MULTIMEDIA UNIVERSITY OF KENYA

FACULTY OF COMPUTING & INFORMATION TECHNOLOGY

INTERACTIVE MEDICAL CHATBOT FOR PATIENTS

BY

STEPHEN KAMAU WAIRIMU

CIT-223-021/2018

SUPERVISOR: MS. YVETTE OTUKANA

22nd March, 2022

Submitted in partial fulfilment of the requirements of Fouth Year Bachelor of Science in Computer Science.

DECLARATION

I hereby declare that this project is my work and has, to the best of my knowledge, not been submitted to any other institution of higher learning.

Student: Stephen Kamau Wairimo **Registration Number:** CIT-223-021/2018

Signature:  **Date:** 26-04-2022

This project has been submitted as a partial fulfilment of requirements for the Bachelor of Science in Computer Science of Multimedia University of Kenya with my approval as the University supervisor.

Supervisor: _____

Signature: ..... Date: .....

ACKNOWLEDGEMENT

I sincerely appreciate myself for the work done throughout from project proposal to completion while overcoming all hindrances met on the way.

I might want to truly recognize the true help and significant season of my supervisor, Ms Yvette Otukana. Her significant direction and criticism have given me splendid thoughts on the best way to work on the venture and furthermore to think of a research paper that is of standard and has met every one of the necessary rules.

I likewise need to thank all lecturers of the Multimedia University of Kenya who have ever educated me. The establishment they laid in me gave me the certainty and information to think of an all-around formed research project. Additionally, I might want to appreciate all my classmates for the help and encouragement that has helped me towards working on this project. Ultimately, much gratitude goes to my folks who have been a wellspring of support and for being with me constantly.

Table Of Contents

DECLARATION ii

ACKNOWLEDGEMENT iii

LIST OF TABLES AND FIGURES. ix

Introduction 1

1.1 Background of the study 1

1.2 Problem Statement 2

1.3 Aim of the study 3

1.4 Significance of the study. 3

1.5 Scope The study 4

1.6 Assumptions 4

1.7 Limitations 4

2. LITERATURE REVIEW 5

Background Research 5

2.1 Introduction 5

2.2 Related Systems 7

2.4 Proposed Solution. 8

3. METHODOLOGY. 10

3.1 Introduction 10

3.2 Methodology 10

The research will be done using a well known and adapted framework used for data science and AI projects called **Cross-Industry Standard Process for Data Mining** (CRISP-DM). This framework reflects all processes done for machine learning specifics in order to ensure it is successful upto completion. Since Machine Learning includes a broad area of methods, this project will focus on adapting CRISP-DM to the specifics and requirements of supervised machine learning(being done for the project) with inclusion of deep and transfer learning methods. This framework has the following steps involved. 10

3.3. Tools and Resources 14

3.4 Tools and Resources 14

3.4 Project Budget. 14

3.5 Project Schedule 15

REFERENCES 16

LIST OF ABBREVIATION.

AI – Artificial Intelligence.
DL – Deep Learning Neural Network.
CRISP DM – Cross Industry Standard Process for Data Mining.
NLP – Natural Language Processing.
NN - Neural Network.
A.L.I.C.E. - Artificial Linguistic Internet Computer Entity
NLU – Natural Language Understanding.

LIST OF TABLES AND FIGURES.

Figure 1 above shows the main chatbot workflow. 9
Table 1 showings project budject on various resources. 14
Table 2 below Shows Project schedule to be used. 15

CHAPTER ONE.

Introduction

1.1 Background of the study

Chat bots are software applications that often make use of Artificial Intelligence. It is a simulation that recognizes the human language and processes it and converses back with the same language. Chat-bot is well liked these days and it plays a major role in the enhancement of computer communication. Normally people go to hospital and get themselves checked according to their wishes. But even for small issues, they need to visit the hospital. In some pandemic situations like Covid-19, it is so hard for the people to get checked by the doctor. This project sorts out this issue.

