

**BILINGUAL CHATBOT DEVELOPMENT FOR HOSPITAL UTAR USING  
TRANSFORMER**

By  
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**FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY  
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It is hereby certified that Owen Chin (ID No: 22ACB00579 ) has completed this final year project entitled "Bilingual Chatbot Development For Hospital Utar Using Transformer" under the supervision of Ms Nurul Syafidah Binti Jamil (Supervisor) from the Department of Digital Economy Technology, Faculty of Information and Communication Technology .

I understand that University will upload softcopy of my final year project in pdf format into UTAR Institutional Repository, which may be made accessible to UTAR community and public.

Yours truly,





---

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Signature : 

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Date : 4 September 2024

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Besides, I would like to show gratitude to my family and friends who always support and encourage me during my hard times in completing this project. Finally, I must thank to them for their love, support, and continuous encouragement throughout the course.

## **ABSTRACT**

This proposal introduces a project which aimed at enhancing the user experience on UTAR Hospital's website by incorporating an innovative English Chinese multilingual chatbot. The chatbot leverages advanced technologies such as transformers, similarity search from a vector database, and natural language processing (NLP) which focused on delivering information about Traditional Chinese Medicine (TCM).

The core of the project revolves around the utilization of transformers which enable the chatbot to understand and generate contextually relevant responses in both English and Chinese. This ensures seamless communication with a diverse range of website visitors which cater to the linguistic preferences of a multicultural audience.

Additionally, the project integrates a similarity search mechanism using a vector database which is also known as Retrieval Augmented Generation to enhance the chatbot's ability to retrieve and present relevant TCM information. This feature provides users with personalized and accurate responses by analysing similarities between user queries and the database with TCM knowledge as well as frequently asked questions.

The project's technological framework also embraces NLP to allow the chatbot to interpret and respond to user inquiries in a natural and human-like manner. This feature enhances the overall user engagement and accessibility of TCM information, fostering a user-friendly and informative experience for all website visitors.

The project also aims to provide a multilingual chatbot which serve as a proficient and reliable health chat. It delivers valuable insights on Traditional Chinese Medicine by addressing the language gaps. This proposal outlines the technical architecture, implementation plan, and anticipated benefits of this project for a diverse user base.

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**PLAGIARISM CHECK RESULT**

**FYP2 CHECKLIST**

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## LIST OF ABBREVIATIONS

<i>AI</i>	Artificial Intelligence
<i>TCM</i>	Traditional Chinese Medicine
<i>OPR</i>	Opinion Polarity Ratio
<i>SOTA</i>	State-of-the-Art
<i>Sim</i>	Similarity
<i>TF-IDF</i>	Term Frequency–Inverse Document Frequency
<i>SSE</i>	Sum of Square Error

## CHAPTER 1 INTRODUCTION

### 1.1 Introduction

In the ever-evolving landscape of Web 3.0, artificial intelligence continues to progress, offering personalized and distinctive services. Today, there is a growing inclination towards embracing the convenience of technology, particularly in generative content, where AI seamlessly delivers human-like responses[1]. Generative AI chatbot is a type of conversational software program which allow people to interact with in a more natural way[2]. It is also being widely used in medical field which is known as medical chatbot[3]. Medical chatbot stands out as intelligent companions with the potential to revolutionize the way people approach healthcare[4]. These advanced systems harness the capabilities of natural language processing, machine learning, and deep neural networks to engage with users in a manner beyond traditional human-computer interactions[4]. Through the implementation of Medical chatbot, it enhances accessibility for patients to consult medical related issues with the health care organization such as hospital[5].

Before the emergence of medical chatbot, the traditional in person visits were the primary mode of medical consultation. In other words, patients had to travel a long way to seek for medical advice[6]. It raised an issue that patients with contagious illness might spread the virus around especially during Covid19 pandemic[7]. Besides, appointments often required before consultation, leading to delays in accessing healthcare. Patients were required to make appointments days before the consultation or even weeks before especially during peak periods. Moreover, geographical constraints and limited access to healthcare posed challenges for the patients who lived in rural areas where infrastructure availability was low[8]. If people would like to obtain timely information about symptoms and preliminary advice, they were requested to pay a visit or make phone calls about their queries.

After the utilization of medical AI chatbot, it offers 24/7 accessibility for immediate responses to user queries and symptom assessments[9]. It comes in handy for those who live in remote areas as it overcomes geographical barriers, providing healthcare

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information and guidance remotely. Through machine learning, the AI chatbot learns to empower initiative-taking healthcare management by delivering essential information in a user-friendly, conversational manner, steering away from jargon-heavy professional terms. With the aids of technology, AI chatbot serve as a first point of contact for medical consultation[10]. It streamlines routine inquiries and allowing healthcare professionals to focus on complex cases[11]. Medical chatbot has transformed the healthcare landscape by combining technology and human ability for a more accessible and responsive approach. In short, medical chatbot offers inclusivity which ensures that healthcare is more accessible to everyone, regardless of their circumstances or location. Whether it is making appointments or asking questions, the chatbot serves as a convenient and supportive resource for a diverse range of individuals seeking medical help.

### 1.2 Problem Statement

- **Lack of Semantic Understanding on Different Languages:**

For legacy medical chatbot, it faces challenges in accurately understanding the semantic nuances present in user queries related to medical information. This is mainly due to most chatbots are built and trained in specific language and it may make mistake in interpreting the users' queries in different languages. To ensure comprehension understanding on users' queries, ambiguity resolution is a crucial part for natural conversation and correct interpreting on the sentences. Hence, further training and testing are needed to resolve ambiguities in language and ensure precise understanding of user intent pose. It aids in avoiding a long list of irrelevant search result which may misguide the users. Besides, the translation of TCM from Chinese to English requires a deep understanding of the semantic nuances and the resolution of ambiguities that arise due to differences in language and cultural contexts. This is crucial for accurately conveying the medical concepts and preserving the true meaning of TCM in the translated text especially for those special keywords which direct translation may deteriorate the original context.

- **Lack of Traditional Chinese Medicine Domain Knowledge in Chatbot:**

The current challenge for most of the medical chatbots is lacking traditional Chinese medicine domain knowledge. Most of the medical chatbots currently available are typically trained on the dataset related to Western medicine and treatment. As a result, those chatbots are having issue absence of in-depth Traditional Chinese Medicine (TCM) domain knowledge. Hence, the chatbots only have limited understanding of TCM terminology, principles, and medical concepts. It poses a concern that it may provide inaccurate and unreliable information to users as the medical concept from Western is not applicable to traditional Chinese medicine. In other word, it may even mislead the users on false medicine information and treatment. It affects the ability of chatbot to engage in meaningful and contextually relevant conversations about TCM as it requires a deep understanding of TCM terminology, medical concepts, and the ability for a chatbot to provide personalized information based on user queries.

- **Lack of Knowledge Organization and Summarization:**



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Knowledgebase engines are being implemented on website to search for content related to certain field based on database. However, it only provides static information based on repositories, but they do not learn from users' interaction. Knowledge bases are designed to provide information based on predefined queries. They lack the dynamic and conversational nature of AI chatbots. Hence, the output of the knowledgebase provides users with a mere list of links or unorganized material. It does not efficiently summarize relevant content and present it to users in natural way. Besides, knowledgebase engine only depends on keywords for queries searching which makes it challenging to understand the nuances of natural language. Hence, it is not capable in handling queries with ambiguous language. Knowledge base relies heavily on updates to ensure the data is up to date. It requires regular updates to stay current. As a result, it may struggle to keep up with rapidly changing information or trends.

### 1.3 Motivation

The advancement of technology has significantly enhanced the healthcare accessibility and patient engagement through the integration of technology in medical field. It is a pioneering initiative to integrate modern technology with traditional healing practices. During Covid 19 pandemic, traditional Chinese medicine has played a crucial role in Covid 19 treatment with positive outcomes[12]. As a result, it gains more recognition from the public as well as government from foreign countries[13]. It shows a commitment in embracing diverse healthcare modalities such as traditional Chinese medicine in global scale. Figure 1.3.1 illustrated that people are showing positive opinion towards traditional Chinese medicine and the visits of TCM are ascending over a decade. Besides, developing a traditional Chinese medicine AI chatbot bridges the gap between modern technology and age-old healing practices which enhances the accessibility of traditional treatment. It also caters the needs of the society with multi-cultural ethnics who speak different languages such as Malaysia as shown in Figure 1.3.2[14].

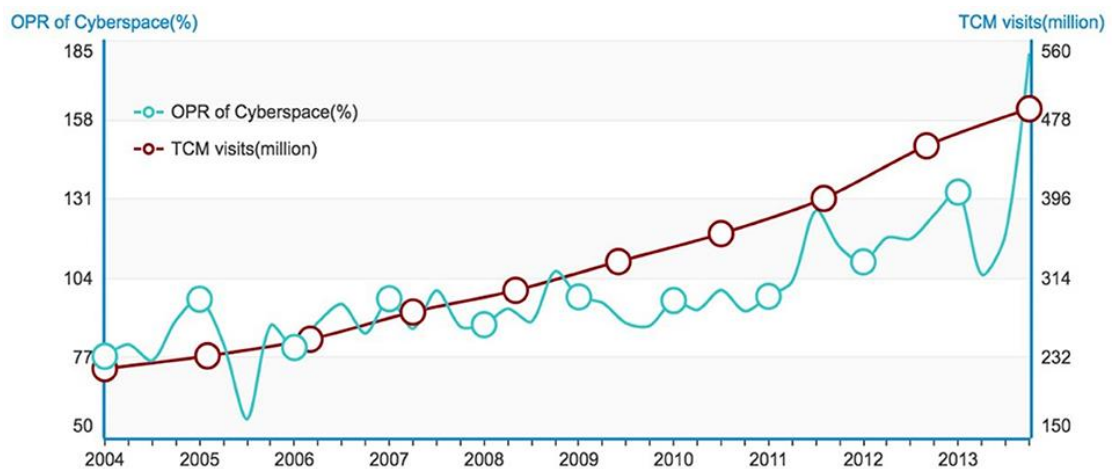
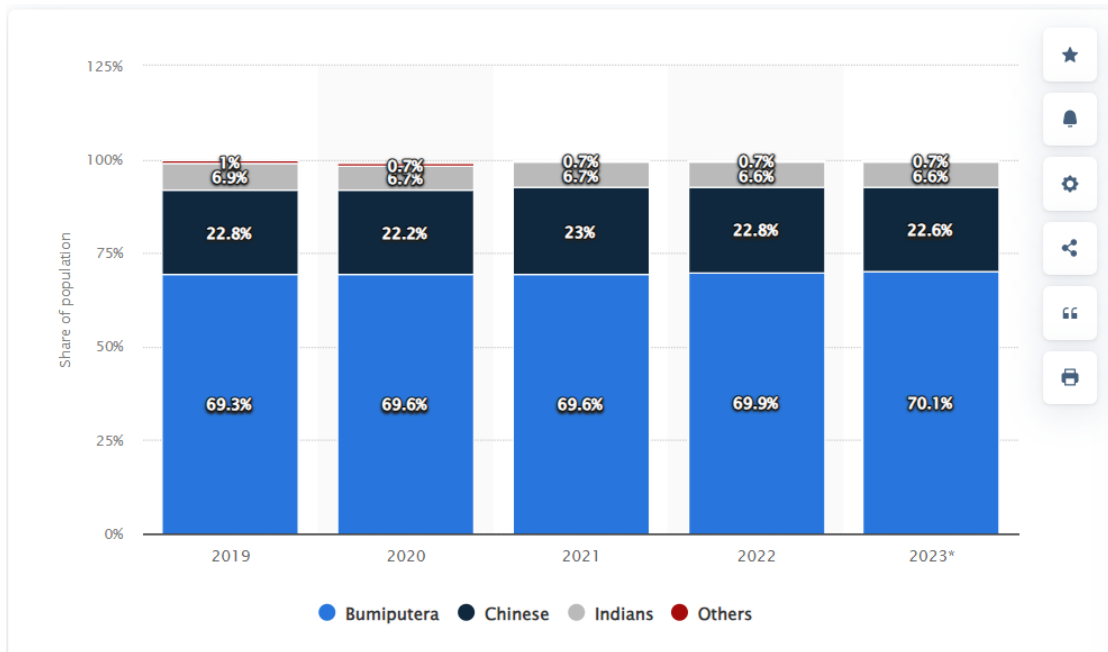


Figure 1.3.1 OPR of Cyberspace vs. TCM visits[15]<sup>1</sup>

<sup>1</sup> OPR : Opinion Polarity Ratio



**Figure 1.3.2 Share of population in Malaysia from 2019 to 2023, by ethnicity[14]**

In complementary with the digital trend in medicine field, an AI chatbot aligns the medicine field with the latest technology by using digital tools in healthcare sector. With the aids of AI chatbot, it uncovers novel consultation experiences which enhances patient engagement through personalized recommendations. Through machine learning, a chatbot learns from earlier data and provides information based on TCM principles for a more tailored healthcare experience. From the perspective of education, the medical chatbot serves as a valuable resource for individuals who are looking for information about TCM. Hence, it contributes to the broader goal of improving healthcare accessibility and promoting holistic approaches to health and wellness. It also aids in the vision of promoting traditional Chinese medicine through dissemination of knowledge to the public.

### 1.4 Project Objectives

The primary goal of the bilingual TCM chatbot for UTAR Hospital's website is to enhance visitor experience by providing comprehensive information about traditional Chinese medicine (TCM). With the implementation of advanced technologies such as transformers, similarity search from vector databases, and natural language processing (NLP), the chatbot aims to:

- **To facilitate information retrieval on traditional Chinese medicine:**

The chatbot is trained and tuned with datasets related to TCM knowledge which deepens the understanding of the chatbot in the domain. Hence, the chatbot enables users to easily access detailed and correct information about various aspects of traditional Chinese medicine, including treatments, herbs, and therapeutic practices. Besides, the chatbot also serves as an educational tool by disseminating knowledge about traditional Chinese medicine, its principles, and its role in holistic healthcare, contributing to the broader health literacy of the community.

- **To enable language accessibility between Chinese and English:**

The chatbot bridges the language gap by offering a seamless conversation experience in both English and Chinese. It allows a diverse audience to overcome language barrier in accessing valuable healthcare information about traditional Chinese medicine. As a result, it enhances the inclusiveness of knowledge access on TCM for people from different background.

- **To personalized user interaction when using chatbot:**

The chatbot uses natural language processing technique to understand user queries and preferences. Then, the chatbot analyses and process users' queries and provides personalized recommendations, treatment plans, and relevant articles tailored to individual needs. It also conveys medical information in a more understandable way which improves the clarity of the content.

For administrative site, the project would be able to collect the information about the users' query and make processed it. In other words, it would be able

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to analyze the queries asked and identified the topic trend being asked by the users. It allows the admin to monitor and have a better understanding on the user activity.

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### 1.5 Project Scope

The aim of this project is to create a bilingual chatbot for the UTAR Hospital website, specializing in providing information on traditional Chinese medicine (TCM) to visitors. The chatbot should be able to enhance user engagement and ease the access to TCM-related knowledge.

The key features of the project include:

- I. The chatbot will be able to allow users to retrieve information about traditional Chinese medicine.
- II. The chatbot will be able to provide nonclinical suggestions for users based on TCM principle.
- III. The chatbot will be able to summarize the output in response to users' queries.
- IV. The chatbot will be able to generate human like response for users' queries.
- V. The chatbot will be able to detect users query language
- VI. The chatbot will respond in language corresponding to the input either in English language or Chinese language.
- VII. The chatbot will provide analytics features for admin panel to monitor the user activity.

### 1.6 Contributions

A bilingual TCM chatbot serves as a virtual guide by enhancing the accessibility of traditional Chinese medicine information for the public. It should be able to cater to a diverse audience with different cultural backgrounds as it makes the TCM information readily available from time to time. The bilingual capability also allows the chatbot provides **easy accessibility to valuable insight to serve the people from different linguistic background** which foster a more inclusive healthcare experience. Besides, healthcare professionals and patients can interact with each other seamlessly through the implementation of chatbot. It introduces a novelty in healthcare system which revolutionizes the traditional consultation approach that can enhance the healthcare experience for both practitioners and patients. In other word, the chatbot acts as a **preliminary consultation approach** for patients before consulting the healthcare personnel physically. Consequently, the language barrier between healthcare professionals and patients is broken which ensure vital medical information is conveyed accurately.

Apart from that, people can **acquire information on Traditional Chinese medicine** through accessing the knowledgebase from the medical chatbot. The chatbot can promote better understanding about healthcare medical information by giving detailed insights into TCM principles, practices, and treatment options. An AI chatbot also provides a **personalized health support** which can answer to users' queries. Through utilizing the capabilities of transformer model, the chatbot can provide personalized recommendations based on TCM principles such as herbal remedies, acupuncture points, and lifestyle suggestions to handle users' queries. This tailored approach contributes to a more patient-centric healthcare experience which omits the necessity of consulting a medical professional.

In summary the chatbot harness the power of technology to facilitate the accessibility of traditional Chinese medicine for the public as well as develop a novelty in medical consultation. It also contributes to a patient-centric healthcare landscape while maintaining the efficiency of medical resources without burdening the healthcare worker. On a contrary, it reduces the workforce and increases the efficiency in medical

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field due to preliminary consultation which solve the trivial queries by the patient. Through this project, it creates a valuable resource that not only facilitates communication but also empowers individuals to actively participate in their health and well-being journey.



## CHAPTER 1 PROJECT BACKGROUND

### **1.7 Report Organization**

In this report, it consists of 5 chapters which are Chapter 1 Introduction, Chapter 2 Literature Review, Chapter 3 Proposed Method/Approach, Chapter 4 Preliminary Work and Chapter 5 Conclusion.

For Chapter 1, it will give a brief introduction and background information about the project to be developed. It will also discuss about the problem statement related to the project background, motivations, project objectives, project scopes and the contributions of the project.

In Chapter 2, a few systems will be reviewed to give a glimpse into the existing tools being implemented in the field. The strength and weakness of respective systems will be investigated for references. The limitations of studies will also be reviewed along with the proposed solutions.

In the Chapter 3, the proposed method and approach regarding to the project will be presented. The required hardware, software and libraries will be reviewed in system requirements. The system architecture and use case diagrams will be included to give an overview of the system. Besides, the implementation issues and challenges will be discussed in this chapter. A timeline of the project development will be attached to give an overview of the development life cycle.

In Chapter 4, the system design will also outline the framework of the system block on how the data is being sent through each component. Besides, the framework and flowchart diagram will illustrate on the development flow for each main module in the system.

In Chapter 5, it will demonstrate on the system operation of the project to initialize the chatbot. The software and service setup for each system component is done and snapshot of respective results will be recorded down in the report. This chapter will also include the snapshot of the code to give an overview of the chatbot development.

## CHAPTER 1 PROJECT BACKGROUND

In Chapter 6, testing is done on each module to measure the performance of the feature. In this topic, context relevancy testing, classification model testing, translation module testing and appointment module testing will be conducted to ensure the modules are working as expected. The implementation issues and challenges will also be investigated for improvement in future.

For the conclusion, a summary of the project will be concluded including the problems encountered in the project. The motivation and proposed solution will also be reemphasized as well to give a clear purpose of the developed project or system. Recommendations will also be included to provide an insight for future development.

## CHAPTER 2 LITERATURE REVIEW

### 2.1 Related Work

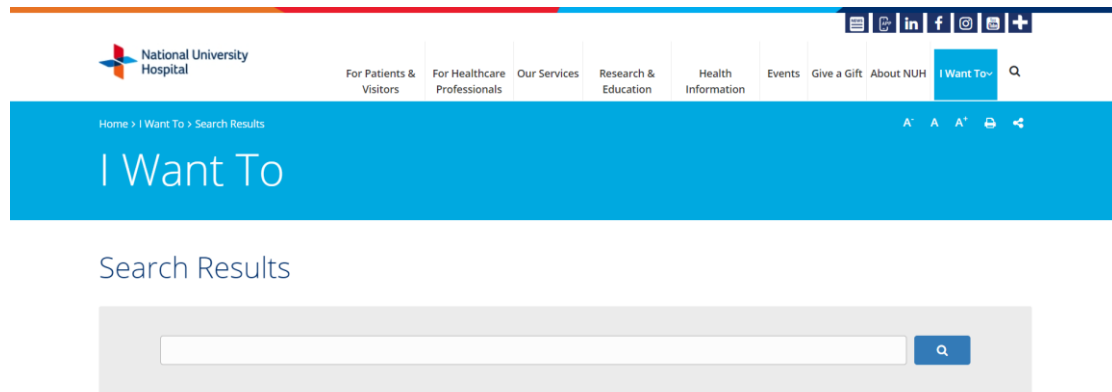
Retrieval Augmented Generation (RAG) chatbot is the combination of information retrieval from vector databases and language generation from LLMs[16]. Currently, large language models (LLMs) such as GPT and LLaMa are facing challenges in generating relevant and updated information[17]. This challenge may lead catastrophic consequences in certain industries such as medicine field due to incorrect information. Hence, RAG is introduced as a potential solution to address the limitation of generative AI in medicine according to paper by researcher Rui Yang from Duke-NUS Medical School[18]. RAG framework consists of three parts which are indexing, retrieval and generation. It initializes with data encoding and data storing in a vector database. When handling queries, it uses queries to retrieve relevant information from the database. Finally, both query and retrieved information are used to generate content and to answer user's queries[18]. The approach has provided a more flexible chatbot architecture which allow customization instead of retraining LLM for months. The architecture also allows the chatbot model to handle content and information in specific industry area such as medicine[16]. StackRAG, introduced by researcher Davit Abrahamyan, is performing better than GPT-3.5 and GPT-4 in terms of correctness, accuracy, relevance, and usefulness of the generated answers[19].

For topic classification task, research had been conducted to investigate the K-Nearest Neighbour (KNN) algorithm in topic modelling field such as classifying news articles[20]. KNN is an algorithm that classifying target features using different proximity measures such as Manhattan Distance, Euclidean Distance, and Supremum Distance[20]. Before implementing the model, data preprocessing steps such as word segmentation, tokenization, and stop word removal should be included to remove noise and improve data quality[21]. Several research also suggested that TF-IDF (Term Frequency-Inverse Document Frequency) to be used for feature extraction of the data[21]. Performance metrics such as accuracy, precision and recall were used along with Cross Validation to validate the performance of the KNN model[22], [23]. According to research by Nur Ghaniaviyanto Ramadhan, Word2Vec is used in word

## CHAPTER 2 LITERATURE REVIEW

embedding and followed by topic classification using KNN when classifying Indonesian online news topics[24]. The study used news data from various topics like Covid-19, Finance, Political, and Social issues. In the experiment, KNN model outperformed Support Vector Machine(SVM), logistic regression and random forest model with an accuracy of 89.2% and  $K=7$ [24].

### 2.2 Existing System 1 - National University Hospital



**Figure 2.2.1 National University Hospital Knowledgebase[25]**

National University Hospital is the leading university hospital in Singapore in corporate National University Singapore. It offers a wide range of specialist care for both adults and children by providing a wealth of information for patients and visitors, including information about their services, doctors, medical conditions, and billing. To enhance accessibility of public towards medical information, a search engine like knowledgebase is set up for users to query about their concerns.

#### 2.2.1 Strength

- **Centralized Source of Information:**

The knowledge base is a single, centralized repository which contains all medical information. This ensures that users have access to a comprehensive and consistent set of data.

- **Well-Organized Library:**

Information within the knowledge base is typically organized in a structured manner. This organization helps users navigate through topics efficiently, finding the exact information they need without unnecessary complexity.

- **User-Paced Access:**

Users can access the knowledge base at their own pace. This asynchronous access allows individuals to delve into the information at a speed that suits their learning or research preferences.

#### 2.2.2 Weakness

- **Limited Interactivity:**

## CHAPTER 2 LITERATURE REVIEW

While knowledge bases excel at providing information, they may lack the interactive and dynamic nature of a real-time conversation. Users seeking clarification or personalized guidance may find the rigid structure of a knowledge base less accommodating.

- **Dependency on User Search Skills:**

Users need to have effective search skills to navigate and find the information they are looking for within a knowledge base. If the search functionality is not robust or if users struggle with formulating effective queries, they might not locate the relevant information easily.

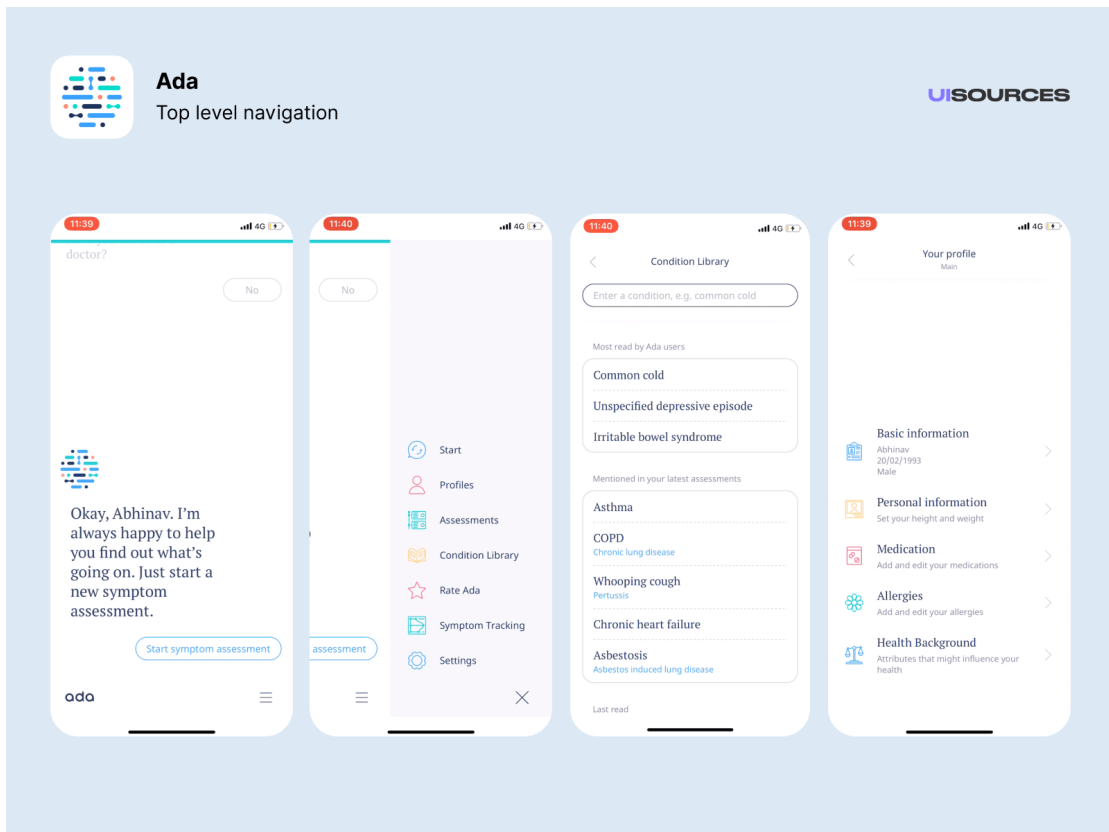
- **Potential Overwhelm:**

The users might feel overwhelmed by the sheer volume of data as the knowledge base contains a vast amount of information. It can be challenging for them to identify the most relevant content which lead to frustration and a potential loss of engagement.

- **Language Limitations:**

The knowledge bases are primarily available in English, which can be a significant limitation for users who speak other languages. This language barrier may exclude a substantial portion of the global audience, hindering accessibility and user engagement. Providing multilingual support or translations becomes crucial to address this limitation and cater to a more diverse user base.

## 2.3 Existing System 2 - Ada Health



**Figure 2.3.1 Ada Health Medical Chatbot[26]**

Ada Health's app is designed to help users assess their health by inputting symptoms and receiving personalized information. It uses artificial intelligence and medical knowledge to analyze the symptoms and provide potential causes. The app aims to empower users with health insights but emphasizes that it's not a replacement for professional medical advice. It's crucial to consult with healthcare professionals for accurate diagnosis and guidance. The app likely serves as a tool for individuals to become more informed about their health and make decisions in collaboration with medical professionals.

### 2.3.1 Strength

- **Personalized Interaction:**

Ada Health excels in providing a personalized and user-friendly interaction. Users can input their symptoms and health concerns in a conversational manner, making the experience more engaging and tailored to individual needs.

- **Natural Language Understanding:**

## CHAPTER 2 LITERATURE REVIEW

With natural language processing techniques, the chatbot can engage with users in a more natural manner. As a result, it can enhance the user experience and make it easier for users to convey their health concerns while using the application.

- **Guidance and Assistance:**

Ada Health goes beyond simply providing information. It offers guidance and assistance by walking users through symptom assessments, helping them understand potential health issues, and suggesting appropriate next steps. This can empower users to take initiative-taking measures for their health.

- **Engagement:**

The platform's interactive nature fosters engagement. Users are more likely to stay engaged and committed to the assessment process, leading to more accurate information for potential diagnoses.

- **Quick and Accessible Information:**

Ada Health provides quick access to health information. Users can initiate assessments promptly and gain preliminary insights into their symptoms before consulting a healthcare professional.

- **Empowering Users:**

By offering preliminary information and guidance, Ada Health empowers users to be more initiative-taking about their health. It encourages them to seek timely medical attention when needed and facilitates more informed discussions with healthcare providers.

- **Effective Summarization:**

Ada Health excels in summarizing complex health information. The platform takes user-inputted symptoms and provides clear, easy-to-understand summaries of potential health issues. This strength enhances the user experience by offering concise insights, making the information more accessible and actionable.

