Hey GloBot! A user study for climate change chatbot

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ABSTRACT

UPDATED—April 30, 2020.

In pursuance of a communication tool that can help with the discussion of climate change, we must understand the popularity of using a chatbot in daily life these days and the problems of the conventional ways of searching for the topic.

A number of climate change related chatbots exists such as the BBC Climate Change chatbot, CliMate, ActNow. All these examples are response-button based chatbots, thus limitating the conversational experience and possibility for the users to share their opinion using only pre-defined responses. Current research works leverage the use of machine learning to build conversational chatbots for climate change. However, most works focus on the technicality of deploying such a chatbot. In this paper, we propose a conversational chatbot to address the HCI design principles for such chatbots. We study existing articles and conduct online survey to understand how users are using online discussion forums to learn or inform about climate change. Based on the results of this study, we conduct a wizard of oz test to explore what HCI design implications can be derived from such experiments. The intent with this chatbot application is to help the people clearing out queries and discuss related to climate change.

Our results indicated that the chatbot as communication tool does have substantial impact that should be tapped further on. As most works focus on the technical discussion of such chatbots, our work explore the human-interaction side and aspire to help designers and developers to take a user-driven approach.

Author Keywords

Climate Change, Chatbot, Online Discussion Forums, User Study

CHI'20, April 25–30, 2020, Honolulu, HI, USA

ISBN 978-1-4503-6708-0/20/04…$15.00

DOI: https://doi.org/10.1145/3313831.XXXXXXX

CCS Concepts

•**Human-centered computing** → **Human computer interaction (HCI);** *Haptic devices;* User studies; Please use the 2012 Classifiers and see this link to embed them in the text: https://dl.acm.org/ccs/ccs_flat.cfm

INTRODUCTION

In 2019, the study 'Comparing Data from Chatbot and Web-Surveys'[35] was conducted to work for the quality problems of the web surveys, one of a point for the research concludes that the with chatbot's conversation is classified as an interaction rather than a task. It includes, "One in the casual chatbot condition reported,"I did not feel like the chatbot as a robot, but I felt like talking to a real person," and another in the same condition said, "It was like having a conversation with a friend because I received a reply in real time."[35] Also in 2019, the ICDSE research titled "Generative model chatbot for Human Resource using Deep Learning" works on the idea of Chatbot that is an automated structure expected to begin a dialog with human customers or diverse Chatbots that gives through text. The Chatbots which is being proposed for Human Resource is Artificial Intelligence based Chatbot for major measurement profiling of contenders for the explicit task [34].

Recent development has shown that goal-oriented conversational facilitates more natural user interaction. They typically focus on short interactions, as in products such as Amazon Alexa, Google Assistant and Apple Siri [12]. Chatbots are able to provide answers while understanding users' intention and thus it does become a technological reflection of a human being[20]. Though there are some chatbots which works with certain age, likes and dislikes. The personality and the persona of the people that we can deploy within the chatbot is used to produce more personal, specific and engaging responses than a persona-free model, thus alleviating some of the common issues in chit-chat models [43].

According to a survey by Oracle [31], different businesses understand the effectiveness of the chatbot and intend to incorporate it into their processes. The responses are from 800 decision-makers from France, the Netherlands, South Africa, and the UK.This implies the pervasiveness of chatbots and the fact that it can't be narrowed to one industry. Other times the Facebook researchers have turned to deep learning, so the chatbot can be taught by looking into the patterns of a large dataset [41].

A large part of past studies and scientific works focused on the graphical user interface design, subsiding the design considerations for natural language user experience. However, the rapid growth of voice search and other conversational interfaces urges the need to design natural language interfaces that can interpret user needs to provide the best possible solutions [13] [9]. While a consistent personality provides the chatbot fluency[42], the speech assistant like Alexa are usually taken for multitasking[8].

The motivation of this study is to find out that how a chatbot can be effective in discussion of climate change. Through reviews of various literature, related works and user surveys, we inquired whether a chatbot can be used as an emerging communication tool for the climate change discussion. We conducted a Wizard of Oz test to find out if the human tendency of interaction, popularity of the chatbots can be utilised to create a conversational agent which we are referring as GloBot to do the discussion for climate change.

The decision for the topic climate change comes from the fact that though according to NASA, 97% scientist believes that the global warming is happening due to the human activities [6]. The new information still clearly depicts that if we'll keep our way of living like this, crossing the threshold of the climate temperature would lead to a much higher global average temperature than any inter glacial in the past 1.2 million years and to sea levels significantly higher than at any time in the Holocene [36].

