information to persist. This algorithm is a development of Artificial Neural Networks (ANN) with an architecture similar to the Multilayer Perceptron (MLP) [14].

Other research [16] related to chatbots also focuses on enhancing business performance. In that study, the chatbot was developed using Chatfuel as the bot builder, as the platform is capable of responding quickly to many queries simultaneously. Additionally, the chatbot was integrated with Facebook Messenger as the communication medium.

Unlike study [17], which developed a chatbot named ALITTA, functioning as a virtual assistant and information center within the BALITTAS application. To build ALITTA, Yuniar and Purnomo used the API.AI platform, which provides Natural Language Processing (NLP) and Natural Language Understanding (NLU) services. NLU is a branch of NLP that conducts semantic analysis so that the meaning of a sentence can be understood by the chatbot application.

Study [18] concluded that although there are strengths and weaknesses, there are still limitations in chatbot capabilities for English language learning. The Android-based English Learning Chatbot was able to provide answers related to 16 tenses in English, but it still requires further development. Additional features such as logging previously asked questions and expanding the variety of questions that can be answered by the chatbot are highly needed. It is hoped that in the future, this application can operate online and be accessible to more users.

Study [19] found that the chatbot functioned well according to the defined flow, starting with a greeting message, followed by the user asking questions based on their needs, and then the chatbot responding based on pre-set keywords. The UAT (User Acceptance Testing) results showed high user satisfaction, with chatbot effectiveness reaching 94%.

Study [20] concluded that Natural Language Processing is a branch of artificial intelligence that enables computers to understand human communication through everyday language. Based on testing on a chatbot application with 40 data sets, 37 responses matched expectations while 3 did not, resulting in an accuracy rate of 92.5%.

3. Method

The system consists of three main components: sentence input, sentence processing, and Knowledge Base management. When the chatbot is first launched, users are presented with a page to enter a sentence as part of a conversation. The input sentence is then

processed to find a pattern that matches the data stored in the chatbot's Knowledge Base. If a matching pattern is found, the system proceeds to retrieve the appropriate response. If no pattern matches, the system will apply a spelling correction mechanism. Once a response is found, the chatbot displays it to the user. The general system diagram of the developed NLP system is shown in Figure 1 below.

This system is divided into three main components: sentence input, sentence processing, and knowledge base management. When the chatbot is run for the first time, the interface appears and prompts the user to enter a sentence to begin a conversation. The entered sentence is then processed by looking for patterns that match the data stored in the chatbot's knowledge base. If a relevant pattern is found, the next step is to search for the correct response based on that input. However, if no pattern is identified, the system applies spelling correction. After the correct response is obtained, the chatbot displays it to the user. The general system diagram of the developed NLP system is shown in Figure 1.

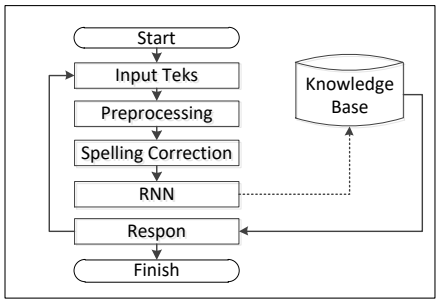

Fig. 1: General Diagram of the NLP System

In preprocessing, the process is divided into three stages: case folding, tokenizing, and filtering.
Case Folding is the process of removing unwanted characters from a sentence. Only letters from 'a' to 'z' are accepted. The analysis of case folding is shown in Figure 2 below.

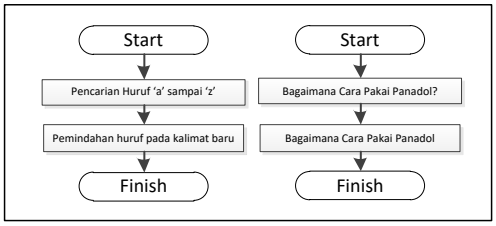

Fig. 2: Case Folding Analysis

Tokenizing is the process of breaking down a sentence into its constituent words. This step is necessary for the system to understand the user's input. The general steps of tokenizing are as follows:

1. Split each word in the text and convert them into lowercase.
2. The result is a list of words that make up the entered sentence.

