Improvement of Chatbot in Trading System for SMEs by Using Deep Neural Network

Sathit Prasomphan
Department of Computer and Information Science, Faculty of Applied Science,
King Mongkut's University of Technology North Bangkok,
1518 Pracharat 1 Rd. Wongsawang, Bangsue, Bangkok, 10800 THAILAND
e-mail: sathit.p@sci.kmutnb.ac.th

***Abstract*— This research presents a method for developing chatbots to serve their users. In general, these chatbots are used for answering questions in many businesses, providing customer information, providing train schedules, helping customer reservations, virtual assistants; serve as call centers to serve ten million customers automatically. A deep learning based conversational artificial intelligence technique was used as tools for learning conversation between machine and customer. In addition, the steps required are the technique used in conjunction with the convolution neural network technique by using Tensorflow training to improve the accuracy of these chatbots. From the experimental results, using deep learning for chatbots learning, the accuracy is better than the traditional model.**

Keywords- NLU; NLG; Word Embedding; Tensorflow; RNN; LSTM; Sequence to Sequence Model; chatbots

I. INTRODUCTION

Chatbot stands for chat robot, a type of computer program that communicates, responding to human in a conversational manner. The program usually runs on the server and then talk to us. The responds from machine may be using text or voice through various channels such as web sites, applications or chat programs. Chatbot programs are often designed to talk to people or talk to chatbots together. Some programs respond and provide basic information. However, some programs have a complex machine learning system, which can learn and develop itself. Chatbot has been developed and reputation in the past, such as Artificial Linguistic Internet Computer Entity (A.L.I.C.E.). Nowadays, with the popularity of the type of chat or messaging applications, we use every application on a regular basis. It is an opportunity for developers and businesses to develop chatbots to serve their users. In several, chatbots were used for answering questions, providing customer information, providing train schedules, helping customer reservations, virtual assistants; serve as call centers to serve ten million customers automatically. Nowadays, artificial intelligence or AI is used instead of the shop staff of various stores, for example, some shop recently announced the launch of AI for customers to order goods through the sound in mobile application. The AI implementation will allow each client to order a customized theirs good directly. Using AI to do business for customers, the profit will be increased. From that reason, if we can develop chatbots for businesses to be able to bring chatbots to serve users in different ways, it will greatly benefit to the business. Accordingly, ours research's objective is to develop a prototype of interactive trading system for small businesses. Deep learning technique is used to help chatbots more powerful.

The rest of paper is organized as follows. Section II presents a related theory of deep learning and natural language processing. The proposed approach to chatbots is detailed in section III. Experimental results and discussions are shown in section IV. Section V concludes the paper.

II. RELATED WORK

Related theory inside this research concerns with convolution neural network, also named as deep learning. Deep learning [3] is a branch of machine learning that mimics the neuronal system in the human brain (neural network). Therefore, its ability in the future may be supernatural. It can increase the amount of processing power, which can simulate the nerve and neurons (called node) into Artificial Neural Network (ANN). This model composed of three parts: input (data received), the neural system in the brain processes is comparable to the hidden layer, the brain responds after processing is the output layer or the result as shown in Figure 1.

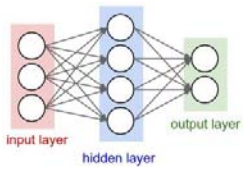

Figure 1. Structure of Artificial Neural Network (ANN).

Deep Learning is artificial neural network with many hidden layers. The ability to process more than usual. Many

hidden layers make it very complicated. Figure 2 shows the structure of deep learning neural network.

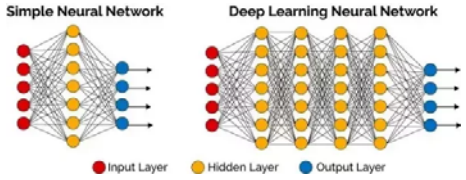

Figure 2. Deep Learning Neural Network.

Several researchers have been interested in exploring the details of Deep Learning and Chatbot. Alessandro Sordoni, et. al [1] presented a research paper on *Neural Network Approach to Context-Sensitive Generation of Conversational Responses*. They offers an exhilarating response system that can be traced to the end of unstructured Twitter conversations. Neural network architectures were used to identify issues that arise when contextual data is included in a classical statistical model, so that the system can consider the preceding discussion. The dynamic model of the researcher's context shows good performance in terms of machine translation and context-sensitive querying.