Some of the main contributions and learning outcomes of this research are:

1. While chatbots offer major potential as a tool for climate change and discussion, there is lack of research and related work on the design of chatbots in the domain of climate change.
2. Through our work we contribute to this area of development by gathering examples from current climate change related chatbots

Research Questions

The research questions for our work is as followed:

- How a chatbot can be developed as a climate change discussion tool?
- What role user study play in the development of a chatbot for discussion of climate change?

Research Objectives

To answer these research questions, we design a user study method with the following objectives:

1. to assess the main factors that contribute to a positive or negative conversation experience between the user and GloBot
2. to propose implications for a user-centric chatbot design based on the identified factors

BACKGROUND AND RELATED WORK

Why Not Reddit and Quora?

The online discussion forums are common use for attaining new information and learning[38], and an increase in development of means of communication among citizens is seen in recent years[26].

Online discussion spaces have well-developed behavioral guidelines on how to proceed with communication, including what constitutes a successful post, how much to post, and how to communicate with others. Violations of these norms can lead to misunderstandings, flaming wars, and other forms of social breakdowns in online communication [24].

Some current problems of online discussion forums are about removing posts, banning users, lousy community, unwelcoming, negative feedback, unhelpful, aggressive and lack of effective bullying policy. Quora users are expected to conform to strict rules when asking and answering questions. All questions must be raised in the proper form, or they will be either edited by other users or removed by Quora. Moreover, users will be required to offer supporting evidence if Quora thinks they are using fake names. Also, Quora is dealing with another problem of keeping the answers up which are the herd favorite, for example if the answer is not appreciated or preferred by the audience, it gets down-voted, and then the website literally hides those answers [23].

On the other hand, Reddit is considered to be one of the internet giants; most Reddit pages have a throwback aesthetic, with a few crudely designed graphics and a tangle of text: an original post, comments on the post, responses to the comments, responses to the responses [27]. This is immense amount of data and it takes much time and effort to search for any answer which can be precise and most relevant to the question.

Another significant fact is that cyberbullying and harassment are the problems on social media. Many adverse effects associated with cyberbullying extend into the real world. A report from the Cyberbullying Research Center indicates a link between cyberbullying and young people are more vulnerable for it[19].

These threats may create a massive discouraging impact for the online discussion forums, and thus persistently threatening new users that will lead this large community into the shrinking process [7].

The youth are an important community to consider and prioritize when it comes to climate change communication because this community comprises, besides being people of today, and they will be the ones addressing the future negative effects of this global crisis.[30] However, findings from a study indicate that young people should be targeted to take climate friendly actions[11].

Chatbots are the new face for the specific area knowledge[16], these task-focused chatbots seems promising to be taken over many areas that needs exploration about its effectiveness. To know the popularity and effectiveness we'll describe some of the areas which are already well established and their potential of further integration.

Chatbot for climate change communication

Climate change oriented chatbots are not something out of the box. There is a gradual rise of using chatbots for various campaigns such as to promote sustainable lifestyle, distribute climate change news or communicate key messages with target users. BBC News developed a Facebook Messenger based chatbot as a new approach to reach their desired audiences. This chatbot helps users to understand various climate change challenges and learn what actions can be taken to mitigate these challenges [3]. The BBC journalist Dulcie Lee explained that the interactions between the user and the bot helps the BBC reporting team to get extensive insight about their audience current concerns and tailor their reporting to better serve their user needs [32]. The conversational chatbot, CliMate, is a Facebook Messenger based chatbot developed by the David Suzuki foundation. It aims to help both climate change believers and skeptics have more constructive conversations with each other. In a button-based interaction, the users learn how to avoid conflicts during climate change related arguments by selecting different responses to statements posed by the bot [**?**]. Based on the response selected by the user, CliMate explains what reaction the user will get and how to avoid conflicting responses. ActNow is another Facebook Messenger based chatbot by the United Nations, that prompts users to take different everyday actions to reduce their carbon footprints. The users choose an action they would take, and then mark it as completed once they have taken the action [5] [1].

We observed that a common similarity amongst these chatbots is that all of them use response-button based interactions. A button-based chatbot constraints the user to pre-defined responses. Whereas a conversational chatbot would allow the user to write their responses as same as they would when talking to another human[33]. User often prefer to chat using chatbot instead of clicking buttons [21]. In their workshop paper on chatbot typologies to understand interaction design, Asbjorn Folstad et.al [14] discussed that while there is insufficient research on how to design for chatbot, differently there are guidelines for conversational interaction designs available from chief companies in this industry. The Conversation design guidelines by IBM suggest that natural conversations should be adapted to flow of the conversation and to users level of knowledge [2]. The adaptable design patter for situational design by Amazon discusses that, in a conversational interaction users should be able to use their own words.

