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CHATBOT-BASED CULINARY TOURISM RECOMMENDER SYSTEM USING NAMED ENTITY RECOGNITION

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ABSTRAK

Seiring berjalan nya waktu, wisata kuliner yang terdapat pada beberapa kota di Indonesia berkembang dengan cepat, salah satunya adalah wisata kuliner di kota Bandung. Hal ini dapat membuat wisatawan merasa kesulitan dalam menentukan pilihan kuliner yang tersedia. Untuk mengatasi permasalahan tersebut, diperlukan sebuah sistem rekomendasi. Dalam penelitian ini kami mengembangkan sistem rekomendasi dalam bentuk conversational recommender system berbasis chatbot untuk membantu user dalam mencari rekomendasi wisata kuliner. Chatbot dibangun menggunakan platform Google Dialogflow dengan menggunakan metode dalam Natural Language Processing yaitu Named Entity Recognition. Named Entity Recognition digunakan untuk mengambil entitas yang terdapat pada masukan user, seperti Nama user dan kuliner preferensi user. Untuk mencari rekomendasi kuliner, digunakan TF-IDF dan cosine similarity untuk mencari kemiripan antar kuliner berdasarkan Review, telegram digunakan sebagai media untuk mengimpelmentasi chatbot yang telah dibangun. Chatbot yang dibangun mempunyai performa yang baik dalam memberikan rekomendasi kuliner, hal tersebut dapat dilihat dari score yang didapatkan dari usability testing pada aspek rekomendasi, yaitu 85.7%.

***Kata Kunci**: wisata kuliner, sistem rekomendasi, chatbot, natural language processing, google dialogflow, named entity recognition, TF-IDF*

ABSTRACT

Over the time, culinary tourism in several cities of Indonesia is growing rapidly, one example is culinary tourism in Bandung city. This makes it difficult for tourists to decide their choice. To overcome these problems, a recommendation system is needed. Thus, in this study we developed a chatbot-based conversational recommendation system to assist users in finding culinary tourism recommendations. The chatbot was built using Google Dialogflow platform and uses methods in Natural Language Processing, namely Named Entity Recognition. Named Entity Recognition was used to extract entities from user's input, such as usernames and culinary preferences. To find culinary recommendations, TF-IDF and cosine similarity was used to find similarities between each culinary based on reviews, telegram was used as a medium to implement the chatbot that has been built. The chatbot has a good performance in providing culinary recommendations, it can be seen from the score obtained from usability testing on the recommendation aspect, which is 85.7%.

***Keywords**: culinary tourism, recommendation system, chatbot, natural language processing, google dialogflow, named entity recognition, TF-IDF*

I. INTRODUCTION

CULINARY tourism is one of the destinations for tourists when traveling, because with culinary tourism, tourist can learn about various culinary from cities in Indonesian, especially Bandung city [1]. Over the time, culinary in Bandung is growing rapidly. The number of culinary tourisms sometimes makes it difficult for a tourist to decide their choice of culinary tourism [2]. Because of that, a recommender system is needed for tourist to decide their culinary choice without having difficulties.

There are several ways for implement a recommender system to a system that can be used, one of them is using Conversational Recommender System (CRS). CRS is a form of recommendation system that works through conversations with humans. In CRS, user will have a conversation with the system for asking recommendations about something [3]. To implement CRS, a media is needed so that CRS can operate properly, one of them is Chatbot. A chatbot can be a media for implementing CRS, because Chatbot is a form of computer application that can interact with users using natural language such as interaction with humans [4], [5]. Thus, users can interact with Chatbot in providing recommender system for culinary tourism.

The implementation form of the Chatbot and the recommender system can be found in [6], where the research applies a Chatbot to detect diseases based on the symptoms experienced by the user and then recommends the treatment. The chatbot works by doing text processing using Natural Language Processing to input the symptoms experienced by the user, the K Nearest Neighbor algorithm is used to predict existing diseases based on the dataset

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and then provide recommendations treatment for user [5]. Other implementation of chatbot and recommender system is applying chatbot to doyouwannaread.com website. In the study, the Chatbot was built using the Engati platform [7].

