Exploration in Potential Use of Chatbots
Especially in Healthcare

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Abstract. The long-term goal of the research is to develop an efficient natural language processing application for both healthcare and education purposes. Chatbots are identified as a program within a website or an application that simulates human conversations using NLP. The objective of the current study is to provide a comprehensive review of chatbot's possible impacts on the healthcare and education industry. To be specific, the study has the following subobjectives: The result of this study will be valuable to the healthcare and education industry as well as related software providers in developing better proactive and tools for understanding the intent behind individuals' requests.

Keywords: The Literature And Real-World Cases Of Chatbots Application · Working Principle Of Chatbots · A Model Of Chatbots That Have Satisfying Functions Respectively For The Healthcare · Current Industry Practices And Research In Current And Perceived Use Of Chatbots · A Conceptual Framework For The Perceived Use Of Chatbots

1 Introduction

1.1 Background

In recent years, the automatic responding artificial intelligence called chatbot began to help with the consumer service [3]. They are designed to give quick responses by analyzing and sorting consumers' demands. For voice-based chatbots such as the ones used by U.S. banks, they can transform consumers' bank accounts from voice-form to text-form followed by sorting the problems, and then sending the consumers to different departments based on their demands. Text-based chatbots like the ones used by shopping platforms such as Amazon and Dyson, which save the energy of manual customer services by replying to simple problems such as changing current home address or switching payment methods. During the Turing test, it is generally suggested that chatbots perform less human-likely, and each chatbot varies from each other depending on types [4]. Thus, chatbots are now widely used for quick responses by online platforms. However, in this paper, we will introduce the complex work chatbot, especially in the health and education fields.

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1.2   Current State of Chatbots Market

To better understand Chatbots, people should know their working principle, which is based on an operating system. It is easier to recognize chatbots belonging to bots from the name, so what are the difference and similarities? If a bot is an automated tool designed to complete a specific goal, then a chatbot is the same thing, just emphasizing on communication. Chatbots are a sub-type of the bots, and are created to have a conversation with humans. Chatbots are also useful in doing research work for clients. They play the role of interactive Fact And Questions (FAQs) where customers can get the answers to frequently asked questions. Chatbots play a significant role in today's customer service because they are as valuable as access to information and guidance. They can even arrange customers booking consultations with product managers and consultants (Fig. 1).

There are many parts in the learning process of chatbots, and the most familiar components are natural language processing (NLP), natural language understanding (NLU), and natural language generation (NLG). A formula can explain the relationship between the three parts: NLP = NLU + NLG. Simply, learn NLP just like learning a language. NLP, NLU, and NLG all play a role in teaching machines to make them humanize. The most crucial component for a chatbot is the language recognition, an indispensable part of NLP, which combines AI and machine learning, where the NLP algorithm is used to understand natural speech to execute commands. A technical process that allows text input. In doing so, it tries to understand the input's intention, not just the information of the intention. To make it possible for developers to teach robots to extract valuable information from sentences, enter or pronounce them, and then convert them into structured data. NLP comprises intent, utterance, entity, context, and session. To be specific, the core concept of building conversational UI is the intent. In other words, the intent is the task that the user wants to complete or the problem that the user wants to solve. Entities include the important details for the user's intent since it can be anything such as location, date, and time. Context helps save and share parameters throughout a session, which is a conversation from the beginning to the end [1]. NLU, which is a smaller part of NLP, converts text into structured data. The NLU understands the data based on the syntax and context to determine the intent and entity. NLG generates text
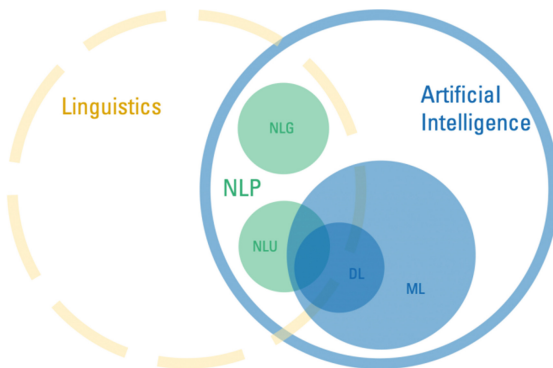

Fig. 1.   The working principle of chatbots

based on structured data generation, and it can also be used to create data-based content at scale.

