West Visayas State University
COLLEGE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
La Paz, Iloilo City, Philippines

SYRENE: CHATBOT ASSISTING MENTAL HEALTH PROFESSIONALS IN DEALING WITH PATIENTS/CLIENTS USING MACHINE LEARNING

An Undergraduate Thesis

Presented to the Faculty of the

College of Information and Communications Technology

West Visayas State University

La Paz, Iloilo City

In Partial Fulfillment

of the Requirements for the Degree

Bachelor of Science in Computer Science

by

Gene Caleb C. Carbonilla

Xyphrus Von Keith V. Caguan

Joshreen D. Reyes

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June 2023

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Approval Sheet

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Abstract

It has always been a conundrum for most people to reach out when it comes to mental health related problems due to the negative stigma society has created. Since the majority prefer to communicate digitally rather than in person, the researchers created a chatbot that can accommodate this dilemma. "*Syrene*" intends to create a system that makes use of Natural Language Processing (NLP). It can help mental health professionals assist their patients who are experiencing mental health issues, especially those who are having difficulty interacting with others. The goal is to assist both mental health professionals and people who are having difficulty contacting a mental health practitioner. This study concludes that mental health professionals have a split decision regarding the *Syrene chatbot*. Psychiatrists and Psychologists recommend a face-to-face interview with the patient due to the standard testing and assessment methods

utilized by both fields. Guidance Counselors, on the other hand, find the website useful for monitoring the students' input into the chatbot. Making it simple for them to monitor the records.

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CHAPTER 1 INTRODUCTION TO THE STUDY

Background and Theoretical Framework of the Study

In a pandemic situation, COVID-19 resulted in the emergence of emotional distress and/or mental health conditions both during and after the pandemic (Salhi et al., 2021). Health crises, such as the COVID-19 pandemic, cause psychological changes in both medical workers and citizens, and these psychological changes are triggered by fear, anxiety, depression, or insecurity (Salari et al., 2020).

People's ability to perform their jobs effectively and efficiently can suffer as a result of the widespread effects of emotional distress and/or mental health conditions such as anxiety and depression, but this can be effectively treated with a variety of treatment methods,
such as psychotherapy and medication including also cognitive-behavioral therapy (CBT) (Kaczkurkin & Foa, 2015). Furthermore, it is a vital role of a mental health professional (psychologist/therapist) to address emotional distress and/or mental health conditions via

the internet and screening them for emotional distress (Ying et al., 2021). However, most students who are stressed and suffering from emotional distress are typically hesitant or afraid to disclose their true feelings with others and it is much more uncommon that they will actively seek professional help. Since many students are turning to the internet to vent out their negative feelings, then it is reasonable to think that a chatbot, or an artificial intelligence-based chatting system, can act as a "virtual friend" to help people release their unpleasant emotions, because it allows them to express their true feelings that cannot be expressed in real life (Yin et al., 2019).

According to Potts et al. (2021), in the field of mental health, digital technologies such as chatbots can be applied. Chatbots are digital tools that utilize artificial intelligence and machine learning to interact with users, recreating humanlike conversational capabilities during service encounters and are rapidly being used in a wide range of internet-based public services (Makasi et al., 2020).

Natural Language Processing methods are responsible for the intelligence of chatbots. Ideal chatbots must be able to grasp the context of a discussion, learn from it, and improve over time. This may be accomplished using a variety of machine learning and deep learning approaches (Baby et al., 2017). Based on proven psychological theories, a psychological chatbot is a type of emotional chatbot meant to alleviate symptoms of anxiety, depression and other unpleasant emotions (Xu & Zhuang, 2022). Chatbots offer patients timely information, which can be important in particular situations, such as gaining access to mental health resources (Safi et al., 2020). Furthermore, users must register and disclose personal information, including some sensitive healthcare information to utilize existing health chatbots (Wang & Siau, 2018).

Thus, this study aims to develop a system that can assist mental health professionals with their patients and assist patients that are experiencing emotional distress and/or mental health conditions such as anxiety/depression using Machine Learning.

Theoretical Framework

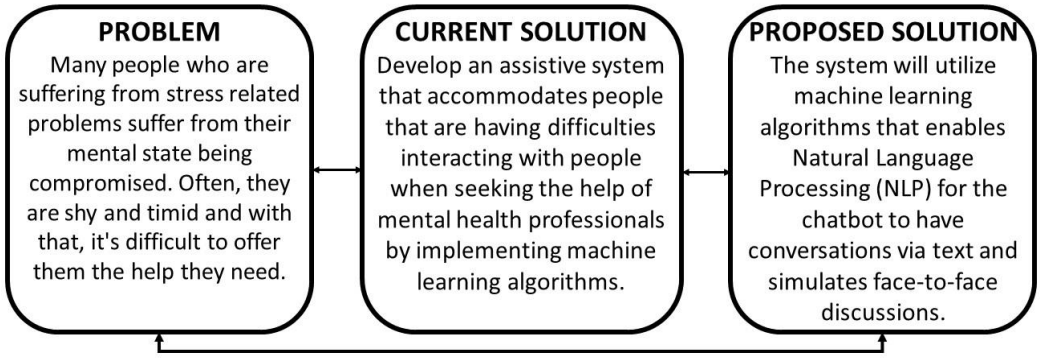


Figure 1. Theoretical Framework of the Proposed System.

In Figure 1, the theoretical framework serves as a guide as the primary means for the researchers in which the research problem is understood and investigated.

Objectives of the Study

This study aimed to develop *"Syrene: Chatbot Assisting Mental Health Professionals in Dealing with Patients/Clients Using Machine Learning"* to assist patients that have mental health conditions such as anxiety/depression. The system serves to aid people with mental health problems that are having difficulties

interacting with people when seeking the help of mental health professionals.

The specific objectives of the study are the following:

1. develop an assistive system for mental health professionals and their patients with mental health conditions that utilizes Machine Learning algorithms and applies Natural Language Processing (NLP) to facilitate the dialogue and analysis of text conversations;
2. collect data and transform it into a JSON (JavaScript Object Notation) file that can be used as a dataset of the system;
3. using Machine Learning for Natural Language Processing (NLP) to mimic the conversational approach of mental health professionals in dealing with their patients/clients on a website;
4. evaluate the quality and usability of the proposed system according to its intended users;

Significance of the Study

This study is beneficial to the following:

Mental Health Professionals. This study aids mental health professionals by letting them use the chatbot to retrieve the gathered data from the patients.

Patients. This study aids the patients with mental health conditions that are having a hard time disclosing their true feelings with others.

The Researchers. The study of this system will give useful ideas, information, and speculations to other researchers who will conduct a study connected with the *"Syrene: Chatbot Assisting Mental Health Professionals in Dealing with Patients/Clients Using Machine Learning"*, and the researchers can likewise add to this project as a solution for problems in regard to those individuals who have emotional distress as well as psychological conditions.

Definition of Terms

For better understanding, the following terms were defined conceptually and operationally:

Chatbot -- A chatbot is a piece of software or a computer program that uses text or voice interactions to replicate human conversation or "chatter." (Brush & Scardina, n.d.).

In this study, a chatbot is a software the researchers are going to use as an assistant of mental health professionals to gather data from the patients.

Cognitive-behavioral techniques (CBT) -- Cognitive behavioral therapy (CBT) is a type of psychological treatment that has been shown to be useful for a variety of issues such as depression, anxiety disorders, alcohol and drug abuse issues, marital problems, eating disorders, and serious mental disease (*What Is Cognitive Behavioral Therapy?*, 2017).

Cognitive behavioral therapy (CBT) is the psychological treatment the researchers are going to incorporate into the chatbot. A lot of mental health chatbots have been created that can listen and gather

data to what the patient has to say and make recommendations based on the data from their responses. To put it in other words, they can work as therapists (*ChatBots for Cognitive Behavioral Therapy*, n.d.).

Natural Language Processing -- Natural Language Processing (NLP) is a subject of computer science—specifically, a branch of Artificial Intelligence (AI)—concerning the ability of computers to understand text and spoken words in the same manner that humans can (IBM Cloud Education, 2020).

In this study, Natural language processing (NLP) is used in this study is to help chatbot adapt and learn human speech and words to be fully effective as a chatbot assistant (Arnab Mondal, 2021).

Machine Learning -- Machine Learning (ML) is a kind of Artificial Intelligence (AI) that enables software applications to improve their prediction accuracy without being directly programmed to do so (Burns, n.d.).

In this study, machine learning is used by the chatbot to enhance its ability to learn from the information it receives.

Delimitation of the Study

This study focuses primarily on the development of a chatbot when using it as an assistant to mental health professionals and patients. Many aspects of chatbots and health-related topics will not be covered in this study.

This study is subject to limitations. The chatbot is limited only to gathering general personal information that will be used by the mental health professionals for the evaluation of their patients. In addition, the chatbot’s responses are also limited to the user's query. Due to doctor and patient confidentiality, the researchers were not able to cover all the possible responses. In other words, not all questions can be answered by the chatbot.

Moreover, this study is limited to youth patients ages 15-24 and the common stress-related problems they encounter. In addition, the users that will participate in this study will be selected and assessed. In other words, they will not represent the general population. The participants will consist only of chatbot users such as practitioners (mental health professionals and

guidance counselors), IT experts, and youth patients with mental health concerns since they are the primary ones who will benefit from this study.

CHAPTER 2 REVIEW OF RELATED STUDIES

Review of Existing and Related Studies

Mental Health

Definition of Mental Health

Mental health is defined as the ability to perform mental functions, resulting in fulfilling relationships, productive activities, and the ability to adapt, to change and manage with adversity (Gamm, 2010). Mental health also refers to healthy functioning or well-being in psychological and social areas. Well-being is more than just the absence of impairment; it also refers to the presence of personal and interpersonal attributes that enable optimal functioning (Kazdin, 1993). The benefits of better understanding of mental health among young individuals, particularly students, are expected to be considerable. Early adult mental health affects many aspects of well-being, including alcohol and substance misuse, academic performance, and future jobs and relationships (Eisenberg et al., 2007).

Mental Health Problems

Major depressive disorder, dysthymia, and bipolar disorder are all examples of depressive disorders that produce considerable impairments in everyday activities. Low mood, lack of interest or pleasure, feelings of guilt or low self-worth, interrupted sleep or appetite, feelings of weariness, poor concentration, and suicidal thoughts are all symptoms of serious depression (Kris-Etherton et al., 2021). Although it is commonly acknowledged that people with intellectual impairments are more likely to suffer mental health problems, there is presently no consensus on the best method of evaluation. There is no agreement on which problems should be included in the phrase "mental health problem" when used to persons with intellectual impairments, and defining mental disease is difficult (Costello et al., n.d.).

Mental Health Professionals Handling Mental Health Issues

Recognizing anxiety disorders and depression by general practitioners is seen as a crucial condition in primary care to ensure appropriate treatment of these

illnesses (Nieuwenhuijsen et al., 2015). The majority of patients with serious mental illnesses have frequent interaction with primary care services, and for many, this is their only engagement with health care. However, such interaction does not guarantee that they will receive adequate physical health care. The reactive nature of primary care may not sit well with patients who may be hesitant or unwilling to seek treatment (Phelan et al., 2001). Young people's reluctance to seek professional treatment for mental health problems is increasingly recognized as a barrier to successful early intervention approaches. Engaging in appropriate care is well acknowledged as a generalized protective factor, and because of the high prevalence of mental health problems during adolescence and young adulthood (12–24 years), early treatment and prevention are critical (Rickwood et al., 2007). When patients are accompanied by mental health professionals, psychological and social issues may receive more attention (Phelan et al., 2001).

