Project No.8

Virtual Doctor Chatbot for basic diagnosis

Presented by

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Advisor

Asst. Prof. Santitham Prom-on, Ph.D.

“I’ve read and approved the content of this report”

…………………………………………….
(…………………………………………)
Advisor

Virtual Doctor Chatbot for basic diagnosis

Mr.Ronnapat Buranakate
Miss Rachaya Angkanawin

A Project Submitted in Partial Fulfillment of the Requirements
for the Degree of Bachelor of Engineering
Department of Computer Engineering, Faculty of Engineering
King Mongkut’s University of Technology Thonburi
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Project Committee

………………………………………………………… Committee
(Asst. Prof. Pipat Supasirisun,)

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Project Title	Virtual Doctor Chatbot for basic diagnosis
Project Credit	3 credits
Project Participant	Mr.Ronnapat Buranakate
	Miss Rachaya Angkanawin
Advisor	Asst. Prof. Santitham Prom-on, Ph.D.
Degree of Study	Bachelor's Degree
Department	Computer Engineering
Academic Year	2018

Abstract (English)

For our project we intend to create the doctor chatbot. Our chatbot is the system that can interact with the patient similar to real doctor. The chatbot will ask the question to the patient and then using the natural language processing and machine learning to understand the symptoms from the user and diagnosis from these symptoms and show the result of disease which include disease information and basic treatment to the patient. Our chatbot also have the configuration interface for create the conversation flow or intent and also have the interface for training the model which the intelligence of the chatbot will depend on dataset that we have a use for trained in the intent classification model. In the future we will have more conversation to diagnosis more disease for the patient.

หัวข้อโครงงาน	ระบบสนทนาโต้ตอบอัตโนมัติแพทย์เสมือนจริงสำหรับการวินิจฉัยโรคเบื้องต้น
หน่วยกิตของโครงงาน	3 หน่วยกิต
จัดทำโดย	นายรณภัฏ บูรณเขตต์ นางสาวรชยา อังคะนาวิน
อาจารย์ที่ปรึกษา	ผู้ช่วยศาสตราจารย์ ดร.สันติธรรม พรหมอ่อน
ระดับการศึกษา	วิศวกรรมศาสตร์บัณฑิต
ภาควิชา	วิศวกรรมคอมพิวเตอร์
ปีการศึกษา	2561

บทคัดย่อ

สำหรับโครงการนี้เป็นการสร้างแชทบอทแพทย์เสมือนจริงโดยแชทบอทคือระบบในการถามคำถามจากคนไข้จากนั้นใช้การประมวลผลธรรมชาติ(natural language processing) และการเรียนรู้ของเครื่อง(machine learning) ในการทำความเข้าใจอาการจากคำตอบของคนไข้ เมื่อเก็บข้อมูลจากอาการต่างๆเพียงพอแล้วจึงนำอาการเหล่านั้นมาวินิจฉัยและแสดงผลการวินิจฉัยกลับไปให้คนไข้โดยประกอบไปด้วยข้อมูลของโรคที่วินิจฉัยพร้อมทั้งวิธีการรักษาเบื้องต้นแก่คนไข้ นอกจากนี้แชทบอทจะมีเว็บสำหรับการสร้างบทสนทนาของแชทบอทสำหรับเก็บคำตอบอาการของคนไข้และมีหน้าเว็บสำหรับฝึกโมเดลแชทบอทโดยความฉลาดนั้นขึ้นอยู่กับชุดข้อมูลที่เตรียมไว้สำหรับการฝึกโมเดล ในอนาคตทางผู้จัดทำจะมีการขยายบทสนทนาของแชทบอทเพื่อขยายขอบเขตในการวินิจฉัยโรคแก่คนไข้มากขึ้น

Table of Contents

Page

Chapter 1 Introduction

Chapter 2 Background, Theory and Related Research

Chapter 3 Design and Methodology

Chapter 4 Results and Discussion

List of Figures

page

Chapter 1 Introduction

Chapter 2 Background, Theory and Related Research

Chapter 3 Design and Methodology

Chapter 4 Results and Discussion

List of Tables

page

Chapter 1 Introduction

Chapter 2 Background, Theory and Related Research

Chapter 3 Design and Methodology

Chapter 4 Results and Discussion

Chapter 1
Introduction

1.1 Problem Statement and Approach

In commonly, sickness and going to see medic is not what people wants. There are many people don’t want to see medic with many reason but when you found you are sick, seeing a medic in both appreciate place and time is important things for you to have the right treatment. Also the type of symptom is important things to determine that patient should meet medic or not. Sometimes people are usually have commonly symptom like fever, sneeze or sore throat and we define that it’s common cold. The patient can be treated initially by taking medication which can purchase in drugstore. However, If it does not improve at the time it should do, say that in 2-3 days, it can indicates that you must have to see a medic or if it not the common symptoms for example, hemoptysis you have to going to see a medic immediately because it can’t not improve by taking a medication. So, The main problem is how can we know that it serious or not, the lack of knowledge and understand will get bad effect to the symptoms increasingly. Another major problem is nowadays Thai medical staff is still lacking and not enough for the people. From the research found that 80 percent of medical staff have been working more than 24 hours and there are medic who died from work. Because of the bad process management in the hospital and amount of medical staff not suitable to amount of patient affect the process slowly, patient waiting for long time so it cause to patients don’t want to see a medic . If we can solve this problem it will benefit for both patient and medic .

So it is motivating our group to find something to solve the problem that people are shy to see medic , give more knowledge about disease and symptoms, make the people more convenient to have diagnosis disease and also solve the overtime woking problem of medic . we want to make something that can act as medic and help the patient similar to medic .

The problem mentioned above, so we have an idea to create something to act as medic , patient Inquiry and basic diseases diagnosis. The technology to help us to achieve the objective is called “chatbot”. Chatbot or commonly known as a robot that can talk and response conversation back to the user as a real human which we will using chatbot instead medic to receive necessary information from patient and show basic diseases diagnosis result along with recommendations for treatment of patients.Finally, Our project is in the Benefitting society category.

1.2 Objectives

1. To make the chatbot that diagnosis disease from the symptoms and also give the information which including disease information and basic treatment
2. To apply the natural language processing, machine learning combine with the medical diagnosis to develop our project

1.3 Scope

1. The Chatbot that diagnosis disease from the symptoms of patient

In this system the user can send the message to the chatbot about symptoms.then, the chatbot with analyze the message to find the intent that we trained.When the chatbot understand the intent it will ask the flow of question that we set to receive more information before diagnosis.Finally, the chatbot will send the result to the user which including of disease list from diagnosis, basic treatment information .Moreover, the user can also ask the disease information to the chatbot and it will send back the information and basic treatment of that disease.

2. The Chatbot configuration system for develop the chatbot on web interface

In this system is for the developer to config the chatbot on web interface.In the interface we can create the intent for the chatbot which including context input,context out, training data,response message and parameter and it can also training the intent classification model from the interface.

1.4 Tasks and Schedule

Table 1.1: Table for show task and schedule

	Aug				Sep				Oct				Nov				Dec				Jan				Feb				Mar				April				May			
1) Requirement Analysis																																								
1.1. Meet advisor	⬛							🟥	🟥							🟥	🟥												🟥	🟥									🟥	🟥
1.2. Requirement document		⬛	⬛	⬛				🟥	🟥							🟥	🟥												🟥	🟥									🟥	🟥
1.3. Background Research			⬛	⬛	⬛	⬛	⬛	🟥	🟥							🟥	🟥												🟥	🟥									🟥	🟥
2) Software Design								🟥	🟥							🟥	🟥												🟥	🟥									🟥	🟥
2.1 Design Prototype								🟥	🟥	⬛	⬛	⬛				🟥	🟥												🟥	🟥									🟥	🟥
2.2 Documentation				⬛	⬛	⬛		🟥	🟥							🟥	🟥												🟥	🟥									🟥	🟥
2.3. Find and Study tools						⬛		🟥	🟥							🟥	🟥												🟥	🟥									🟥	🟥
2.4 Presentation 1								🟥	⬛							🟥	🟥												🟥	🟥									🟥	🟥
2.5. Design Chatbot flow								🟥	🟥	⬛	⬛	⬛	⬛	⬛	⬛	🟥	🟥												🟥	🟥									🟥	🟥
3) Implementation								🟥	🟥							🟥	🟥												🟥	🟥									🟥	🟥
3.1. Implement web interface for configuration chatbot								🟥	🟥	⬛	⬛	⬛	⬛	⬛	⬛	⬛	⬛												🟥	🟥									🟥	🟥
3.2.Implement chatbot diagnose system								🟥	🟥							🟥	🟥	⬛	⬛	⬛	⬛	⬛	⬛						🟥	🟥									🟥	🟥
3.2. Testing code								🟥	🟥							🟥	🟥	⬛	⬛	⬛	⬛	⬛	⬛						🟥	🟥									🟥	🟥
3.3. Presentation 2								🟥	🟥					⬛	⬛	🟥	🟥												🟥	🟥									🟥	🟥
4) Integration Testing								🟥	🟥							🟥	🟥												🟥	🟥									🟥	🟥
4.1. Integrate All function								🟥	🟥							🟥	🟥						⬛	⬛	⬛				🟥	🟥									🟥	🟥
4.2. Integrate with Bayesian Neural Network								🟥	🟥							🟥	🟥								⬛	⬛			🟥	🟥									🟥	🟥
4.3.Test Application								🟥	🟥							🟥	🟥									⬛	⬛		🟥	🟥									🟥	🟥
4.2. Fix bug								🟥	🟥							🟥	🟥									⬛	⬛	⬛	🟥	🟥									🟥	🟥
5) Data Migration and User Testing								🟥	🟥							🟥	🟥												🟥	🟥									🟥	🟥
5.1. Fix bug								🟥	🟥							🟥	🟥									⬛	⬛	⬛	🟥	🟥									🟥	🟥

5.2. User Testing								🟥	🟥							🟥	🟥												🟥	🟥	■	■	■	■	■	■			🟥	🟥
6) Presentation								🟥	🟥							🟥	🟥												🟥	🟥									🟥	🟥
6.1. Final report								🟥	🟥							🟥	🟥												🟥	🟥						■	■	■	🟥	🟥
6.2. Final presentation								🟥	🟥							🟥	🟥												🟥	🟥									🟥	■

Chapter 2
Background, Theory and Related Research

2.1 Literature Review

2.1.1 Comparison Application

2.1.1.1 DoctorMe Application

DoctorMe application is a mobile application that develop by thai people. This app act as the health assistant and diagnose the symptoms which its have a lots of information for diagnose your symptoms. First, when you open the application, the application will separate the human body in each part so you will choose the position of your symptoms and select the symptom that most similar for you and then the information will show up.

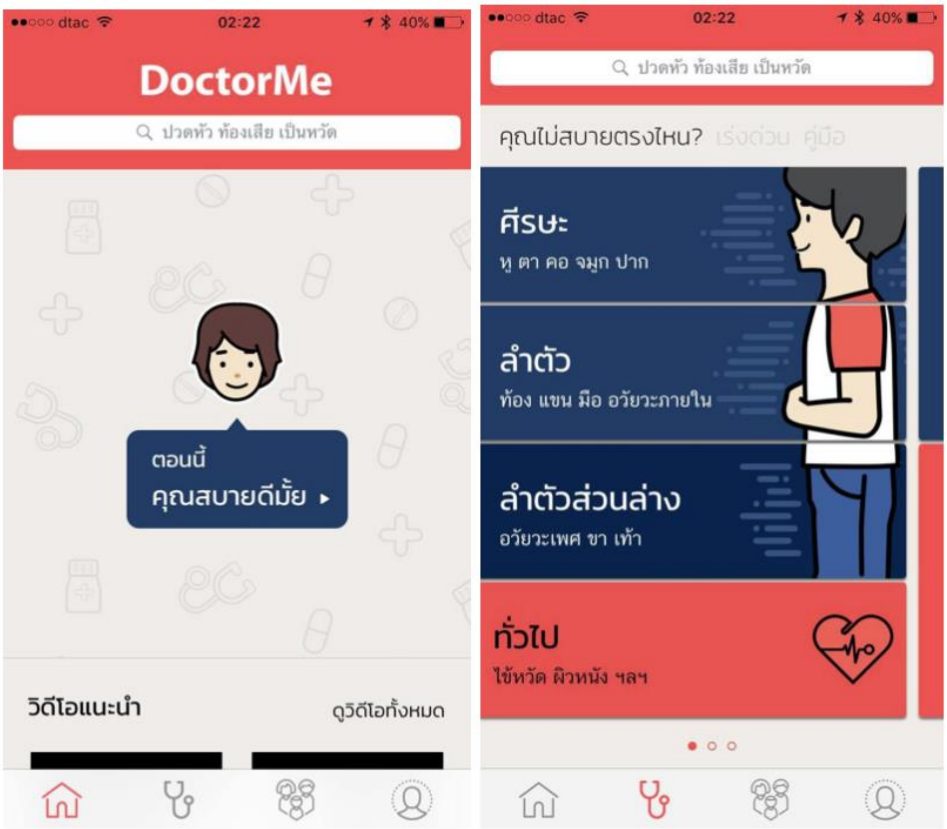
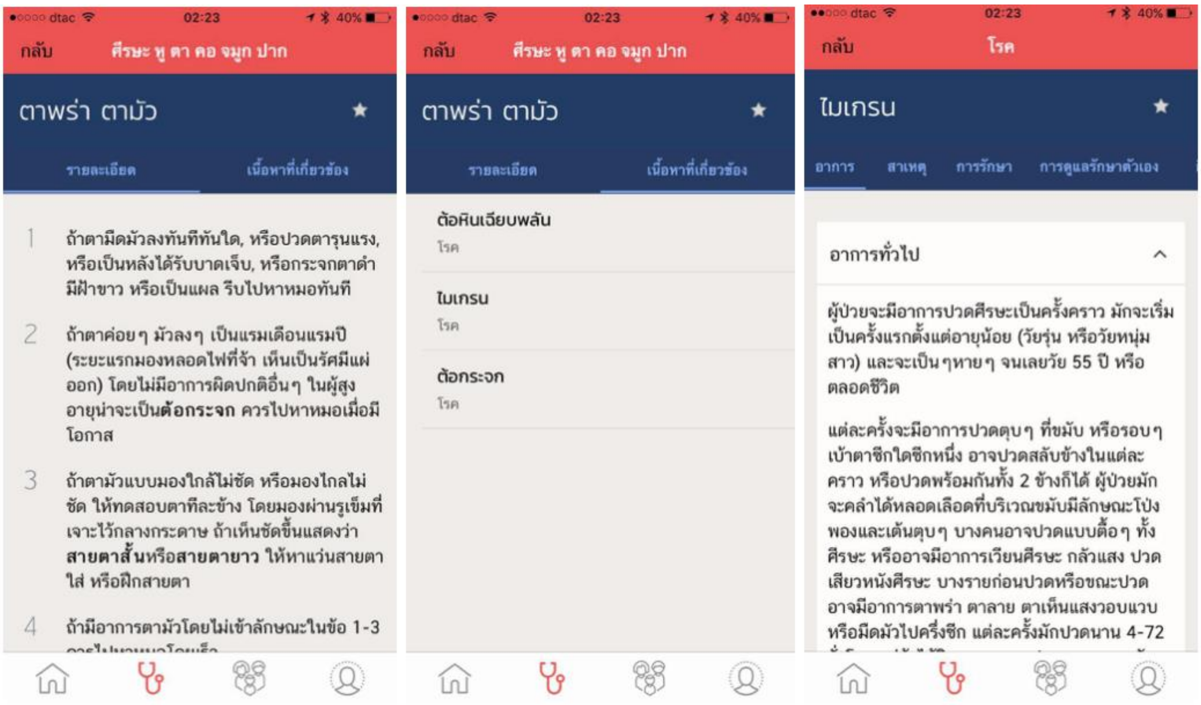


Figure 2.1: The interface of Doctorme application[Ref. DoctorMe Application]

Then, the application will show the detail of symptom and the risk level that can be occur with this symptom, it also have advice for each situation for instance if your symptoms is similar like this go to see the medic immediately. In addition, It also show the related disease from your symptoms within detail of the disease, causes of disease and how to treatment yourself.



1 ถ้าตามืดมัวลงทันทีทันใด, หรือปวดตารุนแรง, หรือเป็นหลังได้รับบาดเจ็บ, หรือกระจกตาดำมีฝ้าขาว หรือเป็นแผล รีบไปหาหมอทันที

2 ถ้าตาค่อยๆ มัวลงๆ เป็นแรมเดือนแรมปี (ระยะแรกมองหลอดไฟที่จ้า เห็นเป็นรัศมีแผ่ออก) โดยไม่มีอาการผิดปกติอื่นๆ ในผู้สูงอายุน่าจะเป็น**ต้อกระจก** ควรไปหาหมอเมื่อมีโอกาส

3 ถ้าตามัวแบบมองใกล้ไม่ชัด หรือมองไกลไม่ชัด ให้ทดสอบตาทีละข้าง โดยมองผ่านรูเข็มที่เจาะไว้กลางกระดาษ ถ้าเห็นชัดขึ้นแสดงว่า**สายตาสั้น**หรือ**สายตายาว** ให้หาแว่นสายตาใส่ หรือฝึกสายตา

4 ถ้ามีอาการตามัวโดยไม่เข้าลักษณะในข้อ 1-3

ต้อหินเฉียบพลัน
โรค

ไมเกรน
โรค

ต้อกระจก
โรค

อาการทั่วไป

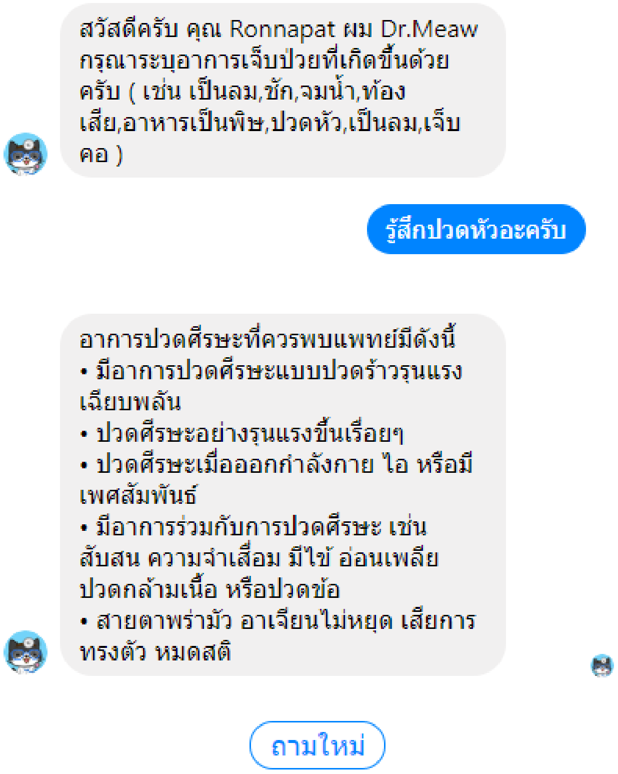
ผู้ป่วยจะมีอาการปวดศีรษะเป็นครั้งคราว มักจะเริ่มเป็นครั้งแรกตั้งแต่อายุน้อย (วัยรุ่น หรือวัยหนุ่มสาว) และจะเป็นๆหายๆ จนเลยวัย 55 ปี หรือตลอดชีวิต

แต่ละครั้งจะมีอาการปวดตุบๆ ที่ขมับ หรือรอบๆ เบ้าตาซีกใดซีกหนึ่ง อาจปวดสลับข้างในแต่ละคราว หรือปวดพร้อมกันทั้ง 2 ข้างก็ได้ ผู้ป่วยมักจะคลำได้หลอดเลือดที่บริเวณขมับมีลักษณะโป่งพองและเต้นตุบๆ บางคนอาจปวดแบบตื้อๆ ทั้งศีรษะ หรืออาจมีอาการเวียนศีรษะ กลัวแสง ปวดเสียวหนังศีรษะ บางรายก่อนปวดหรือขณะปวดอาจมีอาการตาพร่า ตาลาย ตาเห็นแสงวอบแวบหรือมืดมัวไปครึ่งซีก แต่ละครั้งมักปวดนาน 4-72

Figure 2.2: Information of symptom and the relate disease
[Ref. DoctorMe Application]

2.1.1.2 Dr.Meaw Bot

Dr,Meaw Bot is the Chatbot that can give the information of your symptoms and it will advise the situation of your symptoms which level must have to see medic but if the symptoms not risk, the chatbot will give the information for treatment by yourself.



