Chatbot Utilization for Medical Consultant System

Nudtaporn Rosruen and Taweesak Samanchuen
Technology of Information System Management Division, Faculty of Engineering,
Mahidol University, Nakhon Pathom, Thailand, 73170
nudtaporn.ros@student.mahidol.ac.th, taweesak.sam@mahidol.ac.th

***Abstract*—Medical services are basic needs for human life although they normally have limited resources. Modern technologies are utilized for increasing service capability and decreasing the operation cost. Auto-response system or chatbot, which is widely known in the field of online businesses, can be applied to the medical services. Therefore, the objective of this work is to implement the medical consultant system service by using chatbot Technology. It was implemented based on the information of the symptoms and treatment records gathered from the DoctorMe application. The test results show the capability of the proposed system. Moreover, it can be used as a guideline for future improvement and also a guideline for future study.**

Keywords— Consultant System; Chatbot; Natural Language Processing

I. INTRODUCTION

The number of people seeking for health information form the internet increases dramatically [1]. There are several factors that influence people to use the internet for searching for health information. Trusted medical information such as diseases, symptoms, and treatment is necessary for people to handle with some general illness or being used as a decision support information before visiting a doctor. In Thailand, the government has provided the websites [2] to serve this requirement. However, due to the limited computer skill of the users, this information may be difficult to access. Another solution called "DoctorMe," an application by Thai Health Promotion Foundation is proposed for providing the health information to the people. However, it still consists of multiple steps before reaching desired information.

A chatbot is a computer system, which can interact with users by using natural language. Normally, it is designed to serve in a certain domain such as online shopping, online frequently asked questions (FAQ) and also assistant system [3]. Users can easily use it without background knowledge or experiences. Moreover, chatbot can serve many people at the same time with the same topic and without getting bored. Consequently, this may be the suitable capability to be adopted in public service such as the medical service. Hence, the objective of this work is to increase the service capability and decrease the operation cost of medical consultant service by using the chatbot.

In this work, the medical consultant system called "MedBot" was developed by using Dialogflow powered by Google's machine learning [4]. The knowledge for conversation which is covered 16 symptoms. The chatbot can be easily implemented in Instant Messaging (IM) application, or online chat such as Facebook, Hangout, and Line by using the provided APIs. In this work, Line is used as the test system for our study. The evaluation result can be a guideline for future improvement and also being used as a guideline for future study.

The organization of this paper is as follows. After this section, Section II describes related work of this study and Section III presents system implementation and tools to develop this system. Section IV provides the experiment results of MedBot and the last section is the conclusion.

II. LITERATURE REVIEW

Chatbot technology has been investigated for a long time, which was also used in many areas. In this section, the literature review of technology and application of chatbot are given as follows.

A. Chatbot Types

A chatbot is a program computer using auto reply via text, picture, links, video and etc. There are 2 types of the chatbot, i.e., Rule-Based chatbot and AI-Based chatbot [5].

Rule-based approach is the way to develop chatbot by specifying conditions or rules to the chatbot. When a user asks some questions without giving any conditions, the chatbot will not understand that question. Therefore, this type of chatbot is not suitable for the conversation application.

AI-based or intent-based approach is the technique that bases on the human ability to learn by themselves and gain effective information. To do this, the chatbot is trained based on natural language processing (NLP) with the data sets, which are conversion dialogs, to extract the combination of conversation including intent, context, and entity [6]. There are many modern tools that can be used for this approach such as IBM Watson [7], Api.ai or Dialogflow and Wit.ai [8].

Typically, the basis of implementation chatbot requires templates that can match the user's inputs and generate the appropriate answer. At this moment, there are many ways to develop a chatbot without coding which makes the development of the chatbot is simple, convenient and fast.

B. Related work

There are a lot of works that study, develop, and publish about this topic. The famous idea for chatbot is Eliza which was introduced by Weizenbaum [9]. This work described conversation by using natural language between human and machine, which is a possible solution to develop the chatbot.

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After that, many techniques for developing the chatbot have been proposed such as bibliometric analysis [10] and long short-term memory (LSTM) networks [11]. Bibliometric is a quantitative analysis by using statistics to measure and assess publications. LSTM networks use deep learning technique in term of natural language generation to create chatbot and train a million conversations in Twitter between users and agents. Over 40 percent of users like this system and the result of this system.

