

Improving Back-End Services for Community Enterprise Through using Thai Chatbot

Sumitra Nuanmeesri, Lap Poomhiran



Abstract: Nowadays, chatbots are widely used in business and marketing. Especially in the front-end of application is used to the automated customer response service. This research presents Thai chatbot that helps increase the efficiency of usage for community enterprise entrepreneurs. This system focusing on back-end services such as payment status, product delivery, and product sales information. It can help entrepreneurs to inquire or check their selling information through a Thai chatbot using ontology technology to help identify messages from users and matching the results from the developed web services. It can classify the Thai words or messages from users say and respond to the relevant back-end services to the user with an efficiency value of over 90%. As a result of black box testing, Thai chatbot had the highest effectiveness in improving the back-end service for community enterprise entrepreneurs.

Keywords: back-end services, chatbot, community enterprise, ontology, social media marketing.

I. INTRODUCTION

Technological advances are changing the way people communicate and connect with others in the social media movement. It can directly influence sales and marketing. It enables users to track carry out additional social media interactions on their own. Social media is an instrument that helps communities' benefit and communicates more directly to consumers and entrepreneurs. Causing the sale of products today requires the use of social media technology to apply in the business.

In usually, the e-marketing will focus on front-end management to sell products mainly. On the other hand, back-end management is responsible for providing and providing information for customers and entrepreneurs for monitoring and viewing the movements and activities that occur in sales processes that are more difficult to manage than the front-end management. It needs to be adjusted to be in line with the behavior of consumers to buy products online that can change at any time.

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Although selling products online helps increase marketing opportunities and sell products to community enterprise product entrepreneur, but it still has problems because selling products online is different from selling products at the shop or store. There is a post-sale procedure that must verify the accuracy of the daily sales to match the amount transferred into the account as well as contacting the purchase situation, product shipping, and the number of inventories in the warehouse. These processes are quite a difficulty for entrepreneurs selling their products in community enterprise.

There is a lot of research that brings chatbot to support the front-end product sales process and also focuses on the purchase. In the community enterprise product, most of the entrepreneurs are elderly who have not knowledgeable in information technology. Therefore, the purpose of this research is to use the concept of adaptive ontology used in Thai chatbot as back-end services on social media such as Facebook to help sellers monitor sales of products and the status or daily payment amount for community enterprise.

II. RELATED WORKS

To increase and improve the back-end services for community enterprise entrepreneurs using Thai chatbot, there are three main related knowledge: back-end management, chatbot, and ontology. The related works show as following.

A. Back-end management on social media marketing

Nowadays, social media is used to communicate and communicate directly to business and marketing. Social media is an important tool for doing business in both front-end and back-end. Osterwalder and Pigneur [1] introduced the business model canvas framework for business operations. There are nine main sections which are categorized into front-end business and back-end business. The front-end business is consisting of five sections, there are customer segments, value propositions, channels, customer relationships, and revenue streams. For the back-end business, it includes key resources, key activities, key partnerships, and cost structures [1]. Considering the factors that affect the business, the front-end is a business process that involves external factors. And the back-end, it is related to the internal factors of the business [2]. Business can reduce their cost of production while retaining quality content that helps a wide range of value propositions to consumers by using social media marketing. Because of the internet and social media platforms allow creating unique business models, including the values of social media resources which are not their own [3][4].



Buying and selling goods via social media does not finish with paying, but there is a more important part of the back-end business. The back-end business is hidden out of the customer sight such as the summarizing daily sales, packaging for each customer, reporting the delivery results to each customer. These processes are the back-end business which does not explain in social media marketing. The back-end business is considered an important process in managing the resources that the organization has to make products and services valuable to customers [5]. Moreover, financial management is included in the back-end business process. It is considered the cost of business operations. The business model canvas framework shows as Figure 1.