Psychotherapy (Cognitive Behavioral Therapy (CBT)) for Treating Individuals with Mental Health Conditions

Digitalization has brought improvements and new opportunities to health care in general, as well as clinical psychology and psychotherapy in particular. Psychological Internet treatments have been studied extensively, and they are regarded as a medium that is independent of time and location. They may be able to assist in the reduction of treatment barriers and the expansion of care options. Numerous studies have demonstrated that these therapies, which frequently employ cognitive-behavioral strategies, are as successful as traditional face-to-face psychotherapy. Anxiety and depression, for example, are already being efficiently managed in this manner (Bendig et al., 2019).

Cognitive-behavioral therapy (CBT) refers to a group of therapies based on the idea that cognitive factors contribute to the recurrence of mental conditions and psychological distress (Hofmann et al., 2012). CBT intends to alleviate discomfort by assisting patients in developing more adaptive cognitions and behaviors (Dilgul et al., 2020). CBT was shown to be an effective therapy for adult and adolescent bipolar disorder, generalized anxiety disorder, panic disorder with or without

agoraphobia, social phobia, post-traumatic stress disorder, and childhood depressive and anxiety disorders by the researchers (Fenn & Byrne, 2013). In other words, technology-based tools (e.g., internet, computer, smartphone, tablets, personal digital assistants, wearables) may promote CBT therapy involvement and serve at various stages in a "stepped care" approach to CBT treatment (Muroff & Robinson, 2022). CBT, unlike other therapy modalities, is especially well suited for computer or internet delivery since it is highly organized and often performed in a sequential method (Berry & Lai, 2014). Moreover, CBT delivery may be shared by medical professionals and psychologists in medical, community, and self-help settings using information and communication technology (ICT) devices (Dilgul et al., 2020).

Application of Machine Learning and Natural Language Processing to Mental Health

Machine learning and natural language processing (NLP) models have been major topics in medicine in recent years, and they may be regarded as a new paradigm in

medical research (le Glaz et al., 2021). NLP techniques have been identified as a key aspect of development within the artificial intelligence (AI) in health industry. Because natural language processing (NLP) approaches make assumptions about what others say and feel, and these conclusions might cause messages or other actions to be sent (Calvo et al., 2017).

Machine Learning approaches have the ability to open up new avenues for learning human behavior patterns, recognizing mental health symptoms and risk factors, making illness progression predictions, and customizing and improving therapies. Despite the potential benefits of employing machine learning in mental health, this is a new field of study, and developing successful ML-enabled apps that can be implemented in practice is bound up with complicated, interwoven problems (Thieme et al., 2020). Furthermore, machine learning and natural language processing (NLP) approaches extract relevant information from previously undiscovered data (e.g., patients' daily behaviors, which are often inaccessible to care providers). Before adopting it as a support tool for mental health care, ethical concerns must be addressed.

Machine learning and natural language processing (NLP) technologies may provide diverse viewpoints in mental health research, but they should also be viewed as tools to enhance therapeutic practice (le Glaz et al., 2021).

Chatbot

Chatbot as a Tool for Conversation

Human-computer interaction in the form of speech or text is becoming increasingly prevalent these days. People anticipate having comparable interactions with machines as they do with humans. A dialogue system or program, sometimes referred to as a chatbot or a chatterbot, is required to offer appropriate responses based on phrases or keywords extracted from queries (Xie et al., 2019).

A chatbot is an artificially intelligent robot that can speak with humans. This might be a text-based or spoken dialogue (in case of voice-based queries) (Lalwani et al., 2018). It is intended to be the ultimate virtual assistant, assisting one in completing activities such as answering queries, finding driving directions, playing one's favorite song, and so on (Prasad et al., 2019).

The popularity of chatbots is growing because they provide access to a wide range of services (for example, buying flights or monitoring weather conditions) via online apps or social networks such as Telegram, Twitter, Skype, or Slack. Users may access those services without having to install additional apps and interacting with the service is made easier by the usage of natural language (NL) (Perez-Soler et al., 2021). According to some studies, they investigated the function of chatbots in fostering motivational factors such as learner autonomy, intrinsic motivation, and an inquiry-oriented frame of mind (Fryer et al., 2019). Every day, developers and researchers work on newer ways for bots to comprehend people better, provide relevant replies, predict the next query, and store recent dialogues (Kandpal et al., 2020).

Machine Learning and Natural Language Processing (NLP) in AI Chatbot

Nowadays, advanced automated chatbots often leverage Machine Learning (ML) techniques in combination with Natural Language Processing (NLP) within the field of Artificial Intelligence (AI) to understand and respond to

human natural language. This approach allows chatbots to process and interpret the meaning of user inputs, enabling them to generate appropriate and contextually relevant responses (Suta et al., 2020). Moreover, Natural Language Processing and Machine Learning developments have played a vital role in the vast improvement of conversational Artificial Intelligence (AI). The usage of text-based conversation AI, such as chatbots, for everyday purposes to connect with actual people for a number of activities has expanded substantially (Sanjay, 2019).

Recent advances in Natural Language Processing (NLP), as well as increasingly available processing power and communication technologies, have aided the fast development and deployment of chatbots in a variety of industries (Maroengsit et al., 2019). To explain further what Natural Language Processing (NLP) is, it is the process of translating natural language into meaning, wherein it enables the computer to understand the text in the same way that people do (Baby et al., 2017).

NLP systems have demonstrated their uniqueness and relevance in the fields of information retrieval,

particularly in the retrieval and processing of vast amounts of unstructured healthcare records and the return of structured information via user-defined queries (Omoregbe et al., 2020). For instance, introducing medical chatbots with exceptional learning ability and problem-solving abilities. These chatbots have been shown to be quite useful in offering assistance to daily routine patients with minor diseases. They can swiftly address people's health concerns thanks to medical chatbot Natural Language Processing (NLP) (Soufyane et al., 2021). Furthermore, in order to make natural language conversation more efficient, a chatbot must accurately evaluate and interpret the user input in order to respond appropriately (Singh & Thakur, 2020).

Chatbot in Mental Health Domain

As the world becomes more competitive by the day, the number of individuals suffering from stress and other mental health concerns grows tremendously. In today's world, even school children and older adults are becoming victims of stress and pressure. An individual's mental health is just as vital as their physical health.

However, there is a lack of understanding and sufficient mental health facilities in today's society, which forces individuals to struggle against the odds without any assistance (More et al., 2021). Furthermore, as a result of recent technological advancements, there has been an increase in digital interventions aiming at either supplementing or replacing face-to-face mental health care, such as the introduction of mental health chatbots that promise to offer supportive care using a therapeutic approach. Natural Language Processing (NLP) is driving these developments (Tewari et al., 2021).

Chatbots have also been used in healthcare for research and therapeutic support. Chatbots have been used in clinical research in the field of psychology, where survey or interview data gathering is replaced by chatbots that may communicate with patients via phone messaging apps in a non-clinical setting (Siddig & Hines, 2019). Even though there is still much to be discovered about chatbots in mental health, their potential has already begun to emerge. Chatbots, in particular, may be useful in offering treatment for people who are uncomfortable disclosing their emotions to a human being.

As a result, virtual therapy delivered by a chatbot might not only increase access to mental health care but also be more successful for people who are hesitant to interact with a therapist (Vaidyam et al., 2019). Chatbots have great potential in the mental health domain since getting one's thorough self-disclosure is crucial for mental health professionals to comprehend people's mental problems. There is, however, a lack of research addressing whether and how individuals self-disclose sensitive matters to a genuine mental health professional (MHP) via a chatbot (Lee et al., 2020). Therefore, according to the study, “Chatbots and Conversational Agents in Mental Health: A Review of the Psychiatric Landscape”, the preliminary evidence for psychiatric use of chatbots is favorable (Vaidyam et al., 2019).

CHAPTER 3 RESEARCH DESIGN AND METHODOLOGY

Description of the Proposed Study

The study entitled, "*Syrene: Chatbot Assisting Mental Health Professionals in Dealing with Patients/Clients Using Machine Learning*" aims to develop a system that uses Natural Language Processing (NLP). It can assist mental health professionals with their patients that are experiencing mental health concerns, especially those who are having a hard time interacting with people. Their goal is to help both mental health professionals and the people having difficulties reaching out to a mental health practitioner.

Methods and Proposed Enhancements

The researchers used Visual Studio Code as a development platform using Python programming language and JavaScript Object Notation for the text-based response of the chatbot.

In a text-based chatbot, a bot answers the user's questions via text interface. In a rule-based approach, a bot answers questions based on some rules on which it is

trained on. The rules defined can be very simple to very complex. The bots can handle simple queries but fail to manage complex ones (Dave, 2022).

Our enhancement will be to the query from the user in which even when phrased differently as long as it has the same intent, the chatbot can reply appropriately. With this, chatbot can respond to the user's query with its dynamic response.

Pre-processing Flow

The conversational capabilities of the chatbot will be taken from the data that the researchers have gathered.

Chatbots use Natural Language Understanding (NLU) to retrieve context from the unstructured user input in human language and respond based on the current user’s intention (Jung, 2019).

The response of the chatbot will be based on the trained model that is stored in a JSON file, in which the researchers can update the library for the improvement of the conversational capabilities of the chatbot.

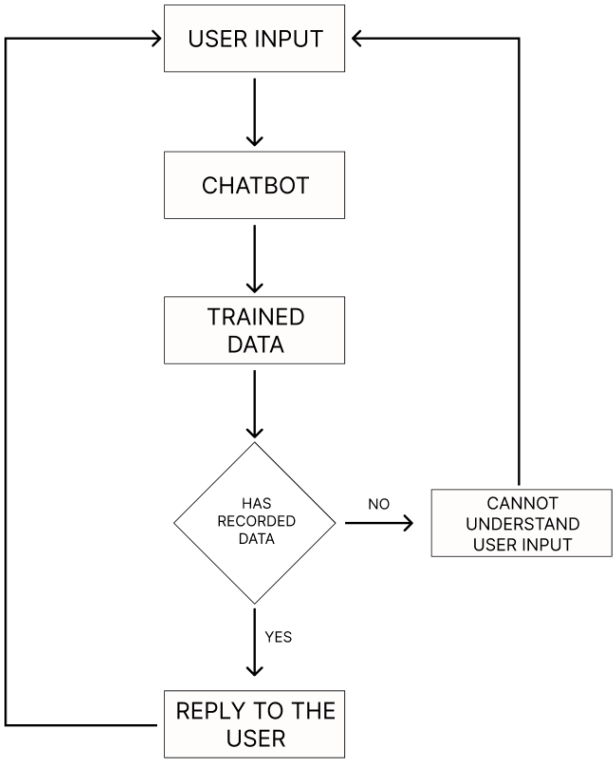


Figure 2. Error Threshold of the Proposed System.

Error Threshold

In Figure 2, The chatbot's ability to understand the user's input is limited to the data it was trained on by the researchers. Therefore, for the chatbot to generate a meaningful response, the user's input must closely match the patterns and language structures present in the training data. If the user's input deviates too much from the learned patterns, or if it contains random characters or text outside the scope of the training data, the

chatbot will not be able to process it and will respond with a message such as "I do not understand". In essence, the chatbot has an error threshold beyond which it cannot function effectively.

Training

Stemming is the process of reducing the words to their word stem or root form. The objective of stemming is to reduce related words to the same stem even if the stem is not a dictionary word (Yse, 2021).