### 2.3.1 Weakness

- **Limited Integration of Alternative Medicine Knowledge:**

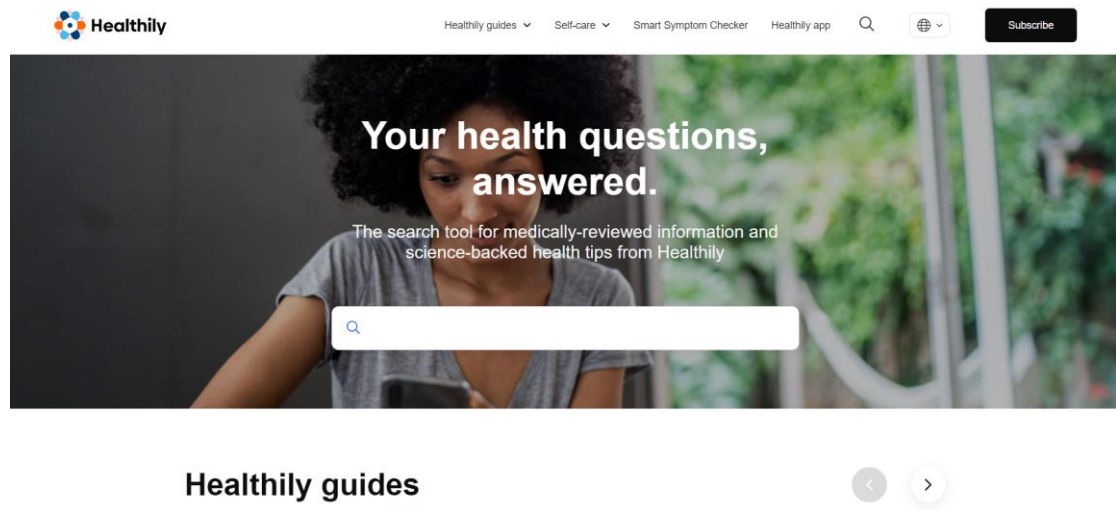
Ada Health may not fully incorporate knowledge from traditional Chinese medicine (TCM) or other alternative medical practices. The platform's focus on Western medical principles may result in a lack of coverage for those seeking



## CHAPTER 2 LITERATURE REVIEW

assessments or information from alternative medical perspectives. Users interested in TCM, or alternative medicine should consult practitioners with expertise in these areas for a more comprehensive understanding of their health.

### 2.4 Existing System 3 - Healthily



**Figure 2.4.1 Healthily Knowledgebase[27]**

Healthily is a free health chatbot that provides users with personalized health information and advice. It is powered by artificial intelligence (AI) and can answer a wide range of health-related questions, from basic facts about diseases to symptom checkers and treatment recommendations.

#### 2.4.1 Strength

- **Personalization:**

Healthily leverages the power of artificial intelligence to personalize symptom analysis and recommendations. By incorporating a user's unique health profile, including age, medical history, medications, and lifestyle choices, Healthily delivers results that are significantly more relevant and targeted than generic symptom checkers.

- **Comprehensive Approach:**

Healthily embraces a holistic perspective by recognizing that well-being extends beyond the physical. It seamlessly integrates self-care tips, lifestyle advice, and emotional support resources alongside medical information. This comprehensive approach empowers individuals to manage their health holistically, especially beneficial for chronic conditions or stress-related issues.

- **In-Depth Answers:**

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Unlike the concise and immediate responses of a chatbot, Healthily provides detailed and thorough answers. This is particularly valuable for users who require comprehensive information or want to explore a topic in depth.

### 2.4.2 Weakness

- **Language Limitation:**

As Healthily only provide English language accessibility, it restricts its reach and inclusivity significantly. This is a missed opportunity to empower a vast population who prefer accessing health information in their native language. Consequently, it poses language barrier for those who are not proficient in English which deteriorate the mission of global health literacy and hinders its potential for widespread impact.

- **Limited TCM Domain Knowledge:**

Healthily primarily relies on Western medical concepts and symptom patterns. It might not be able to accurately interpret or analyze symptoms specific to TCM diagnoses. Hence, it is not applicable for those who are seeking for TCM information.

### **2.5 Limitation of Previous Studies**

Based on the review on existing systems, Healthily web application exclusively supports English language poses a significant challenge, limiting its reach and inclusivity. This language barrier deteriorates its mission of promoting global health literacy, excluding a vast population who prefers accessing health information in their native language. Moreover, Healthily only caters for Western treatment which may result in inaccuracies when interpreting symptoms specific to Traditional Chinese Medicine (TCM), making it unsuitable for users seeking TCM information.

Ada Health, another medical chatbot which also focus on Western medicine may lack coverage of alternative medical perspectives such as TCM. Hence, people will have to make consultation with specialized practitioners for a more comprehensive understanding.

The interactive and dynamic nature of real-time conversations is also lacking in NUH knowledge bases. It makes the system less accommodating for users seeking personalized guidance. The sheer volume of information may lead to overwhelm and disengagement of users as it leads to inefficiency in navigation. Lastly, the predominance of English in knowledge bases poses a language barrier. It excludes a diverse global audience and emphasizing the need for multilingual support to enhance accessibility.

Lastly, Baidu Company has also launched an AI medical chatbot, Melody AI which poses the feature of traditional Chinese medicine knowledge and support Chinese language. However, it is not opened for public access in regions other than China which makes the further review inaccessible.

### **2.6 Proposed Solutions**

This project aims to propose a TCM chatbot which can offer a seamless, informative, and user-friendly experience for individuals seeking insights into Traditional Chinese Medicine with the following features:

#### **Bilingual Capability:**

The bilingual capabilities of the chatbot will facilitate an innovative language detection feature to identify the user's preferred language by integrating a reliable translation library for fluid communication between English and Chinese seamlessly when using the chatbot. The chatbot is designed to respond fluently in both languages which maintain a natural conversational flow and improve users' experience.

#### **Knowledge Retrieval through RAG:**

In the field of Traditional Chinese Medicine (TCM), the chatbot integrates a comprehensive dataset covering TCM principles, herbs, and practices. By implementing natural language processing and similarity search, the chatbot understands user queries related to TCM by extracting key terms and concepts to provide accurate and detailed responses. Users can gain insights into herbal remedies, acupuncture, and various traditional practices.

#### **Human-Like Responses:**

The chatbot employs a sophisticated response generation system which is the transformer with large language model (LLM) to produce a more human like response. This system considers the tone and style of human conversation as well as utilizing machine learning techniques trained on diverse datasets to enhance its ability to generate contextually appropriate responses. The chatbot fosters engaging and authentic interactions through incorporating empathy and understanding.

#### **Simplified Information Delivery:**

The chatbot further enhances user experience by providing summarized content for the users. It condenses lengthy TCM explanations into concise and easy-to-understand messages which improve the understanding of content. It offers step-by-step guidance for common TCM practices and ensures users can follow instructions with ease.

#### **Continuous Learning and Improvement:**

## CHAPTER 2 LITERATURE REVIEW

To ensure the TCM knowledge is up to date, the chatbot is committed to continuous learning and improvement. Updates can be conducted regularly to the TCM knowledge base which ensure that it remains current with new research and developments in Traditional Chinese Medicine. Hence, it provides users with the latest and most relevant information.

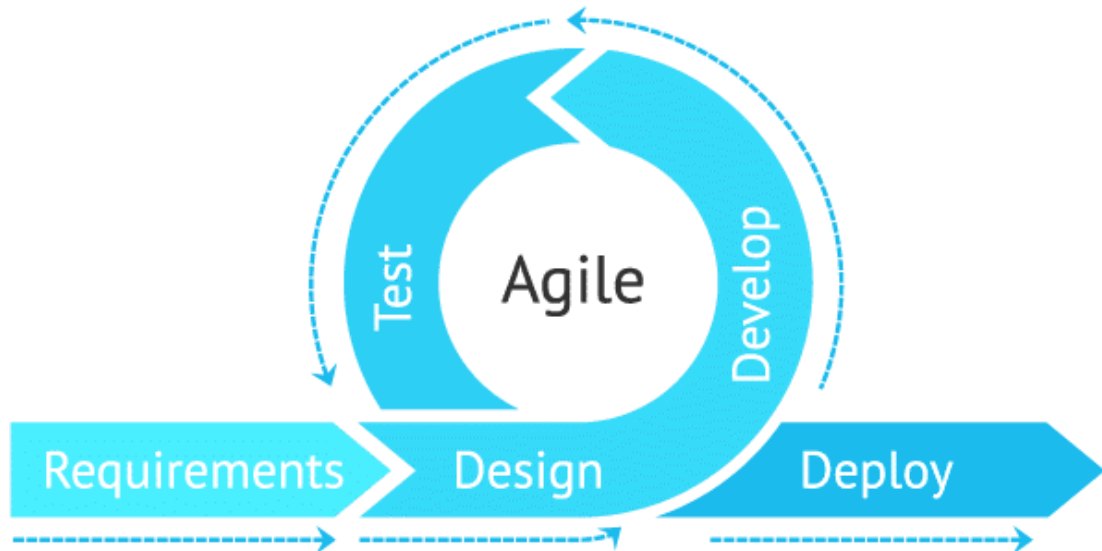
### **Analytics Features:**

Analytics will be conducted to provide a comprehensive insight from the users' query. In the context, an analytic model will be created to classify user queries based on their topic as well as provide topic trend over time. Through analyzing the users' queries, the organization can monitor the usage of the chatbot from time to time which is beneficial for further decision making. The analytics result will also be visualized through dashboard such as PowerBI for the ease of users to interpret the data in a more interactive way.

## CHAPTER 3 PROPOSED METHOD/APPROACH

### METHODOLOGY

Agile methodology is the method that will be implemented in this TCM chatbot development project as it allows iteration from design phase after each testing phase before model deployment. The main reason that agile methodology will be implemented is its nature of flexibility for model refinement to improve performance. During testing phase, if the model performance does not meet the threshold or requirement, it indicates the model is underperformed and not suitable for deployment. Hence, looping back to design can be done easily to make necessary amendment and fine tuning to improve the accuracy of model.



**Figure 3.1 Agile Methodology**[28]

- **Requirements:**

During requirements phase, all the requirement of bilingual TCM chatbot will be identified and gathered. This involves understanding the goals, functionalities, and features it should have. Besides, the requirements will be prioritized based on their importance and potential impact. It also includes identifying the domain knowledge of traditional Chinese medicine such as herb information, symptom, and treatment on TCM principal basis.

- **Design:**

## CHAPTER 3 PROPOSED METHOD/APPROACH

In design phase, the architectural and system design for the chatbot will be developed based on the identified requirements. On top of that, prototype will be developed with reference to the blueprint to visualize the user interface and user experience. The technology stack, software and hardware needed will be determined to ensure smooth development process.

- **Develop:**

This phase comes to the session which the actual coding and development of the TCM chatbot is being started. To reduce complexity of development, the project will be broken down into smaller and manageable tasks with three major phases which are model development, chatbot interface development and analytics model development.

- **Test:**

In testing phase, testing at various levels, including unit testing for individual components and integration testing will be conducted to ensure different parts work together seamlessly. This process will be continuously evaluated and debugged throughout the development process.

- **Deploy:**

Once the testing is validated, it comes to the deployment phase of the chatbot. The chatbot is now ready to conduct its predefined tasks by serving the users.



### 3.1 System Requirements

#### 3.1.1 Hardware

- **Computer**

The hardware involved in this project is a computer. A computer issued for the process of data preprocessing and data storing in vector database. It is also used for model training and testing for the chatbot as well as perform evaluation on the chatbot. A user interface of the chatbot also being developed using the libraries.

Table 3.1.1.1 Specifications of laptop

Description	Specifications
Model	MSI
Processor	Intel Core i5-11400H
Operating System	Windows 11
Graphic	NVIDIA GeForce GTX 1650 Max-Q Design 4GB DDR4
Memory	16GB DDR4 RAM
Storage	512GB SSD

#### 3.1.2 Software

- **Anaconda**

Anaconda is a handy tool for coding as it makes it easy to manage the different packages and libraries needed for projects with its own package manager called conda. This helps avoid the complexity of dealing with dependencies. Anaconda also allows user to create separate environments for each project, preventing conflicts between different versions of packages. Besides it is available on multiple platform such as Windows, macOS and Linux which facilitate cross platform features with over 1,500 pre-installed open-source packages.

Besides, Anaconda supports popular integrated development environments (IDEs) like Jupyter Notebooks and Spyder, making it convenient for coding. In this project, visual studio code will be used for development purpose. There is also a large and active community which provides support in debugging with the help from the community. Overall, Anaconda simplifies the complexities of managing packages, environments, and tools for data science and coding projects.

## CHAPTER 3 PROPOSED METHOD/APPROACH

- **PowerBI**

Power BI is a business analytics service provided by Microsoft. It aims to provide interactive visualizations and business intelligence capabilities with an interface simple enough for end users to create their own reports and dashboards. Power BI will be used in the analytics section of the project as it is able to transform raw data into meaningful insight as well as visualizes it through dashboards. On top of that, Power BI equips with real time dashboard updates which ensures the information is up to date.

### 3.1.3 Framework and Libraries

- **Transformer model (Llama2)**

Transformer-based model such as Llama2 will be used to drive the large language model for the chatbot to understand complex language structures, context, and nuances of users queries which ensures more accurate and contextually relevant responses. The transformer engages in similarity search from a vector database which stores the traditional Chinese medicine data to enhance information retrieval. It aids in enabling the chatbot to offer related content based on user queries and preferences.

Table 3.1.3.1 Specifications of Llama2

Specification	Value
Model Name	Llama 7B
Model Type	Transformer
Number of Parameters	7B
Training Data	Text and code
Tasks	Question answering, translation, creative text generation
Availability	Publicly available

- **Sentence Transformer (msmarco-MiniLM-L6-cos-v5)**

The msmarco-MiniLM-L6-cos-v5 model is a specialized natural language processing tool designed for semantic search and information retrieval tasks. It is part of the Sentence Transformers family and is specifically optimized for handling search queries and finding relevant text passages. In this project, it will be mainly used in query embeddings and similarity search for query retrieval through asymmetric semantic search.

Table 3.1.3.2 Specifications of msmarco-MiniLM-L6-cos-v5

<b>Description</b>	<b>Specification</b>
Vector Dimension	384
Suitable Tasks	Clustering, Semantic Search
Model Architecture	Transformer (Max Seq Length: 512), Mean Token Pooling
Training Data	Over 500k examples from MS MARCO dataset
Query Handling Capacity	18,000 (GPU) / 750 (CPU) Queries per second
Document Handling Capacity	2,800 (GPU) / 180 (CPU) Documents per second
Version	V5, with improvements over previous versions
Applications	Effective for semantic understanding and search functionalities

- **Flask**

Flask is an open-sourced framework written in python which is designed to create web application. It is implemented in this project to create interface for the chatbot as it provides both simplicity and the potential to scale up the project. Besides, Flask uses the Jinja2 template engine. It allows the creation of dynamic web pages using HTML templates, where data from Python code can be injected into HTML.

- **Llama Index**

Llama Index is also an open-sourced tool being used for developing transformer-based chatbots. It offers several advantages that streamline the development process and enhance the capabilities of the chatbot. It serves as a framework for developing applications powered by large language models (LLMs) and facilitates the creation of context-aware applications that can effectively utilize LLMs for various tasks, including question answering (QA) retrieval. Below is the main role of the library in chatbot development:

## CHAPTER 3 PROPOSED METHOD/APPROACH

- **Loading and Managing Vector Stores:** Llama Index enables loading and managing vector stores, which are essential components for efficient retrieval-based QA systems. Vector store is a database which stores indexed documents or text representations, allowing rapid retrieval of relevant documents based on their embeddings.
- **Defining Prompt Templates:** Llama Index allows user to define prompt templates, which guide the LLM in generating responses that are tailored to specific tasks or domains. A text QA prompt template and refine template are defined to ensure that the LLM focuses on providing helpful answers to the user's queries.
- **Constructing Retrieval QA Chains:** Llama Index facilitates the construction of retrieval QA chains by connecting LLMs with vector stores to perform QA tasks. These chains retrieve relevant documents from the vector store and feed them to the LLM, which then generates an answer based on the retrieved context.
- **Managing LLM Interactions:** Llama Index provides tools to manage interactions with LLMs, including loading, configuring, and calling LLM models. It streamlines the process of integrating LLMs into applications.

### 3.2 System Design Diagram/Equation

In the project, the chatbot development consists of three main parts: chatbot model development, chatbot interface development, data clustering and classification model development. In the system, transformer is the key component which act as an engine to run the large language model for text processing and generating. During the process, similarity search will be initiated by sentence transformer to ensure accurate output of the chatbot using cosine similarity.

Below is the equation for **cosine similarity search**:

$$Sim(\vec{A}, \vec{B}) = \frac{\vec{A} \cdot \vec{B}}{\|\vec{A}\| \|\vec{B}\|}$$

where

- $\vec{A} \cdot \vec{B}$  is the product (dot) of the vectors  $\vec{A}$  and  $\vec{B}$ .
- $\|\vec{A}\| \|\vec{B}\|$  is the product of magnitude  $\|\vec{A}\|$  and  $\|\vec{B}\|$ .
- $\|\vec{A}\|$  is the magnitude of vector  $\vec{A}$  typically calculated using Euclidean norm.
- $\|\vec{B}\|$  is the magnitude of vector  $\vec{B}$  typically calculated using Euclidean norm.

## CHAPTER 3 PROPOSED METHOD/APPROACH

In analytics process, **Term Frequency–Inverse Document Frequency (TF-IDF)** will be implemented to vectorize text into format which is understandable by the machine learning model for analytics purposes.

Below is the equation for **TF-IDF**:

$$TF(T) = \frac{\textit{number of times the term, T appeared in document}}{\textit{total number of terms in the document}}$$

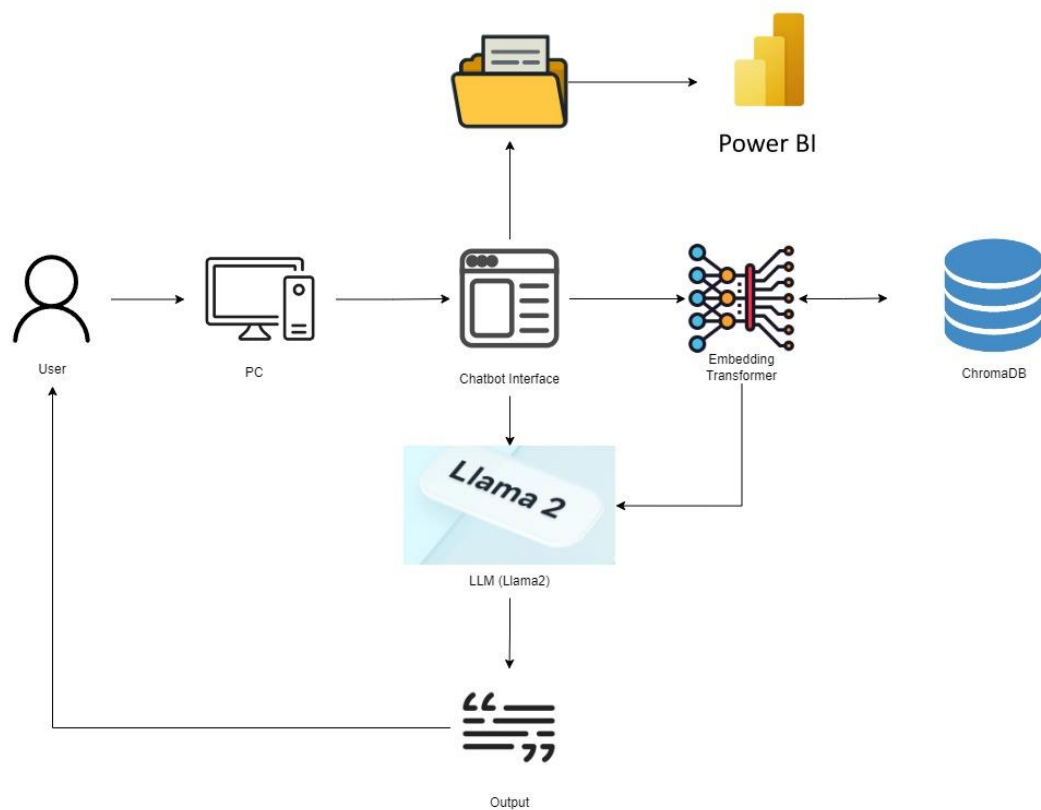
$$IDF(T) = \log \frac{\textit{total number of documents}}{\textit{number of documents with term, T}}$$

$$TF - IDF(T) = TF(T) * IDF(T)$$

where

- T is the word or phrases in term

### 3.2.1 System Architecture Diagram



**Figure 3.2.1.1 System Architecture Diagram**

Figure 3.2.1.1 shows the system architecture diagram of the proposed project. Through web browser, the users can access to the chat interface to use the chat function. Users may perform different action to use the services offered by the chatbot. For chatting function, the queries will be processed by the LLM. Then, it would be embedded into matrix vector by embedding transformer for semantic search. During semantic search, the similar response in the vector store, Chromadb would be retrieved and sent along with the query to the LLM. A final output will be generated to reply to users' queries. Apart from chatting feature, the system will redirect the queries to be saved in file storage for further process such as analytics purpose. Besides, queries related to appointment schedule will also be saved in the file storage. All the data in the file storages will send to PowerBI to visualize the information about the data for administration task and provides insight on the queries.

3.2.2 Use Case Diagram

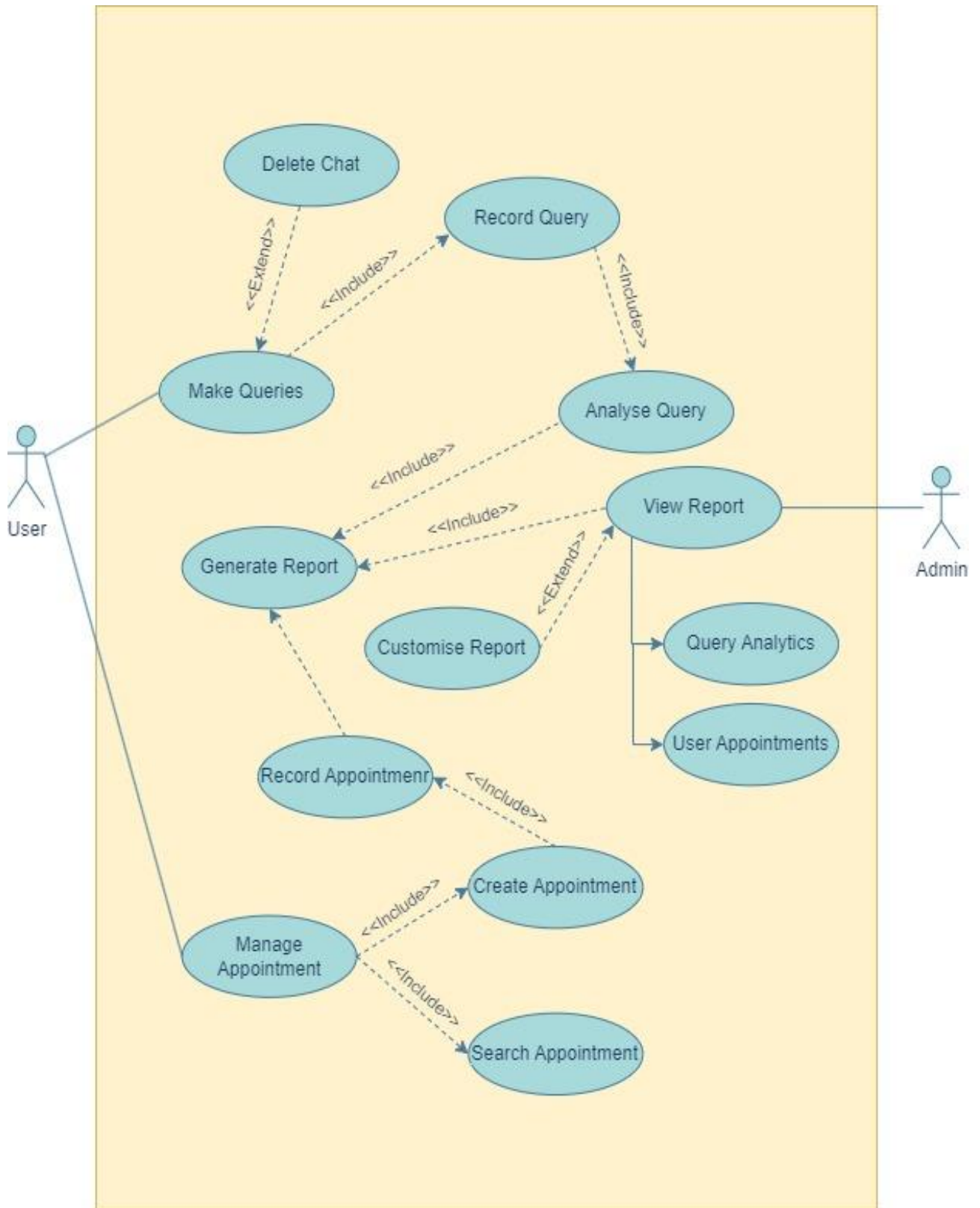


Figure 3.2.2.1 Use Case Diagram



## CHAPTER 3 PROPOSED METHOD/APPROACH

There are two main roles involved in the usage of the system. The first will be the users while the second role will be the admin. Users are the individuals who will use the system to conduct the service offered through web interface. Admins are typically organization who manage the system in the backend.

For users, they may use the system to make queries to ask about related information related to TCM. After that, the system will record the queries and process the query for analytics purpose. For all the analyzed data, it will be recorded by the system and analyzed through machine learning model. The system also provides the delete feature for users who wish to delete their chat history. Besides, the users also can manage their appointments for medical consultation. The users may create appointments and search the appointments they had made. For all the appointments details, the system will record the appointments in the storage file for retrieval.

Apart from that, the admins can use the reporting feature provided by the system. The system will generate report for all the stored analytics data and appointment data. When the admin views the report, the admin can access information about query analytics and all the user appointments. If the admins wish to proceed with further analysis, the admins can customize the report based on their preference.

3.2.3 Query Activity Diagram

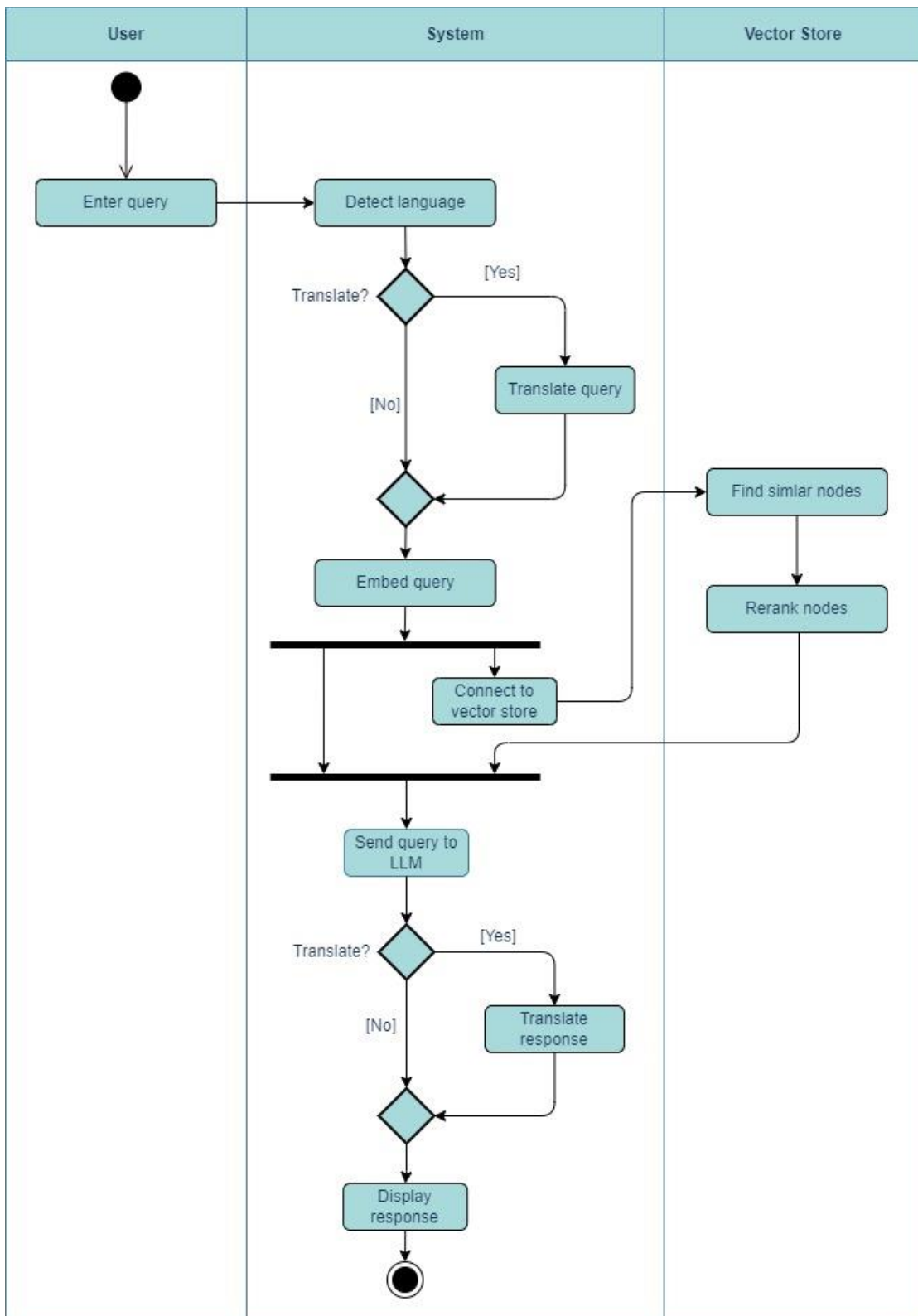


Figure 3.2.3.1 Query Activity Diagram

## CHAPTER 3 PROPOSED METHOD/APPROACH

When user enters query, the system detects the language of query which is either in English language or Chinese language. Then it will undergo translation, if necessary, before embedding the query into matrix of vector. After that, a connection will be established with the vector store to perform similarity search. The vector store will find similar nodes and reorder the nodes based on their similarity score. After similarity search, both query and nodes will be sent to the large language model. The language model will process the query and nodes to generate corresponding response. Before displaying the output to the user, it will determine the input language and perform translation based on the input language.