The main purpose of the scheme is to build the language gap between the user and health providers by giving immediate replies to the Questions asked by the user. Today's people are more likely addicted to the internet but they are not concerned about their personal health. They avoid going to the hospital for small problems which may become a major disease in future. Establishing question answer forums is becoming a simple way to answer those queries rather than browsing through the list of potentially relevant documents from the web or maybe visiting a health facility for a doctor-patient talk. Many of the existing systems have some limitations such as There is no instant response given to the patients they have to wait for experts acknowledgement for a long time. Some of the processes may charge an amount to perform live chat or telephony communication with doctors online (Kumar, 2016). Over 75% of the current population will find it hard to get to speak with a medical practitioner due to fear or social stigma. They may rather keep quiet with their own problems and die with them. By use of a chatbot, someone will be able to chat either via text or voice with it and get direct response without fear since a chatbot is not a human that may raise stigma on the condition he is suffering from. Chatbot may also be better as most of the people are currently using internet services hence accessing it will be of much advantages to them.

This system Allows computers to communicate between humans and computers by using natural language processing (NLP). There are three analyses which understand natural language i.e. identification of main linguistic relations is completed to parse subject into

object of the sentences. After that description of the texts is done. The semantic interpretation uses knowledge of word meaning.

Chatbot is an Entity which imitates human discussion in its particular accepted set-up together with a text or vocal language with techniques such as Natural Language Processing (NLP). The aim of this system is to replicate a person's discussion. The development of a chatbot application can be done by making a user interface to send input and receive responses. It is a system that interacts with the user by keeping track of the state of interaction and recollecting the preceding commands to give functionality. The medical chat-bots can be developed by using artificial algorithms that scrutinise user's queries and recognize them and give replies to related queries. A big disease can start from small problems such as headache which feels normal but it may beginning of big disease such as brain tumour, most of the disease can be identified by common symptoms so the disease can be predicted if the patient body is analysed periodically (Madhu, 2017).The system give response by use of an efficient Graphical User Interface such that if actual person is chatting with the user. Chatbots can be used in various fields like education, healthcare, and route assistance(Ahmed, 2015).

1.2 Problem Statement

Ideally , everyone would be able to maximise their savings, time and also be able to overcome fear of going for a medical checkup with a doctor when using an automatic medical response system.

Currently, over the recent past, there have been increased campaigns by WHO and other health care organisations to reduce physical contacts among people. Most organisations have been tasked to at least come up with ways to perform virtual meetups or working environments.

Doctors and Patients spend a lot of their time travelling to locations of meetup points for the diagnosis or prescription process between the two parties. This means that a lot of time will be spent on travelling and waiting, maybe for a queue that a doctor has since they are very scarce. Because of this, a better way that will cut this time is by removing doctors almost completely and also cutting cost of travelling will make this process of prescription or medical diagnosis over 3 times faster than previous.

Since we are currently in a computing error when everything is being done by use of computers and even simulation real systems functionalities. A newer concept that has been of

the talk recently in the technology space can be used to solve and reduce this problem of spending much time when looking for medical practitioners for diagnosis. Natural Language Processing (NLP) and Machine learning (Deep Learning) has been on the rise recently and can be used to simulate and mic the actual doctor to patient conversations. This project seeks to solve the issue of scarce doctors, slow response to patient queries for those offering online medical services, minimise time wastage when looking for medication etc. The project will be a desktop peer to peer chat of a patient with a Bot which will act like a nurse. This bot will be responding to the queries in which someone feeds into the system. It will be a direct query to respond as responses will be immediately hence no waiting for results.

1.3 Aim of the study

The aim of this project is to contribute to the solution of the problem of direct communication between patients and a medical practitioner through replacing these practitioners with an enhanced bot.

1.3.1 Research objectives.

- To be able to scrape medical transcription conversations from and transcribe audios for algorithm implementation by the end of may.
- To implement both logic based approaches, Deep learning approaches and RASA NLU to create better algorithms for use in keyword matching and string distance comparison algorithms to retrieve the best answer by the end of june.
- To develop a web interface which aims to give the ability to potential patients and their guardians to converse with chatbot.

