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Chatbot Health System

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May 2, 2021

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March 2021

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Abstract

Chronic diseases have affected many people globally and causing morbidity, and modality—the impact of chronic disease related to people's lifestyles and their choices of habits like food, among others. Also, a model that immune and improves patients' lifestyle and habits by giving guidance and follow-up for future symptoms. As seen that there is high demand for specialists/experts in that field. Only a few studies have considered reducing the workload and exhaustion of physicians during the treatment phase. This article aims to provide a preliminary assessment of the Chatbot health system, a conversational agent-assisted health guiding framework to help doctors cope with burnout and provide continuous treatment to their patients. The approach is taken to create the chatbot dialog, and the guiding system is presented in this paper. As a result, talk about the first patient profiling technique for classifying patients based on their cholesterol levels. The machine then makes recommendations to the expert on tasks to include in the patient's guidance in dialogue. This study makes three significant contributions to disease complications prevention (i.e., preserving a healthier lifestyle): (1) It provides the specialist/expert with a conversational agent to support patients; (2) It reduces experts'/specialists' workload and safe their time to improves patient care by categorizing patients into groups, each group has its case scenario, that would help to follow up with patients until he visits a clinic/hospital for drugs or meeting doctors face-to-face; and (3) It gives the physician physical/nutrition activity guidelines when creating a general patient activity guiding choices based on his cholesterol level whether its normal, abnormal, or risk.

1 Introduction

Recently, the number of infected people with chronic diseases increased dramatically around the world especially after COVID-19 lockdown. In addition, dangerous diseases appear as well, taking into account many different factors, such as age, obesity, smoking, genetic history, and bad lifestyle, which cause type 2 diabetes, liver disease, heart disease, etc. However, this project focuses on individuals' nutrition and physical activity using machine learning techniques and algorithms based on patient history/entries to reach the normal case. So that will help to implement a system that merges nutrition/physical therapy and computer science together to achieve the results that immune the patient with a healthy lifestyle and decrease risks via chatbot health system. In [4], intelligent chatbots have many pros, such as react with textualnon-textual human languages via Nural Language Processing (NLP) and are also used in different industries. So, this paper proposes a system that helps the end-user for recommendations for food, exercise, and habits based on his case in healthcare applications by guiding him following that chatbot health system to create a healthy lifestyle and immunity against health complications.

Saudi Arabia has been increasingly westernized over the last few decades, and it now has one of the highest obesity and overweight prevalence rates in the world [17].

Besides that, obesity is a significant cause of concern in the county, with 7 out of 10 people suffering from the condition. Past studies related to the prevalence of weight within the Kingdom of Saudi Arabia (KSA), demonstrate an expanding slant in corpulence and overweight, which are major sources of a number of other infections, counting hypertension, diabetes, obstructive rest apnea, hyperlipidemia, and osteoarthritis.

According to the Saudi Heart Association (SHA), Heart failure (HF) has become a major cause of morbidity and mortality around the world, with unfavorable consequences for the quality of life (QoL), healthcare costs, and life expectancy [5]. In adults from developing countries, the prevalence of HF varies from 1% to 2%, and it is greater than or equal to 10% in those over the age of 70, according to the term used. Moreover, patients with AHF and CHF in the KSA were average 57–60 years old, nearly ten years younger than patients in developing countries. 44.7% percent of patients with AHF have a history of chronic heart failure (CHF), implying an early onset that may be linked to the exceptionally high prevalence of coronary artery disease (CAD) risk factors. Furthermore, diabetes mellitus was found in 60.7 percent of AHF patients in the KSA, which is twice the rate registered by AHF registries around the world; additionally, despite the population being younger, the prevalence of hypertension (70%) was comparable to global registries as well as in patients with HCHF, similar results were published. When compared to patients with AHF, the rates of diabetes mellitus (53%) and hypertension (69%) were lower, but the rates of hypertension (69%) were higher. In comparison to other trials, almost three-quarters of the patients had moderate/severe left ventricle (LV) dysfunction. Moreover, dyslipidemia is the most common cardiovascular risk factor in the KSA, and it is a significant risk factor for vascular diseases, including coronary heart disease. Dyslipidemia affects both children and adults, and if aggressive approaches are not initiated early, the public health system will be overwhelmed in the long run. The most common lipid condition in patients with HF was a low level of high-density lipoprotein cholesterol (82.9%), followed by hypertriglyceridemia (35.2%), atherogenic dyslipidemia (27.8%), and hypercholesterolemia (9.2 percent). For that population, diabetes mellitus was the single most important predictor of mortality ($p = 0.001$).