Using NLP, NLG, and machine learning in chatbots free up resources and allows companies to offer 24/7 customer service with reduced huaman cost. With these functions, NLP allows chatbots to talk and serve humans. Chatbots are already very common in human life, such as Alexa, Siri, and Google, and they have many applications. Various chatbot platforms can handle all kinds of businesses, such as selling, banking, travel, and healthcare. Moreover, they may become powerful information-gathering tools in the future. For example, patients with Alzheimer's disease engage in the most basic conversations, so Endurance, a Russian technology company, has developed companion chatbots to help this group of patients. This chatbot aims to identify and analyze deviations in the conversation branch and help doctors and family members view the analysis it obtains. Specific Chatbots, which develop the ability to have imaginative conversations, can also help insomniacs stay up late by assitainting people pass the time when they cannot fall asleep and making their spirits happy and relaxed. UNICEF, the international children's advocacy nonprofit organization, also uses chatbots to help people in developing-countries speaking out about their pressing needs. U-Report, the bot, sents users in Liberia a poll to ask whether teachers were forcing students to have sex in exchange for higher grades. About 86% of the 13,000 Liberian children responded that their teachers engaged in this despicable practice, which led to a collaborative project between UNICEF and the Liberian Minister of Education to stop it [5]. Of course, everything has disadvantages, also chatbots and this will be explained later. The following essay will focus on the use of chatbots in healthcare and education.

2   Future Usage of Chatbots in Healthcare

2.1   In Mental Consulting System

From Tieldman, a chatbot is used as part of the autonomous e-mental health (AEMH) system to detect crises and boost referrals to human caregivers [12]. It takes much human effort to provide help to those vulnerable people if they do not intentionally seek help, so the AEMH system is an excellent help to increase such behaviors and reduce the suicide potentials. The Fig. 2 introduces how the chatbot will help patients with full regard to their safety. It will catch the phrase during communication and further "judge" whether it is necessary to refer the patient to a human caregiver. It develops complex modes to facilitate and persuade the patients according to their willingness to see a doctor, and the routine checkup will significantly reduce the likelihood of being neglected by the mental health provider. It is also efficient to use a chatbot for building up the keyword database for any crisis line operators. It is easier for them to check the words and lookup for recommended solutions, which will further decrease the pressure on crisis line operators at the scene. If a mental health organization widely adopts the chatbot, it will be easier for chatbots to develop and fit in with users with poor computer skills as in Thailand [10].
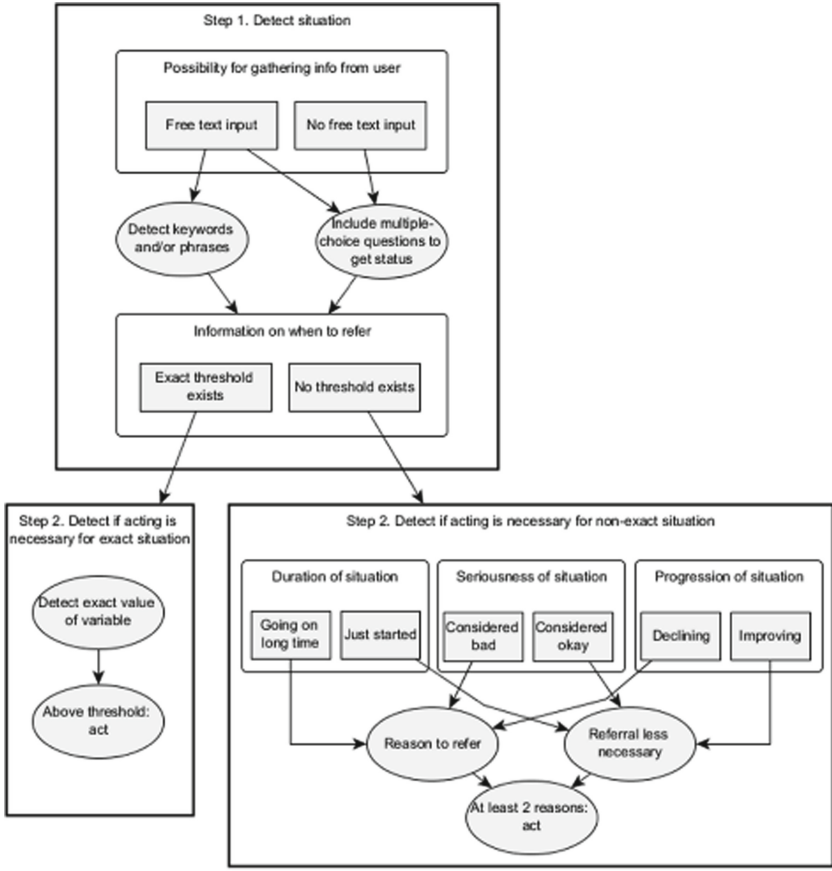
Fig. 2. Detection model.