The tokenizing stage is illustrated in Figure 3 below.

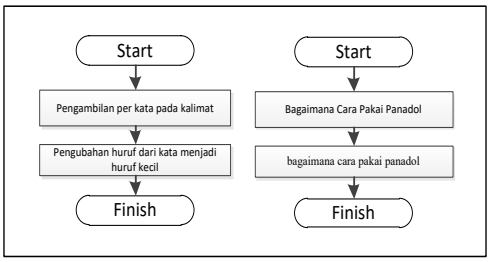

Fig. 3: Tokenizing Stage

Filtering is the step of extracting meaningful words from the tokenized results. This process may use the stop list method—to remove non-essential words—or a word list to keep significant words. In this system, the stopword method is used, where non-important words are identified through inspection of the tokenized output and removed if they are found in the stopword list. As a result, only relevant keywords or patterns remain.

The steps in the filtering process are:

1. Check if the tokens generated from the tokenizing process exist in the stopword table.
2. Remove tokens that match the entries in the stopword list.
3. Mark tokens that are not in the stopword list as important words (keywords).

An illustration of the filtering process is shown in Figure 4 below.

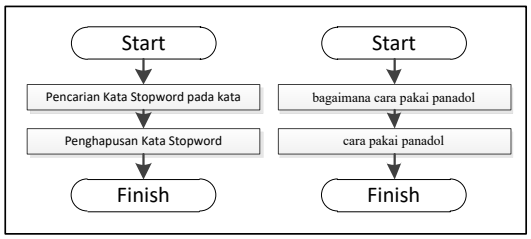

Fig. 4: Filtering Stage

Spelling Correction is the process of detecting, correcting, and suggesting proper words for those that have spelling errors in a text. The spelling correction stage is shown in Figure 5 below.

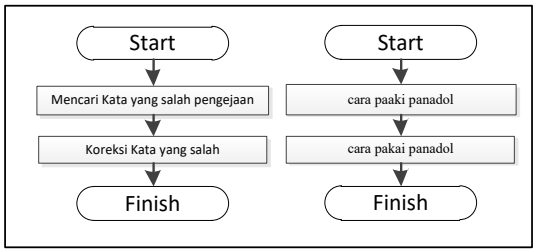

Fig. 5: Spelling Correction Stage

Recurrent Neural Network (RNN) is a machine learning algorithm designed to process sequential data such as text. This model can understand the relationships between words in a sentence by retaining contextual information. The RNN stage is illustrated in Figure 6 below.

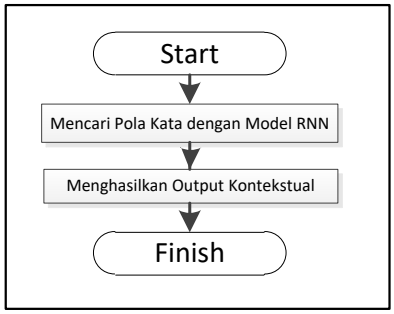

Fig. 6: Recurrent Neural Network (RNN) Stage

RNN Model Training Process

1. Data Collection
   Collect a dataset consisting of input-output pairs (user texts and corresponding responses or intents). The dataset may include chat logs, FAQ data, or any domain-relevant data.
2. Dataset Preprocessing
   Case Folding: Remove irrelevant text such as special characters.
   Tokenization: Split the text into words or tokens.
   Filtering: Convert words into vector representations.

The RNN (Recurrent Neural Network) model is designed to understand data sequences, such as conversational text. In the chatbot context, this model processes the input text sequentially, word by word, to understand the context and provide an appropriate response.
How RNN Works

a. Sequential Input: The input text is split into words or tokens and fed into the model one by one.
b. Contextual Memory: RNN has the ability to remember information from previous steps, allowing the model to understand the relationships between words in a sentence.
c. Output Prediction: After processing the entire input text, the RNN produces a result in the form of an intent or response based on learned patterns.