Machine learning algorithms cannot work directly with raw text; the text must first be converted into numbers. Specifically, vectors of numbers (Ghosh, 2018).

A bag-of-words model, or BoW for short, extracts feature from the text for modeling using various techniques (e.g., machine learning algorithms). It is a straightforward and flexible approach used to extract text features from documents. A bag-of-words is a representation of text that describes the occurrence of words within a document (Qadir, 2022).

The dataset will be trained and will go through an epoch, which means training the neural network with all

the training data for one cycle. In an epoch, the researchers use all of the data exactly once. A forward pass and a backward pass together are counted as one pass (Crusoveanu et al., 2021).

An epoch is made up of one or more batches, where the researchers use the dataset to train the neural network.

Storing Data

The necessary data that are gathered by the chatbot through the conversation from the user would be saved to the MongoDB database that the researchers have created. MongoDB is an open-source NoSQL database management program. NoSQL is used as an alternative to traditional relational databases (Bothelo & Vaughan, 2022).

Data Presentation

The data that will be presented are retrieved from the MongoDB database that the researchers have created. The necessary data retrieved in the database will then be presented to the mental health professionals in an easier way to understand output.

Implementation

This chatbot is an English-based website that is primarily designed to be available locally and is accessible for free through the internet, but because it is in a beta phase, it requires more testing to be more reliable and effective.

Components and Design

Software Architecture

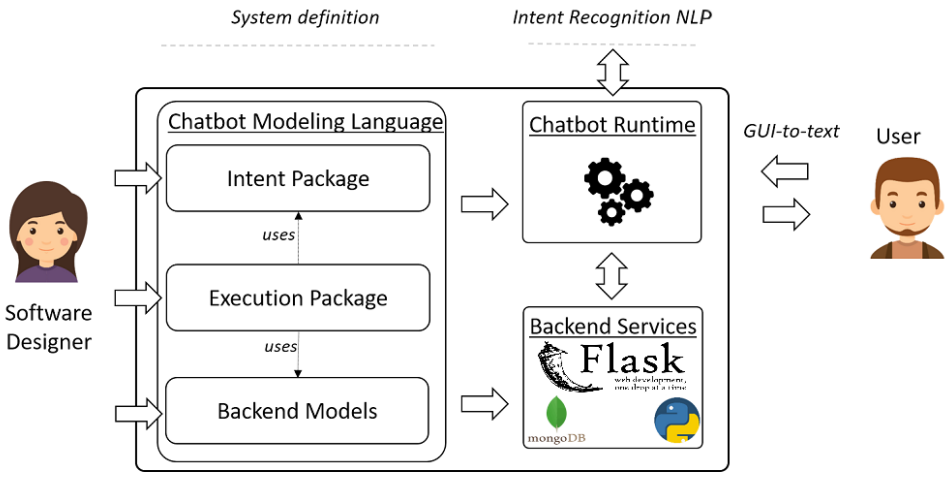


Figure 3. Software Architecture of the Proposed System.

In Figure 3, the software architecture of a chatbot involves multiple components that work together to enable seamless communication between the user and the bot. The process usually starts with a software designer who is

responsible for creating a chatbot modeling language. This language comprises several packages, including an intent package, execution package, and backend models. The backend models are then connected to the backend services, which typically include a MongoDB database, flask server, and Python programming language. These services provide the necessary functionality for the chatbot to store user data, process user requests, and generate responses.

The chatbot runtime is then connected to the backend services and the intent package, which utilizes Intent Recognition in Natural Language Processing. This technology enables the chatbot to understand the user's input, classify it based on the intent, and generate an appropriate response. The chatbot runtime then receives the user's text input, processes it, and generates a response, which is then delivered back to the user.

Overall, the software architecture of a chatbot is designed to enable seamless communication between the user and the bot while ensuring that the bot is able to process and respond to user requests accurately and efficiently. With the right combination of backend

services, natural language processing technology, and chatbot modeling language, a chatbot can provide an engaging and intuitive user experience.

System Architecture

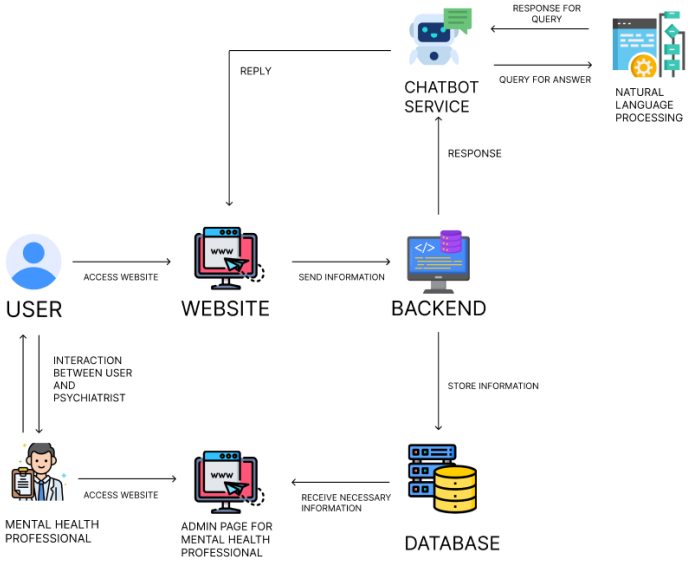


Figure 4. System Architecture of the Proposed System.

In Figure 4, the proposed system architecture for *"Syrene: Chatbot Assisting Mental Health Professionals in Dealing with Patients/Clients Using Machine Learning"* starts from the user accessing the website in which the chatbot will be in charge of receiving the query and sending a response to the user. After the session between

the chatbot and the user, the necessary information will be stored in the database for the mental health professionals to access. And finally, the mental health professionals can diagnose the severity of the user's gathered data and will be able to interact with the user for further diagnosis.

Database Design

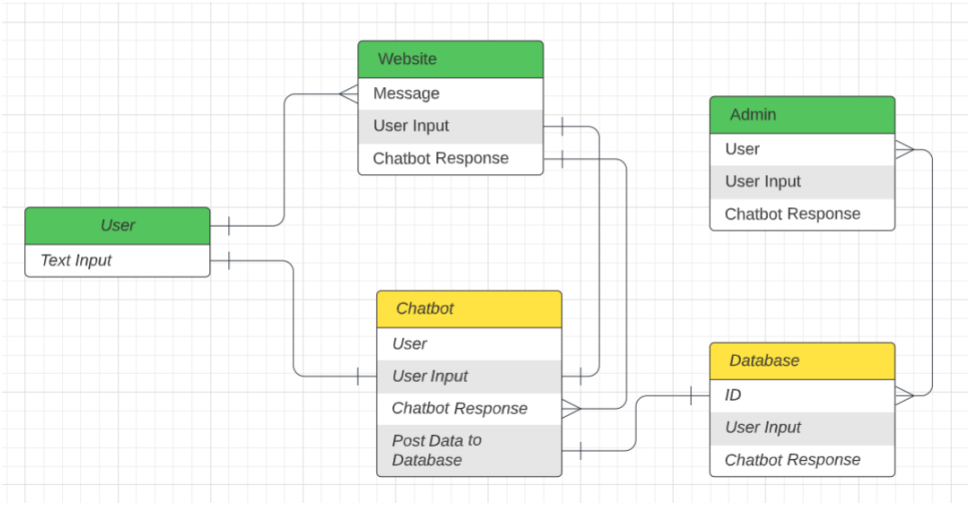


Figure 5. Database Design of the Proposed System.

In Figure 5, when a user interacts with the chatbot, the chatbot receives their input and generates a response based on the user's request. This exchange of information is then stored in the database for future reference. Typically, the data stored in the database includes the

user's input, chatbot response, date and time of the interaction, and other relevant metadata.

The database is designed to efficiently manage and organize this data to facilitate easy access and retrieval. The chatbot can use this data to improve its responses and provide a better user experience over time. Finally, the database can be designed to enable seamless integration with other tools and systems, allowing admins to easily access and use the data stored in the database.

Procedural and Object-Oriented Design

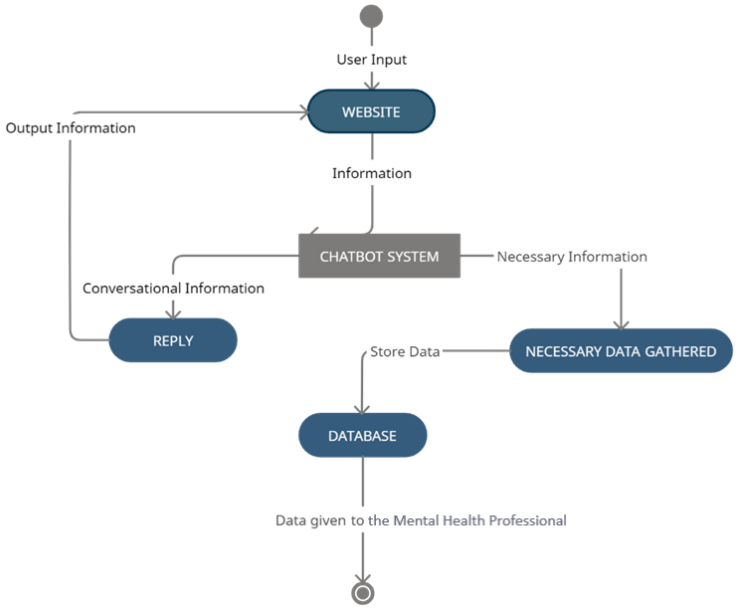


Figure 6. Procedural and Object-Oriented Design of the Proposed System.

Figure 6 shows the procedural and objected design of the proposed system.

The User class represents the user interacting with the chatbot basing the chatbots response on the text input of the user.

The Chatbot class represents the chatbot interacting with the user. The reply generates a response based on the user's input.

The Admin class represents the admin responsible for analyzing the stored data.

Process Design

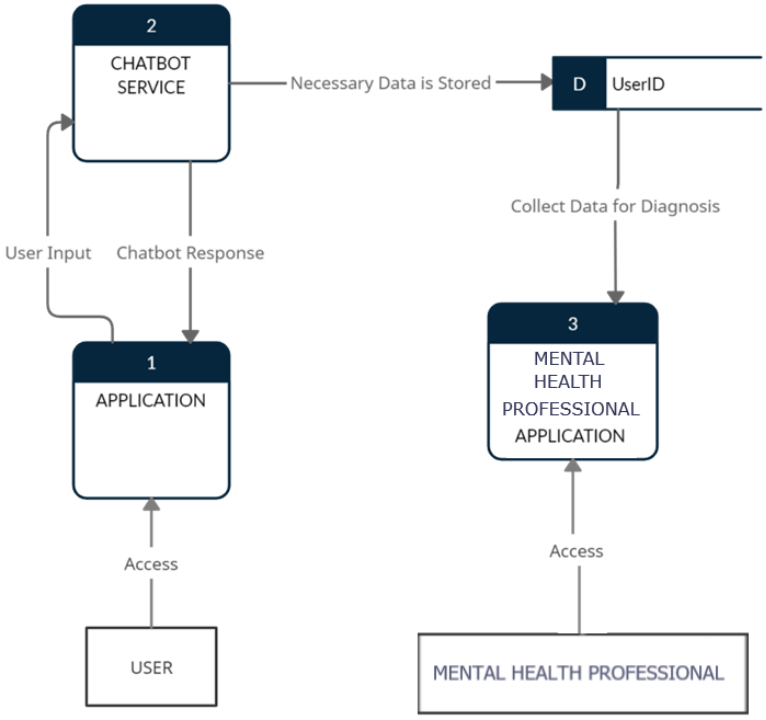


Figure 7. Process Design of the Proposed System.

