

**HANOI UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**SCHOL OF INFORMATION TECHNOLOGY AND COMMUNICATION**

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**AI PROJECT REPORT**

Project name: AI-Powered Chatbot for fighting Covid-19

**Supervisor Assoc. Prof: Phạm Văn Hải**

**Student names:** **Group 6**

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| --- | --- |
| **Trần Tấn Dũng** | **20194746** |
| **Đinh Hữu Đại** | **20194735** |
| **Nguyễn Trung Thành** | **20194844** |
| **Đỗ Văn Tuấn** | **20194874** |

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AI Project name: AI-Powered Chatbot for providing statistics about Covid-19 in the world

Student name: Tran Tan Dung, Dinh Huu Dai, Nguyen Trung Thanh, Do Van Tuan Class ICT Global K64, Hanoi University of Science and Technology, No1. Dai Co Viet st., Hanoi, Vietnam

**Abstract:** The huge number of deaths caused by the novel pandemic COVID-19, which can affect anyone in the world, presents a serious threat for humanity and society. In this paper we aim at developing a smart ubiquitous chatbot, called COVID-Chatbot, for COVID-19 assistance during and after quarantine. It uses natural language processing (NLP) which help AI software analysis and understand user’s request to have suitable responds. Thanks to NLP, chatbot can be easy to communicate with a citizen to increase his/her consciousness and provide exactly pandemic data towards the real danger of this outbreak. The proposed method is a ubiquitous healthcare service that is presented by its four interdependent modules: Information Understanding Module (IUM) in which the NLP is done, Data Collector Module (DCM) that collect user’s non-confidential information to be used later by the Action Generator Module (AGM) that generates the chatbots answers which are managed through its three submodules. Using this model. Additionally, experimental results show that the evaluation about Chatbot’s able to communicate with citizen after using NLP through proportion table. To provide for users trust and fast information we use real-time dataset, it included statistic number about Covid-19 in countries of the world.

**Keywords:** Covid-19, AI chatbot, natural language processing, supervised-learning, real-time dataset, mental health…

1. INTRODUCTION / OVERVIEW OF SYSTEM/ BACKGROUND

In early 2020, China and the rest of the world have been threatened by the new Covid-19 pandemic, which has killed thousands of people around the world. Both in the news reports, as well as in academic and scientific reports have demonstrated the need for telemedicine and telehealth, the Public Health Ministry of Ecuador began with some plan in the so-called number to help people which is a possible suspected case of Covid-19. In fact, while the number of people who are being treated for COVID-19 is increasing by the day, some citizens are not aware of the real threat of this outbreak which explains its quickly spread all over the world, however others, panicked and desperate and even worse committing suicide. Therefore, this gave the fundamental idea of creating a web Chabot to support citizen from far away.

Some interesting chatbots that were previously developed for the healthcare domain such as, SPeCECA which is a smart pervasive chatbot for emergency case assistance. Additionally, Mandy Health care assistance is a chatbot that communicates with normal people using natural language in order to provide an online healthcare suggestion. In Health Online Medical Suggestion, a chatbot is designed to mimic human interaction in a medical case. However most of them only gave the fundamental idea of creating a web Chabot to help online doctors who were overwhelmed by the large number of cases they have to handle. Our chatbot is able to collect and detect user’s daily health data, in order to diagnose Covid diseases and give preventive information, fast treatment to accidents and exactly fast Covid information of countries. This type of applications to reduce pressure in health systems and can be used as a reliable source of information by professionals in the area, to avoid problems with the collective panic that generally occurs for fake news, or malicious news.

In this research, the main focus will be on the automatic generation of conversation “Chat” between a computer and a human by developing an interactive artificial intelligent agent with the use of natural language processing. Based on the nature of this project, we need to apply sequence-to-sequence learning, which means mapping a sequence of words representing the query to another sequence of words representing the response. Text mining and natural language processing are used to transform unstructured text to a structured representation which computer software can understand, process and response. The other component AGM and DCM will analysis user’s input, compare in dataset and send back answer to UIM. NLP will transfer to unstructured text which users can understand.

The remainder of the paper is organized as follows: First, we enumerate some basic theories about AI chatbot and NLP, we also declare some famous related work about health chatbot. Next, we explain our approach through a global architecture module of our Chatbot. The proposed model presents three main systems. The first component called **Information Understanding Module (IUM)**. The second one called **Action Generator Module (AGM),** the final one is **Data Collector Module (DCM).** In the experiments, we evaluate our work by a test case in 4, beside our team also indicate generally about achieved result and dataset. And finally, the paper ends with a conclusion and an outlook on some perspectives and future works for interesting research directions.