David et al. build a CRS chatbot based on the functional requirements from the user, the chatbot that was built has a good result through user trials. Tested aspect is how the chatbot can simulate giving recommendations when users get recommendations from other users [8]. In another study, Hilman et al. build a CRS chatbot with an Ontology-based smartphone recommendation based on product functional requirements, chatbot are evaluate based on the interaction between user and system. The interaction is succeeded if the user likes the smartphones that are recommended by the system [9].

In CRS, one of the problems faced is the large number of interactions between user and the system, which makes it difficult for users to express their needs. So therefore, Baizal et al. build the CRS system with query refinement model, query refinement model works by produce interaction iteratively to narrow down user needs and reduce the number of interactions that occurs between user and system. [10]. Ashay et al. implements chatbot on travel agent domain, the chatbot use voice recognition from user as input and will be forwarded via amazon echo platform. Chatbot was built using Restricted Boltzmann Machine (RBM) approach with Collaborative Filtering [11].

Based on the problem and previous study, we implement chatbot as a media for CRS because chatbot have advantages where user can express their needs in natural language flexibly. Chatbot was build using Google Dialogflow and will be implemented in Telegram by using NLP methods i.e. Named Entity Recognition. To find recommendations from culinary tourism, a content-based approach with TF-IDF algorithm is used in this study.

II. THE PROPOSED METHOD

A. System Design

System Design from chatbot that we build are shown in fig 1, the first step from our system design is obtain the dataset, then the preprocessing stage is carried out such as drop duplicate data, drop unused column, removing stopwords on reviews column, etc. TF-IDF and Cosine Similarity used for giving the weight to the terms contained in the reviews columns and finding similarities between the TF-IDF values. After that cosine similarity result will be applied to find culinary recommendation and implements recommender system to a chatbot. The final step from system design is Named Entity Recognition to extract important entities that required for culinary recommendations.

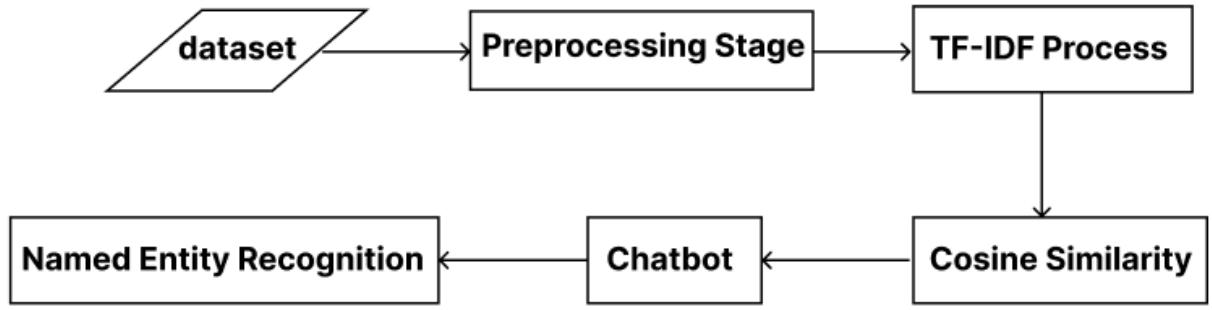

Fig 1 System Design

B. Dataset

In this study, culinary dataset is obtained using Places API from google maps. 186 culinary data for Bandung city are obtained. Dataset example that used for this study is shown in table I.