The process design starts with the user giving input to the chatbot, which the chatbot receives and generates a response based on the input. The chatbot then stores this data in the database, which served as a repository for all user input and chatbot responses as shown in Figure 7.

The data are then passed to the admin, who can use it to analyze user behavior, identify patterns, and make

informed decisions to improve the chatbot's performance and user engagement.

The process design ensures that each component of the system works together seamlessly to create a smooth and engaging user experience. By defining clear steps and workflows for each interaction, the process design helps to identify potential bottlenecks or issues, enabling developers to optimize the chatbot's performance and ensure that it provides a positive user experience.

Methodology

System Development Life Cycle

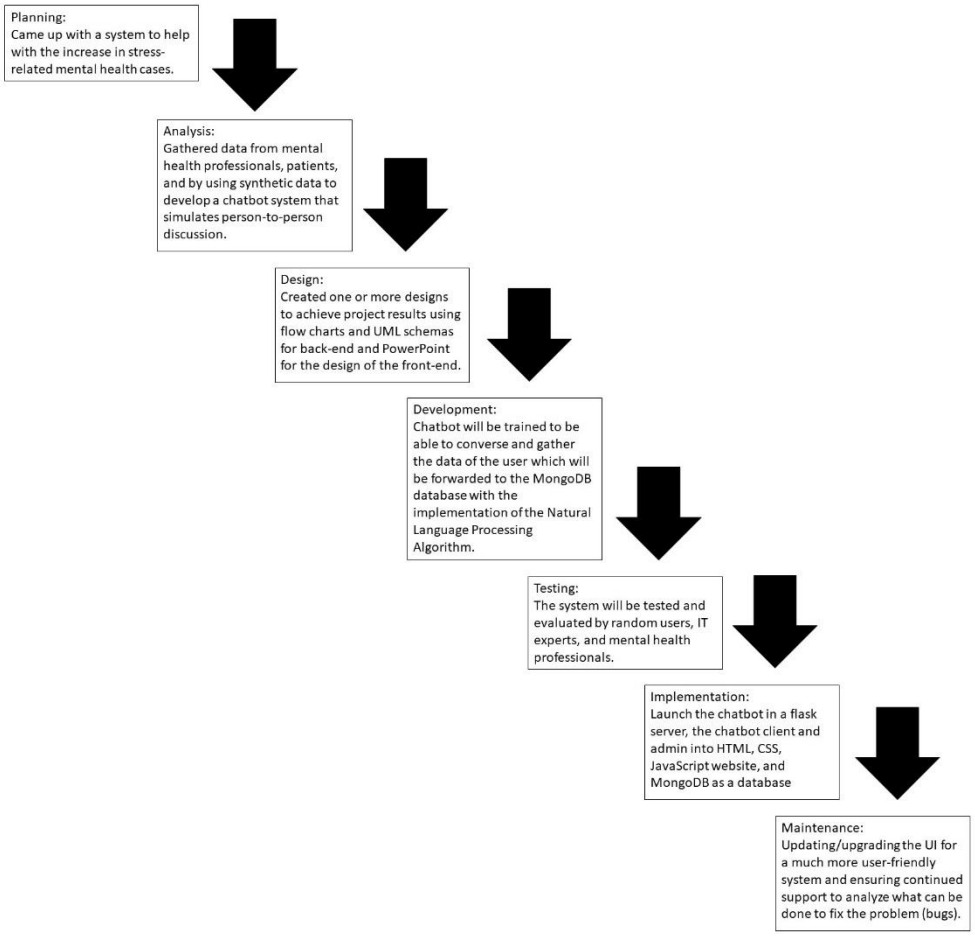


Figure 8. SDLC of the Proposed System.

As shown in Figure 8, for the chatbot system that simulates face-to-face discussion, the researchers followed the waterfall model to implement the system in a systematic manner. The chatbot was designed to receive

user input, process the text using NLP algorithms, and generate a response. The chatbot system was connected to a database where all user input and chatbot responses were stored for analysis and evaluation.

The System Development Life Cycle for the chatbot system involved several phases, including requirement gathering, analysis, design, development, testing implementation, and maintenance. Each phase had specific goals and objectives that were achieved before moving on to the next phase. This approach ensured that the chatbot system was thoroughly tested and evaluated before it was deployed to users.

CHAPTER 4 RESULTS AND DISCUSSION

Implementation

The researchers will integrate the system into the website that will be developed into a progressive web application using ReactJS and Bootstrap. Furthermore, the chatbot will be trained to be able to converse and gather the data of the user which will be forwarded to the MongoDB database with the implementation of the Natural Language Processing (NLP) algorithm.

Hardware and Software Specifications or Environment

Before the system could be implemented, some specifications were required. Hardware and software were all part of the requirements. The following conditions must be satisfied for the system to fully function and efficiently work.

Table 1

Hardware Specifications

Hardware	Description
Processor	Intel core i7 10th gen
Memory	16 GB
GPU	NVIDIA GeForce GTX 1660 Ti GPU
Hard Disk space	500 GB
Others	Other required standard computer peripherals, such as keyboard and mouse.

Hardware Specifications

A laptop was used to develop a chatbot and integrate to the website. In Table 1, the specifications of a laptop are shown.

Table 2

Software Specifications

Software	Description
Operating System	Microsoft Windows 10 Home (64-bit)

Development Tools (IDE)	Visual Studio Code and PyCharm Community Edition
Version Control System	GitHub
Database	MongoDB
Internet browser	Google Chrome, Mozilla Firefox, Brave Browser, etc.

Software Specifications

The software specification described the development of the software in connection to the software, as well as the requirements for the system to be authorized and implemented, (as shown in Table 2). Furthermore, the researchers used Visual Studio Code and PyCharm Community Edition as development tools (IDE) that helps the researchers develop software code efficiently, GitHub as version control system for storing, tracking and collaborating on the code of the system, and MongoDB as a document database for managing document-oriented information, store or retrieve information.

Gathered Dataset

The researchers gathered data from patients and mental health professionals which can be used for the conversation of the chatbot to the users. However, the gathered data are insufficient due to doctor and patient confidentiality. So, the researchers used synthetic data as the other option to make up for the insufficient data. The dataset that the researchers used can be found at the Kaggle website where data sets are published and was generated by Elvis (n.d.).

Dataset Details

The dataset contains basic conversations, therapy conversations, mental health FAQ, and general advice given to people suffering from anxiety and depression. Furthermore, this dataset was used to train a model for a chatbot that can give advice like a therapist would do and give emotional support to people who had mental health issues.

Intents are included in the dataset. An “intent” is the intention or purpose of a user’s message. For example, if the user were to say “I can’t sleep” to the

chatbot, then the intent of this would be "sleep". There is a collection of "Patterns" and "Responses" that are acceptable for the intent. Patterns are representations of a user's message that corresponds with the intent, whereas Responses are the responses provided by the chatbot in line with the intent. Various intents are established, and their patterns and responses are utilized as training data for the model to identify a specific intent.

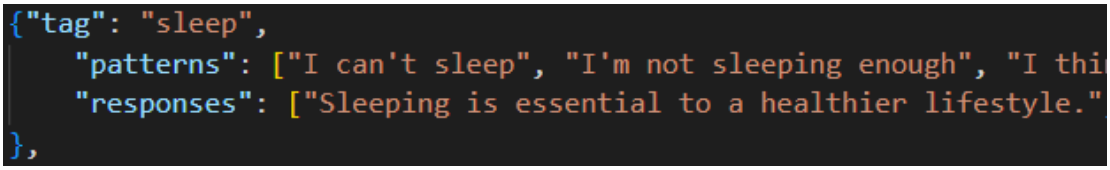


Figure 9. Intent ("sleep"), Patterns and Reponses of the Dataset.

Figure 9 shows the intent, patterns, and responses of the dataset. An "intent" is the intention or purpose of a user's message. For example, if the user were to say, "I can't sleep" to the chatbot, then the intent of this would be "sleep". There is a collection of "Patterns" and "Responses" that are acceptable for the intent. Patterns are representations of a user's message that corresponds with the intent, whereas Responses are

the responses provided by the chatbot in line with the intent. Various intents are established, and their patterns and responses are utilized as training data for the model to identify a specific intent.

Inputs and Outputs

The inputs and outputs of the system showed the overall functionality of the proposed thesis, "*Syrene: Chatbot Assisting Mental Health Professionals in Dealing with Patients/Clients Using Machine Learning*".

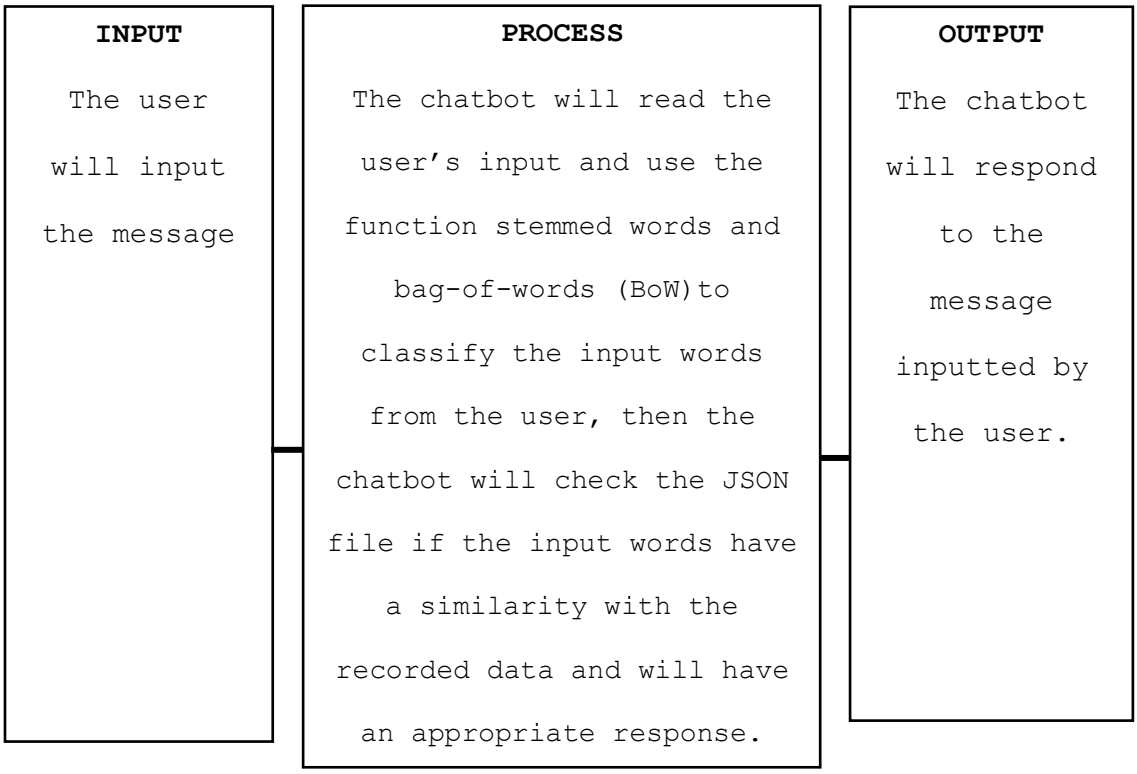
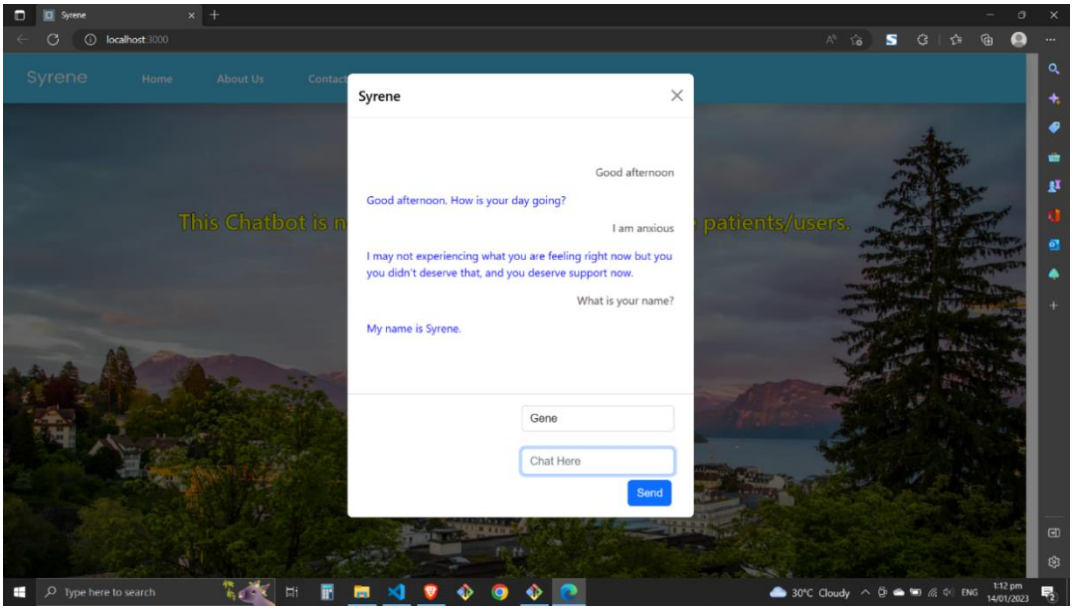


