CS 147 Autumn 2014: Assignment 7 - Low-fi Prototyping & Pilot Usability Testing

OLA Diabetes Care

Ian Holmes, Tang Zhang, Albert Chen (hselin)

I. Team member name and role.

Manager: Ian Holmes
Design: Tang Zhang
Development: All
User testing: Ian Holmes
Documentation: Albert Chen

II. Introduction and Mission Statement

OLA is a system that consists of a smartphone application and wearable pod that provides real time context-aware care for diabetic patients through advanced data analytics and the pod's continuous blood glucose monitor, insulin/Glucagon pump.

The purpose of our current experiment is to evaluate OLA's user interface design against user tasks to ensure a great user experience.

Our mission statement is "To enabling diabetics to live a normal life without having to worry about their conditions and medication".

III. Prototype description

Our prototype consists only of the smart-phone application component of the OLA system. For its design, we made the assumption that the pod component would have the necessary functionality described above. We did not concern ourselves with the particulars of its design, as we considered the hardware out of scope for this assignment.

Our prototype provides the following pieces of functionality:

- Blood sugar level testing
- Insulin/Glucagon delivery management
- Emergency assistance instructions and contact with paramedics
- Doctor-patient communication
- Carbohydrate counting from user-entered photo

The prototype is a touch-based smartphone app organized by tabs associated with the representative tasks. The app opens by default to the “home” tab, in which the user can see his or her recent data (i.e. blood glucose levels and insulin delivery) as well as communications with his or her doctor (Figure 2). From here, the user may tap on any of the other tabs running across the bottom of the screen: “Glucose”, “Insulin”, “Food” and “Profile.”

Example usages:

- When eating food
    - Press the “Food” tab button to access the food camera (Figure 3).
    - Use the food camera to take a picture of what you are about to eat.
    - OLA will then determine the amount of carbohydrates in the food from the photo (Figure 4) and calculate the amount of insulin needed to cover them (Figure 5) and deliver it to your body (Figure 6).
- When changing dosages
    - Press one of the active doctor communiqués on the home screen (Figure 2).
    - OLA will then display details of that communiqué (Figure 8).
    - Pressing the “Implement” button will then bring up the insulin delivery screen (Figure 5) and the associated delivery confirmation screen (Figure 6).
- Responding to emergency low blood sugar event
    - OLA will detect the emergency and automatically administer Glucagon to revive the user, at the same time contacting paramedics (Figure 9).
    - Any tap/swipe gesture at the emergency messages will result in the display of emergency care information (Figure 10) which will instruct bystanders on how to care for the patient before paramedics arrive.

