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STEM Outreach Activity with Fitbit Wearable Devices

Dartmouth College Computer Science Technical Report TR2018-839

February 9, 2018

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Abstract: This document provides a toolkit for an STEM outreach activity based on Fitbit wearable fitness devices. The activity is targeted toward high-school students. This document provides guidance preparing for and executing the activity and measuring outcomes. This document contains templates that can be used as is or altered to suit your specific needs.

Acknowledgements: This outreach activity was developed as part of the Trustworthy Health and Wellness (THaW) project; see thaw.org. THaW is supported by a collaborative award from the National Science Foundation (NSF) the National Science Foundation (NSF award numbers 1329686 and 1329737).

Introduction

This document will guide you through the process of setting up a STEM outreach activity based on Fitbit activity trackers focusing on personal data security and careers in STEM. The goal of the activity is to encourage more students to consider pursuing academic or career paths in STEM, and to broaden the awareness of information security and privacy among high-school students. The target audience of this activity is high-school students and the required age minimum per Fitbit's Terms of Service is 13 years old.

This activity will require you (the conducting institution) to:

1. Partner with a local high school and identify a teacher willing to host you in her/his classroom, or collaborate to adapt the activity to their course.
2. Arrange with the teacher so you can visit their classroom at least twice – first to explain the activity and hand out Fitbit devices, and later to retrieve the Fitbits and hold a discussion – one or two weeks apart.
3. Assure that the students' parents or guardians are notified of the activity.
4. Provide the students with Fitbit devices.

IRB Approval

Your institution may require that you notify its Institutional Review Board (IRB) of this activity. Although IRB approval should not be required – because this activity is not research, and IRB approval is only required for research activities – we advise you to discuss your plans with your IRB in advance.

Audience Selection

This activity is designed with high-school students in mind. We recommend reaching out to a local high school and asking them to select a class or group of students to participate in this activity. You should then meet with the teacher to describe your plans and, as needed, adapt those plans to meet the context of the course or needs of the students. The Activity Model Document, provided below, can be used to describe the activity to leadership at the candidate school.

This activity will require that the students have access to a mobile phone or tablet computer (Android or iOS), or a laptop computer. In the event that the student does not have access to one of these devices, it will have to be provided by either your institution or the high school.

Equipment Acquisition

Fitbit may offer discounts on the equipment required for this activity. To inquire about an educational discount, contact Fitbit Business Development to see if this activity will qualify for a discount and how to apply for a discounted purchase.

Parental Notification

Once you have commitment from the school, develop a parental notification message (See the Template below) and ask the high-school teacher or administrator to deliver the message to the student's parents or guardians. The message should include the following:

1. A description of the project;
2. The name of your institution;
3. The names and job titles of the personnel that will be conducting the activity;

4. Contact information for the responsible person (professor);
5. How the parents or students can opt out of the activity.

Set Up Instructions

A set up instructions handout is provided below. Because the Fitbit technology changes from time to time, verify that the instructions are accurate and make any necessary changes to the handout before printing it out.

Suggested Activities / Homework

There are, of course, multiple ways that this activity can be used to demonstrate STEM concepts to the students. In the past, students have been instructed to perform statistical analysis on the data that the Fitbit devices and application collect. For example, students could calculate the standard deviation of their step counts. The students could also be provided with anonymized data for the class and perform statistical analysis of this data as well. The level of effort would be dependent on the students' capabilities, and on the teacher's interest in connecting this activity to the course material. Work closely with the teacher to develop any such exercises.

Activity Model Document

We summarize the activity on the pages below. Edit this document accordingly. The activity model can be used to pitch the activity to local high schools.

Wearable fitness device outreach activity

HIGH SCHOOL & INSTITUTION

Introduction and goals

INSTITUTION proposes an activity for students at HIGH SCHOOL with the following goals:

1. Provide an educational experience to the students, in the context of the class,
2. Teach students a little about wearable technology and how it works,
3. Inform students about the security and privacy issues involved in health and wellness applications and devices, and
4. Inspire students to learn more about computer science and careers in computing.

This activity is not a research study. It is an educational outreach activity, and concludes with some questionnaires used to evaluate the activity so we can determine how well the activity meets our goals and so we can improve the activity before repeating it at other schools.

This document describes the activity to teachers and administrators at HIGH SCHOOL, and serves as instructions for those conducting the activity.