1.4 Significance of the study.

The study will aid in the reduction of the time used by patients to access medical information and also assist in getting immediate responses when they submit their query. It will also cater for services that available scarce doctors cannot be able to provide frequently.

1.5 Scope The study

The Project will be constrained to the use of only the RASA NLU platform with a trained deep learning model with dataset set from the named pages above. It will be constrained to registering at the platform, giving your query and viewing responses provided by the bot. The study will stick to the use of open source libraries and technologies and the resources that are easily available.

1.6 Assumptions

The following assumptions were made during the study.

- Inputs into the system will only be Voice or text typing and output will be of similar way.
- It is also assumed that everybody who wants to use the system has an email address for registration in order to use the system and has no internet access.
- All users will be anonymous to the system.

1.7 Limitations

The proposed application has a few limitations that include:

- Since the application is running on cloud there will be need access to stable internet connectivity to work efficiently
- Currently the application has no features to support the blind or the illiterate.
- It will require the use of a computing application or phone which may be inaccessible to some.

CHAPTER TWO.

2. LITERATURE REVIEW

Background Research

This chapter contains the background research about topics relevant to the medical conversational chatbot. It presents an overview of chatbots and their interaction with humans. Further more the keyword matching and the template matching algorithms are mentioned, followed by real world examples of their use.

2.1 Introduction

A chatbot is a program that is used to participate in conversations with humans. It uses an appropriate interface for input and output and with the use of AI techniques it can provide realistic answers so the user will think that the communication taking place is with another human. The implementation of such systems varies from using keyword matching, string similarity or complex natural language processing techniques. More sophisticated chatbots could learn from the user input. Nowadays chat bots are used widely in web applications in order to provide help or information when it is asked by the users. It is mostly applied in Ecommerce websites to chat with the site visitors. "Chatbots are computer programs that interact with users using natural languages (Shawar, 2007)."

In recent days, the need for an automated way of conversing with people has been raised. This is attributed to the fact that more people are joining various organisations which becomes overwhelming to those who always answer their queries. One of the sector in which needs Chatbot is in the Health sector. Training medical practitioners is very costly which then results in few medical personnel in hospitals who are limited to answer every customer. There are countless cases where intelligent medical chatbots could help physicians, nurses,

therapists, patients, or their families. They can step in and minimise the amount of time they spend on tasks like:

- providing health-related information to users
- guidance for patient
- medication management and dosage
- connecting people and organisations with first responders
- FAQ-type queries (contact details, directions, opening hours and service/treatment details)

Although Chatbots are not qualified like the medical practitioners and cannot offer valuable facts and symptoms hence cannot give official diagnosis, the main goal of chatbot is smart texting and talking algorithms to have first point of contact before any human is involved.

Types of chatbots

a. Base-line chatbot:

It is a chatbot that is based on a database and uses if / then logic to create a conversation flow and that takes a lot of time to ensure the understanding of the question and the answer needed (Grudin, 2019).

b. AI chatbot:

This type of chatbot is more complex than base-line but it is more interactive and personalised and needs big data training to be impressive if the problem is matched to their capabilities (Fryer, 2006)

c. Hybrid Model:

A hybrid approach mixes the Base-line & AI chatbot to make it smart and his behaviour more expected by depending on database and Ai algorithm to work together(Mai, 2021).

How do chatbots work?

There are two ways to interact with a chatbot:

Text - chatbot analyzes the inputted text and matches the text with predefined data called intents which are categorised to manage the conversation. The user utterance is tagged

with one of these intents, even if what the user says stretches over two or more intents. Most chatbots will take the intent with the highest score and take the conversation down that avenue.

Voice Some chatbots can interact and understand the voice of the user using a set of application programming interfaces (api's) that convert the recorded voice to the language and then convert the voice to words of that language and then deal with the transformed text as mentioned above.