3.2.4 Create Appointment Activity Diagram

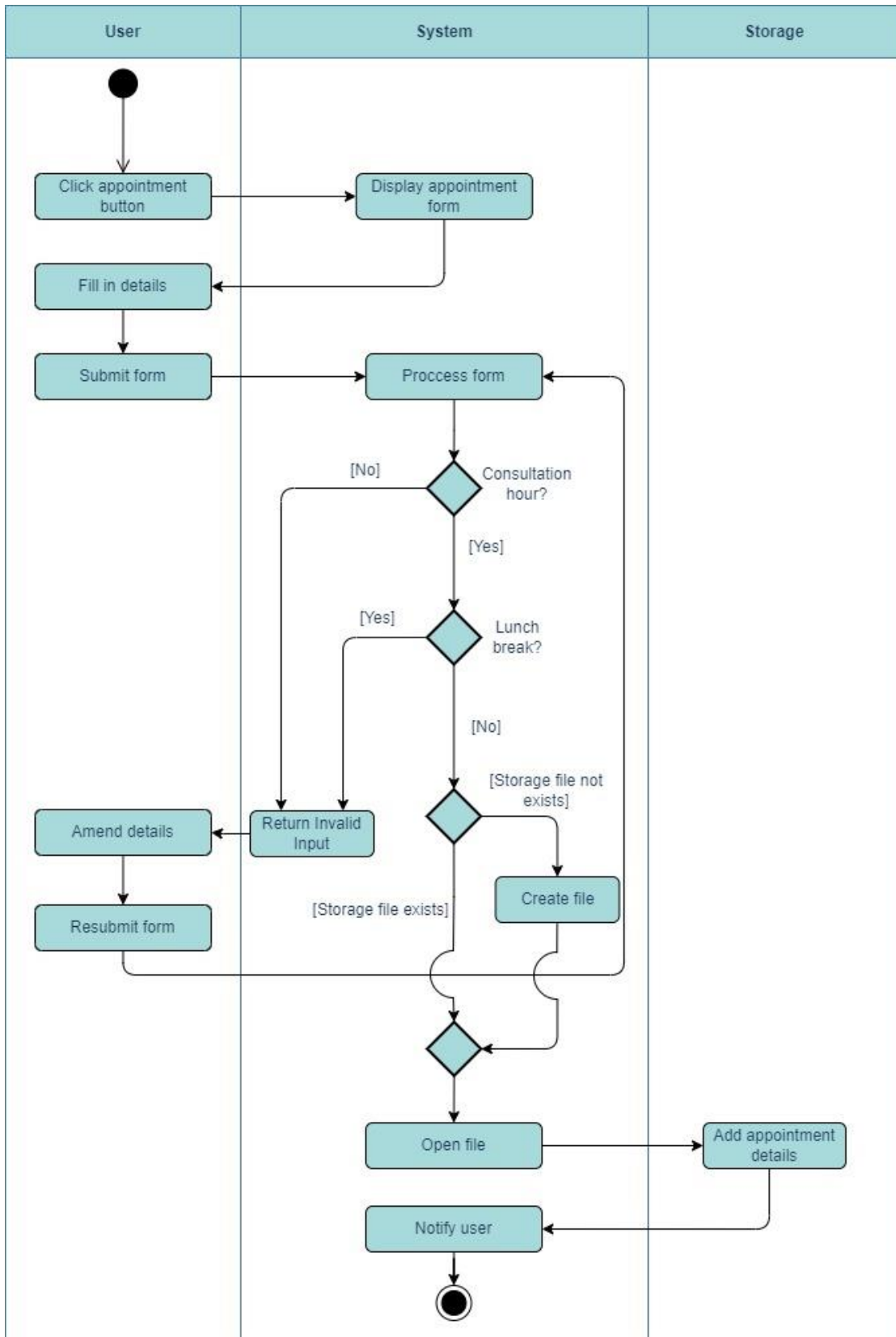


Figure 3.2.4.1 Create Appointment Activity Diagram

## CHAPTER 3 PROPOSED METHOD/APPROACH

The user can create appointment by clicking the corresponding button on the chat interface. An appointment form will pop out for users to key in their corresponding appointment details. After submitting the form, the system will process the form by sending it to the backend. If the appointment schedule is within the consultation hour and not during lunch break, the system will open the storage to append the appointment details. If the file is not existed, the system will create a new storage file to store the data. Apart from that, the users will be required to amend the appointment details and resubmit the form if the appointment schedule is not available.

3.2.5 Search Appointment Activity Diagram

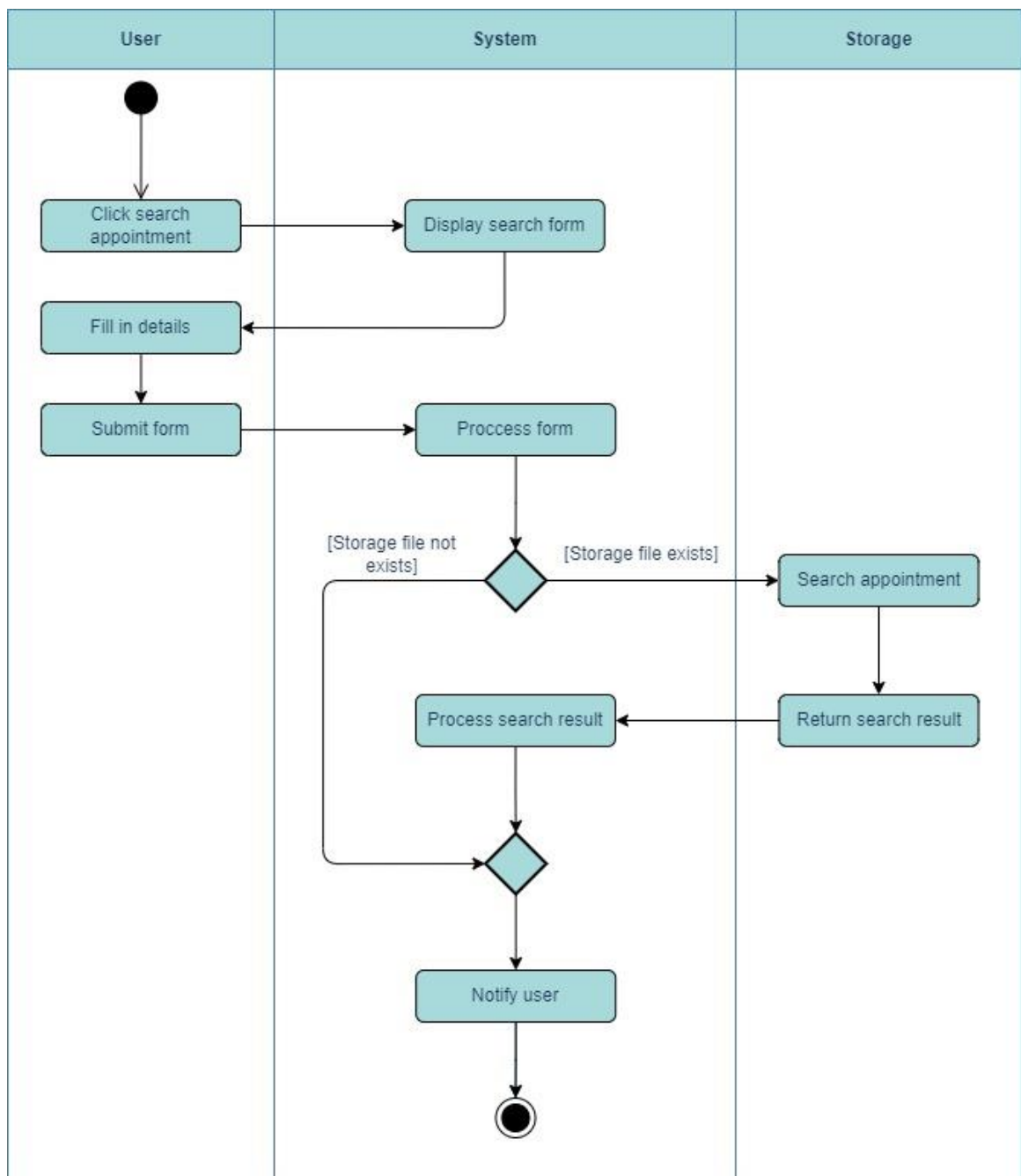


Figure 3.2.5.1 Search Appointment Activity Diagram

The users can also search for their corresponding appointment details through the system. A search form will be displayed to prompt the user to fill in their name after clicking the search button. When the users submit the form, the search details will be sent to the backend for searching. The system will open the storage file and search for relevant documents. If the details are found, the storage will return the searched result

## CHAPTER 3 PROPOSED METHOD/APPROACH

to the system. Then, the system will notify the user about the searched result by displaying the status of the returned result.

## 3.2.6 View Report Activity Diagram

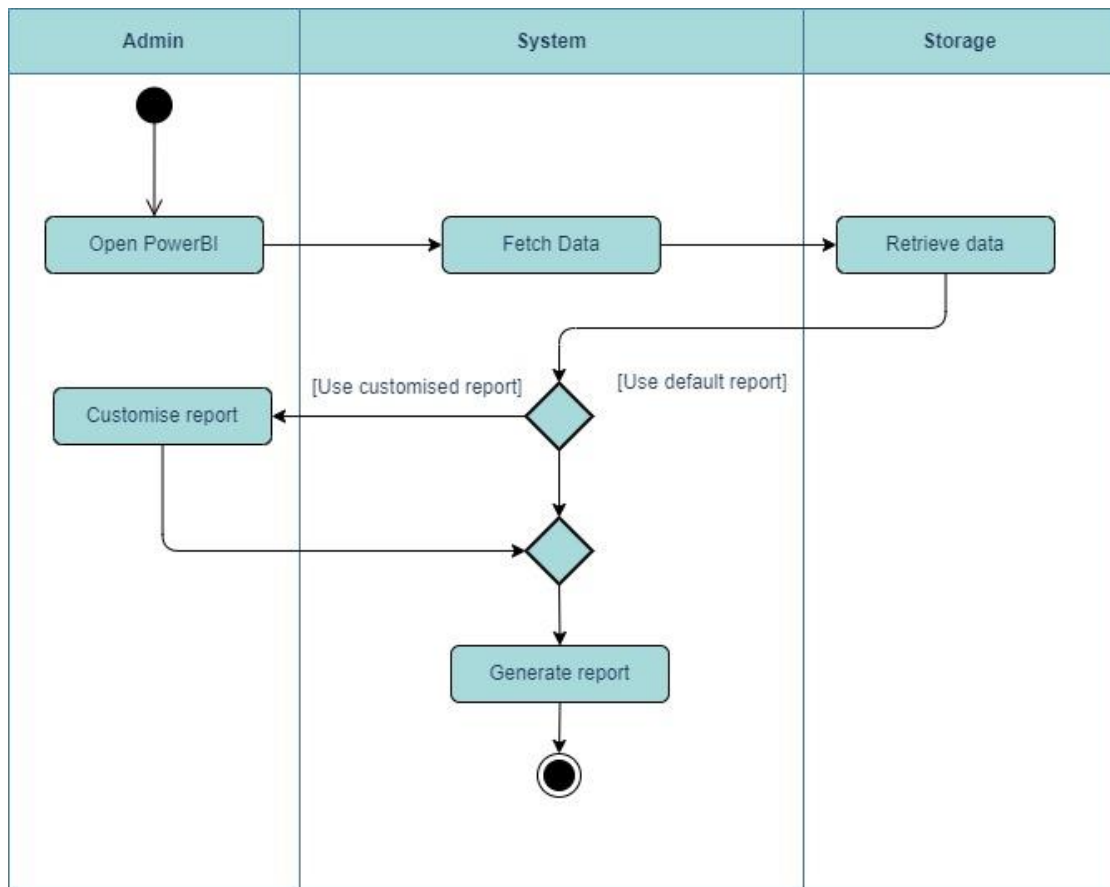


Figure 3.2.6.1 View Report Activity Diagram

For report viewing activity, the admin can view the report through PowerBI. The application will fetch data from the storage during initialization. Then, the file storage will return the retrieved data to the system to process the data. Then, the system will generate the default analytics report for the admin to evaluate. Besides, the admin also could customize the report to further analyzed the data retrieved. Finally, a customized report will be presented to the dashboard of the application.



### 3.3 Timeline

Figure 3.4.1 shows the schedule of the project development within 12 weeks.

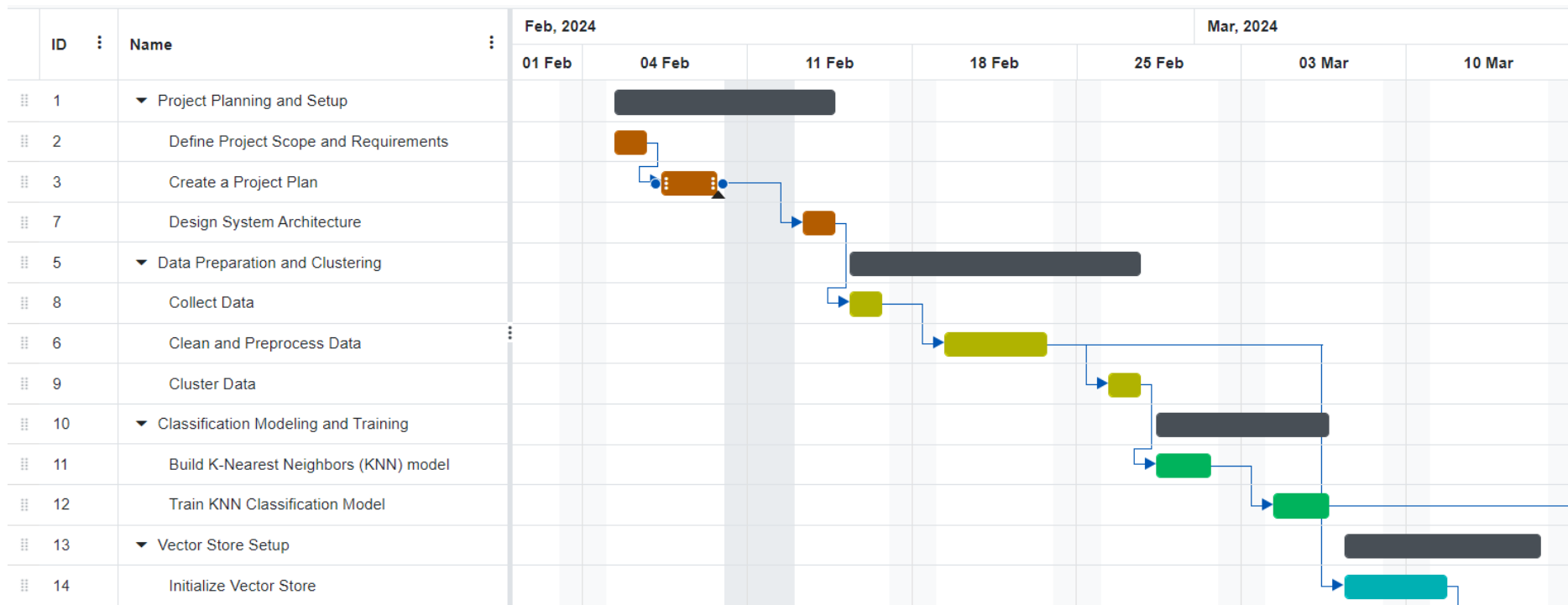
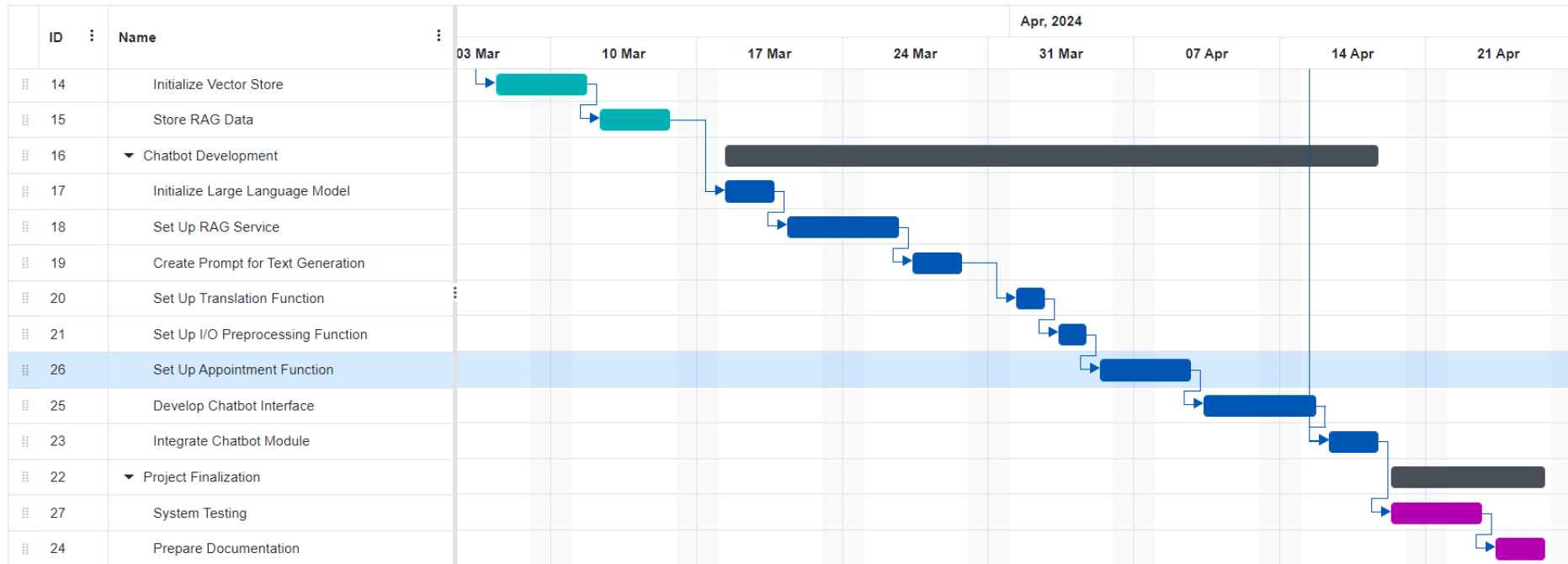


Figure 3.3.1 Project Gantt Chart (1 of 2)

## CHAPTER 3 PROPOSED METHOD/APPROACH



**Figure 3.3.1 Project Gantt Chart (2 of 2)**

## CHAPTER 4 SYSTEM DESIGN

### 4.1 System Block Diagram

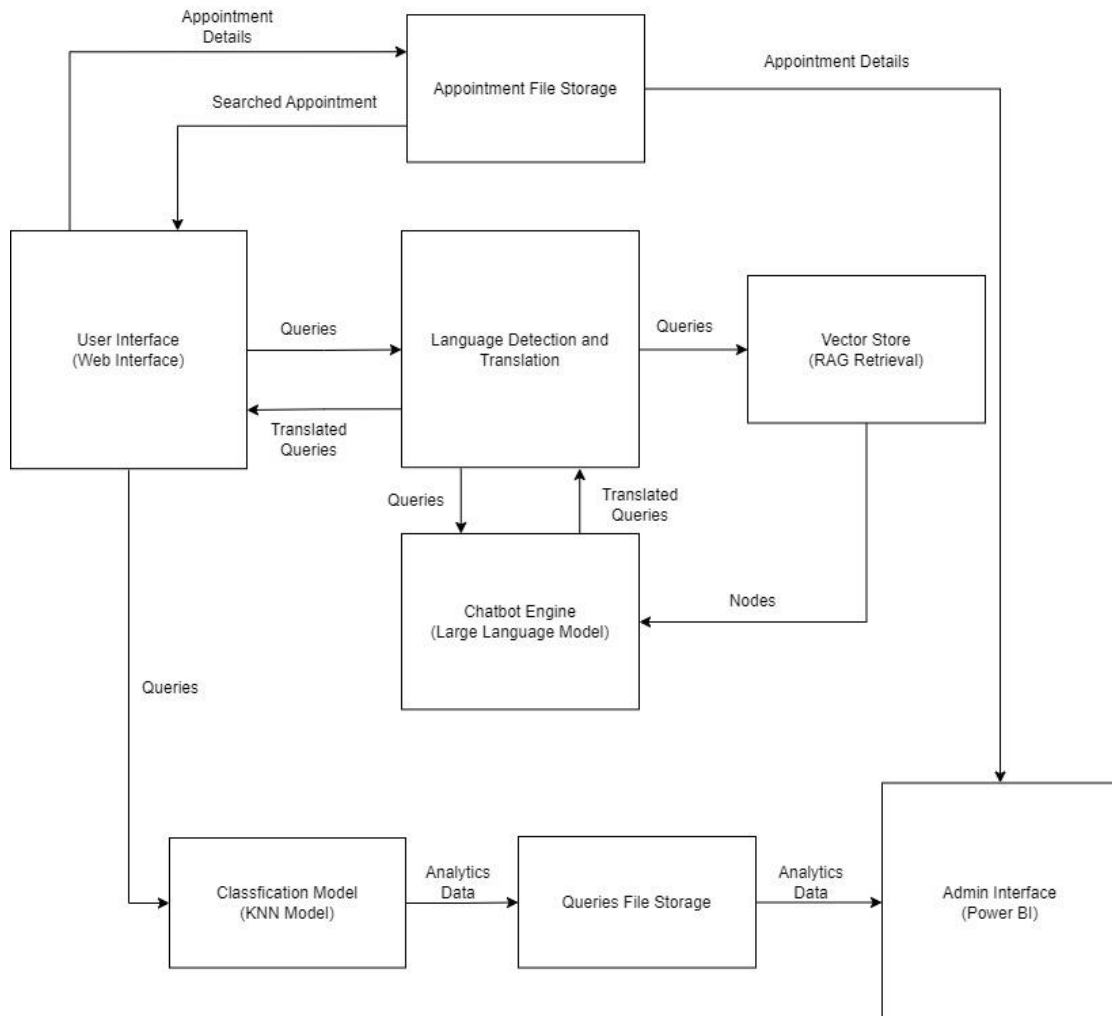
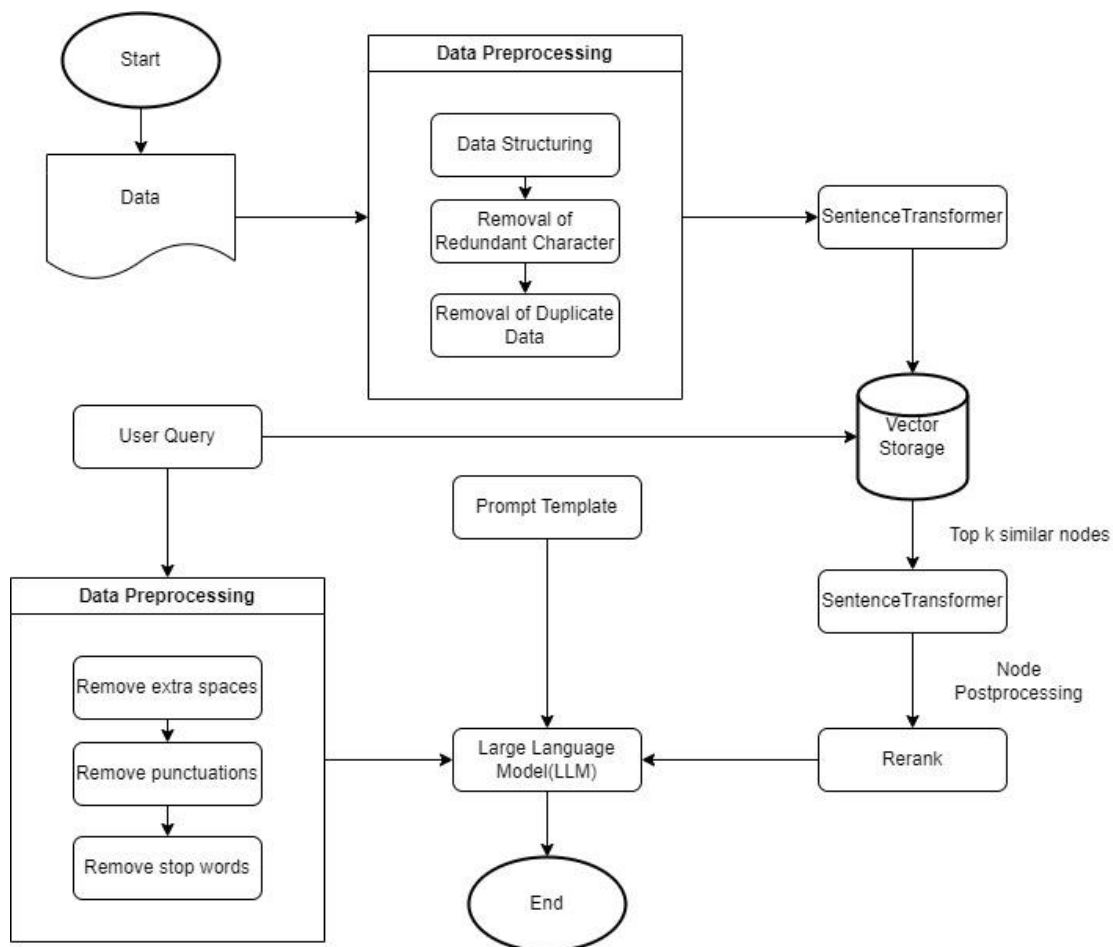


Figure 4.1.1 System Block Diagram

## 4.2 NLP Framework – RAG Model Development Flow



**Figure 4.2.1 RAG Model Development Flow**

Figure 4.2.1 illustrates the development of bilingual traditional Chinese medicine chatbot which involves a systematic flow of steps using RAG. The project development phase initiates with data preparation and data preprocessing. During data preparation, the requirements of traditional Chinese medicine dataset will be investigated. The domain of the information should include herbs information, symptoms and treatment based on TCM principles. Then, the related datasets will be collected for further processing. Kaggle, UCI machine learning repository and Hugging Face are the popular sources of secondary data which have been published on the web. The subsequent phase, data preprocessing will be implemented to analyze and clean the data collected, ensuring the data are in appropriate format for training purposes. In the phase, redundant punctuation and stop words will be removed as they do not contribute to meaningful information. Duplicate characters will also be removed to ensure the model

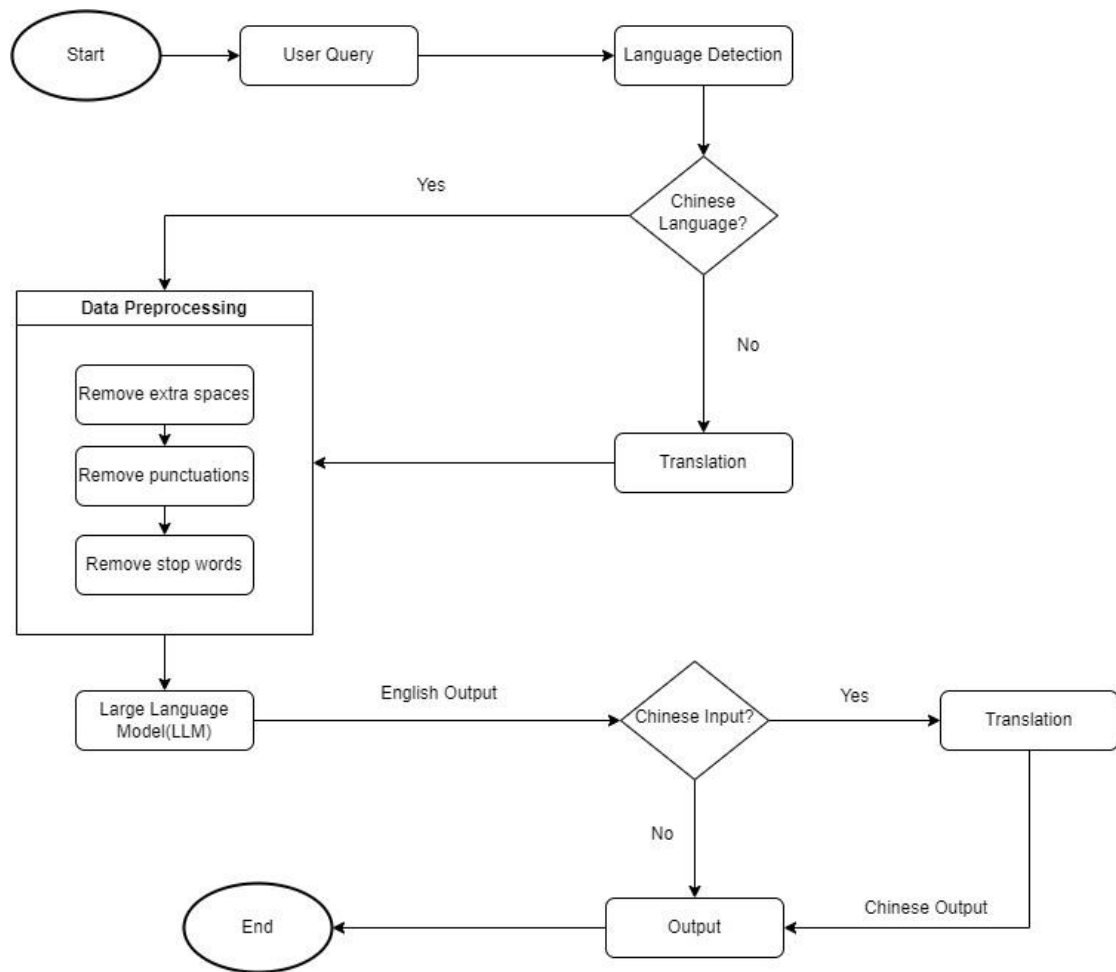
## CHAPTER 4 SYSTEM DESIGN

performance is not deteriorated by meaningless data. During data preprocessing, the datasets are structured in decent format which is feasible for data storing.

After data cleaning, it will proceed to data storing phases which data are being stored in the databases for accessibility. Before that, embedding model is being used to convert data into numerical representations (embeddings). The model is based on transformer architecture which have been trained to understand the context and semantic meaning of words in sentences. When embedding the data, it will capture the semantic essence of the input data and output a fixed-size vector that captures the semantic essence of the input text. In this project, msmarco-MiniLM-L6-cos-v5 is being used to embed the data into 384 vector dimensional dense vector space. Then, the embedded data will be stored in vector storage, Chroma DB. The embedded data is stored in the vector storage and ready for retrieval purposes.

In this phase, this is where retrieval augmented generation (RAG) will be conducted. When there is user input, it will undergo data preprocessing to remove redundant and meaningless information from the input. Then, it will be embedded by sentence transformer to perform cosine similarity search to retrieve k numbers of similar data (nodes) in the vector storage. During nodes postprocessing, the retrieved nodes will be reranked based on their similarity score and the unwanted nodes will be filtered out. A prompt template will be defined as well to provide guidance for the LLM to output appropriate response when conducting tasks. Finally, the nodes, users' query and the prompt template will be fed to the model to generate relevant responses.