A Chatbot Healthy System has been shown via a conversational AI system based on the machine learning model in this paper. The platform helps doctors keep track of their patients' general health, gives end-user advice to their patients, and suggests appropriate things for end-user to follow. The key point that will address in this paper is the conversational AI auxiliary feature. The solution to patient clustering/classification and hypothesis testing with real users will be discussed in this paper. So, that system's role in managing doctor duties and supporting them in defining a patient plan will also be addressed. Finally, potential study directions are highlighted.

2 Background

There are attempts to predict the recommended food and exercise and handle textual data using the classifier. In [11] the researchers tried to train a classifier for different patient's data regarding providing the recommended food or activity to go for it in different situations and cases. Moreover, in [3], also they suggested in their survey to use Neural Language Toolkit (NLTK) and Neural Language Processing (NLP) accordingly for speech recognition. Thus, they also contribute to doing this survey for different papers they selected among chatbot designs to improve the interaction process and approach.

2.1 Is chatbot a good option for recommending advice forcontrolling the health system?

The research [14] illustrates that the chatbot can simulate human conversation and the fulfillment of various roles, such as customer service and simulated virtual interactions with doctors. One of the user's goals of interacting with a chatbot can be short-term goals, such as booking an appointment with a dentist or for a long-term period, for example, managing one's mental health. It was reported and confirmed that 2016 was the "rise of chatbots" (Wharton University, 2016) and Google, supported Amazon and Microsoft audio technologies on Cortana, Alexa, and Google Allo services.

These systems provide a natural conversation interface and intuitive interactions with users to maintain healthy eating habits and exercises. The chatbot can replace a human factor, it can provide access and be connected 24/7 and allow normal communication while maintaining anonymity.

Currently, chatbot usually includes scheduling doctor's appointments based on the severity of symptoms, monitoring individual health [11]. However, the current applications have reached a high level of maturity in dealing with users regarding food and health advice in the English language. For example, the "Fit- Circle" bot, "GYMBOT", "The CountIt" bot,

”Forksy”, and finally the ”Whole Foods” bot, which mostly focuses on two main axes: exercise and healthy food. To ensure timely health information, the chatbot must be able to know the symptoms, the person’s medical history and receive medical advice besides the right foods and good exercises. However, this is not possible with current approaches, as many bots like the ones mentioned earlier are only focusing on general aspects.

3 ChatBot Designing Principle

The current state of the dialog interface is limited in terms of interface design for the created user by styles. Available studies mainly focus on designing chat agents and dealing with automation tasks [8].

Chatbot design patterns have only been discussed in a few studies and areas mainly identified in the scientific literature. There was previously no in-depth analysis and extensive discussion of specific design elements and techniques in the conversational user interface (CUI) or highlighting problems and challenges ac- companying the design style [12].

The real need is a unified approach in this direction for follow-up when working with CUI patterns. This available design includes methods, techniques, and what to consider when applying them during application design and development. The big question remains about how to make an automated dialog with the user a wonderful new experience. The user's point of view, needs, what motivates him to search for a bot, and how to create unique CUIs for users and domain are important when designing CUIs.

Social chatbots require a high intelligent quotient (IQ) that can be enough to acquire a set of skills to keep up with users and help them complete specific tasks. Most importantly, social chatbots also required a rate sufficient to satisfy the emotional needs of users, such as embassy and social affiliation, among the basic needs of humans Maslow [1943]. The combination of both IQ and emotional quotient (EQ) is essential to the design of the Chatbots Nutrition System and the unique personality.

3.1 Intelligent quotient, emotional quotient and individuality

IQ skills are indispensable and essential for social networking programs, such as the capabilities of knowledge, knowledge, memory modeling, image, and understanding of natural language, logic, generation, and prediction to meet users' specific needs and help users to accomplish specific tasks.

For the past five years, the most important and sophisticated skill is Core Chat, which can engage a long and open chat relationship with users [10].

EQ contains two main components, Empathy and Social Skills. Empathy is the ability to understand and feel what another person is experiencing from within its frame of reference, that is, the ability to put yourself in the other person's position.

A social chat robot with empathy needs to have the ability to recognize a user's emotions from the conversation, discover how emotions develop over time, and understand a user's emotional needs. This requires understanding the query, defining user profiles, detecting emotion, recognizing feelings, and dynamically tracking the user's mood in the conversation.

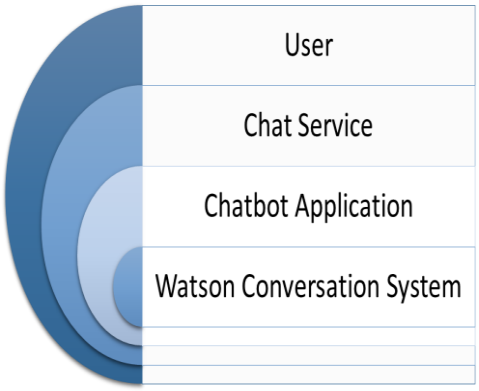

Figure 1: simple chatbot architecture.

The social chat program must demonstrate sufficient social skills. Users with different backgrounds and diverse personal interests have unique needs. The social chat software needs to have the ability to customize emotionally appropriate (that is, personal responses) responses and possibly encourage, motivate and fit the user's interests [18]. Individuality is defined as a distinct set of behaviors, perceptions, and emotional patterns that constitute the distinct personality of an individual. The social chat program needs to provide a consistent personality to set the correct expectations for users in the conversation and gain confidence in the long run.

Chatbot character design needs to direct the primary design goal as an AI facility through which users can form long-term emotional bonds and take into account cultural differences and many sensitive moral questions as illustrated in [7].

3.2 Chatbot architecture

As shown in figure 1, the structure of the chat system can be generally categorized as:

- The user.
- The interface of the chat.
- The chatbot application.
- Watson chat system.

Nowadays, the new and smart chatbots contain NLU, NLG and ML engines have the following components as shown in 2. The chatbot detects patterns in the user's entered words then links them to the specified destination database. It can extract intent from writing any abbreviations or emojis and creating a list of food or exercises. This makes the system know the food and items that users have entered carefully.

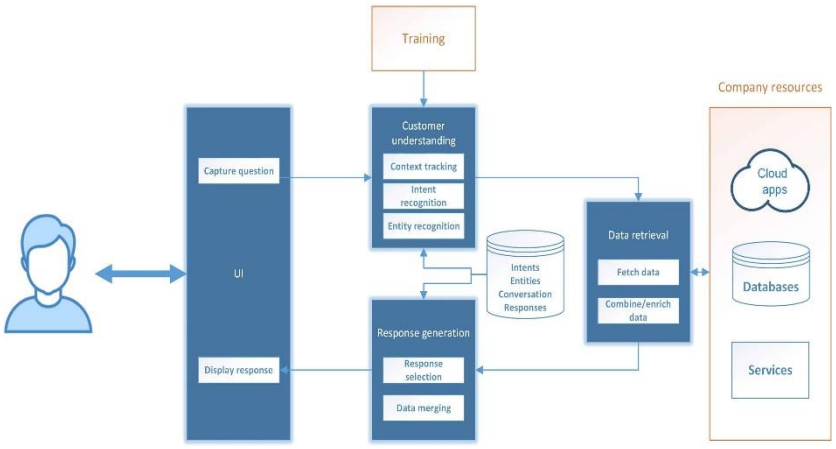

Figure 2: Smart chatbot architecture.

The bot determines diet, exercise, and general life, and it can also ask the userto record his daily habits and collect data from them for further analysis and build knowledge of it.
The user starts the conversation, and then the bot can define the main input flows and define the user's intentions which depend on the next robot response or what the user will do with the selection of buttons.

3.3 Matching Pattern

Pattern matching will be performed for each level, so the chatbot can detect keywords from user input data. Several steps in the process and steps shouldbe taken as follows [13]:

- Receive input data from the user.
- To convert all the letters of the alphabet to their origins as the basic rite.
- Words should be separated from the sentence by point, comma or distance.
- Putting all words into an array.
- Create a set of possible inputs to be matched (sentence, phrase, words).
- Match the array to the "Keyword" database one by one from full sentenceto each word (note that the matching will depend on the level in which the conversation is located).
- Each loop must be terminated if a match is found.

The total of the inputs that can be matched is calculated using the Triple Number Equation, as shown.