Currently, the chatbot is utilized in various fields such as education, smart systems, and medical services. For education, the chatbot is designed for providing FAQ system to the repository and responding the university students, which the results show that the specific topic of conversation alongside the conversation [12]. An interactive session will be higher than the conversation to the general knowledge. For the smart system application, the chatbot is used to control home appliances via the internet system [13]. For medical application, the chatbot is also an interesting technology. There are a lot of works addressing this area. Lokman et.al. [14] utilized chatbot for a diabetic patient to record medical histories in a short description. Diabetic patients communicated with chatbot system via Vpath, which is the process to recognize the conversation path of this work. Another approach of chatbot is used to predict diagnosis from the patient's information such as age, weight, height, and status of smoke [15], [16]. Amato et.al. [15] introduced a system called Health On-Line Medical Suggestions (HOLMES) to serve as a medical consultant from doctors and record big data features such as personal health records, electronic health records and mobilized health records. This makes the system be more reliable, higher quality and can reduce cost.

The next section shows about the design and implementation of MedBot. Moreover, the next section will describe tools to develop chatbot.

III. System Implementation

In this section, the system implementation process is described. Firstly, the system architecture is explained. After that, the implementation process is elucidated. Finally, the toolset that uses to build the chatbot is demonstrated. The details of each part are given below.

A. System Architecture

The chatbot type of our system, MedBot, is the intent-based approach, which the architecture is shown in Fig. 1. The chatbot is implemented in IM application, where Line application is used in our study. A user sends a conversation phrases to the application. Then the application transfers the message to Dialogflow, which is the engine of the chatbot. The message is extracted to obtain the intent. The response according to the message intent is predefined from the training phrase in the fulfillment. In some case, to react to the request message, the system needs to pick up the data from an external database or external APIs. To do this, the additional coding is necessary. After that, the systems will generate the actionable data that user can understand and send back to the application. Finally, the user will receive responses in forms of text, image, voice, and video.

A. Implementation Process

To implement MedBot, four steps of work, which are System Analysis, System Design, Development, and Testing system were performed as shown in Fig. 1. The details of this process are given below.

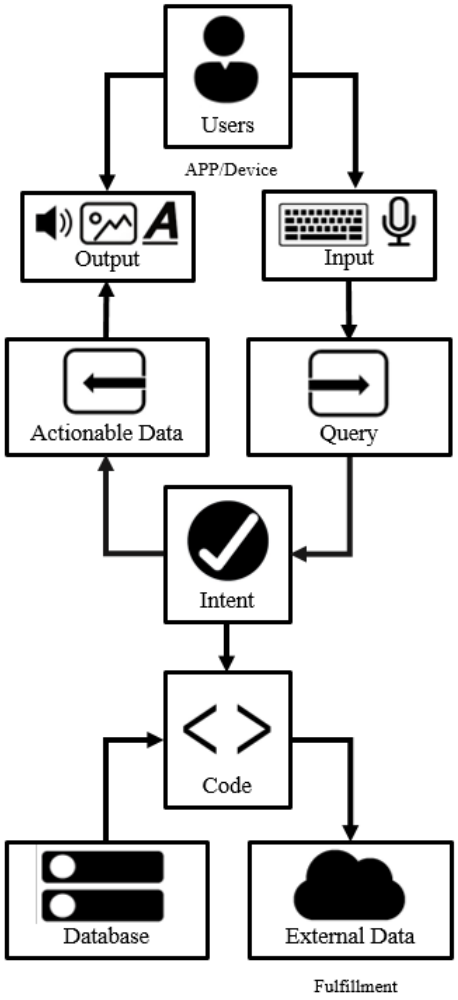

Fig. 1: Basic diagram of MedBot.

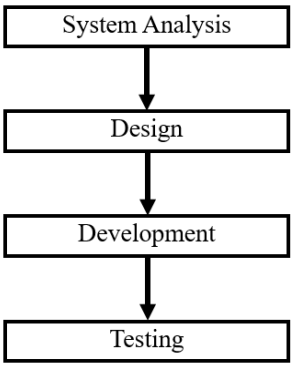

Fig. 2: Implementation process.