2.2 Related Systems

The first chatbot, called ELIZA, was developed by Joseph Weizenbaum in 1966 to simulate a psychotherapist (Weizenbaum, 1966). This functionality was chosen because no prior knowledge of the world was needed. For example, if someone entered the sentence "I went for a long boat ride", ELIZA responded "Tell me about boats" [1, p. 42]. Thus, the participants did not assume that their interlocutors had no knowledge about boats. Even though this first chatbot was developed more than 50 years ago, the technology only became popular with today's technical possibilities. Through natural language processing (NLP), modern chatbots are able to understand the language of the user (Belfin, 2019). There are opportunities to use them in the healthcare sector (Barak, 2009 & Pereira, 2019) for treating different diseases such as cancer (Belfin, 2019) or asthma (Kadariya, 2019) and for changing harmful behaviour by encouraging smoking cessation or weight control. Previous research showed that most of the existing scientific work on chatbots is concerned with technical developments. Therefore, in this paper, we examine the behaviour perspective about using a medical chatbot, i.e., based on the theory of planned behaviour (TPB) (Ajzen, 1991) and to change harmful behaviour based on the transtheoretical model (TTM) from the patient's point of view and analyse how far chatbots are useful for that purpose.

A.L.I.C.E. (Artificial Linguistic Internet Computer Entity) was implemented by Richard Wallace in 1995 (Shawar, 2002). It uses pattern matching and stores the information in Artificial Intelligence Mark-up Language, or else known as AIML, files. An AIML file is similar to an XML file that was developed to store pattern knowledge for chatbots. There are three types of AIML categories, atomic categories (where there is exact match), default categories (uses wild characters such i.e * is used to match any input) and recursive

categories (special tags are used to refer to a recursion to convince the user to be more specific)

Above two chatbots were the earliest in the 19th century. Over the 20th century, there have been numerous advancements in this field. In the year 2009, a company called WeChat in China created a more advanced Chatbot. Since its launch, WeChat has conquered the hearts of many users who demonstrate an unwavering loyalty to it. It is a highly thriving social media platform. Beside these, advance chatbot that uses data based services and Artificial Intelligence have been developed i.e

- Alexa by Amazon from 2014.
- Google Assistant by Google from 2012
- Cortana by Microsoft from 2014
- Siri by Apple in 2010.

2.3 Limitation of the Systems.

ALICE and ELIZA;

- They use low level technology e.g pattern and keyword matching is not much useful in the current centuries.
- These systems are not adaptable to new conversation and will only have a database of the stored rules only.
- Their user Interface does not look appealing to those who are going to use it as they look like a command line tool which most users hate.

Modern Chatbots (21st Century Chatbots).

- They are quite costly in terms of system requirement and cost of installation.
- Some are only made for a specific platform e.g Siri is used only on apple products.
- Their scope is large and are not for a specific purpose i.e they can chat on everything.
- They are not easily available

2.4 Proposed Solution.

The study will focus on developing a Hybrid chatbot systems that uses RASA NLU platform, deep learning transformers (Bert Models) and rule based pattern matching. With the

help these artificial intelligence and machine learning methods, a model is going to be trained using medical data. This model will then be used to create a humanoid chatbot that can help in diagnosis or answering health related questions that a user is asked. It's scope is only focused on health part as it is the main goal of the project. A patient will then be provided with a nice Interface where he can Anonymously login and then interact with the systems by querying questions onto it. Its main workflow will look as shown in the figure below.

Figure 1 above shows the main chatbot workflow.

The proposed system will enhance interaction with the user by the use of text or voice messaging. Rasa NLU will help to add more results to the user queries since only small quantity of data is available for training. The system first cleans the text and converts it to tokens then uses Natural Language Understanding methods to extract the intent of the query before looking for the best matching answers with high precision. Integration of the model into a working system will be done on a single Web page that will allow conversation to take place. The study aims to be as cheap as possible where anyone can use their laptop or phone and a browser in order to use the chatbot.