Model Training
The training process of the RNN model is a step in which the model learns to recognize patterns in text data so it can understand input contexts and generate accurate responses.

Here's a simple explanation of how the training process works:

a. Input Data
   Text Data: Preprocessed text (tokenized, normalized, and vectorized) is input into the model.
   Label (Target): Each input text has a label indicating the correct intent or response category.
b. Learning Process
   Prediction: The model processes each word in the input sequence, producing predictions based on patterns.
   Error Calculation: The model's prediction is compared to the actual label. The difference is called the error.

Model Adjustment: Based on the error, the model updates its internal weights using backpropagation and optimization algorithms such as gradient descent to minimize errors in future iterations.

c. Data Splitting
Training Data: Main data used to train the model.
Validation Data: Data used to monitor model performance during training to avoid overfitting.
Test Data: Data that the model has never seen before, used to evaluate how well the model understands text.

d. Repeated Iterations (Epochs)
Learning is done repeatedly over several epochs. Each epoch is a full cycle in which the model sees the entire training dataset. With each iteration, the model gets better at identifying patterns and reducing errors.

e. Training Results
The model can predict intents or response categories based on the patterns it has learned.
The model's performance is evaluated using the test data to ensure its accuracy.

4. Result

Based on the results of the research conducted, the data displayed are as follows:

1. Login Interface
The login page serves as the entry point for the chatbot administrator to modify various elements within the system, ranging from the logo to conversation settings and other options. On this page, users input a username and password already stored in the database. Once the credentials are entered correctly, simply click the "Sign In" button to access the admin panel. The Login Interface is shown in Figure 7.

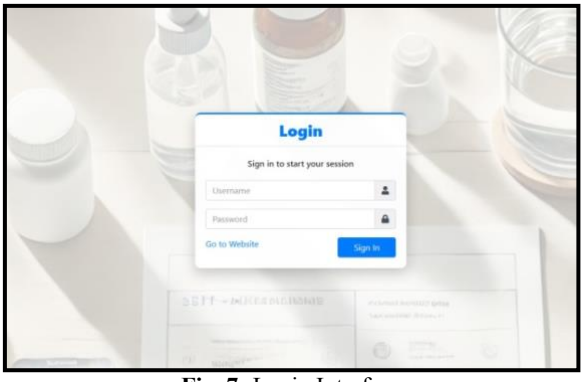

Fig. 7: Login Interface

2. Main Interface
The main interface displays a dashboard once the administrator has successfully logged in. This page shows the five most frequently asked questions by chatbot users in graphical form. The Main Interface is shown in Figure 8.

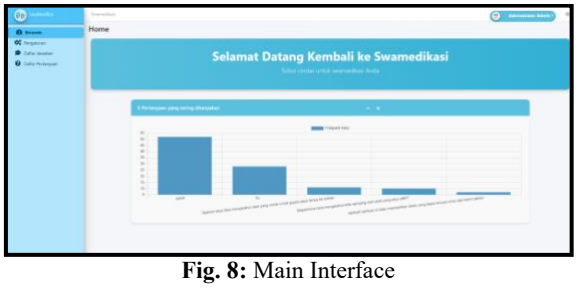

Fig. 8: Main Interface

3. Settings Interface
The Settings page displays a dedicated interface when users open the Settings menu. Here, the administrator can customize various options such as the system's full name, abbreviation, welcome greeting message, and the default text shown when the chatbot cannot find a matching keyword. On this page, the administrator can also change the main system logo, the chatbot avatar, and user icons as needed. The Settings Interface is shown in Figure 9.

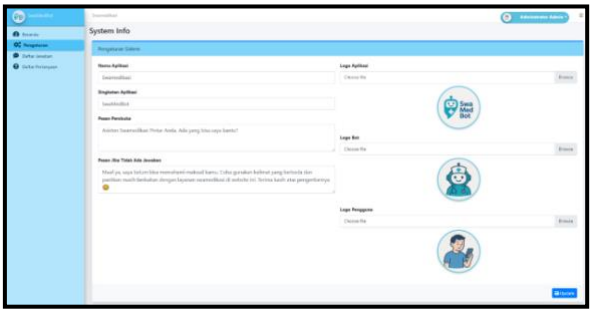

Fig. 9: Settings Interface

4. Responses Interface

The Responses interface shows a list of saved responses when users select the "Responses" menu, allowing administrators to review, add, edit, or delete chatbot replies. The Responses Interface is shown in Figure 10.

