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DESENVOLVIMENTO E AVALIAÇÃO DA USABILIDADE DE APLICATIVO COM RECURSO DE AVATAR PARA EDUCAÇÃO DE AUTOCUIDADO DOS JOVENS COM DOENÇA FALCIFORME [View project](#)

ANA: A Brazilian Chatbot Assistant about COVID-19

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Abstract

This study introduces ANA, a chatbot assistant about COVID-19 in Brazilian Portuguese, developed by a multi-disciplinary team of Linguists, Computer Scientists and Medical Researchers. ANA aims to assist Brazilian Portuguese-speaking patients seeking information about the disease as well as screen suspect cases, initially in the Brazilian cities of *Belo Horizonte* and *Divinópolis*.

1 Introduction

Chatbots are computational systems which aim to hold conversations with another (human or artificial) agent via text or speech. Applications of such dialogue agents have flourished in the domain of healthcare and telemedicine (Fadhil, 2018; Mairitha et al., 2018; Abd-alrazaq et al., 2019).

Telemedicine aims to provide medical support to patients at home, scenario in which the application of chatbots is ideal. Engaging in a conversation with a chatbot in the comfort of their homes, patients may have access to the medical information they desire, check for a diagnosis based on the symptoms and signs they feel as well as look for the most suitable and closest healthcare provider (Palanica et al., 2019). All this information may be obtained even outside the common operating hours, since chatbots work 24/7. From a user experience point of view, chatbots present additional advantages, since patients may experience difficulties accessing a complex eHealth application user interface, but are very likely to know how to type text messages or communicate by voice what they want (Fadhil, 2018).

Healthcare professionals, as well as healthcare systems, may be also positively impacted by the integration of chatbots in telemedicine applications. With the appearance of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and

its fast spreading behaviour which caused a global pandemic, these applications can alleviate the pressure on overloaded healthcare systems (Razzaki et al., 2018), helping to screen patients who actually need emergency or hospital care from the ones who can seek medical treatment online or do not need treatment at all.

In this context, this work describes ANA, a chatbot assistant on COVID-19 interacting in Brazilian Portuguese, developed by a multi-disciplinary team of Linguists, Computer Scientists and Medical Researchers. ANA is currently assisting patients seeking relevant information about COVID-19 as well as screening suspect cases, initially in the Brazilian cities of *Belo Horizonte* and *Divinópolis*.

This paper is organized as follows: Section 2 describes the background on which ANA was developed; Section 3 describes the virtual assistant, including its goals and overall architecture; and Section 4 concludes the work, discussing learned lessons and future work.

2 Background

In December 2019, the appearance of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) caused an outbreak of respiratory infections, which has developed into a global pandemic. The virus is easily transmitted through person-to-person contact and contamination of surfaces or objects. As of June 29th 2020, 10,154,984 patients have been infected globally, with more than 0.5 million deaths and numbers still rising fast (Center, 2020). The dissemination of the disease in low and middle income countries is very worrying, due to the low responsiveness of the healthcare providing units to assist the huge number of cases, which can lead to the collapse of the health system.

Clinical symptoms of the disease caused by SARS-CoV-2, COVID-19, are heterogeneous and

vary in severity. In some patients, COVID-19 leads to serious outcomes, such as acute respiratory distress syndrome, coagulation dysfunction and death (Borges do Nascimento et al., 2020). Based on data from the Chinese Center for Disease Control and Prevention, mild disease was reported in 81%, severe disease in 14% and critical disease in 5% of the cases (Wu and McGoogan, 2020).

Screening suspect cases and educating the population, in order to avoid unnecessary overload of health services with mild cases and reduce the infection risk, are two of the major challenges. Chatbots have become a useful support tool for health promotion and education, and have the potential to help address these challenges. In the next section, we describe the development of ANA, a chatbot to support the screening of suspect cases of COVID-19 as well as education of the Brazilian population on the disease.

3 Overview

3.1 Goals

The chatbot was developed with two purposes: screening of suspect COVID-19 cases and education of the Brazilian Portuguese-speaking population.

Screening of suspect COVID-19 cases Figure 1 depicts a decision tree we built for screening suspect cases of COVID-19 based on the patient's symptoms and comorbidities following the recommendations from the World Health Organization (WHO, 2020) and the Brazilian Ministry of Health Guidelines (SAPS, 2020). According to the Brazilian Ministry of Health Guidelines, dyspnea, hypotension, fever persisting over 3 days, or returning after 48 hours of improvement, are considered alarm signs and patients need to be assessed at a hospital or healthcare unit. Additionally, the Ministry recommends that patients with comorbidities adding to the risk of severe disease should be assessed in reference centers.