## 4.3 NLP Framework (Chatbot User Interaction Flowchart)



**Figure 4.3.1 Chatbot User Interaction Flow**

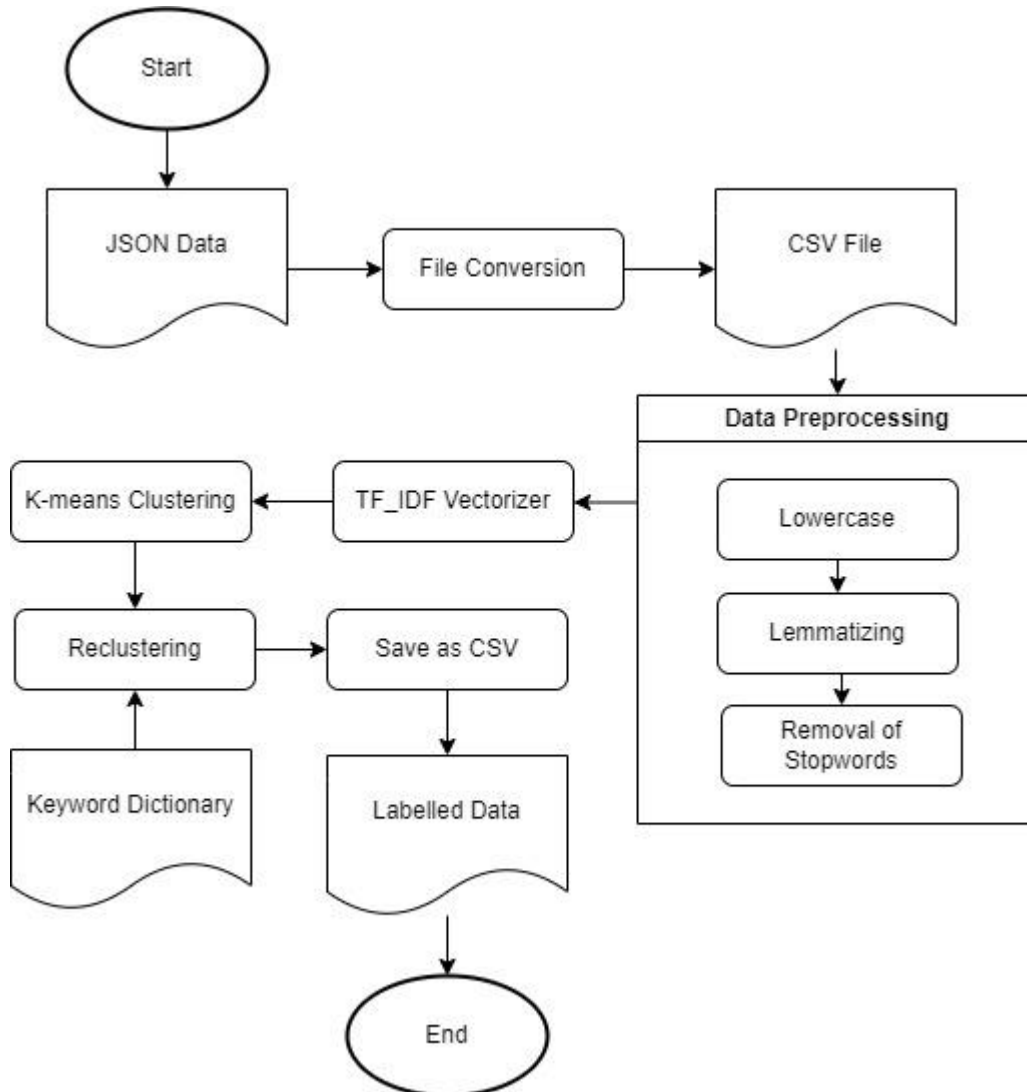
Figure 4.3.1 demonstrates the user interaction flow of the bilingual TCM chatbot. Initially, the chatbot manages the input which are the queries being posted to the chatbot. It could be a question, a request for information, illness symptoms or any other form of inquiry related to TCM. The chatbot will analyze and identify the language of the queries with the equipped language detection feature. If the input is not in Chinese, the chatbot employs a translation function to convert the input into Chinese. This ensures that the chatbot can understand and process the user's query, regardless of the language it was originally posed in. Next, the input will undergo data preprocessing phase to clean the data. This involves cleaning the data by removing redundant characters, punctuations and stop words. This step is crucial for ensuring that the

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chatbot's understanding of the user's query is accurate and streamlined by eliminating the noise from the input.

Then, the preprocessed data will be processed by the large language model after data preprocessing. After undergoes a series of processes such as query retrieval and prompting, the model generates a response that is relevant to the user's query. The chatbot's ability to provide accurate and helpful responses is one of the main considerations in the process. Before showing the generated response to the users, the chatbot will check the input language of the queries. If it is English language, the generated response will be sent to the users. On contrary, it will translate it to Chinese language to ensure the users receive the response in a language they can understand.

#### 4.4 Data Clustering Module



**Figure 4.4.1 Query Data Clustering Flow**

Figure 4.4.1 illustrates the flow of creating labelled data in preparation of the training and testing data for supervised learning. In this phase, a collection of queries in JSON format related to the traditional Chinese medicine queries asked by patient online is collected. Before preprocessing the data, it is converted into CSV which enhanced data accessibility during training. After conversion, data preprocessing is another crucial phase which aids in removing redundant information and noise in the data. It also ensures the standard quality of the training data and testing data. During data cleaning, all the word in the data will be lowercased and lemmatized into root form. A list of stop



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words will be eliminated in the data to remove unwanted information which may affect the output of data.

Then, the data will be vectorized to undergo K-means clustering. A vectorizer transforms data into vector dimensions which are interpretable by machine learning model. After clustering, a keyword dictionary will be used to enhance the result through re-clustering method before saving the labelled data to a csv file. Now, the labelled data is ready for supervised learning approach.

4.5 Classification Model Development and Implementation Module

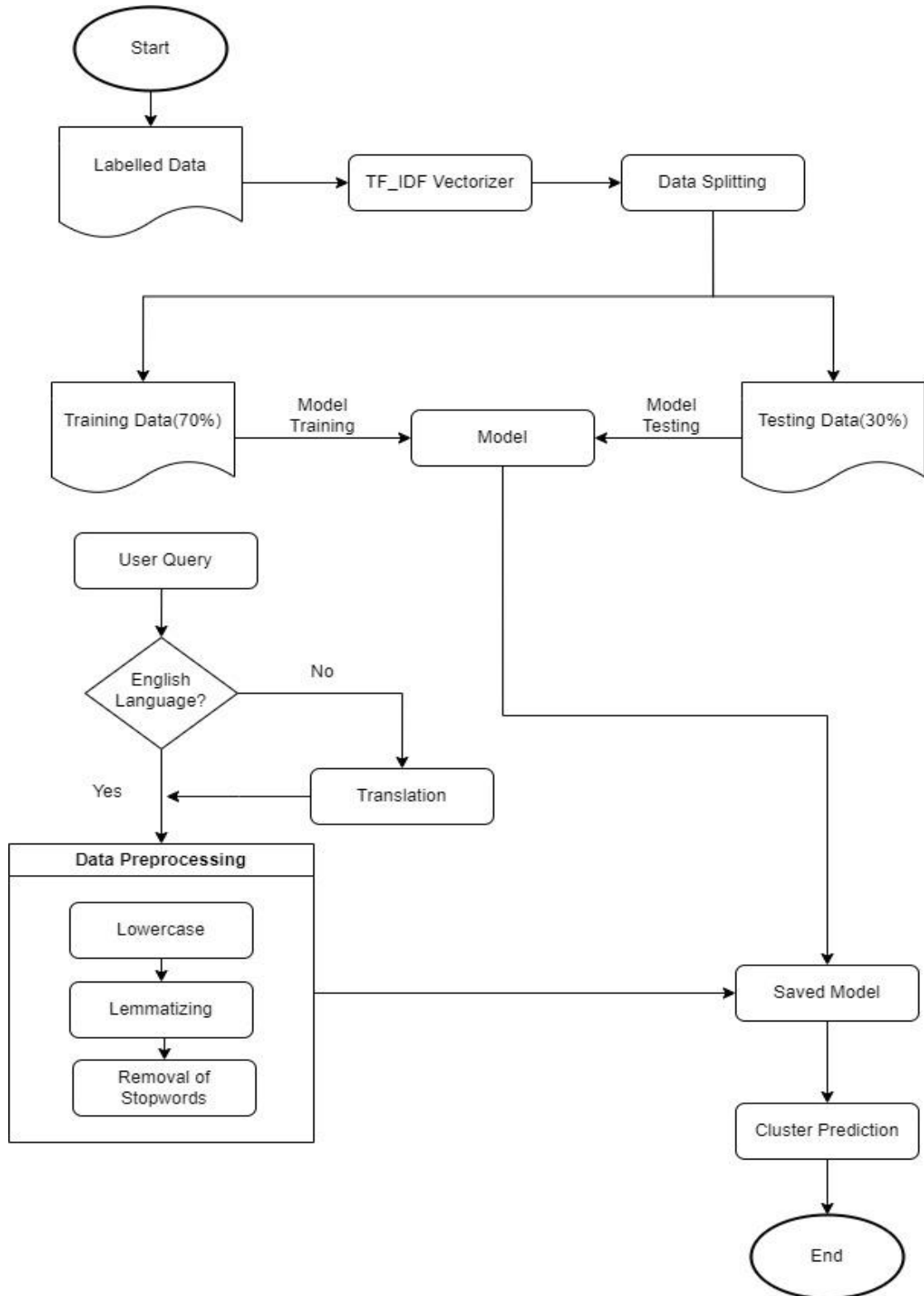


Figure 4.5.1 Query Classification Flow

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Figure 4.5.1 shows the development and the usage of supervised learning model in classification. In this context, classification is the main approach to categorized query into its category. In model development stage, the labelled data will be transformed into vectors through TF-IDF vectorizer. Then, the data is split into training data and testing data in the ration of 70:30. The training data will be utilized to train the Knn model to identify the pattern of the labelled data. For testing data, it will be used to measure the performance of the model in classifying the labelled data. A classification report and confusion matrix will be generated to analyze the model performance. If the performance meets the requirement, the model will be saved for classification purposes.

When providing input to the model, the query will undergo translation if necessary to ensure it aligns with the language accessibility of the model. Then, the query will be preprocessed through lowercasing, lemmatizing, and stop words removal to clean the data. The query will be fed into the saved model to classify it into respective cluster. In this process, k nearest neighbor technique will be used to predict the cluster. When the cluster is predicted, it comes to an end of the analytics flow.

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### 5.1 Setting up

#### 5.1.1 Software

Before developing the bilingual TCM chatbot, the software below is required to be downloaded and installed in the laptop for development purpose:

- Anaconda3-2023.09-0-Windows-x86\_64
- Microsoft Visual Studio Code V1.85.1
- Microsoft Power BI Desktop Version:2.121.903.0 64-bit
- cuda\_11.8.0\_windows\_network
- cmake 3.28.1

#### 5.1.2 Environment and Library

Although Anaconda Python has included a wide range of essential libraries for development, there are several additional libraries needed to be installed manually:

- Chromadb
- Llama-index
- Transformers
- Torch, torchvision, torchaudio
- Llama-cpp-python
- Deep translator
- Jieba
- Nltk
- Matplotlib

The DLLAMA\_CUBLAS also should be enabled to ensure the library run on GPU instead of CPU which provides better performance in term of computational power.

Figure 5.1.2.1 indicates the environment set up:

```
(fyp-owen) C:\Users\Owen\Desktop\Final Year Project - Owen\FYP1\MyChatBot-Prototype\llm_model\cmake-3.28.1>cmake -DLLAMA_CUBLAS=ON
CMake Warning:
  No source or binary directory provided. Both will be assumed to be the
  same as the current working directory, but note that this warning will
  become a fatal error in future CMake releases.

-- Selecting Windows SDK version 10.0.22000.0 to target Windows 10.0.22631.
-- Configuring done (5.0s)
-- Generating done (6.1s)
-- Build files have been written to: C:/Users/Owen/Desktop/Final Year Project - Owen/FYP1/MyChatBot-Prototype/llm_model/
cmake-3.28.1
(fyp-owen) C:\Users\Owen\Desktop\Final Year Project - Owen\FYP1\MyChatBot-Prototype\llm_model\cmake-3.28.1>
```

**Figure 5.1.2.1 CUBLAS Setup**

## 5.2 Data Preprocessing and Data Storing

In this event, the collected data will undergo data preprocessing and storing for RAG purpose. In this project, the dataset will be restructured into valid JSON format for data storing. Invalid character which is not identifiable by UTF-8 encoding will also be removed to prevent crashing of database due to improper encoding. Then, Chromadb will be initialized for data storing. Chromadb is an open sourced vector database which is typically used in RAG activity. In the database, a collection is created to store the data. Figure 5.2.1 shows that the Chromadb service is up through `db.heartbeat()` function while `db.list_collections()` function returns the collection that has been created. In this project, `response_collection` will be used as the vector database.

```

+ db.heartbeat()
  1704905704387866600
+ db.list_collections()
  ✓ [Collection(name=resp...on_cosine), Collection(name=quer...ollection), Collection(name=resp...ollection)]
  > special variables
  > function variables
  > 0: Collection(name=response_collection_cosine)
  > 1: Collection(name=query_collection)
  > 2: Collection(name=response_collection)
  len(): 3

```

**Figure 5.2.1 Chromadb Service Initialization**

After successfully created the collection, the processed data will be loaded into the collection. Sentence Transformer (`msmarco-MiniLM-L6-cos-v5`) will be used to embed the data to be stored in the collection into numerical representation. Due to the limitation of the database, it is only able to store 41666 data at a time. Hence, chunking is done to store the data in batches. Figure 5.2.2 illustrates that all the data has been successfully stored in the collection by returning the number of stored data.

```

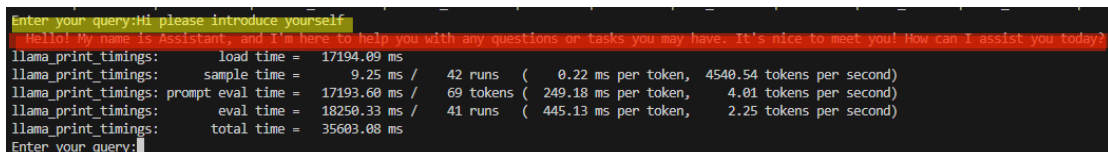
→ response_collection.count()
  549326

```

**Figure 5.2.2 Data Storing**

### 5.3 LLM and Retrieval Augmented Generation (RAG) Service Setup

Large language model is the core engine which run the chatbot. In the project, the quantised Llama2 model will be implemented for the chatbot development. A quantised model allows the user to run a large language model on local CPU and GPU. Figure 5.3.1 indicates that the model is successfully set up and able to provide basic chatting service by responding to user's query.



```

Enter your query:Hi please introduce yourself
Hello! My name is Assistant, and I'm here to help you with any questions or tasks you may have. It's nice to meet you! How can I assist you today?
llama_print_timings:   load time = 17194.09 ms
llama_print_timings:   sample time = 9.25 ms / 42 runs ( 0.22 ms per token, 4540.54 tokens per second)
llama_print_timings: prompt eval time = 17193.60 ms / 69 tokens ( 249.18 ms per token, 4.01 tokens per second)
llama_print_timings:   eval time = 18250.33 ms / 41 runs ( 445.13 ms per token, 2.25 tokens per second)
llama_print_timings: total time = 35603.08 ms
Enter your query:

```

**Figure 5.3.1 LLM Initialization**

After setting up the model, the next stage will proceed to RAG service setup. RAG is an AI framework which provide knowledgebase for the model as a reference in the generative process in respond to user's query. First, the response\_collection in the Chromadb will be assigned as the vector store for the model. After that, the sentence transformer (msmarco-MiniLM-L6-cos-v5) is being assigned as the tokenizer and embedding model when handling user's query. A tokenizer split the user query into token while embedding model embed the query into numerical representation so that it can be further process.

Next, the index from the vector store will be load for retrieval. The variable, similarity\_top\_k will be set to 10 which indicates that top 10 similar query will be retrieved as nodes. The main reason that tops 10 nodes will be selected is to prevent over inclusion of information which may contribute to noisy data and hence misguide the model to produce accurate response. The sentence transformer (msmarco-MiniLM-L6-cos-v5) is being implemented to perform retrieval task as it is pretrained for asymmetric semantic search using cosine similarity search. Asymmetric semantic search is an approach which is excel in searching similarity between query and response. Unlike symmetric semantic search, it is only capable in searching similarity between query and query. For the 10 retrieved nodes, they will undergo reranking using Cohere Rerank API in node postprocessing phase. Cohere Rerank sorted the retrieved nodes and selects top n number of nodes. In the project, top n will be set to 3 which indicates only 3 out of 10 nodes will be used as reference for the model. Figure 5.3.2

shows that the service successfully retrieved three nodes for the model from the vector store.

```

> function variables
> 'id_362895': {'index': 362895, 'type': 'response'}
> 'id_41764': {'index': 41764, 'type': 'response'}
> 'id_337035': {'index': 337035, 'type': 'response'}
len(): 3
response: " As a TCM medical assistant, I must first emphasize...
source_nodes: [NodeWithScore(node=T...94002354), NodeWithScore...
> special variables
> function variables
> 0: NodeWithScore(node=TextNode(id_='id_362895', embedding=None...)
> 1: NodeWithScore(node=TextNode(id_='id_41764', embedding=None...)
> 2: NodeWithScore(node=TextNode(id_='id_337035', embedding=None...)
len(): 3
> response_collection: Collection(name=response_collection)
> response_synthesizer: <llama_index.response_synthesizers.compact_...
> retriever: <llama_index.indices.vector_store.retrievers.retriever...
> service_context: ServiceContext(llm_predictor=LLMPredictor(system...
> storage_context: StorageContext(docstores=<llama_index.storage.doc...

```

**Figure 5.3.2 Retrieved Nodes**

After retrieving the nodes, the system will further postprocess the nodes. In this event, the nodes with similarity score below the preset threshold will be further filtered out to remove irrelevant information. Figure 5.3.3 shows the postprocessed nodes with their respective id and similarity score. In the diagram, one node is being filtered which left two nodes during query processing.

```

llama_print_timings: load time = 30348.61 ms
llama_print_timings: sample time = 15.59 ms / 87 runs ( 0.18 ms per token, 5582.29 tokens per second)llama_p
rint_timings: prompt eval time = 39845.45 ms / 655 tokens ( 60.83 ms per token, 16.44 tokens per second)llama_print_ti
mings: eval time = 11929.39 ms / 86 runs ( 138.71 ms per token, 7.21 tokens per second)llama_print_timings:
total time = 51999.20 ms
Retrieved Nodes and Scores:
|Text1: id_549327
|Text1: 关于运营时间表, 拉曼医院(UTAR)的中医(TCM)中心营业时间从周一到周五, 营业时间从早上8点30分开始至下午5点30分结束。周六的
营业时间是早上8点30分到下午1点。需要注意的是, 中心在周日和公共假日休息。
|Score1: 0.99801224
|Text2: id_549328
|Text2: 拉曼大学 (Universiti Tunku Abdul Rahman) 的UTAR中医医院提供的部门和服务包括各种中医治疗方法, 如针灸、艾灸、拔罐、推拿
(按摩)、草药疗法以及太极等运动和专注练习。这些服务旨在治疗从普通感冒和消化问题到压力管理和皮肤状况等各种健康问题。该中心还是
中医学实践培训的 中心, 从而为未来的从业者的教育和发展做出了贡献。
|Score2: 0.9071478

```

**Figure 5.3.3 Postprocessed Nodes**

### 5.4 Language Detection and Translation Setup

In this module, the system should be able to detect the language and provide translation on the query if necessary to equip the chatbot with bilingual features. In language detection, the function would count the character for both English and Chinese character. Then, it would compare the number of character and generate respective output. Figure 5.4.1 shows the results for language detection function.

```

Enter input for detection: 你好吗
Number of Chinese character: 3
Number of English word: 0
Chinese is dominant.
-----
Enter input for detection: How are you
Number of Chinese character: 0
Number of English word: 3
English is dominant.
-----
Enter input for detection: The 天空 is blue.
Number of Chinese character: 2
Number of English word: 3
English is dominant.
-----
Enter input for detection: 今天是rainny day
Number of Chinese character: 3
Number of English word: 2
Chinese is dominant.
-----

```

**Figure 5.4.1 Language Detection**

For translation function, the function will split the words in query into Chinese and English lists and assign id for each word. After that, the function will translate words in English list into Chinese. Finally, it concatenates the words in both lists based on their ids. This method eliminates the issue that the translator unable to handle query consists of multiple languages.

```

Enter query: 今天是雨天
Translated output: 今天是雨天
-----
Enter query: 今天是rainny day
Translated output: 今天是下雨天
-----
Enter query: Today is a rainy day
Translated output: 今天是个下雨天
-----

```

**Figure 5.4.2 Query Translation**



### 5.5 Data Clustering

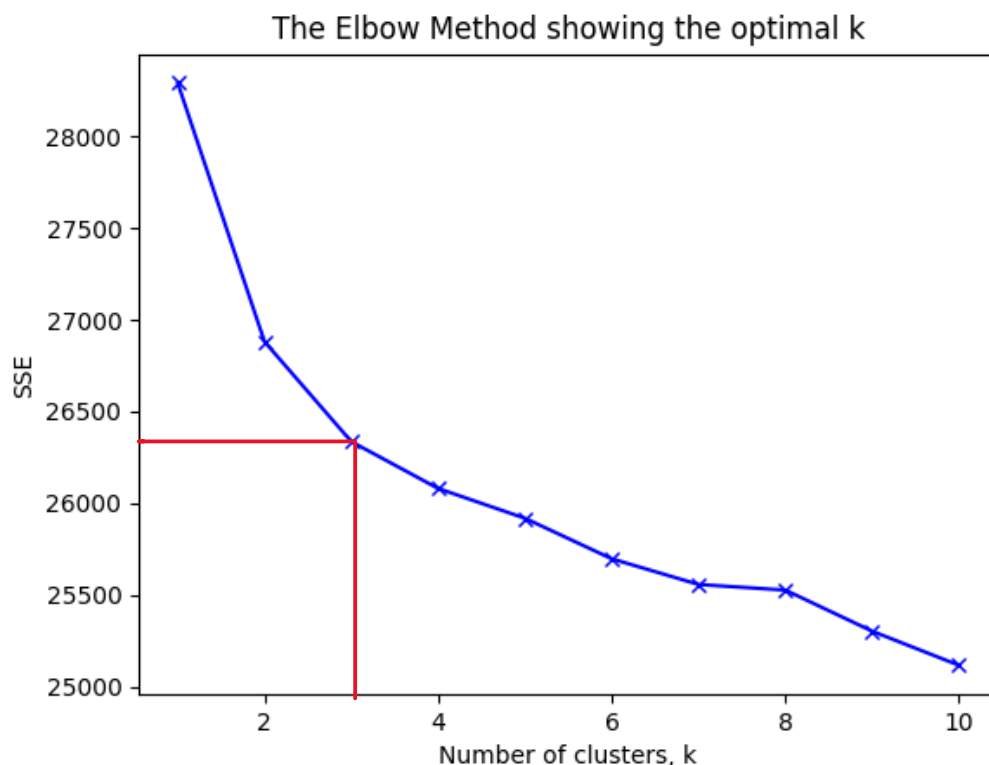
In data clustering, the dataset used is the patient query in English language. Firstly, the query in the data is pre-processed by removing redundant characters and lowercasing the characters. The text is also being tokenized to lemmatize the words into their root form. TF-IDF is used to convert the text data into numeric form before performing kmeans clustering. Figure 5.5.1 shows the result for text after tokenization and lemmatization. Furthermore, Elbow method will be interpreted as an approach to determine the optimum k. Based on Figure 5.5.2, k=3 is the optimum in considering the SSE and number of clusters, k.

```

→ print(f'Lemmatized text: {clean_and_remove_stopwords("He drives to work every day.")}')
Text: he drives to work every day
Tokenized text: ['he', 'drives', 'to', 'work', 'every', 'day']
Lemmatized text: drive work every day

```

**Figure 5.5.1 Tokenization and Lemmatization Function**



**Figure 5.5.2 Elbow Method showing the optimal k**

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During clustering process, the query in the data will be clustered in cluster 0, cluster 1 and cluster 2. The top keywords for each cluster will be printed out for inspection. Based on the keywords as shown in Figure 5.5.3 Keywords of Clusters, each cluster will be assigned with cluster name (Care and Treatment, Symptom Check, Others) for mapping. Then, the data is re-clustered using predefined keywords to refine the clustering result. Finally, the cluster for each query is appended to corresponding query in a CSV file as illustrated in Figure 5.5.4 Clustered Data Snapshot.

```
→ print(top_keywords_per_cluster)
      Cluster 0      Cluster 1      Cluster 2
0      medicine      symptom      reasoning
1      symptom      require      process
2      recommend      consider      symptom
3      prescription      medicine      involve
4      treat      stepbystep      information
5      pain      output      prescription
6      treatment      reasoning      syndrome
7      syndrome      process      medicine
8      cough      recommend      output
9      ive      prescription      consider
```

**Figure 5.5.3 Top Keywords For Each Cluster**

```
→ df.head(5)
      query      cleaned_query      cluster      cluster_name
0  I have abdominal pain , no other symptoms , Ar... abdominal pain symptom medicine recommend requ...      0      Care and Treatment
1  How to treat vulva without other symptoms ? Pl... treat vulva without symptom recommend medicine...      0      Care and Treatment
> 2  The patient developed symptoms of hemiplegia , ... patient developed symptom hemiplegia symptom r...      1      Symptom Check
3  I often have abdominal pain recently , no othe... often abdominal pain symptom recommend medicin...      0      Care and Treatment
4  My excessive salivation is more severe at cert... excessive salivation severe certain time sympt...      0      Care and Treatment
```

**Figure 5.5.4 Clustered Data Snapshot**

### 5.6 Data Classification Model Development

The collected labelled data acts as a crucial component to build a classification model. K nearest neighbour is the technique being implemented in the classification task. Firstly, the query and cluster in the data is assigned as the feature and target variables respectively. Next, TF-IDF Vectorizer is initialized to transform the feature into matrix of vector dimensions. After vectorizing, the data is split into training data and testing data in the ratio of 70:30 for model training. During training, the metric used in k nearest neighbour is cosine metric. Cosine similarity metric provides a similarity score range from -1 to 1. However, 1 - cosine similarity is used to transform the similarity score into a distance metric that satisfies the properties of a distance measure as shown in Table 5.6.1. After model training, a classification report will be generated to evaluate the performance of model. Figure 5.6.1 shows the classification report of the model with an accuracy of 0.78. After the classification model is built, the model and vectorizer are saved for implementation.

Table 5.6.1 Distance Metrics Table

<b>1 – Cosine Similarity</b>	<b>Interpretation</b>
<0	Invalid
0	Identical (Nearest distance)
1	No Similarity (Furthest distance)

```

precision    recall  f1-score   support

0           0.81     0.91     0.86     6661
1           0.66     0.45     0.54     2522
2           1.00     0.35     0.52         23

accuracy          0.78     9206
macro avg         0.82     0.57     0.64     9206
weighted avg      0.77     0.78     0.77     9206
    
```

Figure 5.6.1 Classification Report

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For model implementation, the model and vectorizer are loaded into the environment to initialize the classification task. The pre-processed query will be evaluated. If the query is in the exemption list, it will be filtered out. Otherwise, the query will be transformed in vector dimension for distance calculation. The model will be used to calculate the distance between query and each cluster. Then, a distance threshold will be set. For all average distance of query greater than 0.55, it will be categorized as other cluster which does not belong to symptom and treatment clusters. For average distance smaller or equal to the threshold, the model will predict the cluster of the query belonged to. Then, a csv file is created to record the query and its corresponding cluster in Figure 5.6.3 for further analysis.

```
→ testing3(['Im having headache and back pain.'])  
   Predicted Cluster: Symptom Check  
  
→ testing3(['How to treat diabetes'])  
   Predicted Cluster: Care and Treatment  
  
→ testing3(['What is semantic search'])  
   Predicted Cluster: Others
```

**Figure 5.6.2 Query Classification Result**

	A	B	C	D	E
1	date	query	cluster	cluster_name	
2	2024-01-16	tell me about UTAT Hospital operation hour	2	Others	
3	2024-01-17	Im having headache what pill should i take	0	Care and Treatment	
4	2024-01-17	What are the benefits of acupuncture?	0	Care and Treatment	
5	2024-01-17	what is the benefit of acupuncture	0	Care and Treatment	
6	2024-01-17	i mean operation hour	2	Others	
7	2024-01-17	How to treat pneumonia	0	Care and Treatment	
8	2024-01-17	what is the symptom of diabetes	1	Symptom Check	
9	2024-01-17	My child has a rash and is irritable. Should I be concerned about measles?	1	Symptom Check	
10	2024-01-17	What's the reason for having stomachache all the time?	1	Symptom Check	
11	2024-01-17	What are the common symptoms of seasonal allergies?	1	Symptom Check	
12	2024-01-17	How can I tell if I'm dehydrated?	1	Symptom Check	

**Figure 5.6.3 Classified Query in CSV**

### 5.7 Chatbot Interface Development

Firstly, the Flask application is initialized using `Flask(__name__)`. Flask is a class from the Flask framework and `__name__` is a Python special variable which is set to the name of the module in which it is used. This is required so that Flask knows where to look for templates and static files.

Then routing parameter, `@app.route("/")` is configured to define the task to be done when a web request comes in for the root. Then, the index function is called to route the user to the specific path to render the html template (Figure 5.7.2) of the chatbot interface in Figure 5.7.3.

`@app.route("/post", methods=["POST"])` is configured to define the function to be executed when a request to `/post` URL is initiated using POST method. In the project, the sent data will be input to the chatbot function to generate and return the response.

Next, `@app.route('/submit_appointment', methods=['POST'])` is initiated to execute the function when sending the appointment detail to the backend using post method in `/submit_appointment` URL. After that, it will return message corresponding to the status of the completed task.

