Nora: The Well-Being Coach

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Abstract

The current pandemic has forced people globally to remain in isolation and practice social distancing, which creates the need for a system to combat the resulting loneliness and negative emotions. In this paper we propose Nora, a virtual coaching platform designed to utilize natural language understanding in its dialogue system and suggest other recommendations based on user interactions. It is intended to provide assistance and companionship to people undergoing self-quarantine or work-from-home routines. Nora helps users gauge their well-being by detecting and recording the user’s emotion, sentiment, and stress. Nora also recommends various workout, meditation, or yoga exercises to users in support of developing a healthy daily routine. In addition, we provide a social community inside Nora, where users can connect and share their experiences with others undergoing a similar isolation procedure. Nora can be accessed from anywhere via a web link and has support for both English and Mandarin.

1 Introduction

It is broadly accepted that loneliness poses a significant mental health problem (Mushtaq et al., 2014; Beutel et al., 2017) and that surrounding social conditions of a person contributes to loneliness (Tiwari, 2013). Lockdowns have been enforced worldwide to deal with the COVID-19 pandemic, causing many people to feel socially isolated. Many also have even been forced to self-quarantine for weeks after crossing a border or having close contact with a patient. The resulting social isolation can have a negative impact on our mental health, and mental support for those under isolation is suggested (Choi et al., 2020; Zhao et al., 2020).

Traditionally, conversational agents have played the role of therapist, psychologist, or counselor to support mental health (Weizenbaum, 1966; Cameron et al., 2017). While some are intended to replace professionals by diagnosing or providing a counselling (Rudra et al., 2012; Vaidyam et al., 2019), others offer a more casual conversation to maintain mental well-being and encourage users to take formal sessions if necessary (Rizzo et al., 2011; Lee et al., 2020; Fitzpatrick et al., 2017).

Here, we introduce Nora†, the well-being coach, extending the idea of an empathetic dialogue system that mimics a conversation with a psychologist (Winata et al., 2017). To meet the emerging need caused by the COVID-19 pandemic, our system is currently optimized for people under self-quarantine. Supporting English and Chinese, Nora asks a set of questions to screen for stress, depression, and health conditions, such as body temperature or shortness of breath during a conversation session. The screened health conditions and emotional states are recorded throughout the self-quarantine. We also implement user-to-user interaction functions so a user can have a chitchat with other users. This is inspired by online support groups for people with depression where they can

†Demo video: https://youtu.be/M2FFer2GXe8
Website: https://nora2.emos.ai (supports Google Chrome Browser.)
seek information and support from others with a similar condition (Griffiths et al., 2012). In this work, we demonstrate the possibility of combining affecting computing research in a practical scenario. It has the benefits of gauging and helping the users improve their psychological and physical well-being.

2 System Description

In this section, we describe the components of Nora and how Nora interacts with the user. Figure 2 shows the overall architecture of the Nora system. Nora web client is the front-end that is shown to the user. The user can interact with the system by providing speech and text input. The speech input is used in the Nora session, while the text input is used in the chat feature.

The user speech is first converted to text by our automatic speech recognition (ASR). We use the ASR with a particular language based on the user preference. Then, the generated text is passed to the dialogue service. The dialogue module identifies the user’s intent and captures slot values by the natural language understanding (NLU) component. Then, the dialogue manager uses the intent and slots to plan to decide the response to the user according to the sentiment, emotion, and stress scores. Finally, to create a natural response, we output the speech by translating the text to speech using the text-to-speech (TTS) module. We use the TTS with the same language as the ASR.

2.1 Front-end Application

We develop a web-based system by extending the interface design of the previous version of Nora (Winata et al., 2017). To access Nora, the user has to log in to the system by using social media accounts or registering a new account in the system. The user then will have an individual account, where they use to save the session logs and progress of all sessions. This will help the user to understand their mood progression throughout the program. In the front-end, we use English and Mandarin ASR and TTS to recognize speech to text and later converted the generated text to speech.

2.1.1 Nora Dashboard

We show the Nora dashboard page in Figure 3. The dashboard page gives the user access to customize the user profile, preferences on meditation, exercise, yoga videos, and chat features. The user can also change their quarantine program and language preference on this page.

2.1.2 Nora Console

Figure 1 shows the daily session user interface design. On the left-hand side of the interface, the console displays the conversation box where we can follow the dialogue turns between the user and system. The system accepts speech input from the user to make the interaction as natural as possible. On the upper-right side, we show the progress bars, indicating the dynamics of temperature and empathetic scores across days. On the lower-right side,
we display the session day indicator and empathetic scores, such as stress and emotion scores.