Based on these directions, our chatbot was built in a way to classify patients through color tags matching the severity of the reported symptoms. Patients with dyspnea or who reported a fainting sensation were ranked as “red”, and advised to seek emergency care as soon as possible. Patients with fever under the described alarming features were ranked as “orange” and advised to seek care in a hospital. The ones without alarming signs, but with

comorbidities which may increase the risk of severe disease, were ranked as “yellow”, and advised to seek a reference center or call 136, a teleconsultation service provided by the Brazilian Ministry of Health. The ones without alarming signs or comorbidities were ranked as “green” and received advice about how to deal with their mild disease, home isolation measures, need for rest and hydration. They were also advised to call 136 for a consultation by phone if they needed to. Except for the patients ranked as “red”, all the other groups were offered to participate in the educational session in the chatbot.

Educational Session was built based on 75 frequently asked questions on the database from the Healthcare Network of the Brazilian state of Minas Gerais. All the answers to the selected questions were given by a group of researchers from the Federal University of Minas Gerais (UFMG), based on the best available evidence and following the WHO directions (WHO, 2020). The researchers also grouped the question-answer pairs into 11 different topics, namely General Information, Transmission, Symptoms, Orientation for Suspicious Cases, Treatment, Homecare, Hygiene, Lifestyle, Mask Use, Pregnancy and Pet care.

3.2 Architecture

The chatbot assistant ANA was developed using BLiP¹, a platform as a service that allows the development of conversational applications. The current version of ANA is available on WhatsApp as well as on the official website of the Telemedicine Center of Minas Gerais.²

Welcoming Intent Once a start stimulus is received, the virtual assistant begins a conversation welcoming the user and asking for some personal information such as name, age, gender and address. Request for the latter information is done differently depending on the platform that the user is chatting at. On the web application, ANA requests access to the user's GPS location, whereas on WhatsApp the virtual assistant asks for the Brazilian state and city where the user lives.

Once the user's general information is collected, the assistant asks whether the user feels sick and wants to check what s(he) is feeling; or if s(he) wants information and guidelines about the disease caused by the coronavirus. According to the

¹<https://www.blip.ai/en/>

²<https://telessaude.hc.ufmg.br/>

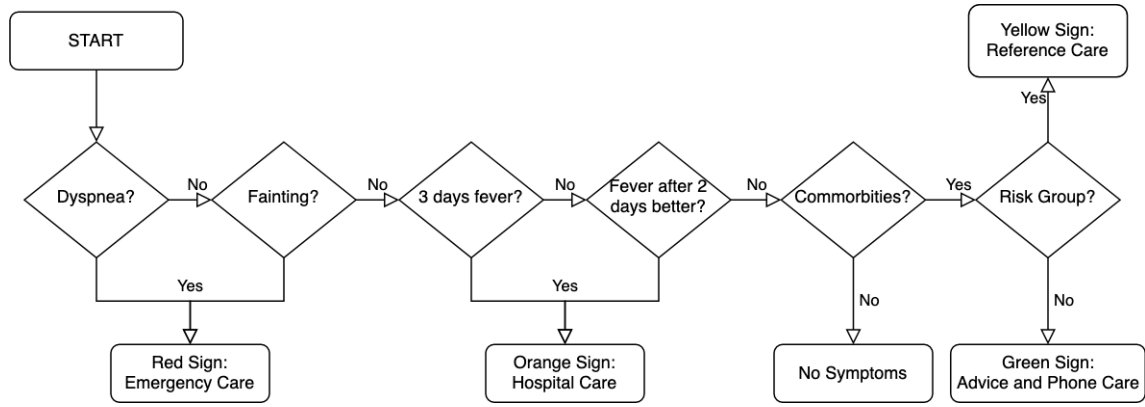


Figure 1: Decision tree for screening suspect cases of COVID-19.

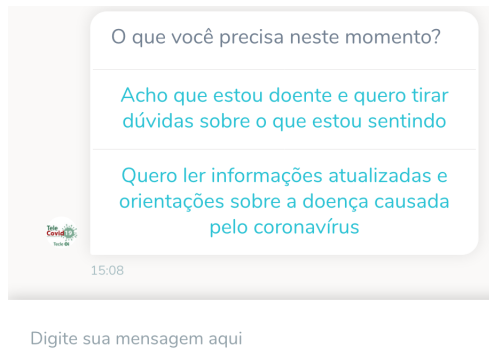


Figure 2: Display of the two features of the Assistant (in Portuguese): (1) “I think I am sick and want to clarify what I am feeling” and (2) “I want to read up-to-date information and guidelines about the disease caused by the coronavirus.”

goals previously described, both options aim to screen symptomatic patients of COVID-19 and to inform the user about the disease, respectively. For guidance, a button is displayed for each one of the options as depicted in Figure 2.