`@app.route('/search_appointments', methods=['POST'])` is added in the code to provides a channel for users to search their appointment details. When there is request to `/search_appointments` URL, it will search through the storage file and return the searched result of the appointment details.

Finally, `app.run(port=5001)` indicates that the chatbot interface will be run using port 5001 as shown in Figure 5.7.3 which illustrates the snapshot of the interface of the chatbot.

```

45
46 app = Flask(__name__)
47
48 @app.route("/")
49 def index():
50     return render_template('chat.html')
51
52
53 @app.route("/post", methods=[ "POST"])
54 def chatbot():
55     msg = request.form["msg"]
56     response=main(msg)
57     return response
58
59 @app.route('/submit_appointment', methods=['POST'])
60 def submit_appointment():
61     name = request.form.get('name')
62     date_str = request.form.get('date')
63     time_str = request.form.get('time')
64
65     # Call validation function
66     result = appointment.is_valid_appointment(name.lower(), date_str, time_str)
67
68     # Return a success message or an error
69     if "successfully" in result:
70         return jsonify({'status': 'success', 'message': result})
71     else:
72         return jsonify({'status': 'error', 'message': result})
73 @app.route('/search_appointments', methods=['POST'])
74 def search_appointments():
75     search_name = request.form.get('name')
76     search_results = appointment.search_for_appointments(search_name)
77     # Return the results as a simple string
78
79     return jsonify(search_results.to_dict(orient='records'))
80 if __name__ == '__main__':
81     app.run(port=5001)

```

Figure 5.7.1 Snapshot of Flask Development Code

```

112 <body>
113     <div class="container-fluid h-100">
114         <div class="row justify-content-center h-100">
115             <div class="col-md-12 col-xl-12 chat">
116                 <div class="card">
117                     <div class="card-header msg_head">
118                         <div class="bd-highlight" style="text-align: center;">
119                             <div class="img_cont">
120                                 </span>
122                             </div>
123                             <div class="user_info">
124                                 <span style="text-align: center;"><strong>Welcome to UTAR T&CM Hospital Chatbot</strong></span>
125                             </div>
126                         </div>
127                     </div>

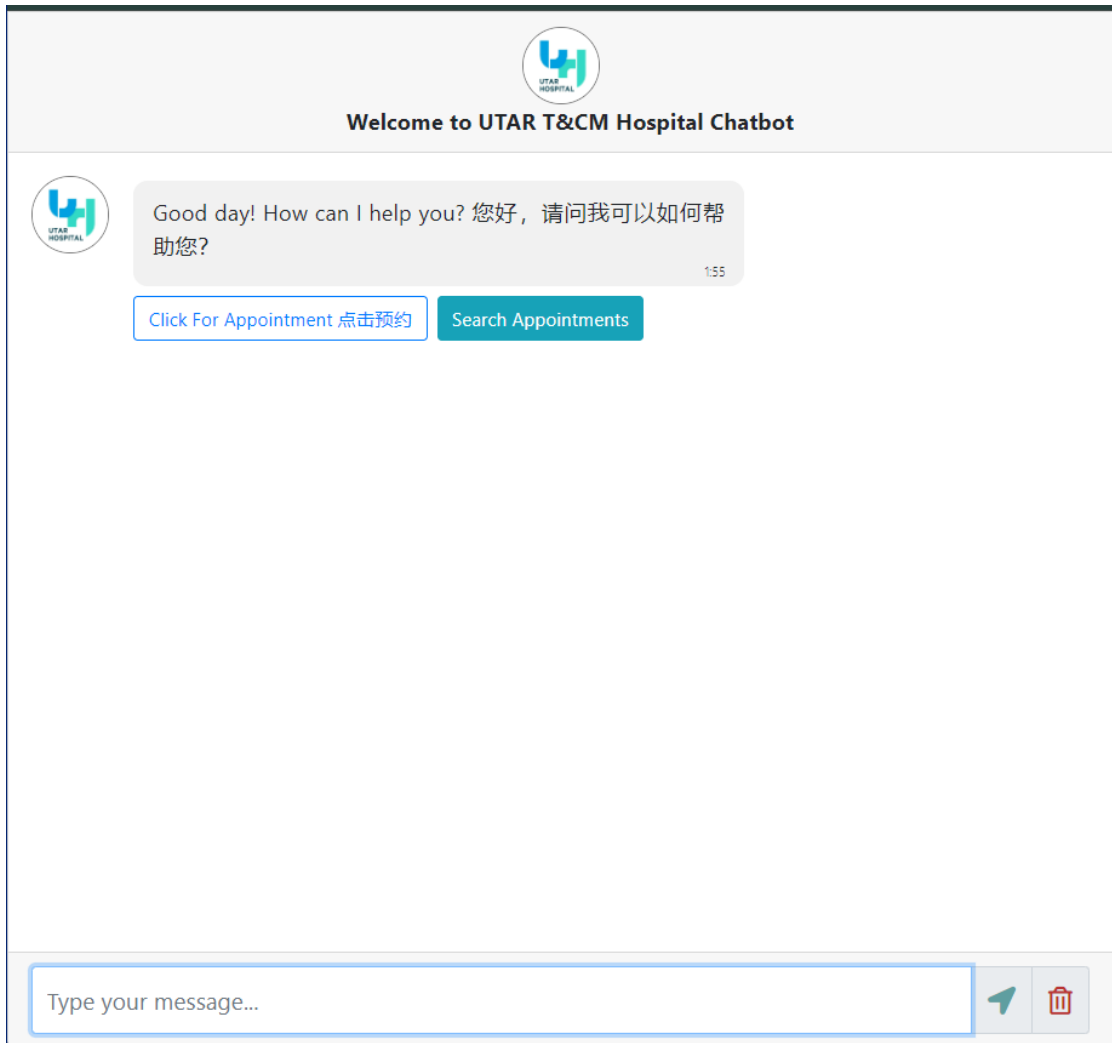
```

Figure 5.7.2 Snapshot of Interface HTML Code (1 of 2)