Fig. 10: Responses Interface

When users click the Add button in the Responses menu, an interface is displayed for adding new responses, complete with input forms for entering the question, answer, and related settings. The Add Response Interface is shown in Figure 11.

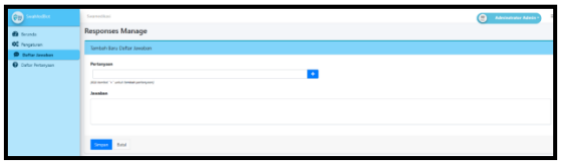

Fig. 11: Add Response Interface

When the administrator selects an action option (such as Edit or Delete) in the Responses menu, the interface displays a special configuration form for that response, allowing the user to adjust the question content, reply, or other parameters before saving changes. The Action Response Interface is shown in Figure 12.

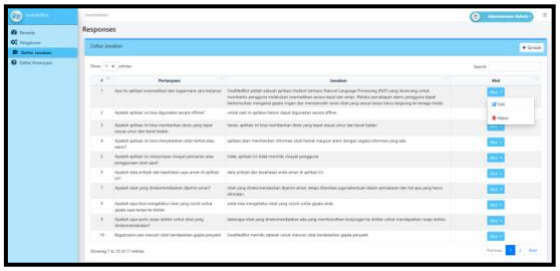

Fig. 12: Action Response Interface

The Responses page provides a concise view of all saved questions and answers when the administrator opens this menu, with options for further actions like editing or deleting. The Edit Responses Interface is shown in Figure 13.

Fig. 13: Edit Responses Interface

5. Unanswered List Interface

The Unanswered List page displays a collection of unanswered questions whenever the administrator selects this menu, making it easier to review and handle unanswered queries. The Unanswered List Interface is shown in Figure 14.

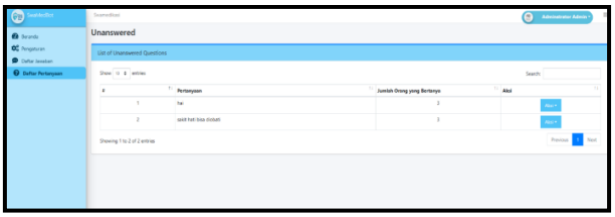

Fig. 14: Unanswered List Interface

When the administrator clicks on an action (such as "Add Answer" or "Delete") for an entry in the Unanswered List, the interface will show a detailed panel for that question, allowing the administrator to immediately enter a response or delete irrelevant items. The Action Unanswered List Interface is shown in Figure 15.

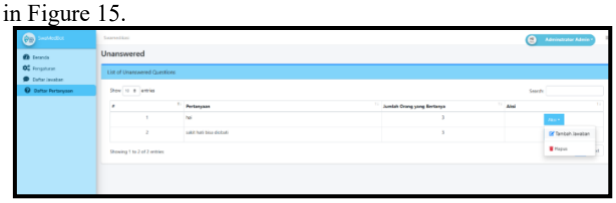

Fig. 15: Action Unanswered List Interface

When the administrator selects the Edit option from the Unanswered List menu, a form will appear containing the details of the unanswered question, allowing the administrator to update the response or related information before saving. The Edit Unanswered List Interface is shown in Figure 16.

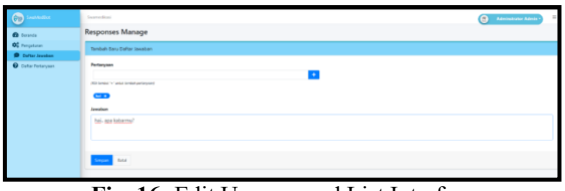

Fig. 16: Edit Unanswered List Interface

6. User Chatbot Interface

The chatbot interface for users appears when they access the site, displaying an interactive chat page with the chatbot. The User Chatbot Interface is shown in Figure 17.