Activity overview

Participants will be students in a relevant subject (e.g., science, math, computer science, or information technology). For HIGH SCHOOL we are expecting to target AUDIENCE DESCRIPTION. The students will be provided with a Fitbit MODEL wearable fitness device, which is an off-the-shelf consumer product. The Fitbit will be connected to a phone, a tablet, or a laptop computer. The phone/tablet/computer will in turn be connected to the Fitbit website. The activity consists of three parts: the first class meeting, the data collection period, and the second class meeting.

At the first class meeting the students will be given an overview of the Fitbit system with a little information about how the technology works, and what kinds of skills are involved in developing such technology. The students will each be provided a Fitbit kit at this meeting, along with information about how to use and care for the Fitbit, and access to the Fitbit privacy policy. There will be no cost to the students, but the students will be told they are responsible for returning the Fitbit devices and all accessories. (If they lose or break a device or accessory, we won't force them to pay for a replacement, but we won't tell them that up front. The goal is to encourage responsibility without imposing a financial burden on any student or family.)

During the data collection period (two or three weeks) the students will wear the Fitbit during waking hours. (Optionally, students may enable 'sleep mode' on the device and wear it while sleeping.) The device will collect data about their physical activity: steps counted, distance traveled, stairs climbed, calories burned, and (optionally) sleep quality. INSTITUTION representatives will help with the technical means to download data from Fitbit.com and assemble all student data in a way that removes individual identifiers. (At the time of this writing, Fitbit has a simple web interface to manually download a csv file for a given Fitbit, after logging into that Fitbit account.) [OPTIONAL:] The students will use this data in a homework assignment (designed and graded by the classroom teacher) that is consistent with the pedagogical goals of the course.

In the second class meeting, the **INSTITUTION** representatives return to the classroom to hear about the students' homework assignments and lead the students in a discussion about the activity – including the topics of data security and privacy as well as related skills and education for careers in mobile computing, health and wellness, cybersecurity.

At the end of this class, the students return the Fitbit devices to **INSTITUTION** representatives, and complete a brief survey to help assess the effectiveness of this activity.

Roles

Activity Conductor – **NAME** will be responsible for the overall organization and execution of the activity, including any approvals necessary from **INSTITUTION** officials or review committees. One or two **INSTITUTION** students will assist **NAME** in conducting the classroom visits and assist the classroom instructor in arranging for the students' download of the Fitbit data. The **INSTITUTION** students will assist in configuring, distributing, and collecting the Fitbit devices.

Classroom Instructor – Responsibilities include: providing a suitable meeting place for all activity meetings, monitoring student progress between meetings, developing and grading the homework or classroom exercises using the data, and emphasizing to the students the importance of responsible care for the devices and for the use of the data. The instructor is welcome to include this activity's assignments in their grading structure for their class however she or he sees fit.

Students – All students must be at least 13 years of age (a Fitbit rule). The students will be responsible for the attendance at all activity events, the completion of all activity-related assignments, and the care of activity-related equipment.

Parents – parents will be informed about their student's participation in the activity, and (if required by the school) to sign their approval of their student's participation. Parents will also be informed of the student's responsibility to return the device (and accessories).

Devices

This activity will be conducted with the Fitbit **MODEL**. The device includes the following components:

- **LIST COMPONENTS**

Each kit will be numbered and labeled as **INSTITUTION** property and students are expected to return all components at the end of the activity.

The details

First class meeting

The activity conductor will introduce the students to the Fitbit devices and how they work. They will provide a Fitbit kit to each student, and (if there is sufficient class time) walk them through the steps required to set up a Fitbit.com account and pair their device with their own mobile phone, tablet, or laptop computer. For students that do not have a personal mobile device, we will pair their Fitbit with the classroom computer. Data will subsequently upload to the student's Fitbit.com account via the paired device, whether it is a personal or school computer.

The activity conductor will discuss the components of the Fitbit device including the accelerometer, microcontroller, Bluetooth unit, and the user-interface. The activity conductor will describe the

development that had to go into designing the Fitbit device. The activity conductor will explain how the components interact at a very high level and explain to the students that these are the kinds of things that people who develop “embedded systems” do.

The activity conductor will then discuss the Fitbit mobile application. They will discuss the interface between the wearable device and the mobile device and how that data is represented in the application. The activity conductor will describe the development of the mobile application at a high level and explain to the students that these are the kinds of things that “App Developers” do.

The activity conductor will then discuss the Fitbit web application. They will discuss how the website gets the information from the mobile application. They will discuss how the user’s data is stored on the website and how that is different from how the data is stored on the phone. The activity conductor will describe the development of the website at a very high level and explain that these are the kinds of things that “Web Application Developers” do.

