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Implementation of Natural Language Processing On Chatbot for Tourist Information Services (Case Study: Serang City)

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ABSTRACT
This research aims to develop and implement a chatbot system based on Natural Language Processing (NLP) that can provide tourist information services in Serang City. With the increasing need for fast and accurate information in the digital era, it is hoped that chatbots can be an effective solution to help tourists obtain information regarding tourist attractions, accommodation and activities in Serang City. The methods used in this research include data collection through interviews and surveys, as well as developing an NLP model using natural language processing techniques to understand and respond to user questions. The results of this research show that the chatbot developed is able to provide relevant and satisfying answers to users. In addition, feedback from users shows that this chatbot improves tourists' experience in exploring Serang City. It is hoped that this research can become a reference for the development of technology-based tourism information systems in other areas.

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INTRODUCTION

The success of developing the tourism sector does not only depend on how many tourist objects it has, the beauty, naturalness and uniqueness of the culture and traditions of the people around the tourist object or area, but what is much more important than that is human resources as managers, the tourism management system. and information from tourism itself. Therefore, the management and utilization of the tourism potential of each region must be the responsibility of each region itself (Holijah, 2023). Serang City is one of the areas in Banten Province which has various interesting tourist attractions.

The development of information and communication technology has brought significant changes in various aspects of life, including in the tourism sector. In today's digital era, tourists increasingly rely on technology to get fast and accurate information about the destinations they want to visit. One innovation that has emerged as a solution to meet this information need is the use of chatbots. Chatbots, which are computer programs designed to simulate human conversation, can provide real-time and responsive information services. Chatbots can be used as customer service to serve large numbers of customers (Yoanda, 2022).

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Natural Language Processing (NLP) is a branch of artificial intelligence that focuses on interactions between computers and humans using natural language. By leveraging NLP, chatbots can understand and process questions asked by users in everyday language, thereby improving the quality of interactions and user experience. In Indonesia, especially in the city of Serang, the tourism potential which is rich in culture and history has not been fully exploited. Therefore, developing an NLP-based chatbot for tourist information services in Serang City is very relevant. The existence of technology helps tourists to find all information related to the destination they will visit (Sanjaya, 2024).

This research aims to implement a chatbot system that can provide accurate and useful tourist information for visitors to Serang City. By using an NLP approach, it is hoped that this chatbot can understand various questions asked by users and provide appropriate answers. In addition, this research will also evaluate the effectiveness of chatbots in improving tourist experiences and provide recommendations for further development.

Through this research, it is hoped that it can contribute to the development of information technology in the tourism sector, as well as increasing the attractiveness of Serang City as a tourist destination. Thus, this research focuses not only on the technical aspects of chatbot development, but also on its impact on the local tourism industry.

In previous research, the implementation of a chatbot improved the user experience in obtaining academic and financial information at the Muhammadiyah University of Sukabumi. Based on surveys, users are satisfied with chatbots, giving an average rating of 3-4. Users appreciate the ease of use, relevance of information, and time efficiency offered by chatbots. Research succeeded in developing an effective chatbot and conducting performance comparisons between LSTM and Transformer models (Hafizh, 2024).

Based on the description presented above, the author wants to create an application that can be used as an information service or helpdesk. In this research, a chatbot application will be built as a helpdesk that can assist users in obtaining precise and accurate information efficiently on Serang City tourist attraction websites. Users can have conversations like humans and the system will answer automatically with the keywords provided.

METHODS

Determining the object where the researcher conducts this case study research. Researchers collected the data needed for this research. Chatbot developers generally create basic knowledge that represents the space of the chatbot. This space is needed as part of the chatbot's learning environment. This space includes types of expectations, actions, along with sentence layouts for speech responses to user messages.

At this stage, initial domain design is carried out based on questionnaire data. The domain specifies the training data that will generate the model for the chatbot. Training data for chatbots consists of NLU training data and dialogue training. The quality of this training data can continue to be improved so as to produce a chatbot model that can respond well to messages and information needs from users.

At this stage, the system is built using the flask framework. The training process uses machine learning algorithms specified in the policy section. This section determines the

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machine learning process that will be used to process received text messages and response text messages to users.

Chatbot systems are built to serve messages from real users. For this reason, the implementation of the system interface uses the flask framework to help implement models and test live conversations with real users. Real users can directly interact with the chatbot via links created by researchers. In this research, the chatbot developed was named LIWKSERA as an abbreviation for Serang City Tourist Information Service. Before being used by end users, the chatbot implementation is first tested in a local environment, to ensure that the training process, the resulting model and system implementation are free from errors or mistakes. At this stage, training data validation is also carried out to ensure the training data has the correct structure.

RESULTS AND DISCUSSION

The places needed to obtain data in this research are all tourist areas in the city of Serang Banten. Researchers conducted direct interviews with tourists who visited tourist attractions in Serang. Distribute questionnaires to tourists to collect large amounts of data. Questionnaires can be distributed via online media. Natural Language Processing (NLP) is the ability of a computer to process language commonly used by humans in everyday conversations. Therefore, using Natural Language Processing (NLP) allows chatbots to understand messages and respond appropriately. The capabilities contained in Natural Language Processing (NLP) can identify errors in spelling, grammar and also allow the chatbot to interpret messages even if there are errors.

Artificial Intelligence or artificial intelligence is a computer system that is capable of carrying out tasks that usually require human intelligence to carry out. The processes that occur in Artificial Intelligence include learning, reasoning, and also self-correction. The process carried out by Artificial Intelligence is similar to humans carrying out analysis before making a decision. In another sense, Artificial Intelligence is able to do things that humans do, such as analyzing reasoning to draw conclusions or make decisions or translating from one language to another. Artificial intelligence is able to learn from experience and data that has been collected or provided to communicate and speak word for word.

Artificial Neural Network is a model of the brain's artificial neural network from machine learning that can learn data patterns independently, and is able to provide responses based on input through a process so that it can produce appropriate output. The similarities between Neural Networks and Neurons from the human brain are depicted in figure 1.

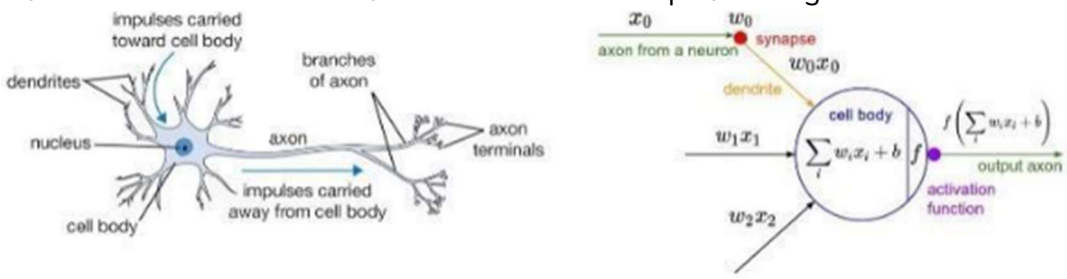

Figure 1. Similarities between Neural Networks and Brain Nuerons

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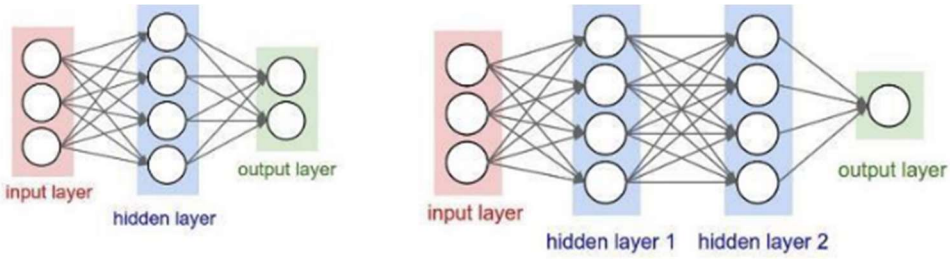

Figure 2. Architectural Neural Networks

Based on Figure 2, the neural network architecture uses 3 types of interconnected layers , namely: Input Layers, the input layer is a layer that receives input from outside the system, which is adjusted to the number of inputs. Hidden layers, hidden layer or hidden layer is a layer whose position is between the input layer and the output layer which consists of a group of neurons that receive data from the input layer. Output Layer, the output layer is the layer that produces the final output of the artificial neural network. The number of neurons in this output layer must be adjusted to the amount of output desired by the system.

Based on the data collected by the researcher, a dataset is created which will be entered into intents.json as in Figure 3. Intents are a collection of input and output data prepared to train the chatbot.

intents.json

```
"intents": [
  {
    "tag": "tempatwisatakeagamaan",
    "patterns": [
      "Apa saja tempat keagaaman di Serang?",
      "Wisata keagaaman Serang?",
      "Tempat keagaaman Serang?",
      "Keagamaan?"
    ],
    "responses": [
      "1. Masjid Agung Banten\n2. Vihara Avalokitesvara\n"
    ]
  },
  {
    "tag": "tempatwisataalam",
    "patterns": [
      "Apa saja tempat wisata alam di Serang?",
      "Wisata alam Serang?",
      "Tempat wisata alam Serang?",
      "Alam?"
    ],
    "responses": [
      "1. Cagar Alam Pulau Dua\n2. Curug Betung\n3. Gunung Pinang\n4. Curug Leuwi Bumi\n5. Curug Cigumawang\n"
    ]
  },
  {
    "tag": "tempatwisatamuseum",
    "patterns": [
      "Apa saja tempat wisata museum di Serang?",
      "Wisata museum Serang?",
      "Tempat wisata museum Serang?",
```

intents › 15

Figure 3. Data intents.json

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In intents there are tags to group the same text data as output or targeted output for neural network training. Patterns, this section contains keyword data or input patterns that users want from the chatbot. Response, this section contains output pattern data generated by the LIWKSERA chatbot and will be sent to the user.

In the context of chatbot training, tags serve as labels that group related patterns and responses, enabling the neural network to classify and understand the type of user query. Each tag represents a specific intent or category, such as tourism, hotels, or transportation. By categorizing inputs into distinct tags, the chatbot can effectively recognize the purpose of a user's query and respond accordingly. For example, if a user asks about tourist attractions in Serang, the chatbot may identify the query under the tourism tag and then generate the appropriate response related to travel recommendations in Serang. The patterns section contains various user inputs or keywords that the chatbot uses to identify intent. These patterns are the diverse ways users might phrase their questions or requests. The chatbot learns to associate these varied patterns with specific tags, ensuring it can handle a range of possible queries. For instance, the pattern "What can I do in Serang?" could be linked to the tourism tag, guiding the neural network to recognize this query as one seeking travel or sightseeing recommendations. Once the tag is identified, the response section generates an appropriate answer, providing the user with the information they need. The response could be a list of tourist destinations, helping the chatbot deliver a relevant and accurate message.

The results in the discussion of researchers used the Pycharm platform and interface for the chatbot testing process which can be used to answer questions from users to get information about tourism in Serang City. Following are the steps for the training and testing process using Natural Language Processing:

Creating a Chatbot Project-LIWKSERA

Using the Pycharm IDE, the author created a new project with the name "Chatbot-LIWKSERA". As follows in figure 4.

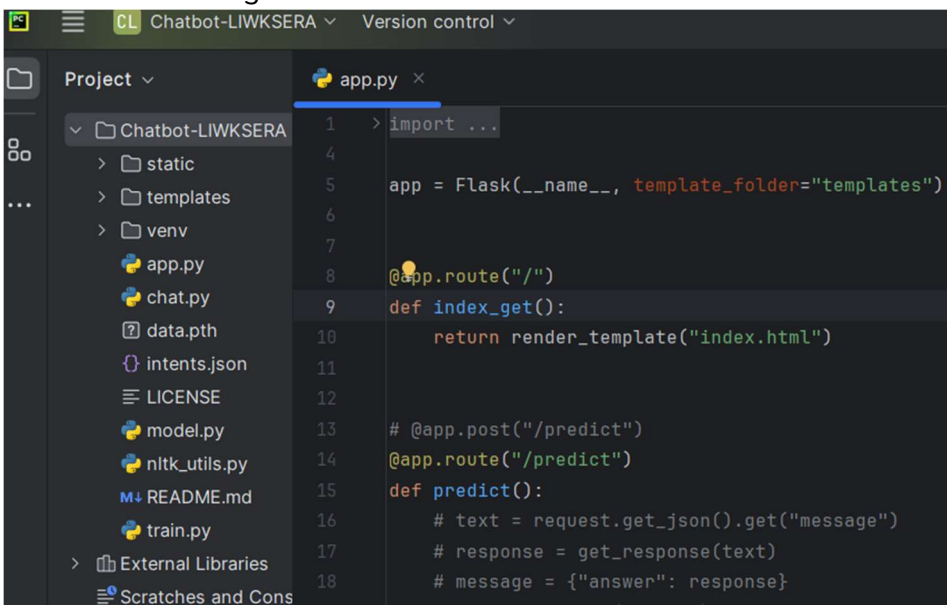

Figure 4. Project Chatbot_LIWKSERA

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In PyCharm IDE, the author created a new project named "Chatbot-LIWKSERA" to build and manage the chatbot application. PyCharm, a popular integrated development environment (IDE) for Python, provides an efficient workspace where developers can write, test, and debug their code. By creating a dedicated project in PyCharm, the author sets up a structured environment for organizing all the necessary files, such as source code, configuration files, and dependencies, which are essential for the chatbot's development. This approach helps ensure that the project remains modular, maintainable, and easy to scale as the chatbot's functionality expands.

Naming the project "Chatbot-LIWKSERA" clearly reflects its purpose, which is to develop a chatbot application (likely focused on tourism in Serang, based on the previous context). With PyCharm's robust features, such as code completion, debugging tools, and version control integration, the author can streamline the development process. The IDE also helps in managing virtual environments, dependencies, and libraries, making it easier to maintain the chatbot's functionality over time. In this project setup, the author can focus on tasks like training the neural network, developing intents, and fine-tuning the chatbot's interactions with users.

Setting up the environment

An environment is required to run the LIWKSERA chatbot. The author creates an environment with the name venv as in Figure 5.

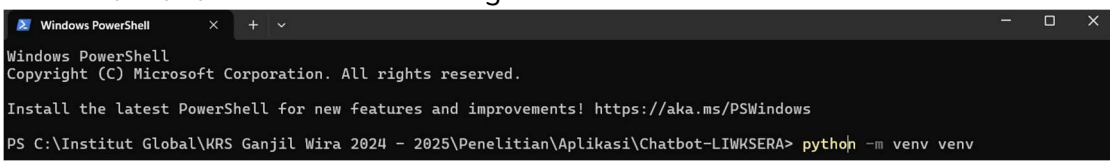

Figure 5. Creation of virtual environments

The virtual environment is the environment where the LIWKSERA chatbot application will run. Then, we can activate the virtual environment that was created earlier by writing the script .\venv\scripts\activate as in Figure 6.

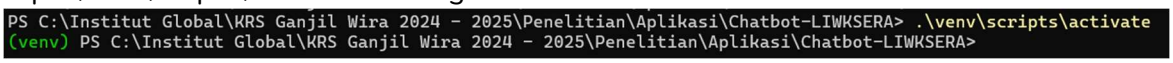

Figure 6. Activate the virtual environment

The virtual environment is a dedicated workspace that isolates the LIWKSERA chatbot application and its dependencies from the system's global Python environment. By creating a virtual environment, the author ensures that the chatbot application uses specific versions of libraries and packages that are necessary for its functioning without interfering with other projects or system-wide installations. To activate the virtual environment, the author runs the script .\venv\scripts\activate in the command line, as shown in Figure 6. This command activates the environment, allowing the chatbot application to run with its configured dependencies, ensuring compatibility and avoiding version conflicts between different Python projects.

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Install the library in the virtual environment

So that the application can run well, it is necessary to install libraries that will later be used by the chatbot. The script that needs to be run is pip install Flask torch torchvision nltk as in figure 7.

```
(venv) PS C:\Institut Global\KRS Ganjil Wira 2024 - 2025\Penelitian\Aplikasi\Chatbot-LIWKSERA> pip install Flask torch torchvision nltk
Requirement already satisfied: Flask in c:\institut global\krs genap wira 2023 - 2024\penelitian\aplikasi\chatbot-liwat2\venv\lib\site-packages (3.0.3)
Requirement already satisfied: torch in c:\institut global\krs genap wira 2023 - 2024\penelitian\aplikasi\chatbot-liwat2\venv\lib\site-packages (2.3.1)
Requirement already satisfied: torchvision in c:\institut global\krs genap wira 2023 - 2024\penelitian\aplikasi\chatbot-liwat2\venv\lib\site-packages (0.18.
1)
Requirement already satisfied: nltk in c:\institut global\krs genap wira 2023 - 2024\penelitian\aplikasi\chatbot-liwat2\venv\lib\site-packages (3.9)
Requirement already satisfied: Werkzeug>=3.0.0 in c:\institut global\krs genap wira 2023 - 2024\penelitian\aplikasi\chatbot-liwat2\venv\lib\site-packages (f
rom Flask) (3.0.3)
Requirement already satisfied: Jinja2>=3.1.2 in c:\institut global\krs genap wira 2023 - 2024\penelitian\aplikasi\chatbot-liwat2\venv\lib\site-packages (fro
m Flask) (3.1.4)
Requirement already satisfied: itsdangerous>=2.1.2 in c:\institut global\krs genap wira 2023 - 2024\penelitian\aplikasi\chatbot-liwat2\venv\lib\site-package
s (from Flask) (2.2.0)
Requirement already satisfied: click>=8.1.3 in c:\institut global\krs genap wira 2023 - 2024\penelitian\aplikasi\chatbot-liwat2\venv\lib\site-packages (from
 Flask) (8.1.7)
Requirement already satisfied: blinker>=1.6.2 in c:\institut global\krs genap wira 2023 - 2024\penelitian\aplikasi\chatbot-liwat2\venv\lib\site-packages (fr
om Flask) (1.8.2)
Requirement already satisfied: filelock in c:\institut global\krs genap wira 2023 - 2024\penelitian\aplikasi\chatbot-liwat2\venv\lib\site-packages (from tor
```

Figure 7. Install libraries

Then user need to import nltk as in Figure 8.

```
(venv) PS C:\Institut Global\KRS Ganjil Wira 2024 - 2025\Penelitian\Aplikasi\Chatbot-LIWKSERA> python
Python 3.12.3 (tags/v3.12.3:f6650f9, Apr  9 2024, 14:05:25) [MSC v.1938 64 bit (AMD64)] on win32
Type "help", "copyright", "credits" or "license" for more information.
>>> import nltk
>>> nltk.download('punkt')
[nltk_data] Downloading package punkt to
[nltk_data]     C:\Users\wirah\AppData\Roaming\nltk_data...
[nltk_data]   Package punkt is already up-to-date!
True
>>>
```

Figure 8. Import nltk

To ensure the LIWKSERA chatbot application runs smoothly, it is necessary to install the required libraries that provide the essential functionalities for the chatbot's operation. The script pip install Flask torch torchvision nltk, as shown in Figure 7, installs three critical libraries: Flask, which is a lightweight framework for building web applications and handling user interactions with the chatbot; Torch and Torchvision, which are libraries used for machine learning and computer vision tasks, enabling the neural network capabilities required by the chatbot; and NLTK (Natural Language Toolkit), a library for processing and analyzing human language, essential for understanding and generating responses to user queries. Running this script in the activated virtual environment ensures that the chatbot has all the necessary tools and dependencies for its operation.

Change intents.json

Filling in intents according to the model specified in conversation modeling is more or less like the following.

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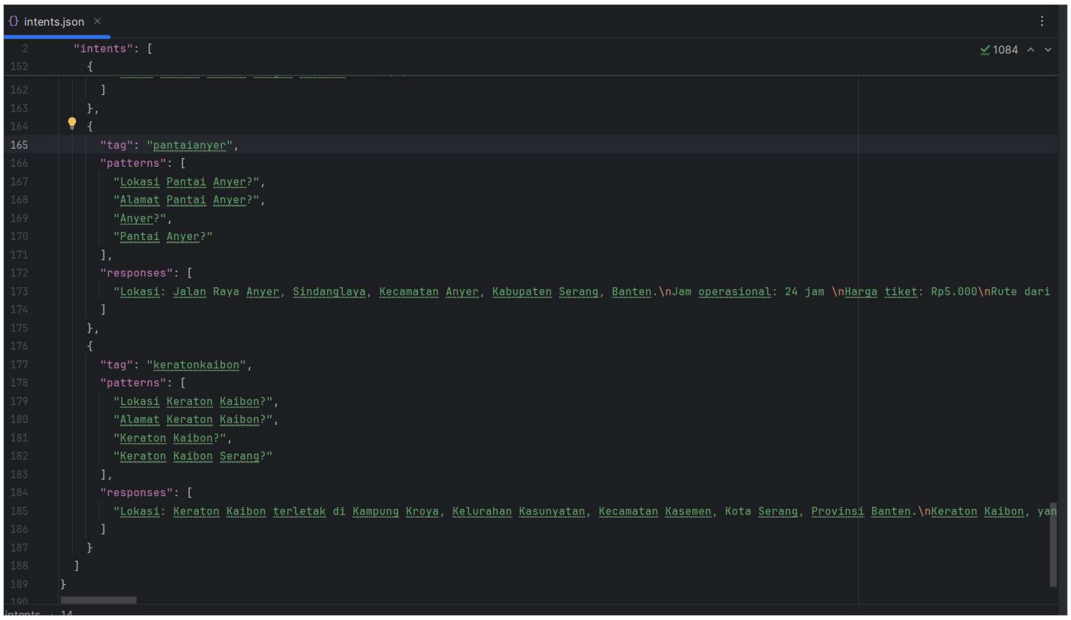

Figure 9. *intents.json*

Conduct training

The data in intents.json is then subjected to training which will produce epochs. The script that is run is python train.py as in Figure 8. In the train.py file there is a script for testing the model created.

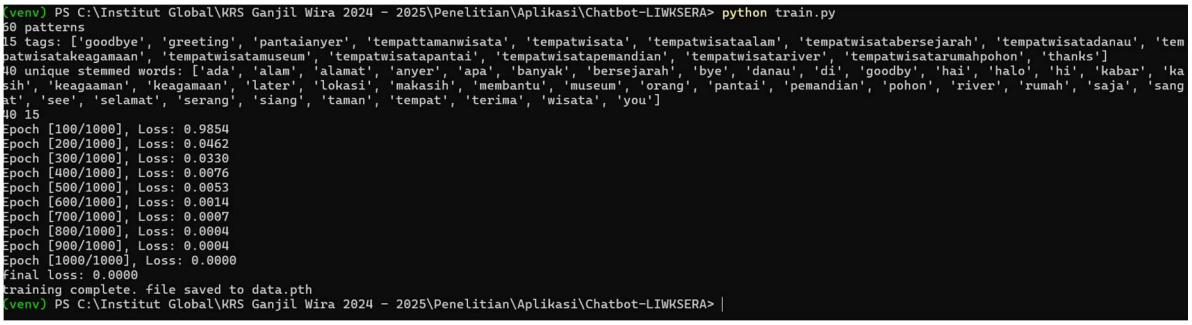

Figure 8. Python training

Activate chatbots

Because the chatbot was built using flask, which has been bundled into app.py. So just give the command python app.py, the link URL will appear as in Figure 9.

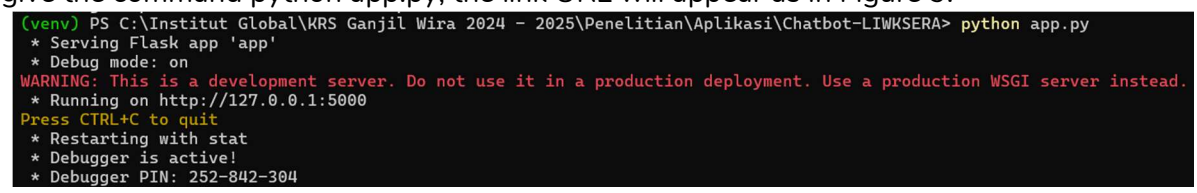

Figure 9. Activate the chatbot

Test System

The chatbot that has been built, then we test it. By displaying the url http://localhost:5000, the chatbot-LIWKSERA interface will appear. The author tried to carry out tests as in table 1.

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Table 1. Test scenarios

Question	Chatbot Answer Expectations	Results
Tour	Showing various tourist attractions in Serang	Success
Beach	Displays information about various beach tourism in Serang	Success
Museum	Displays information about various museums in Serang	Success
Anyer Beach	Displays information on Anyer beach tourist attractions in Serang	Success

*) Data processed by researchers (2025)

The Tour intent is designed to provide general information about various tourist attractions in Serang. When users inquire about things to see and do in the area, this intent will generate a response that highlights popular destinations, offering an overview of the city's main attractions. This could include a mix of historical sites, natural landmarks, and cultural experiences that make Serang an appealing place for tourists. By covering a broad spectrum of locations, the Tour intent serves as a starting point for visitors who are exploring the city.

The Beach intent specifically targets users who are interested in beach tourism in Serang. This is important because Serang, with its coastal location, is home to several beautiful beaches. The chatbot will provide users with information about various beaches in the region, highlighting notable spots like Anyer Beach, known for its scenic views, activities, and local attractions. This intent helps cater to beach lovers and those seeking a relaxing coastal experience, making it easier for them to discover the best seaside locations.

The Museum intent focuses on showcasing the rich cultural heritage of Serang by providing information about the museums in the area. Museums offer insight into the region's history, art, and traditions, which is especially valuable for tourists interested in learning more about the local culture. When users ask about museums, this intent will provide them with details about the available cultural institutions, their exhibits, and other relevant information.

Finally, the Anyer Beach intent gives a more specific response for users who ask about Anyer Beach, one of the region's most famous coastal tourist spots. This intent highlights the unique features of Anyer Beach, ensuring that users who are particularly interested in this location receive comprehensive details about it. All of these intents work together to provide a well-rounded view of Serang's tourism offerings.

CONCLUSION

This chatbot can provide various tourist information in the city of Serang, according to the setup listed in the application's intents.json. It is hoped that this chatbot can help the Serang regional government, especially in the tourism sector. This chatbot not only aims to provide useful information for tourists, but also to support the development of the tourism sector in Serang by providing a fast, efficient and easily accessible information channel. By utilizing chatbot technology, the Serang Regional Government can be more optimal in promoting the city's tourism potential, attracting more tourists, and introducing Serang's cultural diversity and natural beauty.

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