Figure 1 - Base phone

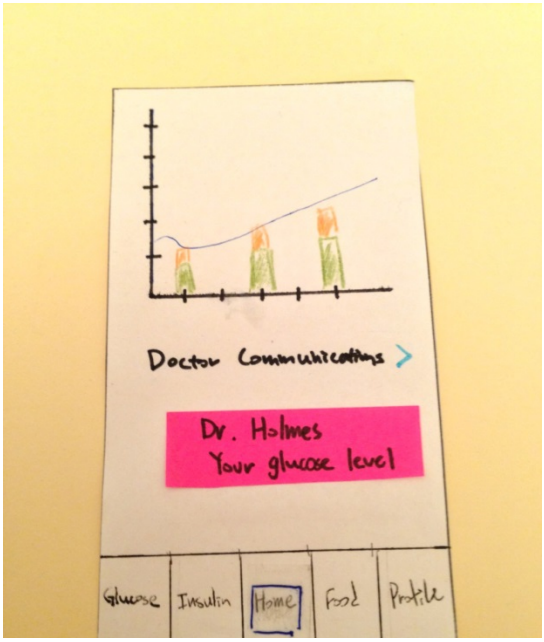


Figure 2 - Home screen

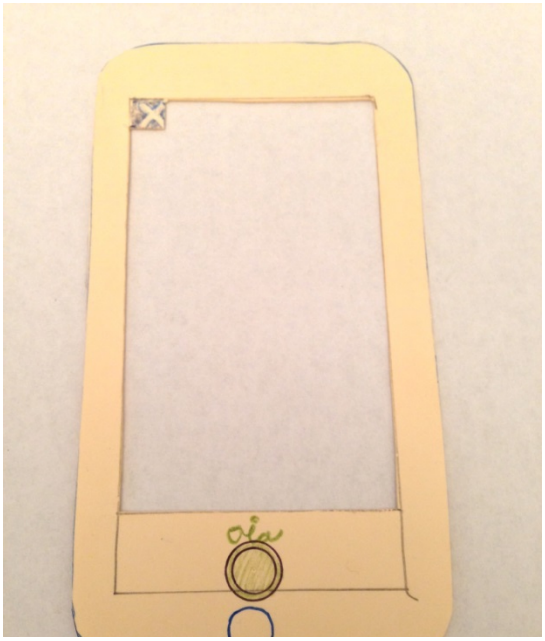


Figure 3 - Food camera

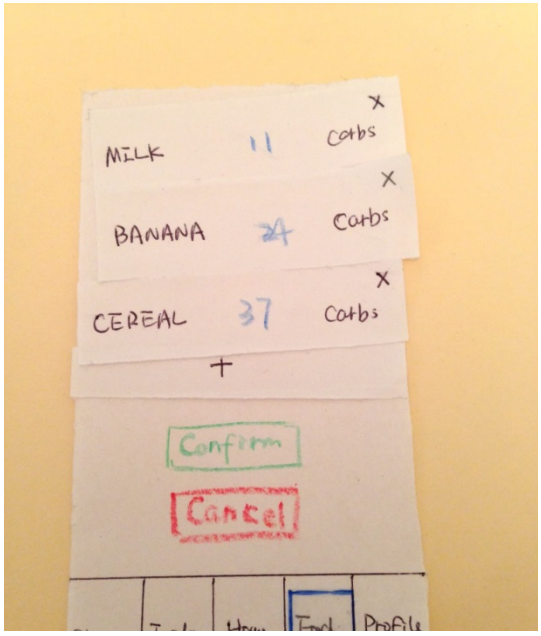


Figure 4 - Food carbohydrate count screen

Figure 5 - Insulin delivery screen

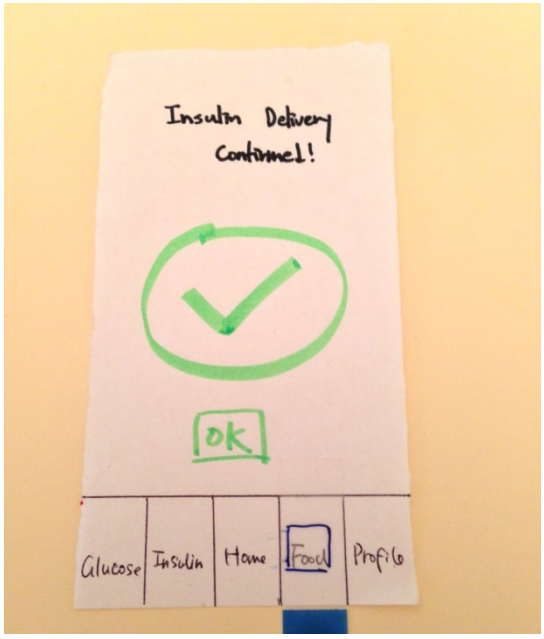


Figure 6 - Insulin delivery confirmation screen

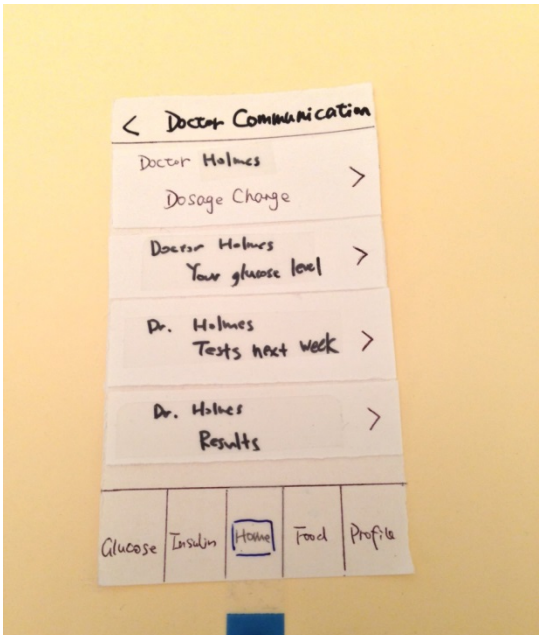


Figure 7 - Doctor communications screen

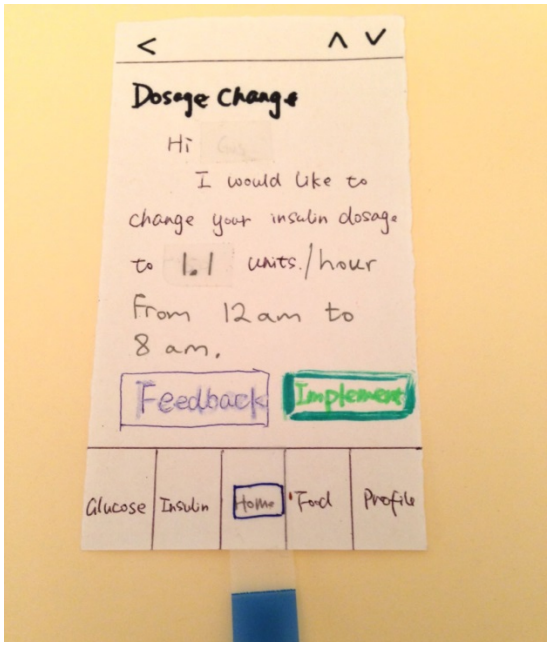


Figure 8 - Doctor dosage change request

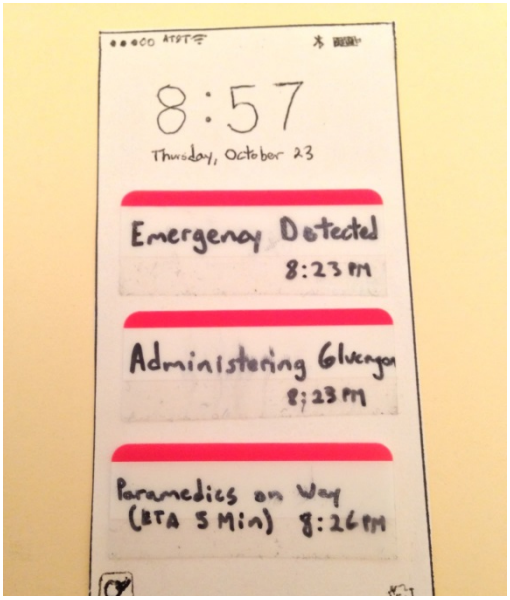


Figure 9 - Emergency response screen

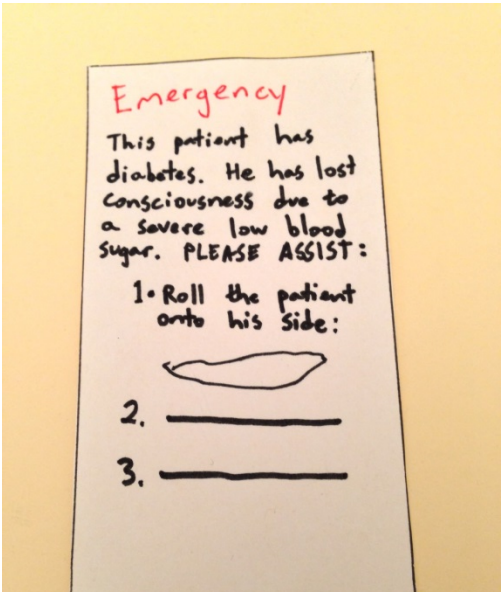


Figure 10 - Emergency care instruction screen

Figure 11 - Coming soon screen

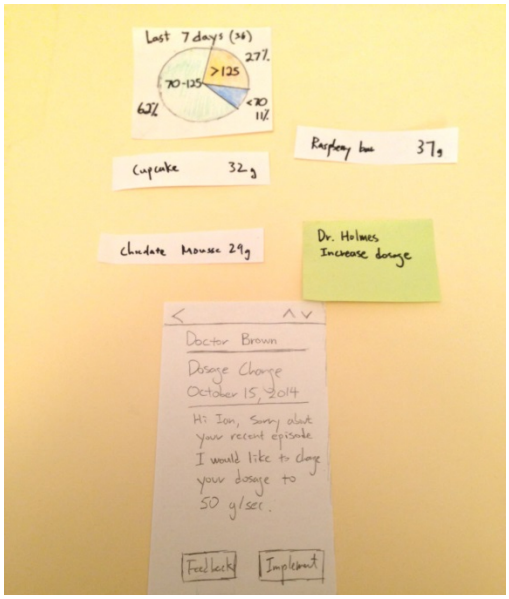


Figure 12 - Screen widgets

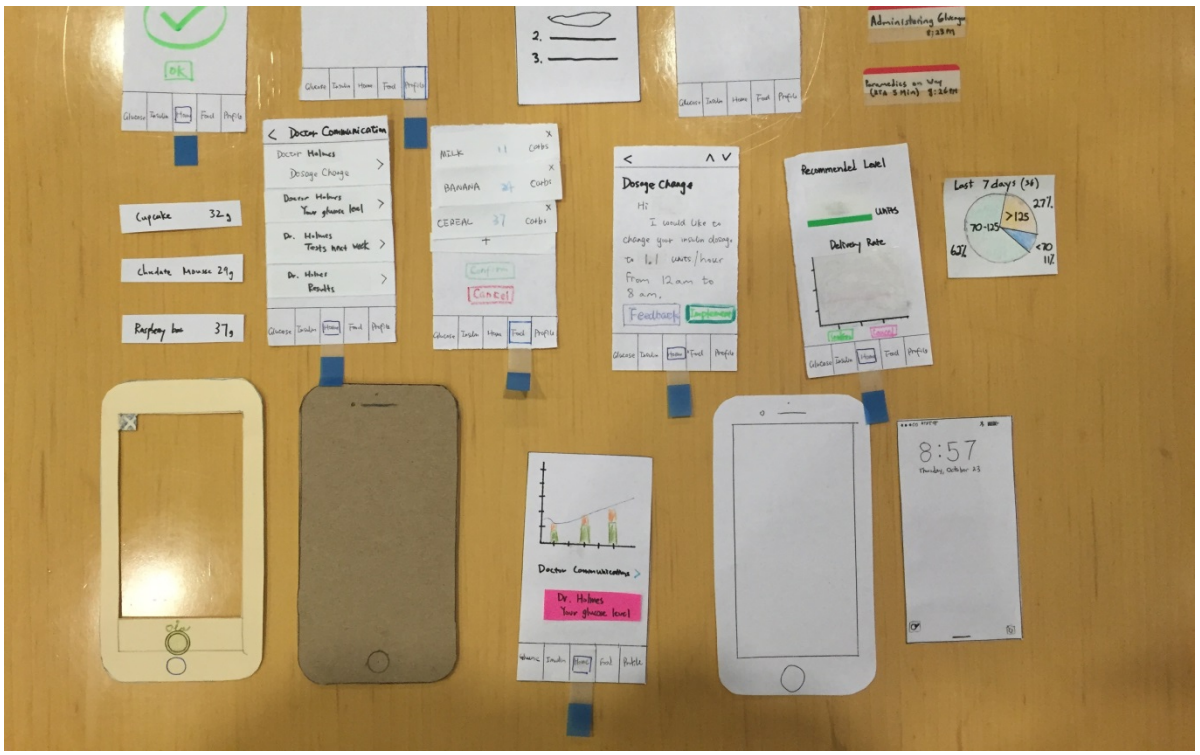


Figure 13 - Entire paper prototype

IV. Method