Finally the activity conductor will discuss all the components of the system. They will discuss the challenges of getting all the parts to work together. They will discuss how the Fitbit or any similar device goes from concept to production. The activity conductor will explain that these are the kinds of things “Systems Engineers” do.

Data download and privacy (OPTIONAL)

Fitbit makes it relatively easy for a user to download his or her own data, e.g., in ‘csv’ format suitable for loading into spreadsheet software. For the purposes of this activity, we wish to provide all students with data from all students, so they may manipulate all the data in their homework assignment. The students will download their own data (from their personal Fitbit account) and contribute that data to an anonymous pool of data from their classmates. Fitbits will be numbered before distribution to the students; submitted data will be labeled only by Fitbit number, and students will know only their own Fitbit number, so students will be able to identify their own data (and only their own data) within the pool of data provided. The teacher will assemble the submitted csv files into one pooled dataset, suitable for use by the whole class.

Second class meeting

The activity conductor will remind the students of the four career fields that were discussed at the first event (embedded systems, app development, web application development, and systems engineering) and then discuss two more fields as part of the discussion below.

The activity conductor will review the security and privacy issues of the wearable devices. The following questions will be posed to the students as a group:

1. How many of you read the privacy statement?

Discussion – Fitbit’s privacy policy is actually pretty good. The policy states that they do not share Personally Identifiable Information with any third party without the user asking them to do so. They MAY share or sell de-identified information. How do you feel about that?

2. How is the data transmitted along the path from the device to the vendor’s website?

Discussion – Review the path of the data from the wearable device, to the mobile device and from the mobile device to the website. The privacy policy is pretty vague here. How do you feel about these issues?

The activity conductor will review all the places at which the data could become exposed. They will explain how these are the kinds of things that “Security Engineers” do.

3. Did anyone use Fitbit to push their data out to other sites?

Discussion – Review how the data moves to a separate site. How does this impact the privacy of your data that Fitbit collects? How do you feel about these issues?

The activity conductor will describe at a high level how the data gets from Fitbit to a third party application like Facebook or My Fitness Pal. The activity conductor will explain that these are the kinds of things that “Systems Integrators” do. They will explain that systems integrators are similar to systems engineers but they work in a less controlled environment with parties that may not be willing to cooperate.

The instructor will distribute the surveys and ask that the students fill them out. The answers from these surveys will be shared with the activity conductor.

The activity conductor will collect all of the Fitbit devices and accessories.

Sample Message to Parents

The following is a template for a message to notify parents of a student's participation in this activity. We recommend that this message be sent by the teacher or school official.

Parents,

I am writing to inform you that your child has been invited to participate in an outreach project run by **INSTITUTION**. The overarching goal of the project is to increase young people's awareness of personal data security, and to help students understand the broad range of careers available in the computing field. Participating students will be loaned a Fitbit wristband to wear during **TIME PERIOD**. **INSTITUTION PERSONNEL** will facilitate discussions with the students about aspects of privacy and personal data security involved when using such devices. At the end of the period, students will return their Fitbit (and accessories) and download the data it collected. The teacher may ask the students to pool their data so the students can conduct further classroom activities with the data; in this case, all of the data will be de-identified so that it will not be possible to connect a student with a particular subset of the data. At no time will **INSTITUTION** personnel have access to the student data.

Your child is responsible for returning the Fitbit and all of its accessories. If he/she loses or damages the Fitbit, then he/she will have to replace it.

If you have any questions whatsoever, or if you would prefer your student not participate in this project, please do not hesitate to contact me.

Survey

The following pages contain a survey to help you assess the effectiveness of this activity. You should edit it to fit your particular goals.

Survey

Instructions: **Do not** write your name on this paper. The survey is anonymous and your opinion will help us to better conduct this activity in the future. Answer the questions honestly using the following scale:

1. The activity increased my interest in the general topic of health and wellness.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Comments:

2. The activity encouraged me to think more about my own health and wellness.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Comments:

3. I have used (or currently use) a Fitbit or similar fitness tracking device or mobile app.

1	2	3	4
no	Fitbit	other wearable	smartphone app

Comments:

4. The activity increased my interest in the topic of technology related to health and wellness.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Comments:

5. The activity provided a useful example of applying statistical analysis.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Comments:

6. The activity made me more aware of privacy issues in apps and devices that address health or wellness.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Comments:

7. The activity increased my interest in careers in science, engineering, technology, or mathematics.

1	2	3	4	5
Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree

Comments:

8. Any other comments you would like to add: