Evaluation of Physical Activity Monitoring Applications for Android

Danish U. Khan, Swamy Ananthanarayan, An T. Le, Katie A. Siek
Department of Computer Science
University of Colorado Boulder
{khand, ananthas, anle9371, ksiek}@colorado.edu

INTRODUCTION

The recent surge in ubiquitous computing technologies has grabbed attention of health informaticians, both from commercial (Fitbit) and academic [1] sectors. This has given rise to plethora of health and wellness applications for various technological platforms that provide individuals the ability to track and manage various health metrics.

Generally, these technologies are informed by different sociotechnical theories of health behavior change borrowed from applied psychology. These theories highlight that reflecting on one's health habits allow an individual to gain a deep understanding of how these health habits could improve or worsen an individual's long-term health. This in turn could bring about a positive health behavior change in the individual. Consequently, we have witnessed change from short-term health tracking applications to long-term health monitoring applications that gather an individual's health data for an extended period of time, and visualize it in a meaningful manner.

Moreover, research in predicting health behavior has shown that an individual's health habits are affected by other people, who the individual perceives as being influential. Accordingly, a number of health and wellness applications provide individuals the ability to share their wellness information on different social networking websites.

While there are various off the shelf technologies that can be used for tracking health including Fitbit (fitbit.com) and BodyMedia FIT (bodymedia.com), we selected smartphones for this evaluation because of their increasing prevalence as compared to auxiliary wearable devices. Moreover, for smartphone users, it is convenient to download a health and wellness application on their phone rather than buy, setup, and use another device.

DEVICE AND APPLICATION OVERVIEW

Our system will consist of a smart phone and two different applications.

Motorola Droid

We will use Motorola Droid A855 smartphones (Figure 1) that runs Android Froyo 2.2.3 operating system. The phone has a 550 MHz ARM Cortex A8 processor and 256 MB internal storage. In addition, we will also use a 16 GB SD card for external storage. The data inputs for the phones include a capacitive touch screen display, onscreen and slide-out QWERTY keyboards, 3-axis accelerometer, proximity and ambient light sensors, and digital compass.

Figure 1: Motorola Droid Phone

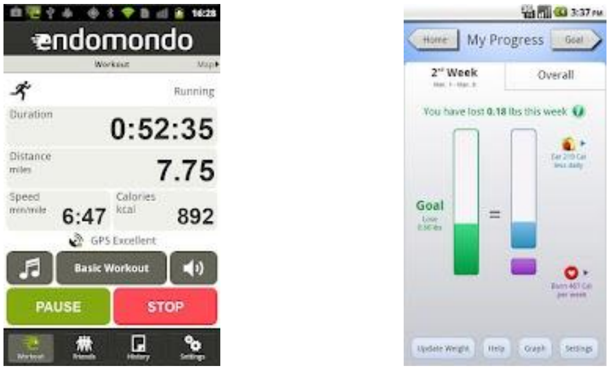
Endomondo Sports Tracker

Endomondo Sports Tracker (Figure 2a) is one of the most popular wellness-based Android applications currently on the market. It can be used to track different distance-based activities including running, cycling, and walking. It uses a smartphone's GPS, and provides the ability to track any outdoor sport and monitor duration, distance, speed, and calories. The application has an audio coach that provides motivation to achieve goals and outperform previously achieved targets.

Endomondo primarily relies on graph-based visualizations to display lap times, heart rate, speed, and altitude throughout the workout. The application also provides the functionality to share workouts on Facebook Timeline, view friends' latest workouts in real-time, and compete against friends' workout times.

Cardio Trainer

Cardio Trainer, shown in Figure 2b, is yet another highly acclaimed Android application that can be used to track walking, running, biking, and other activities. Similar to Endomondo, Cardio Trainer also relies on a smartphone's GPS and accelerometer to monitor various indoor and outdoor activities. It provides workout schedules with reminders, and can also be used to track interval workouts. Users can share their workout information on Facebook.