Oriol Vinyals, Quoc Le [5] presented a research paper entitled "*A Neural Conversational Model*". In this research, modeling conversation is an importance task for understanding the natural language and intelligence of the machine. Although previous methods exist, they are often limited reserved only for some domains and require handcrafted rules. In this article, the researcher presents a simple guideline for this task, which uses sequential sequencing technique. The model of this research was guessing the next sentence by using the previous sentence in the conversation. The strength of this model is end-to-end training and makes fewer hand-built rules. They found that this straightforward model could easily create a dialogue for a large series of training sessions. The preliminary study of them pointed out that although the target function was incorrect; the model was able to communicate well. It can extract knowledge from both domain-specific sets and from large, noisy domain and general-purpose domain names in the IT helpdesk datasets. The data set is the open movie series, noisy domain formats that can be implemented for a simple reason. We also found that the lack of consistency was a common failure mode of the model.

Lifeng Shang, Zhengdong Lu, Hang Li [6] presented the *Neural Responding Machine for Short-Text Conversation (NRM)*, a response generator for the network. NRM uses a common decoding and decoding framework, it generates a response as a decoding process based on the latency of the input text, while encoding and decoding takes place. Along with recurrent neural network (RNN) . NRM has been training with several ways to loop a certain amount collected from the service. Empirical studies have shown that NRM can generate accurate grammatical responses and intelligent content in response to more than 75% of text input than better state-of-the-art in settings. The foundation of chatbots is providing the best response of any query that it receive. The best response like answering the sender questions, providing sender relevant information, ask follow-up questions and do the conversation in realistic way. Figure 3 illustrate the conceptual map of chatbots using deep learning [16].

Based on the previous researches and the occurring problem, ours research is interested in developing an interactive system prototype in the trading of goods for small businesses. Deep learning technique are used for training to help chatbots more powerful.

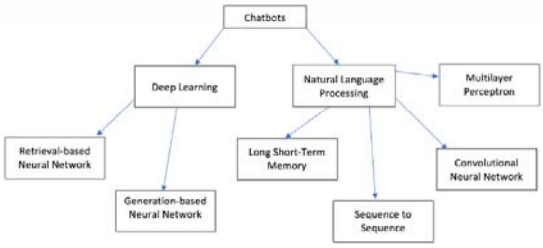

Figure 3. Deep learning neural network for chatbots [16].

III. METHODOLOGY

A. System overview

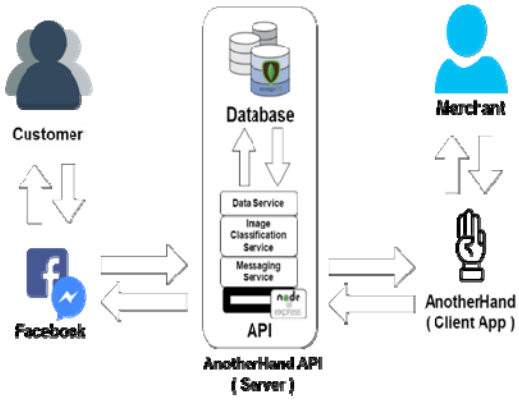

Figure 4. System overview.

From Figure 4, the details of the proposed system are explained as follows. **Customer** is the representative of the customer of the system, which will be contacted by sending messages via Facebook to the administrative of Facebook page of the shop as usual. Then, **Facebook Webhook** will send those messages to the server. **Server** is the system

behind the client (web application) which will receive messages from Facebook Webhook and various information from the client. The service is divided into 3 major services as follows: *Data Service*, *Image Classification Service*, *and Messaging Service*. *Data Service* is responsible for adding, deleting, updating or searching various information from the database, which can be composed by store information, conversation, product information and purchase orders. *Image Classification Service* serves to inspect and search for images received through the message or from the seller. *Image Classification Service* is divided into 2 parts: the part of checking whether the image from the customer's message is a valid of transfer or not. If yes, it will change the status of the last order of the customer who sent the image to pending status and update the number of stock of the product that was ordered. However, if the checked image was found that it is not a valid of payment, it will take that image send back to the customer via the Messaging Service. *Messaging Service* accepts and sends messages between the system and Facebook via Facebook Webhook and Facebook Messenger API. **Client** is a web application for merchants to use, which consists of a view of products, chat rooms, order lists and parts for various settings

For details of chatbots components, in this research we developed the chatbots with the following details: when given user input, heuristics was used by the system to locate the best response from its database of pre-defined responses. The most appropriate response template may involve simple algorithms like keywords matching or it may require more complex processing with machine learning or deep learning for the dialogue selection process which is the essentially a prediction problem, and using heuristics to identify. Regardless of the used of heuristic, these systems only regurgitate pre-defined responses and do not generate new output.

