DEVELOPMENT OF A CONVERSATIONAL AGENT FOR HEALTHY FOOD RECOMMENDATIONS IN THAILAND

Jarumon Nookhong[1], Nutthapat Kaewrattanapat[2], Phachaya Chaiwchan[3], Natcha Wattanaprapa[4]

[1,3,4] Faculty of Science and Technology, Suan Sunandha Rajabhat University, Thailand

[2] Faculty of Education, Suan Sunandha Rajabhat University, Thailand
Email: jarumon.no@ssru.ac.th[1], nutthapat.ka@ssru.ac.th[2], phachaya.ch@ssru.ac.th[3], natcha.wa@ssru.ac.th[4]

Abstract.

This research aims to (1) develop a conversational agent system for healthy food recommendations in Thailand, and (2) evaluate the efficiency of the conversational agent for healthy food recommendations in Thailand. The research tool used in this study was a questionnaire to assess the efficiency of the developed system, which was evaluated by 17 experts using Mean, Standard Deviation (S.D.), Median, Interquartile Range (IR), and Quartile Deviation (QD). The research findings indicate that the group of experts unanimously approved the developed system. The results can be summarized in three aspects: System efficiency and requirements (Mean=4.28, S.D.=0.15, IR<=1 and QD<=0.5) System operational efficiency (Mean=4.29, S.D.=0.37, IR<=1 and QD<=0.5) System design efficiency (Mean=4.75, S.D.=0.25, IR<=1 and QD<=0.5) In conclusion, the developed system is suitable for practical use and can effectively recommend healthy foods and cooking methods. Additionally, it can track users' ingredient search behavior to provide relevant healthy food recommendations, thereby supporting consumers' decision-making processes.

Keywords: Conversational Agent, Recommendations, Healthy Food

1. Introduction

The stressful work lifestyle in urban societies often leads to a lack of rest, exercise, and self-care, resulting in changes to the eating habits of Thai people. This is considered a high-risk behavior for serious diseases and subsequent health problems. Repeatedly consuming the same foods may lead to incomplete nutrient intake and nutritional deficiencies (Niyomsuk, 2017). The Thai Health Report 2014 stated that obesity is a cause of easy illness, leading to various diseases. Obesity can simultaneously cause multiple chronic non-communicable diseases, including high blood lipids, hypertension, diabetes, stroke, and heart disease (Pornsukvivatana, 2017).

Currently, healthy eating has gained significant attention, especially among the elderly who are increasingly focusing on health care and consuming healthy food. Thailand is trending towards an aging society, with more than 20% of the total population aged 65 and above, mostly female. Adolescent and working-age consumers are also continuously increasing their

consumption of healthy food, choosing low-fat foods, unsaturated fats, mild-flavored foods, or foods that provide energy balance to the body. These choices promote health and may reduce the risk of potential diseases or prevent subsequent complications, leading to better health (Poolpraj & Smithr, 2020). With technological advancements, people can live their daily lives more easily (Jullabudee, 2019). Recommendation systems are among those that can analyze content-based data, recommending information similar to what users are interested in, and analyze user behavior references (Collaborative Filtering) to recommend information to users based on popularity (rating). Currently, the trend of applying chatbots has gained increasing importance in research with many existing applications, offering flexibility and applicability to applications such as Line and Facebook Messenger (Kaewrattanapat et al., 2019; Alotaibi et al., 2020). Sixty-seven percent of business people view chatbots as growing beyond applications and likely to grow rapidly. This can be seen from many business owners stating that chatbots are more interesting than applications (Tangkriangkij, 2020). Health care recommendations for health-conscious groups are becoming popular, as healthy eating is currently gaining much popularity (Manoi et al., 2019). The trend of people's health care is also currently very popular and is expected to become more popular in the future, such as choosing nutrient-rich foods and taking care of both physical and mental health. Controlling food intake and exercise helps control weight, improve skin, and reduce body fat. Chatbots are being used to answer questions about nutrition and daily exercise details, simulating natural language interaction with users to increase user understanding (Alotaibi et al., 2020).

Therefore, the researcher has the concept of developing a conversational agent for recommending healthy food in Thailand by applying the Dialogflow platform and LINE Developer. This system can recommend healthy food by typing the name of ingredients used in cooking. The system will recommend healthy food along with recipes and cooking methods. Additionally, the system will store the user's ingredient search behavior to help recommend relevant healthy food back to the user. This supports consumer decision-making and helps those who want to cook healthy food enjoy cooking and avoid monotony in eating while receiving a variety of nutrients.

Research Objective

This research aims to:

1. Develop a conversational agent system for recommending healthy food in Thailand.
2. Evaluate the effectiveness of the conversational agent for recommending healthy food in Thailand.

