

Computer-assisted English learning system based on free conversation by topic

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Abstract. This paper aims to describe a computer-assisted English learning system using chatbots and dialogue systems, which allow free conversation outside the topic without limiting the learner's flow of conversation. The evaluation was conducted by 20 experimenters. The performance of the system based on a free conversation by topic was measured by the success rate of the dialogue turn. The average success rate of the dialogue turn was 80.86% and the success rate of dialogue turns for each topic was as follows: (1) 'purchasing New York city tour tickets': 71.86%; (2) 'ordering food': 71.06%; (3) 'talking about health habits': 85.41%; and (4) 'thinking about future currency': 95.09%. Additionally, the precision and recall of English grammar error correction was 66.7% and 31.9% respectively.

Keywords: dialogue system, computer-assisted language learning, free conversation, topic.

1. Introduction

A dialogue system is a system that allows conversation between a user and a system in a natural voice. The dialogue system, which provides an educational environment similar to that of receiving English conversation education from a native speaker by combining the English education field with the dialogue system, is said to be a computer-assisted English learning system. The Korea Electronics and Telecommunications Research Institute has developed GenieTutor, a computer assisted English learning system from 2010 to 2015 (Choi, Kwon, Kim, & Lee, 2016). While GenieTutor asks questions based on a given topic, talks to the learner according to the scenario of the topic, and provides feedback on grammar errors,

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it has the disadvantage of limiting the learner's flow of conversations and does not allow free conversation outside the topic. To overcome these drawbacks, the computer-assisted English learning system described in this paper has been developed: GenieTutorPlus (Kwon et al., 2015). It allows free conversation outside the topic without limiting the learner's flow of dialogue and feedback on grammatical errors.

2. Free talk by topic

GenieTutorPlus, as opposed to GenieTutor, aims to help learners continue their English learning by returning to the topic without interrupting their learning, even if they are talking with the dialogue system outside the topic. Therefore, the newly developed English learning system is a system that allows free conversation by topic. GenieTutor and GenieTutorPlus are summarised in Table 1.

Table 1. Comparison between GenieTutor and GenieTutorPlus

GenieTutor	GenieTutorPlus
<ul style="list-style-type: none"> • System-initiative • No free conversation outside the topic 	<ul style="list-style-type: none"> • Mixed-initiative between learner and system • Free conversation outside the topic • Chatbot dialogue

Figure 1, below, is an example of GenieTutorPlus for the topic of 'ordering food'.

Figure 1. Example of GenieTutorPlus for the topic of 'ordering food'

1. [System] Hi. What would you like?
2. [Learner] Do you have menu?
3. [System] Here you are. What would you like to have?
4. [Learner] I would like cheese omelette.
5. [Tutor] I would like to have a cheese omelette.
6. [System] Okay, there are side dishes you can order.
Would you like something with your omelette?
7. [Learner] I want to take the coffee.
8. [System] Is this to go or will you be dining in?
9. [Learner] For here. How much is it?
10. [System] That will be 12 dollars and 55 cents, please.
11. [Learner] I have no money.
12. [System] What a pity! 12 dollars and 55 cents, please.
13. [Learner] Here you are.
14. [System] Thanks. Here's your order. Have a nice day.
15. [Learner] Goodbye

For instance, [Tutor] refers to the result of recommending the correct sentence by operating the grammar error correction function of the [System]. The second line of [Figure 1](#) shows a [Learner]'s utterance that is related to the topic but is not in the learning corpus. Line 11 shows a learner's utterance that has nothing to do with the topic. While GenieTutor has an 'awkward' or 'wrong' system answer to the learner utterance in these two situations, GenieTutorPlus responds correctly as shown in [Figure 1](#).

3. Processing of free talk by topic

3.1. How does GenieTutorPlus recognise that user utterance is off the topic?

Whether or not the learner's utterance is out of the topic is determined by the topic recognition. Topic recognition is done by comparing a dialogue intention generated from a morphological analysis and a named entity recognition of user utterance with a dialogue intention learned from dialogue maps of topic ([Choi et al., 2016](#)).

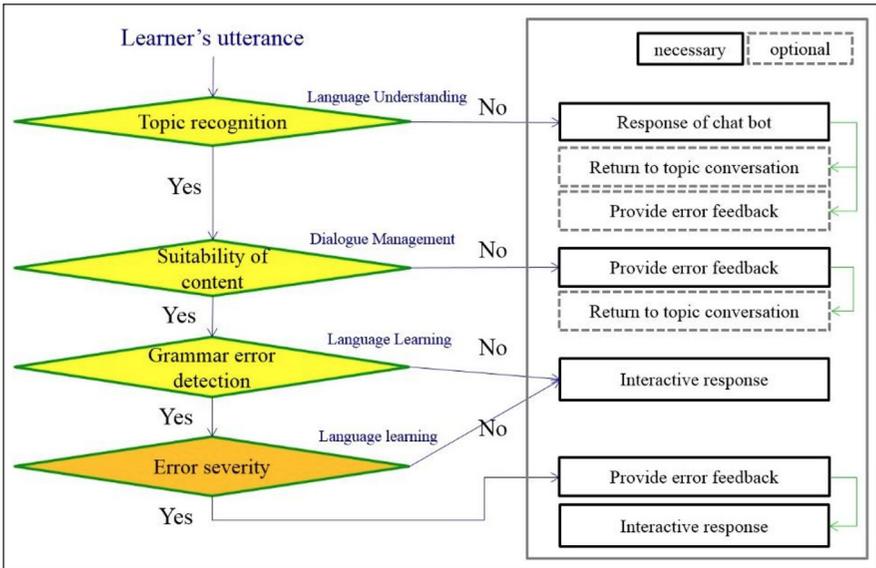
If a dialogue intention of the user utterance is not included in dialogue intentions by topic, the user utterance is considered to be outside the topic. A dialogue intention is obtained by machine learning and consists of dialogue act and slot. When the user utterance is out of topic, the chatbot responds to the user utterance.