E-ISSN : 2540 - 8984

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TABLE I
CULINARY DATASET

Place Name	Place Id	Rating	Vicinity	Category	Reviews	Service - Option
Zifana Restaurant	ChIJdQZeWyzDaC4RkH34O_OJCRc	5.0	Ashfa Group, Jl. Riung Sauyunan I No.7, Cipamokolan, Kota Bandung	Jawa, Indonesian	Rasanya unik dan bikin nagihhh Mantapp Ayam Geprek dan Zifananya Panggang rasanya pedas asam manis seimbang (The taste is unique and makes you addicted. Zifana Geprek Chicken and Roasted, it tastes spicy, sweet, and sour, balanced)	Dine-in, Takeaway
Masakan Padang Restaurant	ChIJazntoZjCaC4R1YcKYKlegKs	5.0	Jl. Cipamokolan No.61, Cipamokolan, Kota Bandung	Padang	Rasanya konsisten enak dan murah... dari SMP sampai sekarang punya anak 1 dan masih enak (The taste is consistently delicious and cheap... from middle school until now I have 1 child and it's still delicious)	No-contact-delivery, Takeaway, Dine-in

C. *Preprocessing Stage*

Pre-processing is a step taken to make sure of the quality of the data being used. In this study, pre-processing in dataset are includes, drop unused column, rename column name, using Reviews column that does not contain null values. Text processing are used in reviews column, these include case folding by changing sentence in Reviews column to lowercase, removing symbol and stop words, and stemmer to return the word to its original form. Example of text processing are shown in table II.

TABLE II
REVIEWS COLUMN AFTER TEXT PROCESSING

Before (Reviews)	After (Cleaned Reviews)
Ayamnya enak krispi, sambalnya enak!!! Level 5 sadisss benar-benar pedas! Kalian harus coba guys!! (the chicken is crispy; the sambal is delicious!!! Level 5 sadisss is spicy! you guys must try it guys!!)	ayam enak krispi sambal enak level 5 sadisss benarbenar pedas kalian coba guys (yummy chicken, delicious crispy chili, level 5, sadisss, it's really spicy, you guys try it)
Makanan yang enak dan tempat yang nyaman (good food and cozy place)	makan enak tempat nyaman (eat well comfortable place)

D. *TF-IDF*

TF-IDF is an algorithm that commonly used for text processing and information retrieval, TF-IDF will look for important term to represent a document [12]. TF-IDF is divided into 2 words, namely $Tf(Term\ Frequency)$ and $Idf(Inverse\ Document\ Frequency)$ [13].

$$t\,f_{t,d} = \frac{f_{t,d}}{n_d} \quad (1)$$

$$idf_t = log\frac{N}{df_t} \quad (2)$$

$$W_{t,d} = t\,f_{t,d} \text{ x } idf_t \quad (3)$$

Where $f_{t,d}$ is frequency of term t contain in the document d, df_t is frequency from document where term t contained. After that (2) and (3) will be multiplied to giving the weight to documents. In this study TF-IDF was used to give the weight of word that contained in Reviews column.

E-ISSN : 2540 - 8984

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E. Cosine Similarity

Cosine Similarity is a method that used for finding similarities with calculating the cosine angle between 2 vectors. Cosine similarity values are 0 and 1, if the values are 1 that indicates a strong similarity, if the values are 0 that indicates a weak similarity between 2 vectors [14]. Formula to calculate cosine similarity are shown in (4).

$$CosSim(x, y) = \frac{\sum_i x_i y_i}{\sqrt{\sum_i x_i^2}\sqrt{\sum_i y_i^2}} \quad (4)$$

In this study cosine similarity was used to find similarities from TF-IDF calculation on reviews column, example of cosine similarity score for "Gormeteria" is shown in table III.

TABLE III
COSINE SIMILARITY SCORE FOR EACH CULINARY

Culinary Name	Cosine Similarity Score
Gormeteria	1.0
Swarga Loka The Garden Restaurant	0.15
Saffron Restaurant	0.09
Sukahati Restaurant	0.08
Roasted 66 Antapani	0.08
Gudeg Pakde	0.07
The Restaurant Padma Hotel Bandung	0.06
WaterLeaf Restaurant	0.05
Dakken Restaurant Setiabudhi	0.05
Hongkong Restaurant	0.05

F. Chatbot

Chatbot is a form of Artificial Intelligence that acts as a tool to simulate human-like conversations to finish the task, such as answering several questions regarding how to use website and become virtual assistant [15]. Natural Language Processing and Natural Language Understanding are applied to chatbot for understanding its conversations with human, conversation in the form of text or voice [16].

