International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN:2147-6799 www.ijisae.org Original Research Paper

Tourism Information Multi-Domain Dialogue State Tracking Datasets for Smart Tourism Chatbot

Myeong-Cheol Jwa[1] Tae-Seung Ko[2] Byeong-Joo Kim[3] and Jeong-Woo Jwa[4]

Submitted: 06/06/2022 **Accepted:** 10/09/2022

Abstract-The smart tourism service provides tourism information and recommended travel products so that tourists can create a personalized travel itinerary before travel and provides a tour guide service according to the travel itinerary during travel. To efficiently provide smart tourism services to tourists, it is necessary to develop a chatbot system as well as a smart tourism web/app. The smart tourism chatbot system consists of tourism information Named Entity Recognition (NER), Dialogue State Tracking (DST), and Question and Answering (QA) models. In this paper, we develop the tourism information multi-domain DST datasets to provide chatbot services using the tourism information knowledge base of the smart tourism information system implemented with Neo4J DB. The developed tourism information multi-domain DST datasets consist of 5 domains and 22 slots. The joint goal accuracy of the SOM-DST model [8] using the developed tourism information multi-domain DST dataset is 0.622.

Keywords*: Dialogue State Tracking, Smart Tourism Chatbot, Task-oriented Dialog System.*

1. Introduction

Smart tourism provides Smart tourism provides tourist information, recommended travel products, my travel itinerary, and tour guide service through various channels such as web/apps, chatbots, Instagram, and YouTube, etc. The smart tourism chatbot can provide smart tourism services to tourists easily and conveniently through conversation. The smart tourism chatbot is a typical task-oriented dialog system that consists of natural language understanding (NLU), dialog state tracking (DST), dialog policy and natural language generation (NLG), name entity recognition (NER) question and answering (QA) algorithms.

DST updates the dialogue state every dialogue turns according to the user's utterance, and then grasps the user's goal and understands the entire dialogue. The smart tourism chatbot provides answers to tourists by searching the tourism information database of the smart tourism information system according to the identified user's goal. Dialogue state consists of domain-slot-value pairs. We are developing a smart tourism information system to provide smart tourism services through various channels such as smart tourism apps, Instagram, YouTube, and chatbots [1]. We developed the rule-based chatbot service using Khaiii (Kakao Hangul Analyzer III) morpheme analyzer and the tour information Neo4J graph database [2]. We developed the tour information NER dataset [3] for smart tourism chatbot.

Multi-Domain DST dataset includes Multi-domain Wizard-of-Oz (MultiWOZ) 2.0, MultiWOZ 2.1 [4, 5] and Korean Wizard-of-Seoul (WOS) [6]. The MultiWOZ dataset is a fully labeled human-human conversational corpus spanning over 7 distinct domains and 8438 multi-turn dialogues. The dialogues span seven domains: restaurant, hotel, attraction, taxi, train, hospital and police. Wizard-of-Seoul (WOS) is a Korean DST dataset developed as a KLUE project [7] and consists of five multi-domains: tourism, accommodation, restaurant, subway, and taxi. In this paper, we develop the tourism information multi-domain DST

[1] [1]*Korea University of Technology and Education, Cheonan-si, Korea*
ORCID: 0000-0002-7916-9292
[2]*Jeju National University, Jeju, Korea*
ORCID: 0000-0002-3765-146X
[3]*Jeju National University, Jeju, Korea*
ORCID: 0000-0001-7713-8612
[4]*Jeju National University, Jeju, Korea*
ORCID: 0000-0002-2164-7896
[4]*Corresponding Author E-mail: lcr02@jejunu.ac.kr*

dataset for the smart tourism chatbot service based on the tourism information data of the smart tourism information system. The tourism information multi-domain DST datasets are tagged with domain-slot-value according to WOS dataset format. We confirm the performance of the tourism information DST datasets using the SOM-DST model [8]. The SOM-DST model uses the CARRYOVER, UPDATE, DONTCARE, and DELETE operations, but the F1 score of the DONTCARE and DELETE operations is relatively low. We create a tourism information DST dataset so that the DONTCARE and DELETE operations do not occur to improve the performance of DST model.

The smart tourism chatbot requires a multi-domain DST model that finds the user's goal in the user's utterance. In this paper, we develop the tourism information multi-domain DST dataset to efficiently provide tourism information to tourists through a smart tourism chatbot. The domains, slots, and values of the tourism information multi-domain DST dataset are developed to utilize the contents of the smart tourism information system that provides tourism information services through smart tourism apps, Instagram, and YouTube.