### 2.1.3 Activity Recommendation

Nora also shows recommendations to the user in the console. For example, Nora can ask the user whether they want to do an exercise or a meditation, or a yoga session. If the user agrees to participate in the session, then Nora will show a window on the right-hand side of the interface as shown in Figure 4. After the session, the user can resume the conversation by clicking the “continue” button.

![Figure 4: Example of a yoga session.](image)

### 2.2 Back-end Server

The back-end server manages the communication between the front-end and the other two services, which are chat service and dialogue service. To decouple the whole system, we set up the system into micro-services where they are independent, and each of them can be scaled individually. Specifically, in the back-end server, we store all user and dialogue information in the database. We use MongoDB to store non-structured dialogues, chat logs, and user setting data.

### 2.3 Dialogue Service

The dialogue service consists of NLU and dialogue manager modules. The NLU module predicts the user intent and slots related to the intent (e.g., user input: “I am very grateful because of my parents”, intent: “grateful_family”, slot: “parents”). Then, the intent and slots are used in the dialogue manager to generate appropriate responses back to the user by also conditioning on the sentiment and emotion scores from the empathy service.

### 2.4 Empathy Service

The empathetic service consists of three APIs: sentiment, emotion, and stress. All of the APIs are run in our in-house system. For the sentiment analysis, we use a text based model that outputs a binary classification result (positive or negative) for each text. We train a Long short-term memory (LSTM) model using Word2Vec word embedding vectors (Mikolov et al., 2013) as input for the text, and we train on the Movie Reviews dataset and we further improve our performance by training on the larger 1.6M labeled tweets from the Sentiment 140 dataset. For the emotion classification models, we use text-based and audio-based emotion classification models. For our text-based model we use DeepMoji (Felbo et al., 2017), and for our audio based model we build a Convolutional Neural Network (CNN) model that takes raw audio as input, trained for multiple emotion classes. The model and dataset used for audio emotion is described in Bertero et al. (2016), and we fuse the emotion scores from both text and audio using a weighted average method to get the final score for each emotion class. For the stress detection, we use a text-based stress detection model using BERT (Devlin et al., 2019) to generate a stress score in a scale from 0 to 1 using the stress dataset from Winata et al. (2018).

### 3 Dialogue Design

In this section, we describe the flow of our dialogue in the Nora session.

#### 3.1 Dialogue Flow

Currently, we design the session in an agent-initiative interaction. Figure 5 shows the dialogue flow of the Nora session from the start towards the end of the conversation. Several scenarios are depending on the day of the quarantine. Each day, the user will experience different interactions with Nora to avoid repetitions that may cause boredom.

**First Day Conversation** During the first day, Nora introduces the session and what the user shall expect at the end of the session. Nora also asks the users to introduce themselves. Then, Nora starts the daily agent.

**After First Day Conversation** After the first day, Nora begins to ask personal questions about plans after quarantine, such as asking about where

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2 https://ai.stanford.edu/~amaas/data/sentiment/
3 https://www.kaggle.com/kazanova/sentiment140
4 https://github.com/gentaiscool/lstm-attention
to travel, what to eat, or what to do after quarantine. We design this agent to help the user retain hope and look forward to their future after quarantine.

**Daily Conversation** In the daily agent, Nora starts by asking the user’s mood to understand what the user feels today. Then, Nora checks the user’s health condition by asking about the temperature and whether the user has shortness of breathing. In the following turns, Nora allows the user to remember what they feel grateful for on that day. After that, Nora recommends the user to have a yoga, exercise, or meditation session. At last, Nora asks a follow-up question to know the feedback from the user.

### 3.2 Temperature and Shortness of Breath Test

As monitoring symptoms is one of the most essential things during self-quarantine, Nora requests the user to take their temperature and shortness of breath test daily. If the user report between 32 to 38-degree Celsius, Nora regards as normal temperature, as high if between 38 to 43, and else invalid number to ask again. To screen the shortness of breath, Nora asks the user to count up loud in a single breath, “one, two, three, ...”, and a follow-up question whether they feel out of breath or not. If the user has a fever or feels shortness of breath, Nora displays a hotline number and recommends consulting a doctor. Temperature and breathing states are recorded and traceable throughout the quarantine.

### 3.3 Activity Recommendation

During the session, Nora recommends the user participate in the exercise, yoga, or meditation session. This allows the user to have an activity that can be done together with the dialogue agent. Nora shows a video of activity on the user interface as shown in Figure 4. We also allow the user to dynamically set their preferred activity videos for each quarantine day. This feature can be accessed on the dashboard.