In this study, we use google dialogflow [17] as an agent to implement recommender system and chatbot. The chatbot interaction mechanism are shown in fig 2.

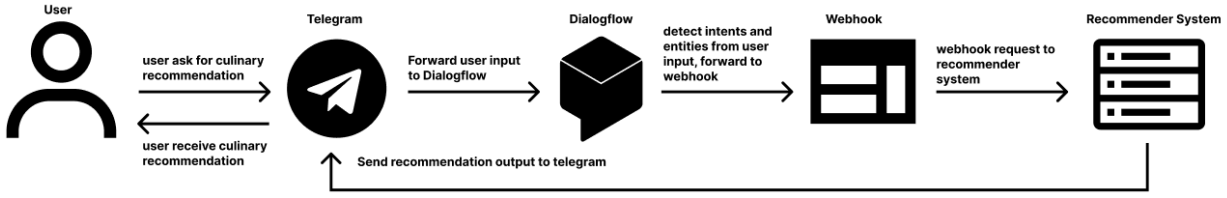

Fig 2 chatbot interaction mechanism

G. Named Entity Recognition

NER is an NLP method that used for extraction process from entity such as name, location, verb, and others [18]. NER plays an important role to solve problems such as information extraction and question answering system [19]. In this study NER was used for extract entities from user's input, such as user's name and culinary name, dialogflow has a built-in facility to implement NER, namely intents and entities. To create an entity, we have to set the person's name and culinary name as shown in fig 3 and fig 4

E-ISSN : 2540 - 8984

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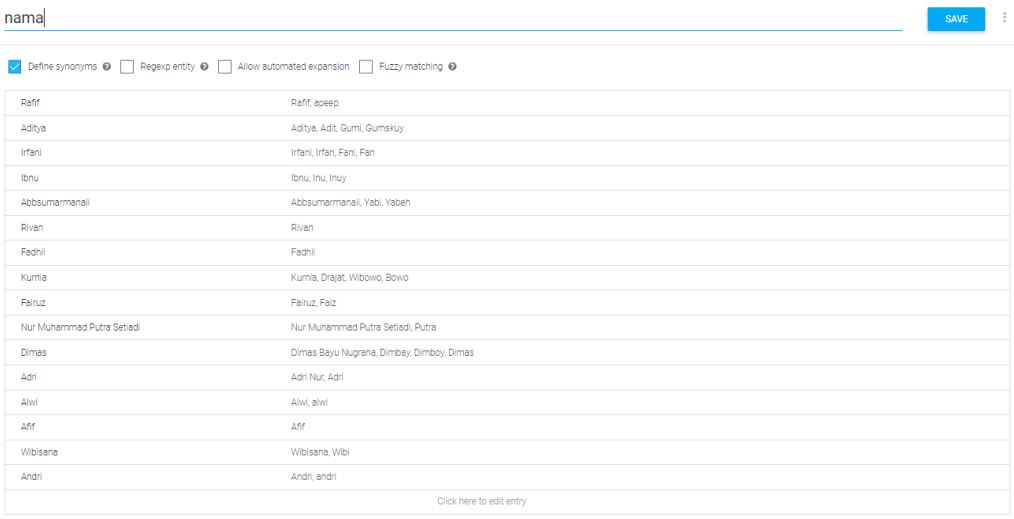

