

Healthcare beyond monitoring: Bliss an AI Conversational Agent Support for Elderly Individuals

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ABSTRACT

Healthcare chatbots or conversational agents are novel technological service platforms that make healthcare services more accessible for a wide range of populations. In this project, we researched issues on elderly population accessing healthcare services and how conversational agents can help with solving the problems. Then, a survey (n=13) was conducted and taken by the target audience for learning about their issues and needs on healthcare experiences. Finally, we tried to develop a voice + text based healthcare chatbot prototype for elderlies, and discuss how our system can bring better access to healthcare for old people and be easy to learn and use.

Author Keywords

Chats; messaging; healthbot; chatbots; consultation, emergency; Chronic diseases; computer mediated communication; NLP

ACM Classification Keywords

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INTRODUCTION

Elderly population (aged 60 and older) presents an increasing trend in recent years, seniors occupied 13% of the total population in the world in 2017, which is projected to increase to 21.2% by 2050 and 27.5% by 2100. [3] Elderly people are likely to have more health issues than people in other age groups, and there is a higher chance for issues to get very serious and result in death. Chronic diseases account for 65% to 70% of death for old people; cardiac diseases and cancer cause approximately 48% death; irregular blood sugar (e.g. diabetes), kidney issues, and blindness are also causes for death. These statistics demonstrate more medical attention is required for elderlies. [3]

However, there are several barriers for old people to access healthcare services. The barriers include geographical distance, financial issues, socioeconomic status, educational background etc. [1] Research findings show that elderly tend to obtain health literacy through mass media like newspapers and written material, only few of them access information through the internet. [2] There is an implication stating to offer training programs for senior people to improve their access to health literacy, [2] but physical distance and difficulties in mobility may be factors that limit the access to training programs.

Healthcare chatbots or conversational agents would be suitable solutions for expanding access to healthcare services. They have multiple benefits, such as high accessibility and cost-effectiveness for both patients and physicians, anonymity, convenience in obtaining information, and reassurance with users' situations. [6] On the other hand, healthcare chatbots also have some problems that need to be addressed, like unknown accuracy and efficacy of information, not able to replace human interaction and information security issues. [6] This demonstrates further investigations, improvements and tests need to be done for developing a more human-centered healthcare chatbot.

Due to the increasing elderly population and barriers in accessing healthcare information and services, we plan to propose a design for voice and text based healthcare chatbot app called Bliss to assist seniors' healthcare after the following research questions arose:

RQ1: How a chatbot can help elderly people have better access to healthcare?

RQ2: How would that medium (chatbot) be easy to use for elderly?

Building on the review of the research issue, our primary objective in this analysis is to better understand how this kind of chatbot can help the elderly to have better access to healthcare. Not just that but we are trying to go further and give access to different kinds of features like calling for emergencies, booking appointments, checking medical reports, et cetera with one-click control.

LITERATURE REVIEW

We reviewed several literatures based on healthcare issues for old people, the features of healthcare chatbot and also seniors as target audience using our chatbot.

Existing healthcare chatbots

Healthcare chatbots are novel and still in development period, and here are some examples:

- *Babylon* is a healthcare chatbot that can analyze user's symptoms to provide diagnosis and people can also have a video consultation with physicians using this platform. [4]
- *Florence* is another healthcare chatbot that has functions of setting reminders for taking medications, keeping track of health status, and searching for pharmacies and clinics for users. [4]
- *SWITCHes* is a mobile app intervene and monitor weight control for obese people and give valuable health advice, it contains an AI-powered health chatbot. The chatbot can also piggy-back to LINE, which is a popular social media platform in Taiwan where SWITCHes is developed. [5]

These existing healthcare chatbots have some important features like checking symptoms, providing information about healthcare, and keeping track of personal healthcare status. These features can be inspirations for features to be put into our healthcare chatbot. We also can consider setting channels to communicate with chatbot on social media platforms. Since Bliss chatbot is focused on serving the senior population, voice + text based chatbot can be more accessible than solely text based models like most existing healthcare chatbots. This chatbot setting is an improvement from existing systems and we hope to further develop on it.