### 4 User-to-User Social Interaction

It is reported to be promising for recovery to have social interaction with people in the same predicament (Griffiths et al., 2012). In addition to Nora-to-user interaction, we provide a few functions to enable users to communicate with each other, aiming to offer a platform where users can share their emotions, struggles, tips, etc. There are three interaction interface types: 1-on-1 messaging, topic threads, and topic threads video call.

#### 4.1 1-on-1 Messaging

1-on-1 messaging allows the user to have a conversation with another user. To start a conversation, the user can add another user as a friend using their alias. Once added, they will appear in the contact list. From this point onward, they can exchange text messages and communicate. We also provide a report feature to protect users from inappropriate messages.

There are a sender and a receiver for every message; both are registered as Firebase clients by the system. In our 1-on-1 chat implementation, while we store users’ messages in our database, we utilize Firebase Cloud Messaging (FCM)\(^5\) to send push notification from the server to the receiver’s client-side every time there is a new message. After the notification is acquired on the receiver’s client-side, it will generate a REST API call to the server to

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\(^5\)https://firebase.google.com/docs/cloud-messaging/
synchronize. Our server will fetch the new messages from the database and update the receiver’s client-side according to the most recent chat log.

4.2 Topic Threads

We provide topics threads where users can freely and anonymously discuss predefined topics such as movies, cooking, music, etc. Once a user identifies their interests, they will be automatically invited into relevant topic threads. In addition to text messages, topic threads also support a group video call feature, which will be explained in the following subsection.

After users update their profile with particular interests, their Firebase client will be subscribed to the related topics. Rather than the usual push notification, we use FCM topic messaging in topic threads. FCM topic messaging enables our server to send a push notification to multiple clients who have subscribed to a particular topic. When a user sends a message in the topic threads, other group members will receive a push notification and update their interface to load the new messages.

Users can decide not to partake in a topic thread anymore by removing the corresponding interest on their profile. When this happens, the server will fire an unsubscription request to Firebase so the user will not receive notifications from the topic thread again. Users can re-join the topic thread by adding the respective topic to their interest list later.

4.3 Group Video Call

To enrich the user-to-user interaction activity, we provide a group video call for each topic threads group. There is an option on the upper right section of topic threads that can lead users to the relevant group video conference room when clicked. Members of the group can use it to have a face-to-face or a strict voice conversation without being pressured to reveal their original identities.

We implement the group video call feature using Zoom API’s recurring meeting without a fixed time. The first-ever request to have a group video call in a topic thread makes an API call to Zoom to create a meeting and return the join URL to the user. The meeting credentials will then be saved in our database for future use. The subsequent requests will obtain those credentials from the database and retrieve the meeting via Zoom API.

5 Related Work

Conversational Agents

One of the major challenges in dialogue systems is to make systems respond in a more empathetic manner (Zhou et al., 2018; Ma et al., 2020), and several works have been explored to incorporate empathy in end-to-end open-ended chatbots (Lin et al., 2019, 2020; Madotto et al., 2020). In the task-oriented dialogue system, Lin et al. (2020b) explored the transfer learning approach to train end-to-end task-oriented dialogue system. Lin et al. (2020a) extended end-to-end conversational agents to the multilingual setting.

Companion Systems

Recently, dialogue systems are attracting more interest in psychiatry, and a mental companion that offers guidance for self-help or mental well-being is often discussed as a promising application (Vaidyam et al., 2019; Bendig et al., 2019). For example, SimCoach is aiming to empower military service members to
seek professional resources if needed by providing pre-screening (Rizzo et al., 2011). Woebot offers a self-help program for students with anxiety and depression concern (Fitzpatrick et al., 2017), and Lee et al. (2020) invented a chatbot which encourages self-disclosure.

6 Conclusion

In this paper we introduce Nora, a virtual coaching platform designed to help people undergoing mandatory quarantine or other self-isolation routines. Nora helps by gauging users’ well-being with its in-built emotion, sentiment, and stress detection models, as well as by recommending various exercises (yoga, meditation, workout) based on their preferences. By interacting with Nora daily, users can set up a healthy daily routine and keep track of their mood and activities. Also, they can connect to other users going through a similar isolation procedure via the social community inside of Nora, where they can share their experiences and recommend exercises to each other. Nora also has support for both English and Mandarin languages, and can be accessed from anywhere via a browser and web-link. Such a system uses Human-Computer Interaction techniques together with the empathy services to help users in isolation improve their psychological and physical well-being, which is crucial in today’s pandemic ridden world.

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