1. PRELIMINARIES / LITERATURE REVIEW/ BACKGROUND / THEORIES ….

2.1 AI-Powered Chatbot

The first conceptualization of the chatbot is attributed to Alan Turing, who asked “Can machines think?” in 1950. Turing put a test called Turing Test, in which a person blindly asks questions to a machine and to a human. The Chatbot passes the test if the interrogator can’t identify the machine. Many chatbots did pass the test like Mitsuku, ELIZA and Alice. The ultimate goal then of each Chatbot is to simulate human conversation, to provide the function of presence, give the impression of an embodied agent. Currently, the research topic of natural language processing (NLP) is of great interest to many people. Its main mission is user intention identification and Information extraction. Later years, researchers presented several AI chatbot models using natural language processing method (NLP). Recently the development of Artificial intelligence and especially deep learning and deep neural network models have helped a lot in building self-learning chatbots. However, several attempts have been made to treat the seq2seq model problems with the help of deep learning concepts such as deep neural networks (DNN), recurrent neural networks (RNN), and convolutional neural networks (CNN). Many chatbots have a “general use” as a virtual assistant; it can wake you up, start your musique, do a google search for you, etc. Other Chatbots were developed to do specific tasks, like consumer services chatbots, travel and airlines chatbots, gaming chatbots and our concern in this paper is Chatbot about Covid 19 statistics.

**2.2. Natural Language Processing (NLP)**

NLP allows users to communicate with computers in a natural way. The process of understanding natural language can be decomposed into the syntactic and semantic analysis. Syntactic refers to the arrangement of words in a sentence such that they make grammatical sense. Moreover, syntactic analysis transforms sequences of words into structures that show how these words are related to each other. On the other hand, semantic refers to the meaning of each word and sentence. The semantic analysis of natural language content captures the real meaning; it processes the logical structure of sentences to find the similarities between words and understand the topic discussed in the sentences.

As part of the text mining process, the text needs many modifications and cleaning before using it in the prediction models. As mentioned, the text needs many preprocessing steps which include removing URLs, punctuation marks and stop words such as a, most, and is and so on in the text because those words do not contain any useful information. In addition, tokenizing, which is the process of breaking the text into single words. Moreover, text needs stemming, which means changing a word into its root, such as “happiness” to “happy”. For features extraction, the authors use Bag of Words (BoW) to convert the text into a set of features vector in numerical format. BoW is the process of transforming all texts into a dictionary that consist of all words in the text paired with their word counts. Vectors are then formed based on the frequency of each word appearing in the text.

Before entering the data into a model or a classifier, it is necessary to make sure that the data are suitable, convenient, and free of outliers. In, the authors explain how to preprocess the text data. The main idea was to simplify the text for the classifier to learn the features quickly. For example, the names can be replaced with one feature {{Name}} in the feature set, instead of having the classifier to learn 100 names from the text as features. This will help in grouping similar features together to build a better predicting classifier. On another hand, emoticons and punctuation’s marks are converted to indicators (tags). Moreover, a list of emoticons is compiled from online sources and grouped into categories. Other punctuation marks that were not relevant to the coding scheme are removed. Chat language contains many abbreviations and contractions in the form of short forms and acronyms that must be expanded. Short forms are shorter representations of a word which are done by omitting or replacing few characters, e.g., grp → group and can’t → cannot. The authors created a dictionary of these words from the Urban Dictionary to replace abbreviations by expansions. Spell checking is performed as the next step of the pre-processing pipeline on all word tokens, excluding the tagged ones from the previous steps.

**2.3. Realtime datasets**

**2.3.1. Dataset**

A data set (dataset) is a collection of data. In the case of tabular data, a data set corresponds to one or more database tables, where every column of a table represents a particular variable, and each row corresponds to a given record of the data set in question. The data set lists values for each of the variables, such as height and weight of an object, for each member of the data set.

In the open data discipline, data set is the unit to measure the information released in a public open data repository. Currently, The European Open Data portal aggregates more than half a million data sets. Some other issues related to data sets are being concerned such as real-time data sources, non-relational datasets, etc.