Fig. 17: User Chatbot Interface

When a user asks a question and the system cannot find a keyword match, the chatbot interface displays a failed response message based on the preconfigured "not found" text. The Failed User Chatbot Interface is shown in Figure 18.

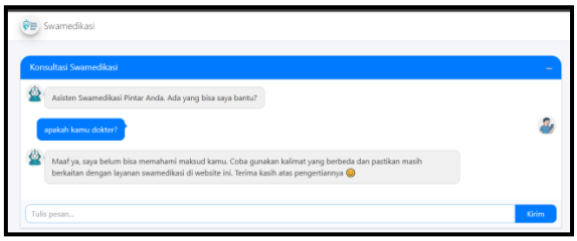

Fig. 18: Failed User Chatbot Interface

The chatbot interface displays a response when a user asks a question and the system successfully finds a matching keyword, then shows the configured reply message. The Successful User Chatbot Interface is shown in Figure 19.

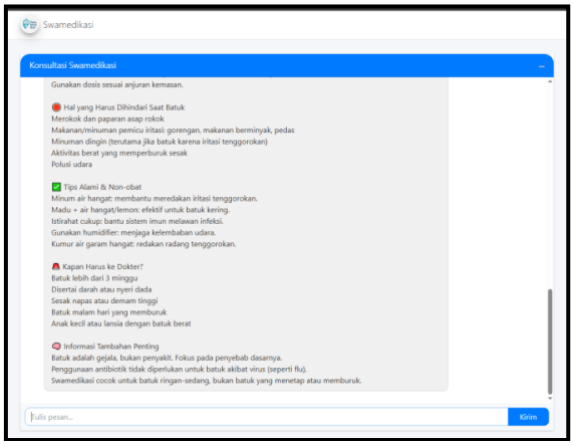

Fig. 19: Successful User Chatbot Interface

Dataset Testing
Dataset testing results are shown in Figure 20:

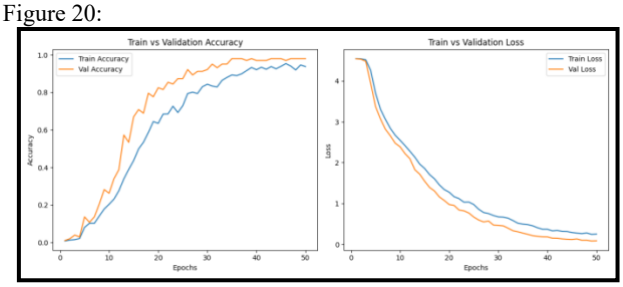

Fig. 20: Dataset Testing

The graphs display the model's performance during the 50 training epochs, with two main metrics: accuracy and loss for both training and validation data. The explanation is as follows:

a. Accuracy Development

In the early epochs, accuracy was very low (e.g., 0.7% at epoch 1), indicating that the model had not yet learned the patterns in the text data. Over time, accuracy increased consistently from 7% → 20% → 40% → 60%, eventually reaching a training accuracy of 93.8% and a validation accuracy of 98.06% at epoch 50. This indicates the model learned well from the data.

b. Loss Development

Loss also decreased drastically from around 4.5 at the beginning of training to only 0.25 at the end for the training data. Validation loss dropped more quickly and stably, reaching very low values (around 0.08–0.13), indicating good generalization on unseen data.

In the Train vs. Validation Accuracy graph (left), the model's accuracy increases steadily from the start and approaches 1.0 (100%) for both datasets. Validation accuracy grows faster and even remains higher than training accuracy throughout, indicating no significant overfitting. This may suggest that training data augmentation could be improved to better match the validation data.

In the Train vs. Validation Loss graph (right), the loss consistently decreases for both training and validation data. Validation loss declines more quickly and remains lower than training loss, reinforcing that the model has learned well and generalizes effectively to unseen data.