Figure 10. Inputs and Outputs of the Proposed System.

Figure 10 shows the process of how the users' input was read by the chatbot using the function stemmed words and bag-of-words (BoW) to classify the input words from the user. In addition, if the entered words are comparable to the recorded data, the chatbot will verify the JSON file and respond appropriately.



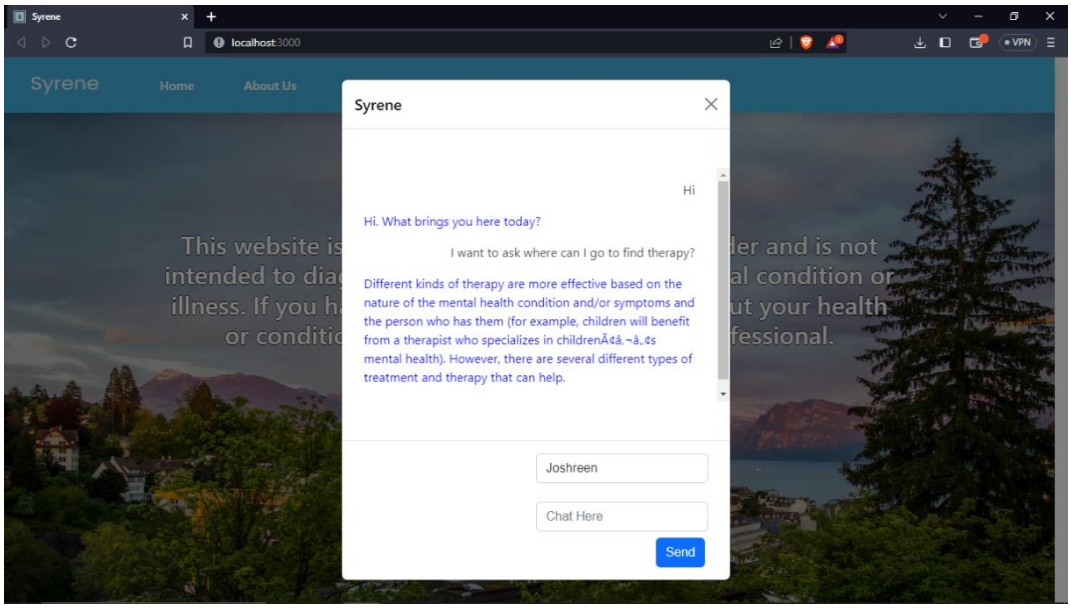


Figure 11. Process of the Proposed System Integrated to a Prototype Website.

Figure 11 illustrates how the chatbot utilizes a Machine Learning algorithm, specifically Natural Language Processing (NLP), to provide responses to user inputs. As the chatbot receives input from the user, it generates a relevant response based on its training data.

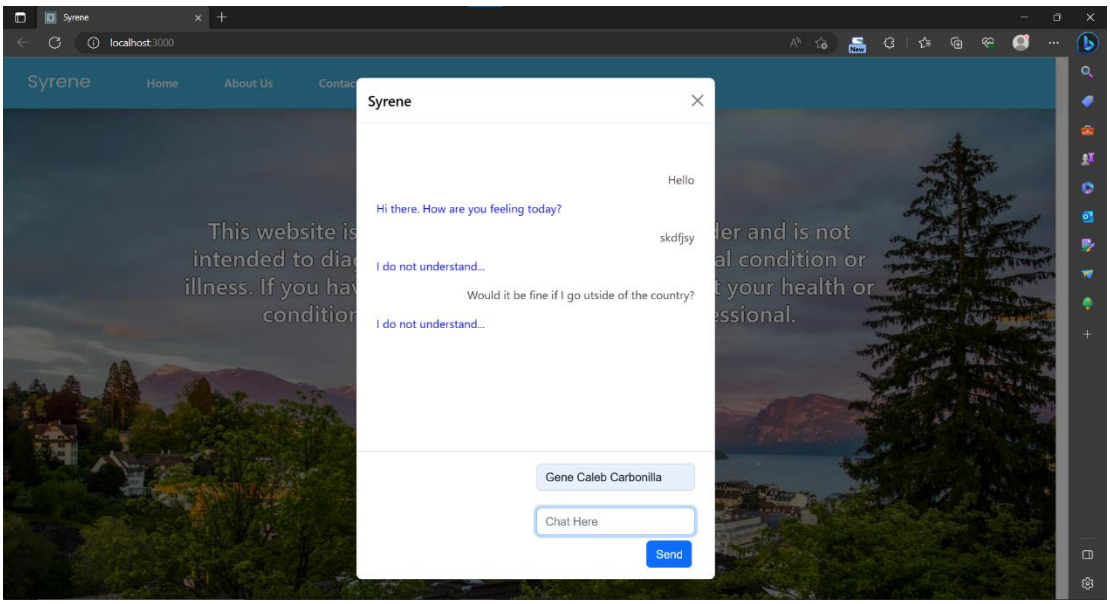


Figure 12. The Chatbot Can't Comprehend the Input of the User.

However, data in Figure 12 demonstrates that if the user inputs random characters or discusses a topic that is not included in the chatbot's trained response data, it will acknowledge that it cannot comprehend the input and provide an appropriate response. This emphasizes the

importance of providing the chatbot with adequate training data and highlights its limitations in understanding inputs outside of its knowledge base.

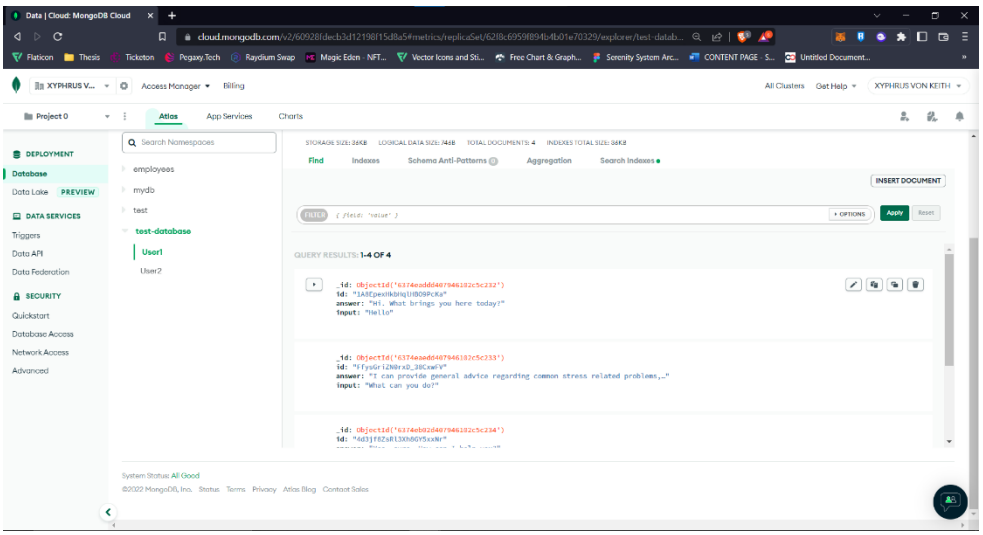


Figure 13. Data Saved in the Database (MongoDB).

Figure 13 shows where the data have been saved after the user input text chat on the website.

Results Interpretation and Analysis

The researchers gathered system evaluation results comprising five random users, five IT experts, and five mental health professionals in total of fifteen respondents. To determine the evaluation result from the respondents, the researchers used weighted mean to find out the average of the values.

The formula used:

$$M = \frac{\Sigma X_i}{n}$$

Where:

M – weighted mean

X_i – scores

n – total number of frequencies

Table 3

Evaluation Results by the Respondents

Respondents	Mean	Description
Random users	4.01	Good
IT experts	4.28	Good
Mental Health Professionals	2.39	Poor
Grand Mean	3.56	Fair

In Table 3, based on the evaluation from the respondents, the results showed that the highest rate attained was from the IT experts who were most familiar with using the system and saw that the system is capable in doing its job, functions well and is useful to users who will use the system.

On the other hand, the survey got the lowest rate from the mental health professionals since they preferred to have a personal interview with the patient rather than gathering their data through the chatbot.

Overall, the grand mean from the respondents is 3.56, rated as “fair”.

System Evaluation Results

The system was presented to the users to determine the quality and usability of the proposed system. The researchers used the ISO 25010 for specifying, measuring and evaluating the system product quality. It also gives a set of quality characteristics that may be evaluated for completeness to specified quality criteria. The criteria are made up of eight product quality characteristics and thirty-one sub-characteristics:

1. Functional Suitability – for functional completeness, functional correctness, and functional appropriateness.
2. Reliability – for maturity, availability, and fault tolerance.
3. Performance Efficiency – for time behavior, resource utilization, and capacity.
4. Usability – for appropriateness recognizability, learnability, operability, user error protection, user interface aesthetics, and accessibility.
5. Security – for confidentiality, integrity, non-repudiation, accountability, and authenticity.

6. Compatibility – for co-existence and interoperability.
7. Maintainability – for modularity, reusability, analyzability, modifiability, and testability.
8. Portability – for adaptability, installability, and replaceability.