- m = matching variable
- n = sum of words in the input data

$$T_n = \frac{n+1}{n} = \sum m$$

3.4 Chatbot Interface

It is the front end of the system. It is responsible for collecting user queries directly from it, which are inputs to the system. It is also responsible for displaying the results generated by the system to the user.

Therefore, we can conclude that the chat interface is the face of the system through which the entire communication is made, which is the intermediary of the conversation between the system and the user.

The process that the user runs on the chat interface is passed to the backend of the chat, which acts as a messaging system between the chat interface and the machine learning layer. This interface can be accessed either as a website or as a smartphone app.

3.5 NLU Engine

NLU Any natural language knowledge is a subsection of NLP (Natural Language Processing) that enables the system to understand the natural language or conversation language spoken by users. The language of conversation used by humans in everyday conversations is not fixed as the official language but rather focuses much on vocabulary and grammar.

Thus, it becomes difficult for the system to understand the intent of the sentence. User inputs are in an unstructured text format that the system cannot understand directly. Inputs are understood only in structured formats. The unstructured text received from the user is converted to a structured format by extracting important words and patterns from the user text using NLU technologies.

3.6 Decision engine or ML

The researcher Sachin S. Gavankar [16] presented the proposed algorithm making decision tree for prediction. This type of decision tree is the default version of the traditional decision tree. It creates this tree at the current runtime, based on user inquiries, and updates the tree in new user messages. Consider its work to anticipate the situation in which the user communicates.

In this algorithm, the symptoms detected in the user's query as sub nodes are added to the root node. Nodes continue to add to reveal new

symptoms. In addition, for each algorithm, the algorithm checks for the second symptom that has the highest occurrence with the previous symptom and asks the user for this symptom. If he says yes, the system tracks this path to check the health status in the root node will continue to repeat for all users, and the tree will continue to update to new entries or follow the available path.

3.7 NLG Engine

NLG performs the opposite of an NLU task. NLG is the process of generatingtext or speech from patterns created by the system. The system produces the results in an organized manner so that the system can be easily understood and addressed.

NLG represents the system's knowledge base in a natural or conversational language representation that the user can easily understand. There can be similarities between two sentences but may involve the use of synonyms.

Thus, while responding to the user, the NLG unit needs to calculate all possibilities to interpret the same sentence, then determine the most appropriate one, and the NLG engine performs a series of tasks to create sentences. The primary task is to determine the content. It involves choosing the response that will be given to the user.

4 Challenges

Difficulties can be challenges while building a chatbot, and the authors of [9] summarize them in the following three points:

1. Lack of transparency involves a great responsibility for a chatbot. In the context of customer service, the lack of transparency places great responsibility on system designers to create systems so that automated chat software does not give wrong responses that the user can misunderstand.

2. It is possible that the chat software behaves and does not fully understand it. Still have a big gap to compete with humans for understanding and behavior. Computers are social actors. Researchers investigated how users responded to social signals from chat robots and other systems with chat user interfaces (for example, chatbots agents). Most studies examined the effect of visual cues such as the presence of a hypothetical character, or smile, or the fonts used in the conversational user interface. However, other types of social cues have also been found to influence users' perception of an automated chat program, such as the degree of interaction, communication method, or a hypothetical agency (i.e., whether Users believed they were interacting with humans or computers. Chatbot response is a key asset. Conversation flow is crucial for the user experience in the case of chat.

3. Research of [13] has shown that system response time (sometimes called response latency or response speed) is a very important influencing factor for obtaining user satisfaction and other aspects of perceived system quality. In the context of face-to-face communication and machine communication, response time was also found to influence people's impressions of others. Here, response time indicates the amount of time a person takes to respond to what has been entered from the user as well as the delay time between repetition and reply to messages. Short response times are seen as a lack of thinking and cognitive effort, while long response times are seen as an indicator of deception.

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5 Methodology

5.1 Data modeling for end-user dialog

In order to build and create a classifier, real datasets[1] has been gathered from real sources for patients history, taking into account domain expert guidance for identifying general cholesterol measurements and other factors, such as age (young, middle age, and elderly) and others including supported resources that give us more general details [15]. However, the focus was based on serum/total cholesterol (normal, abnormal, and risk). Based on it, the chatbot system scenario has been created on three different cases of total/serum cholesterol and that knowledge base followed by general advice via that domain expert for each case, which focused on cholesterol rates.