Conversational agents for elderly

Conversational agents like chatbots are an easily adopted interactive communication platform for elderly rather than social media platforms. There is an AI chatbot developed for assisting telemedicine and providing effective healthcare for old people living in rural areas after discharge from the hospital. It tackles the geographical distance obstacles, provides patients timely care and promotes better interactions in telemedicine. The medical providers also don't need to have overwhelming problems from patients to address. [7] Wearable sensors like motion sensors can assist conversational agents for old people, they can analyze motions like fall down and take emergency actions. [8]

Features of existing applications and limitations

According to the existing healthcare chatbot proposed that we have researched, there are features like checking symptoms and giving initial diagnosis, giving reminders on taking medications, tracking health status, and searching for suitable healthcare services etc. There are also some conversational agents created specialized for monitoring old people's health. Chatbots with voice user interfaces like Siri, Google Assistant and Alexa are easy to use for people in all age ranges with different technological literacy levels. [9] But voice user interfaces have not applied to any healthcare chatbot targeting old people yet. We think that a conversational agent or chatbot addressing healthcare issues for seniors that have a voice-based interface would be a unique system to build.

METHOD

We are going to build a healthcare chatbot for old people that allows both voice and text as mediums for interactions. The main features of the chatbot would be assisting healthcare services, providing health and wellness advice, and keeping track of medical status. Accessibility and voice-based features will be apply through the whole interface of this system.

Survey

We first conducted a user study survey (n = 13) for target audiences which are seniors over age of 65. The survey was created in google form and participants accessed the survey by shared link. It contains questions on asking participants' opinions on chatbots and views on how healthcare services can be improved by integrating a chatbot. We aim to take potential users' thoughts into development of chatbot that can better suit users' needs.

Participants

We recruited participants aged over 65 from people with certain relations with us. 61.5% of females and 38.5% of males took this survey. 8 of the participants are in the 65-69 age group, 4 participants are in the 70-74 age group, and 1 participant is in the 75-79 age group.

Data processing

We analyzed and found the top choices for issues encountered related to healthcare services and features for healthcare chatbots by percentages. These top answers are taking into consideration in developing a healthcare chatbot that better satisfies user's needs.

Chatbot development

The software we use to build the chatbot prototype would be Snatchbot. We will build conversations based on different user scenarios, like if a user asks questions on suggestions about which healthcare service facility to go to for health checks, the chatbot will provide relevant answers. Reminders on taking medications will be auto chatbot messages provided timely based on every user's conditions, time for sending reminders can be customized. The chatbot will also keep track of user's information, such as health status and medication records.

User evaluation on chatbot

After finishing developing the chatbot prototype, we recruited 2 potential users to go through the chatbot prototype. Then, we ask for their feedback on things they like or dislike in this chatbot and anything they hope to see improvements on.

RESULT

There are increasing demands on accessible healthcare services for all populations over time, they can overcome not only physical distance barriers but also financial barriers and barriers in accessing healthcare literacy. Conversational agents are one of the most applicable solutions for providing accessible healthcare services, however, most of them are specially created for elderlies. We decided to develop a healthcare chatbot for the senior population that offers voice and text as two communication interfaces, also including multiple accessibility options to provide a better experience in using the chatbot.

Survey data analysis

In the user study survey, questions are designed to ask people's needs on healthcare and their opinions on chatbots. The results show that the apps everyone would use on smartphones are mainly social medias, therefore Bliss can be integrated on social media platforms for easier access. 69.2% of participants have not used a chatbot before, which means it would be important for us to make the chatbot easy to understand and use for people.

84.6% of people expressed it is difficult to find suitable healthcare service, so that it would be one of the main features we can develop in our system. People that found it difficult to schedule medical appointments and remember to take medicines take up 61.5% of all survey takers, and these can be high priority solutions to create in the chatbot. Figure 1 displays that the top 3 features survey takers would like to have in healthcare chatbot are providing help in sensitive topic problems (84.6%), reminders in taking medications (76.9%) and procedures in healthcare services (check symptoms (76.9%), schedule appointments (69.2%), access test results (84.6%)), and they are considered as potential features available in our chatbot.

