Ecological Assessment Tool

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Motivation

Diabetes affects ~30 million U.S. adults with another ~80 million being prediabetic. Diabetes prevention programs exist to aid in prevention however many participants never see these programs through to completion. Currently, Ecological Momentary Assessments are used to find out why many participants never complete these programs, however these assessments are flawed.

Current EMA issues:

- **Expensive**
- **Time consuming**
- **Limits Participation**
- **Intrusive to participants**

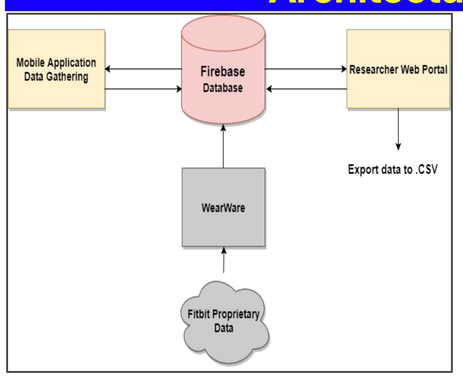
Solution Overview

Our solution involved the creation of a web portal for researchers and a mobile application for study participants. Researchers set up a study on our portal and then deploy it to participants' mobile applications for them to complete.

Solution requirements:

- **Free**
- **Quick Real-time data capture**
- **Uncapped number of participants**
- **Culturally adaptive**
- **Highly configurable**
- **Android and IOS capable**

Architecture



The web portal uploads created studies to the database, then using a given code participants who have downloaded the mobile application can connect to the appropriate study and download it to their devices. A third party portal, 'WearWare' allows the team to make use of Fitbit data.

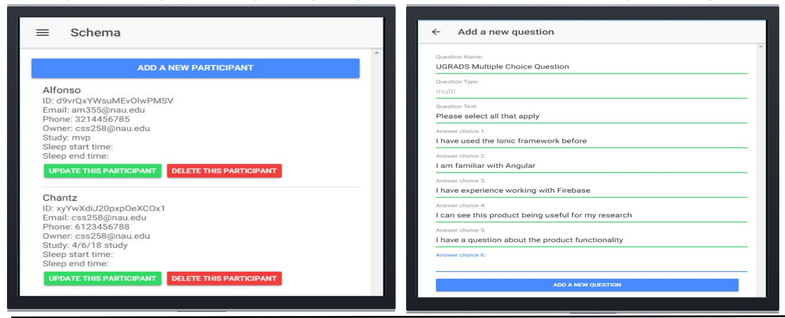
Key Features

Key features were developed after discussions with our client concerning desired functionality and a market analysis on similar applications.

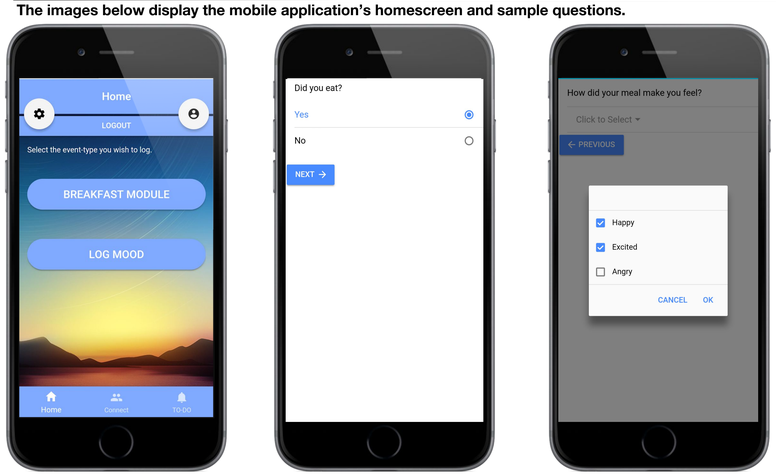
Key Features:

- **Administrator data download to .csv format**
- **Application individualized to each participant**
  - Participants will not receive questions that do not apply to them
- **Time based and user initiated questionnaires**
- **Mitigate intrusive interruptions**
  - The application adheres to participants' schedules
- **Minimal need for application usage training**
- **Fitbit integration**
- **Android and IOS deployable**
- **Questionnaire backlog**

The images below display the web portal's participant viewer and the creation of a multiple choice question.



The images below display the mobile application's homescreen and sample questions.



Technologies

The team leveraged the Ionic framework for hybrid mobile application development, Angular provided us with many useful packages for database functionality, Firebase's Firestore database allowed us to have realtime data capture and reporting, and the majority of our solution was programmed in TypeScript.

Outcomes

Modularity - The application was made with modularity in mind, so not only will this application be useful for NAU's Health and Human Development Lab but any researcher in various disciplines will be able to design and administer a study to suit their needs.

Project Impact:

- **Decreased client's cost to perform research**
- **Decreased client's time usage**
- **Decreased client's needed manpower**
- **Increased amount of participants per study (study scalability)**

Challenges

Challenges	Why was this a challenge?	Resolutions
Offline Functionality	App needed to administer study and record results even while offline	Have study download locally and wait to upload results until web connection is achieved
Database Functionality	The database needed to be updated and pulled from in real time to ensure robust functionality	Firestore, a Firebase product, is a new bleeding edge database that provided almost all of our needs
Notifications	Notifications needed to alert participants when new questionnaires were available and be dismissed into a backlog should a participant be busy	Utilize Firebase functionality and Cordova plugins to administer notifications at appropriate times and create a questionnaire 'TO DO' list
Hosting Services	The project needed to be free or as cost effective as possible and databases and site hosting can become expensive	Firebase Hosting service offers limited free application that we were able to utilize
Fitbit Integration	The third party portal, WearWare, was unable to connect to Fitbit's proprietary repositories at this time	Utilized previously gathered Fitbit data to assure our product will work once WearWare is functioning again

Testing

- Unit Tests
  - Utilized Chai and Mocha, typescript testing software, to quickly write tests and check correct functionality
  - 25 unit test over 10 modules
- Integration Tests
  - Ensured our web and mobile modules communicate with the database and each other correctly
- Usability Tests
  - Team's main focus
  - Rapid iterative development meetings with client
  - Moderated and unmoderated user tests

Future Work

The team was successful in creating an Ecological Assessment Tool that can expedite and lower cost for numerous researchers, while being less intrusive and easy to operate for study participants. Moving forward the client is looking to implement social functions to the application so participants have a greater sense of community and desire to complete diabetes prevention programs in particular. Beyond our current client, the application will start making its way into other researchers hands so they can begin utilizing it and requesting additions or modifications of their own.In the coming years the product is poised to have a widespread effect in the ecological research community as a whole.