2.2 During Diagnosis of Infectious Disease

Step 1 is to detect if a risk might exist, which can be done by text detection or by including specific questions, depending on the possibilities within the system. Step 2 is to detect if the situation is severe enough to refer to human care. If a threshold value on a questionnair exists, this can be used for the decision. If not, the duration, severity and progression of the situation could be taken into account to make this decision. Although dependent on exact implementation and situation on type, the model gives the guideline of referring if at least two of these values are negative.

The chatbot will help with the self-diagnosis of infectious disease by reducing patients' awkwardness and decreasing the exposure of clinic staff to the infectious disease. During the spread of syphilis in Japan, chatbots proved their convenience by providing the patients an easy way to self-screen the possibility for sexually infectious diseases [7]. Moreover, during the COVID-19 pandemic, people in Korea also suggest that chatbots should significantly improve the public's psychological reactions, such as

	Chatbot group (n = 21)	Book group (n = 20)	χ^2/t	p value
Gender			0.61	0.44
Male	9 (42.9%)	11 (55.0%)		
Female	12 (57.1%)	9 (45.0%)		
Education level			1.62	0.20
≤High school	8 (38.1%)	4 (20.0%)		
≥College	13 (61.9%)	16 (80.0%)		
Occupation			0.18	0.68
Employed	3 (14.3%)	2 (10.0%)		
Unemployed	18 (85.7%)	18 (90.0%)		
Age (years)	37.6 ± 11.2	44.5 ± 11.9	1.91	0.06
Onset age (years)	32.9 ± 11.1	36.8 ± 11.8	1.10	0.28
Duration of illness (months)	53.3 ± 82.1	92.5 ± 88.6	1.47	0.15
Medications (mg)				
Antidepressants	55.1 ± 40.9	81.0 ± 87.1	1.23	0.23
Benzodiazepines	4.7 ± 7.1	9.3 ± 9.2	1.79	0.08
Intelligence score	103.8 ± 8.9	101.8 ± 9.5	0.69	0.50
PDSS	12.9 ± 4.7	12.3 ± 5.6	0.41	0.69
APPQ				
Total	64.3 ± 39.8	64.7 ± 49.8	0.02	0.98
Agoraphobia	23.0 ± 14.4	24.0 ± 21.4	0.22	0.82
Social phobia	30.0 ± 23.8	26.9 ± 24.3	0.41	0.68
Interoceptive fear	11.4 ± 8.9	13.6 ± 13.1	0.62	0.54
HADS				
Anxiety	8.1 ± 4.7	8.9 ± 5.2	0.52	0.61
Depression	7.6 ± 4.5	7.5 ± 4.7	0.08	0.94
BSQ	3.2 ± 0.9	3.0 ± 1.0	0.79	0.43
ACQ				
Total	64.7 ± 16.3	70.0 ± 17.2	0.93	0.35
Emotion control	28.0 ± 9.3	32.5 ± 10.4	1.42	0.16
Threat control	22.1 ± 5.5	22.0 ± 5.7	0.08	0.94
Control helplessness	14.5 ± 3.9	15.5 ± 4.1	0.77	0.44