2. Multi-domain DST Datasets for Tourism Information Services

2.1 Smart Tourism Chatbot System based on the Tourism Knowledge Base

Smart tourism provides tourists with tourism information and recommended travel products before trips and allows them to create their own itinerary. Tourism information and recommended travel products are provided to tourists through various channels such as mobile apps, chatbots, Instagram, and YouTube. Tourists can use the tour guide service during their trip according to their own itinerary. Figure 1 shows the proposed smart tourism system [1] that provides tourism information, recommended travel products, personalized travel products, and tour guide services to tourists through mobile apps and chatbots. The Smart Tourism Information System contains the tourism information DB, the recommended travel product DB, and the tourism information knowledge base. The tourism information knowledge base is an extension of the implementation of the Neo4J graph DB in the rule-based tourism information chatbot system [2]. Tourists can create their own travel itinerary using recommended travel products and tourism information services and use the tour guide service according to the travel itinerary during their trip.

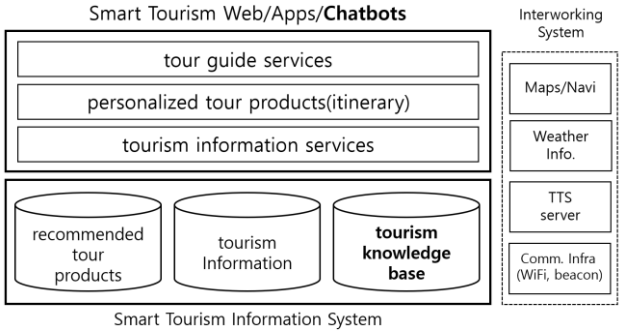

Figure 1- The proposed smart tourism system that provides chatbot services using the tourism information knowledge base.

The smart tourism chatbot system is a task-oriented dialog system that efficiently provides smart tourism services of the smart tourism information system to tourists. The smart tourism chatbot consists of NER, DST, and QA models for smart tourism services. We developed the Korean and English NER datasets [3] used in the tourism information NER algorithm based on the tourism information DB and the tourism information knowledge base of the tourism information system. In this paper, we develop the DST dataset used in the tourism information multi-domain DST algorithm. The slots and values of the tourism information DST dataset are developed based on the classification of the tourism information knowledge base of the rule-based smart tourism chatbot system.

2.2 Tourism Information Multi-domain DST Datasets

The smart tourism chatbot requires a multi-domain DST model that finds the user's goal in the user's utterance. In this paper, we develop the tourism information multi-domain NER datasets so that the tourism information service provided by the smart tourism app can be easily and conveniently provided to tourists with the smart chatbot system. We define the domains and slots of the tourism information NER dataset so that tourists can be accurately searched for in the tourism information knowledge base and tourism information DB of the smart tourism information system according to the intention of the tourist. Table 1 shows the 5 domains of the tourism information multi-domain DST datasets. The tourism information dataset is created in JSON format according to the format of the WOS dataset.

Table 1. Domains and slots of tourism information multi-domain DST datasets

Domains	Slots
Tourism information	Name, Phone, Address, Hours (open, close), Distance, Duration, Difficulty, Routes, Entrance, Exit, Reservation, Website, Description, Map, Navi
Tourism purpose	Who, What, When, Where, How
Additional information	Price, Parking, Weather, Pet, Scenery, Flower, Dark tourism, Religion, History, Mythology
Tourism category	Large category, Medium category, Small category
Tourist area	Province, Regional division, City, Dong, Nearby attractions

The “tourism information” domain is defined so that the smart tourism information system can properly provide tourism information to user questions. As shown in Table 1, the slots of the “tourism information” domain are defined based on the attribute data of the tourism information DB provided by the smart tourism app. The smart tourism chatbot can more efficiently provide the tourism information provided by the tourism information app by analyzing tourist conversations according to the slots of the tourism information domain.

The "tourism purpose" domain is basically used to analyze tourist conversations with Five Ws of when, where, who, what, and how and to search in the tourism information knowledge base.