With a large amount of data available, to build a retrieval based conversational system can be created more easily as information retrieval techniques are developing fast. To query the candidate response from the system, a user's input utterance was submitted as a query. The matching metrics were performed to give the better results. We presented the retrieval based conversational system by using the matching algorithms between the input utterance and the candidate responses. The inner product of two feature vectors for queries and candidate responses was calculated. Before the inner product was performed a transformed space of these two inputs are calculated. A mapping from the original input to the feature vector was the importance steps to be performed. A retrieval technique with two steps was considered. Firstly, a fast ranking by standard **TF-IDF** measurement and secondly, the re-ranking process using conversation-oriented features designed with human expertise. In this research, we applied the statistical language model called *cross-lingual information retrieval* for select the most matching between the query and responds pairs in database. Inside this method, it learn representations with deep neural networks (DNNs). Inside the representations are based on shallow representations, which used the one-hot representation of word. To use deep neural networks they can extract underlying abstract features of data automatically by exploring multiple layers of non-linear transformation. The combination between convolution neural networks (C-NNs) and recurrent neural networks (RNNs) was used inside this model. A series of matching methods can be applied to short-text conversations for retrieval-based systems. Not all of these methods were originated for conversation problems; however, they give a good effective for short-text matching tasks and are included as strong baselines for retrieval-based conversational studies. The architecture of these combination methods was shown in Figure 5.

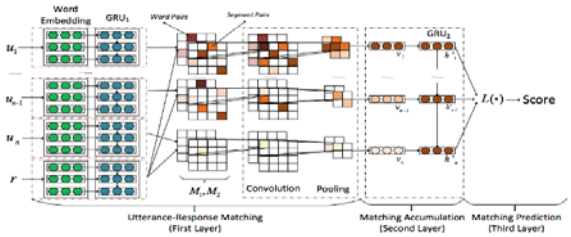

Figure 5. Deep Learning Neural Network for chatbots [16].

To use Deep Learning to train chatbots to talk intelligently, to address issues, and to translate our purposes accurately from the questions we ask. The model uses sequence-to-sequence (Seq2Seq) or encoder RNN that was first introduced by Sutskever, Vinyals and Le [17]. The advantage of the Seq2Seq model is that it does not limit the size of input and output like any other machine-learning model. We are not necessary to know the size of the input that comes in advance, such as translating machine translation, speech recognition, or question answering using the chatbots. Dataset used in the training phase of this work is a work of the log of the message. The message was wrote on social media such as Facebook was used to train the model. The data in social media log was the main data set. We provide python code to organize the data into a working format and use Word2Vec to create the word vector. The Seq2Seq model was trained. We wrote the code on TensorFlow that has the rnn_seq2seq function available. We, deploys a model that is already trending using the Flask server, linking to the Facebook Messenger chatbots. The aims of this training was to develop the intelligence chatbots, which can interact to the user and can talk by using its own language.

B. Back-end Architecture

Figure 6. Back-end Architecture.

From Figure 6, each section has the following functions: **NodeJS**: it is used as JavaScript runtime for JavaScript code. Express.js: it is used as web application framework, manage request to server. **Socket.IO**: it is used for manage data transmission that requires real-time, such as displaying messages. **TensorFlow.js**: it is used to detect payment evidence from the incoming messages. **OpenCV4nodejs**: it is used to resize and compare product images in the searching process. MLab, MongoDB in the cloud format is used as the main database. Cloudinary: cloud storage is used to store all product images.