In contrast, we propose a machine learning based chatbot, named as GloBot, that would leverage the data from online discussion [39] forums. Our work is most similar to the Climebot by Daniel Toniuc and Adrian Groza [15], which is an argumentative agent based on textual entailment and ontologies. As the current work of Climebot is focused on enhancing the agent's conversational skills using ontologies, we are motivated to draw design implications based on a user study. Unlike the aforementioned chatbots with button-based responses, GloBot is an open-domain [29] chatbot where a user can type their dialogs in form of a question or a comment regarding climate change.

GLOBOT USER STUDY DESIGN

In order to answer our research questions, a user study was designed using the the user study and data collection methods outlined by Raul Valverde (2001) [40]. A number of online surveys were conducted to understand how our target users are using the internet, or mainly the discussion forums to either learn or inform about climate change.To achieve our second research objective to understand whether a chatbot can become a viable second to such forums, we adopted a user-centric design approach. A wizard-of-oz experiment was carried out to collect user insight about climate-change based chatbots. Finally, a number of user-centric design implications are proposed as discusssed in the Discussion section of this paper.

Participants

Participants of this study were recruited with prior experience of using an online forum and interest in learning or informing about climate change. From our background work we see that young people are one of the eminent users of online discussion forums. This demographical group is also most likely to use a chatbot. In order to recruit the participants, a pre-study survey was sent out to 38 people. From these 38, a total of 15 people were invited to participate in further surveys and a wizard of oz setup. While these 15 participants were informed about the background of this study and a user scenario of using a chatbot as climate discussion tool were presented, they were unaware of the wizard of oz test. Google Forms was used as a tool to run this survey.

We conducted another online survey to understand how people are using existing common online discussion forums such as Quora, StackExchange, Reddit to find information about climate change. The 55 participants which includes the 38 participants of previously mentioned survey.

All participants of this study accepted climate change as a global threat, thus indicating their interest in participating in a study like this. All of them are students at graduate and post-graduate levels. In order to ensure that participants are able to make a conversation with the chatbot, their comfortable level of command in English was confirmed.

Online survey

The online survey is a method of data collection by using various online tools such as Google forms, social media platforms i.e. Facebook polls, Doodle and more. In this study, we used Google forms to conduct a number of surveys. In these surveys, the participants are presented with 5-10 questions to understand how they usually learn about climate change, what technology tools they use to educate themselves about climate change [4].

We conducted an online survey to understand how people are using existing common online discussion forums such as Quora, StackExchange, Reddit to find information about climate change. In this survey, 55 participants answered questions about how they use different discussion forums and social media sites to get or share information about climate change. The questions were based on these websites and social me-

dia sites: Quora, Reddit, Twitter, Facebook, Climate-debate, StackExchange and TedTalk.

We also inquired about the user experience on these websites in terms of the ease of searching information, posting a question or replying to them, and navigating through the websites. The results indicate that users find it easy to use these websites.Most users use these sources to read past threads and to find study material.

Next, follow up surveys are conducted to collect feedback from the user on the Wizard of Oz test to understand how they rated the sessions, what they liked and what changes they would like to see.

Wizard of Oz test

Wizard of Oz test is one the most effective ways of collecting user feedback about a product, interface, service, tool and more before the actual product has been developed. In this test, the product or tool is mocked up by humans while pretending to be the actual product or tool [17] [28].

We derived steps to conduct our wizard test from existing research works [22] [37] and online articles [17] [28]. The test design consisted of the following stages:

1. Prepare scripts to be used by the wizard to pretend as the chatbot
2. Create a digital mock chatbot interface
3. Invite the participants to test a climate change beta chatbot
4. Supply the participant with a user scenario
5. Conduct the sessions
6. Analyze the session transcripts and feedback survey data to derive learning outcomes

To create a make-beleive chatbot, a free trial version of a chat box plugin available on the WordPress Plugin repository [25] was installed in a WordPress website. A link where users can interact with the wizard was created and shared with participants. A Google Form was create to collect some questions the users would like to ask a chatbot like GloBot. The survey included a total 4 questions, where 3 questions were asked to collect user demographic information including their gender, age and country. The other question asked the users to enter questions they would ask a climate change related chatbot. The users were asked to list all the questions they would ask to GloBot. The purpose of this question was to prepare a script for a Wizard of Oz test and also to understand what concerns motivates people to interact with such systems.