Each quality characteristic is evaluated as "excellent", "good", "fair", "poor', "very poor". For statistical purposes, numerical weights were assigned as follows:

Description	Weight
Excellent	5.00
Good	4.00 – 4.99
Fair	3.00 – 3.99
Poor	2.00 – 2.99
Very Poor	1.00 – 1.99

Table 4

System Evaluation Results by Random Users

Criteria	Mean	Description
Functional Suitability	3.93	Fair
Performance Efficiency	4.27	Good
Compatibility	4.20	Good
Usability	3.83	Fair
Reliability	3.65	Fair
Security	3.92	Fair
Maintainability	4.08	Good
Portability	4.27	Good
Grand Mean	4.01	Good

In Table 4, the evaluation shows that Functional Suitability had a weighted mean of 3.93, rated as “fair”; Performance Efficiency had a weighted mean of 4.27, rated as “good”; Compatibility had a weighted mean of 4.20, rated as “good”; Usability had a weighted mean of 3.83, rated as “fair”; Reliability had a weighted mean of 3.65, rated as “fair”; Security had a weighted mean of 3.92, rated as “fair”; Maintainability had a weighted mean of 4.08, rated as “good”; and Portability had a weighted

mean of 4.27, rated as "good", having the total grand mean of 4.01, rated as "good".

The system got the highest rating for Performance Efficiency and Portability.

Random Users' Evaluation

According to the random users, the system functions/performs well without any problem and can be transferred from one environment to another. They also saw the potential of the system that it can be of used for people who have difficulty accessing in-person services or who prefer the privacy and convenience of online support.

Table 5

System Evaluation Results by IT Experts

Criteria	Mean	Description
Functional Suitability	4.27	Good
Performance Efficiency	4.33	Good
Compatibility	4.30	Good
Usability	4.20	Good

Reliability	4.25	Good
Security	4.32	Good
Maintainability	4.08	Good
Portability	4.53	Good
Grand Mean	4.28	Good

In Table 5, the evaluation shows that Functional Suitability had a weighted mean of 4.27, rated as “good”; Performance Efficiency had a weighted mean of 4.33, rated as “good”; Compatibility had a weighted mean of 4.30, rated as “good”; Usability had a weighted mean of 4.20, rated as “good”; Reliability had a weighted mean of 4.25, rated as “good”; Security had a weighted mean of 4.32, rated as “good”; Maintainability had a weighted mean of 4.08, rated as “good”; and Portability had a weighted mean of 4.53, rated as “good”, having the total grand mean of 4.28, rated as “good”.

The system got the highest rating for Portability since the system can be transferred without any problem from one environment to another.

IT experts' Evaluation

The IT experts' rating was all "good" because they saw the capability of the system and said that the system was very useful especially to users who had mental health issues and needed emotional support.

Table 6

System Evaluation Results by Mental Health Professionals

Criteria	Mean	Description
Functional Suitability	2.20	Poor
Performance Efficiency	2.33	Poor
Compatibility	2.20	Poor
Usability	2.53	Poor
Reliability	2.25	Poor
Security	2.64	Poor
Maintainability	2.40	Poor
Portability	2.60	Poor
Grand Mean	2.39	Poor

The evaluation in Table 6 shows that Functional Suitability had a weighted mean of 2.20, rated as "poor";

Performance Efficiency had a weighted mean of 2.33, rated as "poor"; Compatibility had a weighted mean of 2.20, rated as "poor"; Usability had a weighted mean of 2.53, rated as "poor"; Reliability had a weighted mean of 2.25, rated as "poor"; Security had a weighted mean of 2.64, rated as "poor"; Maintainability had a weighted mean of 2.40, rated as "poor"; and Portability had a weighted mean of 2.60, rated as "poor", having the total grand mean of 2.39, rated as "poor".

The system got the highest rating for Security since the Mental Health Professionals saw that the system is able to ensure that the data are only accessible to those who have authorized access and protects information and data from security invulnerabilities.

Mental Health Professionals' Evaluation

According to the Mental Health Professionals' evaluation, the majority rating was "poor" because they are not familiar with using the system and most probably preferred in a personal manner than in online.

Evaluation of the Algorithm

"*Syrene: Chatbot Assisting Mental Health Professionals in Dealing with Patients/Clients using Machine Learning*" uses Natural Language Processing as its algorithm. According to IT expert that the researchers consulted during the evaluation of the supposed system and algorithm is that there are no flaws and had all "good" ratings.

CHAPTER 5 SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary of the Proposed Study Design and Implementation

The *"Syrene: Chatbot Assisting Mental Health Professionals in Dealing with Patients/Clients using Machine Learning"* is helpful in assisting patients that have mental health conditions such as anxiety/depression. The system serves to aid people with mental health problems who are having difficulties interacting with people when seeking the help of mental health professionals.

The chatbot is integrated to the website that is developed into a progressive web application. Furthermore, the chatbot is trained to converse with the patient and gather the data which is forwarded to the mental health professional with the implementation of the algorithm NLP.

In this study, the system is built using a development platform that allows for efficient coding, a version control system for storing, tracking, and collaborating on code, and a document database for

managing documented-oriented information, storing, or retrieving data.

Summary of Findings

Table 7

System Evaluation Results by Random Users Summary

Criteria		Mean
Performance Efficiency		
Time behavior		4.60
Resource utilization		4.40
Capacity		3.80
	Mean	4.27
Portability		
Adaptability		4.00
Installability		4.40
Replaceability		4.40
	Mean	4.27
	OVERALL MEAN	4.27

Table 7 provides an overview of the evaluation of results of the respondents during the testing and evaluation.

Table 8

System Evaluation Results by IT Experts Summary

Criteria	Mean
Portability	
Adaptability	4.80
Installability	4.60
Replaceability	4.20
Mean	4.53

Table 9

System Evaluation Results by Mental Health Professionals Summary

Criteria	Mean
Security	
Confidentiality	2.60
Integrity	2.80
Non-repudiation	2.60

Accountability		2.60
Authenticity		2.60
	Mean	2.64

Performance efficiency is a characteristic that represents the performance relative to the number of resources used under stated conditions. This characteristic is composed of the following sub-characteristics: time behavior, resource utilization, and capacity. Time behavior evaluates the degree to which the response and processing times and throughput rates when performing its functions meet requirements. Resource utilization evaluates the degree to which the amounts and types of resources used by a product or system, when performing its functions, meet requirements. Lastly, replaceability evaluates the degree to which the maximum limits of product or system parameter meet requirements. Based on the evaluation of the five random users, the system got a mean of 4.27 (Good).

Portability emphasizes the ease with which a system may be transferred from one hardware, software, or other operational or usage environment to another. This

characteristic is composed of the following sub-characteristics: adaptability, installability, and replaceability. Adaptability evaluates the degree to which a system may be effectively and efficiently adapted for a new or evolving hardware, software, or other usage environments. Installability evaluates the degree of efficacy and efficiency with which a product may be installed and/or uninstalled in a specified environment. Lastly, replaceability evaluates the degree to which a product may replace another specified software product in the same environment for the same purpose. Based on the evaluation of the five random users and five IT experts, the system got a mean of 4.27 (Good) and 4.53 (Good), respectively.

Security describes the degree to which a system protects information and data so that individuals or the system have data access appropriate to their types and levels of authorization. This characteristic is composed of the following sub-characteristics: confidentiality, integrity, non-repudiation, accountability, and authenticity. Confidentiality evaluates the degree to which a system ensures that the data are only accessible

to those who have been granted access. Integrity evaluates the degree to which a system prevents computer programs or data from unauthorized access or modification. Non-repudiation evaluates the degree to which actions or events may be shown to have occurred so that actions cannot be repudiated afterwards. Accountability evaluates the degree to which an entity's actions may be traced uniquely to the entity. Lastly, authenticity evaluates the degree to which a subject's or resource's identity may be proven to be the one claimed. Based on the evaluation of the five mental health professionals, the system got a mean of 2.64 (Poor).

Conclusions

The goals of the suggested system as outlined in the study's first phase were achieved by the researchers.

1. The researchers were able to develop a support system that uses Machine Learning Algorithms and Natural Language Processing (NLP) to facilitate text conversation analysis and communication between mental health professionals and their patients who have mental health conditions. The system can successfully make a decent conversation to a patient regarding stress-related problems which simulates face-to-face discussions.
2. The researchers were able to gather information from the patients and Mental Health Professionals and convert it into a JSON (JavaScript Object Notation) file that the system can utilize as a dataset. However, the gathered data are insufficient due to the confidentiality of the information. So, the researchers used synthetic data as the other option to make up for the insufficient data.

3. The researchers were able to use Machine Learning for Natural Language Processing (NLP) to imitate the conversational approach of mental health professionals in dealing with their patients/clients on a website by training the system's dataset that will go through an epoch, which means training the neural network with all the training data for one cycle.
4. The researchers were able to assess the proposed system's usability and quality in relation to the target user. The system was tested by random users, IT professionals, and mental health professionals to which the researchers have concluded the overall result as "fair".

Contributions

The present study attempts to address multiple gaps and in doing so makes important contributions.

1. The study extends the limited research on the understanding of using a chatbot in assisting mental health professionals with patients and clients with the help of machine learning. The present study is among the chatbots that uses machine learning. They believe that chatbots will play an important role in developing a new way to assist people in their daily lives and mental illnesses. The study also shows that chatbots can help in a variety of other mental-health related fields. For instance, a conversation with a machine can provide an understanding for someone suffering from depression or anxiety. This can lead to more effective treatment and a better life.
2. For the website "*Syrene*", Machine Learning (ML) was used for Natural Language Processing (NLP) to emulate the conversational approach of mental health professionals in dealing with their patients.

3. Assess the proposed system's quality and usability in relation to its intended users. Verify that the proposed system meets the intended use with its capabilities.

Recommendations

According to the findings of the study and the judgments made, it is advised:

1. That adding a user log in feature would be helpful to keep track of each user's information;
2. That allowing a user to send their review regarding the website can help improve the system;
3. That allowing the doctor to have a conversation with the patient through the app and not only rely on the inputs from the database;
4. That training the chatbot more in order to have an extensive scope of topics that the chatbot can tackle with;
5. That the website's user interface can still be improved; and
6. That chatbot system is best used by guidance counselors/school counselors in assisting the students as psychologists prefer to have a personal engagement with the patient.

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Appendices

Appendix A

Letter to the Adviser

DR. FRANK I. ELIJORDE
Associate Dean of CICT
West Visayas State University Main Campus
Luna Street, La Paz, Iloilo City

Dear Dr. Elijorde,

The undersigned are BS in Computer Science Research 1/Thesis 1 students of CICT, this university. Our thesis/capstone project title is "SYRENE: CHATBOT ASSISTING MENTAL HEALTH PROFESSIONALS IN DEALING WITH PATIENTS/CLIENTS USING MACHINE LEARNING".

Knowing of your expertise in research and on the subject matter, we would like to request you to be our ADVISER.

We are positively hoping for your acceptance. Kindly check the corresponding box and affix your signature in the space provided. Thank you very much.

Sincerely yours,

Gene Caleb Carbonilla
Xyphrus Von Keith Caguan
Joshreen Reyes
Jirah Kate Solano

Appendix B

Letter to the Technical Editor

DR. FRANK I. ELIJORDE
Associate Dean of CICT
West Visayas State University

Dear Dr. Elijorde;

Greetings!

We are the 4th year Bachelor of Science in Computer Science students of West Visayas State University. As part of the requirements for the degree, we are conducting a research study entitled, "SYRENE: CHATBOT ASSISTING MENTAL HEALTH PROFESSIONALS IN DEALING WITH PATIENTS/CLIENTS USING MACHINE LEARNING".

In connection with this, we would like to request for your expert service as our thesis technical editor. We believe that your expertise would be a great help for our research.

Thank you very much and we are hoping for your positive response.