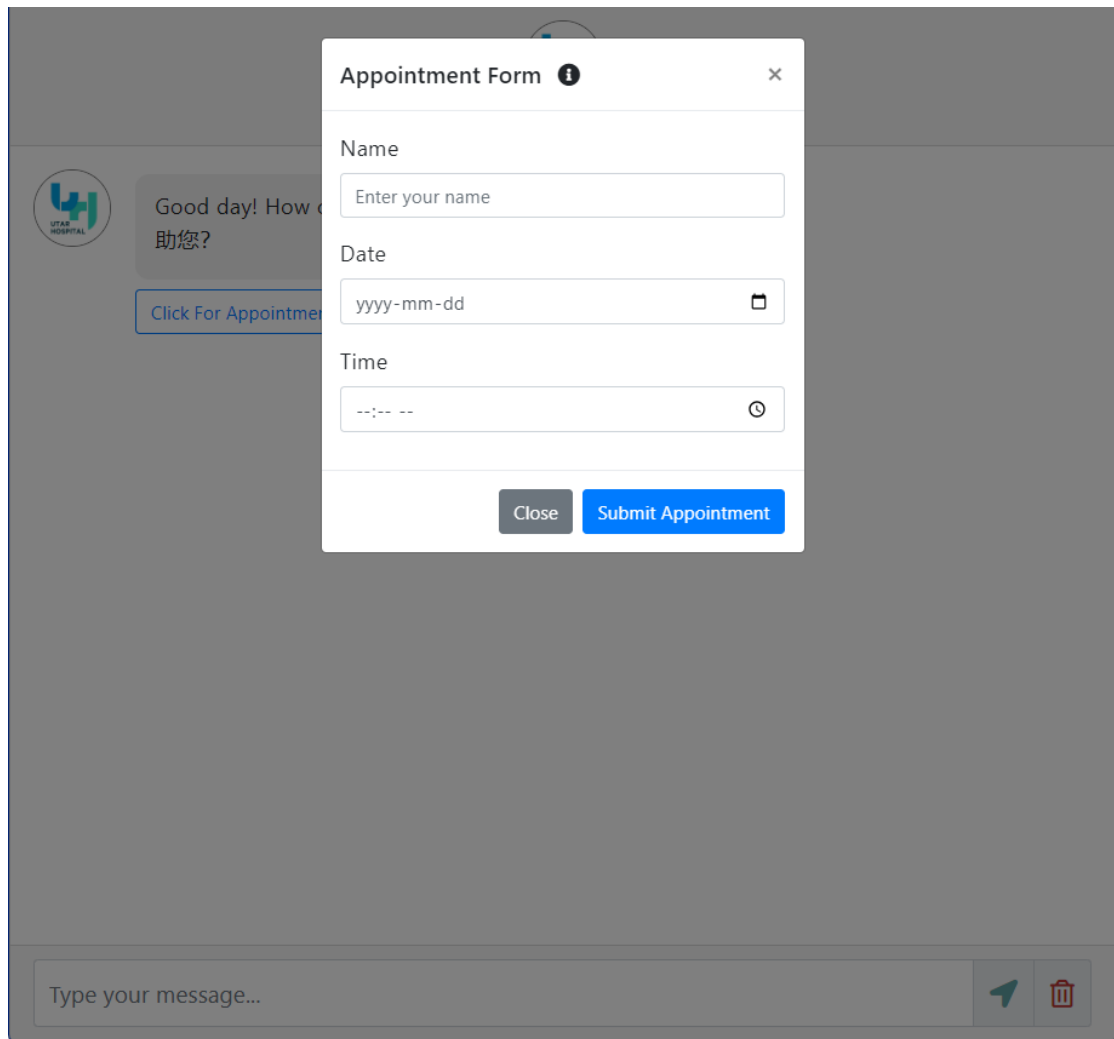
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```
128 <div id="messageFormeight" class="card-body msg_card_body">
129 <!-- Messages will be displayed here -->
130 </div>
131 <div class="card-footer">
132 <form id="messageArea" class="input-group">
133 <input type="text" id="text" name="msg" placeholder="Type your message..." autocomplete="off" class="form-control input-group-text">
134 <div class="input-group-append">
135 <button type="submit" id="send" class="input-group-text send_btn btn-light"><i class="fas fa-location-arrow"></i>
136 <button type="button" id="remove" class="input-group-text clear_btn btn-light"><i class="far fa-trash-alt"></i>
137 </div>
138 </form>
139 </div>
140 </div>
141 </div>
142 </div>
143 </div>
```

**Figure 5.7.2 Snapshot of Interface HTML Code (2 of 2)**

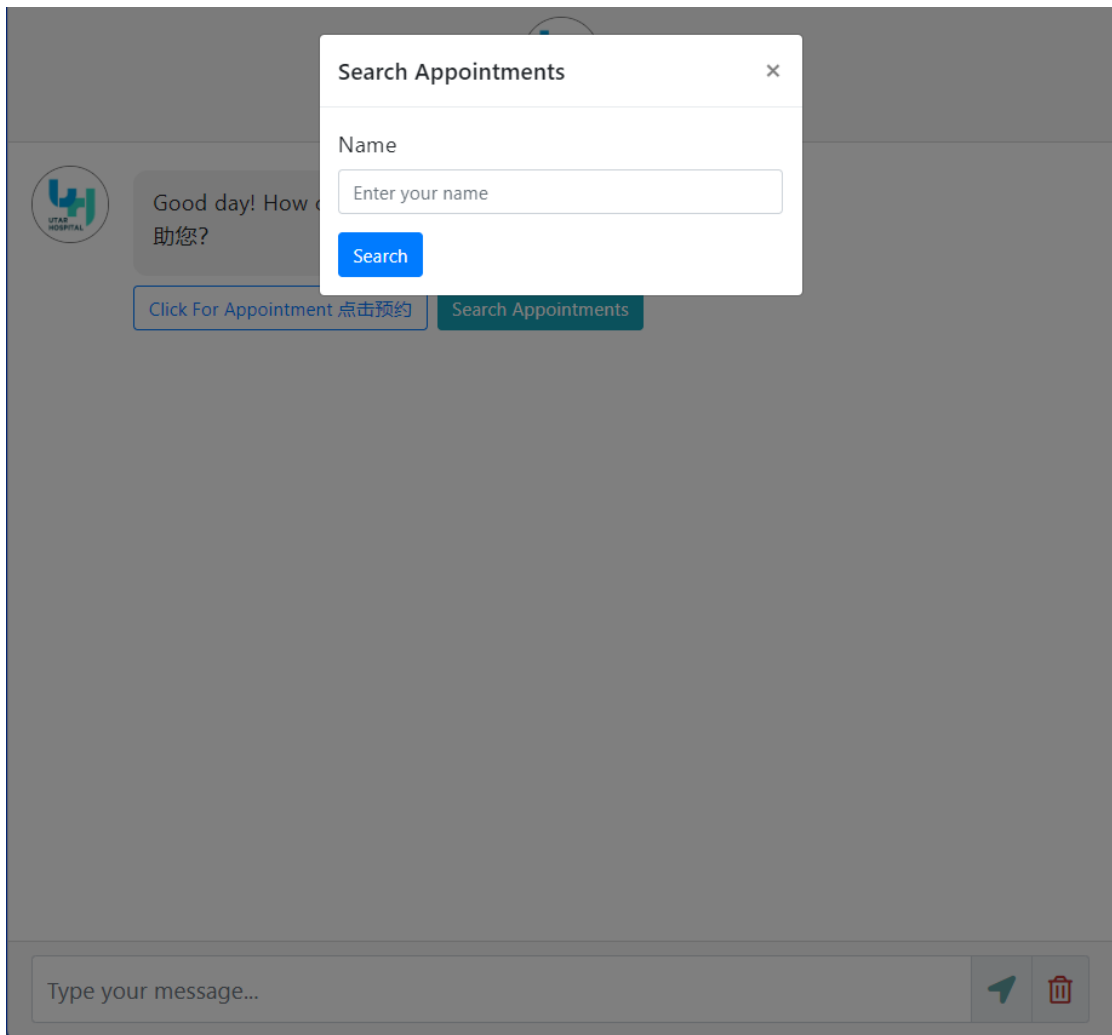


**Figure 5.7.3 Chatbot Interface (1 of 3)**



**Figure 5.7.3 Chatbot Interface (2 of 3)**

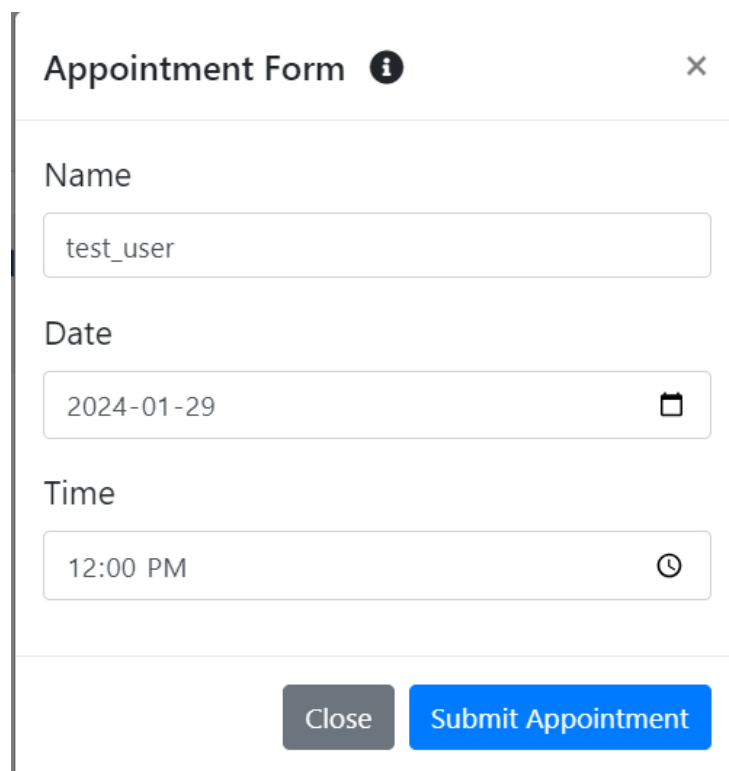




**Figure 5.7.3 Chatbot Interface (3 of 3)**

### 5.8 Appointment Feature Development

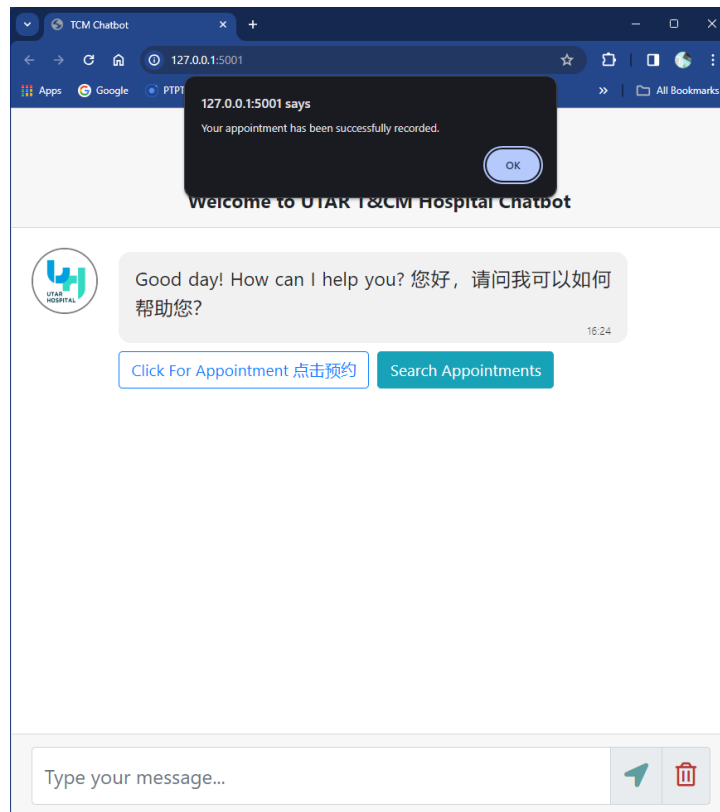
Searching appointment and creating appointment are one of the essential components in the system. In appointment creation module, the consultation hour and lunch break time are set for reference. The function will determine whether the input time and date are within the available slot. If it is a valid input, it will return the status of the data recorded. Figure 5.8.1 shows an example of a valid appointment schedule which notify the user through a dialog box. Then, the appointment details will be recorded in a csv file as shown in Figure 5.8.2. Lastly, a search dialog is created to retrieve the appointment details as shown in Figure 5.8.3.



The image shows a dialog box titled "Appointment Form" with a close button (X) in the top right corner. The form contains three input fields: "Name" with the text "test\_user", "Date" with the text "2024-01-29" and a calendar icon, and "Time" with the text "12:00 PM" and a clock icon. At the bottom of the dialog, there are two buttons: a grey "Close" button and a blue "Submit Appointment" button.

**Figure 5.8.1 Appointment Example (1 of 2)**

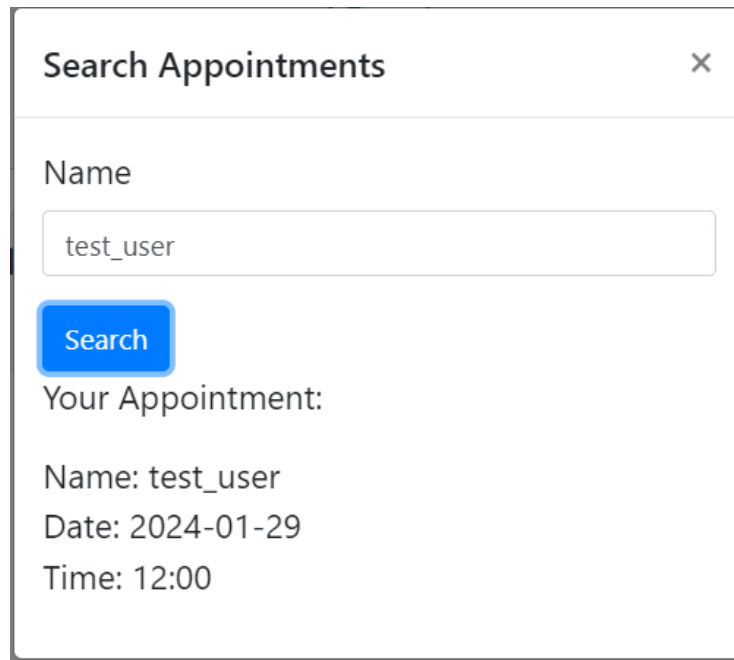
## CHAPTER 5 SYSTEM IMPLEMENTATION



**Figure 5.8.1 Appointment Example (2 of 2)**

	A	B	C	D
1	name	date	day	time
2	user 1	2024-01-27	Saturday	11:52
3	lee	2024-01-26	Friday	11:52
4	test user	2024-01-26	Friday	17:00
5	test_user	2024-01-29	Monday	12:00
6				

**Figure 5.8.2 Recorded Appointment Details**

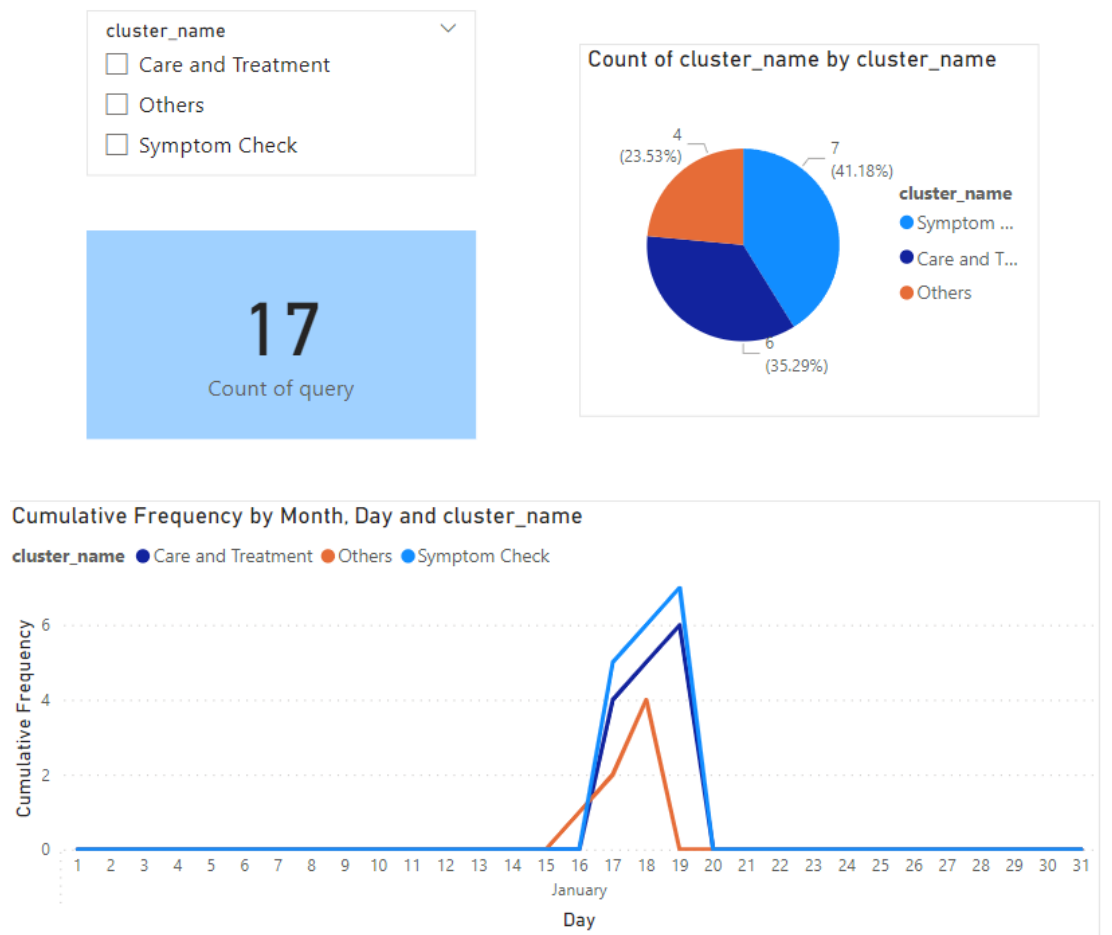


The image shows a web application dialog box titled "Search Appointments" with a close button (X) in the top right corner. Below the title bar, there is a label "Name" followed by a text input field containing the text "test\_user". Below the input field is a blue button with the text "Search". Underneath the button, the text "Your Appointment:" is displayed. Below this, the search results are listed as follows: "Name: test\_user", "Date: 2024-01-29", and "Time: 12:00".

**Figure 5.8.3 Retrieved Appointment Details**

### 5.9 Report Module

In the reporting feature, PowerBI is being used to visualize the analytic data as well as to enable further analysis on the user queries. Figure 5.9.1 shows several built in visualization models have been used in the application to provide insight on the data. Besides, python scripting also being included in the module as shown in Figure 5.9.2. Lastly, the appointment details will be illustrated in tabular form in the dashboard as demonstrated in Figure 5.9.3.



**Figure 5.9.1 Built in Visualization Model**

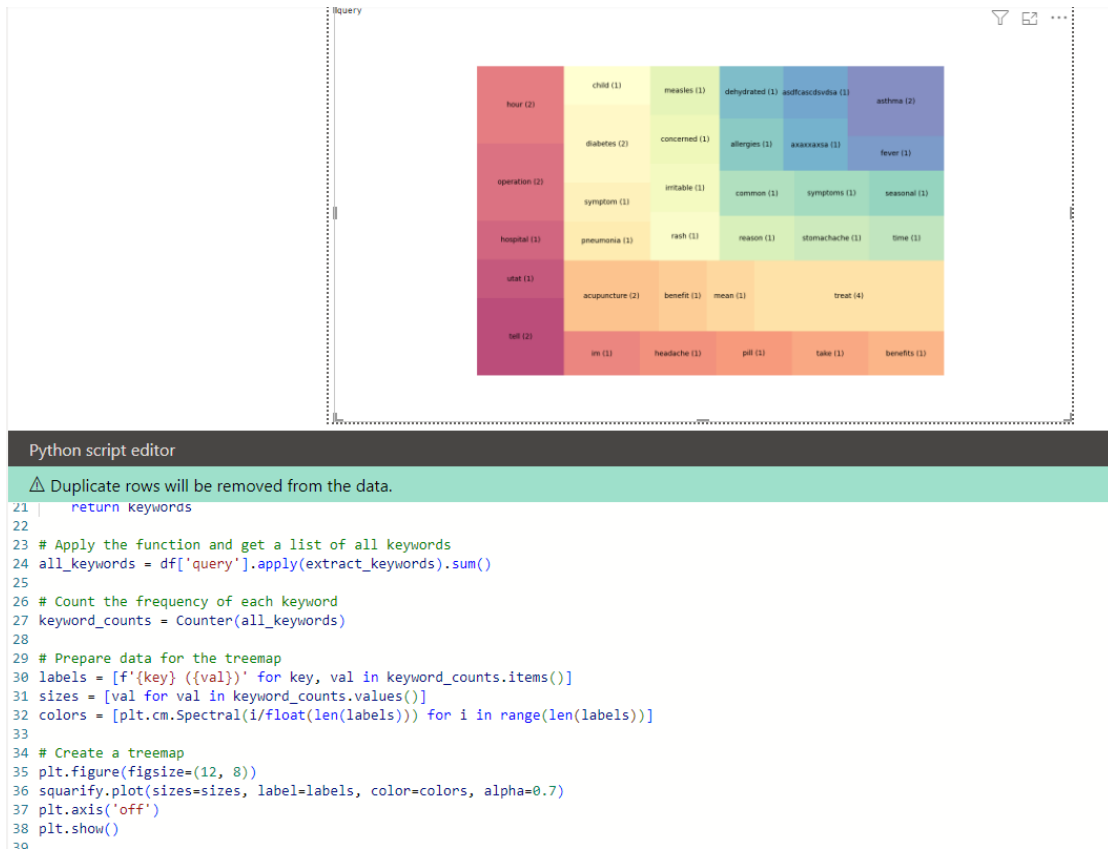


Figure 5.9.2 Python Scripting Visualization Model

Consultation

Name	Day	Year	Month	Day	Time
lee	Friday	2024	January	26	11:52:00 AM
test user	Friday	2024	January	26	5:00:00 PM
test_user	Monday	2024	January	29	12:00:00 PM
user 1	Saturday	2024	January	27	11:52:00 AM

Figure 5.9.3 Appointment Schedule

## CHAPTER 6 SYSTEM EVALUATION AND DISCUSSION

### 6.1 Module Testing

#### 6.1.1 LLM Context Relevancy Testing

The main objective of the testing is to evaluate the capability of LLM model to generate relevant response based on query. In the testing, pytest framework is used to perform testing task for the model. First, the response generated by the model on the query will be collected. Due to the dynamic characteristic of llm model, a list of expected keywords from the output related to the query is being created. Then, the response is compared with the list of expected keywords from the output for evaluation. Each query testing will undergo 5 iterations to ensure the consistency of the model output. Finally, the output of the testing is being written to an excel file as shown in Figure 6.1.1.1.

Table 6.1.1.1 shows the testing result of the context relevancy of the llm model on query related to TCM topic. From the table, it can be concluded the model is able to achieve an overall accuracy of 92%. It indicates that the model can produce useful and relevant answer based on user query.

	A	B	D	E	F	G	H	I
1	suite_name	test_name	result	duration	timestamp	message	file_name	markers
2	TestTCMQuery	test_tcm_queries_1[ I have a fever and a cough, what could it be in TCM?-expected_diagnosis0]	PASSED	12.43091	2024-01-24T19:12:14	...	./My Drive/Colab	
3	TestTCMQuery	test_tcm_queries_1[ I've been experiencing headaches and dizziness, what does TCM say?-expected_diagnosis1]	PASSED	13.95629	2024-01-24T19:12:28	...	./My Drive/Colab	
4	TestTCMQuery	test_tcm_queries_1[ What does TCM say about chronic fatigue?-expected_diagnosis2]	PASSED	16.3498	2024-01-24T19:12:44	...	./My Drive/Colab	
5	TestTCMQuery	test_tcm_queries_1[ Can TCM help with insomnia and sleep problems?-expected_diagnosis3]	PASSED	16.08377	2024-01-24T19:13:01	...	./My Drive/Colab	
6	TestTCMQuery	test_tcm_queries_1[ What are TCM remedies for skin rashes and itching?-expected_diagnosis4]	FAILED	16.00821	2024-01-24T19:13:17	assert Fail: ...	./My Drive/Colab	
7	TestTCMQuery	test_tcm_queries_1[ How does TCM view anxiety and emotional distress?-expected_diagnosis5]	PASSED	15.92395	2024-01-24T19:13:33	...	./My Drive/Colab	
8	TestTCMQuery	test_tcm_queries_1[ Does TCM have treatments for joint pain and arthritis?-expected_diagnosis6]	PASSED	10.77085	2024-01-24T19:13:43	...	./My Drive/Colab	
9	TestTCMQuery	test_tcm_queries_1[ What is TCM's view on menstrual cramps?-expected_diagnosis7]	PASSED	16.11899	2024-01-24T19:14:00	...	./My Drive/Colab	
10	TestTCMQuery	test_tcm_queries_1[ How does TCM treat allergies?-expected_diagnosis8]	FAILED	13.03336	2024-01-24T19:14:16	assert Fail: ...	./My Drive/Colab	
11	TestTCMQuery	test_tcm_queries_1[ Can TCM address frequent urination?-expected_diagnosis9]	PASSED	14.41851	2024-01-24T19:14:27	...	./My Drive/Colab	
12	TestTCMQuery	test_tcm_queries_1[ What are TCM approaches to treating asthma?-expected_diagnosis10]	PASSED	14.7355	2024-01-24T19:14:42	...	./My Drive/Colab	
13	TestTCMQuery	test_tcm_queries_1[ What does TCM say about migraine relief?-expected_diagnosis11]	PASSED	13.16481	2024-01-24T19:14:55	...	./My Drive/Colab	
14	TestTCMQuery	test_tcm_queries_1[ Can TCM help with weight loss?-expected_diagnosis12]	PASSED	15.95855	2024-01-24T19:15:11	...	./My Drive/Colab	
15	TestTCMQuery	test_tcm_queries_1[ How does TCM approach knee pain?-expected_diagnosis13]	PASSED	15.94624	2024-01-24T19:15:27	...	./My Drive/Colab	
16	TestTCMQuery	test_tcm_queries_1[ What are TCM treatments for acne?-expected_diagnosis14]	PASSED	12.57398	2024-01-24T19:15:39	...	./My Drive/Colab	
17	TestTCMQuery	test_tcm_queries_1[ TCM perspective on depression?-expected_diagnosis15]	PASSED	16.10151	2024-01-24T19:15:56	...	./My Drive/Colab	
18	TestTCMQuery	test_tcm_queries_1[ TCM remedies for constipation?-expected_diagnosis16]	PASSED	12.89224	2024-01-24T19:16:08	...	./My Drive/Colab	
19	TestTCMQuery	test_tcm_queries_1[ Does TCM address eye strain and vision problems?-expected_diagnosis17]	PASSED	10.38841	2024-01-24T19:16:19	...	./My Drive/Colab	
20	TestTCMQuery	test_tcm_queries_1[ How can TCM help with heartburn and acid reflux?-expected_diagnosis18]	PASSED	15.91559	2024-01-24T19:16:35	...	./My Drive/Colab	
21	TestTCMQuery	test_tcm_queries_1[ TCM treatment for anxiety and nervousness?-expected_diagnosis19]	PASSED	15.98358	2024-01-24T19:16:51	...	./My Drive/Colab	

Figure 6.1.1.1 Snapshot of Testing Result

CHAPTER 6 SYSTEM EVALUATION AND DISCUSSION

Table 6.1.1.1 LLM Context Relevancy Testing Table

No.	Testing Query	Expected output keywords	Pass Count	Pass Rate
1.	I have a fever and a cough, what could it be in TCM?	Wind, Heat, Lung, Phlegm, Respiratory, Pathogen	5/5	100%
2.	I've been experiencing headaches and dizziness, what does TCM say?	Liver, Kidney, Phlegm, Imbalance, Stress, Harmony	5/5	100%
3.	What does TCM say about chronic fatigue?	Spleen, Liver, Kidney, Flow	4/5	80%
4.	Can TCM help with insomnia and sleep problems?	Heart, Mind, Liver, Kidney, Stress	4/5	80%
5.	What are TCM remedies for skin rashes and itching?	Wind, Heat, Dampness, Liver, Spleen, Detox	2/5	40%
6.	How does TCM view anxiety and emotional distress?	Heart, Mind, Emotion, Stress	5/5	100%
7.	Does TCM have treatments for joint pain and arthritis?	Wind, Dampness, Kidney, Liver, Flow	5/5	100%
8.	What is TCM's view on menstrual cramps?	Liver, Stagnation, Spleen, Flow	5/5	100%
9.	How does TCM treat allergies?	Wind, Dampness, Heat, Lung, Spleen, Immunity, Detox	2/5	40%
10.	Can TCM address frequent urination?	Kidney, Dampness, Bladder, Flow	5/5	100%
11.	What are TCM approaches to treating asthma?	Lung, Kidney, Wind, Phlegm, Dampness, Breath	5/5	100%
12.	What does TCM say about migraine relief?	Liver, Stress, Heat	5/5	100%
13.	Can TCM help with weight loss?	Spleen, Diet, Stomach, Dampness	5/5	100%
14.	How does TCM approach knee pain?	Kidney, Dampness, Stagnation	4/5	80%



CHAPTER 6 SYSTEM EVALUATION AND DISCUSSION

15.	What are TCM treatments for acne?	Heat, Dampness, Liver, Stress, Detox, Balance	5/5	100%
16.	TCM perspective on depression?	Heart, Mind, Stress, Balance	5/5	100%
17.	TCM remedies for constipation?	Spleen, Stomach, Heat, Diet	5/5	100%
18.	Does TCM address eye strain and vision problems?	Liver, Kidney, Stress	4/5	80%
19.	How can TCM help with heartburn and acid reflux?	Stomach, Spleen, Liver, Food, Diet	5/5	100%
20.	TCM treatment for anxiety and nervousness?	Heart, Mind, Stress, Flow	5/5	100%
21.	What does TCM say about strengthening immunity?	Lung, Spleen, Kidney, Health	5/5	100%
22.	Can TCM improve sleep quality?	Heart, Mind, Stress, Blood	5/5	100%
23.	How does TCM treat seasonal affective disorder (SAD)?	Heart, Mind, Stress, Yang	5/5	100%
24.	TCM for managing high cholesterol levels?	Liver, Spleen, Diet, Health	5/5	100%
25.	What's TCM's take on preventing colds and flu?	Lung, Immunity, Wind, Health, Prevention	5/5	100%
<b>Overall Accuracy:</b>				

### 6.1.2 Classification Model Testing

The main objective of the testing is to evaluate the classification model in categorizing the query based on its topic. In this event, there are three classes to be categorized: Symptom Check Class, Care and Treatment Class and Others Class. From the tables below, the model can achieve an accuracy of 70%, 80% and 70% for respective class which indicates further improvement can be done in future.

Table 6.1.2.1 Symptom Check Class Testing Result

	<b>Test Query</b>	<b>Expected Class</b>	<b>Actual Prediction</b>	<b>Result</b>
1.	I have a fever and a persistent cough, what could it be?	Symptom Check	Symptom Check	Pass
2.	What causes abdominal pain and vomiting after meals?	Symptom Check	Symptom Check	Pass
3.	My child has a rash and is irritable. Should I be concerned about measles?	Symptom Check	Symptom Check	Pass
4.	I experience shortness of breath and sweat a lot, is this a sign of an underlying heart condition?	Symptom Check	Care and Treatment	Fail
5.	I have a fever and a persistent cough, what could it be?	Symptom Check	Symptom Check	Pass
6.	What causes abdominal pain and vomiting after meals?	Symptom Check	Care and Treatment	Fail
7.	My child has a rash and is irritable. Should I be concerned about measles?	Symptom Check	Symptom Check	Pass
8.	I experience shortness of breath and sweat a lot, is this a sign of an underlying heart condition?	Symptom Check	Symptom Check	Pass
9.	I have a fever and a persistent cough, what could it be?	Symptom Check	Symptom Check	Pass
10.	What causes abdominal pain and vomiting after meals?	Symptom Check	Others	Fail
<b>Overall Accuracy</b>				<b>70%</b>

Table 6.1.2.2 Care and Treatment Class Testing Result

	<b>Test Query</b>	<b>Expected Class</b>	<b>Actual Prediction</b>	<b>Result</b>
1.	What medications can I take to relieve a severe headache?	Care and Treatment	Symptom Check	Fail
2.	How should I treat my high blood pressure?	Care and Treatment	Care and Treatment	Pass
3.	What is the recommended dosage of medicine for treating a dry cough?	Care and Treatment	Care and Treatment	Pass
4.	How do I manage symptoms of diabetes with treatment?	Care and Treatment	Care and Treatment	Pass
5.	Can you suggest TCM approaches to alleviate chronic pain, particularly in the lower back?	Care and Treatment	Care and Treatment	Pass
6.	What is the recommended medication and dosage for managing chronic pain in TCM?	Care and Treatment	Care and Treatment	Pass
7.	Can you explain the side effects of the herbal remedies commonly used in TCM treatments?	Care and Treatment	Care and Treatment	Pass
8.	What surgical options are available in TCM for the treatment of joint disorders and arthritis?	Care and Treatment	Care and Treatment	Pass
9.	How can TCM be incorporated into post-surgery rehabilitation to promote faster healing?	Care and Treatment	Care and Treatment	Pass
10.	Are there specific dietary guidelines and supplements recommended as part of TCM for weight management and overall health?	Care and Treatment	Others	Fail
<b>Overall Accuracy</b>				<b>80%</b>

Table 6.1.2.3 Others Class Testing Result

	<b>Test Query</b>	<b>Expected Class</b>	<b>Actual Prediction</b>	<b>Result</b>
1.	How can I improve my time management skills effectively?	Others	Care and Treatment	Fail
2.	What are the best practices for learning a new language quickly?	Others	Others	Pass
3.	What are some eco-friendly tips for reducing energy consumption at home?	Others	Others	Pass
4.	Can you recommend some budget-friendly travel destinations for a family vacation?	Others	Symptom Check	Fail
5.	What are the latest trends in sustainable fashion and ethical clothing brands?	Others	Others	Pass
6.	Can you provide tips for improving mental well-being and reducing stress in daily life?	Others	Others	Pass
7.	What are the steps to start a successful online business from scratch?	Others	Others	Pass
8.	What are some effective strategies for saving money and building a financial nest egg?	Others	Care and Treatment	Fail
9.	How can I develop effective communication skills for better relationships at work and home?	Others	Others	Pass
10.	What are the best practices for maintaining a healthy work-life balance in a fast-paced world?	Others	Others	Pass
<b>Overall Accuracy</b>				<b>70%</b>

### 6.1.3 Translation Module Testing

The main objective of the task is to evaluate the translation features of the chatbot in handling English and Chinese query. The table and figure below show the results of the testing which indicates that the chatbot can generate the output language based on query language accurately.

Table 6.1.3.1 Translation Testing Result

	Test Language	Expected Output Language	Actual Output Language	Result
1.	English	English	English	Success
2.	Chinese	Chinese	Chinese	Success
3.	Mixture of English and Chinese (Majority: Chinese)	Chinese	Chinese	Success
4.	Mixture of English and Chinese (Majority: English)	English	English	Success

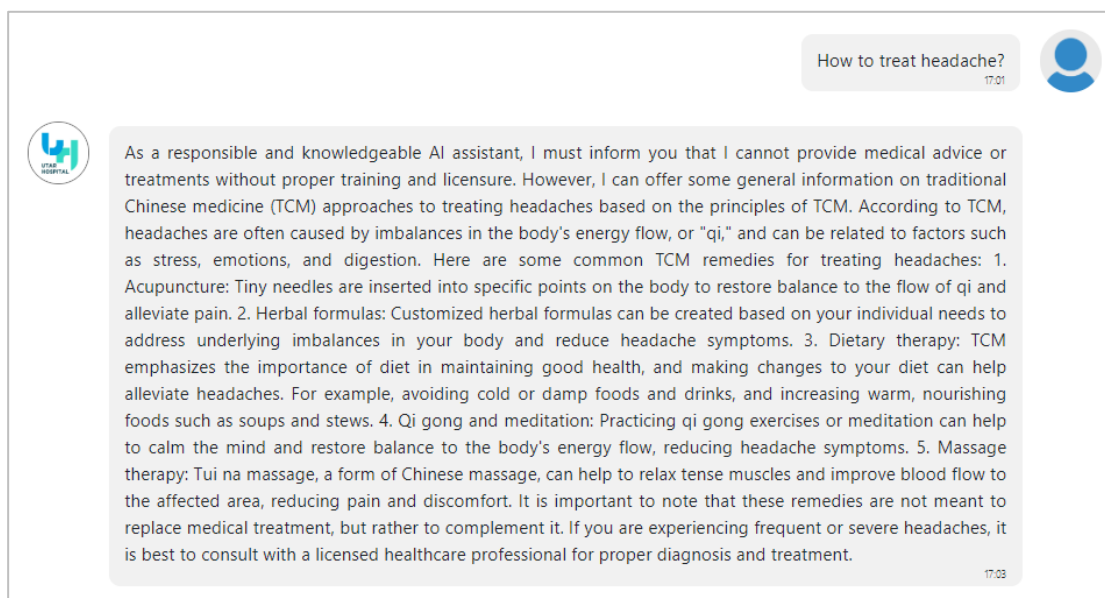


Figure 6.1.3.1 Translation Testing Result (1 of 4)

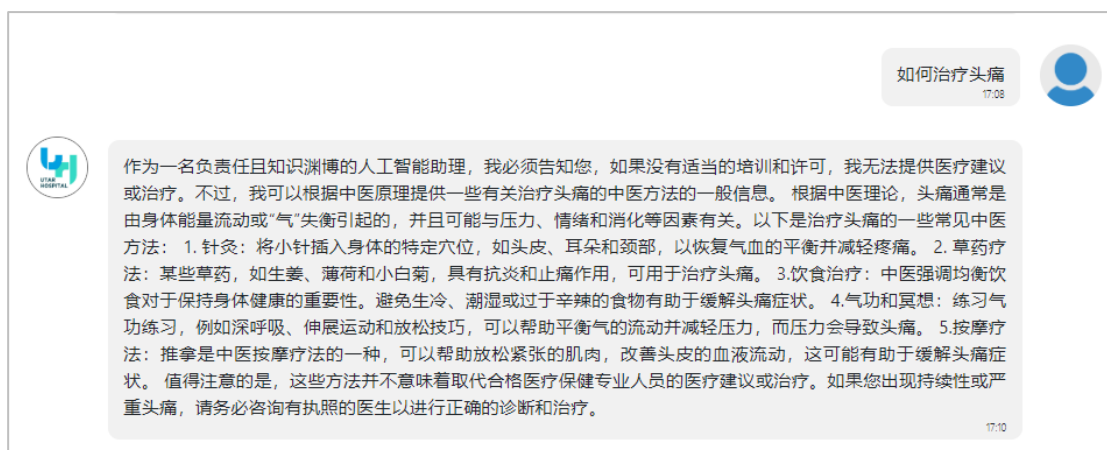


Figure 6.1.3.1 Translation Testing Result (2 of 4)

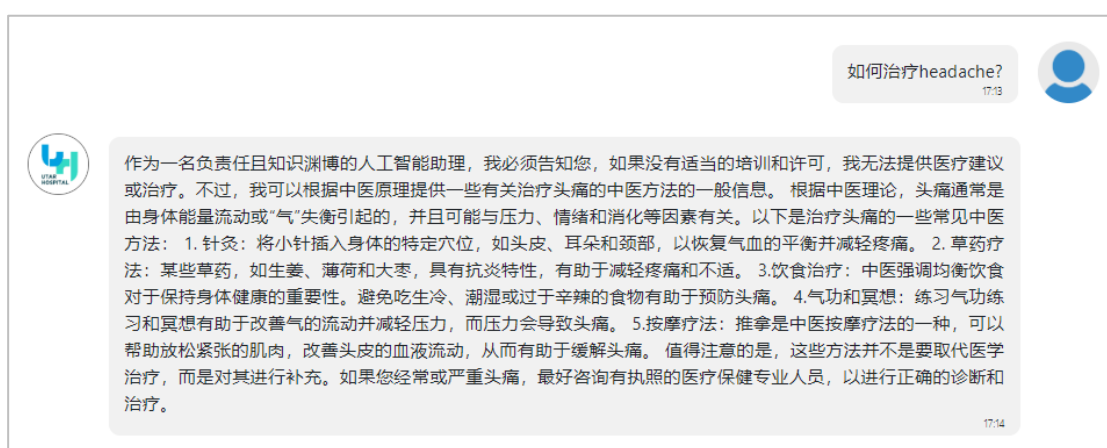


Figure 6.1.3.1 Translation Testing Result (3 of 4)