(a) Endomondo **(b) Cardio Trainer**

Figure 2: Physical activity monitoring applications

EVALUATION

We have two graduate students and one undergraduate student who will evaluate the two applications from June 15th to July 15th. We selected these two applications because they accommodate multiple physical activities. While our primary focus will be on running, we will also evaluate biking and hiking as secondary activities. The three students include one long-distance runner who has participated in different marathons, one regular runner, who runs 3 times a week, and one casual runner. This heterogeneous group will provide us rich feedback from different perspectives for the same activity. We will evaluate user experience, features and functionalities, data fidelity, and integration with research systems for the two applications.

User Experience

We will conduct user experience evaluation in 2 stages: (a) lab-based, and (b) *in-situ*. For lab-based evaluation, we will formulate a list of tasks and then perform cognitive walkthrough to highlight the usability issues with the device/applications.

To better understand the user experience, we will employ *in-situ* evaluation techniques [2] such as experience sampling that would provide us comprehensive information of how the device and application function in the field. The students who will use the applications will gather notes about their usability experience, design shortcomings, and areas for improvement. At the end of the study, the students will discuss their experiences with the applications to draw common usability themes.

Features and Functionality

While using the application, the students will determine whether they were satisfied by the features and functionality offered by the applications. The students will also discuss in detail which features they found useful, what functionality was absent, and how the existing features could be improved.

Data Fidelity

For health and wellness applications, it is important that the device and application report accurate data, especially when users want to set and achieve specific goals (e.g., run 2.5 miles in 15 minutes). We will evaluate the accuracy of distance by comparing the application-captured data with actual distances taken from Google Maps and Bing Maps. For step count, we will first find the distance covered in 100 steps for each student, then we will extrapolate it to the actual distance covered during the run. We will also compare the data captured between the two applications.

Integration with Research Systems

We will evaluate the feasibility of accessing Endomondo's and Cardio Trainer's captured data through their APIs.

Resources

We have 12 Motorola Droid phones that were donated by Google to our research lab. Three students who are also authors of this paper will each use 2 phones simultaneously for different activities. We will run each application on its own phone to simulate real-world usage. This could also mitigate any issues with running two GPS enabled applications simultaneously on the same phone. Moreover, in real world usage, people do not generally use two different applications simultaneously for the same purpose.

AUTHOR INFORMATION

Danish U. Khan is a Ph.D. candidate in Computer Science Department at University of Colorado Boulder. His research lies at the intersection of human centered computing, health informatics, and ubiquitous computing. Danish designed a personal health application for older adults to manage their medications, while recently he has been designing a mobile application for a low socioeconomic status population to improve their snacking.

Swamy Ananthanarayan is a Ph.D. student in the Computer Science Department focusing on human centered computing. His interests are in ambient, pervasive technologies that unobtrusively monitor and gather health and wellness metrics. While this can take the form of wearable technologies, they can also be everyday "smart" objects that monitor and present information in novel ways.

An Le is a third year undergraduate student in applied mathematics at University of Colorado Boulder. She is working on developing interfaces for Personal Health Applications (PHAs). She is a part of NSF REU, and was previously involved with YOU'RE@CU.

Katie A. Siek is an Assistant Professor at the University of Colorado Boulder in the Department of Computer Science. Her primary research interests are in human computer interaction, health informatics, and ubiquitous computing. More specifically, she is interested in how sociotechnical interventions affect personal health and well-being. Her current research examines how to assist low socioeconomic status populations either at-risk of chronic illness or with Type II diabetes manage their dietary health via smart phone apps.

REFERENCES

1. Sunny Consolvo, David W. McDonald, Tammy Toscos, et al. Activity sensing in the wild: a field trial of ubifit garden. In *Proceedings of the twenty-sixth annual SIGCHI conference on Human factors in computing systems*. ACM, NY, USA, 2008. pp 1797-1806.
2. Sunny Consolvo, Beverly Harrison, Ian Smith, et al. Conducting In Situ Evaluations for and with Ubiquitous Computing Technologies. In *International Journal of Human-Computer Interaction*, 22(1), 2007. pp 107-122.