Each of our participants was early 20s, but differed significantly with respect to how long they had dealt with diabetes. Participant One was a 22-year-old white male diagnosed at age 6 . Participant Two was a 19-year-old white female diagnosed at age 8. Participant Three was a 21-year-old Indian female who did not have diabetes herself, but has cared for a type-one diabetic for 2 years. We picked these participants because they fit the profile that we have in mind for users of OLA - people who are technically savvy/adventurous and leads an active lifestyle. We also thought the inclusion of a non-diabetic but who cares for one broadens the diversity of our participants. Moreover, the two diabetics that we interviewed differs in their diabetic experiences - Participant Two kept meticulous record of his blood sugar levels and has experienced multiple severe low blood sugar events whereas Participant One does not keep a glucose journal and has not experienced any low blood sugar event.

All participants were found via reference by friends, and were offered compensation in the form of treats from Coupa Café. We interviewed them in a communal space downstairs in Arrillaga Dining. We laid out all of our UI components on the table across from them, with the

home screen on the table in front of them (see Figure 17). We then demonstrated how we wanted them to physically interact with the prototype (e.g. by tapping on a chart on the home screen in order to change their view) without showing them how to perform any of the specific tasks we intended to test (see appendix for script.)

We broke down individual team member roles as follows:

- Greeter + Facilitator: Ian Holmes
- Observer: Tang Zhang
- Computer: Albert Chen

Task 1 - Covering for eating a snack

- We presented each of our participants with a selection of snacks -- a cupcake, chocolate mousse, and a raspberry bar -- and asked them to complete the steps necessary to calculate the insulin dosage that they would take to cover that snack.

Task 2 - Changing Insulin Dosage

- We prompted our participants with a notification from their doctor, which appeared under the “Doctor Recommendations” label. We then asked them to view the message and take appropriate action.