C. Front-End Architecture

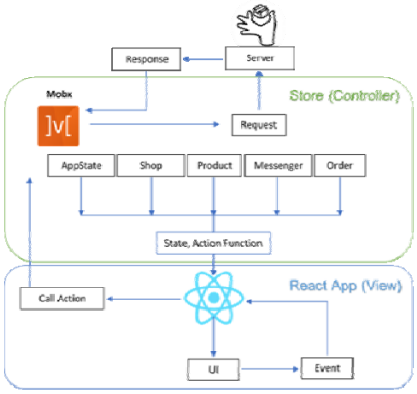

Figure 7. Front-end Architecture.

Figure 7 showing in this section is a front-end architecture of the web application. It has the following main elements: *the Mobx Store* is a section that stores all the important logic on the web application. *The Mobx Store*, which consists of 5 sub-stores: AppState for storing state and logic about various status of the web such as the app is loading important data or not, which is the logic used to display loading, overlay is stored in the store as well. *Shop* is a store for storing various details of the shop. *Product* is a store for storing logic about product items including various loading functions, update or add products to the database, which will be sent to React App to run. *Messenger* is a store for storing logic about conversations or messages by the list of chat rooms. The function of receiving and sending messages is within this store. *Order* is a store for storing logic about order items and functions regarding status updates of various order items. The process for receiving messages from customers is as follows. When the client sends a message / chat to Facebook Page, the Webhook system will send that message to the third party API callback link, registered with Facebook Webhook. When the API of the system receives a message from Webhook, it will store that message into the database. Then will check the message received whether there are pictures attached or not. If there are pictures attached, it will classify images (Image Classification) as whether or not it is a valid of payment. If the invalid picture occurred, it will not search for products. If the message contains a valid of payment, the system will alert the seller to check the amount that is entered into the account and whether the evidence is true or not. Then click to confirm the correct information to send back to the system to change the status of the order or press reject to notify the customer if the information is incorrect. While notifying the request for confirmation of information to the seller and waiting for the answer, the system will temporarily remove the product from that order to prevent others from ordering, which will be brought back into the system if proof of payment is rejected. If the message contains images that do not have a money transfer evidence, the system will assume that the image is a product image and will be compared to the whole product image by using the template matching. The image from the text is the target and all product images are changed to the template until the shop ends. If the matching template is found, which product result will bring the information of that product to send and reply to the customer with the order button and click to see details. If the message does not contain images or in the other forms, the system will just send the message to the seller only. According to messages with large amounts of data, the chatbots can answer customer questions that take a long time to find information, such as color and price. It can use shortcut keys to retrieve information from the database. According to this process, it will effect to the quickly answer to customers. User or customer can search for products by entering the condition to that responds page, which it can send back the result to user. In this way, the product will be sent as a text template, which will include the product image, text and order buttons.

D. Data set

To train the chatbots to more powerful of ours proposed system, the Cornell_Movie-Dialogs_Corpus dataset was used. The Cornell_Movie-Dialogs_Corpus dataset is a natural language dataset and cannot be used in its exact form. It needs to be converted in a suitable data structure in order to use it for further computation and processing. The first step in the pre-processing is to tokenize the sentences into different words. Next, the sentences were split into stories, questions and answers so that they can be fed to the proposed models. Combining all the stories- All the stories were then combined up to the point that the question was asked. This finally becomes the story for that particular question. Finally,

the questions and stories are indexed according to their time of occurrence and are eventually processed via word2vec model. The answers are transformed to one hot encoded vector.

E. Measurement of Algorithm's Performance

Tensorflow already comes with many standard evaluation metrics that we can use. To use these metrics we need to create a dictionary that maps from a metric name to a function that takes the predictions and label.

```
tf.metrics.accuracy(
    labels,
    predictions,
    weights=None,
    metrics_collections=None,
    updates_collections=None,
    name=None
)
```

IV. Results and Discussion

The results of proposed algorithm can be summarized as follows: The process of creating a web application for managing Facebook Page for selling online is divided into 2 parts as follows: **System part**, the system can add and edit products by the owner of the page. It can store the name and image information of the client's Facebook when a conversation occurs. In addition, it can store messages from Facebook to the database. The system can send messages to customers who have already collected data. The system can search for products with pictures. It can automatically import images from Facebook messages to search for products and send customer details. Moreover, the system can display real-time conversation and order lists. Sellers can contact customers on Facebook via the system. The system can automatically create an order list when the order button is pressed. Secondly, the part of **users** (page owners) has the following functions. Users can view the entire product list. They can add or edit product information, can view the order list, can send pictures from chat rooms to search for products. Moreover, users can turn off automatic product search. In addition, the users of the web application can order product in the list page, which list all orders by displaying the order information, ordered products, status of the item, and buttons for changing the status of the item. The status of the item can be shown in a chat room by clicking on the picture of the customer and can view product details by clicking on the product image.