Fig 3 set person's name entity

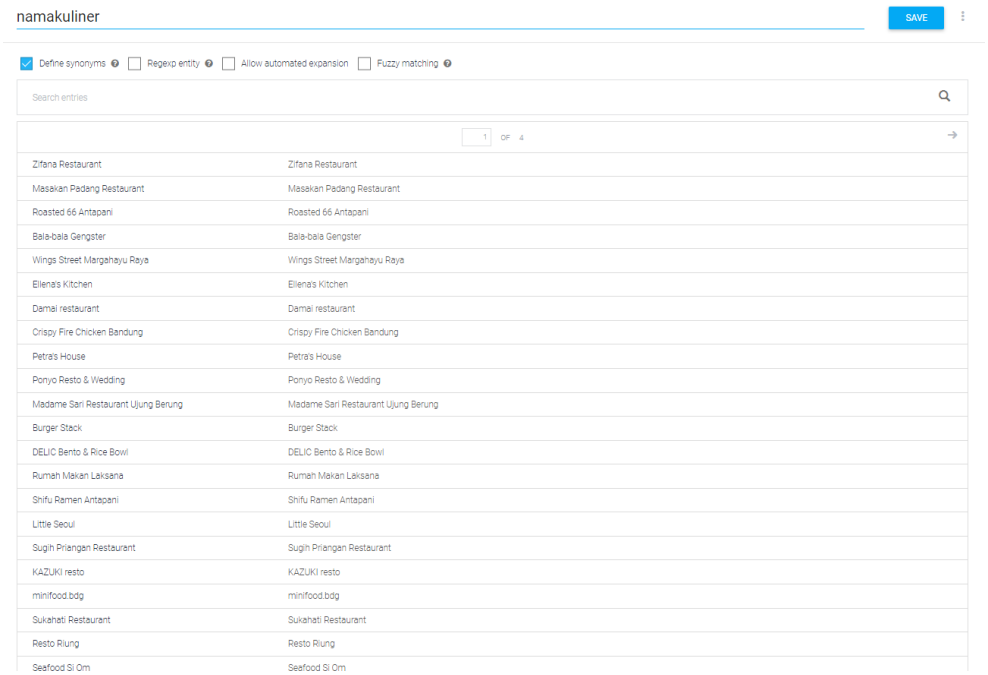

Fig 4 culinary name

III. RESULT AND DISCUSSION

A. Chatbot Implementation

Chatbot that we build are integrated to Telegram messenger app, so the user can access it flexibly. The chatbot conversation flow for showing culinary recommendation are shown in fig 5.

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Fig 5 showing culinary recommendations

User has a choice to like the recommendation that given by chatbot or dislike it, if user likes the recommendation, then chatbot will give the culinary details as shown in fig 6.

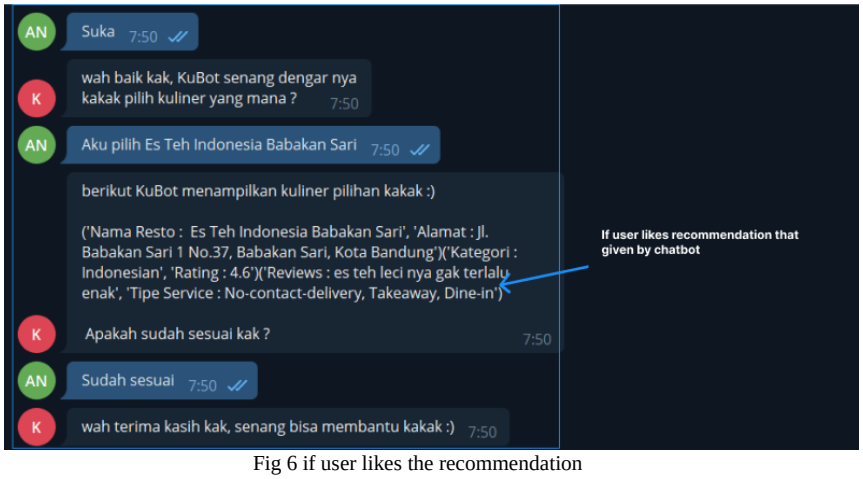

Fig 6 if user likes the recommendation

If user dislike the recommendation, then chatbot will ask for another preference until user likes the recommendation. This example is shown in fig 7.