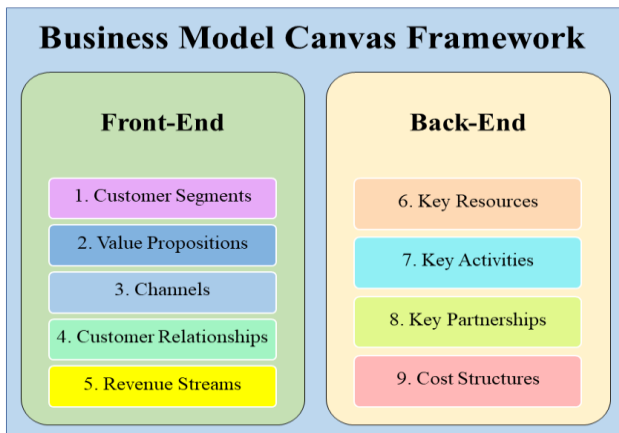


Fig. 1. Back-end and front-end of business model canvas framework (CC BY-SA 3.0).

B. Chatbot

The chatbot is computer software, which imitates human conversation, including text or language, in their natural format which is processing with artificial intelligence technologies [6] such as the natural language processing (NLP) [7]. The most important feature of chatbot is that it evolves from the previous conversation and becomes smarter over period. Chatbot has two forms of style, there are rule-based and smart machine-based. The rule-based chatbot determines the format of the message to be interacted in advance by relying on keywords and stored in the database by users. The smart machine-based chatbot is based on the principles of artificial intelligence (AI) and cognitive computer technology applied to respond to customer inquiries [7]. Nowadays, many users use chat applications, especially on social networks [3]. It is predicted that by 2020, up to 85 percent of machine automation will be used for responding to customers [8]. The new era of customer interaction for e-commerce applications is being used by chatbots as intelligence of conversation [9]. Media Agility [10] shows that chatbots help increase sales, increase efficiency of customer service to be completed, and reduce costs a lot.

On social networks such as Facebook, entrepreneurs can place chatbots like plug-ins for interacting or chatting with customers through Facebook Messenger. Most companies know that Facebook can be used in marketing [11] to deliver company messages and keep the relation to their customers which are one of over one billion users that cannot be ignored

[12]. Chatbot is a tool in Facebook Messenger that can replace people in the organization and other plug-in chat tools [13]. It has been used mainly for service to customer interactions and conversations.

C. Ontology

An ontology is a form of presenting the relationship between a network of terms and their meanings. It is conceptual for the identification of terms to represent the relevant domain knowledge [14] as hierarchy or instance. Currently, ontology technology is applied to use with chat systems such as chatbots for improving and responding to the right messages to customers. According to Nuanmeesri and Poomhira [14], ontology is applied to support customers for Thai chatbot on social media marketing. Altinok [15] shows that the ontology-based dialogue manager (OntoDM) is used to collect the conversation and to offer the solution in banking and financial system.

Therefore, in this research, there is a concept that uses Thai chatbot on Facebook as a back-end service system for community enterprise entrepreneurs by using rule-based chatbot based on ontology technology.

III. RESEARCH METHODOLOGY

This research method adopted in the Thai chatbot to improving back-end services for community enterprise entrepreneurs, include the following steps:

A. System analysis and design

The rapid application development (RAD) was conducted for this work to save cost and time. It has four steps for application development; requirement planning, design, development, and cutover [16]. RAD was illustrated in Figure 2.

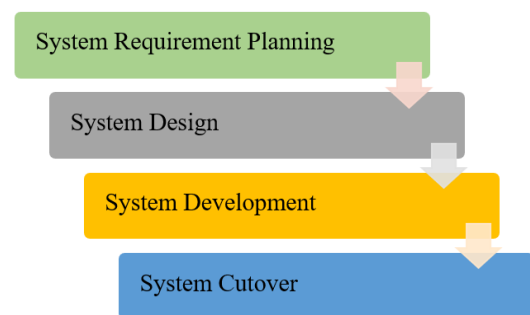


Fig. 2. The rapid application development framework.