Overall, the graph shows that the Bi-LSTM two-layer RNN model performed very well, with no signs of overfitting. This indicates that the preprocessing pipeline, data augmentation, and model architecture are already quite optimal. However, if validation accuracy is consistently higher than training accuracy, it's possible the validation data is "easier" than the training data. In that case, it may be worth checking the data distribution or adding more varied training data.

5. Conclusion

The conclusions of the research include the following: The Self-Medication Chatbot application successfully provides a feature for searching self-medication information based on user input. By utilizing a web-based platform, the application is easily accessible on various devices without requiring additional installation, making it practical to use anywhere. By implementing the Natural Language Processing (NLP) method, the system is able to understand user text input and provide relevant responses based on the context of the questions, thereby improving the accuracy and efficiency in delivering self-medication information..

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This thesis, entitled "SELF-MEDICATION CHATBOT APPLICATION USING NATURAL LANGUAGE PROCESSING METHOD," is written to fulfill one of the requirements for graduation from the Bachelor's degree program in the Informatics Engineering Study Program at the College of Information and Computer Management Technology of Information Management and Education (STMIK TIME) Medan.

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9. All other parties who have assisted the writer in completing this thesis, whose names cannot be mentioned one by one.

The writer realizes that the preparation and writing of this thesis still contain many shortcomings and is far from perfect, due to the writer's limited abilities and the time constraints involved. Therefore, the writer welcomes suggestions, criticisms, and constructive feedback for the improvement of future research.
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References

