

Chatbot for COVID-19

Final Project

KNOWLEDGE AND EXP SYSTEMS
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Introduction

Coronavirus disease a.k.a COVID-19 is a viral contagious disease caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The first known case was identified in Wuhan, China, in December 2019. Since then, the disease spread worldwide, leading to the ongoing COVID-19 pandemic with new mutations coming on a frequent basis. This pandemic has been responsible for the significant loss of human life worldwide and thus poses an unprecedented challenge to public health, food systems and the job market. The economic and social disruption caused by COVID is devastating. Symptoms of COVID-19 vary but prominent ones include fever, cough, headache, fatigue, breathing difficulties, loss of smell and taste. These usually begin one to fourteen days after exposure to the virus and about a third of people who are infected do not develop noticeable symptoms.

Artificially intelligent (AI) based conversational agents commonly known as chatbots are the latest inventions utilized to combat the novel SARS-CoV-2 coronavirus COVID-19 amidst the panic that it has created in different parts of the world. In the past, they have been fruitful in various sectors, however this pandemic has made us realize that there isn't enough human power to control this widespread disease. Chatbots enable users to communicate and interact with software applications that can intelligently respond to frequently asked questions using AI based tools. These applications can be accessed via a website or social media messaging platforms including WhatsApp and Facebook. Some recent examples of chatbots include the World Health Organization (WHO) Bot to fight COVID-19. The bot is responsible to output answers for questions on protecting themselves from the Coronavirus to understand news, symptoms and facts about the disease so as to mitigate the effects associated. Having said that the ability of AI based chatbots is endless with future possible health chatbots answering not just the end-user's questions but helpful in assisting patients consumers in scheduling their appointments and issuing reminders in For improving their medication process and overall health thereby enacting the role similar to health consultants. Developers believe that AI based technologies can attain human-level intelligence in the next ten years 2029 and are expected to cross the level of human intelligence in the next forty years.

Our aim is to build a chatbot expert system which can identify the intent of the input message and respond to COVID-19 user-queries and frequently asked questions. These may vary from extracting information about the symptoms, available vaccines in the market, transmission of the disease, the role of climate in its spread and finally any particular kind of food items to reduce the extremity level of the disease.

Task and Purpose of the Expert System

Expert System is an interactive and reliable computer-based decision-making system which uses both facts and heuristics to solve complex decision-making problems. It is considered at the highest level of human intelligence and expertise. The purpose of an expert system is to solve the most complex issues in a specific domain.

The Expert System in AI can resolve many issues which generally would require a human expert. It is based on knowledge acquired from an expert. Artificial Intelligence and Expert

Systems are capable of expressing and reasoning about some domain of knowledge. Expert systems were the predecessor of the current day artificial intelligence, deep learning and machine learning systems.

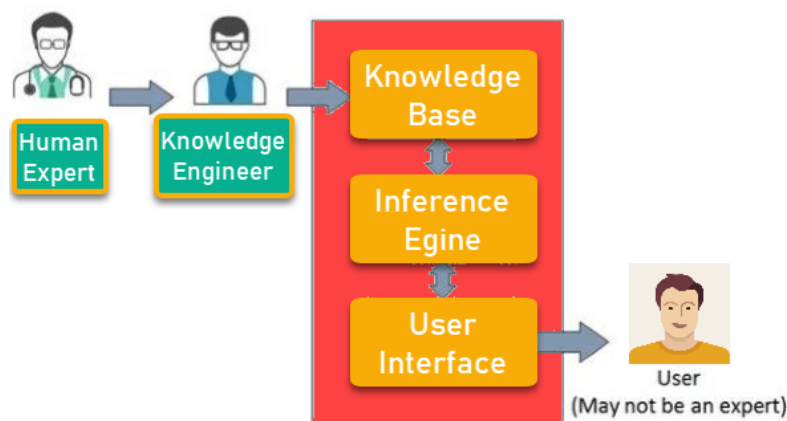
Following are the Expert System Examples:

- **MYCIN:** It was based on backward chaining and could identify various bacteria that could cause acute infections. It could also recommend drugs based on the patient's weight. It is one of the best Expert System Examples.
- **DENDRAL:** Expert system used for chemical analysis to predict molecular structure.
- **PXDES:** An Example of Expert System used to predict the degree and type of lung cancer
- **CaDet:** One of the best Expert System Example that can identify cancer at early stages

Following are the important Characteristics of Expert System in AI:

- The Highest Level of Expertise
- Right on Time Reaction
- Good Reliability
- Flexible
- Effective Mechanism
- Capable of handling challenging decisions and problems.