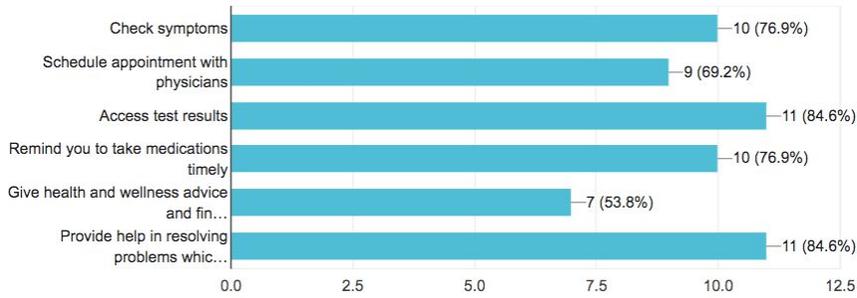


Figure 1. Survey question “If there is a healthcare chatbot developed for you to use, what features you would like to have?” answer distributions

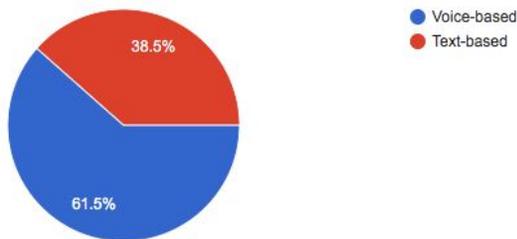


Figure 2. Survey question “When using smart devices to communicate with others, would you prefer voice-based or text-based platform?” answer distributions

According to Figure 2, the survey results display that 61.5% of target audience prefer text-based platforms to communicate with others through smart devices, others prefer using voice-based platforms. Thus, we can apply both text and voice interfaces into our chatbot system to satisfy a wider range of users’ needs.

Bliss Chatbot

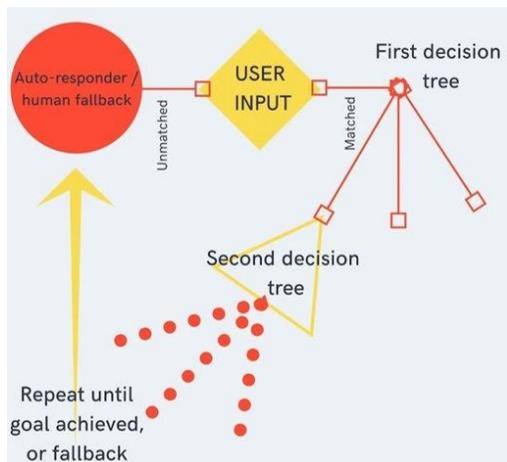


Figure 3 . Bliss Chatbot workflow

Bliss Chatbot is a voice + text hybrid chatbot model, user input can be in speech or text form and output from chatbot will be text with translated audio option. Voice recognition is a function in the system to recognize speech input to provide relevant responses. This function will benefit elder people by not requiring much learning to use the chatbot and it is friendly to old people that are not used to texting to others.

Bliss Chatbot is also AI-powered with Natural Language Processing (NLP), it can understand human languages expressed in different arrangements. It can detect keywords from the response users give or choose from predefined responses to provide relevant following responses. For example, a user said “I need to see a doctor”, chatbot will respond to help the user go through procedures to make a doctor’s appointment. The chatbot system has memories of users’ healthcare information and preferences, like medication status, preference on having appointments with certain physicians.

The system workflow is shown in Figure 3. The diagram explains user input will be sort into 2 categories, one is for input that can match data in the system and system will decide the responses carried out for each input until goal achieved, the other category consist of inputs system cannot match to its data, then a live human agent will help respond and solve the problem.

Features:

- Healthcare services
Reception schedules and managing appointments are 2 main components in this feature. Reception schedule consists of the entire procedure in scheduling doctor’s appointments or online consultation according to figure 3, from selecting a type of professionals to entering personal information and preferences. The chatbot helps book the appointment after all the information is collected. New appointments can be made or cancel previously made appointments in the manage appointments option.
- Provide health and wellness advice
Bliss provides health and wellness advice in the form of “Quote of the day” to the user. The advice can apply to the general senior population. We did not make the advice specific for certain people because Bliss is not a professional consultant on healthcare, and it has high possibilities to provide unsuitable advice.
- Keep track of medical status
After users complete the appointment, if there are any medication instructions from the physician, Bliss will organize and send them to the user. Bliss would ask if users would like to receive reminders on taking medicines, and reminder times can also be customized.
- Accessibility
Emergency contact, Call an ambulance and contact Bliss are 3 accessibility options provided in Bliss. Emergency contact is usually users’ close relatives, friends that can be reached easily, and this is important for old people since they have higher chances to be in emergencies such as sudden worsening in health condition. Call an ambulance can be used when emergency contact cannot be reached or in urgent conditions. Bliss human service will proceed with calling an ambulance normally, but if it cannot be reached, users can enter their address to call an ambulance automatically. Contact Bliss is an option to reach for human service.
An accessibility feature through the whole chatbot would be it confirms with users about important information, such as calling an ambulance. This gives users the option to modify their actions and prevent errors at some point.
Snatchbot platform provides the option of Text-to-Speech on chatbot output and speech recognition in user input. This satisfies our aim to make Bliss a voice + text based chatbot.