2. Research Methodology

2.1 Data Analysis and Synthesis

The researcher collected and analyzed data from various relevant documents, including research related to healthy food content. Traditionally, consumers would search for information from multiple sources, which often led to an overwhelming amount of data. This caused consumers to spend considerable time deciding on food choices that met their needs from various sources.

The study focused on analyzing and synthesizing factors affecting the development of a conversational agent for recommending healthy food, which aids in decision-making

regarding food types and ingredients that consumers want to know about. From studying and synthesizing these factors, the researcher proceeded by analyzing and synthesizing documents and research related to the development of a conversational agent for recommending healthy food. The results can be summarized as follows:

The study and synthesis of factors yielded four key factors applicable to this research:

1. Data Collection Factor: This involves gathering information on food menus, ingredients, and cooking methods.

2. Information Search Factor: This aims to make it convenient for users to search without needing to look for information from multiple sources.

3. Time Management Factor: This reduces the time spent searching for information by consolidating data for easy access.

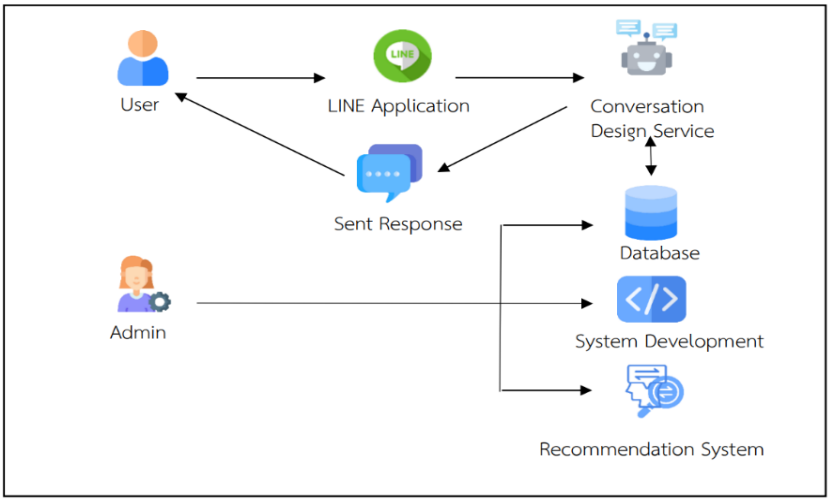
4. Decision Support Factor: This provides additional options to support user decision-making.

The researcher has used these factors as a basis for developing the conversational agent for recommending healthy food.

2.2 System Analysis

The system analysis was conducted to understand and recognize the problems and solutions. The system workflow is illustrated in the following diagram:

Figure 1: System Workflow Diagram



From Figure 1, the system workflow can be explained as follows:

- The User accesses the LINE Application. The user then types ingredient information to search for healthy food menus. This ingredient data is sent to the Conversation Design Service for processing. Once processing is complete, the menu and cooking steps are displayed back to the user (Sent Response).

- The Admin develops the system (System Development) in terms of various functional features and manages the database. The data is sent to the Conversation Design Service for processing and displaying results back to the user. The system also recommends food menus (Recommendation System) based on the stored behavior of ingredient searches from users.

2.3 System Design

In this section, the researcher designed the Graphical User Interface (GUI) for the development of the conversational agent for healthy food recommendations. The system screens can be divided as shown in the following figure:

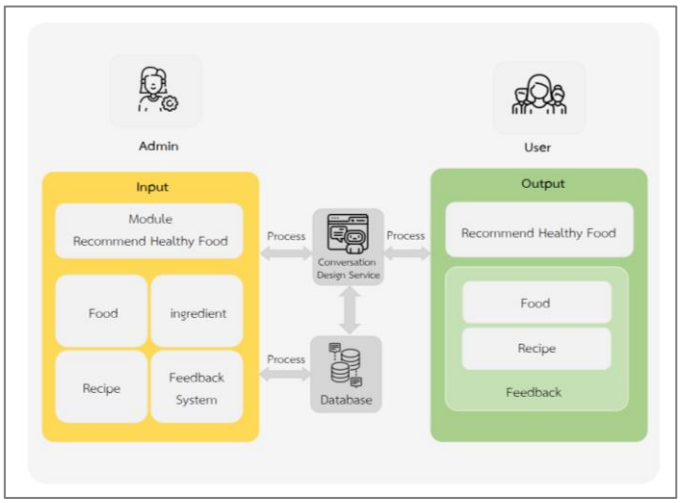
Figure 2: Prototype of the Conversational Agent for Healthy Food Recommendations

Figure 2 presents an overview of the prototype, showing the connections between various screens of the conversational agent for healthy food recommendations.