สวัสดีครับ คุณ Ronnapat ผม Dr.Meaw กรุณาระบุอาการเจ็บป่วยที่เกิดขึ้นด้วยครับ (เช่น เป็นลม,ชัก,จมน้ำ,ท้องเสีย,อาหารเป็นพิษ,ปวดหัว,เป็นลม,เจ็บคอ)

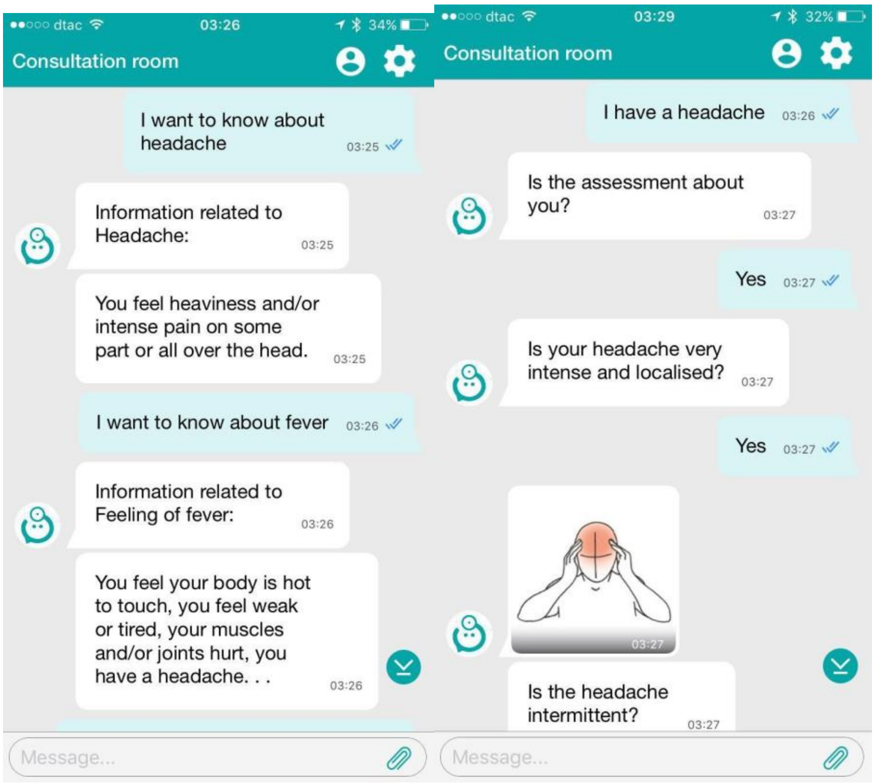
รู้สึกปวดหัวอะครับ

อาการปวดศีรษะที่ควรพบแพทย์มีดังนี้
- มีอาการปวดศีรษะแบบปวดร้าวรุนแรงเฉียบพลัน
- ปวดศีรษะอย่างรุนแรงขึ้นเรื่อยๆ
- ปวดศีรษะเมื่อออกกำลังกาย ไอ หรือมีเพศสัมพันธ์
- มีอาการร่วมกับการปวดศีรษะ เช่น สับสน ความจำเสื่อม มีไข้ อ่อนเพลีย ปวดกล้ามเนื้อ หรือปวดข้อ
- สายตาพร่ามัว อาเจียนไม่หยุด เสียการทรงตัว หมดสติ

Figure 2.3: Conversation between Dr.Meaw Bot and User[Ref. Dr.Meaw Bot Messenger]

2.1.1.3 Mediktor Chatbot Application

Mediktor is the chatbot application that help you to diagnose your symptoms, suggest you about risk of the symptom and give the disease list that relate to your symptoms information.



I want to know about headache 03:25

Information related to Headache: 03:25

You feel heaviness and/or intense pain on some part or all over the head. 03:25

I want to know about fever 03:26

Information related to Feeling of fever: 03:26

You feel your body is hot to touch, you feel weak or tired, your muscles and/or joints hurt, you have a headache. . . 03:26

I have a headache 03:26

Is the assessment about you? 03:27

Yes 03:27

Is your headache very intense and localised? 03:27

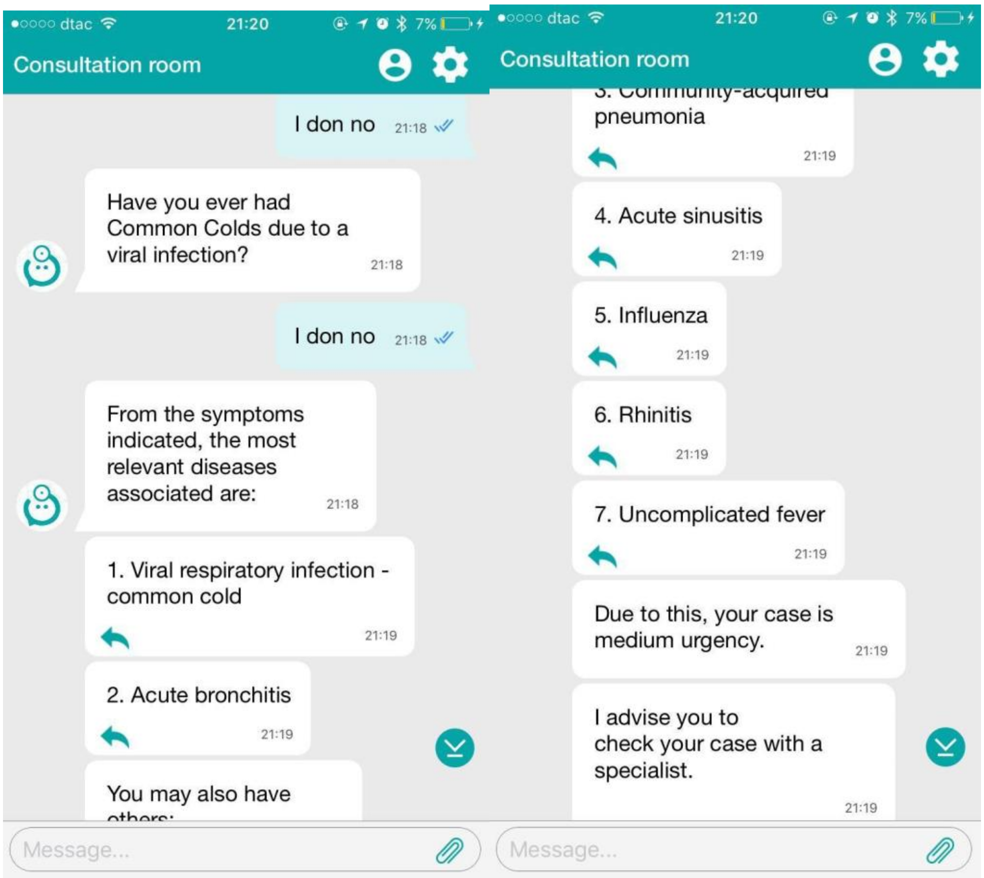
Yes 03:27

03:27

Is the headache intermittent? 03:27

Figure 2.4: Conversation between mediktor and user [Ref.Mediktor application]

When you tell the symptom and the chatbot specific the intent of input it will ask you a question to keep the information and then it will predicted the symptom and show the disease list that can proprability occur with this symptoms. Finally,you can select one in list for more information and the chatbot will tell the risk level within the lists.



I don no 21:18

Have you ever had Common Colds due to a viral infection? 21:18

I don no 21:18

From the symptoms indicated, the most relevant diseases associated are: 21:18

1. Viral respiratory infection - common cold 21:19

2. Acute bronchitis 21:19

You may also have others:

3. Community-acquired pneumonia 21:19

4. Acute sinusitis 21:19

5. Influenza 21:19

6. Rhinitis 21:19

7. Uncomplicated fever 21:19

Due to this, your case is medium urgency. 21:19

I advise you to check your case with a specialist. 21:19

Figure 2.5: The result after predicted the symptoms [Ref.Mediktor application]

Table 2.1 Comparison of Application

Comparison	**DoctorMe**	**Dr.Meaw bot**	**Mediktor chatbot**
Platform	**Application**	**Chatbot**	**Application**
View Symtoms Information	✓	✓	✗
Diagnose and giving Symptom information	✗	✗	✓
Treatment information	✓	✓	✓
Offline mode	✓	✗	✗
Language	**Thai**	**Thai**	**English**

2.1.2 Related Research

2.1.2.1.Chatbots meet eHealth: automatizing healthcare

This research is aim for investigate the effectiveness of novel human-machine interaction paradigms for eHealth application. The example application in this research is called HOLMeS(Health On-Line Medical Suggestions).

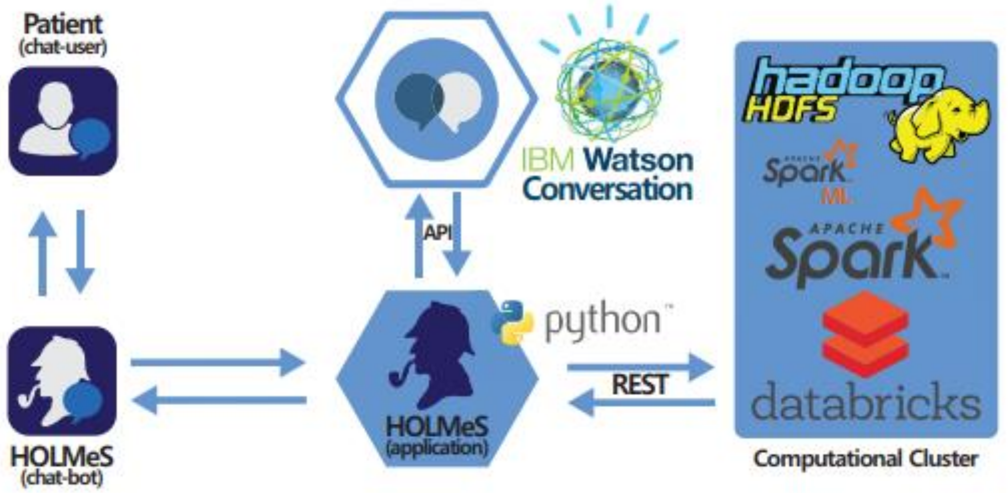
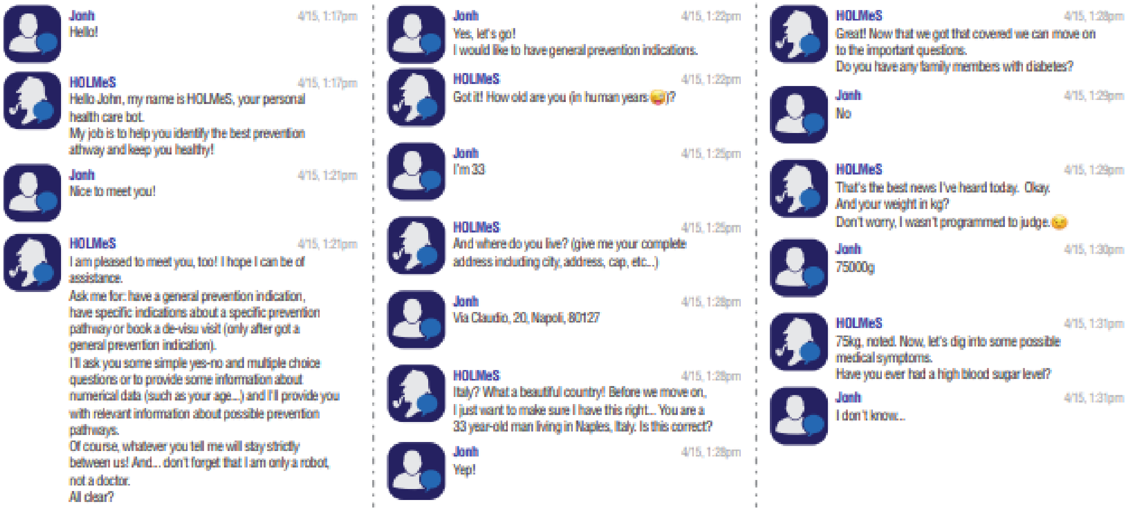


Figure 2.6 : Design of HOLMeS Application[9]

The personar of this chatbot is emulate medic in a clinical environment. The main role of the chatbot is collect the general patient information in order and then give the general prevention pathways indicate with different disease.

They want to design the conversation skill to act similar to human behavior to make the patients feel more comfort and can interact with the chatbot like the real human.



Jonh 4/15, 1:17pm
Hello!

HOLMeS 4/15, 1:17pm
Hello John, my name is HOLMeS, your personal health care bot.
My job is to help you identify the best prevention athway and keep you healthy!

Jonh 4/15, 1:21pm
Nice to meet you!

HOLMeS 4/15, 1:21pm
I am pleased to meet you, too! I hope I can be of assistance.
Ask me for: have a general prevention indication, have specific indications about a specific prevention pathway or book a de-visu visit (only after got a general prevention indication).
I'll ask you some simple yes-no and multiple choice questions or to provide some information about numerical data (such as your age...) and I'll provide you with relevant information about possible prevention pathways.
Of course, whatever you tell me will stay strictly between us! And... don't forget that I am only a robot, not a doctor.
All clear?

Jonh 4/15, 1:22pm
Yes, let's go!
I would like to have general prevention indications.

HOLMeS 4/15, 1:22pm
Got it! How old are you (in human years 😜)?

Jonh 4/15, 1:25pm
I'm 33

HOLMeS 4/15, 1:25pm
And where do you live? (give me your complete address including city, address, cap, etc...)

Jonh 4/15, 1:28pm
Via Claudio, 20, Napoli, 80127

HOLMeS 4/15, 1:28pm
Italy? What a beautiful country! Before we move on, I just want to make sure I have this right... You are a 33 year-old man living in Naples, Italy. Is this correct?

Jonh 4/15, 1:28pm
Yep!

HOLMeS 4/15, 1:28pm
Great! Now that we got that covered we can move on to the important questions.
Do you have any family members with diabetes?

Jonh 4/15, 1:29pm
No

HOLMeS 4/15, 1:29pm
That's the best news I've heard today. Okay.
And your weight in kg?
Don't worry, I wasn't programmed to judge.😉

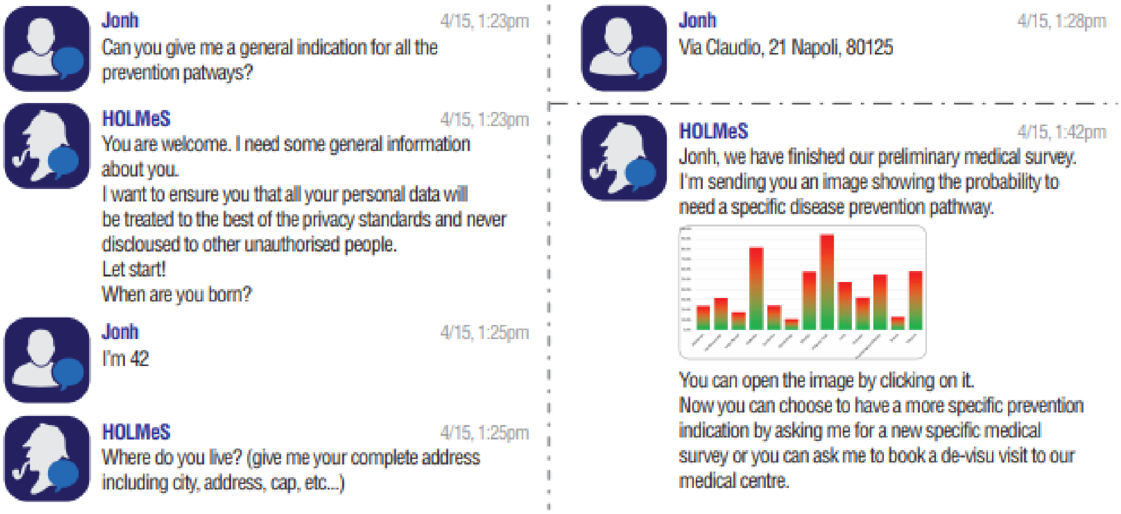
Jonh 4/15, 1:30pm
75000g

HOLMeS 4/15, 1:31pm
75kg, noted. Now, let's dig into some possible medical symptoms.
Have you ever had a high blood sugar level?

Jonh 4/15, 1:31pm
I don't know...

Figure 2.7 : Ideal interaction between chatbot and user[9]

So they use IBM Watson Conversation APIs to make the chatbot understand the natural language processing. The intents and entities(also for context) is the main point of this chatbot dialog to make it good to response user.



Jonh 4/15, 1:23pm
Can you give me a general indication for all the prevention patways?

HOLMeS 4/15, 1:23pm
You are welcome. I need some general information about you.
I want to ensure you that all your personal data will be treated to the best of the privacy standards and never disclosued to other unauthorised people.
Let start!
When are you born?

Jonh 4/15, 1:25pm
I'm 42

HOLMeS 4/15, 1:25pm
Where do you live? (give me your complete address including city, address, cap, etc...)

Jonh 4/15, 1:28pm
Via Claudio, 21 Napoli, 80125

HOLMeS 4/15, 1:42pm
Jonh, we have finished our preliminary medical survey. I'm sending you an image showing the probability to need a specific disease prevention pathway.

You can open the image by clicking on it.
Now you can choose to have a more specific prevention indication by asking me for a new specific medical survey or you can ask me to book a de-visu visit to our medical centre.

Figure 2.8 : Conversation with holmes[9]

In the conclusion, They complete to make the chatbot going over the limitation of interaction between people and chatbot and make the patient feel comfort and natural to talk with

2.2 Knowledge

2.2.1 Getting a patient's information

Getting a patient's information is an important step for diagnosis because this is the first step of collecting information for treatment and protect wrong diagnosis.So it must be based on the principle of getting information that absolute or Simply referred as "OPQQRST" so, the principles are follow.