CHAPTER THREE.

3. METHODOLOGY.

3.1 Introduction

This chapter entails the methodology and algorithms which was used to come up with the models and the dataset description. The working procedure for this proposed research work is as follows ;-

- Data acquisition .
- Preprocessing and feature extractions
- Training and testing
- Integration of the model with RASA NLU.
- Development of Interactive features of chatting.

The implementation of the chatbot will be based but not limited to the use of deep learning Neural Networks techniques which will help in coming up with the model to be used.

3.2 Methodology

The research will be done using a well known and adapted framework used for data science and AI projects called **Cross-Industry Standard Process for Data Mining** (CRISP-DM). This framework reflects all processes done for machine learning specifics in order to ensure it is successful upto completion. Since Machine Learning includes a broad area of methods, this project will focus on adapting CRISP-DM to the specifics and requirements of supervised machine learning(being done for the project) with inclusion of deep and transfer learning methods. This framework has the following steps involved.

- Business or Goal Understanding
- Data Understanding

- Data Preparation
- Modelling
- Evaluation
- Deployment

This methodology (CRISP-DM) can be executed in a not strict manner i.e one could move back and forth between different phases. As it can be seen from flowchart below the arrows pointing to the requirement between phases are also important with each other phase while the outer circle represents the cyclic properties of the framework. CRISP-DM itself is not a one-time process, just as the outer circle diagram shows. Every process is a new learning experience, in which we can learn new things during the process, and it could trigger other business questions.

3.2.1 Cross-Industry Standard Process for Data Mining (CRISP-DM).

Below are steps that are followed for this methodology.

3.2.1.1 Understanding the business.

In this first part, the problem that need to be solved will be studied and understood well from problem statements. Reasons as to why the solution to the problems needs also to be researched on. It's here that objectives are stated, the project plan is developed, finding out the goals and what is needed to be achieved as the final product.

3.2.1.2 Understanding the data and dataset description

In this phase, depending on the problems understanding above, a dataset to solve the problems is looked at. It involves selection of the dataset and the analysis of its attributes and structure. The study will gather its dataset from the following sources in different formats.

- Audio data from to be transcribed https://zenodo.org/record/4279041/files/nazmulkazi/dataset_automated_medical_transcription-v1.0.zip?download=1
- Scraping text data from https://www.tatahealth.com/online-doctor-consultation/general-physician.

These dataset from the two sites will then be formatted into textual one that will be favourable for machine learning.

3.2.1.3 Preparation of data.

In this step, the dataset collected will be processed and prepared into a format that can be used for machine learning. It will involve using various NLP techniques to get good features for training the model. The enlargement of NLP function is quite tough because computers usually need humans to "speak" with them in a certain programming language. Human language is not accurate as it includes a lot of composite variables. NLP permits users to ask a query. The machine understands the important elements from users speech, that may relate to particular features in a data set, and gives an answer. The use of NLP is to recognize the meaning of the text. The stored information contains the text files, like patients' medical records, symptoms related to particular disease on the basis of which we can predict the disease and also some medicine related information. Porter stemming algorithm (or 'Porter stemmer') It is a procedure for discarding the ordinary words which is related to the exact form of words with also having flexional endings in English. Following are the steps of this algorithm:-

- Gets rid of plurals and -ed or -ing suffixes
- Turns terminal y to i when there is another vowel in the stem
- Maps double suffixes to single ones: - ization, -ational, etc.
- Deals with suffixes, -full, -ness etc.
- Takes off -ant, -ence, etc

3.2.1.4 Modelling

This is the most exciting phase of this project as it is the main focus point for the problem. However, this phase is shorter compared to the other previous phases. In this step, the model is created to solve a problem or to answer the business question. The step will involve using Deep Learning Neural Network algorithm with a certain architecture to come up with a model that can try to predict the intent for a particular query in order to answer it.