In figure 4, the flow of chatbot interaction is displayed and indicates how all features in chatbot connect. Users may interact in multiple ways to reach their goals in Bliss. For example, users can select “Reception schedule” or “Manage appointments” to book a doctor appointment.

Bliss chatbot is piggy-backed through Facebook for making learning progress shorter for users, since they are already familiar with Facebook’s interface.

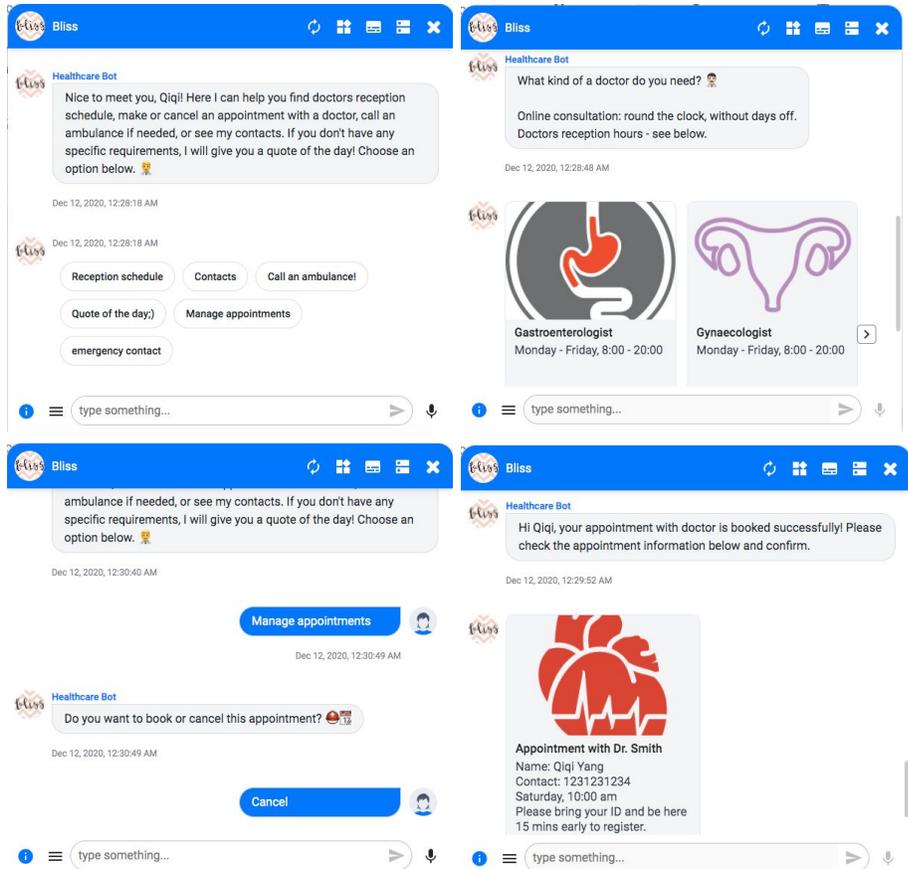
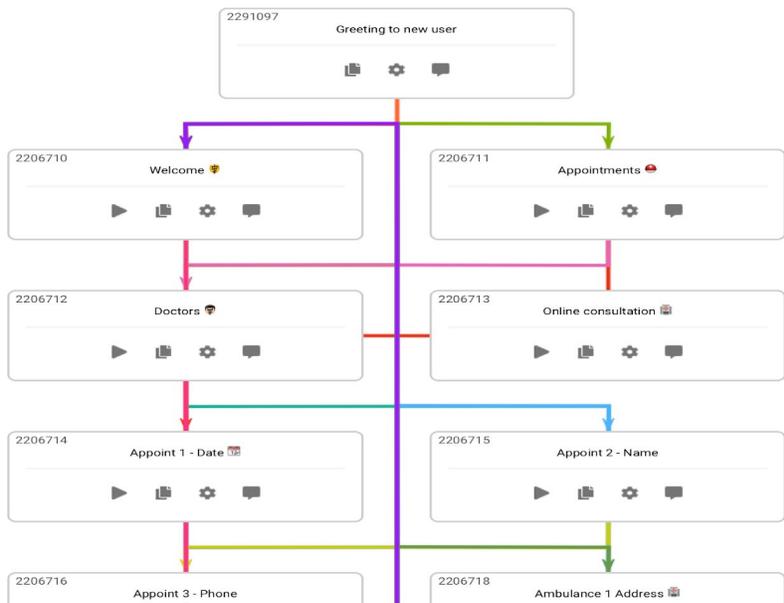