- Onset and chronology : Asking the symptoms when it start. How long? The symptoms occur once or ongoing or several times
- Position and radiation : Asking the patient what position of symptoms occur
- Quality : Asking the patient what symptoms looks like.
- Quantification : Asking for the severity of symptoms and does it affect the activity being done?
- Related symptoms : Asking if there are other symptoms associated with it. What are the symptoms?
- Setting : Asking what the patient doing while the symptoms occur, what emotional?, what environment
- Transforming factors : Asking how the symptoms are reduce or increase

2.2.2 Headache symptom

Headache is the type of symptom that can found normally in patient which most patient that found with headache symptoms is no harm but some disease is difficult to separate the severe headache.

Recently, There are have rules for diagnose headache symptoms by using International Classification of Headache Disorder which separate in 3 group

1.Primary headaches

2.Secondary headaches

3.painful cranial neuropathies,other headaches

By the way it difficult to confirm disease in primary headache group because sometimes there are similar with secondary headaches so the process will comprehensive 2 part that is

1.Find the evidence for secondary headaches

2.Separate the group in which type in primary headaches

2.2.3 Intent Classification

Intent Classification is one major things that important for the chatbots. It is the one process of NLP(Natural Language Processing) that make your chatbot understand what user want or ‘intent’ of the input. When the text input from the user is coming to the process it will identified by the function referred to as a “classifier”, then it will analyze and provide specific intent of the input from user.

the example of how intent classification make you chatbot more intelligent.

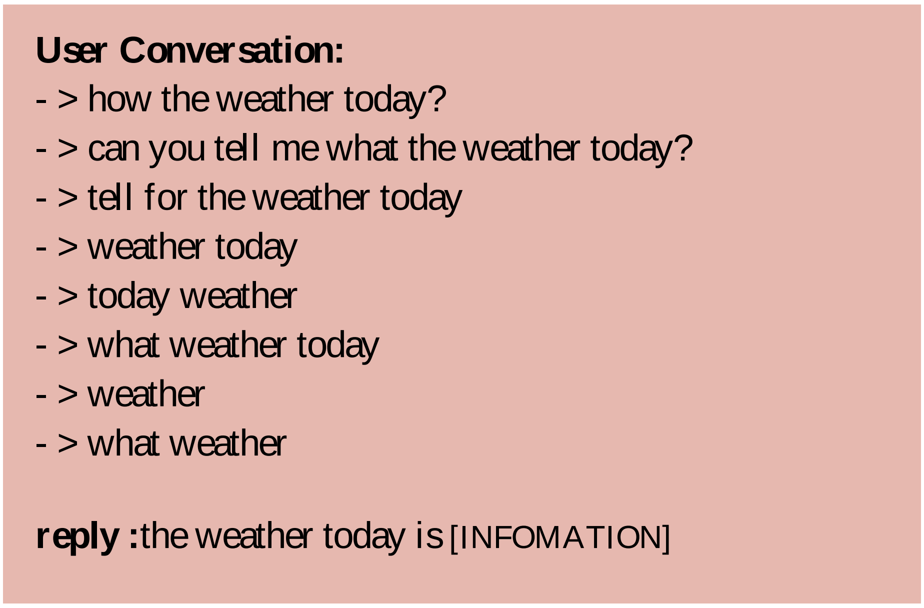
User > What is the weather today ?

// From the message it is the intent of asking for the weather

Intent = Weather

Figure 2.9 : Example for define Intent in user conversation

Now how would it help for the chatbot?, the answer is we can grouping the question and answer to make your chatbot more intelligent For example:



User Conversation:

- > how the weather today?

- > can you tell me what the weather today?

- > tell for the weather today

- > weather today

- > today weather

- > what weather today

- > weather

- > what weather

reply :the weather today is [INFOMATION]

Figure 2.10 : Example intent classification

There are many technology that can develop for this for instance ML(Machine learning), Neural network etc. Finally, the intent classification is the good ways to make the chatbot easily to define the intent without using Rule-based.

2.3 Techniques & Theories

2.3.1 Multinomial naive Bayes

multinomial naive bayes is a one type of the naive bayes but it is different in distribution each feature from the naive bayes. For the naive bayes model there is calculate the probability that one class have feature f1... fn like this:

$$p(f_1, \ldots, f_n | c) = \prod_{i=1}^{n} p(f_i | c)$$

Figure 2. : naive bayes equation[10]

but naive bayes model is not have distribution for each of feature but multinomial naive Bayes is different from the naive Bayes by using multinomial distribution for each feature. So multinomial naive Bayes will be good with classification with independent feature like word count in text.So we will use this one for intent classification in the chatbot.

2.3.2 Multi-Layer Perceptron

Multi-Layer Perceptron is the standard of neural network structure which has input layer as the amount of feature , output node that is a result from the input and the between of input and output is hidden layer which have the function for calculate the output from the previous layer which the hidden layer can be have more than one. It is the one of great supervised machine learning that can change the parameter like weight and bias to make the model more great performance by learning to minimize the error from the previous error which it called Backpropagation step for example at first the data will go to the input layer and then going to the next layer until it reach the output layer then it will be calculate the error value by compare the different from the output result and real result and then it will get the error signal which is using for adjust weight and bias for the next time and it will be do it again N times to minimize the error and get the great result.

2.3.3.Natural Language Processing

Natural Language Processing is the process which using to make the computer understand human language. Natural Language Processing is the important process to make the machine learning can learn the data from the user for example using tokenizer to separate the sentence into list of word to make the machine learning learning the pattern data from the list of word.

2.3.4. Term frequency-inverse document frequency(TF-IDF)

TF-IDF is a one of preprocessing data technique that widely use for prepare the training dataset before training the model.TF-IDF will be using for finding the important word and common word for example the stopword that appear in every sentence is a common word and symptoms word is a important word which mean the word that is important word will be weight as high value and the common word will get low value.So TF-IDF will help to highlight the important word in list of word.

2.4.Technology and tools

2.4.1 Javascript

It is a programming language that using for web develop and also using for web server side and chatbot server.

2.4.2 Angular 7

It is a framework that using html, css and typescript/javascript for develop the front-end website. This framework have great performance for develop the web-platform.

2.4.3 NodeJS

It is javascript runtime that have many useful javascript library by using NPM(Node Package Manager)to install it. It using for server side to make such as chatbot server and web server.

2.4.4 Express

It is a NodeJS Framework that make the developer more convenient to develop the server side such as rest-api, manage request and response from the Front-end side.

2.4.5 Python

Python is an high-level programming language that have many library for training the model for example machine learning library and neural network library.

2.4.6 TFLearn

It’s a neural network library in python which is using for implement the deep neural network layer for the model.

2.4.7 Pythai

The thai natural language processing library in python which can use for tokenization the sentence into word.

2.4.8 Jupyter Notebook

Jupyter notebook is the Interactive computing environment that user can coding and then execute the code but the benefit is we can execute in each step(separate the code) so it will support the user to coding and debug easier.

2.4.9 Cloud Application Platform

Cloud Application Platform is a server on cloud that using for deploy the chatbot on the internet and make it connected with Facebook Messenger

2.4.10 Database

The Chatbot require for database to store the intent data such as context, response message that using for talking with the user. When the user have talking to the chatbot and when the chatbot analyse the message and find the intent then it will get the intent from the database and use response message from that intent to talk back to the user. Also for training model it will gather the training data from each intent and make the model for intent classification.

2.4.10.1 MongoDB

MongoDB is a type of open-source document database. It is a NoSQL database. It not use SQL command and not focus on create data relationships but they are the structure that the NoSQL creates and stores. data by JSON (JavaScript Object Notation), which will be stored as a key and value.The strengths is working speed and faster query data,so mongoDB is suitable for our project to save intent of chatbot because this database is appropriate for uncomplicated data and can working well with real time system.Therefore its feature can support our chatbot to more efficiency.

Chapter 3
Design and Methodology

3.1 Software Specification

So we research more about the application about health that related with our project and then we select application to comparison with our project as show in Table 3.1

Table 3.1 Comparison of application with C-Doctor

Comparison	**DoctorMe**	**Dr.Meaw bot**	**Mediktor chatbot**	**C-Doctor**
Platform	**Application**	**Chatbot**	**Application**	**Chatbot**
View Disease Information	✓	✓	☒	✓
Diagnose symptom	☒	☒	✓	✓
Giving Symptom and Treatment information (after diagnosis)	✓	✓	✓	✓
Offline mode	✓	☒	☒	☒
Language	**Thai**	**Thai**	**English**	**Thai**

From Table 3.1 we have 3 application that we will comparison with C-Doctor. In the first 2 thai application it doesn't have an Diagnosis the symptoms system so it can’t actually help the user to know the associated disease with their symptoms and the last application is not available in Thai so it will difficult to use. So we have motivated to make a chatbot in Thai language that can diagnose the disease from the symptoms with can give the information of the disease and basic treatment and also giving the recommendation from the chatbot. For convenient to using the chatbot we will build it to access with Facebook Messenger.

3.1.1 Feature list

1) Communicate with user in Thai language
2) View disease’s information
3) Analyze associated disease and diagnosis
4) Giving basic symptom and treatment information after diagnosis

3.2 Tools and Materials

3.2.1 Hardware

1) MacBook Pro (13-inch, 2016, Two Thunderbolt 3 ports)
   Processor: Intel Core i5 2 GHz
   Memory: 8 GB 1867 MHz LPDDR3
   Storage: 256GB
   Graphics: Intel Iris Graphics 540 1536 MB
   Operating system: mac OS Sierra Version 10.12.6
2) Dell Inspiron 5558
   Processor: Intel(R) core(TM) i7-5500U CPU @ 2.40GHz
   Memory: 4 GB
   Storage:512 GB
   Graphics: Intel(R) HD Graphics 5500
   Operating system: Windows 10 Pro 64 bit

3.3 Working process design

1. Research and study about tools, medical diagnosis and Chatbot
2. Design dialogue conversation of the chatbot and design system function
3. Design for Chatbot configuration system web interface
4. Implement the Chatbot configuration system web interface
5. Implement the Chatbot dialogue for diagnosis
6. Integrate with other project (Bayesian Network model)
7. Test System and fix bug
8. Train the chatbot with user
9. Evaluate the result

3.4 Detail of project design

3.4.1 Architecture diagram

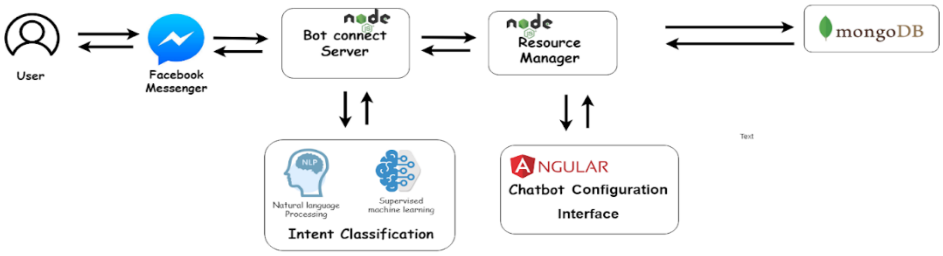


Figure 3.1 : Architecture design of C-doctor

So our major part is separated into 3 part that is input,system process and output.

Input

- User send the symptom or ask for information of disease to chatbot via facebook messenger

System Process

- The chatbot will receive text message from Facebook Messenger and send to Intent Classification Process
- Intent Classification Process will using NLP and preprocessing technique for convert the text to the ready pattern data that can predict with the model
- When find the intent of the user then set the context and add the new parameter from intent to user and then respond the message back(ask more question) to the user until the end of flow question
- Show diagnosis result back to the user

Output

- Diagnosis result that include disease and basic treatment information
- Disease information for the User.

3.4.2 Use case Diagram and Use case narratives

1) Use case Diagram

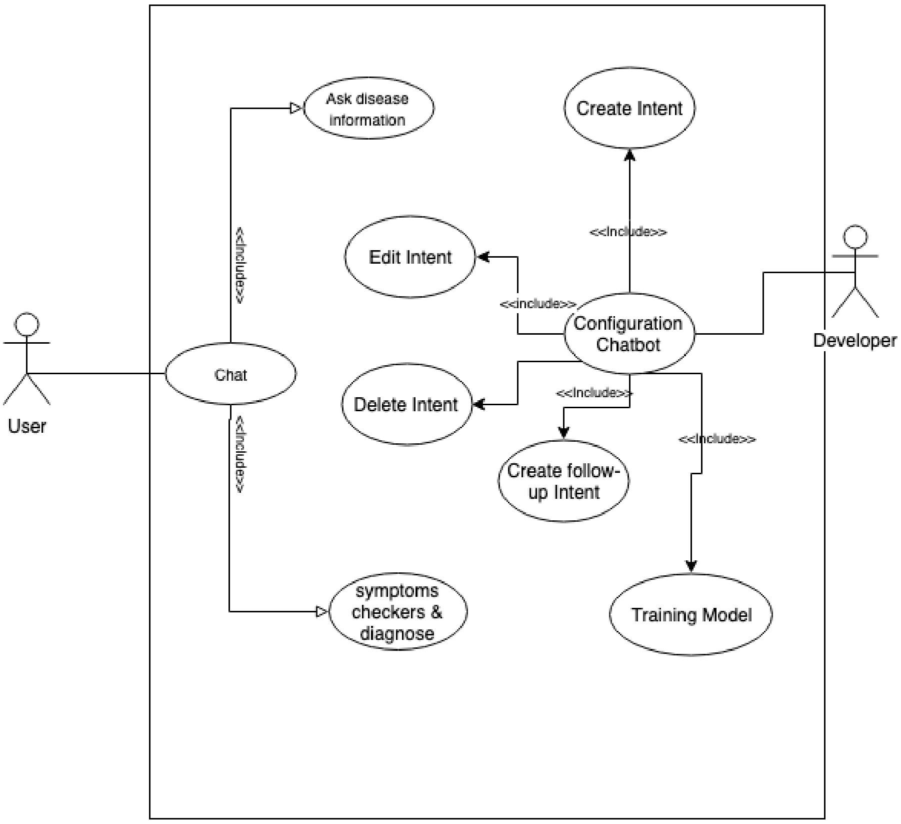


Figure 3.2 : Use case of C-Doctor

2) Use case narrative

Title: Chat
Actor: User
Pre-conditions: Login to Facebook Messenger
Post-Condition : User can interact with the chatbot
Main success scenario:

1. Chat with the chatbot by sending the message
2. the system will send text to the server and find the intent and send response message back
3. the user get response message back

Alternate Flow

1A. The message from the user is not in case of chatbot
2A. response the default dialogue back when the chatbot cannot find the intent

Title: Symptoms checker & diagnose
Actor: User
Pre-conditions: Login to Facebook Messenger
Post-Condition : User can interact with the chatbot
Main success scenario:

1. Chat with the chatbot by send the symptoms or ask for the disease information
2. Response dialogue back from the chatbot and receive result of diagnosis or disease information

Alternate Flow

1A. The message from the user is not in case of chatbot
2A. response the default dialogue back when the chatbot cannot find the intent

Title: Ask disease information
Actor: User
Pre-Condition: Login to Facebook Messenger
Post-Condition: User receive the disease information
Main success scenario:

1. User enter the message about the disease name
2. System send list of related disease
3. User send the message to select disease
4. User get the disease information

Alternate Flow
1A. The message from the user is not in case of chatbot
2A. response the default dialogue back when the chatbot cannot find the intent
3A. Return to primary flow step 1

Title: Create Intent
Actor: Developer
Pre-conditions: -
Post-Condition : Developer can create new intent for the chatbot
Main success scenario:

1. press the intent button for new intent
2. the system will create new intent and send to the back-end
3. the system save the save new intent to database
4. Developer get result that intent was created

Title: Edit Intent
Actor: Developer
Pre-conditions: -
Post-Condition : Developer can edit the intent information
Main success scenario:

1. user select the intent
2. user edit the data in intent
3. user press save button
4. the system save the new update to database
5. Developer get success responses

Title: Delete Intent
Actor: Developer
Pre-conditions: -
Post-Condition : Developer can delete the intent
Main success scenario:

1. Developer press the delete button in that intent
2. the system delete intent and all follow-up intent
3. Developer get success responses

Title: Add follow up intent
Actor: Developer
Pre-conditions: -
Post-Condition : Developer can create follow up intent
Main success scenario:

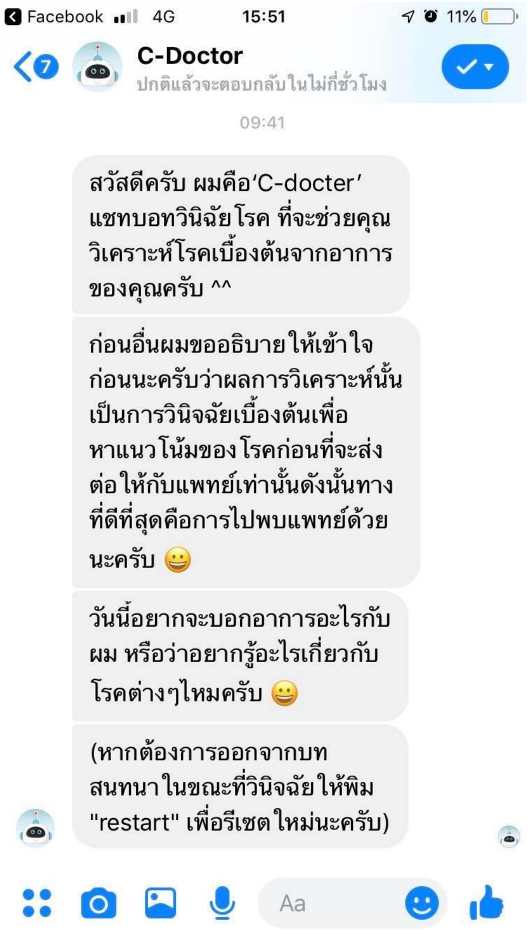
1. Developer press the add button on that intent
2. The system will create the new intent and add the intent as the follow-up intent of selected intent
3. Developer get success responses

Title: Training Model
Actor: Developer
Pre-conditions: -

Post-Condition : Developer can train model for chatbot
Main success scenario:

1. Developer click the train button
2. the system training the model
3. Developer get success response

3.4.3 User interface Chatbot Design



สวัสดีครับ ผมคือ‘C-docter’ แชทบอทวินิฉัยโรค ที่จะช่วยคุณวิเคราะห์โรคเบื้องต้นจากอาการของคุณครับ ^^

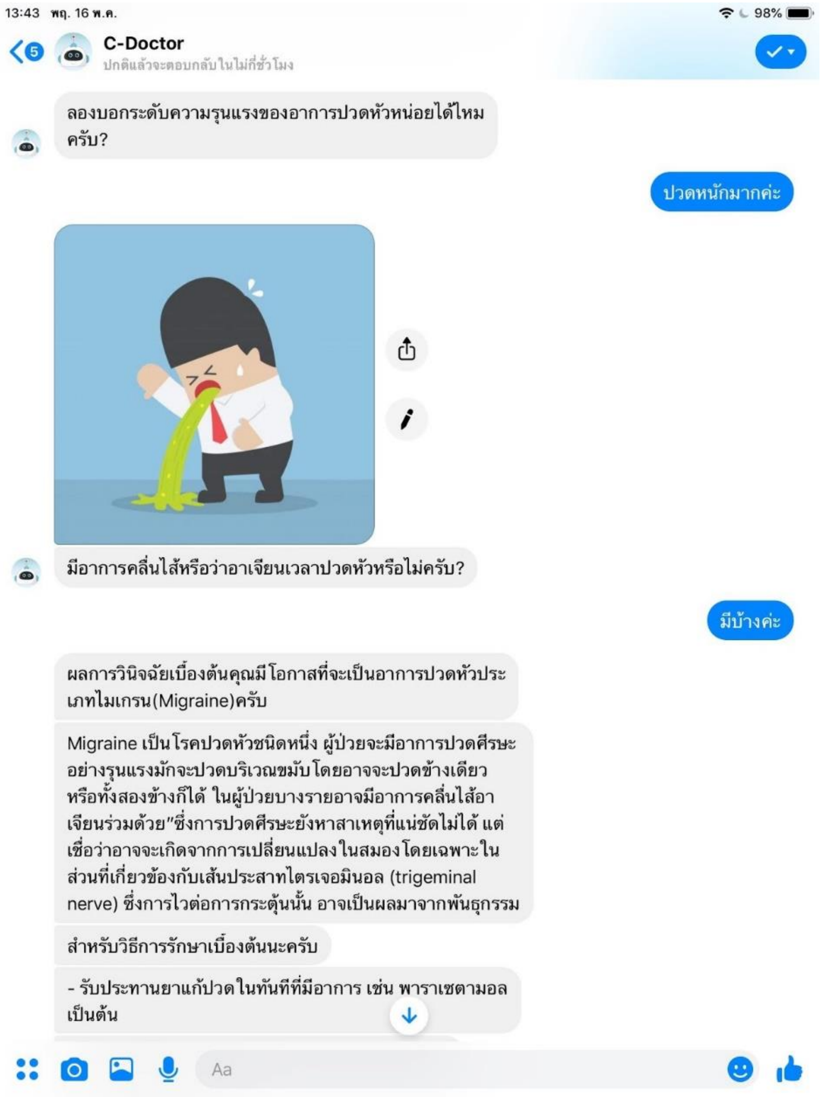
ก่อนอื่นผมขออธิบายให้เข้าใจก่อนนะครับว่าผลการวิเคราะห์นั้นเป็นการวินิจฉัยเบื้องต้นเพื่อหาแนวโน้มของโรคก่อนที่จะส่งต่อให้กับแพทย์เท่านั้นดังนั้นทางที่ดีที่สุดคือการไปพบแพทย์ด้วยนะครับ 😀

วันนี้อยากจะบอกอาการอะไรกับผม หรือว่าอยากรู้อะไรเกี่ยวกับโรคต่างๆไหมครับ 😀

(หากต้องการออกจากบทสนทนาในขณะที่วินิจฉัยให้พิม "restart" เพื่อรีเซตใหม่นะครับ)

Figure 3.3 : Start Chatting with chatbot

For the First time using the chatbot user will receive the welcome message from the chatbot about introduce of chatbot and the actually role to make the user understand.Then, you can start chat with the chatbot



ลองบอกระดับความรุนแรงของอาการปวดหัวหน่อยได้ไหมครับ?

ปวดหนักมากค่ะ

มีอาการคลื่นไส้หรือว่าอาเจียนเวลาปวดหัวหรือไม่ครับ?

มีบ้างค่ะ

ผลการวินิจฉัยเบื้องต้นคุณมีโอกาสที่จะเป็นอาการปวดหัวประเภทไมเกรน(Migraine)ครับ

Migraine เป็นโรคปวดหัวชนิดหนึ่ง ผู้ป่วยจะมีอาการปวดศีรษะอย่างรุนแรงมักจะปวดบริเวณขมับ โดยอาจจะปวดข้างเดียวหรือทั้งสองข้างก็ได้ ในผู้ป่วยบางรายอาจมีอาการคลื่นไส้อาเจียนร่วมด้วย"ซึ่งการปวดศีรษะยังหาสาเหตุที่แน่ชัดไม่ได้ แต่เชื่อว่าอาจจะเกิดจากการเปลี่ยนแปลงในสมอง โดยเฉพาะในส่วนที่เกี่ยวข้องกับเส้นประสาทไตรเจอมินอล (trigeminal nerve) ซึ่งการไวต่อการกระตุ้นนั้น อาจเป็นผลมาจากพันธุกรรม

สำหรับวิธีการรักษาเบื้องต้นนะครับ

- รับประทานยาแก้ปวดในทันทีที่มีอาการ เช่น พาราเซตามอล เป็นต้น

Figure 3.4: Chatbot respond message

From figure 3.4 chatbot can responds message by using text or image.The picture that responds to user make C-doctor more interested and cleary.