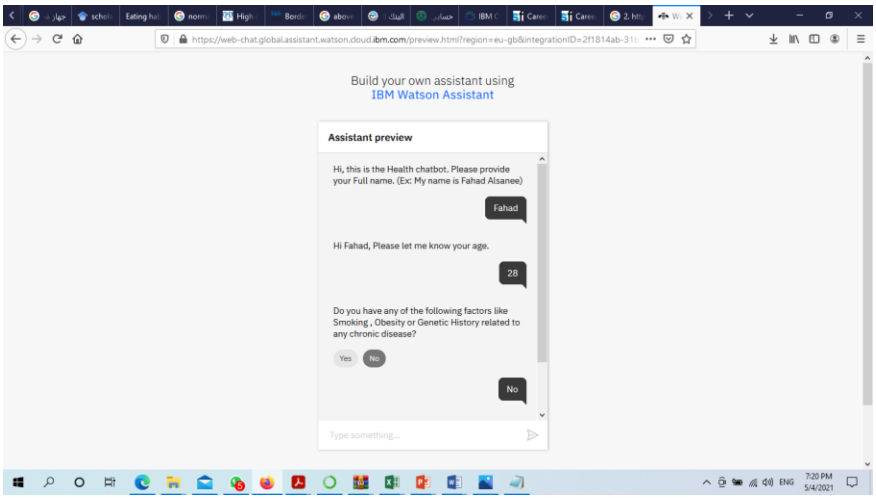

Figure 3: UI for chatbot health system using IBM Watson Assistant.

	Total Cholesterol	LDL	HDL	TG
Normal	< 200	< 130	40 =>	< 200
Abnormal	200 – 240	130 – 160	< 35	200 – 250
Risk	> 240	> 160		> 250

Figure 4: This table shows general lipid profile measurements[6].

	Serum/Total Cholesterol	Advice
Normal	< 200	For normal range, we recommend to visit a doctor with following advices: - Keep the patient continue with same lifestyle. - Put your exercise on your daily schedule from 30-45 minutes.
Abnormal	200 – 240	For abnormal and risk range, we recommend to visit a doctor with the following advices: - Restrict diet with increased fiber and fruits. - Low carb and avoid fat. - Make daily exercise 30-45 minutes.
Risk	> 240	

Figure 5: This table shows guidance for total cholesterol ranges[2].

5.2 End-user classification

It's classified using two datasets [1] which after that trained using KNN classifier using Jupyter notebook. Taking in account different factors, including: age for young (45yrs and less), middle age (45-65), and elderly (more than 65). Additionally, gender, cardio, bmi, and total cholesterol rates as well as visualize these data to help us identify patient's case.

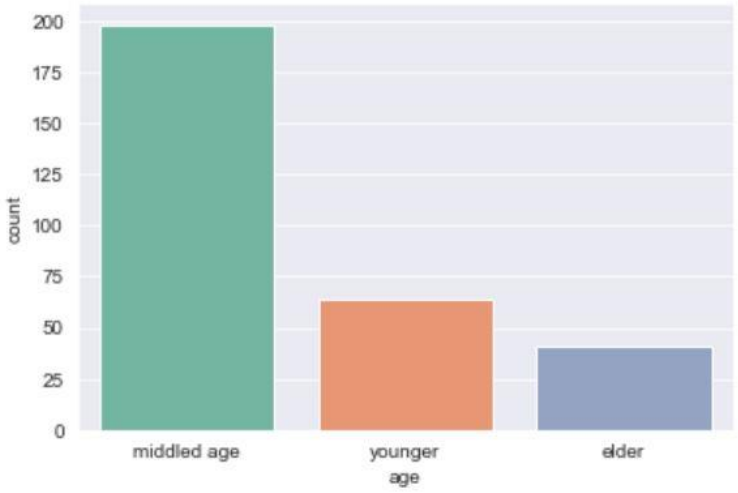

Figure 6: This figure illustrates 1st dataset three groups of age for patients.

Figure 7: This figure shows 1st dataset total cholesterol for patients.