**2.3.2. Realtime data**

Real-time data refers to data that is presented as it is acquired. The idea of real-time data handling is now popular in new technologies such as those that deliver up-to-the-minute information in convenience apps to mobile devices such as phones, laptops and tablets.

The basic definition of real-time data is that it is data that is not kept or stored but is passed along to the end user as quickly as it is gathered. It is important to note that real-time data does not mean that the data gets to the end user instantly. There may be any number of bottlenecks related to the data collection infrastructure, the bandwidth between various parties, or even just the slowness of the end user's computer. Real-time data does not promise data within a certain number of microseconds. It just means that the data is not designed to be kept back from its eventual use after it is collected.

**2.3.3. Realtime datasets**

The combination of the dataset attribute and the real-time data source creates a real-time data set that provides publicly available data sources of value to use.

2.4. Some famous health chatbots in the world:

**2.4.1. The WHO Health Alert**

As of 2019 December, the coronavirus pandemic has started in China then it quickly spread all over the world. It is entirely possible for us to encounter many sources of misinformation throughout social networks, that’s why World Health Organization (WHO) launched chatbot services, is called WHO Health Alert, in Arabic, English, French, Hindi, Italian, Spanish and Portuguese with partners WhatsApp to prevent information pollution about coronavirus. In an effort to better inform the world about CODIV-19, the WHO has launched a Facebook Messenger version of its WHO Health Alert platform – offering instant and accurate information about COVID-19– via Facebook’s global reach.

The WHO Health Alert service has already reached 12+ million people via WhatsApp. In many regions hit hardest by COVID-19, total messaging through Facebook’s family of apps has increased by more than 50%. With this transition into Facebook Messenger, and other communication channels related to it, WHO Health Alert has the potential to reach 4.2 billion people – helping people protect themselves from COVID-19, prevent its spread, and understand the facts related to the disease.

The chatbot was developed in collaboration with Sprinklr, as a part of the WHO Technology for COVID-19 Initiative, a pro-bono collaboration of technology companies brought together by WHO specifically to fight the COVID-19 pandemic. The WHO Health Alert was developed in partnership with Praekelt.Org, using Turn machine learning technology.

Graphical user interface, text, application, chat or text message

Description automatically generated

Fig. 1: The WHO Health Alert chatbot via WhatsApp

2.4.2. Dr.AI

Developed by the startup HealthTap. Beside the application, Dr. Ai is also a Facebook-Messenger-Based chatbot, which gives lot of information about the patient (age, gender, etc.). Based on Artificial Intelligence and Natural Language Process technologies, Dr. Ai is a general symptom checker; when the patient asks a question or give a symptom, the chatbot gives potential causes from a database that contains similar questions [5][8]. Figure 2 shows the Dr. Ai service with an example of a question/answer. At any time, the patient can contact a real-life doctor for texting or video consultation as we can see on the figure.

HealthTap CTO Sastry Nanduri said: “… advanced smart NLP (natural language processing) algorithms, can translate a patient's concerns into structured, mapped, and contextualized data that our artificial intelligence can process into actionable explanations based on who you are, and your symptoms and medical history.” [9]

Graphical user interface, application

Description automatically generated[2]

**2.4.3. Babylon Health**

The name of Babylon Health was inspired from the ancient city of Babylon, almost 2500 years ago, citizens needing medical advice often gathered in the town square to share thoughts on treatments for common illnesses. This is one of the earliest examples of democratizing healthcare that inspire the 21st century services. Babylon Health provides a quick, on-demand service for patients without important health problems, using Artificial Intelligence technologies, it combines different illness symptoms and can also read and learn from patient health records, including the consultation notes made by doctors, and compare it with a database of similar symptoms. When needed, the user can contact a real-life doctor for episodic and well-defined needs. Since 2017, Babylon Health is proposed by UK National Health Service (NHS) to patients near London and Birmingham for online consultations with doctors.

A cell phone with a picture of a person on the screen

Description automatically generated with low confidence[3]

1. THE PROPOSED MODEL / ALGORITHM / STEPS OF THE ALGORITHM / SYSTEM

Diagram

Description automatically generated

Fig. 4: General architecture of a conversational chatbot

As we can see in **fig. 4** this is the proposed architecture for our chatbot, and we will explain every part of it in the next section.