A. Examples of Program Functions

The following is example of user interface for chatbots in Trading System for SMEs. Figure 8 shows a List all products page, which can be used to search for the desired product as well. User can click the view button to view product's details, to edit product's details. In addition, user can press the product they want to send to the customer in the chat room.

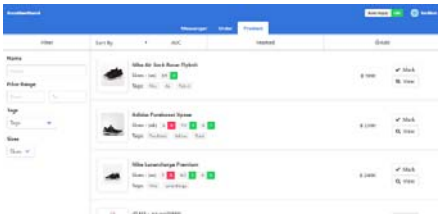

Figure 8. Product's details page.

Users can enter product details and send to the server at this page, which can upload 10 pictures and can set the size for the product as shown in Figure 9.

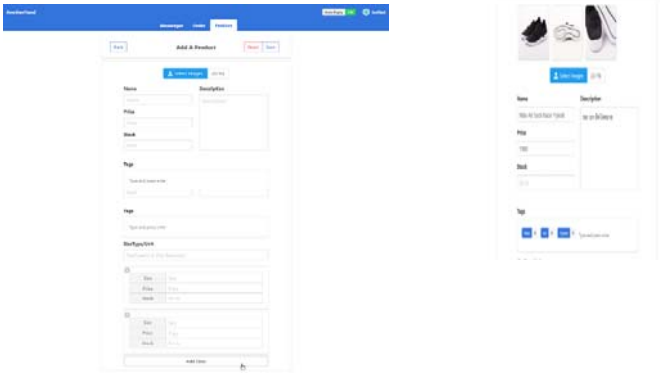

Figure 9. Chat room listing page

List of customers who send all messages in real-time were shown in Figure 10. Users can contact with customers, read messages, search products from pictures of customers in the chat room. Users can send information and order in an order buttons, and can reply to messages. The new incoming messages will always be in the top chat room.

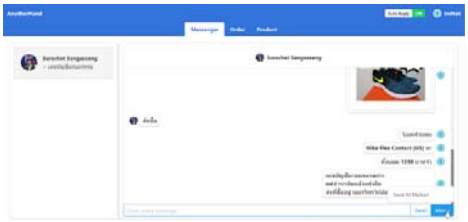

Figure 10. Chatbot page.

Finding products from the chat room was shown in Figure 11. Users can click on the picture in the chat room to find the product's details in the search page. When the product found, the chatbots can send the product details to the customer immediately.

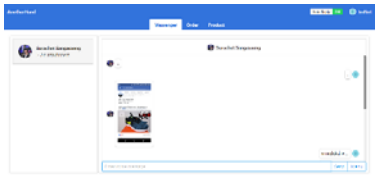

Figure 11. Product's details page.

V. CONCLUSION

From the function development in the online sales assistant application system via Facebook Page. The system composes of two parts: system and user page. In the part of the user, users can access the web application, add and edit product information, use chat rooms on the web to chat with customers instead of Facebook. Users can use pictures in chat rooms to find products, can search and select multiple products to send to customers, can view all order items that have been generated in the system including changing the status of each item as well. Users can turn off the automatic message answering system. The system can automatically search for products for customers when receiving pictures from customers via Facebook. The system can display customer information as soon as the message is sent. It can create an order list or send more details to customers when the customer presses the command buttons that the system sends to Facebook.

Problems encountered in this system is to execute some libraries that are still unstable, such as TensorFlow.js for Node.js that can run on a normal browser but cannot run when running with Node.js. Comparing images using algorithms, if the image is much distorted, it will result in a much worse result. The development of the server is still not complete because the library in the language used is still a problem. For the learning of chatbots conversation, if we able to do text recognition, we can create AI for answering messages with more correctly.

In our work, we used the convolution neural network technique by using Tensorflow training to improve the accuracy of these chatbots.

From the experimental results, using deep learning for chatbots learning, the accuracy is better than the traditional model. Ours research's objective is to develop a prototype of interactive trading system for small businesses. Deep learning technique is used to help chatbots more powerful.

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