Then, participants were asked to test the chat box as a chatbot. Two of the authors of this paper posed as the chatbot, using the plugin Admin Agent dashboards. A script was prepared using

A post-test survey was conducted to collect user input for the chatbot design as a previous wizard of oz test follow up feedback survey. The survey included a total 7 questions, where 3 questions were related to the participants' demographics information and the other 4 questions inquired about design implications for the chatbot. At the beginning of the form, the users are given a scenario to assume that they are someone highly concerned about climate change and they would like to talk to someone about it:

Imagine you are someone deeply concerned about climate change, and you want to talk to someone. This is a beta chatbot, with which you can ask and talk about the climate change. Your participation will help us to understand general public view and beliefs, and functionality of our bot.

In this context, the users are then asked to assume that GloBot is a chatbot trained to converse like a general internet user and give input about how they'd design this chatbot.

RESULTS

Our study aimed to use the chatbot as a climate change communication tool, To build this usability for the application, we approached different methods such as online survey and wizard of oz test. With the online survey, we tried to investigate the key factors of climate change awareness activities of young people. We also identified users' expectations of how they want to use it, and what questions would they ask to discuss climate change or what kind of response they expect from the chatbot?

55 people responded to the survey investigating how people use internet and more importantly the discussion forums. 67% participants identified themselves as believers in climate change and 28 participants are students. The results from this survey indicate that most users use Facebook, Twitter, Reddit and Quora to talk about climate change. The survey also investigated how the users rate the information they find in these websites in terms of their trustworthiness and relevancy. The results reveal that most users find the information found on Tedtalk to be most relevant and trustworthy. On the contrary, Facebook was ranked as the source of both least relevant and least authenticate information.

22 respondents including the confirmed participants as described in the Participants section participated in a survey asking users to list some questions they would ask GloBot. The results of this survey helped us to prepare a script for the wizard of oz experiment.

From the responses by a total of 22 respondents, the questions to be used in the script were selected based on two factors:

1. by manually comparing the questions with questions found on the scrapped websites and select the ones that are most similar
2. assessing whether a question would be answerable by our scraped data

Among the 21 responses, more than 3 participants mentioned that they do not want to ask any questions. Another 7 responses were excluded as irrelevant. The remaining 10 responses questions that users would ask GloBot, including:

1. Who are you?
2. What causes the Earth's climate to change?

3. What are greenhouse gases emissions?

4. Which steps should we take to prevent air pollution?

5. What's your origin?

6. Is it too late to prevent climate change?

7. Which countries are producing most of the waste?

Among the 15 participants recruited for the wizard of oz, 11 responses were taken intro consideration since they completed both the wizard of oz and the follow up feedback survey. Based on the examination of the transcripts of this 11 sessions to identify why a session succeeded or failed, a total 5 were considered valid for analysis. While another 4 are used to identify the reason of not succeeding with the test.

Here are parts of the transcripts of two different wizard of oz sessions between a participant and one of the author posing as GloBot:

Transcript Start

GloBot: Hi! Let's talk climate.

P5: While we are talking about Climate Change, we need to be focusing on 3 major points.

1. Reasons

2. Effects

3. Solutions

Look, the most substantive reason is the cutting down of tress indiscriminately.

GloBot: Yes, you are very right.

P5: It later on produces some other problems too. Increasing the amount of CO2,CFC,Methanes all these happen because of losing too much trees now-a-days. These gases are produces also through the decomposition of wastes in landfills, agricultural etc. So, first we need to come up with such idea which would be a sign of smartness. What should we do? The answer is we have to understand the neg effects and its future outcomes. Unless we get that, no matter how much we are concerned about, we get nothing to do.

GloBot: Yes, these are some very good ideas!

P5: So, more or less we all are acquainted with the effects as these are quite visible to us. But what about the solution ??

GloBot: Addressing climate change will require many solutions — there's no magic bullet. You have to recycle your fear as action. Working at promoting solutions and critiquing policy and talking truth to power really helps my mental state. I really enjoy our talk. Let's talk again another day!

Transcript end

Transcript Start

GloBot: Hi! Let's talk climate.

P3: ok so tell me what's your opinion to prevent climate problems?

GloBot: Addressing climate change will require many solutions-there's no magic bullet. Nearly all of these solutions exit today and many of them hinge on human humans changing the way we behave, shifting the way we make and consume energy. The required changes span technologies, behaviours and policies that encourage less waste and smarter use of our resources.