3.4.4. Sequence Diagram

3.4.4.1.Chatbot Diagram

Chat Diagram

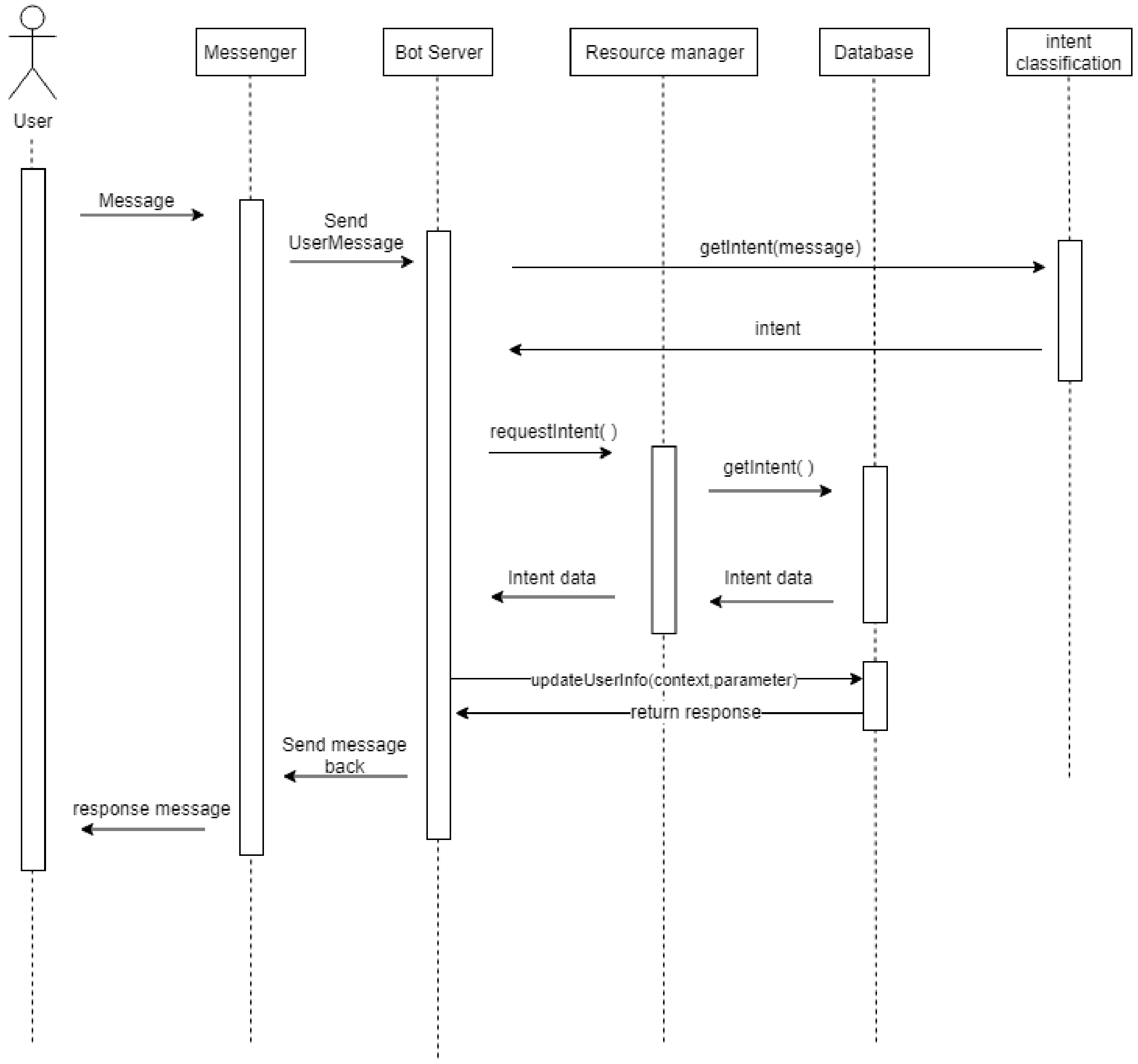


Figure 3.5: Sequence Diagram of chatting

Symptom Checker Chatbot Diagram

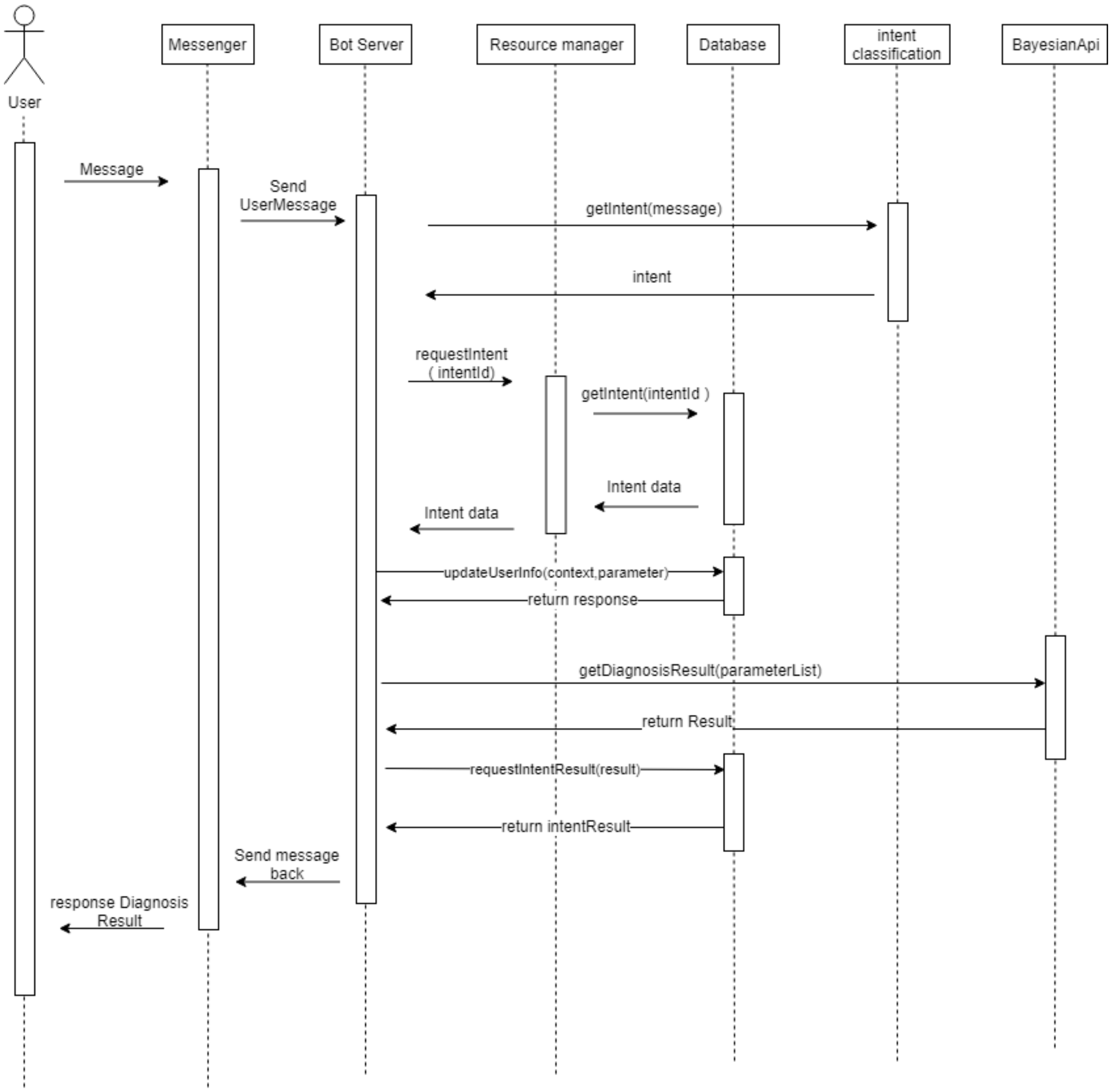


Figure 3.6 : Symptom Checker Chatbot Diagram

3.4.4.2.Chatbot Configuration Diagram

Create Intent of Chatbot Diagram

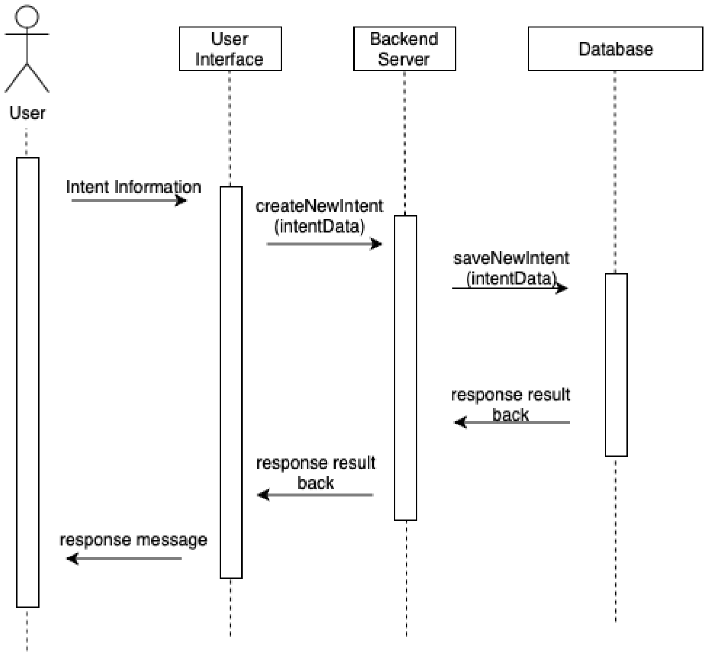


Figure 3.7 : Create Intent of Chatbot Diagram

Edit Intent of Chatbot Diagram

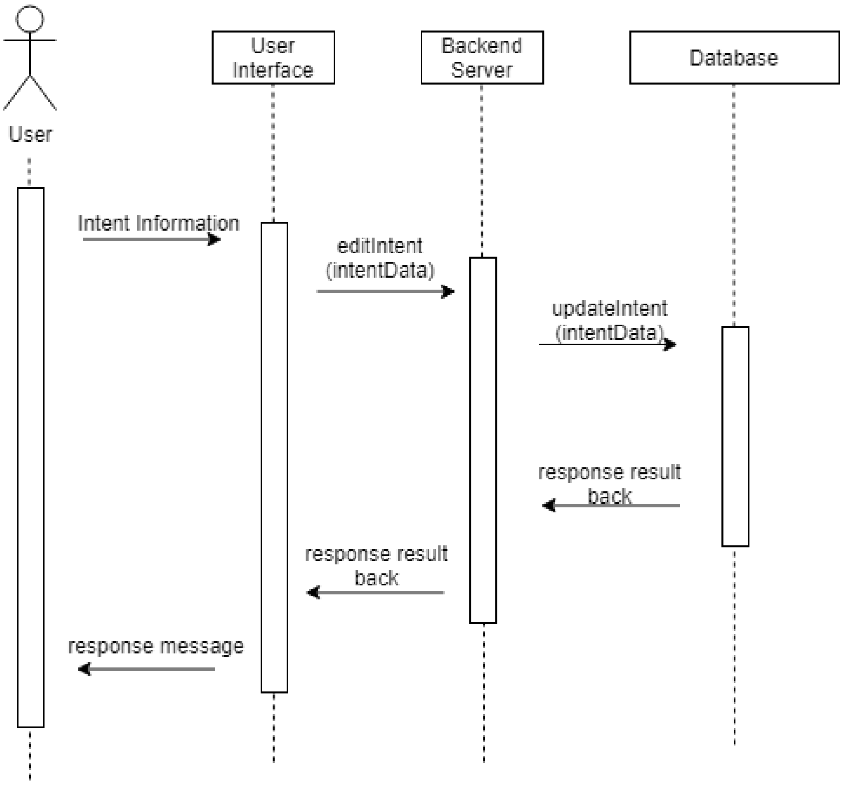


Figure 3.8 : Edit Intent of Chatbot Diagram

Delete Intent of Chatbot Diagram

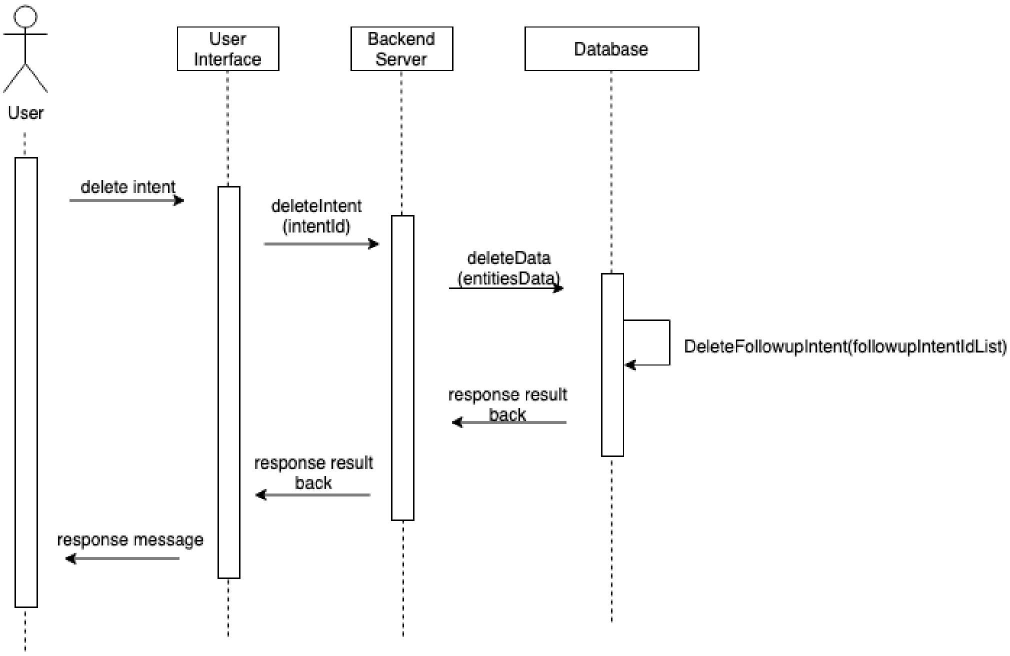


Figure 3.9 : Delete Intent of Chatbot Diagram

Training Model of Chatbot Diagram

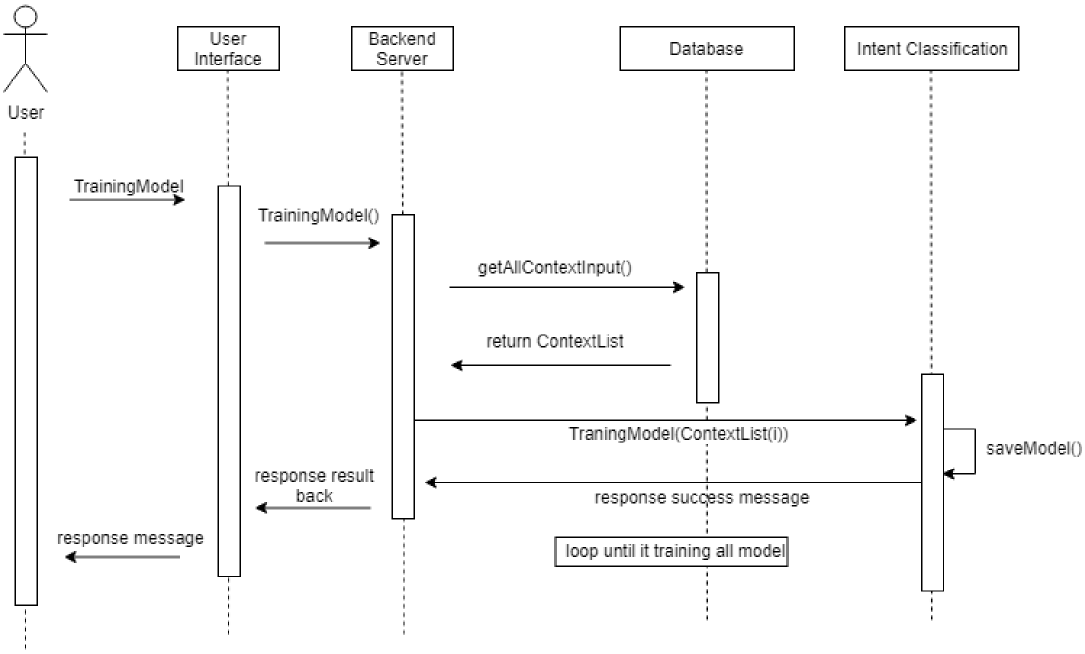


Figure 3.10 : Training Model of Chatbot Diagram

Create follow-up Intent of Chatbot Diagram

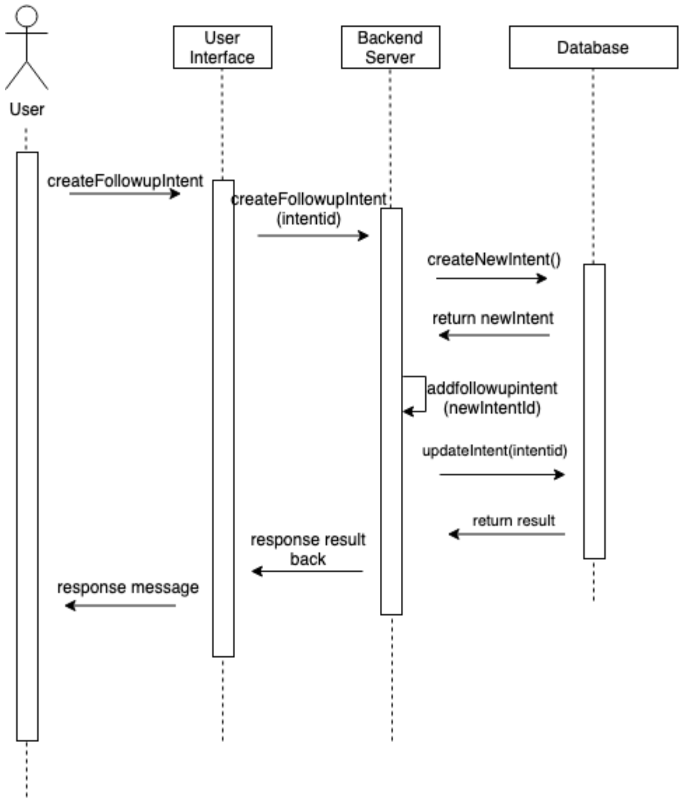
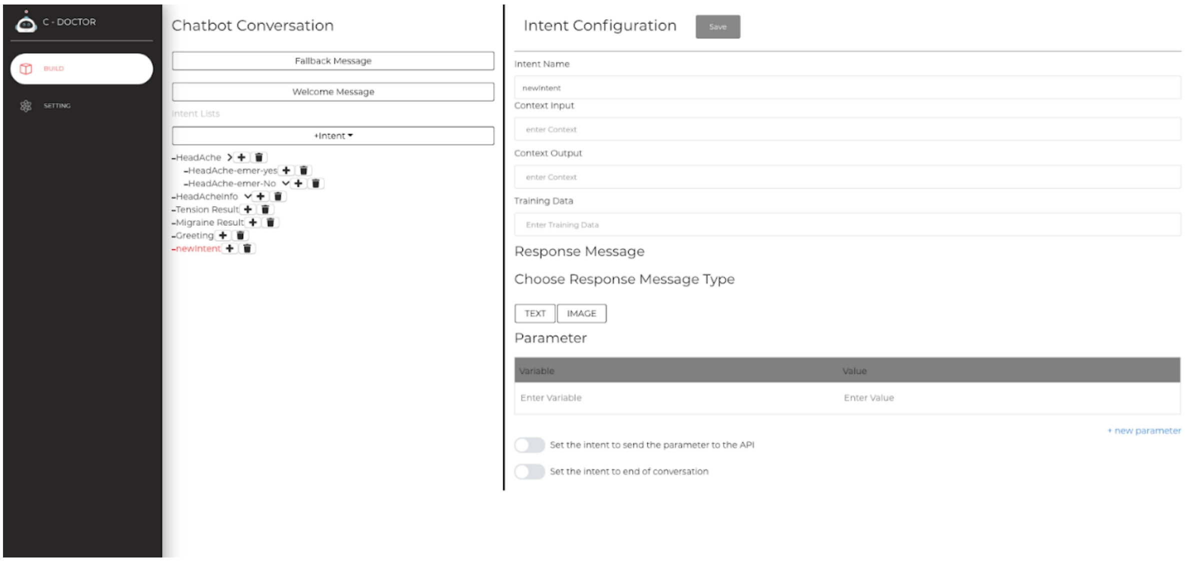


Figure 3.11 : Create follow-up Intent of Chatbot Diagram

3.4.5. Chatbot Configuration Interface Design



Intent Name: newIntent

Context Input: enter Context

Context Output: enter Context

Training Data: Enter Training Data

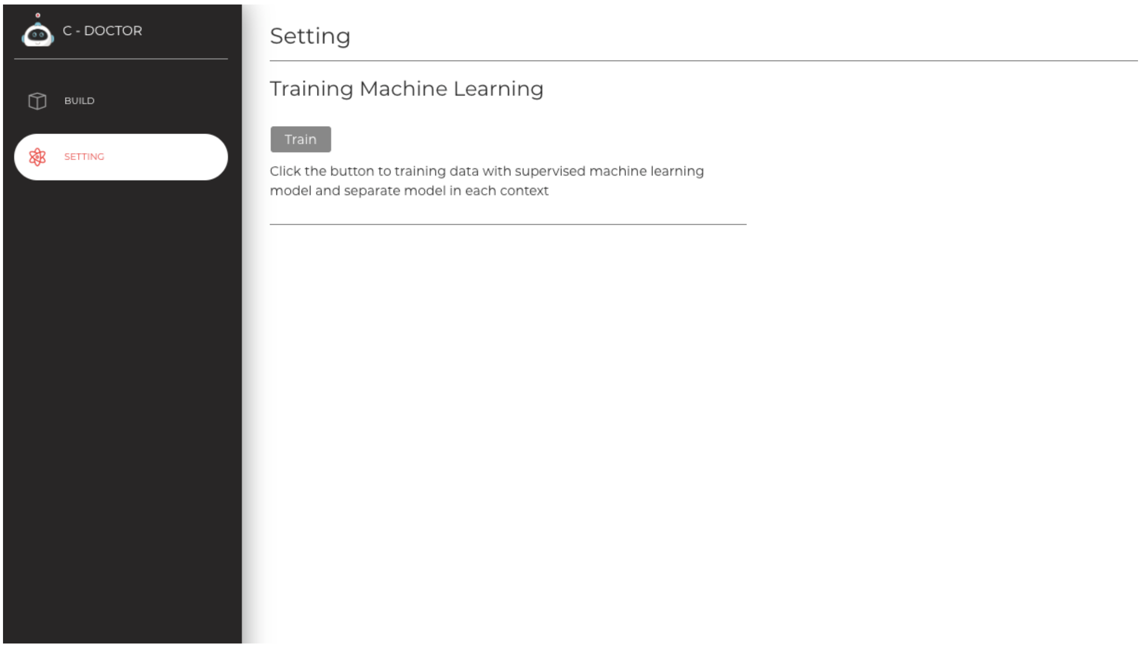
Variable	Value
Enter Variable	Enter Value

○ Set the intent to send the parameter to the API

○ Set the intent to end of conversation

Figure 3.12 : Build Intent interface

For this interface the action that user can use is create an intent of the chatbot.First, when press the plus sign button to create the new intent then, name the new intent,set the context,put the training text that will analyse in machine learning, set the responses message or picture of that intent and set the parameters of the intent. Finally user can set intent to send the parameter to the API and set the intent to end of conversation at the button in the last of page. In addition,the user can make the fallback intent that the intent is use for if the message doesn't match any other intent and the welcome intent for the beginning using the chatbot. The user can create sub intent which called follow intent by press to the follow button to create the follow up intent.



Click the button to training data with supervised machine learning model and separate model in each context

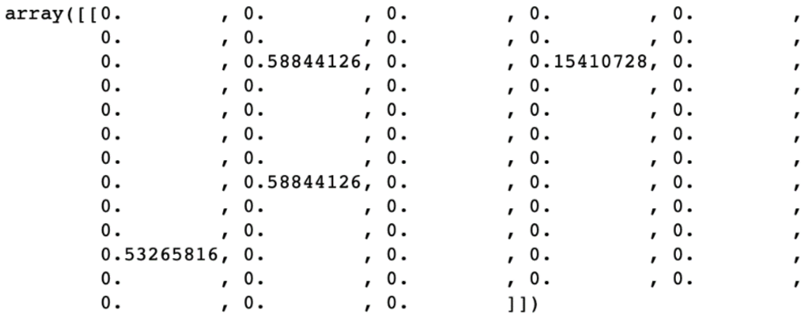
Figure3.13 : setting interface

For this interface it can be press the train button for training the model for each intent separated by context input when click the button it will be loading until the training model is success.

3.4.6.Intent Classification Process

We will use natural language processing to make the chatbot understand the input from user by tokenizing and use TF-IDF and Bag of word technique for prepare the data before training.Then we have separate 2 experiment for learning the training data of intent which is multinomial naive-bayes and deep neural network. For the training data of the intent that using for training the model we have group the intent by using context input so each context of intent will have one model for intent classification.

TF-IDF & Multinomial Naive-Bayes Classification

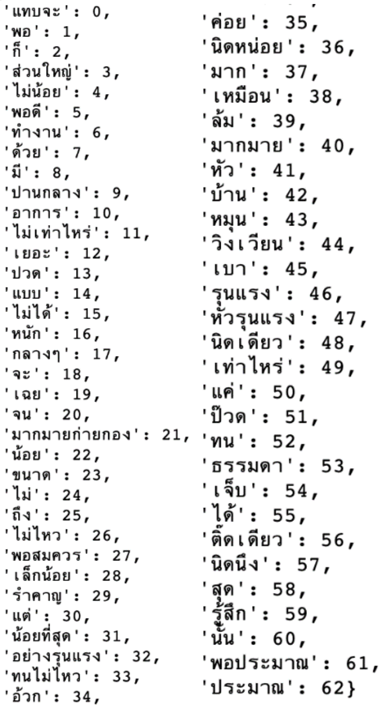


```
array([[0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.58844126, 0.        , 0.15410728, 0.        ,
        0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.58844126, 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        , 0.        , 0.        ,
        0.53265816, 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        , 0.        , 0.        ,
        0.        , 0.        , 0.        ]])
```

Figure3.14 example of list of number after use TF-IDF

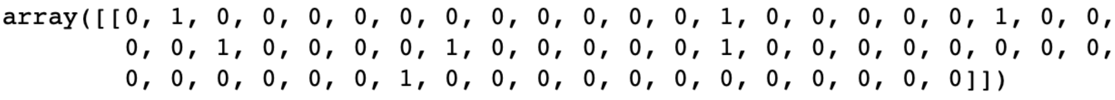
In the first one we will use Term Frequency Inverse Document Frequency as the preprocessing data technique.For this techniques it will weight the the value for each word by the important word will get high value than common word.Then we will use multinomial naive-bayes model to classify the training data so we will send the list of number and list of intent to the model.

Bag of word & Deep Neural Network Classification



```
'แทบจะ': 0,
'พอ': 1,
'ก็': 2,
'ส่วนใหญ่': 3,
'ไม่น้อย': 4,
'พอดี': 5,
'ทำงาน': 6,
'ด้วย': 7,
'มี': 8,
'ปานกลาง': 9,
'อาการ': 10,
'ไม่เท่าไหร่': 11,
'เยอะ': 12,
'ปวด': 13,
'แบบ': 14,
'ไม่ได้': 15,
'หนัก': 16,
'กลางๆ': 17,
'จะ': 18,
'เฉย': 19,
'จน': 20,
'มากมายก่ายกอง': 21,
'น้อย': 22,
'ขนาด': 23,
'ไม่': 24,
'ถึง': 25,
'ไม่ไหว': 26,
'พอสมควร': 27,
'เล็กน้อย': 28,
'รำคาญ': 29,
'แต่': 30,
'น้อยที่สุด': 31,
'อย่างรุนแรง': 32,
'ทนไม่ไหว': 33,
'อ้วก': 34,
'ค่อย': 35,
'นิดหน่อย': 36,
'มาก': 37,
'เหมือน': 38,
'ล้ม': 39,
'มากมาย': 40,
'หัว': 41,
'บ้าน': 42,
'หมุน': 43,
'วิงเวียน': 44,
'เบา': 45,
'รุนแรง': 46,
'หัวรุนแรง': 47,
'นิดเดียว': 48,
'เท่าไหร่': 49,
'แค่': 50,
'ปี๊วด': 51,
'ทน': 52,
'ธรรมดา': 53,
'เจ็บ': 54,
'ได้': 55,
'ติ๊ดเดียว': 56,
'นิดนึง': 57,
'สุด': 58,
'รู้สึก': 59,
'นั้น': 60,
'พอประมาณ': 61,
'ประมาณ': 62}
```

Figure3.15 example of bag of word from AskHeadache Context



```
array([[0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0,
        0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0,
        0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]])
```

Figure3.16 example of list of number that come from count word in bag of word

In the second one we will also tokenize the sentence of each intent in to list of word and then make the bag of word that keep all unique word from list of word in form of value and key.Then we will create a array of number that from count word in bag of word by count amount word id from all word id that appear in each word from list of word.Then we will create the neural network.For the layer in the model we put 2 hidden layer for the neural network so it will be called deep neural network and then train the model with sentence and intent.

3.4.7. Database Design
NoSql Data Model Diagram

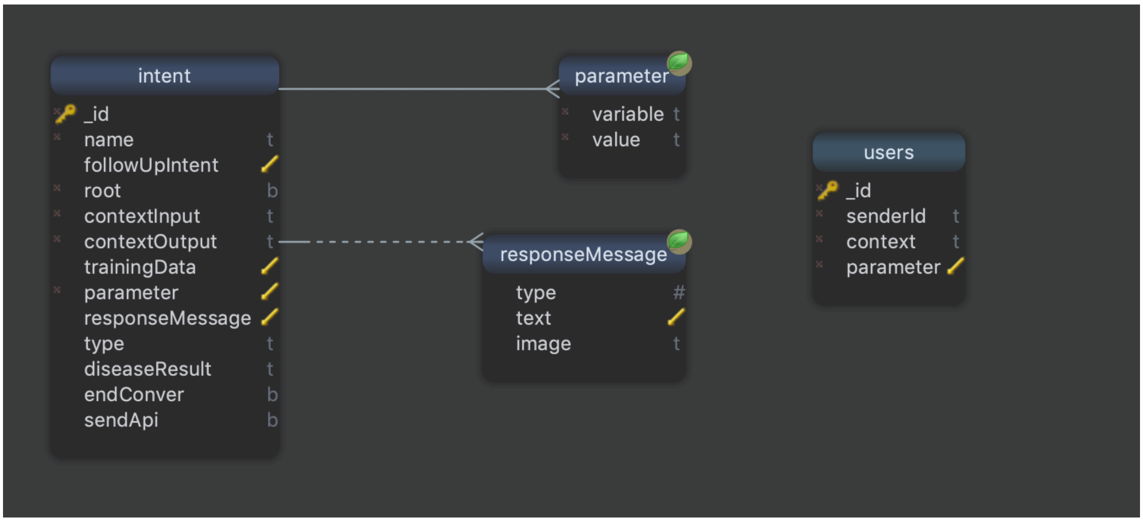


Figure 3.17 : NoSql Data Model Diagram of Chatbot

Intent
Table 3.2.Intent

Name	Description	Type
_id	Unique id for identify intent in database	ObjectId
name	Name of the intent	string
followUpIntent	List follow-up intent by keep the _id of other intent	array<string>
root	The variable to show that this intent is a parent intent using for order intent list in chatbot configuration interface	boolean
contextInput	Keep context input for the intent. use for enter to this intent	string
contextOutput	Keep context output for the intent. use for set new context in the user after enter this intent	string
trainingData	training data of this intent use this data for train the model	array<string>
parameter	Array attribute that keep the value of symptoms from this intent. use for send to the diagnosis Api for get the diagnosis result.	array<{}>

responseMessage	Array attribute that keep response message of this intent.Use for response the message back when user enter this intent	array<{}>
type	this attribute use for define type of intent for example fallback, welcome, custom, result type.	string
diseaseResult	this attribute use in result type for define the intent result for each disease.	string
endConver	boolean for end conversation set true to make the user reset the context and parameter when enter this intent.	boolean
sendApi	boolean for send the parameter to api set true for sending all user parameter to the diagnosis api	boolean

Parameter

Table 3.3. Parameter

Name	Description	Type
variable	name the variable of parameter for send to the diagnosis api	string
value	value of the parameter for send to diagnosis api	string

Responses Message

Table 3.4. Response Message

Name	Description	Type
type	this is a type of response message that separate in 2 type text response and image response	integer
text	text for response message that keep the array of similar text message using to random one of text to response to the user. set blank if it is image type	array<string>
image	the attribute that keeping image url.Use for sending response message to the user. set blank if it is text type	string

User

Table 3.5. User

Name	Description	Type
id	unique id for identify users in database	string
senderId	unique facebook id of user using for communicate with each user in facebook messanger	string
context	keep current context of user	string
parameter	keep the parameter of user.using	string