2.4 System Development

The development of the conversational agent system for recommending healthy food uses the Dialogflow platform and LINE Developer. The system architecture is shown in the following figure:

Figure 3: System Architecture of the Conversational Agent for Healthy Food Recommendations



The system architecture in Figure 3 can be explained as follows:

1. The conversational agent for recommending healthy food (Recommend Healthy Food) consists of 4 modules:

Food Module: Collects healthy food menus for processing and returning to the user after they input ingredients for search. Food is categorized into two types: clean food and keto food.

Ingredient Module: Compiles an ingredient database for processing and displaying as food menus.

Recipe Module: Displays details of ingredients and cooking steps for each dish.

Feedback System Module: Collects user food selection behavior. The system will display related food menus to the user to recommend foods that the user might be interested in.

2. After obtaining the important data and components in each part, the system administrator will collect all the information and store it in the Conversation Design Service and Database system for processing. The results will be displayed to the user in 3 formats:

Food: Displays food menus that match the ingredients searched by the user in the form of conversational messages and images.

Recipe: Shows details of ingredients and cooking steps.

Feedback: Recommends food menus based on the user's behavior, with menus referenced from ingredients the user has previously searched.

The system architecture is then developed into the conversational agent system for recommending healthy food, as shown in sample Figures 4 and 5. From these figures, users can choose between two types of food: clean food and keto food. After selecting the desired food type, users can type ingredient names to search for food menus. The system will display recipes and cooking methods to the user. If users want other menus, they can click to view other options. The system will recommend food menus based on ingredients the user has previously searched. Users can click the "Seasonal Vegetables" button for guidance on ingredients to use in cooking. The "More Health Information" button will direct users to a website with health-related knowledge.

Figure 4: Sample Display Screens

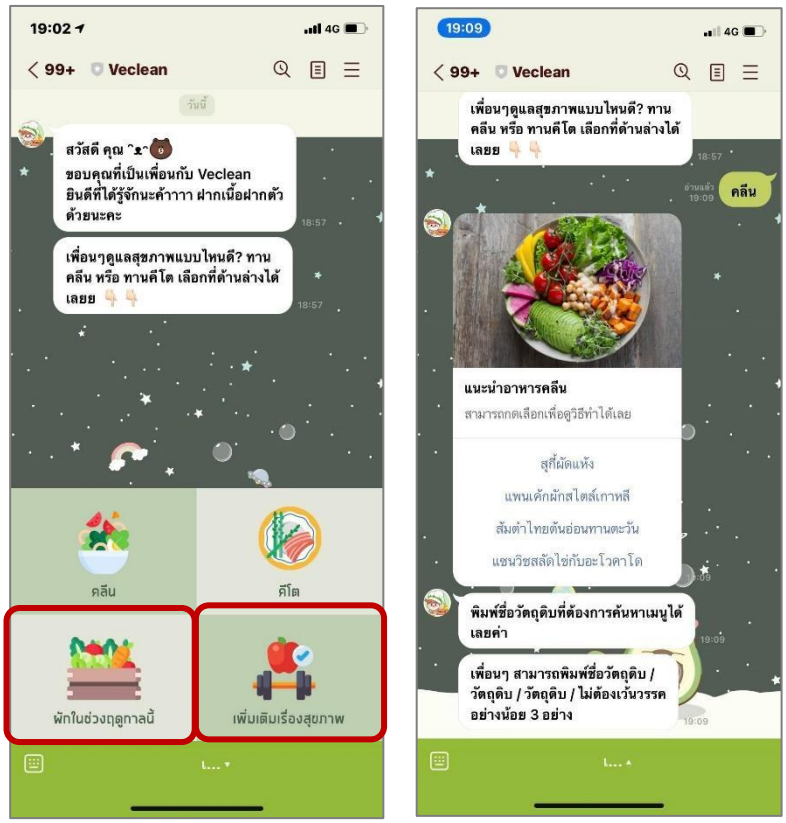


Figure 4 Left: Display screen for adding the conversational agent as a friend on the LINE application to use the healthy food conversational agent. The system will display a welcome message to create a good first impression and allow users to select the food type for the next step.

Figure 4 Right: Display screen for selecting food type. After the user selects a food type, the system will recommend foods according to the selection. If users want to search for food menus, they can type ingredient names.

2.5 System Efficiency Evaluation

The efficiency evaluation of the developed conversational agent for recommending healthy food was conducted by experts. The panel of experts included UX/UI Designers, IT Support personnel, Testers, and IT Operations professionals. The evaluation was based on a consensus summary from 17 experts. The agreement level used a 5-point Likert Scale, consisting of: Strongly Agree, Agree, Neutral, Disagree, and Strongly Disagree.