[1] RB Asyim; Yulianto, "Perilaku Konsumsi Obat Tradisional Dalam Upaya Menjaga Kesehatan Masyarakat Bangsawan Sumenep," 2022.
[2] K. Suarayasa, B. A. Wandira, and A. Magan, "Perilaku Pencarian Pengobatan Masyarakat Desa Owentumbu Keluharan Kawatuna Kota Palu Tahun 2020," *J. Med. Prof.*, vol. 4, no. 2, pp. 183–190, 2022.
[3] M. Yulia, A. Aprillia, and R. Jamal, "Profil Pengetahuan Pasien Terhadap Swamedikasi Obat Batuk Di Apotek Kota Bukittinggi," *SITAWA J. Farm. Sains dan Obat Tradis.*, vol. 2, no. 1, pp. 26–35, 2023.
[4] R. D. Prisusanti, A. J. Rusdi, U. S. Suhariyono, M. M. Anggraeni, and K. Patty, "Pendidikan Kesehatan Tentang Pengetahuan Meminimalkan Penggunaan Obat-Obatan Dalam Sehari-Hari Di Pondok Pesantren Miftahul Ulum At Thohirin Kelurahan Gondang Legi," *J. Peduli Masy.*, vol. 4, pp. 351–354, 2022.
[5] F. Nurjanah and D. Gozali, "Review Artikel : Kesalahan Pengobatan di Fasilitas Pelayanan Kesehatan," *Farmaka*, vol. 19, no. 3, pp. 79–86, 2021.
[6] A. Y. Chandra, D. Kurniawan, and R. Musa, "Perancangan Chatbot Menggunakan Dialogflow Natural Language Processing (Studi Kasus: Sistem Pemesanan pada Coffee Shop)," *J. Media Inform. Budidarma*, vol. 4, no. 1, p. 208, 2020.
[7] T. A. Zuraiyah, D. K. Utami, and D. Herlambang, "Implementasi Chatbot Pada Pendaftaran Mahasiswa Baru Menggunakan Recurrent Neural Network," *J. Ilm. Teknol. dan Rekayasa*, vol. 24, no. 2, pp. 91–101, 2019.
[8] R. Y. F. Nurul Samania, Nirsal, "Rancang Bangun Aplikasi E-VOTING Pemilihan Ketua Umum Himpunan Mahasiswa Informatika (HMTI) UNIVERSITAS COKROAMINOTO PALOPO Berbasis WEBSITE," *Eng. Constr. Archit. Manag.*, vol. 25, no. 1, pp. 1–9, 2020.
[9] A. Ni Made, "Analisa dan Perancangan Aplikasi Pembelajaran Bahasa Inggris Dasar Berbasis Android," *J. IKRAITH-INFORMATIKA*, vol. 1, no. 3, pp. 107–115, 2020.
[10] F. A. Bukharla and N. Nursyirwan, "Perancangan Aplikasi Android Berbasis Mobile Oleh-Oleh Khas Minangkabau (Minang Pedia)," *Gorga J. Seni Rupa*, 2020.
[11] S. Nurhayati and M. A. H, "Pembangunan Aplikasi Chatbot Midwify sebagai Media Pendukung Pembelajaran Ilmu Kebidanan Berbasis Android di Stikes Bhakti Kencana Bandung," *Komputika J. Sist. Komput.*, vol. 8, no. 1, pp. 45–52, 2019.
[12] Expertsystem, "Natural Language Processing and Text Mining," 2016.
[13] N. M Alfareza, "Pembangunan Chatbot Menggunakan Natural Language Processing Di Jurusan Teknik Industri Universitas Islam Indonesia," *Appl. Microbiol. Biotechnol.*, vol. 2507, no. 1, pp. 1–9, 2020.
[14] S. S. Nurashila, F. Hamami, and T. F. Kusumasari, "Perbandingan Kinerja Algoritma Recurrent Neural Network (Rnn) Dan Long Short-Term Memory (Lstm): Studi Kasus Prediksi Kemacetan Lalu Lintas Jaringan Pt Xyz," *JIPI (Jurnal Ilm. Penelit. dan Pembelajaran Inform.*, vol. 8, no. 3, pp. 864–877, 2023.
[15] A. Santoso, A. Irma Purnamasari, and Irfan Ali, "Prediksi Harga Beras Menggunakan Metode Recurrent Neural Network Dan Long Short-Term Memory," *PROSISKO J. Pengemb. Ris. dan Obs. Sist. Komput.*, vol. 11, no. 1, pp. 128–136, 2024.
[16] E. L. Amalia and D. W. Wibowo, "Rancang Bangun Chatbot Untuk Meningkatkan Performa Bisnis," *J. Ilm. Teknol. Inf. Asia*, vol. 13, no. 2, p. 137, 2019.
[17] Eka Yuniar and Heri Purnomo, "Implementasi Chatbot 'Alitta' Asisten Virtual Dari Balittas Sebagai Pusat Informasi Di Balittas," *Antivirus J. Ilm. Tek. Inform.*, vol. 13, no. 1, pp. 24–35, 2019.
[18] Y. Aprilinda, T. Martavia, E. Erlangga, F. N. Afandi, and U. Rizal, "Chatbot Menggunakan Natural Language Processing untuk Pembelajaran Bahasa Inggris Berbasis Android," *Expert J. Manaj. Sist. Inf. dan Teknol.*, vol. 12, no. 1, p. 23, 2022.
[19] M. Furqan, S. Sriani, and M. N. Shidqi, "Chatbot Telegram Menggunakan Natural Language Processing," *Walisongo J. Inf. Technol.*, vol. 5, no. 1, pp. 15–26, 2023.
[20] M. Muliyono and S. Sumijan, "Identifikasi Chatbot dalam Meningkatkan Pelayanan Online Menggunakan Metode Natural Language Processing," *J. Inform. Ekon. Bisnis*, pp. 142–147, 2021.
[21] A. Isroqmi, "Pembuatan Media Pembelajaran Menggunakan Visual Basic Sebagai Salah Satu Upaya Peningkatan Kualitas Pendidikan," *Pros. Semin. Nas. ...*, no. November, pp. 87–95, 2022.
[22] G. Nurqalam, M. H. Jaelani, I. Murweni, and Abdussalaam, "Perancangan Sistem Informasi Akuntansi Penggajian Dengan Menggunakan Microsoft Visual Studio," *J. Ilm. MEA (Manajemen, Ekon. dan Akuntansi)*, vol. 5, no. 3, pp. 494–512, 2021.

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