Components of Expert Systems:



Purpose of Expert System in creating Chatbots:

Chatbots are typically a rule-based and bounded software system that has well-defined categories that automate human interactions. The Chatbots are uncomplicated to build and follow some predefined stream. The Chatbots will give responses to the only pre-determined linear flow of conversations. Suppose if a Chatbot is built to provide solutions for problems A, B, and C. The bot immediately responds when those three instances occur. If a human gives anything other than those three instants, the bot sends you an error message. The Chatbots ease the process for humans by removing clicking on a menu of choices; you can talk or type as you communicate with a human agent. The Chatbots are categorized under three categories based on their purpose, level of advancement, and communication channels.

They are:

- Button/Menu

- Keyword-recognition
- Contextual

The one that we have built is more of an intent based model. The components of the expert system for our chatbot project are as follows:

1. **User Interface:** The user interface is the most crucial part of the Expert System Software. This component takes the user's query in a readable form and passes it to the inference engine. After that, it displays the results to the user. For our project, users can input any question related to COVID 19 and that question will be passed to the inference engine and once it gets the required output the response to that question will be displayed.
2. **Inference engine:** This is the brain of the project. Inference engine contains rules to solve a specific problem. It refers to knowledge from the Knowledge Base. It selects facts and rules to apply when trying to answer the user's query. It provides reasoning about the information in the knowledge base. It also helps in deducting the problem to find the solution. Based on the rules defined, it will help to get the correct response to each question that the user feeds into the system.
3. **Knowledge Base:** The knowledge base is a repository of facts. It stores all the knowledge about the problem domain. It is like a large container of knowledge which is obtained from different experts of a specific field. So we have a large collection of questions and answers on each topic which serves as a knowledge base for our project.

Advantages of Expert System

Below are the main advantages/benefits of Expert Systems:

- It improves the decision quality
- Cuts the expense of consulting experts for problem-solving
- It provides fast and efficient solutions to problems in a narrow area of specialization.
- It can gather scarce expertise and use it efficiently.
- Offers consistent answer for the repetitive problem
- Maintains a significant level of information
- Helps you to get fast and accurate answers
- A proper explanation of decision making
- Ability to solve complex and challenging issues

Knowledge Sources & Knowledge Acquisition

- Centers for Disease Control and Prevention. "Myths and Facts about COVID-19 Vaccines." CDC, National Center for Immunization and Respiratory Diseases (NCIRD), Division of Viral Diseases, 15 December 2021, <https://www.cdc.gov/coronavirus/2019-ncov/vaccines/facts.html>. Accessed 7 April 2022.
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<https://intermountainhealthcare.org/blogs/topics/live-well/2020/03/myths-about-coronavirus/>. Accessed 7 April 2022.
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https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3531782. Accessed 08 April 2022.

Knowledge Design & Engineering

The pandemic has altered the way of living of each and everyone irrespective of the age, race, nationality, wealth, gender, etc. The pandemic gripped the world and left everyone with several unanswered questions and doubts. Throughout the world, many people are battling with questions, misconceptions, and lack of knowledge and information about Covid-19. To seek answers to these questions, they have gone to any source that is accessible: the Internet, friends and relatives, government machinery, doctors, research, etc. Hospitals and the medical fraternity endure the worst part of this volume of enquiry as patients look for dependable answers to questions concerning Covid-19. The entire health system was overburdened with not only attending to the growing number of patients but also to prevent misinformation. Everyone has read about the stories of how nurses and doctors were overworked and suffocated in the PPE. The front line workers overcame all the dangers to carry out their responsibilities dedicatedly.

Most of the inquiries patients have about Covid-19 are questions that are common to many patients. For example, "What are the side effects of Covid-19?"; "Why should I wear masks?"; "What kind of masks should I wear?", "Is lethargy one of the systems?". While every patient has a different clinical history, a significant number of these inquiries have common answers that ought to be based on the latest information, diagnosis, while being easily accessible to everyone.

Across a wide scope of applications, chatbots have been an effective way for business groups to collaborate with their clients. Chatbots are conversational experts that use AI and natural language processing to comprehend the question and provide suitable responses. First, they are available any time, permitting patients to acquire answers every minute of every day and to reduce the load on the doctors. Second, chatbots can be used by any number of people at the same time. Third, the response provided by chatbots can be fine tuned and made more accurate depending on the latest information available and the frequency and variation in the type of query.

The chatbot uses natural language processing (NLP) to understand user intent, which means recognizing user intent at the start of that conversation. When using chatbots for customer service, it is very important to know the difference between intent and entity. Intent means what

the customer is looking for. For example, on an e-commerce site that specializes in clothings, customers may type "Do you have a linen shirt?". The bot recognizes the term from the product database and returns a link to one or two versions of the best collection of shirts. The linen is the entity that modifies the shirt commonly used here. Recognition of intent is a core feature of a chatbot architecture that determines whether a chatbot is successful in meeting a user's sales, marketing, or customer service needs. The amount of chatbot training data is essential to maintain a good conversation with the user. However, the quality of the data determines the ability of the bot to correctly detect the intent and generate the appropriate response.

The NLU and NLG components of dialogue bot systems starting from the early research in 1966 to the present commercial voice assistants mostly rely on rule-based systems rather than a system that can "understand". The NLU and NLG systems are often developed for very narrow cases. General understanding of naturally-spoken language across multiple dialogue steps, even in single task-oriented situations still cannot be achieved.

Most of the products using NLU, such as chat-bots, have constraints on what users can say, how the system responds and the order in which the various subtasks can be completed. They are very precise for specific inputs, but they do not cover all possible valid inputs that users can provide. Such systems are not only unscalable, but also lack flexibility and cannot have a truly natural conversation with the user. The purpose of chat-bots is processing user requests to provide a desired response. Without flexibility and ability to hold a natural conversation they fail in their purpose. This is not surprising as natural language has been changing and developing for centuries. The texts are often extremely context-dependent and ambiguous, especially in multi-person conversations across multiple topics. The application developed by the team is an attempt to demonstrate the chatbot for Covid-19 based on context based intent identification. The next step can be making the application more context aware and more intents covering several scenarios and all the possible questions. The corpus has been created by the team and contains intents for five topics viz. Transmission, food, symptoms, climate, and vaccines. Spacy is used as the NLP engine.

Intent-based chat-bots are well suited for goal-oriented tasks. Such bots operate with utterances, intent and entities. When having a conversation with a user, an input from the user is considered an utterance and will be processed by the bot in order to output a response. An utterance is being mapped to one or more intents where intent explains the motive of the user with the given input. Intent is about what the user wants at a specific step of the conversation and it is often defined as a verb or a noun, such as "latest_news" or "set_alarm". Utterances may contain entities which provide additional information within the intent. An example of such information could be "Monday" with intent "weather_on_day" or "10AM" with intent "set_alarm". The output of an intent-based chat-bot is usually a static list of one or more elements from which one is chosen at random, but it can differ depending on the entities within the utterance. While having semi-static output, with help of machine learning the chat-bot is able to comprehend a large diversity of inputs successfully mapping them to the intents and provide relevant responses for the user.

Although intent-based chatbots are able to digest all kinds of inputs, it is prone to context-specific ones. The bottleneck is when the same input in different contexts would require completely different responses. In case when chat-bot is taught to recognize the response, it cannot take context into consideration out of the box. This problem can be fixed with adding contextuality to the chatbot in the form of a state-machine. This technique comes from another type of chat-bots, flow-based ones. A flow-based chat-bot uses a predefined conversation flow, which can be visualized as a flowchart, for instance. When a user starts the conversation with the bot, she/he will be guided through the states step by step until a certain defined end-goal state is reached. This restrictiveness has its pros, such as clear abilities, maintaining the context, predictability, as well as its cons, such as limited options, unnatural conversation, difficulties with handling complex requests. By combining the flow-based approach with the intent-based approach, we are hoping to challenge some of the cons while at the same time maintaining the pros of both approaches.

User Interface

What is the interaction between the user and the ES?

The interaction between the user and the systems is a dialog that is basically user presented questions being answered by the system.

What information must be entered into the system at the beginning of or during a session?

The user is first greeted by The Covid Chatbot asking for their name, to give the user a sense of familiarity. The user is then able to ask the data any question they want to know the answer to.

What will the user get as a result of the system operation?

The system analyzes the statement given by the user and gives an estimated answer to the question. The question can be anything covid 19 related as mentioned above.

Implementation

In this part we will examine the innovations that we will use while fostering this Chatbot.

First of all we have collected the data by asking our friends and family the common question regarding COVID-19. Then we collected some of the information from the links provided above. The innovations of the chatbot comprise of two significant parts: language and tools. Python makes it easy for developers to define a strategic roadmap for chatbots that can be applied to different scenarios. Python as such, there are mostly required packages for chatbots developing a user-friendly chatbot. Tkinter tool is the most common method in Python for creating GUI applications. Second tool is Scikit-learn (sklearn), probably the most useful machine learning library in Python and the third is the spacy tool which is a free open source library for Python's NLP. We created a dataset and that dataset is embedded using spacy. Then we tested the dataset using three classifiers. They are KNN, GNB (Gaussian Naive Bayes) and Linear. Gaussian Naive Bayes was the best performer. The GUI is also developed using a Python package called tkinter. Tkinter is a standard GUI interface. After training the model and creating UI, the application was ready to deploy. The user input is used by the model to predict the user input to give the user an appropriate response.

Group Members' Tasks

Member	Task	Time Elapsed
Sourabh Potdar	Model training	1 day
Jaydutt Joshi	GUI Development	1 day
Keith Frank	Resources Collection	1 day
Ronak Kumar	Dataset Handling/Resource Interpretation	1 day
Yash Shah	Testing Model & GUI	1 day
Team	Documentation and drafting	2 days
Team	Presentation slides	1 day