The researcher used statistical analysis to evaluate the consensus of the 17 experts, including: Mean; Standard Deviation (S.D.); Median; Interquartile Range (IR); Quartile Deviation (QD)

3. Research Results

Evaluation Results of the Conversational Agent System for Healthy Food Recommendations

Table 1: System Efficiency Evaluation Results from Experts

Evaluation Items	Mean	S.D.	Quatiles			Interquartile Range	Quatile Deviation
			Q1	Median	Q3		
System Efficiency and Requirements							
The conversational agent is easy to understand	4.76	0.44	5	5	5	0	0.0
The conversational agent provides comprehensive information	4.53	0.51	4	5	5	1	0.5
The system is easily accessible	3.94	0.56	4	4	4	0	0.0
The system has effective recommendation capabilities	3.94	0.56	4	4	4	0	0.0
The system can attract and engage users	4.24	0.83	4	4	5	1	0.5
Summary	**4.28**	**0.15**					
System Operational Efficiency							
The system can process information quickly	4.29	0.47	4	4	5	1	0.5
The conversational agent is stable during use	4.29	0.85	4	5	5	1	0.5
The conversational agent can recommend a variety of food menus	4.00	0.00	4	4	4	0	0.0
The processing capability of the conversational agent	4.53	0.87	5	5	5	0	0.0
Convenient to use, helping to reduce search steps	3.94	0.66	4	4	4	0	0.0
Accuracy of information	3.94	0.66	4	4	4	0	0.0
The conversational agent has effective information presentation capabilities	5.00	0.00	5	5	5	0	0.0
Summary	**4.29**	**0.37**					
System Design Efficiency							
Appropriate color selection	4.82	0.39	5	5	5	0	0.0
Effective display of food menus	4.35	0.86	4	5	5	1	0.5
Easy-to-understand layout	4.71	0.47	4	5	5	1	0.5
Use of clear and understandable language in communication	4.94	0.24	5	5	5	0	0.0

Evaluation Items	Mean	S.D.	Quatiles			Interquartile Range	Quatile Deviation
			Q1	Median	Q3		
Text arrangement is readable and concise	4.94	0.24	5	5	5	0	0.0
Summary	**4.75**	**0.25**					

From Table 1, the results of the system efficiency evaluation by 17 experts can be summarized in three aspects:

System Efficiency and Requirements: The mean was 4.28 (experts strongly agree) with a standard deviation of 0.15 (high consensus among experts). When considering the interquartile range and quartile deviation, the interquartile range of each indicator did not exceed 1.0, and the quartile deviation did not exceed 0.5, indicating a high consensus among the experts.

System Operational Efficiency: The mean was 4.29 (experts strongly agree) with a standard deviation of 0.37 (high consensus among experts). The interquartile range of each indicator did not exceed 1.0, and the quartile deviation did not exceed 0.5, indicating a high consensus among the experts.

System Design Efficiency: The mean was 4.75 (experts strongly agree) with a standard deviation of 0.25 (high consensus among experts). The interquartile range of each indicator did not exceed 1.0, and the quartile deviation did not exceed 0.5, indicating a high consensus among the experts.

Therefore, it can be concluded that the developed system is suitable for use and can effectively recommend healthy food and cooking methods. In additional feedback, the experts suggested that food categories should be appropriately organized for all age groups, including those with illnesses, to facilitate safe food selection.

4. Conclusion

The research on the development of a conversational agent for recommending healthy food in Thailand has yielded significant results. The expert panel reached a consensus approving the developed system in three key areas, indicating that the system is suitable for practical use and can effectively recommend healthy food to support consumer decision-making.

These findings align with previous research on the development of knowledge base systems to support healthy cooking (Patumpong et al., 2019). Such systems present valuable information about ingredient selection, food preparation methods, and healthy recipe techniques. They also incorporate features for menu analysis, suggesting modifications to cooking methods or ingredients when necessary. Additionally, these systems can provide information on ingredient sources, such as organic vegetable farms and chemical-free fruit sources, which is crucial for consumers seeking healthy food options.

Our research also corresponds with the study by Kim et al. (2021), which introduced an innovative cooking recommendation system. Their system uses ingredient sets and cooking tags as input to suggest possible ingredients and recipes. This approach is similar to our conversational agent, which uses user input to recommend healthy food options. Moreover, Kim et al.'s predictive model analysis and interpretation provided interesting insights related to

cooking knowledge, which could be incorporated into future iterations of our system to enhance its recommendations.

The positive evaluation of our system across efficiency, requirements, and design aspects suggests that it successfully addresses the need for accessible, user-friendly healthy food recommendations in Thailand. By integrating conversational AI technology with nutritional knowledge, our system represents a step forward in promoting healthier eating habits and supporting informed food choices.

Future research could explore the long-term impact of such systems on users' dietary habits and overall health outcomes. Additionally, incorporating more personalized recommendations based on individual health profiles, dietary restrictions, and cultural preferences could further enhance the system's effectiveness and user satisfaction.

5. Acknowledgments

The authors would like to thank Suan Sunandha Rajabhat University, Bangkok, Thailand (http://www.ssru.ac.th/) to provide funding support to attend the dissemination of research.

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