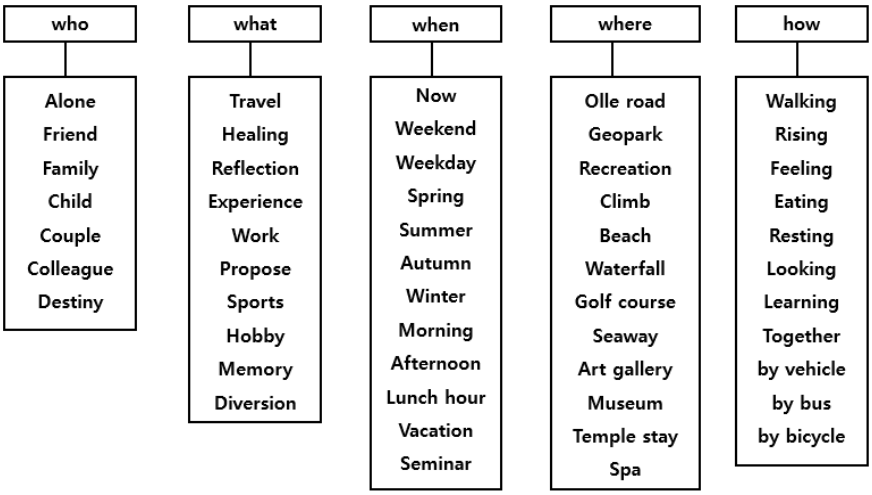

Figure 2- 5 Ws slots and values in the "tourism purpose" domain.

As shown in Fig. 2, the "who" slot in the "tourism purpose" domain represents the people who accompany the tourist, such as parents, friends, lovers, etc. The "what" slot is used to search for tourist information suitable for the tourist's travel purpose, and the "when" slot is used to search for tourism information suitable for the travel time. The "where" and "how" slots are used to search for tourism information in the tourism information DB. We define the "tourism category" domain the same as that of the smart tourism app [1] to efficiently provide tourism information services through the linkage between chatbot and smart tourism app. The smart tourism app classifies tourism information into large category, medium category, and small category. In addition, tourism information is classified and implemented in the tourism information DB by zone type indicating space, line type indicating roads, and point type (POI) indicating general tourist destinations. For example, Mt. Halla is a large category of zone type, and 7 climbing routes of Mt. Halla on Jeju, Korea are defined as medium category of line type, and major points of each trail are defined as value of small category of point type. Because tourism information is implemented to have a hierarchical relationship of zone type, line type, and point type, the chatbot can provide tourism information to tourists easily and conveniently by using slots and values of the "tourism category" domain. The "tourist area" domain is defined as province, regional division, city, and dong slots to provide tourism information with regional information in the conversation of tourists. The "regional division" slot represents regional information such as "west of Jeju city" and "east of Seogwipo city" used in tourists' conversations, unlike administrative district information.

The tourism information multi-domain DST dataset consists of 8000 conversations and 38,504 turns. We verify the performance of the developed tourism information dataset by performing the learning of the SOM-DST model. The DST performance is expressed as domain-specific accuracy, which indicates the accuracy of

matching between the predicted slot values and the ground truth values every turn. The SOM-DST model uses the CARRYOVER, DELETE, DONTCARE, and UPDATE operations, and updates the slot value for the UPDATE operation. In MultiWOZ 2.1, the F1 scores of the CARRYOVER, UPDATE, DONTCARE, and DELETE operations are 98.66, 80.10, 32.51, and 2.86, respectively, with relatively poor performance for the DONTCARE and UPDATE operations. To improve the joint goal accuracy performance of DST, we create a tourism information DST dataset so that the DELETE and DONTCARE operations occur as few as possible.

In the SOM-DST model, the joint_goal_accuracy of the tourism information DST dataset is 0.6544, the turn_slot_accuracy is 0.9802, and the turn slot F1 is 0.9453, respectively. Table 2 shows the FI score of the tourism information DST dataset by operation type. In Table 2, F1 scores of the UPDATE, DONTCARE, and DELETE operations is lower than that of the CARRYOVER operation. Among them, the DELETE operation score shows very bad performance.

Table 2. FI scores of the tourism information DST dataset for operation types

Operation Type	Number of operations		F1 score
	Test	Valid	
CARRYOVER	94,988	94,555	0.99712
UPDATE	5,288	5,203	0.95345
DONTCARE	221	215	0.95322
DELETE	24	0	0.0000

In this paper, we modify the tourism information DST dataset so that the DONTCARE and DELETE operations do not occur and evaluate the performance in the SOM-DST model. Also, we use related words in conversation instead of the "yes" and "no" values. In the modified tourist information DST dataset, joint_goal_accuracy, turn_slot_accuracy, turn slot F1, operation accuracy are 0.9533, 0.9982, 0.9927, and 0.9992, respectively. Table 3 shows the F1 scores of the CARRYOVER and UPDATE operations. We can confirm that the modified tourism information DST dataset performs better than the DST dataset using the "DONTCARE", "DELETE" operations and the "yes", "no" values.