For example, improvements to energy efficiency and vehicle fuel economy, increases in wind and solar power, biofuels from organic waste, setting a price on carbon and protecting forests are all potent ways to reduce the amount of carbon dioxide and other gases trapping heat on the planet.

P3: Our country is facing many problems like air pollution, water pollution etc.

GloBot: Okay

P3: What's the status about others?

GloBot: Humans are increasingly influencing the climate and the earth's temperature by burning fossil fuels, cutting down rainforests and farming livestock. This adds enormous amounts of greenhouse gases to those naturally occurring in the atmosphere, increasing the greenhouse effect and global warming.

Transcript end

3 participants from the 4 invalid sessions revealed that the wizard did not provide enough insight to understand how to interact with it. 2 participant from each of the valid and invalid transcripts expressed that they wished the chatbot would Some of the features that the users mentioned were:

1. Refer to explained literature about climate change

2. Climate crisis alert on my location

3. participant will provide all the updated info in this chat bot so that people know the real scenario of current climate change around the globe.

4. The bot can be sarcastic sometimes.. Maybe have some sense of humour

5. Compare answers with others and give a survey

The analysis of the session conversations and results of the post-session surveys reveal that while users are interested in talking to a chatbot about climate change, there is a lack of user understanding about how to use it as an effective communication tool. The test also indicated that most users prefer a more human-like chatbot to have a better conversation experience.

DISCUSSIONS

We discussed the findings of our surveys about how people use online forums for climate change discussion, and insights collected through a wizard of oz test. In this section, we will outline some design implications that could be used to develop similar chatbots. Then we will discuss some limitations of this work and suggest future research scopes.

Design implications for climate change chatbot

From the results of the online surveys, study of related works and user feedback collected during and after the wizard of study, we compiled a list of design implications for climate change related chatbots. These implications may be relevant for such chatbot with HCI design approach. The implications are as followed:

1. **Guide the users to start a conversation.** The user should be able understand how to use the chatbot and what they are expected to do from the very beginning. The chatbot should clearly define how they expect the user to start a conversation. A similar experience as the online discussion forums could be adopted by asking users to write questions to the chatbot.

2. **Improve user engagement by using topic suggestions.** With such chatbots, users often reported that they do not know how to continue the conversation. In our The chatbot should be able resolve this dilemma by suggesting next steps to users. Providing topic suggestions are effective ways of keeping the user engaged. The machine should be trained to improve its topic suggestion capabilities based on the user conversation.

3. **Examine user dialogues to track user frustration and positive feedback.** The chatbot should keep chat logs to be able to locate under which context the user was satisfied or dissatisfied with the bot.This helps to identify instances where the user expressed frustation and consider it for future improvements of performance [10]. A study by Braden Hancock et al [18] demonstrated a weighty increase in performance for a self-feeding chatbot that learnt from dialog history. Some factors chould be considered when implementing user-system dialog history[10]:

    - Prepare success criteria and metrics adapted to chatbot use case
    - Users can be asked to teach the bot when it fails by specifying how the user would get convinced with the given response and update the model accordingly
    - Use response rating for each response

LIMITATIONS AND FUTURE WORK

The user survey conducted during the research was based on surveys of 55 people from Germany, UK, Pakistan, India, Bangladesh and Canada only, thus limiting the global aspect of such study and the solution derived out of it.

The design considerations outlined in this paper are tentative and would require a larger scale of user feedback collection to make a universal acceptance of these considerations. A further investigation of how specific factors such geographical location, expertise level of climate change and using chatbots may result in better outcomes.

Future research should be devoted to the development of the technical application requiring extensive datasets and advanced machine learning algorithms to have satisfactory and interactive communication that is usually expected between the chatbot and the user.

CONCLUSION

This study indicates that chatbot have a promising role as a future tool but most of the work so far that has been done using the said technology is for the commercial purpose. Thus implies the fact that there is high tendency of adopting the technology for business rather than using the same for the discussion of climate change. There is void of an interactive and real time conversational agent like a chatbot for the dialogue of climate and to contribute to this gap, machine learning could be used to develop chatbots that provide more meaningful experience than a generic communication tool. Additionally, an user-centric outlook needs to be adopted to ensure that the users are in loop of the design and development to provide a seamless and standard user experience.

To go on, this research study is a preliminary contribution to open up the topic of discussion for these kind of tools, and to investigate its further interest with the users.

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