In the step of system requirement planning, we gathering the data and seller inquiries in terms of the post-sale procedure for community enterprise such as quantity of products sale, shipping status, and daily sale amount. All data and user requirements were collected using the survey which answered by entrepreneurs. There are 17 community enterprises which have 370 records of products in total of the sampling group. These questionnaires were collected by using direct interview methods. The user requirements were analyzed for system design at second step.

Next, we design the user interface (UI) which supports a display on the smartphone which is suitable and meets the needs of users obtained from the survey collection from the previous step. This system design was evaluated by five experts who are specialists in the field of information technology and marketing.

In this research, the Index of Item-Objective Congruence (IOC) [17] is applied to evaluating the performance of system design which evaluated by these experts. There is three rating score which are -1, 0, and 1. Each rating score has a meaning as in Table 1.

Table- I: IOC rating scores for system design evaluation

| Rating score | Rating score meaning |
|--------------|---|
| 1 | The content design is consistent and appropriate to the desired objectives. |
| 0 | The content design may not be clear whether it is consistent or appropriate for the intended purpose. |
| -1 | The content design is inconsistent and inappropriate to the desired objectives. |

Each item in the system design assessment will be combined with the evaluation results from experts by the average score which is IOC that calculated in (1) [18].

$$IOC = \frac{\sum R}{N} \tag{1}$$

Where:

$\sum R$ is the total of scores by each item of system design.

R is the score assessed by each expert for each item of system design.

N is the number of experts in total.

The maximum of IOC score is 1. If the IOC score for each item of assessment for system design is equal to or over 0.5, this system design is consistent and appropriate for development in the next step. From the results of the IOC evaluation by all five experts, each item of system design has an IOC score of 0.8 or higher. Resulting in knowing that all the system designed items are consistent and suitable for use in system development in this work.

B. The system development of back-end services for community enterprise entrepreneurs

In order to develop the back-end services for community enterprise through using Thai chatbot on Facebook, there are three main phases for development; ontology structure creation, back-end web services, and chatbot output mapping. This system framework diagram illustrated as Figure 3.

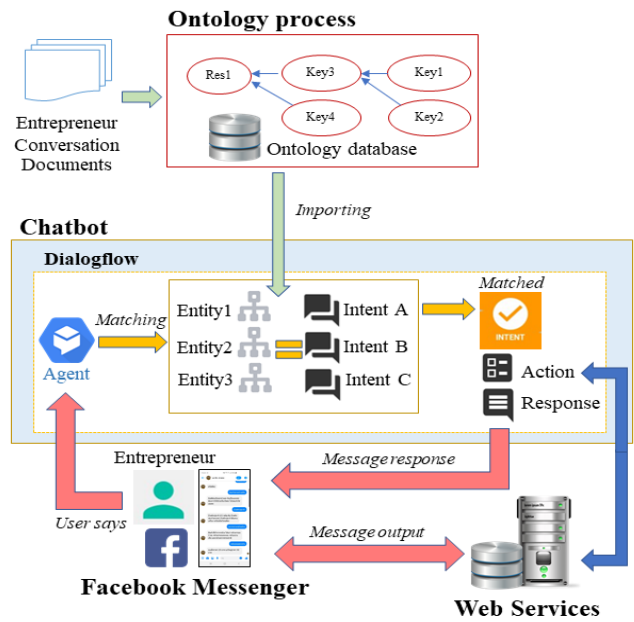


Fig. 3. System framework diagram of back-end services for community enterprise entrepreneurs using Thai chatbot.

First, ontology structure creation, we gathering the Thai entrepreneur’s conversation 850 documents which are relevance to back-end services such as quantity of products sale, shipping status, and daily sale amount. These documents were processed for Thai word segmentation by longest matching technique. Then extract the keywords and knowledge terms related to user inquiries for back-end services. All keywords and knowledge were stored in the ontology database.