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JIPI (Jurnal Ilmiah Penelitian dan Pembelajaran Informatika)
Volume 07, Nomor 04, Desember 2022 : 1131 - 1138

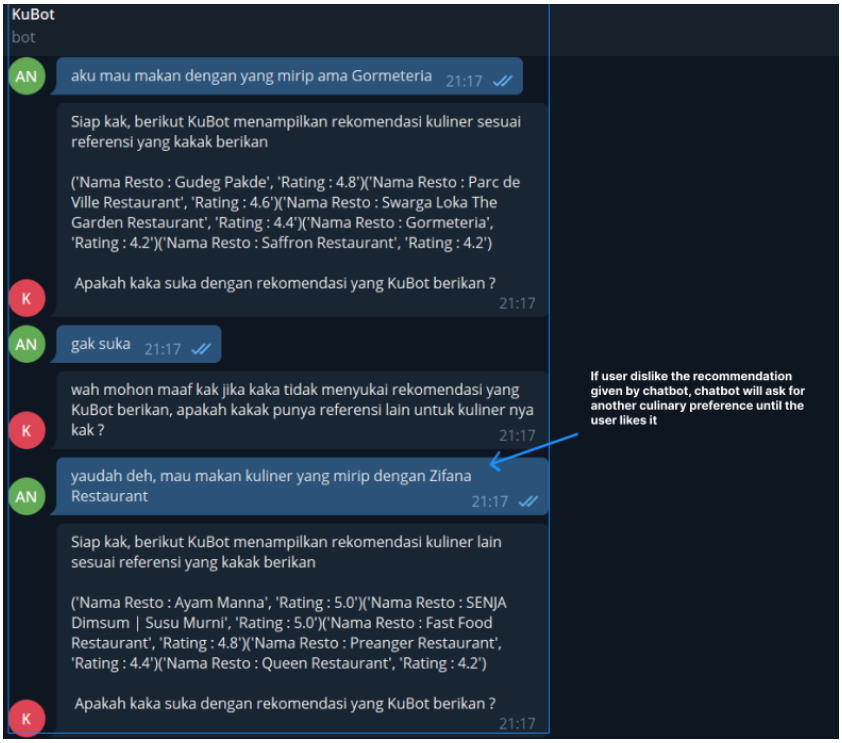

Fig 7 if user dislikes the recommendation

B. *Chatbot Evaluation*

Chatbot are evaluated using usability testing method that conducted to user, there are 5 questions that user must answer after testing the chatbot. Each question represents a different aspect, the aspect are Natural languages (NT), Recommendation (R), Easy to Use (ETU), Question Understanding (QU) and Interaction (I). The questions and aspects are shown in table IV.

TABLE IV
ASPECT AND QUESTION

Aspects	Questions
ETU	Do you think chatbot is easy to use?
QU	Do you understand the question asked by the chatbot?
NT	Do you like the use of natural language in the chatbot?
R	Do you like the recommendations that chatbot gives?
I	Do you like the interaction with the chatbot while using it?

C. *Evaluation Results*

The result from each aspect was shown in table V.

TABLE V
EVALUATION RESULTS

Aspects	Questions	Agree	Disagree
ETU	Do you think chatbot is easy to use?	78.6%	21.4%
QU	Do you understand the question asked by the chatbot?	85.7%	14.3%
NT	Do you like the use of natural language in the chatbot?	78.6%	21.4%
R	Do you like the recommendations that chatbot gives?	85.7%	14.3%
I	Do you like the interaction with the chatbot while using it?	71.4%	14.3%

Based on the result shown in table 5, (R) and (QU) aspects has the highest Agree result from user with the percentage of both 85.7%. Other aspects such as (ETU) and (NT) has Agree result of 78.6% both, and aspects (I) has Agree result of 71.4%.

IV. CONCLUSION

The conclusion from this research is, the chatbot that was built using google dialogflow was able to provide a good culinary recommendation for the user. This can be seen from the result of (R) aspect with the percentage of 85.7%, chatbot was able to find similar culinary from user preferences. (ETU) and (NT) aspects has relatively good result with the percentage of 78.6%, this can be caused by the chatbot that sometimes does not understand user's input. (I) aspects have least good result if compared to other aspects with 71.4%, the result can be caused by user difficulties to answer some questions from the chatbot.

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