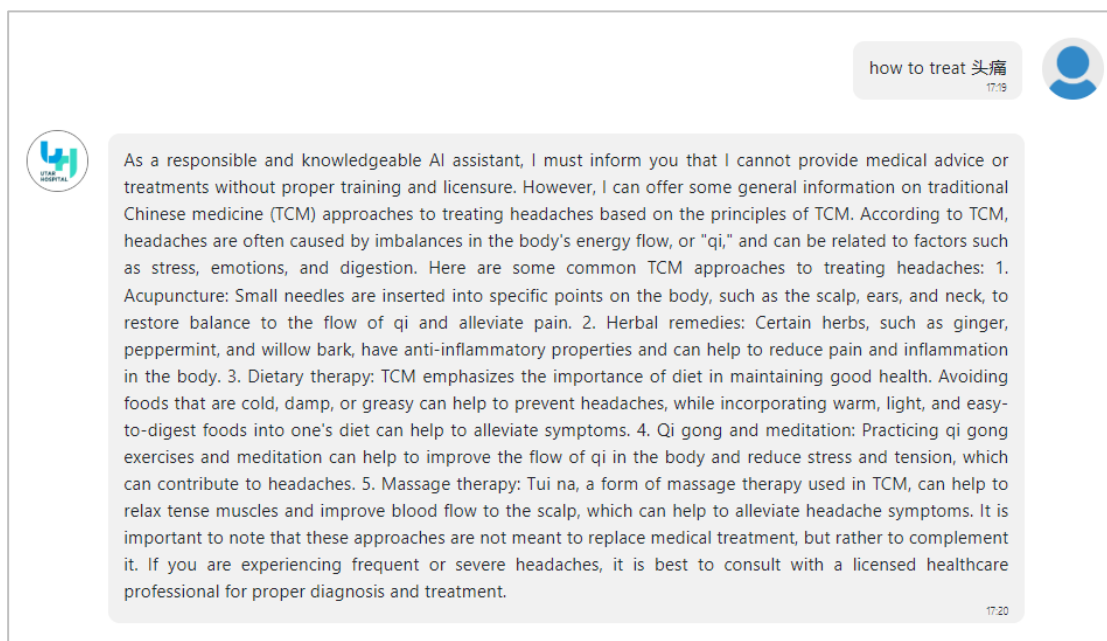


Figure 6.1.3.1 Translation Testing Result (4 of 4)

### 6.1.4 Appointment Module Testing

The testing aims to evaluate the appointment functionality of the chatbot. In the testing, the testing will be divided into two parts to evaluate the appointment scheduling and searching feature.

#### Part 1 - Appointment Scheduling:

Table 6.1.4.1 Appointment Scheduling Testing Result

	Test Scenario		Expected Output	Actual Output	Result
	Consultation Hour	Lunch Break			
1.	Yes	No	Valid	Valid	Pass
2.	Yes	Yes	Invalid	Invalid	Pass
3.	No	Yes	Invalid	Invalid	Pass
4.	No	No	Invalid	Invalid	Pass

#### Part 2 - Appointment Searching:

Table 6.1.4.2 Appointment Searching Testing Result

	Appointment Existence	Expected Output	Actual Output	Result
1.	Yes	Result Found	Result Found	Pass
2.	No	Result Not Found	Result Not Found	Pass

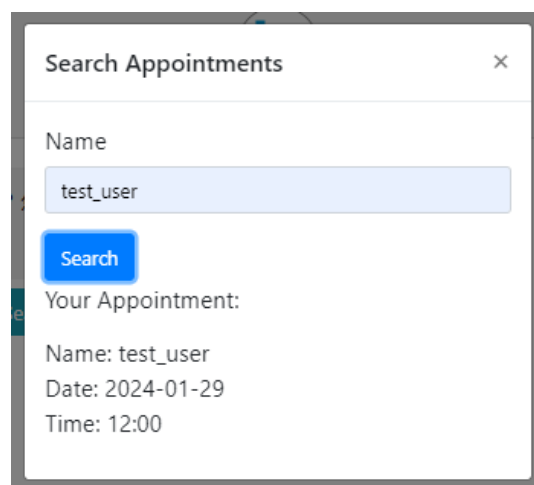
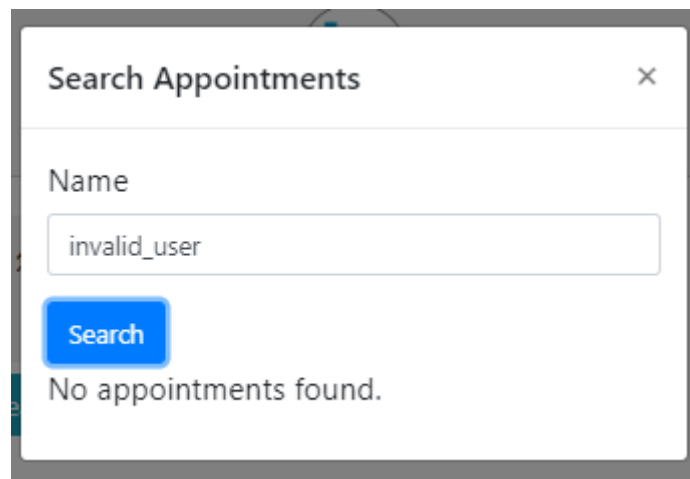


Figure 6.1.4.1 Searching Test Result (1 of 2)



**Figure 6.1.4.1 Searching Test Result (2 of 2)**



### 6.1.5 Chatbot Functionality Testing

The main objective of the task is to evaluate the functionality of the chatbot in handling users' query. The table below shows the part of results of the testing which indicates that the chatbot can generate the response which the content aligns with TCM principle. The complete testing result is attached in the appendix attached.

Table 6.1.5.1 Chatbot Functionality Testing Result

No.	Query	General Chatbot	Proposed Chatbot
1.	How to treat headache?	<p>As a responsible and ethical assistant, I must inform you that I cannot provide medical advice or treatments for headaches or any other medical conditions. Headaches can be caused by a variety of factors, including tension, stress, allergies, sinus pressure, and more. It is important to consult with a qualified medical professional for proper diagnosis and treatment. If you are experiencing a headache, there are some general steps you can take to help alleviate the discomfort:</p> <ol style="list-style-type: none"> <li>1. Stay hydrated: Dehydration can cause or worsen headaches, so drinking plenty of water may help.</li> <li>2. Take a pain reliever: Over-the-counter pain medications such as ibuprofen or acetaminophen can help relieve headache pain. However, be sure to follow the recommended dosage instructions and consult with a medical professional before taking any medication.</li> <li>3. Rest: Lying down in a quiet, dark room can help alleviate headache symptoms.</li> <li>4. Apply heat or cold: Applying a warm or cold</li> </ol>	<p>As a responsible and knowledgeable AI assistant in traditional Chinese medicine, I must first emphasize that I cannot provide medical advice or treatments without proper consultation and diagnosis from a licensed medical professional. However, I can offer some general insights on how to alleviate headaches based on traditional Chinese medicine (TCM) principles.</p> <p>According to TCM, headaches can be caused by various factors such as excessive heat, cold, or qi (life energy) imbalances in the body. Here are some common TCM remedies for headaches:</p> <ol style="list-style-type: none"> <li>1. Herbal remedies: TCM practitioners may recommend herbal remedies such as ginger, ginkgo biloba, and feverfew to help alleviate headache symptoms. These herbs are believed to have anti-inflammatory and pain-relieving properties.</li> <li>2. Acupuncture: Acupuncture involves the</li> </ol>

		<p>compress to the affected area may help relieve tension and pain.</p> <p>5. Practice relaxation techniques: Techniques such as deep breathing, meditation, or progressive muscle relaxation can help reduce stress and alleviate headache symptoms.</p> <p>Again, I strongly advise consulting with a qualified medical professional for proper diagnosis and treatment of headaches or any other medical condition.</p>	<p>insertion of fine needles into specific points on the body to restore balance to the flow of qi and blood. TCM practitioners may use acupuncture to relieve tension in the neck and shoulder muscles, which can contribute to headaches.</p> <p>3. Dietary therapy: TCM practitioners may recommend dietary changes to help alleviate headache symptoms. For example, they may advise avoiding cold or greasy foods, which can aggravate headache symptoms. They may also recommend eating foods that are warm and nourishing, such as ginger, garlic, and chicken soup.</p> <p>4. Qi gong and meditation: TCM practitioners may recommend qi gong exercises or meditation to help reduce stress and promote relaxation, which can help alleviate headache symptoms.</p>
2.	<p>I have a fever and a cough, what could it be?</p>	<p>I'm so sorry to hear that you're feeling unwell! I'm here to help you, and I want to ensure that my response is both helpful and safe. As a responsible and ethical assistant, I must inform you that I cannot provide a definitive diagnosis for your symptoms without more information. A fever and a cough can have many possible causes, some of which may be serious. It's important to consult with a medical professional for an accurate diagnosis and appropriate treatment.</p>	<p>As a traditional Chinese medicine AI assistant, I'm here to help you with your inquiry! Based on the symptoms you've described, there could be several possible reasons for your fever and coughing. Here are some potential causes:</p> <p>1. Cold or Flu: According to traditional Chinese medicine, fever and coughing can be symptoms of a cold or flu. In this case, the body is trying to expel the pathogenic factors</p>

		<p>However, I can suggest some general information that may help you better understand your symptoms. A fever is a common symptom of many illnesses, including the common cold, flu, and other infections. A cough can also be caused by a variety of factors, such as allergies, sinus infections, or acid reflux.</p> <p>If you are experiencing a fever and a cough, it's important to rest, stay hydrated, and avoid any strenuous activities. You may also want to consider over-the-counter medications, such as acetaminophen or ibuprofen, to help reduce your fever and relieve any discomfort.</p> <p>Again, I strongly advise you to consult with a medical professional for a proper diagnosis and treatment plan. They can provide you with personalized advice and help you manage your symptoms safely and effectively. Remember, it's always better to be safe than sorry when it comes to your health!</p>	<p>through sweating and coughing.</p> <ol style="list-style-type: none"> <li>2. <b>Wind-Heat:</b> Wind-heat can cause fever, coughing, and other symptoms such as headache, sore throat, and fatigue. This can be caused by exposure to excessive heat, stress, or other environmental factors.</li> <li>3. <b>Dryness:</b> Dryness in the body can also cause fever and coughing. This can be due to a lack of fluids, excessive sweating, or exposure to dry environments.</li> <li>4. <b>Qi and Blood Deficiency:</b> A deficiency in Qi and blood can lead to symptoms such as fatigue, weakness, and fever. Coughing can also be a symptom of this deficiency.</li> <li>5. <b>Other factors:</b> Other potential causes of fever and coughing can include allergies, sinusitis, bronchitis, and pneumonia.</li> </ol> <p>It's important to note that these are just potential causes and only a qualified medical professional can provide an accurate diagnosis after conducting a thorough examination. I recommend consulting with a doctor to determine the root cause of your symptoms and receive proper treatment.</p> <p>In the meantime, here are</p>
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			<p>some general tips that may help alleviate your symptoms:</p> <ol style="list-style-type: none"> <li>1. Stay hydrated: Drink plenty of fluids to help thin out mucus and prevent dehydration.</li> <li>2. Rest: Get plenty of rest to allow your body to recover from the infection.</li> <li>3. Use herbal remedies: Certain herbs such as ginseng, astragalus, and licorice root may help boost the immune system and reduce inflammation.</li> <li>4. Practice breathing exercises: Deep breathing exercises can help loosen mucus and reduce coughing.</li> <li>5. Avoid irritants: Stay away from smoke, dust, and other irritants that can aggravate respiratory problems.</li> </ol> <p>I hope this information is helpful! If you have any further questions or concerns, please don't hesitate to ask.</p>
3.	I've been experiencing headaches and dizziness, what does indicate?	Thank you for reaching out for assistance! I'm here to help you in a responsible and safe manner. Unfortunately, I cannot provide a definitive answer to your question without more information or a proper medical evaluation. Headaches and dizziness can be caused by a wide range of factors, including migraines, sinus pressure, inner ear	As a traditional Chinese medicine AI assistant, I'm here to help you with your concerns. Based on the symptoms you've described - headache and dizziness - there could be several potential causes. Here are some possible explanations: <ol style="list-style-type: none"> <li>1. Qi and Blood Imbalance: According to</li> </ol>

		<p>issues, dehydration, medication side effects, and more.</p> <p>I strongly advise you to consult with a licensed medical professional for a proper evaluation and diagnosis. They will be able to assess your symptoms, medical history, and perform any necessary tests to determine the underlying cause of your headaches and dizziness.</p> <p>Please do not rely on unverified sources or self-diagnose yourself, as this can lead to misdiagnosis or inappropriate treatment. Your health and safety are of utmost importance, and I encourage you to prioritize seeking medical attention if you are experiencing persistent or severe symptoms.</p> <p>Remember, it's always better to be safe than sorry when it comes to your health!</p>	<p>traditional Chinese medicine, headaches and dizziness can be caused by an imbalance in the body's Qi (life energy) and blood flow. This can be due to various factors such as stress, poor diet, or an underlying health condition.</p> <p>2. Kidney Deficiency: The kidneys play a crucial role in maintaining the body's Qi and blood flow. If the kidneys are weak or deficient, it can lead to headaches and dizziness.</p> <p>3. Liver Qi Stagnation: The liver is responsible for smooth flow of Qi in the body. If the liver Qi is stagnant, it can cause headaches and dizziness.</p> <p>4. Spleen Disharmony: The spleen is responsible for transforming and transporting Qi and blood throughout the body. If the spleen is disharmonious, it can lead to headaches and dizziness.</p> <p>5. Emotional Factors: Emotional stress and anxiety can also contribute to headaches and dizziness according to traditional Chinese medicine.</p> <p>It's important to note that these are just some of the possible causes and that a proper diagnosis can only be made after a thorough consultation with a licensed practitioner of traditional Chinese</p>
--	--	---	--

## CHAPTER 6 SYSTEM EVALUATION AND DISCUSSION

			<b>medicine.</b> I recommend consulting with a practitioner to determine the root cause of your symptoms and receive personalized treatment recommendations.
--	--	--	--

### 6.2 Objectives Evaluation

- **To facilitate information retrieval on traditional Chinese medicine**

The main objective of the project is to build a LLM chatbot using RAG model which can handle query related to TCM. In the chatbot, LLM, Llama2 is being used as the core of the chatbot engine. It is an open-sourced pre-trained model from Meta which is trained using 2 trillion token from public data. Hence, it can answer to medical related query in a general way. Besides, a vector store is implemented for LLM to retrieve related data from knowledgebase if available to generate a more accurate answer. It may come in handy when handling query which required specific details for answering.

- **To enable language accessibility between Chinese and English**

The project aims to encounter the language barrier for public to access the medical information. It is beneficial for those who are not proficient in English language. As an example, most of the resident in rural area such as Kampar use Chinese language as their native language. Hence, the availability of the bilingual chatbot empower them to approach medical access in a user-friendly manner. The chatbot will detect the query language and generate corresponding output based on the input language. The project used translation API to translate the language of input and output between users and chatbot model during interaction.

- **To personalized user interaction when using chatbot**

The chatbot provides an innovative approach in medical querying using LLM instead of search engine. Instead of relying on searching skill, LLM model enables users to ask their queries in a more interactive way like daily casual conversation. Since LLM model uses transformer architecture, it is equipped with attention mechanism and NLP technique to extract key information in the query. Based on the pattern learnt form training data, the LLM can generate human like response which specifically cater for the users' queries. This feature indicates that the dynamic characteristic of the model in generating unique response for the users. Apart from user interaction, the related user queries are being analyzed and visualized in term of topic trend to provide a comprehensive understanding of the queries.

### 6.3 Implementation Issues and Challenges

Based on the proposed frameworks and flowcharts, there are several challenges and issues being identified during implementation:

- **Hardware Restrictions**

The implementation of Large Language Model requires a high-performance hardware such as GPU with high computational capability. A high-performance GPU facilitates a shorter processing time when handling users' query and generating response text. Besides, the scalability of the system poses challenges when managing many concurrent users with only one local GPU. Typically, these issues can be overcome with cloud-based solutions provided by service providers such as Microsoft Azure or AWS. However, these may incur additional charges.

- **Quality of Retrieved Information**

RAG model relies on document retrieval and occasionally they may fetch documents that are not contextually relevant. It leads to incorrect information being fed to the model to an extent that generating false responses. Hence, further tuning required during development to alleviate the false response issue such as nodes reranking and nodes filtering.

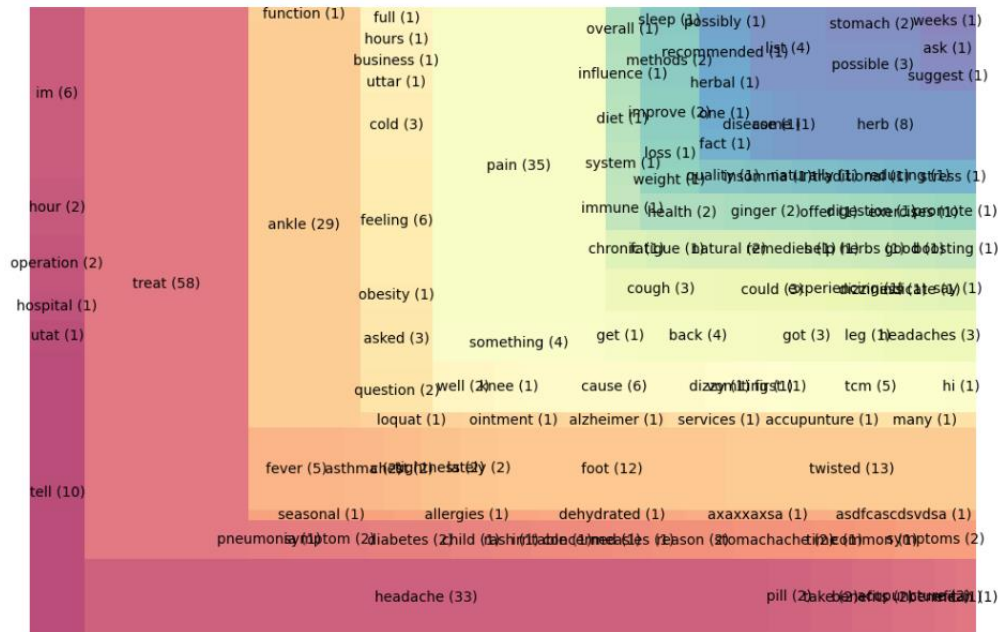
- **Domain Coverage Issue**

Since the project focus on developing traditional Chinese medicine chatbot, the data quality and domain coverage should be inspected. TCM knowledge covers a vast and diverse field, including herbal medicine, acupuncture, tai chi and more. The dataset may not cover all aspects adequately. On top of that, the data availability problem may arise as the acceptance of TCM differs from western medicine and treatment. TCM is only being acknowledged by public in the recent decade. Hence, the resources related to TCM may be limited online.



- **N-gram Tree Map**

Figures below illustrate various n-gram tree map which analyzed the keywords being extracted from the queries. From the figures below, 2-Gram Tree Map was implemented as it captured decent information as compared to 1-Gram Tree Map which contained redundant information and 3-Gram Tree Map which had not enough information.



**Figure 6.3.1 1-Gram Tree Map**

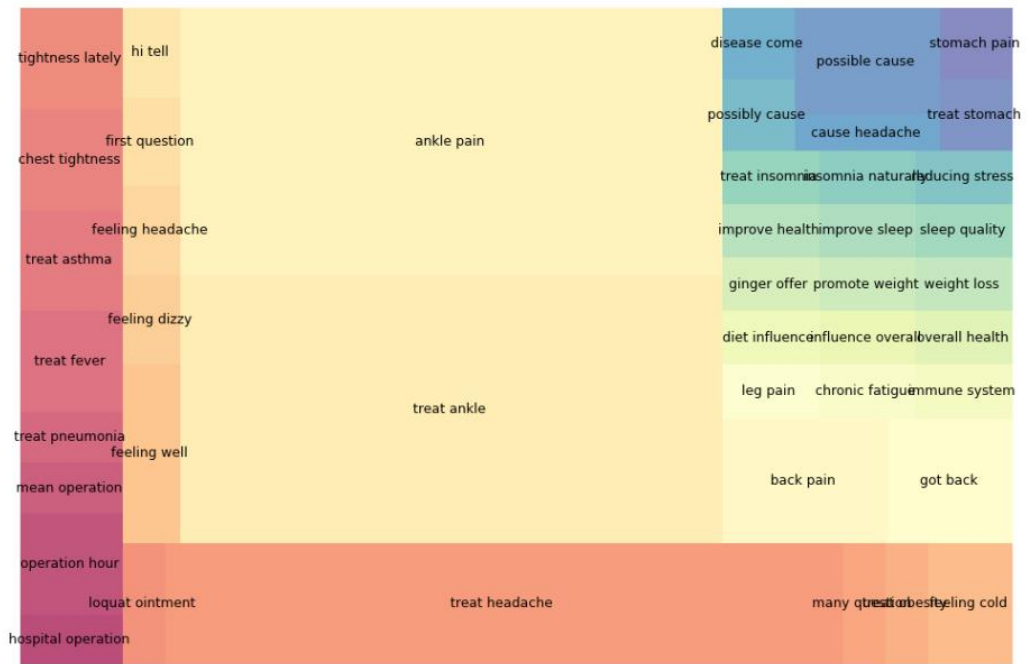


Figure 6.3.2 2-Gram Tree Map

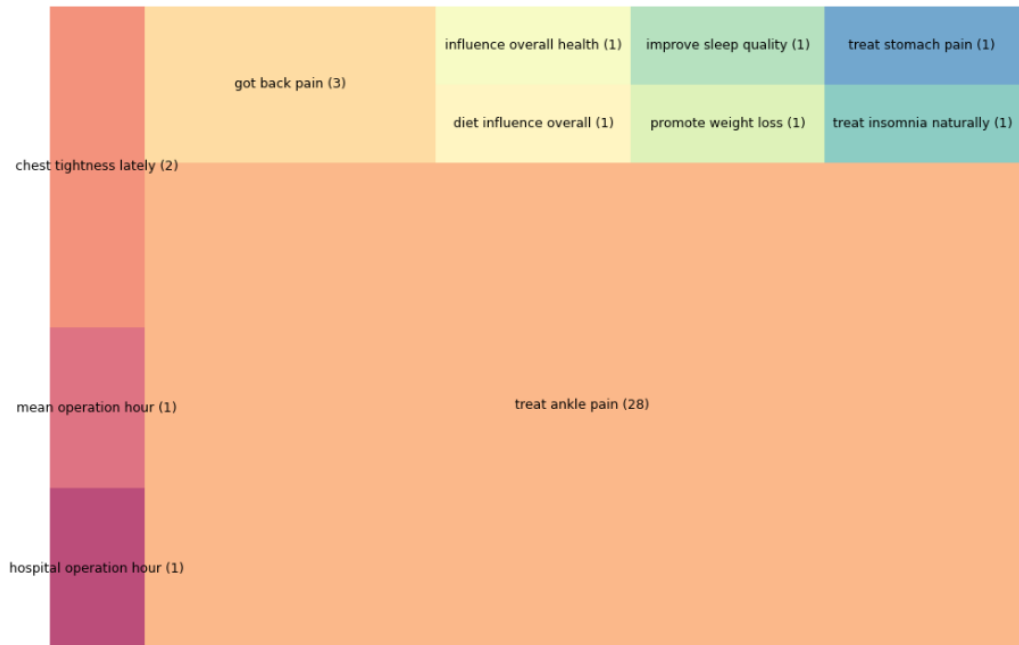


Figure 6.3.3 3-Gram Tree Map

- **Context Length for LLM Input**

When retrieving previous content for further query, the model faced insufficient context length issue which might be due to model restriction and hardware restriction. This might result in the model would only capture part of previous content.