Data are n (%) or mean ± standard deviation. Mean doses of antidepressants and benzodiazepines are presented in imipramine-equivalent dose (mg) and diazepam-equivalent dose (mg), respectively. PDSS, Panic Disorder Severity Scale; APPQ, Albany Panic and Phobia Questionnaire; HADS, Hospital Anxiety and Depression Scale; BSQ, Body Sensations Questionnaire; ACQ, Anxiety control questionnaire.

Fig. 3. Baseline demographic and clinical characteristics of participants

panic attacks, to the disease [9]. With mobile app-based communication, people are provided with timely updates, and as chatbot functions by responding to questions, it lowers the threshold or searching for information and decreases people's feelings of loneliness and anxiety level (Fig. 3).

2.3 For Long Term Support

Chatbots are introduced to monitor health status and provide long-time support. Now chatbot is used for diabetes management [13]. The apparent advantages include last-learning, repetitive check-ups, and compassion with little cost in comparison with humans. Such work needs extraordinary patience and immediate response if any emergency occurs. Thus, the chatbot will significantly reduce the workload of human caregivers. Besides, the chatbot is also adopted for smoking cessation. The chatbot helps shy smokers who "are too awkward to see a counselor," He also suggests that chatbot is free of charge and is open 24/7, so it is convenient for all people [8]. Tomas agrees that chatbot is essential in the absence of a professional. Tomas conveyed a blinded experiment to test whether artificial intelligence will help them to quit [2]. Even human intervention is needed at some point, the chatbot improves the success of smoking cessation. In the future, such apps need to be more personalized.

3   Disadvantage

As mentioned before, chatbots have disadvantages. Firstly, improperly setting chatbots might encourage the chatbots to learn bad words from malicious users such as the function of "repeat back to me." In 2016, Microsoft launched an ambitious experiment with a Twitter chatbot called Tay. The idea is to allow Tay to "learn" human conversation nuances by monitoring online and interacting with real people. Unfortunately, Tay made a misconception and encouraged drug uses. Although some of Tay's tweets are "original," many were the result of the bot's "repeat back to me" function. This function means users can make the chatbots say whatever the users want.

Finally, useful chatbots are hard to build, which is often time-consuming and costly. According to appinventiv.com, the cost of chatbots is between $25,000 and $30,000, including the design, development, and integration portions of the entire chatbot application development process [11]. Robots can handle limited problems. They can only solve routine or straightforward problems such as sorting, finding problems, collecting contact information, conducting surveys, and maintaining standard experiences such as greetings, explaining rules and dealing with frequently asked questions [6].

4   Conclusion

It is an advanced technology time by adopting Chatbots in the Healthcare and education industry, which could largely save time, energy, and costs. If the chatbots in the hospital can provide excellent urgent response services and schools could provide a similar example or relevant educational videos, students could save money from Chegg, Course Hero, or other websites that need to pay to see similar questions. Chatbots also provide opportunities to study for those students who cannot go to professors due to many other reasons, which is very helpful for students and teachers. However, improvements are needed for chatbot design to provide more accurate and personalized services, and concerns must be addressed to popularize the chatbot in the education industry. Many ways can be used to improve chatbots over time. To improve chatbots, they must be changed over time. The first one is to monitor success metrics. Chatbots must be monitored regularly since these metrics can be customer chat level, average chat time, etc. Also, chat logs can be collected to analyze. Based on the chatbot architecture, the bot can be retrained and learn how to overcome its weaknesses. Researchers can also do surveys. Adding an option survey link after each chat can help sellers understand how satisfied their customers are with the robot's performance and give them metrics on how they can improve the chatbots.

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