3.2.1.5 Model Evaluation and Testing

In this step the model once was created was evaluated on the problem. In order to evaluate the model, various known queries and their answers will be used and then responses from the

model identified. This will then be used to check how the model is performing. In this case, in order to test the model, RASA NLU will be integrated with the model created above. This will help in getting the rough idea of how the model is performing on user queries and response time it takes. It will be evaluated based on accuracy only as the metric.

3.2.1.6 Deployment.

After settling on a certain model performance accuracy, the final step will be using that model with a simple UI that will help a patient or a user to interact with the chatbot. The UI will be developed using ReactJS in order to provide an asynchronous real time chatting view from the user.

3.2.2. Reasons for choosing CRISP-DM development methodology.

- Improved quality of the final product: by adapting this methodology, one can deliver solutions in time and with a higher degree of satisfaction since one has to pass through all phases understanding what is required in each phase.
- Focus on objective and plan value through increased focus on delivering strategic value by involving research in each phase of the development process.
- Transparency: this can include prioritising features, iteration planning and review section or frequent software builds containing new features
- Allow usage of the right tool for each development phase
- It also ensures a timely project delivery when the phases are followed accurately without halt.

3.2.3 Challenges of CRISP-DM development methodology

- People's behavioural change: changing the way people work is difficult- the habit and culture of large development organisations are typically in grain. People naturally restrict change and therefore when confronted with this methodology transformation.
- Lack of skilled product owners from the for all phases of development

- Lack of dedicated cross-functional team: In most cases, there has always been inefficient cross-functional teams.

3.3. Tools and Resources

The Dataset that will be used for this research will be obtained from secondary sources like web sources. It will be both scraping directly from a web source and downloading it from their stored databases. Although its accuracy cannot be justified since we will not be knowing what is happening from the behind scenes, It will be of great benefit to this project as it is easy to get and economical.

3.4 Tools and Resources

3.4.1 Software

- Python 3.9.2
- NLTK and Spacy libracies
- Pytorch and Tensorflow
- Pandas and Numpy
- JupyterLab
- Web Browsers and Operating systems

3.4.2 Hardware

- Laptop HP notebook i5 8GB RAM.

3.4 Project Budget.

Below is the projected budget for the whole project.

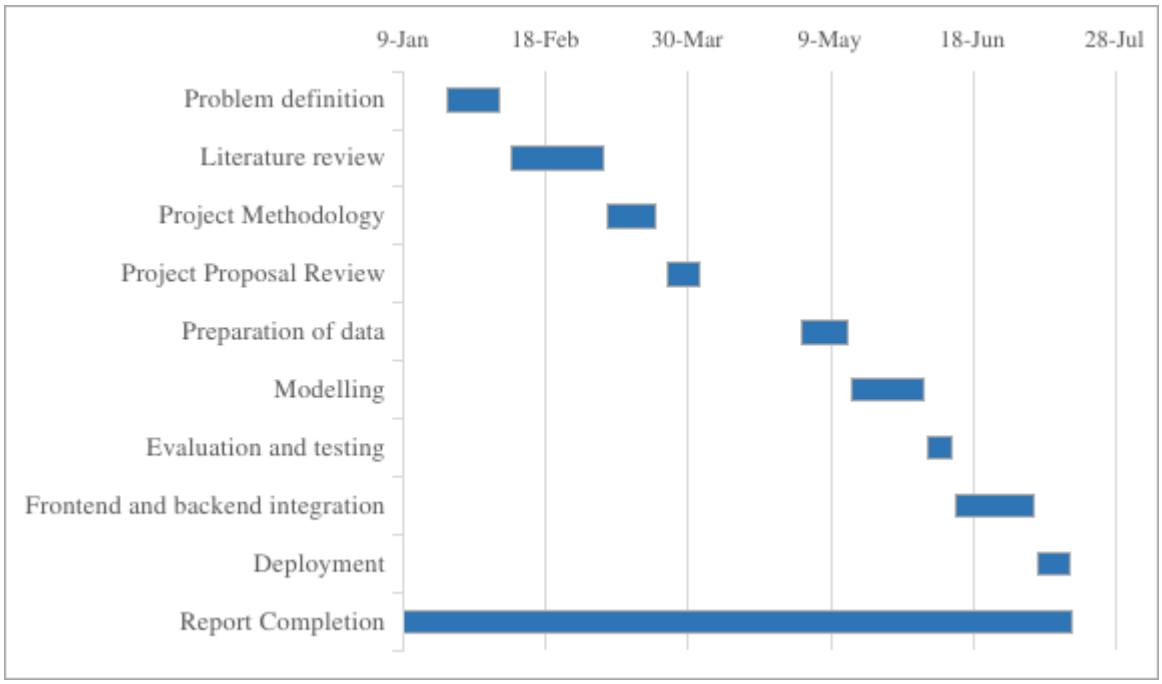
Table 1 showings project budject on various resources.