**Client flatform**

For the user, the first difference between covid chatbots is the client platform holding the chatbot. From the studied chatbots, we choose Autonomous client platform:

* **Autonomous client platform:** the chatbot is a separate application that can be downloaded and used independently from any other client platform. It can however get inputs from other application/devices, e.g., heart rate from a smartwatch or age and gender from google account.

**IUM****: Information Understanding Module**

Information Understanding Module (IUM): When the user sends an input message, COVID-Chatbot must transform unstructured text to a structured representation composed of entities and intents which called the natural language processing (NLP), through several successive steps such as Tokenization, Part of Speech tagging (PoS tagging) [11], Lemmatization and Stemming [12], etc.

We used spaCy, which is an open-source library for advanced Natural Language Processing (NLP) in Python. spaCy is designed specifically to build applications that process and “understand” large volumes of text. It can be used to build information extraction or natural language understanding (NLU) systems. In this part, we used spaCy for transforming text to vector, extracting entities and intent classification.

The natural language processing engine consists of the latest algorithms of machine learning that are used to identify the intent of the user and then match them with the list of those intents that are supported by the bots [13]. Components of IUM:

* **The NLP engine** is the “social” part of the chatbot, it communicates with the user through two subtopics of NLP:

1. **Natural Language Understanding (NLU):** is responsible for handling and converting formless data, allows the machine to understand users and run the necessary parameters for processing requests.
2. **Natural Language Generation (NLG):** is responsible to produce a natural language containing the desired information given a semantic representation.

* **Intent Classifier:** It takes input from the user, interprets its meaning, and then relates it to that intent which is supported by the chatbot. This intent classifier loads pretrained language model which then is used to represent each word in the user’s message as word embedding vector.
* **Entity Extractor:** It extracts the critical information from the query of a user
* **Word embedding models**: have been trained on massive text corpus created from Google news and similar sources so the representations may not always transfer well to specific domains. For example, the word “python” means a very large snake in the everyday context, however it means a programming language in the field of computer science. These differences become even more relevant in our case because we are supposed to analyze medical data. Our solution is to simply train the spaCy model on our domain specific data. Since the embeddings are already trained, the SVM requires only little training to make confident intent predictions.

**AGM**

Action Generator Module (AGM): After understanding the user’s request, COVID-Chatbot must deliver a precise, accurate and rapid actions. This task is done by Action Generator Module (AGM). AGM is trained on customized data that we generated from scratch because until now there is no publicly available conversational data sources between doctors and normal people about COVID-19. So, we use decision trees algorithm to generate actions as we treat this task as a classification problem. Actions delivered from COVID-Chatbot depend on the user input that’s why we have decomposed AGM into three sub-modules:

– **Response Classifier:** is the main sub-module of AGM since it decides the answer that must be generated taking into consideration the psychological state of the user as well as his desire of our chatbot.

It is a fundamental component to answer the users frequently asked questions. This system understands the user's questions properly and responds to those questions with the related answers stored in the knowledge base.

* **Manual Training:** In this training, the domain experts create a list of frequently asked questions and then map the answers. This mechanism is helpful for the bot to recognize the answers to the many important queries.
* **Automated Training:** In this training, different types of company documents such as Q&A documents and policy documents are submitted to the bot, and it is asked to train itself for these documents. This training results in a list of questions and answers from these provided documents. This bot can answer all these questions with full confidence.

Often, users of our chatbot ask questions on specific statistics such as number of confirmed cases in a country, or the death rate of a state or a city. The number of questions of this nature was significant, and answers to such questions are changing constantly. Therefore, it is labor intensive to manually curate answers or create alternative questions for such questions. Instead, we have built a QA Generator to automatically create such QA pairs, based on structured data pulled from reliable sources such as the CDC on a daily basis and question templates derived from the crowdsourced questions.

– **Off-topic input Manager:** when the user shows a non-serious aspect, this sub-module returns a warning message to avoid unnecessary discussions. To accelerate interactions between COVID-Chatbot and the user, there are answers suggested to the user to control the conversation in order to minimize errors as much as possible

**–** **Daily Medical Follower (DMF):** the user who can take advantage of this functionality must either be infected or suspected of being infected with COVID19. During the 14 days of quarantine the patient must fill in a virtual form which differs from the traditional form because there are no boxes to fill in but the fact of answering successive questions in a well determined order. DMF has the role to monitor the progress of the various symptoms during the 14 quarantine days. Then the information will be stored in the Data Collector Module so experts (Doctors, data scientists, etc..) will be able to have access to this information.