Chapter 4

Results and Discussion

4.1 C-Doctor User Interface

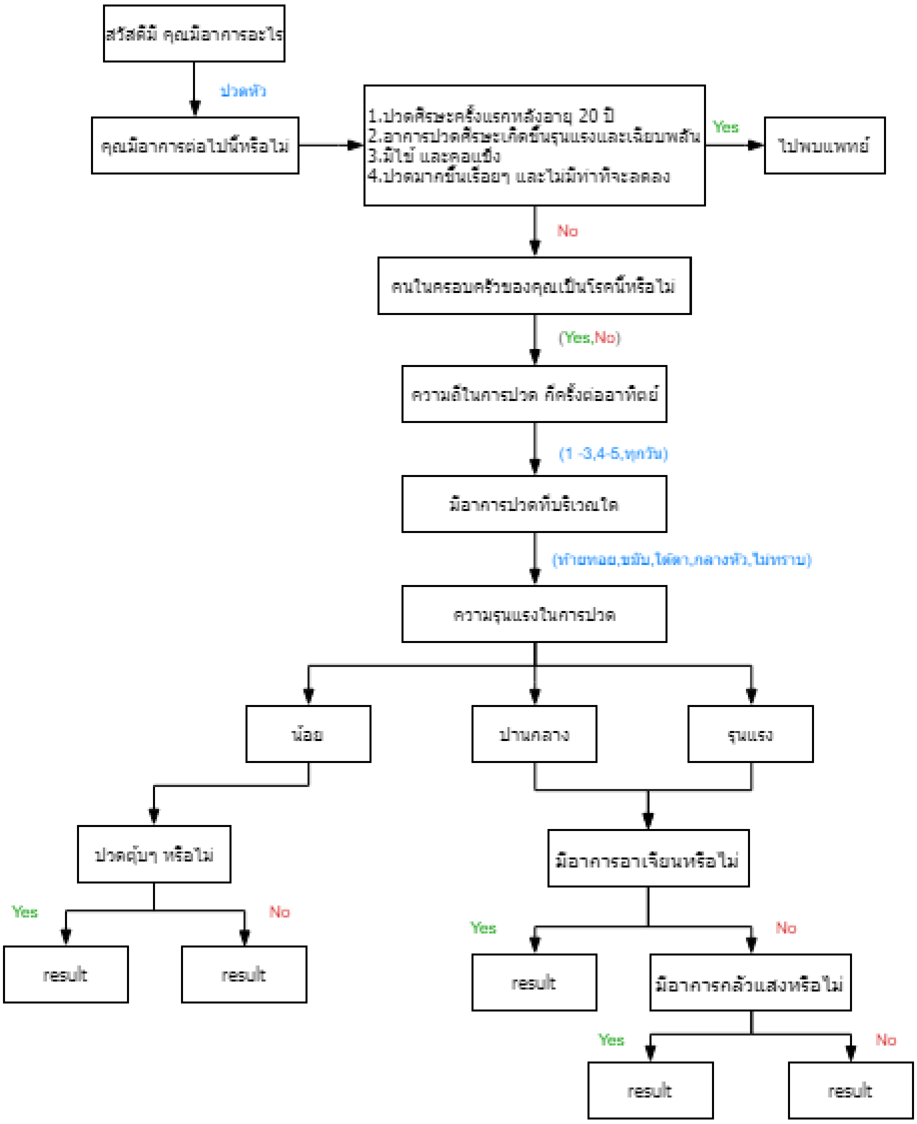
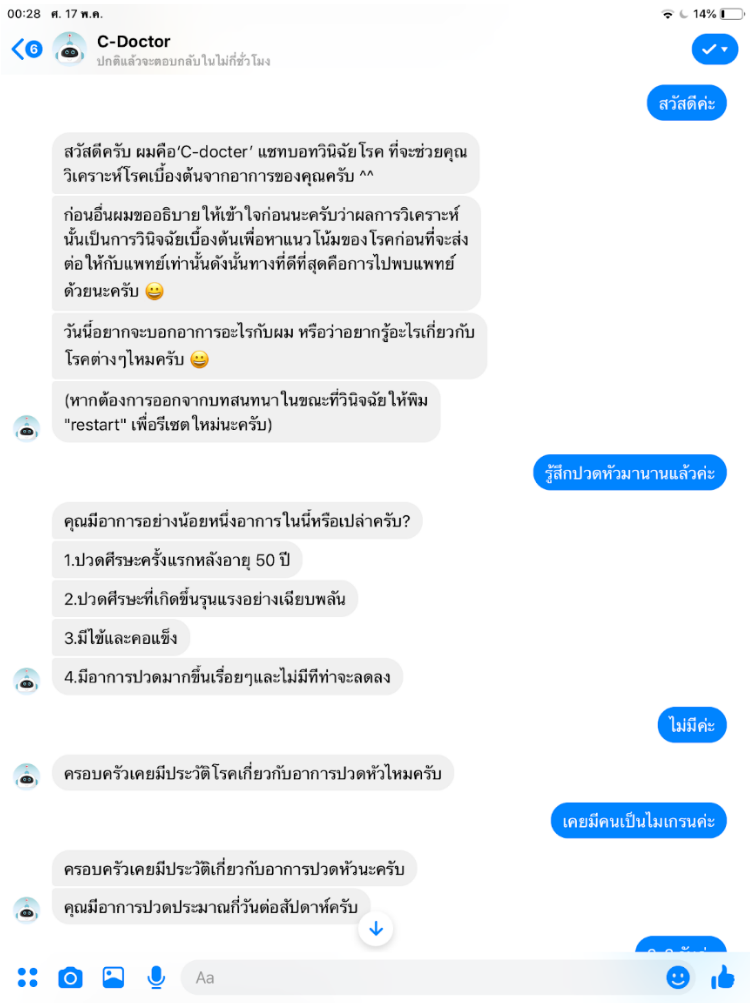


Figure4.1 Flow conversation of headache diagnosis

From the Figure 4.1 This is headache diagnosis conversation flow that the square show the question that will response to the user when the user going to that intent for the result we have separate in to 3 result, first the migraine result that most occur when the user have a symptoms along to the right and the tension result that usually occur when the user have the symptoms along to the left and the last one is emergency case that show on the top right which show the result that the user have an emergency case

In this part we will show the some example conversation flow between the user and chatbot for diagnosis disease from symptoms about 2 scenario,Migraine and Tension Disease and also ask disease information.For the diagnosis result we have ask the user about related symptoms to gather the information before send the information to Bayesian Network Model API and then trigger to the intent result to show the diagnosis result to the user.

4.1.1 Migraine result Conversation flow



สวัสดีค่ะ

สวัสดีครับ ผมคือ'C-docter' แชทบอทวินิจัยโรค ที่จะช่วยคุณวิเคราะห์โรคเบื้องต้นจากอาการของคุณครับ ^^

ก่อนอื่นผมขออธิบายให้เข้าใจก่อนนะครับว่าผลการวิเคราะห์นั้นเป็นการวินิจฉัยเบื้องต้นเพื่อหาแนวโน้มของโรคก่อนที่จะส่งต่อให้กับแพทย์เท่านั้นดังนั้นทางที่ดีที่สุดคือการไปพบแพทย์ด้วยนะครับ 😀

วันนี้อยากจะบอกอาการอะไรกับผม หรือว่าอยากรู้อะไรเกี่ยวกับโรคต่างๆไหมครับ 😀

(หากต้องการออกจากบทสนทนาในขณะที่วินิจฉัยให้พิม "restart" เพื่อรีเซตใหม่นะครับ)

รู้สึกปวดหัวมานานแล้วค่ะ

คุณมีอาการอย่างน้อยหนึ่งอาการในนี้หรือเปล่าครับ?

1.ปวดศีรษะครั้งแรกหลังอายุ 50 ปี

2.ปวดศีรษะที่เกิดขึ้นรุนแรงอย่างเฉียบพลัน

3.มีไข้และคอแข็ง

4.มีอาการปวดมากขึ้นเรื่อยๆและไม่มีทีท่าจะลดลง

ไม่มีค่ะ

ครอบครัวเคยมีประวัติโรคเกี่ยวกับอาการปวดหัวไหมครับ

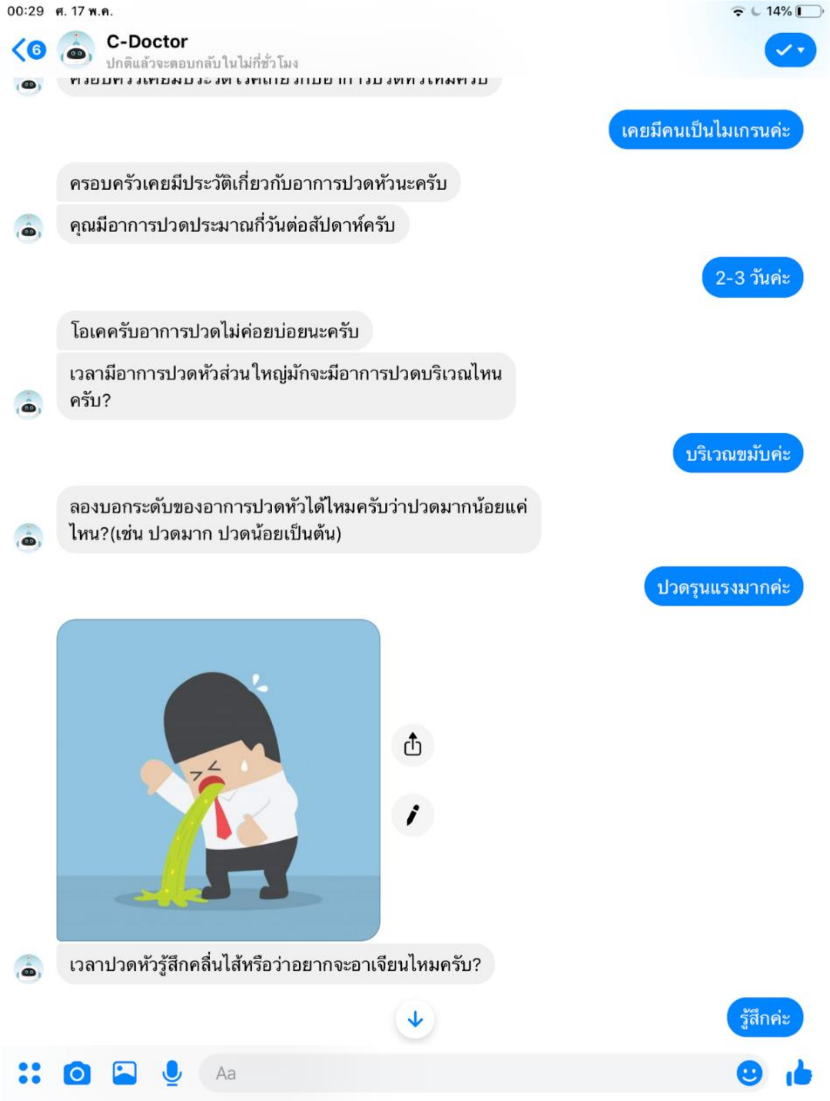
เคยมีคนเป็นไมเกรนค่ะ

ครอบครัวเคยมีประวัติเกี่ยวกับอาการปวดหัวนะครับ

คุณมีอาการปวดประมาณกี่วันต่อสัปดาห์ครับ

Figure 4.2 : Show chatbot conversation

In the figure 4.2 user start to say “สวัสดี” to the C-doctor so the C-doctor will response the greeting message back and give the instruction for using this chatbot to the user. Then the user say ”รู้สึกปวดหัวมานานแล้วค่ะ” which mean the user have an headache then the chatbot will be response the response message back to ask the user that user have those of symptoms or not? And then then user say ““ไม่มีค่ะ” to the chatbot to say that the user don’t have those of symptoms and then the chatbot will be get to the next question by ask the user that the family has history of headache disease before of not? Then the user say “เคยมีคนเคยเป็น” which mean yes so the chatbot will collect the data and then response to the user to confirm the answer and then ask more the question about frequency that the headache occur by day per week .



เคยมีคนเป็นไมเกรนค่ะ

ครอบครัวเคยมีประวัติเกี่ยวกับอาการปวดหัวนะครับ

คุณมีอาการปวดประมาณกี่วันต่อสัปดาห์ครับ

2-3 วันค่ะ

โอเคครับอาการปวดไม่ค่อยบ่อยนะครับ

เวลามีอาการปวดหัวส่วนใหญ่มักจะมีอาการปวดบริเวณไหนครับ?

บริเวณขมับค่ะ

ลองบอกระดับของอาการปวดหัวได้ไหมครับว่าปวดมากน้อยแค่ไหน?(เช่น ปวดมาก ปวดน้อยเป็นต้น)

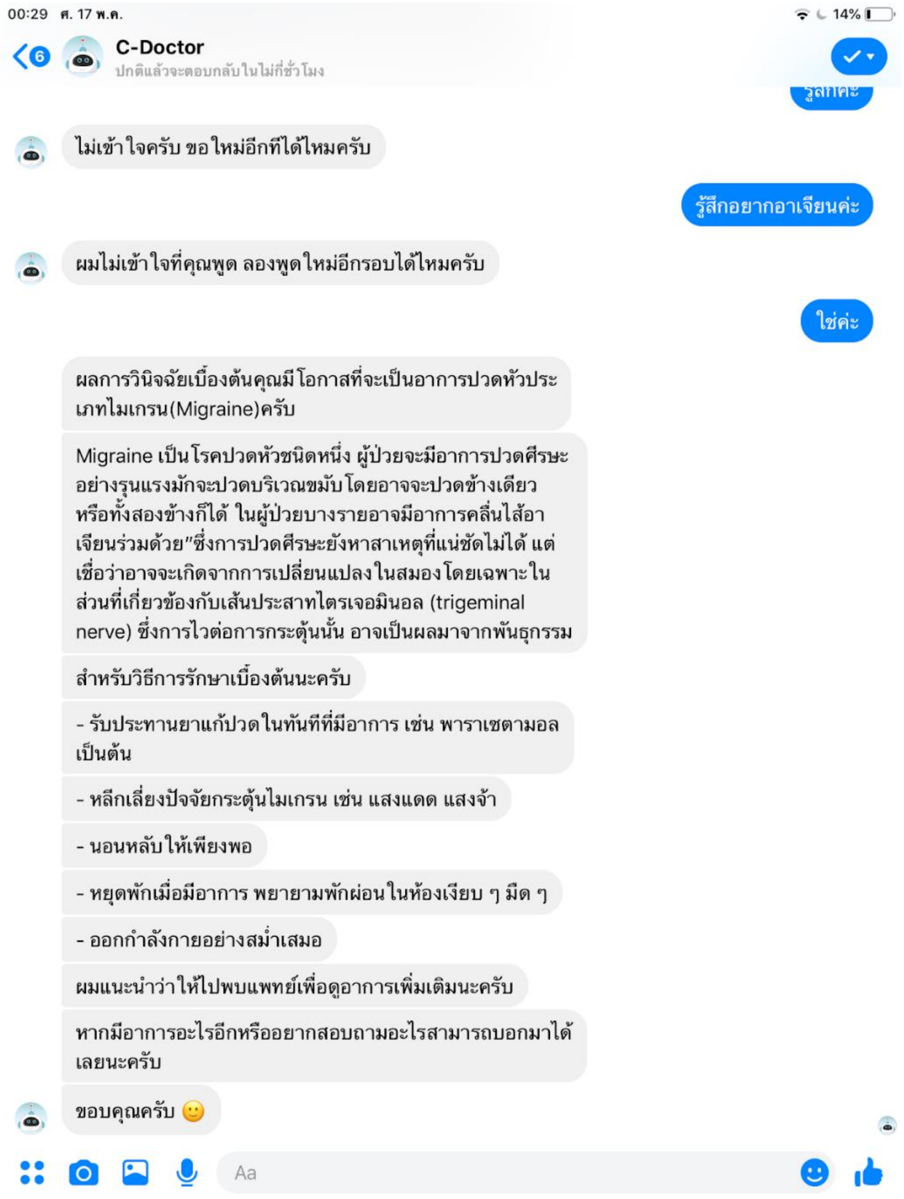
ปวดรุนแรงมากค่ะ

เวลาปวดหัวรู้สึกคลื่นไส้หรือว่าอยากจะอาเจียนไหมครับ?

รู้สึกค่ะ

Figure 4.3 : Show chatbot asking information from patient

From the previous the user say that she has the headache 2-3 day per week so the chatbot will collect the data and confirm that the symptoms is low frequency then the chatbot will ask more the question about the location that was pain when the user get headache so the user answer the temple location then the chatbot will collect data and ask more the question about vomit symptoms to the user then the user answer that she seem to have to vomit.So the chatbot will be collect the data and then response the diagnosis result



รู้สึกค่ะ

ไม่เข้าใจครับ ขอใหม่อีกทีได้ไหมครับ

รู้สึกอยากอาเจียนค่ะ

ผมไม่เข้าใจที่คุณพูด ลองพูดใหม่อีกรอบได้ไหมครับ

ใช่ค่ะ

ผลการวินิจฉัยเบื้องต้นคุณมีโอกาสที่จะเป็นอาการปวดหัวประเภทไมเกรน(Migraine)ครับ

Migraine เป็นโรคปวดหัวชนิดหนึ่ง ผู้ป่วยจะมีอาการปวดศีรษะอย่างรุนแรงมักจะปวดบริเวณขมับ โดยอาจจะปวดข้างเดียวหรือทั้งสองข้างก็ได้ ในผู้ป่วยบางรายอาจมีอาการคลื่นไส้อาเจียนร่วมด้วย"ซึ่งการปวดศีรษะยังหาสาเหตุที่แน่ชัดไม่ได้ แต่เชื่อว่าอาจจะเกิดจากการเปลี่ยนแปลงในสมองโดยเฉพาะในส่วนที่เกี่ยวข้องกับเส้นประสาทไตรเจอมินอล (trigeminal nerve) ซึ่งการไวต่อการกระตุ้นนั้น อาจเป็นผลมาจากพันธุกรรม

สำหรับวิธีการรักษาเบื้องต้นนะครับ

- รับประทานยาแก้ปวดในทันทีที่มีอาการ เช่น พาราเซตามอล เป็นต้น

- หลีกเลี่ยงปัจจัยกระตุ้นไมเกรน เช่น แสงแดด แสงจ้า

- นอนหลับให้เพียงพอ

- หยุดพักเมื่อมีอาการ พยายามพักผ่อนในห้องเงียบ ๆ มืด ๆ

- ออกกำลังกายอย่างสม่ำเสมอ

ผมแนะนำว่าให้ไปพบแพทย์เพื่อดูอาการเพิ่มเติมนะครับ

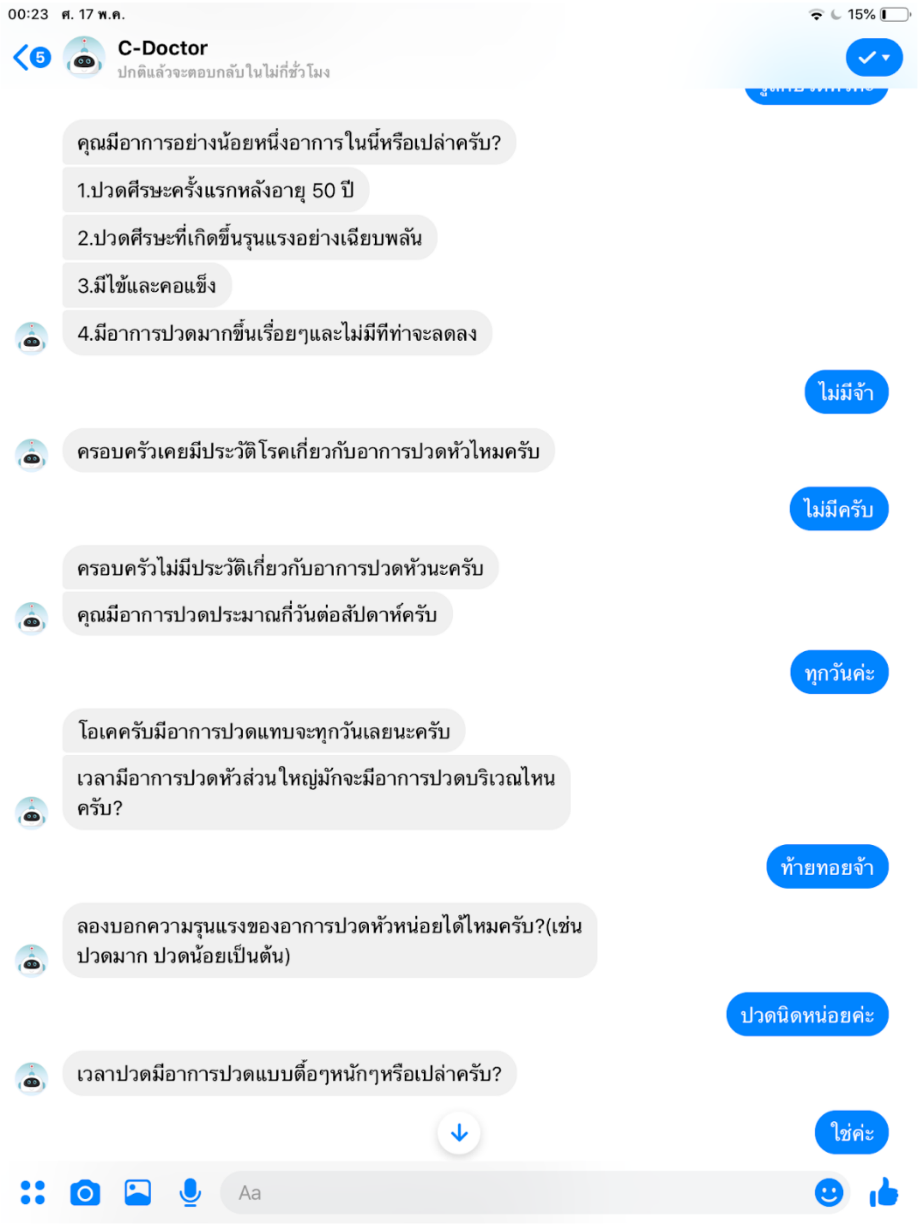
หากมีอาการอะไรอีกหรืออยากสอบถามอะไรสามารถบอกมาได้เลยนะครับ

ขอบคุณครับ 🙂

Figure 4.4 : Show result of migraine

In this picture show that the chatbot send the result back to the user

4.1.2 Tension result Conversation flow



คุณมีอาการอย่างน้อยหนึ่งอาการในนี้หรือเปล่าครับ?