Next, back-end web services, this phase provides the information that response back to users or entrepreneurs who request the result of back-end services through the chatbot. All information about the back-end processing was generated into a query which is formal of uniform resource locator (URL) as web services. These web services were programmed in PHP language version 7.3.10 and running on Apache web server version 2.4.41. The results of back-end services can be displayed in many forms such as a number of product sales, graphic or image, excel files, hyperlinks or web pages.

Last, chatbot output mapping is the last process for the association between users’ inquiries and the results from web services. The Dialogflow [19] is conducted to manage the ontology of dialogue from entrepreneurs and the action responding of back-end web services. Dialogflow will be mapping the ontology structure as an entity and intent for the action message response back to the user. The result will be displayed back to the screen when the entrepreneur types the inquiry into Facebook Messenger. The example results shown in Figure 4 to Figure 6.



Fig. 4. Result of user inquiry when the user says for the user manual of Thai chatbot.

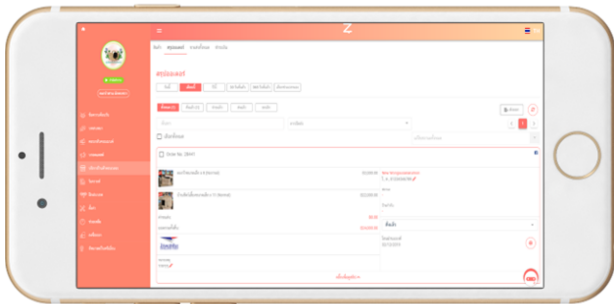


Fig. 5. Result of user inquiry when the user says for checking sales by product.



Fig. 6. Result of user inquiry when the user says for reporting daily sales amount with password requires.

C. Thai chatbot evaluation

This developed system has been evaluated for the efficiency of word classification or message from Thai chatbot on Facebook Messenger by ten experts in field of information technology and marketing or business. The efficiency values include precision, recall, F-measure, and accuracy values which can be calculated in (2), (3), (4), and (5) [16] respectively.

$$Precision = \frac{TP}{TP + FP} \tag{2}$$

$$Recall = \frac{TP}{TP + FN} \tag{3}$$

$$F - measure = \frac{2 \times Precision \times Recall}{Precision + Recall} \tag{4}$$

$$Accuracy = \frac{TP + TN}{TP + FP + FN + TN} \tag{5}$$

Where:

TP: the user message is relevant to the back-end services, with the response output matching the back-end services.

TN: the user message is irrelevant to the back-end services, with the response output does not match the back-end services.

FP: the user message is irrelevant to the back-end services, with the response output matching the back-end services.

FN: the user message is relevant to the back-end services, with the response output does not match the back-end services.

The overall of Thai chatbot for community enterprise entrepreneur was evaluated in black-box testing by thirty users who are entrepreneurs, and five experts who expertise in information technology and marketing. The black box testing is used to measure the effectiveness of Thai chatbot system in terms of functional testing, compatibility testing, usability testing, performance testing, and security testing. All criteria topics of evaluation in black box testing were graded and analyzed to mean and standard deviation (SD) values [20] by scoring one to five points according to the Likert scale [21] guidelines.

IV. RESULT AND DISCUSSION

In this research, the back-end services for community enterprise through using Thai chatbot was implemented and evaluated. The results were shown as follows.

A. The efficiency of Thai chatbot as back-end services

The result of the efficiency of the chatbot was evaluated by ten experts. The precision, recall, and f-measure value are 96.77%, 97.83%, and 97.30% respectively. The accuracy of this system is 90.05%. The results show that this Thai chatbot can classify the Thai words or messages from users say and respond to the relevant back-end services to the user with an efficiency value of over 90%.

B. The effectiveness of Thai chatbot

The results of the effectiveness of Thai chatbot in black box testing shown that functional testing and usability testing are the highest mean value. For expert's evaluation, the mean value is 4.80 and the SD value is 0.45. For entrepreneur's evaluation, the mean value is 4.88 and the SD value is 0.33. The mean values for all criteria topic of evaluations are equal or higher than 4.60 for both experts and entrepreneurs. Considering to average of the total, the mean values are 4.68 and 4.75 for expert and entrepreneur's evaluation respectively.