Respectfully yours,

Gene Caleb Carbonilla
Xyphrus Von Keith Caguan
Joshreen Reyes
Jirah Kate Solano

Appendix C

Letter to the English Editor

ANABELLE L. BAGA-AN
Faculty, DEFFLS
College of Arts and Sciences
West Visayas State University

Dear Ma'am Baga-an;

Greetings!

We are the 4th year Bachelor of Science in Computer Science students of West Visayas State University. As part of the requirements for the degree, we are conducting a research study entitled, "SYRENE: CHATBOT ASSISTING MENTAL HEALTH PROFESSIONALS IN DEALING WITH PATIENTS/CLIENTS USING MACHINE LEARNING".

In connection with this, we would like to request for your expert service as our thesis English editor. We believe that your expertise would be a great help for our research.

Thank you very much and we are hoping for your positive response.

Respectfully yours,

Gene Caleb Carbonilla
Xyphrus Von Keith Caguan
Joshreen Reyes
Jirah Kate Solano

Appendix D

Letter to the Psychiatrist

DR. JAPHET P. GENSAYA- FERNANDEZ DE LEON, M.D., FPPA, FPSCAP
Adult, Child & Adolescent Psychiatry
Iloilo Doctors Hospital, Inc.

Dear Dr. De Leon;

Greetings!

We are the 4th year Bachelor of Science in Computer Science students of West Visayas State University. As part of the requirements for the degree, we are conducting a research study entitled, "SYRENE: CHATBOT ASSISTING MENTAL HEALTH PROFESSIONALS IN DEALING WITH PATIENTS/CLIENTS USING MACHINE LEARNING".

In this connection, we would like to ask permission if we could conduct an interview with you. We believe that your expertise would be a great help for conducting our research.

For further questions you may contact us on this number, 09219931155 or email us through joshreen.reyes@wvsu.edu.ph.

Thank you very much and we are hoping for your positive response.

Respectfully yours,
Gene Caleb Carbonilla
Xyphrus Von Keith Caguan
Joshreen Reyes
Jirah Kate Solano

Appendix E

Letter to the Medical Center Chief

DR. JOSEPH DEAN NICOLO, MD, FPCS, FPSGS, MPA
Medical Center Chief II
Western Visayas Medical Center

Dear Dr. Nicolo:

Greetings!

We are the 4th year Bachelor of Science in Computer Science students of West Visayas State University. As part of the requirements for the degree, we are conducting a research study entitled, "SYRENE: CHATBOT ASSISTING MENTAL HEALTH PROFESSIONALS IN DEALING WITH PATIENTS/CLIENTS USING MACHINE LEARNING".

In this connection, we would like to ask permission from your good office to allow us to conduct an interview from any of your psychiatrists. We believe that their expertise would be a great help for conducting our research.

For further questions you may contact us on this number, 09325695714 or email us thru joshreen.reyes@wvsu.edu.ph.

Thank you very much and we are hoping for your positive response.

Respectfully yours,

Gene Caleb Carbonilla
Xyphrus Von Keith Caguan
Joshreen Reyes
Jirah Kate Solano

Appendix F

Letter to the School Principal

MRS. MA. EMILY CALUMPANG
School Principal II
Calinog National Comprehensive High School

Dear Ma'am Calumpang;

Greetings!

We are the 3rd year Bachelor of Science in Computer Science students of West Visayas State University. As part of the requirements for the degree, we are conducting a research study entitled, "SYRENE: CHATBOT ASSISTING MENTAL HEALTH PROFESSIONALS IN DEALING WITH PATIENTS/CLIENTS USING MACHINE LEARNING".

In this connection, we would like to ask permission from your good office to allow us to conduct an interview with your guidance counselor on Monday, April 13, 2022.

For further questions you may contact us on this number, 09325695714 or email us thru joshreen. reyes@wvsu.edu.ph.

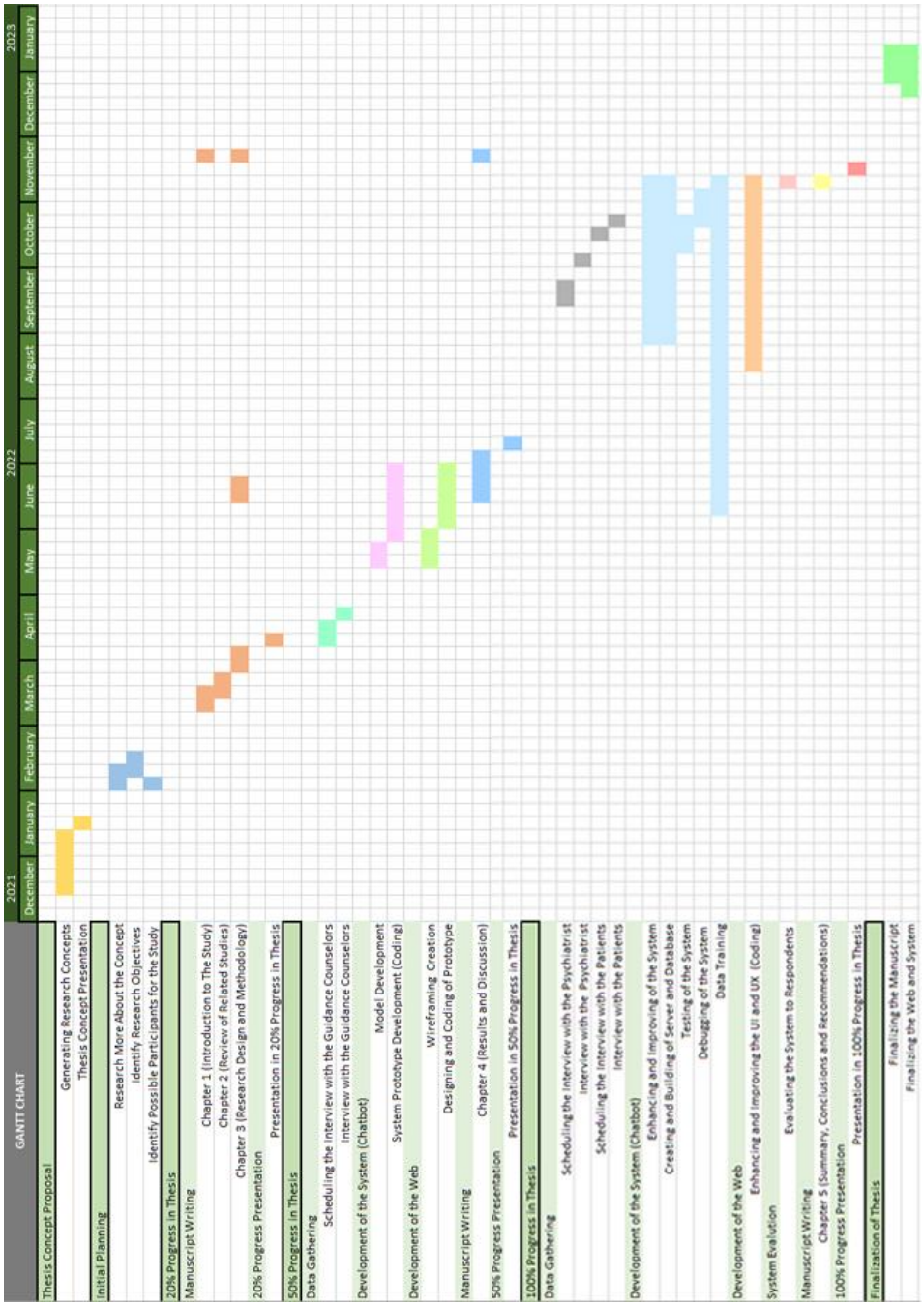
Thank you very much and we are hoping for your positive response.

Respectfully yours,

Gene Caleb Carbonilla
Xyphrus Von Keith Caguan
Joshreen Reyes
Jirah Kate Solano

Appendix G

Gantt Chart



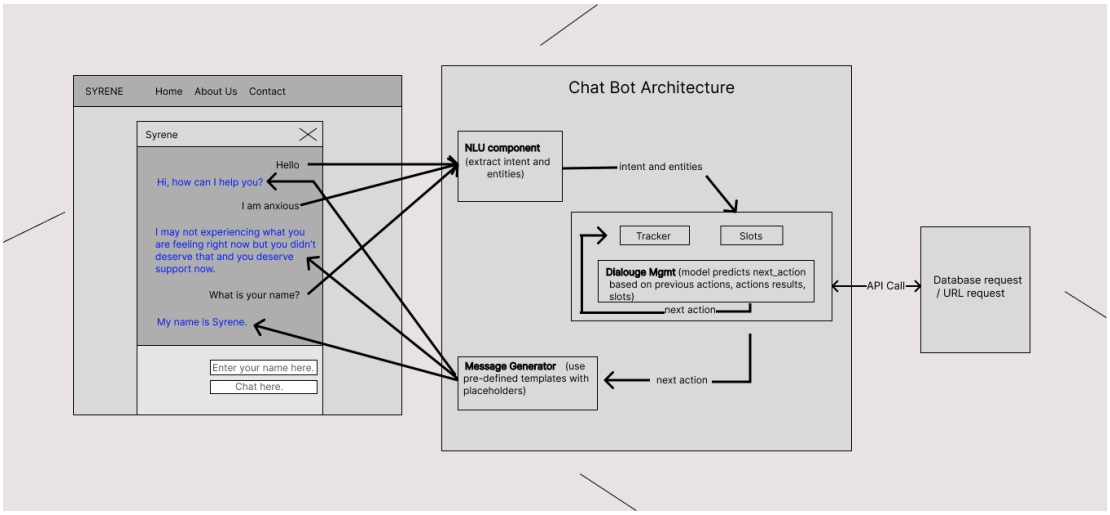
Appendix H

Data Dictionary

Field name	Data Type	Description	Example
User Name	Text	Name of the User	Patient 1
User Messsage	Text	Message input by the user	Hello
Chatbot Reply	Text	Message reply of the chatbot to the user	Hello there