1.ปวดศีรษะครั้งแรกหลังอายุ 50 ปี

2.ปวดศีรษะที่เกิดขึ้นรุนแรงอย่างเฉียบพลัน

3.มีไข้และคอแข็ง

4.มีอาการปวดมากขึ้นเรื่อยๆและไม่มีทีท่าจะลดลง

ไม่มีจ้า

ครอบครัวเคยมีประวัติโรคเกี่ยวกับอาการปวดหัวไหมครับ

ไม่มีครับ

ครอบครัวไม่มีประวัติเกี่ยวกับอาการปวดหัวนะครับ

คุณมีอาการปวดประมาณกี่วันต่อสัปดาห์ครับ

ทุกวันค่ะ

โอเคครับมีอาการปวดแทบจะทุกวันเลยนะครับ

เวลามีอาการปวดหัวส่วนใหญ่มักจะมีอาการปวดบริเวณไหนครับ?

ท้ายทอยจ้า

ลองบอกความรุนแรงของอาการปวดหัวหน่อยได้ไหมครับ?(เช่นปวดมาก ปวดน้อยเป็นต้น)

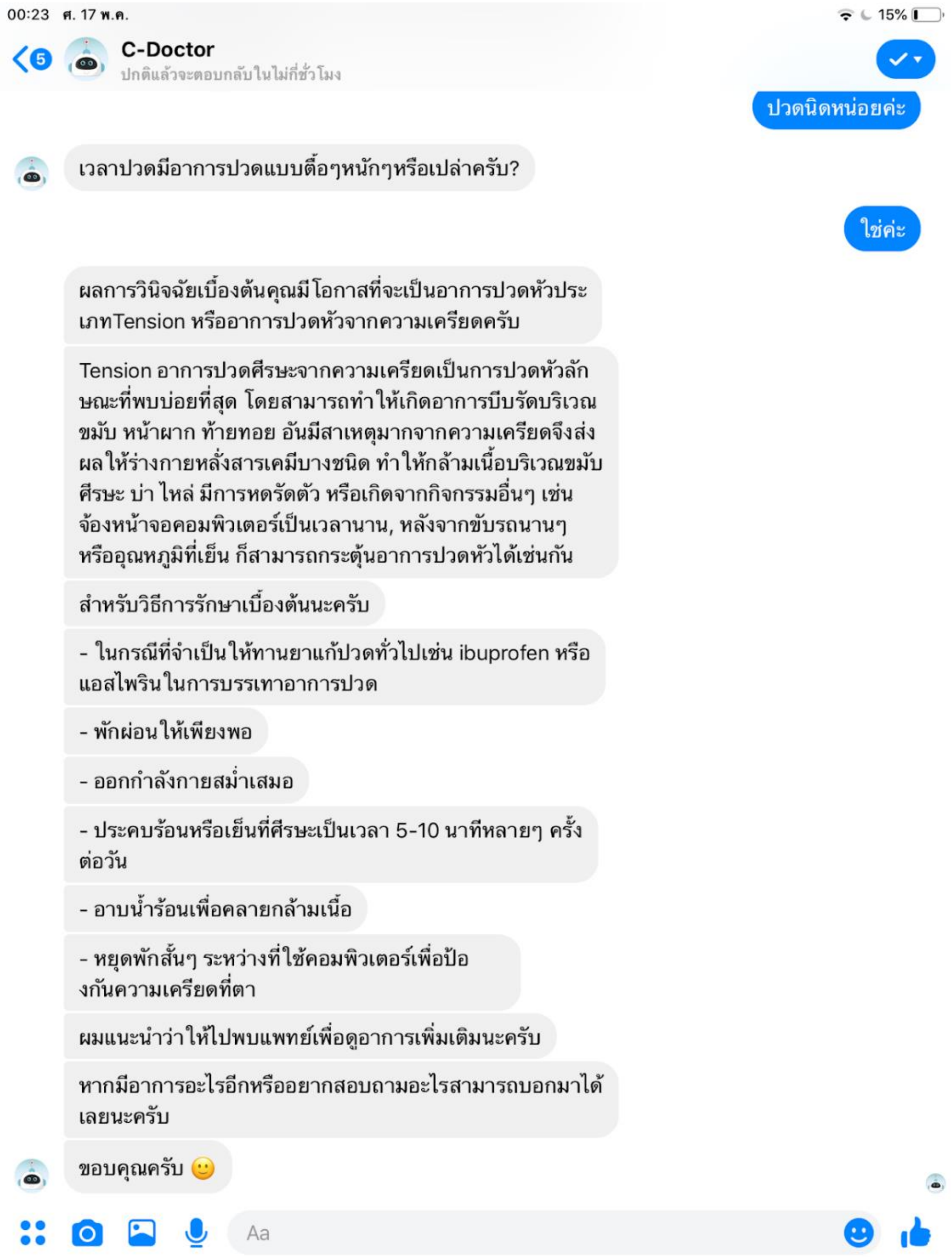
ปวดนิดหน่อยค่ะ

เวลาปวดมีอาการปวดแบบตื้อๆหนักๆหรือเปล่าครับ?

ใช่ค่ะ

Figure 4.5 : Show tension conversation flow

From the figure 4.4 it like the previous one so in this picture show that the user have no the family history about headache and she has the headache everyday and also have the headache in the occipital location and say that the level headache is low and the last answer she say that she has the "ปวดหัวตื้อๆ" symptoms



ปวดนิดหน่อยค่ะ

เวลาปวดมีอาการปวดแบบตื้อๆหนักๆหรือเปล่าครับ?

ใช่ค่ะ

ผลการวินิจฉัยเบื้องต้นคุณมีโอกาสที่จะเป็นอาการปวดหัวประเภทTension หรืออาการปวดหัวจากความเครียดครับ

Tension อาการปวดศีรษะจากความเครียดเป็นการปวดหัวลักษณะที่พบบ่อยที่สุด โดยสามารถทำให้เกิดอาการบีบรัดบริเวณขมับ หน้าผาก ท้ายทอย อันมีสาเหตุมากจากความเครียดจึงส่งผลให้ร่างกายหลั่งสารเคมีบางชนิด ทำให้กล้ามเนื้อบริเวณขมับศีรษะ บ่า ไหล่ มีการหดรัดตัว หรือเกิดจากกิจกรรมอื่นๆ เช่น จ้องหน้าจอคอมพิวเตอร์เป็นเวลานาน, หลังจากขับรถนานๆ หรืออุณหภูมิที่เย็น ก็สามารถกระตุ้นอาการปวดหัวได้เช่นกัน

สำหรับวิธีการรักษาเบื้องต้นนะครับ

- ในกรณีที่จำเป็นให้ทานยาแก้ปวดทั่วไปเช่น ibuprofen หรือแอสไพรินในการบรรเทาอาการปวด

- พักผ่อนให้เพียงพอ

- ออกกำลังกายสม่ำเสมอ

- ประคบร้อนหรือเย็นที่ศีรษะเป็นเวลา 5-10 นาทีหลายๆ ครั้งต่อวัน

- อาบน้ำร้อนเพื่อคลายกล้ามเนื้อ

- หยุดพักสั้นๆ ระหว่างที่ใช้คอมพิวเตอร์เพื่อป้องกันความเครียดที่ตา

ผมแนะนำว่าให้ไปพบแพทย์เพื่อดูอาการเพิ่มเติมนะครับ

หากมีอาการอะไรอีกหรืออยากสอบถามอะไรสามารถบอกมาได้เลยนะครับ

ขอบคุณครับ 🙂

Figure 4.6 : Show result of tension

Finally the chatbot send the message to the api and then resturn the result to say that the user have tension headache

4.2 Intent Classification Model of C-Doctor

In this part we will show the Intent Classification experiment from all of the model but we will start for the model that can be explain the result because of it have the most training data from the other model that is model for ask headache level that is seperate in High-level, Medium-level, Low-level.

Table4.1 result of model from Headahce-Asklevel context

Classification Techniques	**Accuracy**	**Precision**	**Recall**	**F - measure**
Multinomial Naive Bayes (19L,16M,18H)	0.625	0.72	0.62	0.63
Deep neural network (19L,16M,18H)	0.8125	0.88	0.81	0.82

From the table 4.1 it is a result of predictive model of Intent classification by using supervised machine learning technique so we use 2 techniques for Intent classification and calculate the value for compare the performance between 2 algorithm. In this experiment we focus on the accuracy of each model that show the ratio of the correct of prediction from the all case that we use for test it. In this experiment we have the 19 training data for low - level headache, 16 training data for medium - level headache and 18 training data for high-level headache. then, we have testing data for calculate the performance of each model about 16 sentence which separate to 3 intent, 6 low, 5 medium and 5 high.

For the first one Multinomial Naive Bayes, the result is not good as we expected maybe it was a cause of TF-IDF that sometimes can’t help to for some training data for example in this case there are similar sentence between low level headache and medium level headache like “ปวดไม่มากแค่ปวดหน่อยๆ”and”ปวดไม่มากแค่ปวดกลางๆ” .

For the second one Deep neural network, It seem to be great performance as we expected because we change the weight and bias to make the model get the great performance and the model also have backpropagation that can learn from the error and adjust the weight to be near as the result

From the result we can conclude that we will use deep neural network for the intent classification of the text but for the real performance that we have use and type the text that have some different from the training data it seem to be get the wrong answer so we think that Deep neural network model can be overfit but for the overall it still good to be using for classification.finally, we have to gather more training data for the intent to make it higher accuracy.

table 4.2 result of model from HeadAche-AskFrequeancy context

Classification Techniques	**Accuracy**	**Precision**	**Recall**	**F - measure**
Multinomial Naive Bayes (5:1-3 day, 4:4-5 day, 2:everyday	0.64286	0.68	0.64	0.57

,3:not sure)				
TensorFlow Model (Deep neural network) (5:1-3 day, 4:4-5 day, 2:everyday ,3:not sure)	0.714	0.67	0.71	0.65

table 4.3 result of model from HeadAche-AskSide context

Classification Techniques	**Accuracy**	**Precision**	**Recall**	**F - measure**
Multinomial Naive Bayes (3 Occipital, 3 Temples, 3 Eyes, 3MiddleHead , 3Unknown,)	0.66667	0.60	0.67	0.62
Deep neural network (3 Occipital, 3 Temples, 3 Eyes, 3MiddleHead , 3Unknown,)	0.80	0.90	0.80	0.81

From the table 4.2 and 4.3 it is the result of performance of each model for asking the location side and frequency of symptoms by day/week that the user get headache.As you can see the training data was too small for find the result because when we split the data between test data and train data the dataset for each intent is only have 5 for Occipital side,7 Temple side,7 Eyes Side,7 Middle Head Side,6 Unknow side but deep neural network can still classification with the input that similar to the training dataset but it can be wrong if the input is not near to the training data.So the conclusion is we have to get more training data for each intent to compare the performance of the model.

table 4.4 result of model from blank context

Classification Techniques	**Accuracy**	**Precision**	**Recall**	**F - measure**
Multinomial Naive Bayes (3,headache, 2,ask headache information, 3, greeting)	1.00	1.00	1.00	1.00

Deep neural network (3,headache, 2,ask headache information, 3, greeting)	1.00	1.00	1.00	1.00

table 4.5 result of model from HeadAcheInfo 9 8

Classification Techniques	**Accuracy**	**Precision**	**Recall**	**F - measure**
Multinomial Naive Bayes (3,Migraine Infomation, 3,Tension Infomation,)	1.00	1.00	1.00	1.00
Deep neural network (3,Migraine Infomation, 3,Tension Infomation,)	0.83	0.83	0.83	0.83

table 4.6 result of model from HeadAche-Emer context

Classification Techniques	**Accuracy**	**Precision**	**Recall**	**F - measure**
Multinomial Naive Bayes (3 Yes, 3No)	0.500	0.50	0.50	0.49
Deep neural network (3 Yes,3No)	1.00	1.00	1.00	1.00

table 4.7 result of model from HeadAche-familyHistory context

Classification Techniques	**Accuracy**	**Precision**	**Recall**	**F - measure**
Multinomial Naive Bayes (3Yes,3No,3Not sure)	0.88889	0.92	0.89	0.89
Deep neural network (3Yes,3No,3Not sure)	0.84	0.92	0.89	0.89

table 4.8 result of model from HeadAche-TueTue context

Classification Techniques	**Accuracy**	**Precision**	**Recall**	**F - measure**
Multinomial Naive Bayes (2Yes, 1 No,)	1.00	1.00	1.00	1.00
Deep neural network (2Yes, 1 No,)	1.00	1.00	1.00	1.00

table 4.9 result of model from HeadAche-AskVomit-followup context

Classification Techniques	**Accuracy**	**Precision**	**Recall**	**F - measure**
Multinomial Naive Bayes (1Yes, 2 No,)	1.00	1.00	1.00	1.00
Deep neural network (1Yes, 2 No,)	1.00	1.00	1.00	1.00

table 4.10 result of model from HeadAche-AskLight context

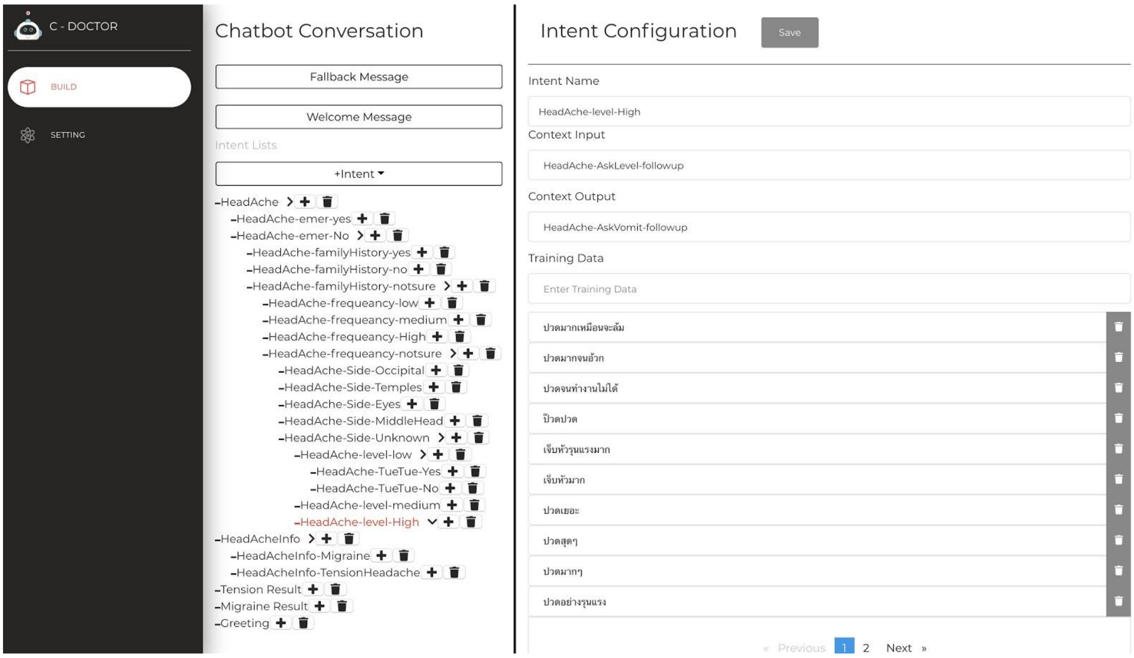
Classification Techniques	Accuracy	Precision	Recall	F - measure
Multinomial Naive Bayes (1Yes, 2 No,)	1.00	1.00	1.00	1.00
Deep neural network (1Yes, 2 No,)	0.66	0.44	0.67	0.53

table 4.11 result of model from HeadAche-AskTubTub context

Classification Techniques	Accuracy	Precision	Recall	F - measure
Multinomial Naive Bayes (2Yes, 1No,)	1.00	1.00	1.00	1.00
Deep neural network (2Yes, 1 No,)	0.00	0.00	0.00	0.00

For the other table above we cannot explain the result of the performance because the training data is too small for using training the model so some of the result will make the model low performance.