**DCM: The Data Collector Module**

The Data Collector Module’s mission is to collect the user’s non-confidential data and create a dataset that contains these user’s information:

– Location – Symptoms (Fever, coughs, dyspnea, etc.)

– Age

– Gender

– Status (Infected, Not infected/Suspected to be infected) – Contact with Infected Person – Recent Travel

– Chronic diseases (Alzheimer disease and dementia, Arthritis, Asthma, Heart disease, Cancer, Diabetes, etc.)

The Data Collector Module’s mission also manages dataset of QnA pairs and statistics of covid

**APIs/Plugins**

* Plugins provide smart chatbot automation components and chatbot solution APIs for those chatbots which are used inside of the companies such as field worker and HR management chatbots
* Since an API is an interface that defines interactions between the user interface and the NLP Engine, it depends on those two components. We’re mentioning it here as a part of the global architecture, but we’re not giving any more details about in this paper

Diagram

Description automatically generated

Fig. 5: COVID-Chatbot’s Data Flow Architecture

**All steps of model architecture**

As we can see in fig.4 this is the proposed architecture for our AI Covid Chatbot, and we will give further explain for model through next steps:

Firstly, the end user interacts with the chatbot through a client platform. It’s important to be user friendly and give an excellent UX.

Each time, the user is having a request, it’s routed to the IUM using the appropriate API’s, in the IUM, and with NLU, the chatbot understands the request and format the data into understandable form that can be understanded by the AGM.

Once the AGM receives the formatted data, it exchanges with DCM

At this DCM collects entities as soon as the conversation begins and saves to create its proper dataset. The AGM receives data from DCM and decide the suitable response for users

Next responses resend to IUM in formatted format, which cannot be understanded by the end user, this is why, and using NLG, the NLP rephrase it the way the user can understand it.

And once again it’s transmitted to the user using the appropriate API’s.

**4. EXPERIMENT AND RESULTS / EVALUATION**

**4.1 Datasets:**

The experiments of proposed model have been tested in datasets.

The Data Collector Module’s mission is to collect the user’s non-confidential data and create a dataset that contains these user’s information:

– Location

– Symptoms (Fever, coughs, dyspnea, etc)

– Age, Gender

–Status (Infected, Not infected/Suspected to be infected) – Contact with Infected Person – Recent Travel

– Chronic diseases (Alzheimer disease and dementia, Arthritis, Asthma, Heart disease, Cancer, Diabetes, etc.)

We also provide the exactly covid data for users from Our complete COVID-19 dataset is a collection of the COVID-19 data maintained by [Our World in Data](https://ourworldindata.org/coronavirus). Often, users of our chatbot ask questions on specific statistics such as number of confirmed cases in a country, or the death rate of a state or a city. At this open source, the statistic about epidemic situation updated every day so that we have a real-time dataset. More information about the datasets is included here: <https://github.com/owid/covid-19-data/tree/master/public/data>

We also prepare some QnA Pairs to answer user’s question about Covid-19. We rely on a repository of Frequently Asked Questions gathered from reliable sources such as the Centers for Disease Control and Prevention (CDC), the World Health Organization (WHO), the University of Washington Bothell, and the Federation of American Scientists

**4.2. Experimental and Results**

In this section, we are going to show some preliminary results regarding our proposed model.

The main objectives of COVID-Chatbot are listed below:

– Help people understand and accept the coronavirus quarantine in order to limit the quickly spread of the viral disease

– Raise awareness but also share reassuring messages to take the required precaution actions

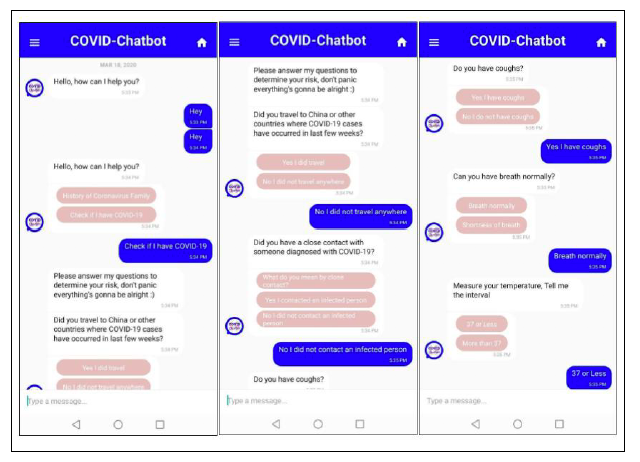
– Collect user’s data (non-confidential information) to use it in machine learning later

– Provide people the knowledge what to do to protect themselves and their entourage from more infections.