1) System Analysis

Firstly, DoctorMe was studied in detail to find out the information about the potential illness, the medicine and

herbs to be used to treat the symptoms. The 16 symptoms including fever, cough, vomit, headache, conjunctivitis, sore throat, feel dizzy, rash on the skin, joint pain, diarrhea, dark colored urine, dengue, migraine, stuffy, catarrh, and stomachache were extracted. This information is used to train the chatbot in the later step. Moreover, from this study, we also found some constraints that can affect the users on the use of the application, including

- Installation of the application is needed,
- Knowledge on application instructions is required,
- Application may compatible only with tablets and smartphones.

These constraints can be eliminated by using chatbot. Users no need to install and learn about the new application. They can use the IM application that they already have and are familiarized with it.

2) Chatbot Design

MedBot is designed to be a doctor, who is an expert on symptoms and treatment. She can give the suggestion and provide medical advice to patients. The objective of the chatbot is to provide the consulting only general symptoms. Further than these, the chatbot will recommend the patients to visit a real doctor.

MedBot has 34 intents including 16 intents of symptoms, ten intents of sub-detail of stomachache, five intents of sub-detail of a headache, one intent of greeting with a chatbot, one intent of no illness, and one intent of finding the hospital by getting the link. In some intents, MedBot has a suggestion that the user should meet the doctor in some harmless symptoms. These intents were trained to the chatbot.

3) Development

To develop MedBot, Dialogflow from Google was used as the major tool. The steps of this process are given below.

• Create agent (MedBot) in Dialogflow by using Google Account.

• Generate the intent by using health information in DoctorMe.

• Train phrases and responses are the functions in intent. Define training phrases to match user utterance. Define responses to be displayed to the user which can be phrases, image, voice, and video. For image, video, and audio must be coding by using JavaScript or JSON format. The phrases, which were trained in training process, come from symptoms and medical sign in DoctorMe application. An example of training phrases is shown in Fig. 3.

4) Testing

The last step of the implementation process is testing. There are 2 steps of testing, i.e., during training testing and system testing. During training, testing is to test the phrase of conversation to a system and check for its response. If the response is not correct, additional training phrases are necessary. This process can be done in a chatbot development tool.

After completing the system development, the system testing is performed. The simulation of conversion is setup and test. The conversation phrases which do not use to train the chatbot is used for this testing, where the results are shown in Section IV.

B. Tools to develop chatbot

In this work, Dialogflow is used as the engine for the chatbot. Dialogflow or originally named Api.ai is Google

Fig. 3: Example of Thai phrases for fever.

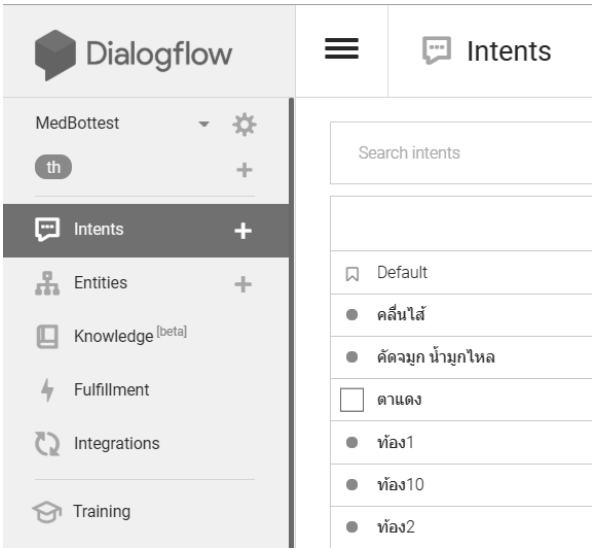

Fig. 4: Dialogflow user interface.

products to develop a chatbot. The advantages of Dialogflow is supported natural language understanding (NLU) which helps to develop chatbot without coding. This means Dialogflow can convert input or query to be intent by using NLP. It can easily integrate with many IM platforms such as Line, Twitter, and Facebook. It covers more than 20 languages including Thai.

Dialogflow contains a lot of tools to create a chatbot as shown in Fig. 4. The details of these tools are described as follows.