4.3 C-Doctor Intent Configuration platform



Chatbot Conversation

Fallback Message

Welcome Message

Intent Lists

+Intent

```
-HeadAche
   -HeadAche-emer-yes
   -HeadAche-emer-No
      -HeadAche-familyHistory-yes
      -HeadAche-familyHistory-no
      -HeadAche-familyHistory-notsure
         -HeadAche-frequeancy-low
         -HeadAche-frequeancy-medium
         -HeadAche-frequeancy-High
         -HeadAche-frequeancy-notsure
            -HeadAche-Side-Occipital
            -HeadAche-Side-Temples
            -HeadAche-Side-Eyes
            -HeadAche-Side-MiddleHead
            -HeadAche-Side-Unknown
               -HeadAche-level-low
                  -HeadAche-TueTue-Yes
                  -HeadAche-TueTue-No
               -HeadAche-level-medium
               -HeadAche-level-High
-HeadAcheInfo
   -HeadAcheInfo-Migraine
   -HeadAcheInfo-TensionHeadache
-Tension Result
-Migraine Result
-Greeting
```

Intent Configuration

Intent Name: HeadAche-level-High

Context Input: HeadAche-AskLevel-followup

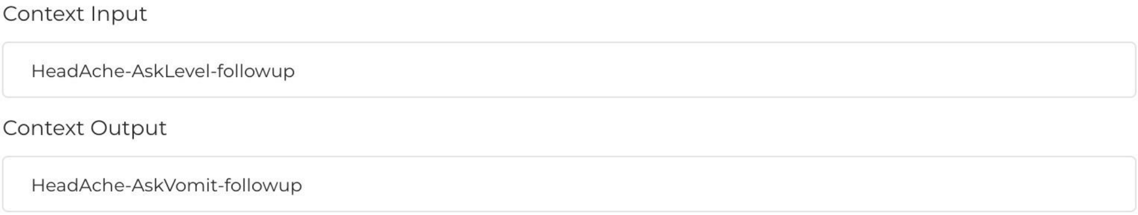
Context Output: HeadAche-AskVomit-followup

Training Data: Enter Training Data

- ปวดมากเหมือนจะล้ม
- ปวดมากจนอ้วก
- ปวดจนทำงานไม่ได้
- ปี๊วดปวด
- เจ็บหัวรุนแรงมาก
- เจ็บหัวมาก
- ปวดเยอะ
- ปวดสุดๆ
- ปวดมากๆ
- ปวดอย่างรุนแรง

Figure4.7 : The build intent interface with the intent example of headache-level-High intent

This is user configuration interface,at the intent page the user can create intent for chatbot and can do a lot of features that make chatbot has efficiency.From the figure4. we show the intent of the headache-level-high intent to show that the web interface can be add intent and information inside intent.



Context Input

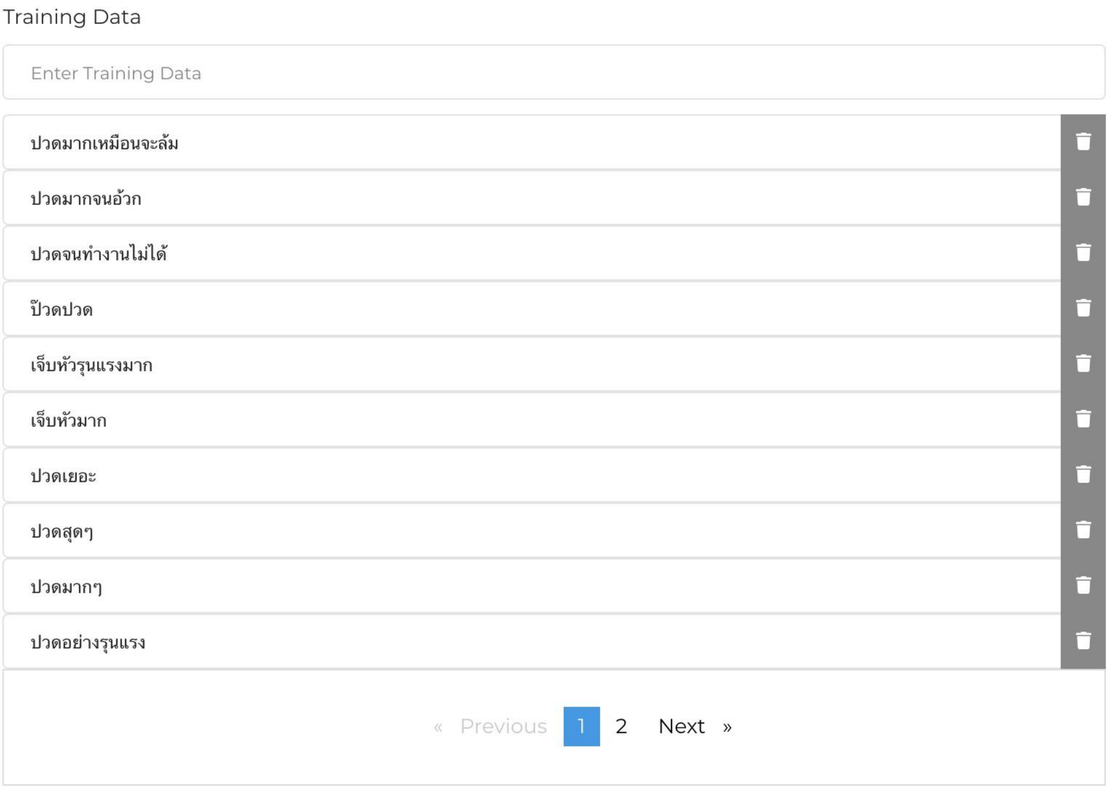
HeadAche-AskLevel-followup

Context Output

HeadAche-AskVomit-followup

Figure4.8: the example of input for set the Context input and Context Output

In first part you can set context input for intent to make the intent can access only when user have this context and set context output for user to go to next context.



Training Data

Enter Training Data

ปวดมากเหมือนจะล้ม

ปวดมากจนอ้วก

ปวดจนทำงานไม่ได้

ปั๊วดปวด

เจ็บหัวรุนแรงมาก

เจ็บหัวมาก

ปวดเยอะ

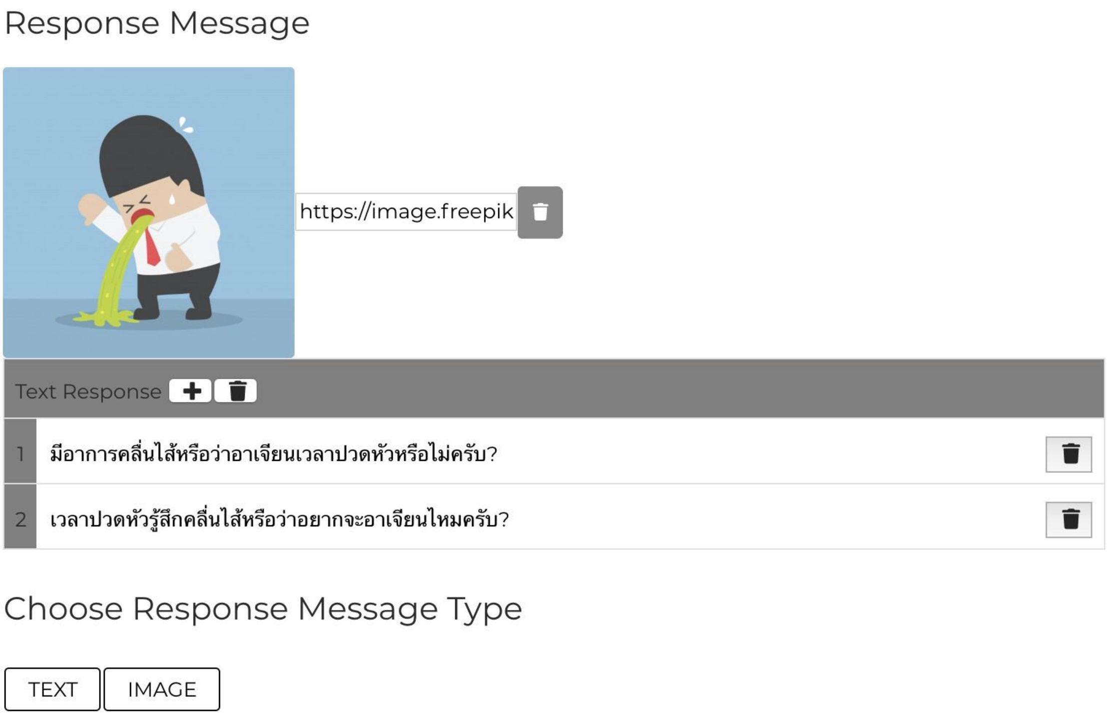
ปวดสุดๆ

ปวดมากๆ

ปวดอย่างรุนแรง

Figure4.9: the example of training data interface

This part is use for training conversation of chatbot.User can type training data and enter to save it. If have a lot of training data user can click next page to see more data.



Response Message

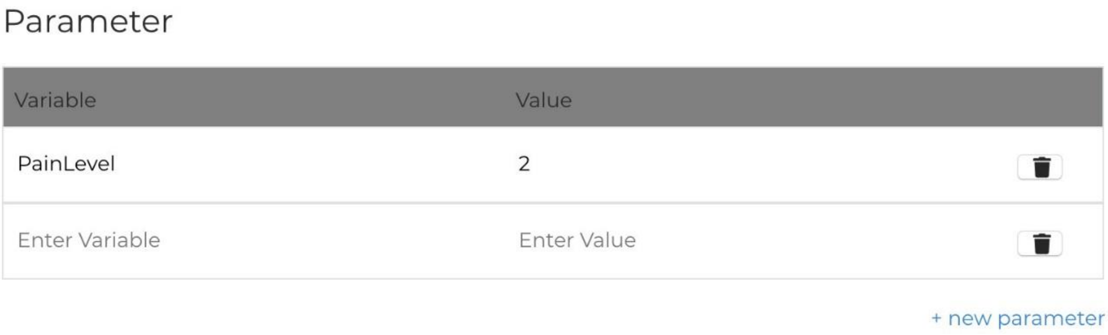
https://image.freepik

Text Response	
1	มีอาการคลื่นไส้หรือว่าอาเจียนเวลาปวดหัวหรือไม่ครับ?
2	เวลาปวดหัวรู้สึกคลื่นไส้หรือว่าอยากจะอาเจียนไหมครับ?

Choose Response Message Type

Figure 4.10: the example of response message interface

This feature is use for send response message to user. First you can choose type of thing that you want to send response to user that are text or image. If you want to create text you can add similar conversation in same table by clicking plus sign button, the system will random response message in that table to user.So from the figure 4. we can see that when the user coming to this intent the user will be get random text between 2 sentence.



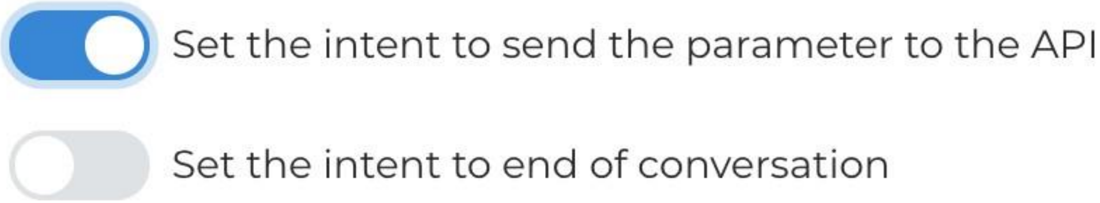
Parameter

Variable	Value	
PainLevel	2	🗑
Enter Variable	Enter Value	🗑

+ new parameter

Figure 4.11 the example of parameter interface

This part you can set answer value of this intent for sending to API of bayesian model project.

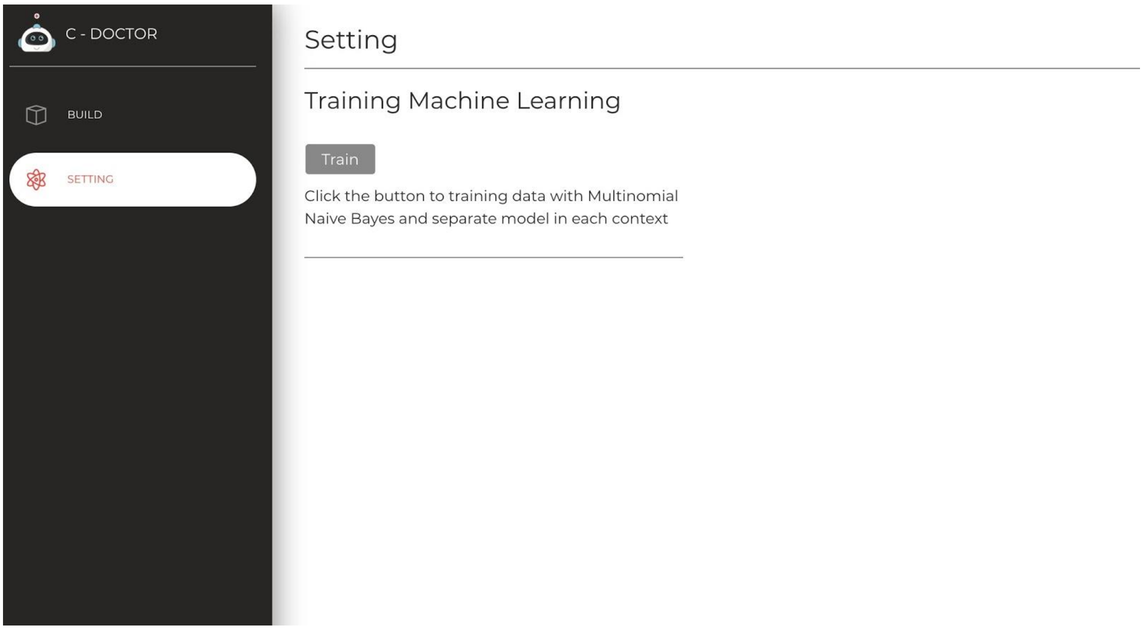


● Set the intent to send the parameter to the API

○ Set the intent to end of conversation

Figure 4.12: the example of button send api and end conversation

In this part we have both 2 button to make it with the bayesian model api because now the api is still have the an slightly error for diagnosis because sometime we just get 2 symptoms and the then the result can be more than 70% that higher that we set for get result but in the real world it not make sense to get only 1 or 2 symptoms and send the result so we will have sendApi button for send the parameter to api if that intent set the button to true but if the probability is not greater than 70% the chatbot will still ask the next question until there is the intent that set both of the button to true so it will be get the result and send the diagnosis back to the user.



Setting

Training Machine Learning

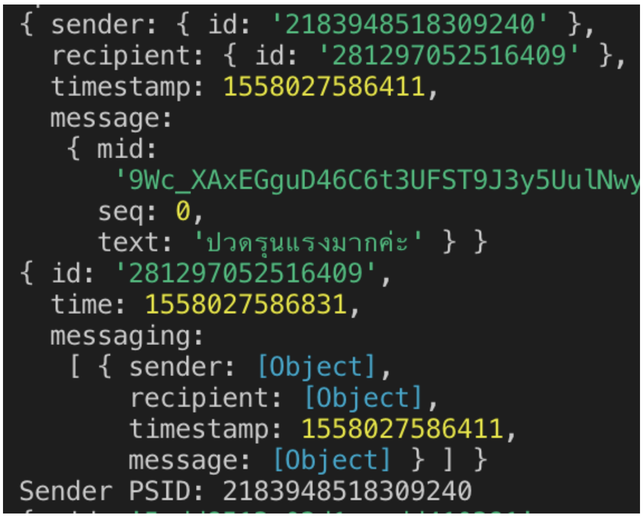
Click the button to training data with Multinomial Naive Bayes and separate model in each context

Figure4.13: the interface of training the model

In second menu that is setting, you can training data for text classification in this part by clicking train button to training the model that separate by the context and waiting in a few minute and then get the success result.

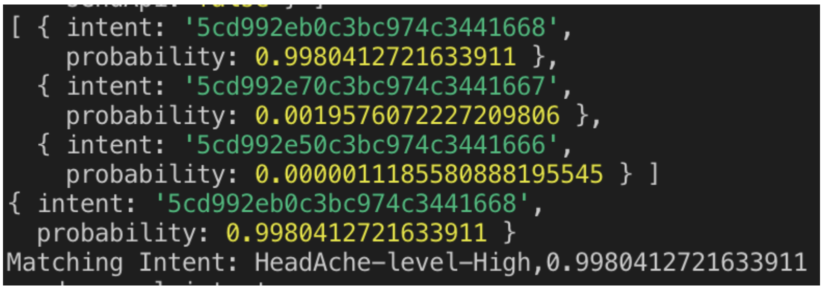
4.4 Back-end system

Text Classification Process



```
{ sender: { id: '2183948518309240' },
  recipient: { id: '281297052516409' },
  timestamp: 1558027586411,
  message:
   { mid:
      '9Wc_XAxEGguD46C6t3UFST9J3y5UulNwy
     seq: 0,
     text: 'ปวดรุนแรงมากค่ะ' } }
{ id: '281297052516409',
  time: 1558027586831,
  messaging:
   [ { sender: [Object],
       recipient: [Object],
       timestamp: 1558027586411,
       message: [Object] } ] }
Sender PSID: 2183948518309240
```

Figure 4.14: example of text input from the user



```
[ { intent: '5cd992eb0c3bc974c3441668',
    probability: 0.9980412721633911 },
  { intent: '5cd992e70c3bc974c3441667',
    probability: 0.0019576072227209806 },
  { intent: '5cd992e50c3bc974c3441666',
    probability: 0.0000011185580888195545 } ]
{ intent: '5cd992eb0c3bc974c3441668',
  probability: 0.9980412721633911 }
Matching Intent: HeadAche-level-High,0.9980412721633911
```

Figure4.15: the prediction of result from the model

From the figure 4.14 and 4.15 we show that the server get the input text of user from the Facebook messenger and then send the text to the intent classification process and then return the highest result which is matching

Chapter 5
Conclusion

Conclusion

From the implementation of the C-Doctor chatbot, the project is reach to the objective.the chatbot is capable to simply diagnose disease from the symptoms of the user.The chatbot will ask for the question to gather more the symptoms from the user and then when we get enough information the chatbot will send the symptoms to the bayesian model api to get the result of disease and then return the disease information and basic treatment to the user. For the configuration chatbot web platform it work perfectly for the function that use for create the chatbot dialog for diagnosis the symptoms. For the conclusion, If we have the more training data for the intent the chatbot will be get high performance for classification

5.1 Problem encountered

1. Training data

It is the mainly problem for our project that we have lack of training data so some model will be overfit and make it low performance for classification and some problem that we found that some context we just only want the yes or no answer so we think that we will create more the response message that have the button for the user to select the answer to solve for that problem

2. Lack of diagnosis information and data for the bayesian network api

First we have lack of information for diagnosis the symptoms but the one important problem that we found is some of symptoms are not have in the bayesian network api so we must cut of some of the symptoms and make the new flow diagnosis conversation to suitable with the model.So the conclusion is we have to find more the data to make the bayesian model more flexible and then we can make more flexible conversation for diagnosis.

5.2 Lesson learn

According to the technical knowledge that we got from the project, we learn how to design the platform for the chatbot including of the diagnosis systems and web design for create the chatbot dialog.Then, we get learn to deal the problem with the web interface for example, some of the interface that we can’t do it from the design so we will re-design the interface and get the comment from the partner to improve the design can be build it real.

The last thing that we can learn from this project is the user experience of the chatbot. we have design the flow of the conversation and think about the appropriate question to get the expected answer from the user so we have to testing the chatbot by give the user testing and then collect the comment from the user to improve the conversation and make the chatbot more effective.

5.3 Future work

For the future work of our chatbot we will create more response message type such as button response to deal with some of the question that have to answer like yes or no or the question that have to answer in time or number.

The next one is we will learn and collect more the diagnosis conversation so the project will be diagnose more than headache symptoms and we will study about the symptoms that have the related with the headache symptom to expand the conversation and make the chatbot more effective to diagnosis more disease.

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