Figure 4. Healthcare services feature interface



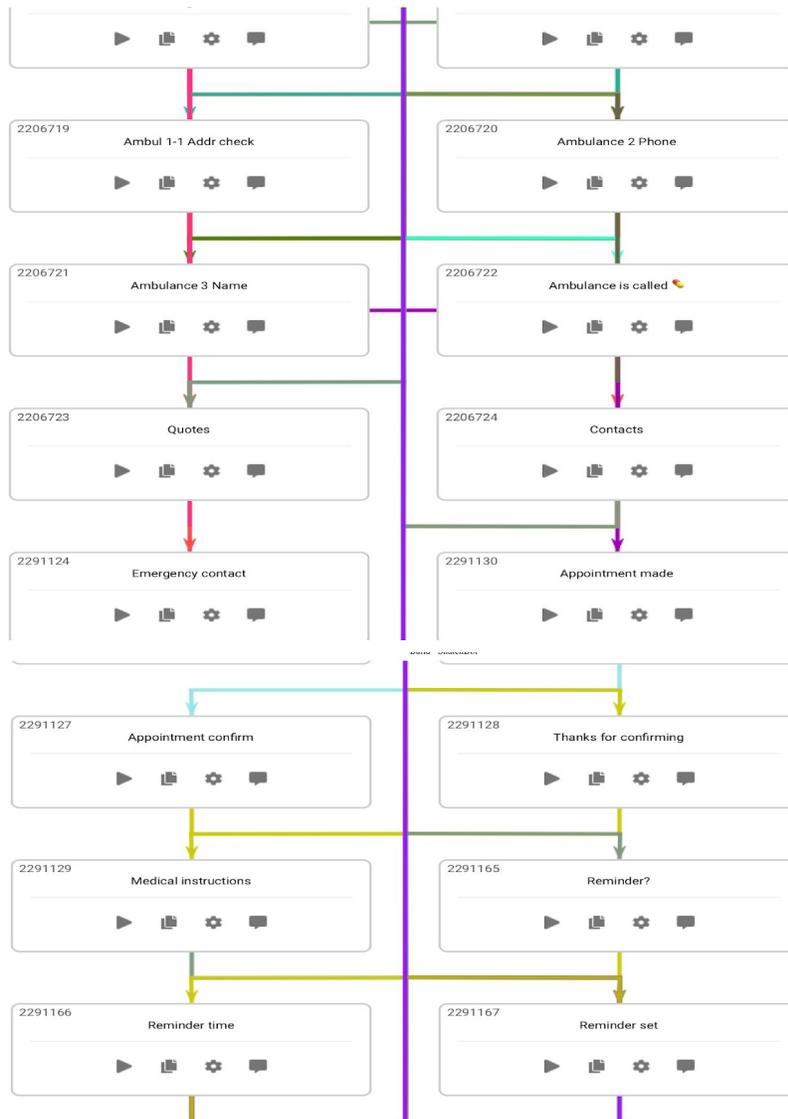


Figure 5. Bliss chatbot flow

DISCUSSION

Motivation of Healthcare chatbot Interaction

Based on analysis of the survey data, we identified that the user's motivation was to gain easy access to healthcare services from any location. This chatbot could benefit them in various ways: they did not have to travel, can access their doctors anytime and anywhere, have access to emergency services in case of crisis and many more. Users had to travel a lot for appointments and along with that came the wait time to see the doctor. This chatbot eliminated every possibility of time waste. There are many advantages that the user might want to shift from the traditional methods to this advanced technology with the age of growing innovations.