**Firstly,** we request users answer some questions of our system.

If fill in a virtual form which differs from the traditional form because there are no boxes to fill in but the fact of answering successive questions in a well determined order. Then the information will be stored in the Data Collector Module so experts (Doctors, data scientists, etc..) will be able to have access to this information.

After users answer all questions from system, chatbot will send a list updated your information so you can use it to answer authorities. We also send you some way to avoid and decrease risks of diseases, increase his/her consciousness towards the real danger of this outbreak



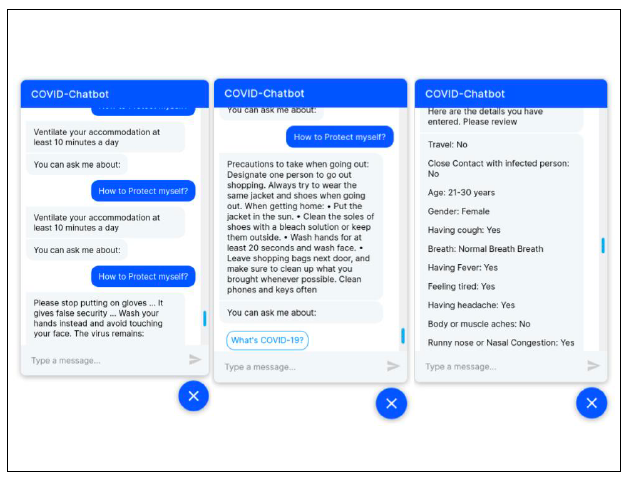


Fig. 6: The web COVID-Chatbot’s Responses Examples

**Secondly,** often, users ask questions on specific statistics such as number of confirmed cases in a country, or the death rate of a state or a city. The number of questions of this nature was significant, and answers to such questions are changing constantly.

Since reading fake news or malicious news, some citizens are not aware of the real threat of this outbreak which explains its quickly spread all over the world, however others, panicked and desperate and even worse committing suicide. We provide the epidemic situation at which the user is living or anywhere is requested in the real-time from WHO. The bot can answer precise statistics if you ask about:

+ total cases, new cases, total deaths, new deaths, total tests, new tests, tests per case, recovers + total vaccinations, new vaccinations, people vaccinated, people fully vaccinated patients in hospital

A screenshot of a computer

Description automatically generated with medium confidence

Fig. 7: A part of Covid 19 Dataset

**Thirdly**, to help people understand and accept the coronavirus quarantine in order to limit the quickly spread of the viral disease, we will provide people the knowledge what to do to protect themselves and their encourage from more infections. We prepare QnA pairs in data source and send the respond to you when the chatbot receive a related question.

This mode relies on a repository of Frequently Asked Questions gathered from reliable sources such as the Centers for Disease Control and Prevention (CDC), the World Health Organization (WHO), the University of Washington Bothell, and the Federation of American Scientists. The questions are provided by the users and volunteers of Jennifer, many based on the FAQs

Text

Description automatically generatedFig 8: An example of QnA pairs

**5. CONCLUSION**

In this project, we build a chatbot with the aim of helping people to find all information about the Covid-19 pandemic. We realize this is necessary in the context that information about the Covid-19 pandemic is spreading in all mass media, so it is difficult to know what accurate information is. After defining our purpose, we looked for some applications of AI in creating a bot that can answer human questions. We identified four key components to have in our Covid-19 chatbot app: client platform, Information Understanding Module (IUM) in which the NLP is done, Data Collector Module (DCM) Action Generator Module (AGM). We found the natural language processing method (NLP) to be extremely effective in determining the content of the question and then giving the most appropriate answer. Along with some other programming and data collection techniques, we have created a supervised - learning chatbot that can bring multiple sources of accurate information to the user.

As future work, we will focus on researching and selecting deep learning algorithms that can better meet the needs of our chatbot, we will focus more on building real-time datasets and use the LSTM for Depression Detector Model that detects anxiety in the text input through a deep leaning sentiment analysis model to help AGM make the decision to deliver a reassurance message if a bad behavior is distinguished. We hope it will help many people, thereby contributing a small part to the common goal of repelling the covid-19 pandemic.

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