Table 3. FI scores of the modified tourism information DST dataset for operation types

Operation Type	Number of operations		F1 score
	Test	Valid	
CARRYOVER	95,803	95,745	0.9996
UPDATE	5,501	5,488	0.9935

3. Discussions

The smart tourism chatbot provides smart tourism services through linking with various tourism information distribution channels such as smart tourism apps, Instagram, and YouTube. The smart tourism chatbot allows tourists to easily and conveniently use tourism information, my travel itinerary using recommended travel products, and tour guide services. The smart tourism chatbot system is a task-oriented dialog system and requires NER, DST, QA models and datasets for them. In this paper, we create a tourism information DST dataset and analyze its performance with the SOM-DST model. The tourism information multi-domain DST dataset is created in the Korean Wizard-of-Seoul (WOS) format and consists of 5 domains and 8,000 conversations. The 5 domains of the tourism information DST dataset are defined as “tourism information”, “tourism purpose”, “additional information”, “tourism category”, and “tourist area” to provide tourism information efficiently through dialogue with tourists. We confirm the performance of the tourism information DST dataset created with the SOM-DST model. To improve the performance of the DST model, we create a modified DST dataset that deletes the "DONTCARE" and "DELETE" operations and replaces the "yes" and "no" values with dialogue words. We plan to expand the number of dialogues so that we can understand the intentions of various users related to tourism information. We also plan to develop the tourism DST algorithm using the tourism information multi-domain DST dataset and provide the tourism information service of the smart tourism chatbot with OSMU (One-source multi-use).

4. Acknowledgments

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (MSIT) (No.2021R1A2C1093283).

References

[1] JeongWoo Jwa, “Development of Personalized Travel P roducts for Smart Tour Guidance Services”, Internation al Journal of Engineering & Technology, 7 (3.33) 58-61, 2018.

[2] Dong-Hyun Kim, Hyeon-Su Im, Jong-Heon Hyeon, Jeong-Woo Jwa, “Development of the Rule-based Smart Tourism Chatbot using Neo4J graph database”, International Journal of Internet, Broadcasting and Communication, Vol.13, No.2, pp 179-186, 2021.

[3] Garg, D. K. . (2022). Understanding the Purpose of Object Detection, Models to Detect Objects, Application Use and Benefits. International Journal on Future Revolution in Computer Science &Amp; Communication Engineering, 8(2), 01–04. https://doi.org/10.17762/ijfrcsce.v8i2.2066

[4] Myeong-Cheol Jwa, Jeong-Woo Jwa, “Development of Tourism Information Named Entity Recognition Datasets for the Fine-tune KoBERT-CRF Model”,

International Journal of Internet, Broadcasting and Communication, Vol.14, No.2, pp 55-62, 2022.

[5] Tume-Bruce, B. A. A. ., A. . Delgado, and E. L. . Huamaní. “Implementation of a Web System for the Improvement in Sales and in the Application of Digital Marketing in the Company Selcom”. International Journal on Recent and Innovation Trends in Computing and Communication, vol. 10, no. 5, May 2022, pp. 48-59, doi:10.17762/ijritcc.v10i5.5553.

[6] Budzianowski, Pawel, et al. "MultiWOZ-A LargeScale Multi-Domain Wizard-of-Oz Dataset for TaskOriented Dialogue Modelling." Proceedings of the 2018 Conference on Empirical Methods in Natural Language Processing, 2018.

[7] Eric, Mihail, et al. “MultiWOZ 2.1: A Consolidated Multi-Domain Dialogue Dataset with State Corrections and State Tracking Baselines. Proceedings of The 12th Language Resources and Evaluation Conference, 2020.

[8] Park, Sungjoon, Jihyung Moon, Sungdong Kim, Won I k Cho, Jiyoon Han, Jangwon Park, Chisung Song et al., “KLUE: Korean Language Understanding Evaluation.”, arXiv, 2021.

[9] Mahmoud, E. H., Gadelrab, M. S., ElSayed, K., & Sallam, A. R. (2022). Modelling Multilayer Communication Channel in Terahertz Band for Medical Applications. International Journal of Communication Networks and Information Security (IJCNIS), 13(3). https://doi.org/10.17762/ijcnis.v13i3.5041

[10] Xipeng Qiu, Tianxiang Sun, Yige Xu, Yunfan Shao, Ni ng Dai, Xuanjing Huang, “Pre-trained Models for Natur al Language Processing: A Survey”, Science China Tec hnological Sciences 63(10), pp.1872-1897, 2020.

[11] Kim, Sungdong, et al. "Efficient dialogue state tracking by selectively overwriting memory." Proceedings of the 58th Annual Meetings of the Association for Computational Linguistics, 2020.