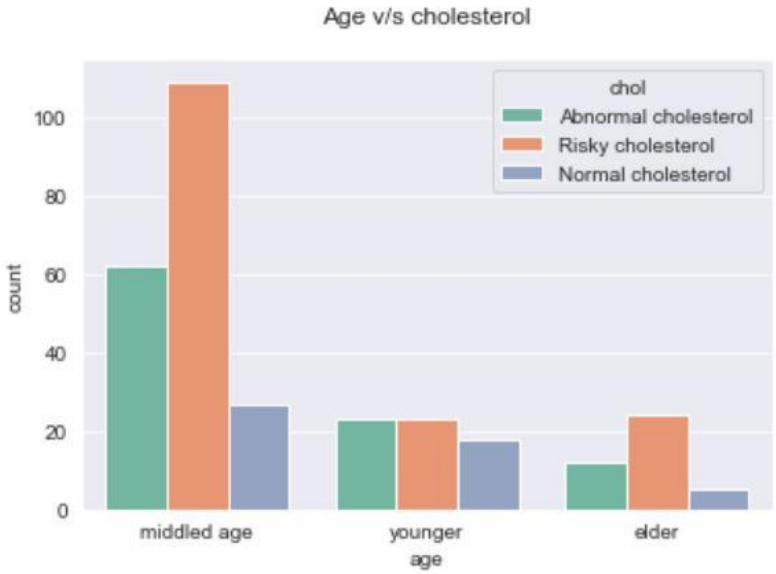

Figure 8: This figure shows 1st dataset age, cholesterol ranges for patients.

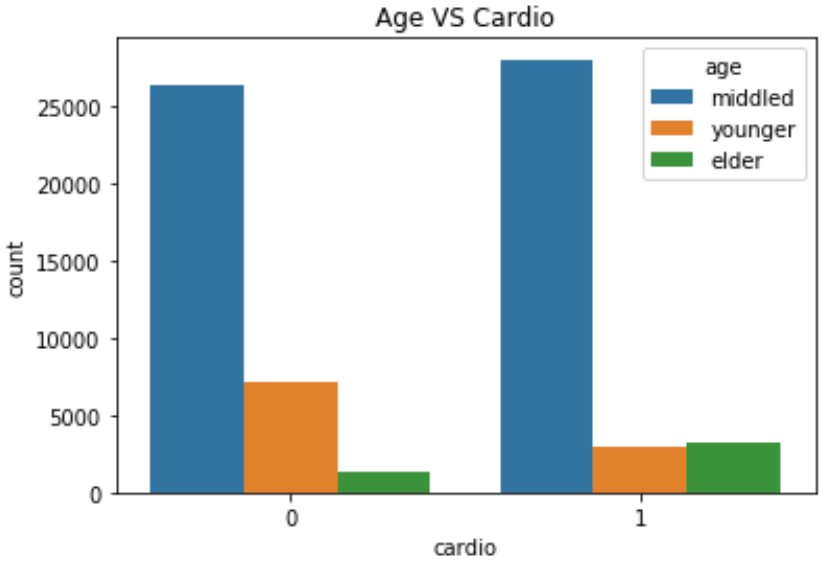

Figure 9: This figure shows 2st dataset relation between age and cardio exercise.

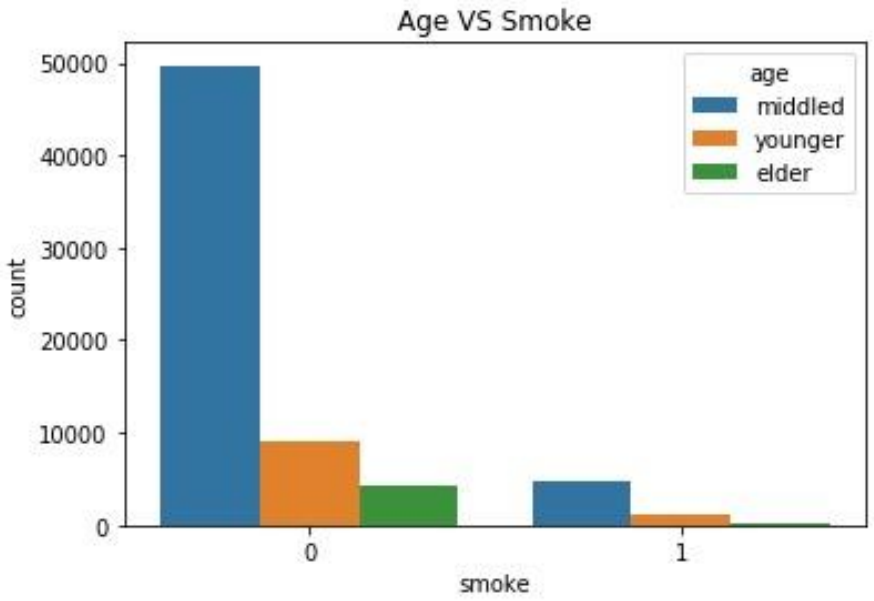

Figure 10: This figure shows 2st dataset relation between age and smoke.