Appendix I

Entity-Relationship Diagram



Appendix J

Sample Program Codes

```
import numpy as np
import random
import json
import matplotlib.pyplot as plt
import torch
import torch.nn as nn
from torch.utils.data import Dataset, DataLoader

from nltk_utils import bag_of_words, tokenize, stem
from model import NeuralNet

with open('intents.json', 'r') as f:
    intents = json.load(f)

all_words = []
tags = []
xy = []
# loop through each sentence in our intents patterns
for intent in intents['intents']:
```

```
    tag = intent['tag']
    # add to tag list
    tags.append(tag)
    for pattern in intent['patterns']:
        # tokenize each word in the sentence
        w = tokenize(pattern)
        # add to our words list
        all_words.extend(w)
        # add to xy pair
        xy.append((w, tag))

# stem and lower each word
ignore_words = ['?', '.', '!']
all_words = [stem(w) for w in all_words if w not in
ignore_words]
# remove duplicates and sort
all_words = sorted(set(all_words))
tags = sorted(set(tags))

print(len(xy), "patterns")
print(len(tags), "tags:", tags)
print(len(all_words), "unique stemmed words:", all_words)
```

```
# create training data
X_train = []
y_train = []
for (pattern_sentence, tag) in xy:
    # X: bag of words for each pattern_sentence
    bag = bag_of_words(pattern_sentence, all_words)
    X_train.append(bag)
    # y: PyTorch CrossEntropyLoss needs only class
labels, not one-hot
    label = tags.index(tag)
    y_train.append(label)

X_train = np.array(X_train)
y_train = np.array(y_train)

# Hyper-parameters
num_epochs = 1000
batch_size = 8
learning_rate = 0.001
input_size = len(X_train[0])
hidden_size = 8
output_size = len(tags)
```

```
print(input_size, output_size)


class ChatDataset(Dataset):


    def __init__(self):
        self.n_samples = len(X_train)
        self.x_data = X_train
        self.y_data = y_train


    # support indexing such that dataset[i] can be used
to get i-th sample
    def __getitem__(self, index):
        return self.x_data[index], self.y_data[index]


    # we can call len(dataset) to return the size
    def __len__(self):
        return self.n_samples


dataset = ChatDataset()
train_loader = DataLoader(dataset=dataset,
                          batch_size=batch_size,
                          shuffle=True,
```

```
                            num_workers=0)


device = torch.device('cuda' if torch.cuda.is_available()
else 'cpu')


model = NeuralNet(input_size, hidden_size,
output_size).to(device)


# Loss and optimizer
criterion = nn.CrossEntropyLoss()
optimizer = torch.optim.Adam(model.parameters(),
lr=learning_rate)


# Train the model
list = []
for epoch in range(num_epochs):
    for (words, labels) in train_loader:
        words = words.to(device)
        labels = labels.to(dtype=torch.long).to(device)


        # Forward pass
        outputs = model(words)
```

```
        # if y would be one-hot, we must apply
        # labels = torch.max(labels, 1)[1]
        loss = criterion(outputs, labels)

        # Backward and optimize
        optimizer.zero_grad()
        loss.backward()
        optimizer.step()

    if (epoch+1) % 100 == 0:
        print (f'Epoch [{epoch+1}/{num_epochs}], Loss:
{loss.item():.4f}')
        new_loss_data = (f'{loss.item():.4f}')
        list.append(new_loss_data)

print(f'final loss: {loss.item():.4f}')

epochs = [100, 200, 300, 400, 500, 600, 700, 800, 900,
1000]
loss_data = np.array(list)
print(epochs)
print(loss_data)
```

```
plt.plot(epochs, loss_data, 'g', label='Training loss')

plt.title('Training loss')

plt.xlabel('Epochs')

plt.ylabel('Loss')

plt.title('Training loss')

plt.legend()

plt.show()


data = {

"model_state": model.state_dict(),

"input_size": input_size,

"hidden_size": hidden_size,

"output_size": output_size,

"all_words": all_words,

"tags": tags

}


FILE = "data.pth"

torch.save(data, FILE)


print(f'training complete. file saved to {FILE}')
```

Appendix K

Interview Form

SYRENE: CHATBOT ASSISTING MENTAL HEALTH PROFESSIONALS IN PATIENTS/CLIENTS USING MACHINE LEARNING

Purpose of the Interview:
To find the best approach in developing our program made with the intent to aid youth (ages 15-24) suffering from stress related problems.

Questions:

1. What is the common stress related problems that patients encounter?

2. What are the common words or phrases patients use to describe their problem?

3. What are your tips on how to approach patients?

4. What topics to avoid when dealing with patients in distress?

5. How do you approach a religious patient?

Appendix L

Software Quality Evaluation Form

Instruction:

Please tick (√) the rating that best apply to each statement about the system entitled "your title"

(5 – Excellent, 4- Good, 3 – Fair, 2 – Poor, 1 – Very Poor)

ISO 25010 Quality Characteristics	5	4	3	2	1
Functionality Suitability					
1. Functional completeness. (The system's set of functions covers all the specified tasks and user objectives)					
2. Functional correctness. (the system provides the correct results with the needed degree of precision)					
3. Functional appropriateness. (The system's functions facilitate the accomplishment of specified tasks and objectives)					
Performance efficiency					
1. Time behavior. (The system's response and processing times and throughput meet requirements.)					
2. Resource utilization. (The amounts and types of resources used by the system meet requirements.)					
3. Capacity. (The maximum limits of a product or system parameter meet requirements.					
Compatibility					
1. Co-existence. (The system can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product)					
2. Interoperability. (The system can exchange information and use the information that has been exchanged.**)**					
Usability					
1. Appropriateness recognizability. (The users recognize the appropriate need of the system)					
2. Learnability. (The users can use the system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use to achieve specified goals of learning)					
3. Operability. (The system is easy to operate and control)					

ISO 25010 Quality Characteristics	5	4	3	2	1
4. User error protection. (The system protects users against making errors)					
5. User interface aesthetics. (The user interface enables pleasing and satisfying interaction for the user)					
6. Accessibility. (The system is designed to be used by different types of users)					
Reliability					
1. Maturity. (the system is reliable under normal operation)					
2. Availability. (the system is reliable in times it is required to be used)					
3. Fault tolerance. (The system operates as intended despite the presence of hardware or software faults)					
4. Recoverability. (In the event of an interruption or a failure, the system can recover the data directly affected and re-establish the desired state of the system)					
Security					
1. Confidentiality. (The system ensures that data are accessible only to those authorized to have access)					
2. Integrity. (The system prevents unauthorized access to, or modification of, computer programs or data.)					
3. Non-repudiation. (The system records transactions and can be proven to have taken place so that the transactions cannot be repudiated later)					
4. Accountability. (The transactions can be traced uniquely to the entity).					
5. Authenticity. (The identity / function of the resource is the same as it was discussed).					
Maintainability					
1. Modularity. (the system is composed of discrete components such that a change to one component has minimal impact on other components)					
2. Reusability. (A part of a system can be used in more than one system, or in building other systems).					
3. Analysability. (The impact of the intended change to one or more parts of the system can be assessed, diagnosed for deficiencies or failures, or be identified on which parts to be modified.)					
4. Modifiability. (The system can be effectively and efficiently modified without introducing defects or degrading existing quality)					
5. Testability. (test criteria can be established for the system and tests can be performed to determine whether those criteria have been met)					

ISO 25010 Quality Characteristics	5	4	3	2	1
Portability					
1. Adaptability. (The system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments.)					
2. Installability. (The system can be successfully installed and/or uninstalled in a specified environment.					
3. Replaceability. (The system can replace another specified software product for the same purpose in the same environment)					

Thank you very much for taking part in this survey.

Source: ISO/IEC 25010. http://iso25000.com/index.php/en/iso-25000-standards/iso-25010?limit=3&limitstart=0

Appendix M

Documentation

Researchers with the Guidance Counselors

Researchers with the Psychiatrist

Researchers with the Random Users

Researchers with the IT Professionals

Researchers with the IT Professionals

Appendix N

Adviser's Endorsement Form

	ADVISER'S ENDORSEMENT FORM (For Thesis Manuscript)	Document No.	WVSU-ICT-SOI-03-F10
		Issue No.	1
		Revision No.	0
	WEST VISAYAS STATE UNIVERSITY	Date of Effectivity:	April 27, 2018
		Issued by:	CICT
		Page No.	Page 1 of 1

Respectfully endorsed to the **Technical Editor**, the attached manuscript of the thesis entitled:

Syrene: Chatbot Assisting Mental Health Professionals in Dealing With Patients/Clients using Machine Learning

Said manuscript has been presented to me for preliminary evaluation and guidance, and after a series of corrections/directions given which was implemented by the proponents whose names are listed hereunder and their thorough research, we have come to its completion.

Now therefore, I hereby **ENDORSE** the said thesis manuscript to the Technical Editor for **TECHNICAL EDITING**.

DR. FRANK I. ELIJORDE
Adviser's Name & Signature

Date: 5/29/23

Group Members:
1. Gene Caleb C. Carbonilla
2. Xyphrus Von Keith V. Caguan
3. Joshreen D. Reyes
4. Jirah Kate C. Solano

Note: *This form should be accomplished and signed if the corrections and changes made by the adviser have been implemented and a new copy of the document have been printed for checking and submission to the next editor*

Appendix O

Technical Editor's Endorsement Letter

	TECHNICAL EDITOR'S ENDORSEMENT FORM (For Thesis Manuscript)	Document No.	WVSU-ICT-SOI-03-F11
		Issue No.	1
		Revision No.	0
	WEST VISAYAS STATE UNIVERSITY	Date of Effectivity:	April 27, 2018
		Issued by:	CICT
		Page No.	Page 1 of 1

Respectfully endorsed to the **English Editor**, the attached manuscript of the thesis entitled:

Syrene: Chatbot Assisting Mental Health Professionals in Dealing With Patients/Clients using Machine Learning

Said manuscript was presented to me and was reviewed and edited in terms of technical specifications, correctness of diagrams and other technical matters. The corrections and suggestions were carried and implemented by the proponents whose names are listed hereunder.

Now therefore, I hereby **ENDORSE** the said thesis manuscript to the English Editor/Grammarian for **English Grammar Editing.**

DR. FRANK I. ELIJORDE
Technical Editor's Name & Signature

Date: 5/10/23

Group Members:
1. Gene Caleb C. Carbonilla
2. Xyphrus Von Keith V. Caguan
3. Joshreen D. Reyes
4. Jirah Kate C. Solano

Note: *This form should be accomplished and signed if the corrections and changes made by the Technical Editor have been implemented and a new copy of the document have been printed for checking and submission to the next editor.*

Appendix P

English Editor's Endorsement Letter

	ENGLISH EDITOR/GRAMMARIAN'S ENDORSEMENT FORM (For Thesis Manuscript)	Document No.	WVSU-ICT-SOI-03-F12
		Issue No.	1
		Revision No.	0
	WEST VISAYAS STATE UNIVERSITY	Date of Effectivity:	April 27, 2018
		Issued by:	CICT
		Page No.	Page 1 of 1

Respectfully endorsed to the **Thesis Format Editor**, the attached manuscript of the thesis entitled:

Syrene: Chatbot Assisting Mental Health Professionals in Dealing With Patients/Clients using Machine Learning

Said manuscript was presented to me for English grammar editing, corrections have been made and the proponents whose names are listed hereunder implemented said corrections and changes in the revised manuscript.

Now therefore, I hereby **ENDORSE** the said thesis manuscript for **Thesis Format Editing**.

ANABELLE L. BAGA-AN
English Editor/Grammarian's Name and Signature

Date: 5/27/23

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3. Joshreen D. Reyes
4. Jirah Kate C. Solano

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Appendix Q

Thesis Format Editor's Endorsement Letter

	THESIS FORMAT EDITOR'S ENDORSEMENT FORM (For Thesis Manuscript)	Document No.	WVSU-ICT-SOI-03-F13
		Issue No.	1
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	WEST VISAYAS STATE UNIVERSITY	Date of Effectivity:	April 27, 2018
		Issued by:	CICT
		Page No.	Page 1 of 1

Respectfully endorsed to the **Thesis Coordinator**, the attached manuscript of the thesis entitled:

Syrene: Chatbot Assisting Mental Health Professionals in Dealing With Patients/Clients using Machine Learning

Said manuscript was presented to me and has checked the preliminaries, thesis document convention and end matters, made some corrections which were implemented by the proponents whose names are listed hereunder.

Now therefore, I hereby **ENDORSE** said manuscript to the Thesis Coordinator for appropriate action.

DR. MA LUCHE SABAYLE
Thesis Format Editor's Name and Signature

Date: 5/29/23

Group Members:
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Appendix R

Disclaimer

This software project and its corresponding documentation entitled *"Syrene: Chatbot Assisting Mental Health Professionals in Dealing with Patients/Clients Using Machine Learning* is submitted to the College of Information and Communications Technology, West Visayas State University, in partial fulfillment of the requirements for the degree, Bachelor of Science in Computer Science. It is the product of our own work, except were indicated text.

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June 2023