Mobile Health EMA
Technical Specifications

Senior Design I (Cpt S 421)

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Introduction

The mobile health ecological momentary assessment (EMA) for real time behavioral measures is a system that allows researchers to collect data from study participants in real time. Researchers will use surveys to ask the participants a variety of questions, from multiple choice, short answer, and checklist selection. Participants will also be able to receive messages in the form of text, image, or both.

To do this the application has three pieces: a mobile app, website, and database. The mobile app will be used by study participants to take surveys and retrieve messages. When a participant completes a survey, the resulting data will be sent to the database tagged with the participant's unique ID. Researchers will use the website to create surveys and messages, schedule them, and download data in the form of a CSV file. The database will be organized in a way such that the data is easy to input and download, as well as understand.

Alpha Prototype Description

We have started to implement the basic functionality of sending survey questions and messages to and from the website and mobile app:

Mobile App (study participants):

- Allows a user to login once and remain logged in
- Retrieves surveys and messages from a database and displays them when a participant clicks "get surveys" or "get messages"
- Participants can provide long form survey answers
- When a user clicks "finished" on a survey, the data is sent to the database along with the participant's unique ID number
- Using Firebase notifications can be sent via the app to the participant to alert them of new messages and/or surveys

Website (study administrators/clinicians):

- Has login system implemented
- Allows the researchers to create survey questions and messages
- Researchers can specify the type of question they want: radio, multiple selection, or free answer
- Survey questions and messages will not be accepted by the database unless a valid ID is given
- Researchers can select schedule times for messages/surveys (optional)
- Surveys and messages will be sent and stored in the database

Furthermore, we have implemented a database API using Docker to simplify development and deployment. By using Docker, we don't have to download as many files when we need to modify something in the mobile app or website. The database, app, and website are

all stored in their own docker container, allowing them to share libraries and operating systems. This will not only simplify and speed up development, but also deployment.

Although we have the database API implemented using Docker, because we haven't had access to a permanent server to host our database it hasn't been completed. To get around this, we have been hosting local databases on our machines. However, since we have Docker and the code prepared to host the full database with seed data (which includes a simple participant with an ID used to login to the app and test sending messages to with the website), when the database is hosted on an external server only a few lines of code will need to be changed in our project.

Design Modifications Resulting from Alpha Prototype Testing

After demonstrating and testing our Alpha Prototype, we have marked several changes needed for both the participant mobile app and researcher website.

Mobile app (study participants):

- Needs to be simplified, currently has too much functionality for participants
    - Take out settings option
    - Notifications must automatically be on with no option to turn off
    - No back button for surveys
    - Simplify login process:
        - If a study administrator can provide user IDs to all participants, a username/password login system may not be required
- Remove user information and registration pages
    - Registration will be done by the researchers after an initial survey, user login information will be provided
- During our Alpha Prototype implementation the app had a lot of issues connecting with the database
    - Partially due to network restrictions with WSU wireless
    - Hosting our database on an external server will solve this issue
    - Will also resolve the problem with having to set up the connection to a local database every time the app is restarted

As a simplification we will also be packaging the mobile app better to allow easier access by team members. Currently it requires searching to find the core files for the mobile app, which we will organize to easily find and modify for next semester.

Website (study administrators/clinicians):

Since the website only has the very core functionality implemented, not a lot of changes were needed to be made or adjusted after testing the Alpha Prototype. However, like the mobile app, the website also had issues connecting with a database. To resolve this issue and help simplify connection between the website, database, and mobile app, our team decided to use

Docker to create an API for each piece. To do so we had to switch from using PHP (which we used during our first prototype) using Javascript and Python.

Originally we were searching for a way to implement surveys and host the data using a service like Qualtrics or Survey Monkey. When functionality, usability, and security came into question, we decided to implement our own database and survey capability. To do so we had to use Docker, which, throughout the Alpha Prototype Testing, has had to be reconfigured and refined several times. We've also had to reorganize our database, and are expecting on having to do so and expand it again next semester.

Further work for next semester

The majority of the work for next semester will include expanding on the basic functionality of the program, which was implemented as the Alpha Prototype this semester. Most of this functionality simply includes aesthetics (UI and design), but there are parts of the system that need implementation or further work:

- Complete and refine the user interface of both the mobile app and website
    - Using mainly Bootstrap we will implement a web interface that will be easy to use, understand, and responsive down to mobile
    - Although it will be able to display on a mobile device or tablet, our focus will be on refining the UI to be used on a large screen (desktop or laptop).
- Implement the ability to download data from the database (via the website)
    - Need to devise a way to retrieve and organize data from the database so it is easy to manipulate and understand once it is in CSV form
    - May require restructuring of database
    - *Bonus:* if time allows we might implement a "data dashboard" page that displays results as a GUI
- Simplify survey creation
    - Right now researchers can create individual questions and need to list out which participants they want to receive each one
    - To simplify we will:
        - Create a section of the website devoted to surveys
        - Instead of creating individual questions, researchers will create surveys and specify which users receive that group of question
        - Surveys will have default settings you can change for individual questions, or all the questions in the survey
- Create user roles for researchers
    - Currently only one user role exists, we need two:
        - Clinicians- can start studies, create surveys and messages, modify study settings, download data

        - Administrators- have all the same abilities as clinicians as well as the ability to delete data from the database, create clinicians, promote clinicians, remove other administrators
- Although a schedule can be specified by the researcher, the notification system isn't setup correctly to so the app to check the database for messages and surveys
    - Currently the specified release time is ignored
    - By implementing this next semester we will avoid having to have the app constantly running in the background to check for new surveys and messages
- Set up the Firebase notification API so notifications are sent directly from the app instead of the Firebase GUI
    - The notification ability is prepared so next semester notifications can be easily sent using the API supplied by Firebase, the notification program we are using
- Complete message functionality and include ability to send images
    - While researching ways to send images, we discovered images can't be sent as app notifications like messages can
    - To resolve this, we will provide a location of the image in the notification, which the app will then retrieve and display
- Implement the logic to display different types of survey questions on the mobile app
    - The website already provides the information, only need the app to interpret it correctly
- Refine and host the database on an external server
- Ensure cross-platform functionality of both mobile app and website
- Thoroughly test entire system, including creating and completing mock studies

Summary of Alpha Prototype Session with Mentor

For our Alpha Prototype demonstration we showed how the mobile app can send messages and survey questions to the database flagged for a certain user. During the Alpha Prototype demonstration we had difficulty creating a locally hosted database because of restrictions with WSU wireless, and also had trouble connecting later on when a mobile hotspot couldn't be available. When we were able to demonstrate the app capabilities, we showed how questions and messages can be retrieved from the database and displayed to the participants. We also showed how a researcher can use the website to send simple survey questions and messages intended for specific participants or groups of participants.

Our project mentors were happy with the progress and provided feedback for the core functionality. Although a researcher could specify what type of question they wanted (radio button, long form answer, etc.) the app didn't have the logic in place to interpret it and thus displayed all questions as long form answers. They stressed the importance of having this functionality, so next semester our team will prioritize it and complete it before moving on to other functionalities required by the mobile app.

As mentioned earlier, they also believed that the app provided too much functionality to a study participant. In order to keep things as consistent as possible, participants should only have the ability to take surveys and receive messages via the app. If a participant had the ability to modify the function of the app, such as turning off notifications, that could hinder data collection or change the responses of a participant.