Resource	**Budget Allocation**
Python & Libraries JupyterLab (Open source)	Kshs. 0
MySQL database	Kshs. 0

Laptop (8 GB RAM, 256GB SSD, 2.4 GHz)	50,000
Internet Connectivity	2000 p.m (6 month) = 12000
Total Cost	**62,00**

3.5 Project Schedule

Table 2 below Shows Project schedule to be used.



REFERENCES

Ahmed, I., & Singh, S. (2015). AIML based voice enabled artificial intelligent chatterbot. *International Journal of u-and e-Service, Science and Technology*, *8*(2), 375-384.

Kumar, V. M., Keerthana, A., Madhumitha, M., Valliammai, S., & Vinithasri, V. (2016). Sanative chatbot for health seekers. *International Journal Of Engineering And Computer Science*, *5*(03), 16022-16025.

Madhu, D., Jain, C. N., Sebastain, E., Shaji, S., & Ajayakumar, A. (2017, March). A novel approach for medical assistance using trained chatbot. In *2017 international conference on inventive communication and computational technologies (ICICCT)* (pp. 243-246). IEEE.

Shawar, B. A., & Atwell, E. (2007, January). Chatbots: are they really useful?. In *Ldv forum* (Vol. 22, No. 1, pp. 29-49).

Grudin, J., & Jacques, R. (2019, May). Chatbots, humbots, and the quest for artificial general intelligence. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (pp. 1-11).

Fryer, L., & Carpenter, R. (2006). Bots as language learning tools. *Language Learning & Technology*, *10*(3), 8-14.

Mai, T. N. T., & Maxim, S. (2021). Enhancing Rasa NLU model for Vietnamese chatbot. *International Journal of Open Information Technologies*, *9*(1), 31-36.

Weizenbaum, J. (1966). ELIZA—a computer program for the study of natural language communication between man and machine. *Communications of the ACM*, *9*(1), 36-45.

Belfin, R. V., Shobana, A. J., Manilal, M., Mathew, A. A., & Babu, B. (2019, March). A graph based chatbot for cancer patients. In *2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS)* (pp. 717-721). IEEE.

Barak, A., Klein, B., & Proudfoot, J. G. (2009). Defining internet-supported therapeutic interventions. *Annals of behavioral medicine*, *38*(1), 4-17.

Pereira, J., & Díaz, Ó. (2019). Using health chatbots for behavior change: a mapping study. *Journal of medical systems*, *43*(5), 1-13.

Kadariya, D., Venkataramanan, R., Yip, H. Y., Kalra, M., Thirunarayanan, K., & Sheth, A. (2019, June). KBot: Knowledge-enabled personalized chatbot for asthma self-management. In *2019 IEEE International Conference on Smart Computing (SMARTCOMP)* (pp. 138-143). IEEE.

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179-211.

Shawar, B. A., & Atwell, E. (2002). *A comparison between Alice and Elizabeth chatbot systems*. University of Leeds, School of Computing research report 2002.19.