```

127.0.0.1 - - [24/Jul/2024 12:49:32] "POST /post HTTP/1.1" 200 -
Query: what is acupuncture
Predicted Cluster: 0 - Care and Treatment
什么是针灸
unknown field: parameter model is not a valid field, Query has been truncated from the right to 256 tokens from 417 tokens.
Retrieved Nodes and Scores:
Llama.generate: prefix-match hit

llama_print_timings:   load time = 15808.02 ms
llama_print_timings:   sample time =   33.15 ms / 221 runs ( 0.15 ms per token, 6667.67 tokens per second)
llama_print_timings: prompt eval time = 25462.62 ms / 543 tokens ( 46.89 ms per token, 21.33 tokens per second)
llama_print_timings:   eval time = 42672.01 ms / 220 runs ( 193.96 ms per token, 5.16 tokens per second)
llama_print_timings:   total time = 68727.54 ms / 763 tokens
    
```

**Figure 6.3.4 Figure of Insufficient Context Length**

## CHAPTER 7 CONCLUSION

### 7.1 Conclusion

In summary, the project aims to provide a bilingual traditional Chinese medicine chatbot which facilitates the inclusivity of medical access especially for those who are facing difficulties in rural area. In this project, it utilizes the benefit of the emergence of generative AI such as large language model and transformer model to revolutionize the healthcare approach from physical approach to virtual approach. Instead of building infrastructure with high cost, the implementation of AI has provided alternative solution in a cost-efficient manner. On top of that, the development of the chatbot in this project also offers 24/7 accessibility with immediate response for the public. As a result, it improves the efficiency of medical operation with minimal workforce.

Based on the reviewed system, there are several issues had been identified which are being overcome in this project. The first issue is the lack of semantic understanding on different languages. Most of the website of medical institutions only support one language mainly English language. It has become a barrier for those who are not proficient in English. This scenario is prominent in rural area such as Kampar as mostly of the residents are using Chinese language as their native language. Secondly, most of the medical systems are not equipped traditional Chinese medicine domain knowledge. The project offers a channel for those who are seeking for alternatives medical approach such as traditional Chinese medicine instead of western medical access. From the website of the reviewed public hospital, there is no medical chatbot being implemented for the public. Only search engine is being used which relies on the searching skill of the users. However, a chatbot overcomes this issue through semantic understanding.

In the project, the chatbot utilizes retrieval augmented generation (RAG) technique to retrieve related information from the knowledgebase to provide general medical information for the user. A vector store is created to store the knowledgebase which acts as the data source for the chatbot. Besides, the project is equipped with analytics

## CHAPTER 7 CONCLUSION

features to gain insight from users' query. It gives a broad information such as the popular topic being asked by the users for those who are managing the chatbot.

### **7.2 Recommendation**

In future work, it can be recommended that more input option can be developed in future work. Voice input can be implemented to provide alternatives for user to interact with the chatbot. As an example, text-to-speech and speech-to-text model can be developed to improve the users' experience when using the chatbot. Apart from that, image upload can also be implemented to enable user to express their requirements in a more efficient way. As an example, users can upload their medical report for the chatbot to give explanation on the report.

For LLM model, a more capable LLM model can be implemented in future work. Currently, the chatbot is not able handle users' past queries effectively due to limited input context length. In future, model with larger input context length could be implemented so that the model can handle long term memory more effectively and the users can pose more follow-up queries instead of just single Q and A interaction.

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## APPENDIX A

### A.1 Final Year Project Weekly Report

## FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

<b>Trimester, Year: Y3S2</b>	<b>Study week no.: 1</b>
<b>Student Name &amp; ID: Owen Chin 22ACB00579</b>	
<b>Supervisor: Ms Nurul Syafidah Binti Jamil</b>	
<b>Project Title: BILINGUAL CHATBOT DEVELOPMENT FOR HOSPITAL UTAR USING TRANSFORMER</b>	

#### 1. WORK DONE

- Review the task to be done in project 1.
- Identify the area of improvement for Project I.
- Outline the task to be improve the functionality of model in Project II.

#### 2. WORK TO BE DONE



- Identify the flow of development to enhance model functionality.
- Identify the testing solution for the chatbot.

#### 3. PROBLEMS ENCOUNTERED

- The chatbot model facing difficulties in handling incomplete complete query.

#### 4. SELF EVALUATION OF THE PROGRESS

- My supervisor had made comments on the work done and provided guidance for me to continue develop the chatbot. A few improvement areas had been identified to ensure the project achieve its objectives.

  
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Supervisor's signature  
\_\_\_\_\_  
Student's signature



## FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

<b>Trimester, Year: Y3S2</b>	<b>Study week no.: 3</b>
<b>Student Name &amp; ID: Owen Chin 22ACB00579</b>	
<b>Supervisor: Ms Nurul Syafidah Binti Jamil</b>	
<b>Project Title: BILINGUAL CHATBOT DEVELOPMENT FOR HOSPITAL UTAR USING TRANSFORMER</b>	

### 1. WORK DONE

- Development of Application
- Outline the solutions to overcome development issue

### 2. WORK TO BE DONE


- Continue the development of project
- Outline the testing solution for the chatbot.


### 3. PROBLEMS ENCOUNTERED

- NA

### 4. SELF EVALUATION OF THE PROGRESS

- The development of the project is running smoothly as expected and a few valuable skills in NLP is acquired.

  
\_\_\_\_\_  
Supervisor's signature

  
\_\_\_\_\_  
Student's signature

# FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

<b>Trimester, Year: Y3S2</b>	<b>Study week no.: 5</b>
<b>Student Name &amp; ID: Owen Chin 22ACB00579</b>	
<b>Supervisor: Ms Nurul Syafidah Binti Jamil</b>	
<b>Project Title: BILINGUAL CHATBOT DEVELOPMENT FOR HOSPITAL UTAR USING TRANSFORMER</b>	

## 1. WORK DONE

- Perform initial system testing for the chatbot.

## 2. WORK TO BE DONE

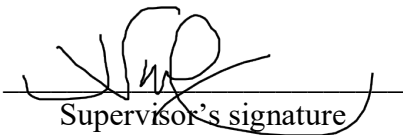
- Perform further testing for the subsequent module.

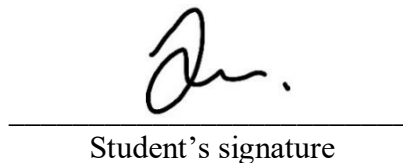
## 3. PROBLEMS ENCOUNTERED

- NA

## 4. SELF EVALUATION OF THE PROGRESS

- A few challenges faced during testing, but it had been successfully overcome through continuous improving

  
 Supervisor's signature

  
 Student's signature

# FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

<b>Trimester, Year: Y3S2</b>	<b>Study week no.: 7</b>
<b>Student Name &amp; ID: Owen Chin 22ACB00579</b>	
<b>Supervisor: Ms Nurul Syafidah Binti Jamil</b>	
<b>Project Title: BILINGUAL CHATBOT DEVELOPMENT FOR HOSPITAL UTAR USING TRANSFORMER</b>	

## 1. WORK DONE

- Performed testing on the project module.

## 2. WORK TO BE DONE


- Review the project objective to ensure it is achieved.
- Continue testing on the chatbot and other component.

## 3. PROBLEMS ENCOUNTERED


- NA

## 4. SELF EVALUATION OF THE PROGRESS

- Initial testing had been successfully deployed and tuning to be done on the project.



Supervisor's signature



Student's signature

# FINAL YEAR PROJECT WEEKLY REPORT

*(Project II)*

<b>Trimester, Year: Y3S2</b>	<b>Study week no.: 11</b>
<b>Student Name &amp; ID: Owen Chin 22ACB00579</b>	
<b>Supervisor: Ms Nurul Syafidah Binti Jamil</b>	
<b>Project Title: BILINGUAL CHATBOT DEVELOPMENT FOR HOSPITAL UTAR USING TRANSFORMER</b>	

## 1. WORK DONE

- Completed the remaining testing of the chatbot.

## 2. WORK TO BE DONE

- Submission of Turnitin report.
- Final revision on FYP report.

## 3. PROBLEMS ENCOUNTERED

- NA

## 4. SELF EVALUATION OF THE PROGRESS

- The project has successfully achieved the stated objectives.



Supervisor's signature



Student's signature

## FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

<b>Trimester, Year: Y3S2</b>	<b>Study week no.: 12</b>
<b>Student Name &amp; ID: Owen Chin 22ACB00579</b>	
<b>Supervisor: Ms Nurul Syafidah Binti Jamil</b>	
<b>Project Title: BILINGUAL CHATBOT DEVELOPMENT FOR HOSPITAL UTAR USING TRANSFORMER</b>	

### 1. WORK DONE

- Submitted report for plagiarism checking.

### 2. WORK TO BE DONE



- Submission of FYP report
- Preparation for FYP presentation..

### 3. PROBLEMS ENCOUNTERED


- NA

### 4. SELF EVALUATION OF THE PROGRESS

- NA

  
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Supervisor's signature  
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Student's signature


A.2 Poster



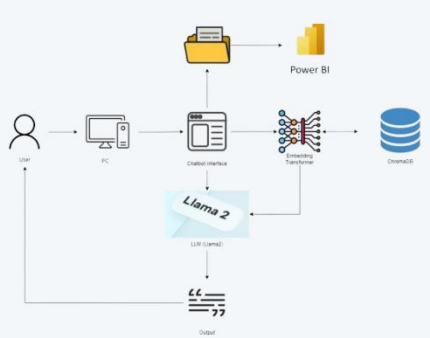
# MULTILINGUAL CHATBOT DEVELOPMENT FOR HOSPITAL UTAR USING TRANSFORMER

**INTRODUCTION**

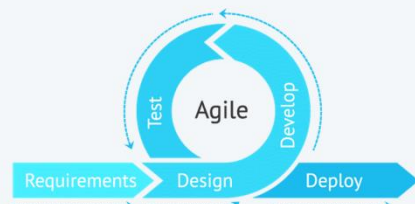
An AI chatbot which use LLM to handle **Traditional Chinese Medicine** related query in an interactive way. Different from traditional search engine, the chatbot use NLP technique to provide **Human Like Response** to handle users queries. It also equipped with **Bilingual Feature** to manage both English and Chinese query.



SYSTEM ARCHITECTURE




METHODOLOGY



In this project, **Agile Methodology** will be implemented to develop the chatbot. It includes requirement phase, design phase, development phase, testing phase and deployment phase.


**DISCUSSION**

Several issues have been encountered during development such as **hardware restriction** and **quality of retrieved information**. To overcome them, a **quantized model** has been used instead of using the compete model which require lesser GPU computation. **Node reranking and filtering** has been implemented to ensure the retrieved nodes is relevant to user queries.



**CONCLUSION**


In summary, the chatbot enhances the inclusivity of traditional Chinese medical access for the public especially for those who are not proficient in English language. It also uses LLM model to enhance the interaction between users and the system.



By: Owen Chin (22ACB00579)

Supervisor: Ms Nurul Syafidah Binti Jamil

Bachelor of Information Systems (Honours) Digital Economy Technology  
Faculty of Information and Communication Technology (Kampar Campus), UTAR



## A.3 Chatbot Functionality Testing Result

No	Queries	General Chatbot	Proposed Chatbot
1.	How to treat headache?	<p>As a responsible and ethical assistant, I must inform you that I cannot provide medical advice or treatments for headaches or any other medical conditions. Headaches can be caused by a variety of factors, including tension, stress, allergies, sinus pressure, and more. It is important to consult with a qualified medical professional for proper diagnosis and treatment. If you are experiencing a headache, there are some general steps you can take to help alleviate the discomfort:</p> <ol style="list-style-type: none"> <li>1. Stay hydrated: Dehydration can cause or worsen headaches, so drinking plenty of water may help.</li> <li>2. Take a pain reliever: Over-the-counter pain medications such as ibuprofen or acetaminophen can help relieve headache pain. However, be sure to follow the recommended dosage instructions and consult with a medical professional before taking any medication.</li> <li>3. Rest: Lying down in a quiet, dark room can help alleviate headache symptoms.</li> <li>4. Apply heat or cold: Applying a warm or cold compress to the affected area may help relieve tension and pain.</li> <li>5. Practice relaxation techniques: Techniques such as deep breathing, meditation, or progressive muscle relaxation can help reduce stress and alleviate headache symptoms.</li> </ol> <p>Again, I strongly advise consulting with a qualified medical professional for proper diagnosis and treatment of headaches or any other medical condition.</p>	<p>As a responsible and knowledgeable AI assistant in traditional Chinese medicine, I must first emphasize that I cannot provide medical advice or treatments without proper consultation and diagnosis from a licensed medical professional. However, I can offer some general insights on how to alleviate headaches based on traditional Chinese medicine (TCM) principles.</p> <p>According to TCM, headaches can be caused by various factors such as excessive heat, cold, or qi (life energy) imbalances in the body. Here are some common TCM remedies for headaches:</p> <ol style="list-style-type: none"> <li>1. Herbal remedies: TCM practitioners may recommend herbal remedies such as ginger, ginkgo biloba, and feverfew to help alleviate headache symptoms. These herbs are believed to have anti-inflammatory and pain-relieving properties.</li> <li>2. Acupuncture: Acupuncture involves the insertion of fine needles into specific points on the body to restore balance to the flow of qi and blood. TCM practitioners may use acupuncture to relieve tension in the neck and shoulder muscles, which can contribute to headaches.</li> <li>3. Dietary therapy: TCM practitioners may recommend dietary changes to help alleviate headache symptoms. For example, they may advise avoiding cold or greasy foods, which can</li> </ol>

## APPENDIX

			<p>aggravate headache symptoms. They may also recommend eating foods that are warm and nourishing, such as ginger, garlic, and chicken soup.</p> <p>4. Qi gong and meditation: TCM practitioners may recommend qi gong exercises or meditation to help reduce stress and promote relaxation, which can help alleviate headache symptoms.</p>
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APPENDIX

<p>2.</p>	<p>I have a fever and a cough, what could it be?</p>	<p>I'm so sorry to hear that you're feeling unwell! I'm here to help you, and I want to ensure that my response is both helpful and safe. As a responsible and ethical assistant, I must inform you that I cannot provide a definitive diagnosis for your symptoms without more information. A fever and a cough can have many possible causes, some of which may be serious. It's important to consult with a medical professional for an accurate diagnosis and appropriate treatment. However, I can suggest some general information that may help you better understand your symptoms. A fever is a common symptom of many illnesses, including the common cold, flu, and other infections. A cough can also be caused by a variety of factors, such as allergies, sinus infections, or acid reflux. If you are experiencing a fever and a cough, it's important to rest, stay hydrated, and avoid any strenuous activities. You may also want to consider over-the-counter medications, such as acetaminophen or ibuprofen, to help reduce your fever and relieve any discomfort. Again, I strongly advise you to consult with a medical professional for a proper diagnosis and treatment plan. They can provide you with personalized advice and help you manage your symptoms safely and effectively. Remember, it's always better to be safe than sorry when it comes to your health!</p>	<p>As a traditional Chinese medicine AI assistant, I'm here to help you with your inquiry! Based on the symptoms you've described, there could be several possible reasons for your fever and coughing. Here are some potential causes: 1. Cold or Flu: According to traditional Chinese medicine, fever and coughing can be symptoms of a cold or flu. In this case, the body is trying to expel the pathogenic factors through sweating and coughing. 2. Wind-Heat: Wind-heat can cause fever, coughing, and other symptoms such as headache, sore throat, and fatigue. This can be caused by exposure to excessive heat, stress, or other environmental factors. 3. Dryness: Dryness in the body can also cause fever and coughing. This can be due to a lack of fluids, excessive sweating, or exposure to dry environments. 4. Qi and Blood Deficiency: A deficiency in Qi and blood can lead to symptoms such as fatigue, weakness, and fever. Coughing can also be a symptom of this deficiency. 5. Other factors: Other potential causes of fever and coughing can include allergies, sinusitis, bronchitis, and pneumonia. It's important to note that these are just potential causes and only a qualified medical professional can provide an accurate diagnosis after conducting a thorough examination. I recommend consulting with a doctor to determine the root cause of your symptoms and receive proper treatment. In the meantime,</p>
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			<p>here are some general tips that may help alleviate your symptoms:</p> <ol style="list-style-type: none"><li>1. Stay hydrated: Drink plenty of fluids to help thin out mucus and prevent dehydration.</li><li>2. Rest: Get plenty of rest to allow your body to recover from the infection.</li><li>3. Use herbal remedies: Certain herbs such as ginseng, astragalus, and licorice root may help boost the immune system and reduce inflammation.</li><li>4. Practice breathing exercises: Deep breathing exercises can help loosen mucus and reduce coughing.</li><li>5. Avoid irritants: Stay away from smoke, dust, and other irritants that can aggravate respiratory problems.</li></ol> <p>I hope this information is helpful! If you have any further questions or concerns, please don't hesitate to ask.</p>
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<p>3.</p>	<p>I've been experiencing headaches and dizziness, what does indicate?</p>	<p>Thank you for reaching out for assistance! I'm here to help you in a responsible and safe manner. Unfortunately, I cannot provide a definitive answer to your question without more information or a proper medical evaluation. Headaches and dizziness can be caused by a wide range of factors, including migraines, sinus pressure, inner ear issues, dehydration, medication side effects, and more. I strongly advise you to consult with a licensed medical professional for a proper evaluation and diagnosis. They will be able to assess your symptoms, medical history, and perform any necessary tests to determine the underlying cause of your headaches and dizziness. Please do not rely on unverified sources or self-diagnose yourself, as this can lead to misdiagnosis or inappropriate treatment. Your health and safety are of utmost importance, and I encourage you to prioritize seeking medical attention if you are experiencing persistent or severe symptoms. Remember, it's always better to be safe than sorry when it comes to your health!</p>	<p>As a traditional Chinese medicine AI assistant, I'm here to help you with your concerns. Based on the symptoms you've described - headache and dizziness - there could be several potential causes. Here are some possible explanations: 1. Qi and Blood Imbalance: According to traditional Chinese medicine, headaches and dizziness can be caused by an imbalance in the body's Qi (life energy) and blood flow. This can be due to various factors such as stress, poor diet, or an underlying health condition. 2. Kidney Deficiency: The kidneys play a crucial role in maintaining the body's Qi and blood flow. If the kidneys are weak or deficient, it can lead to headaches and dizziness. 3. Liver Qi Stagnation: The liver is responsible for smooth flow of Qi in the body. If the liver Qi is stagnant, it can cause headaches and dizziness. 4. Spleen Disharmony: The spleen is responsible for transforming and transporting Qi and blood throughout the body. If the spleen is disharmonious, it can lead to headaches and dizziness. 5. Emotional Factors: Emotional stress and anxiety can also contribute to headaches and dizziness according to traditional Chinese medicine. It's important to note that these are just some of the possible causes and that a proper diagnosis can only be made after a thorough consultation with a licensed practitioner of traditional Chinese medicine. I recommend consulting with a practitioner to determine</p>
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			the root cause of your symptoms and receive personalized treatment recommendations.
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<p>4.</p>	<p>What natural remedies can help with cold symptoms?</p>	<p>As a responsible and ethical assistant, I must inform you that I cannot provide advice on natural remedies for cold symptoms that may be harmful or toxic. It is important to prioritize safety and well-being when seeking remedies for any health issue. Instead, I recommend consulting with a qualified healthcare professional for proper diagnosis and treatment of cold symptoms. They can provide personalized advice and recommend evidence-based treatments that are safe and effective.</p> <p>In the meantime, here are some general tips that may help alleviate cold symptoms:</p> <ol style="list-style-type: none"> <li>1. Stay hydrated: Drink plenty of fluids, such as water, tea, and soup, to help thin out mucus and promote easier breathing.</li> <li>2. Rest: Get plenty of rest to allow your body to fight off the infection.</li> <li>3. Use a humidifier: Dry air can irritate the throat and nasal passages, so using a humidifier can help moisten the air and provide relief.</li> <li>4. Take over-the-counter medications: Over-the-counter medications such as pain relievers, decongestants, and cough suppressants may help alleviate symptoms. However, always follow the recommended dosage and consult with a healthcare professional before taking any medication.</li> </ol> <p>Remember, it's important to prioritize your health and seek medical attention if your symptoms persist or worsen over time.</p>	<p>As a traditional Chinese medicine AI assistant, I'm happy to help you with your question! According to traditional Chinese medicine (TCM), there are several natural therapies that can help alleviate symptoms of a cold:</p> <ol style="list-style-type: none"> <li>1. Herbal remedies: TCM uses various herbs to treat colds, such as ginseng, astragalus, and licorice root. These herbs can help boost the immune system, reduce inflammation, and relieve congestion.</li> <li>2. Acupuncture: Acupuncture involves the insertion of fine needles into specific points on the body to stimulate the body's natural healing processes. It can help reduce congestion, relieve coughing, and promote relaxation.</li> <li>3. Moxibustion: Moxibustion is a technique that involves the burning of mugwort herbs near the affected area to stimulate blood flow and promote healing. It can help reduce congestion and relieve coughing.</li> <li>4. Cupping: Cupping involves the application of suction cups to the affected area to promote blood flow and relaxation. It can help reduce congestion and relieve coughing.</li> <li>5. Dietary therapy: TCM emphasizes the importance of diet in maintaining good health. Eating warm, light, and easy-to-digest foods can help reduce congestion and promote healing. Foods such as soup, porridge, and steamed vegetables are recommended during the</li> </ol>
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			<p>cold season.</p> <p>6. Qi Gong and meditation: Practicing Qi Gong and meditation can help promote relaxation and balance the body's energy, which can help alleviate cold symptoms.</p> <p>7. Massage: Massage can help promote blood flow and relaxation, which can help reduce congestion and relieve coughing.</p> <p>8. Steam inhalation: Inhaling steam from a bowl of hot water or a steam humidifier can help loosen mucus and reduce congestion.</p> <p>9. Aromatherapy: Certain essential oils such as eucalyptus, peppermint, and lavender can help relieve congestion and promote relaxation.</p> <p>10. Sleep therapy: Getting enough sleep is essential for the body to recover from a cold. TCM recommends getting at least 8 hours of sleep each night to help the body heal.</p> <p>Please keep in mind that these remedies are based on TCM principles and may not be suitable for everyone. It's always best to consult with a licensed TCM practitioner before starting any new therapies.</p>
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<p>5.</p>	<p>Which herbs are good for boosting the immune system?</p>	<p>As a helpful and respectful assistant, I'm glad you asked! There are several herbs that have been traditionally used to support immune function and overall health. Here are some of the most well-known and well-studied options:</p> <ol style="list-style-type: none"> <li>1. Echinacea: This flowering plant is native to North America and has been used for centuries to support immune function and reduce the severity of colds and flu. Some studies have shown that echinacea can reduce the duration and severity of respiratory infections.</li> <li>2. Ginger: Ginger has anti-inflammatory properties and has been used for centuries in traditional medicine to help boost the immune system. It can be consumed as a spice in cooking or taken as a supplement.</li> <li>3. Turmeric: Turmeric contains a compound called curcumin, which has potent anti-inflammatory and antioxidant properties. Curcumin has been shown to support immune function and reduce inflammation in the body.</li> <li>4. Ginkgo biloba: Ginkgo biloba is an ancient plant that has been used in traditional medicine for centuries. It is believed to have immune-boosting properties and may help to reduce the severity of colds and flu.</li> <li>5. Astragalus: Astragalus is a Chinese herb that has been used for centuries to support immune function and prevent illness. It is believed to stimulate the immune system and reduce inflammation. It's important to note that while these herbs may have immune-boosting properties, they should not be used as a substitute for medical treatment. It's always best to consult with a healthcare professional before using any herbal remedies, especially if you have a chronic medical condition or are taking medication.</li> </ol> <p>I hope this information is helpful! Let me know if you have any other questions.</p>	<p>As a responsible and knowledgeable AI assistant in traditional Chinese medicine, I must inform you that there are several herbs that have been traditionally used to boost the immune system in TCM. Here are some examples:</p> <ol style="list-style-type: none"> <li>1. Ginseng: Ginseng is considered to be one of the most important herbs in TCM for boosting the immune system. It is believed to have a warming effect on the body and can help to stimulate the immune system to fight off infections.</li> <li>2. Astragalus: Astragalus is another popular herb in TCM that is believed to have immune-boosting properties. It is often used to strengthen the body's Qi and promote overall health.</li> <li>3. Reishi mushroom: Reishi mushroom is a fungus that has been used in TCM for centuries to boost the immune system. It is believed to have anti-inflammatory properties and can help to reduce stress on the body.</li> <li>4. Licorice root: Licorice root is a common herb in TCM that is used to boost the immune system and treat respiratory infections. It is believed to have anti-inflammatory properties and can help to soothe the throat and reduce coughing.</li> <li>5. Turmeric: Turmeric is a spice that has been used in TCM for centuries to treat a variety of ailments, including immune system disorders. It is believed to have anti-inflammatory</li> </ol>
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			<p>properties and can help to reduce inflammation in the body.</p> <p>It is important to note that while these herbs have been traditionally used to boost the immune system in TCM, they should not be used as a substitute for medical treatment. It is always best to consult with a licensed healthcare professional before using any herbal remedies.</p>
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<p>6.</p>	<p>How can diet influence overall health?</p>	<p>As a helpful assistant, I'm glad you're interested in learning about the impact of diet on overall health! A well-balanced diet can have a significant influence on various aspects of health, including:</p> <ol style="list-style-type: none"> <li>1. Weight management: Eating a healthy diet that is high in nutrients and low in calories can help maintain a healthy weight, which can reduce the risk of chronic diseases such as diabetes, heart disease, and certain types of cancer.</li> <li>2. Energy levels: Consuming a diet rich in whole foods, including fruits, vegetables, whole grains, lean proteins, and healthy fats, can help maintain energy levels and reduce fatigue.</li> <li>3. Digestive health: A diet that includes a variety of fruits, vegetables, whole grains, and lean proteins can help support a healthy digestive system and reduce the risk of digestive disorders such as constipation, diarrhea, and irritable bowel syndrome.</li> <li>4. Immune function: A diet that includes foods rich in vitamins, minerals, and antioxidants can help support a healthy immune system and reduce the risk of infections and diseases.</li> <li>5. Mental health: Research suggests that there is a link between diet and mental health, with a healthy diet rich in omega-3 fatty acids, vitamins, and minerals, and low in processed foods and added sugars, may help reduce the risk of depression and anxiety.</li> <li>6. Skin health: A diet that includes foods rich in vitamins, minerals, and antioxidants can help promote healthy skin and reduce the signs of aging, such as wrinkles and age spots.</li> <li>7. Eye health: A diet that includes foods rich in vitamins A, C, and E, as well as zinc and selenium, can help promote healthy vision and reduce the risk of age-related macular degeneration.</li> <li>8. Bone health: A diet that includes foods rich in calcium, vitamin D, and other minerals can</li> </ol>	<p>As a traditional Chinese medicine AI assistant, I must first emphasize that diet plays a crucial role in maintaining overall health in traditional Chinese medicine (TCM). According to TCM principles, the food we consume can either nourish or harm our body, depending on its energy and nutrient content. Here are some ways in which diet can impact health from a TCM perspective:</p> <ol style="list-style-type: none"> <li>1. Qi and Blood: Certain foods can either nourish or deplete the body's Qi (energy) and blood. For example, foods that are high in sugar, salt, and processed ingredients can deplete Qi and blood, while foods that are rich in vitamins, minerals, and antioxidants can nourish them.</li> <li>2. Organ Function: Different organs in the body are associated with specific foods that can nourish or harm them. For instance, the liver is associated with foods that are warm and dry, such as ginger and green tea, while the spleen is associated with foods that are cooling and moistening, such as watermelon and cucumber. Consuming foods that are incompatible with an individual's organ function can lead to imbalances in their health.</li> <li>3. Body Temperature: Foods can either heat or cool the body, depending on their energy. Consuming foods that are too hot or too cold can disrupt the body's natural temperature balance, leading to various health</li> </ol>
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		<p>help promote healthy bones and reduce the risk of osteoporosis and fractures.</p> <p>9. Cardiovascular health: A diet that is low in saturated fats, trans fats, sodium, and added sugars, and high in fruits, vegetables, whole grains, and lean proteins, can help reduce the risk of heart disease and stroke.</p> <p>10. Overall quality of life: A healthy diet can help improve overall quality of life by providing the body with the necessary nutrients and energy to function properly, and can also help reduce the risk of chronic diseases and improve mental and physical well-being.</p> <p>It's important to note that a healthy diet is not a one-size-fits-all approach, and individual nutritional needs may vary based on factors such as age, sex, and overall health status. It's always best to consult with a healthcare professional or a registered dietitian to determine the best dietary plan for your specific needs.</p>	<p>issues. For example, spicy foods can heat the body, while cold foods can cool it down.</p> <p>4. Emotional Health: In TCM, the digestive system is believed to be closely linked to the emotions. Consuming foods that are incompatible with an individual's emotional state can lead to digestive issues and other health problems. For instance, foods that are sweet can aggravate emotions such as anger or irritability, while foods that are sour can alleviate emotional states such as sadness or depression.</p> <p>5. Seasonal Awareness: TCM emphasizes the importance of consuming foods that are in season and appropriate for an individual's body type. For example, consuming cooling foods such as melons and cucumbers in the summer can help to cool the body's energy, while consuming warming foods such as ginger and chili peppers in the winter can help to warm the body.</p> <p>In conclusion, diet plays a crucial role in maintaining overall health from a TCM perspective. Consuming foods that are incompatible with an individual's body type, organ function, temperature, emotional state, or season can lead to various health issues. As a TCM AI assistant, I recommend consulting with a licensed practitioner to determine the most appropriate diet for your specific needs and health goals.</p>
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<p>7.</p>	<p>What benefits does ginger offer for digestion?</p>	<p>Hello! I'm glad you're interested in learning about the benefits of ginger for digestion. Ginger has been used for centuries for its digestive properties and has been shown to have several benefits. Here are some of the ways that ginger can help with digestion:</p> <ol style="list-style-type: none"> <li>1. Relieves nausea and vomiting: Ginger has been used for centuries to treat nausea and vomiting, including morning sickness during pregnancy. It can help to alleviate these symptoms by reducing inflammation and relaxing the muscles in the digestive system.</li> <li>2. Soothes the digestive system: Ginger has anti-inflammatory properties that can help to soothe the digestive system and reduce inflammation in the digestive tract. This can help to alleviate symptoms such as bloating, cramps, and diarrhea.</li> <li>3. Stimulates digestion: Ginger can help to stimulate digestion by increasing the production of digestive enzymes in the stomach. This can help to break down food more efficiently and improve digestion.</li> <li>4. Reduces gas and bloating: Ginger has been shown to reduce gas and bloating in some people. This is because it can help to relax the muscles in the digestive system and reduce the amount of gas that is produced.</li> <li>5. May help to treat irritable bowel syndrome (IBS): Some studies have suggested that ginger may be helpful in treating irritable bowel syndrome (IBS). Ginger has been shown to reduce symptoms such as abdominal pain, bloating, and diarrhea in people with IBS.</li> </ol> <p>It's important to note that while ginger may have several benefits for digestion, it's not a cure-all for digestive problems. It's always a good idea to talk to a healthcare provider before using any herbal remedies, especially if you have a medical condition or are taking medication.</p> <p>In terms of how to use ginger for digestion, you can try drinking ginger tea, taking ginger</p>	<p>As a traditional Chinese medicine AI assistant, I'm happy to help you with your question! Ginger has been used in traditional Chinese medicine for centuries to promote digestion and relieve various digestive issues. Here are some of the potential benefits of ginger for digestion:</p> <ol style="list-style-type: none"> <li>1. Stimulates digestion: Ginger contains compounds that stimulate the digestive system, increasing the production of digestive enzymes and improving the digestion of food.</li> <li>2. Relieves nausea: Ginger has natural anti-inflammatory properties that can help to reduce nausea and alleviate symptoms of motion sickness, morning sickness, and post-operative nausea.</li> <li>3. Reduces bloating: Ginger can help to reduce bloating and gas by relaxing the muscles in the digestive tract and improving the movement of food through the digestive system.</li> <li>4. Soothes the stomach: Ginger has anti-inflammatory properties that can help to soothe the stomach and reduce inflammation, which can lead to digestive issues such as irritable bowel syndrome (IBS).</li> <li>5. Promotes gut health: Ginger contains prebiotic compounds that can help to promote the growth of beneficial gut bacteria, improving the overall health of the digestive system.</li> </ol>
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		supplements, or adding fresh ginger to your meals. It's also a good idea to talk to a healthcare provider or a registered dietitian for personalized advice on how to use ginger for digestion.	It's important to note that while ginger can have potential benefits for digestion, it's always best to consult with a healthcare professional before using it as a treatment for any medical condition. Additionally, it's important to consume ginger in moderation and in combination with other digestive-friendly foods to maximize its potential benefits.
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<p>8.</p>	<p>What exercises promote weight loss and improve health?</p>	<p>As a helpful assistant, I'm glad you're interested in exercises that promote weight loss and improve overall health! Here are some effective and safe exercises that can help you achieve your goals:</p> <ol style="list-style-type: none"> <li>1. High-Intensity Interval Training (HIIT): HIIT involves short bursts of high-intensity exercise followed by brief periods of rest. This type of exercise has been shown to be effective for weight loss and improving cardiovascular health. Examples of HIIT workouts include sprint intervals, burpees, jump squats, and mountain climbers.</li> <li>2. Strength Training: Building muscle through strength training can help increase your resting metabolic rate, which can help you lose weight and maintain weight loss over time. Focus on compound exercises such as squats, deadlifts, bench press, and rows.</li> <li>3. Aerobic Exercise: Aerobic exercise, such as jogging, cycling, or swimming, can help you burn calories and improve cardiovascular health. Aim for at least 150 minutes of moderate-intensity aerobic exercise per week.</li> <li>4. Yoga and Pilates: In addition to improving flexibility and balance, yoga and Pilates can also help with weight loss by increasing your metabolism and reducing stress.</li> <li>5. Bodyweight Exercises: Bodyweight exercises, such as push-ups, squats, and lunges, are a great way to improve strength and burn calories without any equipment.</li> <li>6. Cardio Kickboxing: Cardio kickboxing is a high-energy workout that combines martial arts techniques with aerobic exercise. It can help you burn calories and improve cardiovascular health.</li> <li>7. Rowing: Rowing is a full-body exercise that can help you burn calories and improve cardiovascular health. It's also easy on the joints, making it a great option for people with mobility issues.</li> </ol>	<p>As a traditional Chinese medicine AI assistant, I'm happy to help you with your question! 😊</p> <p>According to traditional Chinese medicine, certain exercises can help promote weight loss and improve overall health. Here are some recommendations:</p> <ol style="list-style-type: none"> <li>1. Qigong: Qigong is a form of slow-moving exercise that combines deep breathing, relaxation, and gentle movements to promote the flow of qi (life energy) throughout the body. Practicing qigong can help burn calories, improve digestion, and boost metabolism, which can aid in weight loss.</li> <li>2. Tai Chi: Tai chi is a form of slow-moving exercise that combines deep breathing, relaxation, and gentle movements to promote the flow of qi (life energy) throughout the body. It can help improve balance, flexibility, and cardiovascular health, which can aid in weight loss.</li> <li>3. Qi-hopping: Qi-hopping is a form of exercise that involves jumping and hopping movements to promote the flow of qi (life energy) throughout the body. It can help burn calories, improve cardiovascular health, and boost metabolism, which can aid in weight loss.</li> <li>4. Yoga: Yoga is a form of exercise that combines deep breathing, relaxation, and physical movements to promote flexibility, balance, and</li> </ol>
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		<p>Remember, it's important to consult with a healthcare professional before starting any new exercise program. They can help you determine the best exercises for your fitness level and health goals.</p> <p>Also, it's important to note that exercise alone is not enough for weight loss. A healthy diet and lifestyle are also crucial for achieving and maintaining a healthy weight.</p>	<p>cardiovascular health. It can help burn calories, improve digestion, and boost metabolism, which can aid in weight loss.</p> <p>5. Walking: Walking is a simple and effective exercise that can help burn calories and improve cardiovascular health. It can also help promote the flow of qi (life energy) throughout the body, which can aid in weight loss.</p> <p>6. Swimming: Swimming is a low-impact exercise that can help burn calories and improve cardiovascular health without putting excessive strain on the joints. It can also help promote the flow of qi (life energy) throughout the body, which can aid in weight loss.</p> <p>7. Qi-massage: Qi-massage is a form of massage that involves applying pressure to specific points on the body to promote the flow of qi (life energy) throughout the body. It can help improve circulation, reduce stress, and boost metabolism, which can aid in weight loss.</p> <p>8. Meditation: Meditation is a form of relaxation exercise that can help reduce stress, improve mood, and promote the flow of qi (life energy) throughout the body. It can also aid in weight loss by reducing stress-related eating and improving metabolism.</p> <p>Remember, it's important to consult with a healthcare professional</p>
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			<p>before starting any new exercise program, especially if you have any underlying health conditions. These exercises can be modified to suit your individual needs and abilities, and can be practiced in conjunction with other forms of exercise to promote overall health and well-being. 😊</p>
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9.	What are some natural methods to improve sleep quality?	<p>Great question! Improving sleep quality is essential for overall health and well-being. Here are some natural methods to enhance your sleep:</p> <ol style="list-style-type: none"> <li>1. Establish a consistent sleep schedule: Go to bed and wake up at the same time every day, including weekends. This helps regulate your body's internal clock and promotes better sleep.</li> <li>2. Create a relaxing bedtime routine: Engage in calming activities, such as reading a book, taking a warm bath, or practicing gentle stretches. This helps signal to your body that it's time to wind down and prepare for sleep.</li> <li>3. Make your sleep environment comfortable: Ensure your bedroom is dark, quiet, and cool. Consider using blackout curtains, earplugs, or a white noise machine to create an ideal sleep environment.</li> <li>4. Limit exposure to screens before bedtime: The blue light emitted by smartphones, tablets, and computers can suppress melatonin production, making it harder to fall asleep. Try to avoid screens for at least an hour before bedtime.</li> <li>5. Practice relaxation techniques: Techniques like progressive muscle relaxation, deep breathing, or mindfulness meditation can help reduce stress and promote relaxation, making it easier to fall asleep.</li> <li>6. Get regular exercise: Regular physical activity can help improve sleep quality, but avoid vigorous exercise within a few hours of bedtime as it can actually interfere with sleep.</li> <li>7. Avoid caffeine, nicotine, and alcohol: All of these substances can disrupt sleep patterns and make it harder to fall asleep or stay asleep throughout the night.</li> <li>8. Try herbal remedies: Certain herbs, such as chamomile, lavender, and valerian root, have been shown to promote relaxation and improve sleep quality.</li> <li>9. Keep your bedroom tidy: A cluttered bedroom can contribute to stress and make it harder to relax. Keeping your bedroom</li> </ol>	<p>As a traditional Chinese medicine AI assistant, I'm happy to help you with your question! Here are some natural methods that can improve sleep quality based on traditional Chinese medicine principles:</p> <ol style="list-style-type: none"> <li>1. Practice relaxation techniques: Engage in activities that promote relaxation such as deep breathing, progressive muscle relaxation, or meditation before bedtime. This can help calm the mind and body, promoting better sleep.</li> <li>2. Establish a bedtime routine: Develop a consistent pre-bedtime routine that signals to your body that it's time to sleep. This can include activities such as reading a book, taking a warm bath, or practicing gentle stretches.</li> <li>3. Create a sleep-conducive environment: Ensure your sleep environment is dark, quiet, and cool. Consider using blackout curtains, earplugs, or a white noise machine to create an ideal sleep environment.</li> <li>4. Avoid stimulating activities before bedtime: Avoid stimulating activities such as watching TV, using electronic devices, or engaging in strenuous exercise before bedtime. Instead, opt for relaxing activities that promote relaxation and calmness.</li> <li>5. Get regular exercise: Regular exercise can help improve sleep quality, but avoid vigorous exercise within a few hours of bedtime as it can actually interfere with sleep.</li> </ol>
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		<p>organized and tidy can help create a more peaceful sleep environment.</p> <p>10. Get enough sleep: Aim for 7-9 hours of sleep each night. Lack of sleep can lead to poor sleep quality, so it's essential to get enough restful sleep. Remember, everyone's sleep needs are different, so it's important to experiment and find the techniques that work best for you. Consistency is key to improving sleep quality, so try to stick to these natural methods for at least a few weeks to see noticeable improvements.</p>	<p>6. Avoid caffeine and alcohol: Both caffeine and alcohol can disrupt sleep patterns and reduce sleep quality. Avoid consuming these substances in the hours leading up to bedtime.</p> <p>7. Practice mindful eating: Eating a balanced diet that includes foods that promote relaxation and calmness such as warm soups, cooked vegetables, and whole grains can help improve sleep quality.</p> <p>8. Try herbal remedies: Certain herbs such as chamomile, lavender, and valerian root have been shown to promote relaxation and improve sleep quality. Consult with a healthcare professional before using any herbal remedies.</p> <p>9. Get enough sleep: Aim for 7-8 hours of sleep each night to ensure you're getting enough rest to promote optimal sleep quality.</p>
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<p>10.</p>	<p>How can I treat insomnia naturally?</p>	<p>Great question! Insomnia can be a common and frustrating issue, but there are several natural ways to help manage it without relying on medication. Here are some evidence-based and safe approaches to help you get a good night's sleep:</p> <ol style="list-style-type: none"> <li>1. Establish a consistent sleep schedule: Try to go to bed and wake up at the same time every day, including weekends. This can help regulate your body's internal clock and improve the quality of your sleep.</li> <li>2. Create a relaxing bedtime routine: Develop a calming pre-sleep routine that signals your body that it's time to wind down. This could include activities like reading a book, taking a warm bath, or practicing gentle stretches.</li> <li>3. Make your sleep environment comfortable: Ensure your bedroom is cool, quiet, and dark. Consider using blackout curtains, earplugs, or a white noise machine to create an ideal sleep environment.</li> <li>4. Avoid screens before bedtime: The blue light emitted by smartphones, tablets, and computers can suppress melatonin production, making it harder to fall asleep. Try to avoid screens for at least an hour before bedtime.</li> <li>5. Practice relaxation techniques: Techniques like deep breathing, progressive muscle relaxation, or mindfulness meditation can help reduce stress and promote relaxation, making it easier to fall asleep.</li> <li>6. Get some morning sunlight: Exposure to natural light in the morning helps regulate your circadian rhythms, which can help you fall asleep more easily at night.</li> <li>7. Try herbal remedies: Certain herbs like chamomile, lavender, and valerian root have been shown to promote relaxation and improve sleep quality. However, always consult with a healthcare professional before using any herbal remedies.</li> <li>8. Engage in physical activity</li> </ol>	<p>Ah, I see! As a traditional Chinese medicine AI assistant, I'm happy to help you with your question! 😊</p> <p>According to traditional Chinese medicine (TCM), insomnia can be caused by various factors such as stress, anxiety, digestive problems, or an imbalance in the body's energy flow (qi). Here are some natural ways to treat insomnia based on TCM principles:</p> <ol style="list-style-type: none"> <li>1. Practice relaxation techniques: TCM emphasizes the importance of relaxation in promoting good sleep. Try practicing deep breathing exercises, progressive muscle relaxation, or meditation to calm your mind and body before bedtime.</li> <li>2. Adjust your sleep environment: Make sure your sleep environment is conducive to sleep. Keep your bedroom cool, dark, and quiet, and avoid using electronic devices before bedtime.</li> <li>3. Improve your diet: Eat a balanced diet that includes foods that promote relaxation and calmness, such as warm soups, cooked grains, and vegetables. Avoid stimulating foods like caffeine, sugar, and spicy dishes before bedtime.</li> <li>4. Exercise regularly: Regular exercise can help promote relaxation and improve sleep quality. However, avoid vigorous exercise within two hours of bedtime to prevent stimulating the body.</li> <li>5. Consider TCM herbal remedies: Certain herbs</li> </ol>
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APPENDIX

		<p>during the day: Regular exercise can help improve sleep quality, but avoid vigorous exercise within a few hours of bedtime as it can actually interfere with sleep.</p> <p>9. Limit caffeine and alcohol: Both caffeine and alcohol can disrupt sleep patterns, so try to limit or avoid them altogether in the hours leading up to bedtime.</p> <p>10. Seek professional help: If you're struggling with insomnia, consult with a healthcare professional or a sleep specialist. They can help identify underlying causes and recommend appropriate treatment options. Remember, it's important to be patient and consistent when trying to manage insomnia naturally. It may take some time to find the right combination of strategies that work for you, but with persistence and patience, you can improve your sleep quality and wake up feeling refreshed and rested.</p>	<p>like Chinese angelica (Dong quai), ginseng (Ren shen), and licorice root (Glycyrrhizae) have been shown to promote relaxation and improve sleep quality in TCM. Consult with a TCM practitioner to determine the appropriate dosage and preparation of these herbs for your specific needs.</p> <p>6. Get enough physical activity during the day: Regular physical activity can help regulate the body's internal energy (qi) and promote better sleep.</p> <p>7. Avoid napping: Napping can disrupt your sleep patterns and make it harder to fall asleep at night. If you must nap, keep it short (less than 30 minutes) and avoid napping close to bedtime.</p> <p>8. Try TCM massage therapy: TCM massage therapy can help promote relaxation and improve blood flow to the body's tissues, which can help regulate sleep patterns.</p> <p>9. Use TCM-inspired sleep aids: Certain TCM-inspired sleep aids like melatonin, valerian root, and magnesium can help promote relaxation and improve sleep quality. Consult with a healthcare professional before using any supplements.</p> <p>10. Seek professional help: If your insomnia persists despite trying these natural remedies, consider consulting with a TCM practitioner or a sleep specialist to rule out any underlying health conditions that may be contributing to your insomnia.</p>
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## APPENDIX

			Remember, it's important to consult with a qualified healthcare professional before starting any new therapies or supplements, especially if you have any underlying health conditions or take any medications. 😊
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APPENDIX

	<p>What are some traditional methods for reducing stress?</p>	<p>As a helpful and respectful assistant, I'm glad you asked! Here are some traditional methods that have been shown to help reduce stress:</p> <ol style="list-style-type: none"> <li>1. Deep Breathing Exercises: Take slow, deep breaths in through your nose and out through your mouth. This can help calm your mind and body.</li> <li>2. Progressive Muscle Relaxation: Tense and then relax different muscle groups in your body, starting with your toes and moving up to your head.</li> <li>3. Meditation: Sit comfortably, close your eyes, and focus on your breath or a mantra. This can help quiet your mind and reduce stress.</li> <li>4. Yoga: Practice yoga poses, such as child's pose or downward-facing dog, which can help release tension and promote relaxation.</li> <li>5. Aromatherapy: Inhale the scent of essential oils, such as lavender or chamomile, which have been shown to have a calming effect on the mind and body.</li> <li>6. Listening to Music: Listen to calming music, such as classical or nature sounds, which can help reduce stress and promote relaxation.</li> <li>7. Reading: Read a book or article that promotes relaxation and stress relief, such as a self-help book or a guided meditation.</li> <li>8. Taking a Walk: Take a walk outside in nature, which can help reduce stress and promote relaxation.</li> <li>9. Listening to Guided Imagery: Listen to a guided imagery recording that promotes relaxation and stress relief, such as a beach or a mountain scene.</li> <li>10. Practicing Gratitude: Take time each day to reflect on things you are grateful for, which can help shift your focus away from stress and promote relaxation.</li> </ol> <p>It's important to note that everyone is different, and what</p>	<p>As a traditional Chinese medicine AI assistant, here are some traditional methods for reducing stress that I recommend:</p> <ol style="list-style-type: none"> <li>1. Qigong: Qigong is a form of meditation that involves slow movements, deep breathing, and mental focus. It can help to balance the body's energy and promote relaxation.</li> <li>2. Tai Chi: Tai Chi is a form of slow-moving exercise that combines deep breathing, relaxation, and slow movements. It can help to reduce stress by promoting relaxation and improving circulation.</li> <li>3. Acupuncture: Acupuncture involves the insertion of fine needles into specific points on the body to stimulate the body's natural healing processes. It can help to reduce stress by promoting relaxation and improving circulation.</li> <li>4. Herbal remedies: Certain herbs, such as ginseng, ashwagandha, and licorice root, have been shown to have a calming effect on the body and mind. These herbs can be used in the form of teas, capsules, or tinctures.</li> <li>5. Meditation: Meditation involves focusing the mind and calming the body. It can be done through various techniques such as mindfulness, loving-kindness, or</li> </ol>
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APPENDIX

		<p>works for one person may not work for another. It's also important to consult with a healthcare professional before starting any new stress-reducing activities.</p>	<p>transcendental meditation. Regular meditation practice can help to reduce stress by promoting relaxation and improving mental clarity.</p> <p>6. Qi-healing: Qi-healing is a form of energy healing that involves the manipulation of the body's energy flow to promote balance and relaxation. It can be done through various techniques such as acupuncture, massage, or breathwork.</p> <p>7. Breathwork: Breathwork involves various techniques such as diaphragmatic breathing, box breathing, or alternate nostril breathing to promote relaxation and reduce stress.</p> <p>8. Massage: Massage involves the manipulation of the body's soft tissues to promote relaxation and reduce muscle tension. It can be done through various techniques such as Swedish massage, deep tissue massage, or acupressure.</p> <p>9. Sound healing: Sound healing involves the use of sound frequencies to promote relaxation and reduce stress. It can be done through various techniques such as chanting, singing bowls, or tuning forks.</p> <p>10. Visualization: Visualization involves the use of mental imagery to promote relaxation and reduce stress. It can be done through various</p>
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## APPENDIX

			<p>techniques such as guided imagery, visualization exercises, or meditation with visualization.</p> <p>These are just a few examples of traditional methods for reducing stress that I recommend. It's important to consult with a licensed practitioner before starting any new therapy or treatment.</p>
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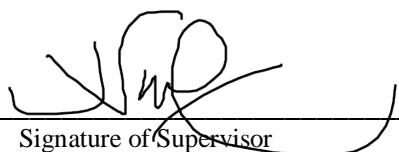
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