On the other hand, when doctors were asked about their perspective about healthcare chatbots, a wide range of positive and negative viewpoints, including the value of patients for maintaining their health and the advantages of physical, psychological and mental health outcomes came up. In terms of administrative advantages associated with chatbots, more consistent consensus occurred; many doctors agreed that chatbots would be most useful for arranging medical visits (78 percent, 78/100), finding health centers (76 percent, 76/100), or delivering prescription information (71 percent, 71/100). In comparison, many doctors think that chatbots can not efficiently take care of all the wishes of patients (76 percent, 76/100), can not show human feeling (72

percent, 72/100), and can not have comprehensive diagnosis and treatment because they do not know all of the patient's personal reasons (71 percent, 71/100). Many doctors have suggested that chatbots for health care could be a concern to patients if they are too frequently self-diagnosed (714 percent, 74/100) and do not understand the diagnosis properly. [14]

Eliminating the chances of wrong self-diagnosis we added the feature of 24x7 doctor availability with options of scheduling appointments for future visits if necessary. In the times of pandemics like COVID-19, such technologies are a boon as one cannot visit a doctor being vulnerable to the virus, but this way the elderly can access healthcare at home. All they need is a smartphone and a stable internet connection.

User Interaction

After using the platform, the users of Bliss claimed that the key reason behind using the platform was to get access to medical assistance without arranging a whole day out only to seek medical assistance. It has also made it easier for them if necessary, to obtain access to medical care in an emergency. This gave users a sense of comfort that they would quickly call an ambulance or get in contact with a loved one instantly when they are in need.

Users seemed to be very satisfied with the short replies and they were presented with the numerous alternatives bliss. One of the participants, for instance, said she loved using bliss to make appointments quick and hassle-free. The users were satisfied with the simplified interface and the different quick response options that the framework offered. Users also had the option of answering with a voice message, and there would be responses from the healthbot bliss in text and a voice note.

We found that the way elderly people talk would be different from younger people, and elderly react to correct mistakes in speech slower. One participant said that when he talked to chatbot about the date for scheduling an appointment, he made a mistake and the chatbot moved on with the conversation before he tried to correct the mistake. We consider adjusting the response time of chatbot, and make further confirmation with users on information they provide. Also, further development on NLP is needed for better understanding user input to provide relevant responses.

This healthbot's key agenda was to make healthcare open and technologies convenient for older adults to use so that they do not have to face challenges using it. We tried to make the GUI as simple and enjoyable as possible to use.

LIMITATION

We asked our users about their experience after using a sample of chatbot bliss to see what their opinions are after using it. Talking about all the positive aspects, users thought that this chatbot can be a very good way to get track of your health, check for different symptoms or schedule appointments with their doctor at the ease of a click. However, there are issues like loss of vision due to aging or difficulties to master modern technologies since the elderly have little experience with technology as a basis for their use. In general, seniors have a smaller frame of reference to allow them to learn new information.

In the EU, 87 percent of citizens aged 75 and over have never been online, according to Eurostat (Eurostat, 2018). [11] Most communication technology depends on the ability to see, hear and read, meaning that a large portion of society is losing out on communication opportunities due to health conditions.

SSB statistics show that 83% of seniors aged 64-74 years of age use the internet on a weekly or more regular basis.

96% of seniors over 67 years old own a cell phone, but less than half own a smartphone (2014 numbers). [12]

Another limitation of the AI based chatbots is that they do not recognize human frailties and are therefore unable to demonstrate concern for disabled persons. In addition, the use of chatbots can lead to a decline in the amount of human interaction encountered by the elderly, which can be harmful to their well-being. Under this opinion, it is immoral to continue to replace real emotional contact for bot simulacra. The failure of bots to care about people and their expanded function as bots in social activities give rise to possible problems of users' deceit and over-reliance on bots.



Figure 6. SWOT analysis on Bliss chatbot

CONCLUSION

Our healthcare Chatbot would have a significant effect on its users' lives. This will give them the benefit of putting a virtual doctor in their pockets. It would also allow them the right to consult a doctor 24/7 and if necessary, they could also get a genuine doctor's advice. For those elderly people, this may be the most common tool so they won't have to hamper their routine to visit a doctor with minor health questions. It can also be a very useful tool for elderly individuals, as this will help them find solutions at their fingertips to all their health-related issues. We will carry to our site doctors and medical experts to feed the medical data into our records and also to talk with our users if possible. It will make our Chatbot run more effectively and reliably with loads of medical details. Right now, our Chatbot is in the design process. We will very soon be incorporating the whole concept and we expect to launch it in the future.

We also want to build and create a wearable that can be worn by people to allow their essential body readings and health data to be obtained. We'd use raspberry pi to make the system compliant with our Chatbot and many other utilities, as well as using APIs. The idea behind comparing our Chatbot with other chatbots was not to demonstrate that in any situation our Chatbot was better than them, but to demonstrate that it was different from any other Medical Chatbot to date.

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