3.2. What is the overall flow of GenieTutorPlus?

[Figure 2](#) illustrates GenieTutorPlus's flow, which starts from the learner's utterance to determine whether it is topic-oriented or chatbot-oriented, and/or whether it has grammar errors.

When a learner makes an utterance, GenieTutorPlus first confirms whether it is topic-oriented. If the utterance is not a topic conversation, GenieTutorPlus responds with the chatbot and then returns to the topic conversation. Otherwise, if the learner's utterance is topic-oriented, GenieTutorPlus in turn processes suitability of content, grammar error detection, and error severity. If a grammatical error is detected, GenieTutorPlus provides feedback on the grammatical error and responds to the contextual sentence within the topic.

Figure 2. Overall flow of GenieTutorPlus



3.3. How does GenieTutorPlus provide feedback on grammar errors?

The language learning module of GenieTutorPlus automatically detects and corrects grammatical errors that may be included in the learner's utterances. Therefore, GenieTutorPlus aims to improve the learner's ability to speak a foreign language by feeding back the corrected result to the learner.

- Detection of grammar errors: grammatical errors are detected in sentences which are spoken by the learner, and are limited to grammatical errors defined in the system, and multiple grammatical errors can be detected in one sentence.
- Correction of grammar errors: grammar error correction information is generated by using the part of the error vocabulary and surrounding context information.
- Feedback of grammar errors: indicates learner's errors, gives better expression, and uses explicit and implicit feedback effectively in context.

4. Evaluation

The English language education institute is building the free conversation by topic for discussion and learning. Among these topics, we chose four topics to evaluate GenieTutorPlus. The selected topics and evaluation methods were as follows:

- Topics for evaluation: (1) purchasing tickets for New York city tour, (2) ordering food, (3) talking about health habits, and (4) thinking about future currency.
- There were 20 participants. Participants' English level was beginners (ten) and intermediate (ten). Participants were aged in the 10's (one), 20's (15), and 30's (4). There were 11 males and nine females.
- Experimental method: the participants randomly chose a mission by topic. They communicated freely with GenieTutorPlus to accomplish their mission. Participants performed ten missions on four topics, each taking an average of 50 minutes per person.
- Success rate of dialogue turn (%) = $(\text{number of correct system's responses to learner's utterance}) / (\text{total number of learners' utterances}) \times 100$.
- Success rate of chatbot (%) = $(\text{number of correct system's responses to learner's out-of-topic utterance}) / (\text{number of learners' out-of-topic utterances}) \times 100$.
- Precision of grammar error correction = $(\text{number of words correctly corrected by the system}) / (\text{total number of words the system attempted to correct for grammatical errors}) \times 100$.
- Recall of grammar error correction = $(\text{number of words that the system corrects correctly}) / (\text{actual grammatical error of the evaluation set total words}) \times 100$.

5. Results and discussion

As illustrated in [Table 2](#), the success rate of dialogue turn on the four topics is 80.86%. The chatbot dialogue rate equals to 10.44% and the success rate of chatbot dialogue turn is 31.49%. Even though chatbot dialogue rate is occasional in the free

dialogue (10.44%), the success rate of chatbot dialogue turnout is rather low. This is mostly due to the fact that generating chatbot responses which are still suitable for the topic of dialogue is difficult to achieve.

Table 2. Evaluation of GenieTutorPlus

Topic	Experimental group	Success rate of Dialogue turn	Rate of Chatbot dialogues	Success rate of Chatbot
Buying New York City Tour Tickets	beginner	73.75%	7.50%	16.67%
	intermediate class	70.11%	9.20%	75.00%
	Total	71.86%	8.38%	50.00%
Ordering Food	beginner	73.66%	6.99%	15.38%
	intermediate class	68.66%	11.94%	33.33%
	Total	71.06%	9.56%	27.03%
Health Habits Dialogue	beginner	80.53%	12.39%	42.86%
	intermediate class	90.00%	14.17%	23.53%
	Total	85.41%	13.30%	32.26%
Thinking About Future Currency	beginner	96.45%	14.18%	15.00%
	intermediate class	93.75%	6.94%	20.00%
	Total	95.09%	10.53%	16.67%
	Total	80.86%	10.44%	31.49%

Moreover, 500 sentences were extracted from log data from the above experiment. Precision and recall of the English grammar error correction was calculated (see Table 3).

Table 3. English grammar error correction

	Precision	Recall
English grammar error correction	66.7%	31.9%

6. Conclusions

In this paper, we describe an English learning system using chatbots and dialogue systems that help learners continue a dialogue in English even if they are outside of a given topic, and then return to the topic again. The system determines whether the learner's utterance is out of topic by comparing the topic itself with the dialogue

intention. The performance of the English learning system using chat bot and dialogue system was measured by the success rate of the dialogue turn and the success rate of the chatbot. The success rate of total dialogue turns reached 80.86% and the success rate of the chatbot was 31.49%. Precision and recall of grammar error correction equaled 66.7% and 31.9% respectively.

In the future, we will investigate how the English learning system handles multiple turns when dialogue goes beyond the predefined discussion topic (Dingli & Scerri, 2013).

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