Thus, the developed Thai chatbot of back-end service for community enterprise entrepreneurs had the highest effectiveness, as shown in Table II.

Table- II: The results of effectiveness of Thai chatbot

| Criteria topic of evaluation | Experts | | Entrepreneurs | |
|------------------------------|-------------|-------------|---------------|-------------|
| | Mean | SD | Mean | SD |
| 1. Functional Testing | 4.80 | 0.45 | 4.88 | 0.33 |
| 2. Compatibility Testing | 4.60 | 0.55 | 4.71 | 0.47 |
| 3. Usability Testing | 4.80 | 0.45 | 4.88 | 0.33 |
| 4. Performance Testing | 4.60 | 0.55 | 4.65 | 0.50 |
| 5. Security Testing | 4.60 | 0.55 | 4.65 | 0.50 |
| Average of total | 4.68 | 0.48 | 4.75 | 0.43 |

C. User acceptance of Thai chatbot

The results of user acceptance of the Thai Chatbot based on black-box testing show that all criteria topic of evaluations focusing on the interquartile range (IQR), it does not over 1, and the quartile deviation (QD) does not over 0.5. Therefore, the user acceptance of Thai chatbot is high consensus when it was evaluated by experts and entrepreneurs. All results of the quartiles, IQR, and QD were shown as Table III.

Table- III: The results of user acceptance of Thai chatbot

| Criteria topic of evaluation | Mean | SD | Quartiles | | | IQR | QD |
|------------------------------|-------------|-------------|-----------|----------|----------|----------|------------|
| | | | Q1 | Median | Q3 | | |
| Experts | | | | | | | |
| 1. Functional Testing | 4.80 | 0.45 | 5 | 5 | 5 | 0 | 0 |
| 2. Compatibility Testing | 4.60 | 0.55 | 4 | 5 | 5 | 1 | 0.5 |
| 3. Usability Testing | 4.80 | 0.45 | 5 | 5 | 5 | 0 | 0 |
| 4. Performance Testing | 4.60 | 0.55 | 4 | 5 | 5 | 1 | 0.5 |
| 5. Security Testing | 4.60 | 0.55 | 4 | 5 | 5 | 1 | 0.5 |
| Total | 4.68 | 0.48 | 4 | 5 | 5 | 1 | 0.5 |
| Entrepreneurs | | | | | | | |
| 1. Functional Testing | 4.88 | 0.33 | 5 | 5 | 5 | 1 | 0 |
| 2. Compatibility Testing | 4.71 | 0.47 | 4 | 5 | 5 | 1 | 0.5 |
| 3. Usability Testing | 4.88 | 0.33 | 5 | 5 | 5 | 1 | 0 |
| 4. Performance Testing | 4.65 | 0.50 | 4 | 5 | 5 | 1 | 0.5 |
| 5. Security Testing | 4.65 | 0.50 | 4 | 5 | 5 | 1 | 0.5 |
| Total | 4.75 | 0.43 | 5 | 5 | 5 | 0 | 0 |

V. CONCLUSION

This research presents the Thai Chatbot on social media based on Facebook to improve back-end services for community enterprise entrepreneurs. The ontology is used to matching the keywords from user inquires and the message responding as action, URL, excel files, and webpages which are related to back-end services. The black box testing is conducted to test this chatbot system in term of functional testing, compatibility testing, usability testing, performance testing, and security testing. All black-box testing for measuring the system efficiency and effectiveness of user acceptance of the Thai chatbot while being used at the highest level by experts and entrepreneurs. It can be said that Thai chatbot on social media could be effectively used to support community enterprises entrepreneurs in improving back-end services. For further work, we will present the Thai Chatbot

techniques for fully support both customers and entrepreneurs in the business model.

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