- Agent is the module in Dialogflow which integrate natural language processing to understand the meaning of user. The agent must be created from the beginning of using this system.
- Intent is the meaning of conversation phrase. It is controlled by the developer to support and determine action which includes
    - Context is the feature used to remember the passing intent.
    - Event is alternative way trigger intent, predefined events or custom the new ones.
    - Training Phrase is possible to the word which users might say with a chatbot. Dialogflow recommends 10-20 examples in Training Phrase.
    - Action and parameters - Defined parameters which are an example of information such as places, date and etc.
    - Response is display back to the user after the user asks the chatbot.
- Fulfillment is the function that the conversation can pass on request and respond between chatbot and user.
- Integrations are the tool to integrate that chatbot with other platforms that are currently popular, such as Google assistant, Line, Facebook Messenger, Slack Or Twitter

IV. Experimental Results and Discussion

In this section, the experimental results of this work are shown. The testing during development and overall system test results are given. The comparison of the current application and new chatbot system is also demonstrated with some discussion. The details are described below.

During the training process, a simple test can be performed to fast check how the chatbot reacts to the question or conversation. If the response is not correct, the additional training phrases are necessary. The example of this test is shown in Fig. 5. From the Fig. 5a, four training phrase is used to train the chatbot. We can see that the chatbot responses with the wrong answer because the training phrase is still small. From Fig. 5b, the additional training phrases as shown in Fig. 3 are used to train to a chatbot. We can see that the chatbot responses with the correct answer.

After completed the system development by integrating with Line application, the system testing was performed. The conversation phrases, which do not use to train a chatbot, are used for this testing as shown in Fig. 6. We can see that chatbot can answer the proper answer to the user. Other types of media such as sound, picture, and movie, can be included in the conversation which can provide more information to the user.

For overall system comparison between the current system, DoctorMe, and the new proposed system, MedBot, is shown in TABLE I. For DoctorMe, the user needs to install a new application to the user's smart devices and needs to learn how to use the new application. On the other hand, MedBot does not need the installation of a new application and the users do not need to learn how to use the new application.

All of these experiments are not the real use by the patients. Feedbacks from the actual users are important, which could be the further work. Moreover, only Line application is selected for integrating with the chatbot, other types of application can also be applied.

(a) Response result of four training phrase

(b) Response result of ten training phrase

Fig. 5: Test results of four and ten training phrases.

V. CONCLUSION

In this work, the development of medical chatbot using Dialogflow was done. Sixteen of symptoms with treatment are trained to the chatbot. The chatbot can respond the proper answers to the user with the proper guidance for handling with the symptoms. It can apply to several IM application. This system helps maximize convenience to the users, increase service capability and decrease the operation cost of medical consultant service.

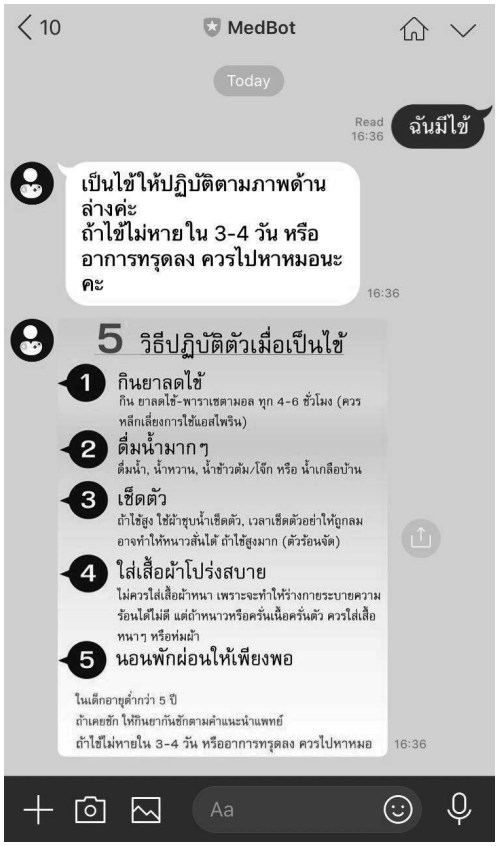

Fig. 6: Example of conversion between user and MedBot.

TABLE I. COMPARISON OF OLD AND NEW SYSTEMS

	DoctorMe	**MedBot**
Installation of Program	Required	Not required
Usability	Required	Not required
Compatibility	Mobile, Tablets	PC computer, laptop, mobile and tablets
Symptoms covered	various symptoms	16 symptoms

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