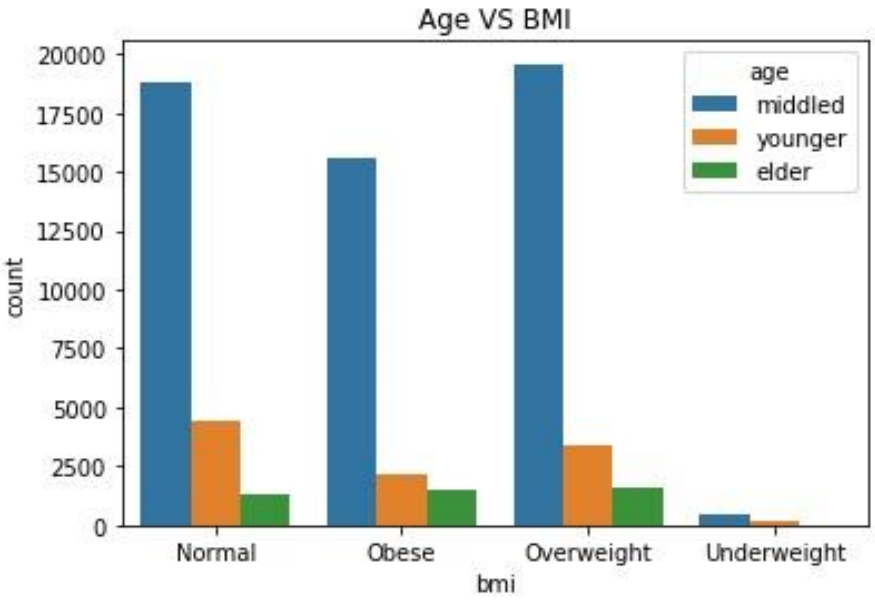

Figure 11: This figure shows 2st dataset relation between age and body mass index (bmi).

6 Results and discussion

Based on the previous model that has been discussed for three different cholesterol scenarios (Normal, abnormal, and risk). The experiment of Chatbot Health System has illustrated the results of each case and the proper procedure to takeby a health expert. Thus, that expert based on his knowledge base can guide that patient via dialogue after end-user gives entries to that system. Automatically the system will respond and give advice in real-time. As seen previously in figures, results show the assigned patient based on history/entries. The expert has identify the guidance thorough the chatbot of ibm watson assistant. Patients should register in order to use that system. Moreover, the data was gathered from real sources.

7 Conclusion and future work

With the medical expenses, the emphasis has changed from pain managementto disease control. It is important to help people live healthy lives and prevent diseases before they begin and decrease morbidity and modality. Early-stage, middle stage, and advanced-stage of disease patients can benefit from health plans. Existing telemedicine platforms for disease prevention and lifestyle promotion are both focused on managing the patient's condition and recommending activities and plans to help them improve it. I tooka different approach, focusing first on increasing physician resource efficiency and decreasing fatigue during diagnoses and patient follow-up, thus enhancing treatment/guidance efficiency. Using conversational agents as a tool to facilitate physicians' tasks and perform patient follow up can significantly improve patient engagement with the coaching system and decrease physicians' workload. Using conversational agents to help doctors complete assignments and follow up with patients will increase patient interaction with the health system while also reducing doctor workload. The patient profile model and activities recommended by the conversational agent-supported platform were presented. When

developing a patient plan, the technique indicates an operation to the doctor. The doctor, on the other hand, is in charge of formulating the final health plan. A robotic agent does routine activities and assists the physician in the chatbot health system. After reviewing patient entries through that device, a human doctor can verify the plan and provide help. In future work, NLP for textualand non-textual entries will be used to consider more chronic conditions and to assess the impact of a plan on the patient. The model will be tested with actual users in a large-scale trial by an ambulatory clinic or hospital.

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