Screening Intent If the user chooses the first option, ANA will initially show a link to the Chatbot’s use terms. If the user agrees to them, the assistant will then ask the questions based on the decision tree depicted in Figure 1 and classify the case as asymptomatic; or according to the *red*, *orange*, *yellow* and *green* color tags, representative of how serious the case is as explained in the previous section. Users who are classified as cases of *red* and *orange* tags will have their phone numbers requested by the assistant. Currently, *Red* ones located in the cities of *Belo Horizonte* and *Divinópolis* will be immediately referred to a doctor, whereas the ones in other locations will be strongly recommended to seek emergency care. The cases classified as *or-*

ange will be instructed to go to a hospital as soon as possible. Users in the *yellow* severity case will be advised by the virtual assistant to seek a reference center or call 136. *Green* tag cases will receive some health recommendations and be also advised to call 136, as previously explained. At the end of the screening process, all users, except the ones classified as *red*, are invited to participate in the educational session, where instructions are given and questions can be asked.

Educational Intents If the user selects the second option at the end of the Welcoming Intent or after the screening process, for all users but the ones classified as a *red* case, the assistant will start the education session asking them to choose one out of the 11 topics they are more interested in to know about. The questions related to the selected topic are then displayed to the user. Table 1 displays some of the question-answer pairs which Ana works with (glossed in English).

4 Conclusion

ANA has been assisting Brazilian Portuguese-speaking users and screening suspect cases of COVID-19, initially in the Brazilian cities of *Belo Horizonte* and *Divinópolis*, since June 24th, 2020. In the future, we intend to expand the screening process integrated to a pool of doctors to other cities of the Brazilian state of Minas Gerais. Currently, we are collecting user logs to analyze how the chatbot is being used. We believe these logs will allow us to examine phenomena such as the interactive paths taken by users, identify whether there are communicative breakdowns (i.e., the user interrupts the conversation without getting to an expected end of the dialog flow), investigate the paths that are more or less explored as well as analyze

| Topic | Example |
|--------------|--|
| General | Q: What is SARS-CoV-2? A: SARS-CoV-2 is the name given to the coronavirus which is causing the current pandemic. |
| Transmission | Q: How long does the coronavirus live? A: These data are still under study. A recent study published in a renowned magazine (NEJM) showed that on average the virus may live for up to 3 hours in the air, up to 24 hours on paper and 3 days on plastic and metals. |
| Symptoms | Q: What are the main signs and symptoms? A: Main signs and symptoms are fever, dry or low-secreted cough, and shortness of breath. Some people may have a stuffy or runny nose, sore throat, head or body, changes in the ability to smell or taste food, while others may experience nausea, vomiting and diarrhea. The most severe cases can develop with severe shortness of breath and feeling of faint. |
| Treatment | Q: Are chloroquine and hydroxychloroquine effective treatments against coronavirus? A: So far, there is no proven effective treatment against the coronavirus. There are no studies that confirm that chloroquine or hydroxychloroquine are effective medications in this context. These medications are still being tested and should not be part of the treatment of infected people. Such medications have many effects that can be harmful to health, including cardiac arrhythmia and visual changes, which can be serious. We need to wait for the results of new studies to assess whether this medication will be incorporated into the treatment of the disease. |

Table 1: Examples of question-answer pairs used to develop the chatbot assistant ANA.

the choice of words or expressions used to answer the chatbot.

Regarding the educational intents, we aim to augment the database of question-answer pairs in order to increase the number of questions that ANA can answer. Moreover, we will implement a more fine-grained intent detection tool so the assistant can recognize different syntactic and lexical variations of a same question asked by different users. In terms of architecture, we will also implement an automatic speech recognition and a voice synthesizer tool so users can also reach ANA by voice platforms.

Finally, we will also conduct user studies regarding the chatbot experience with asymptomatic users and patients. The study with the asymptomatic users will be conducted in a usability lab and will focus on identifying if there are any utterances or terms used by the chatbot that are not clear to the participants. Moreover, this experiment intends to distinguish the different wordings users choose to express themselves that are not understood by the chatbot, and try to understand any communicative breakdowns that take place and what their causes are. From this experiment, we expect to extract insights to improve ANA's dialogue manager and

intent detection modules. Concerning the evaluation with patients, this will be done with participants who will be recruited in the waiting room of hospitals. The goal of the experiment is to collect the patients' views about the chatbot and how accurate the answers given to chatbot questions are (by comparing them to the answers given to the Doctor during an appointment).

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