Task 3 - Emergency assistance

- In this task, we asked our participants to pretend that one of their friends also uses the OLA system has passed out in his room, and they find their friend’s phone buzzing nearby. Again, we asked them what action they would take based upon the messages presented on the screen.

For each of the above tasks, we recorded the time required for the participant to complete the task, as well as the number of errors they made while trying to complete the task at hand (as well as specifically where and what each error was exposed). Furthermore, we asked each participant to talk to us while they attempted the task (i.e. we asked them for stream-of-consciousness feedback). This way, we would be able to collect general data about the positive and negative aspects of our UI for each task as well as any critical incidents that occurred.

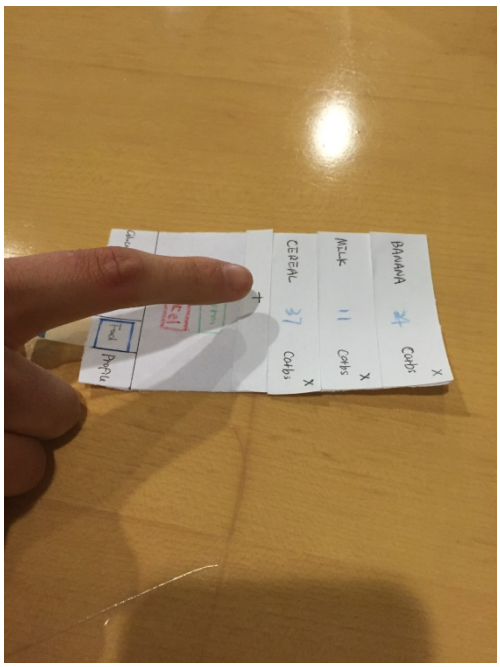


Figure 14 - Participant One accessing food carb count screen

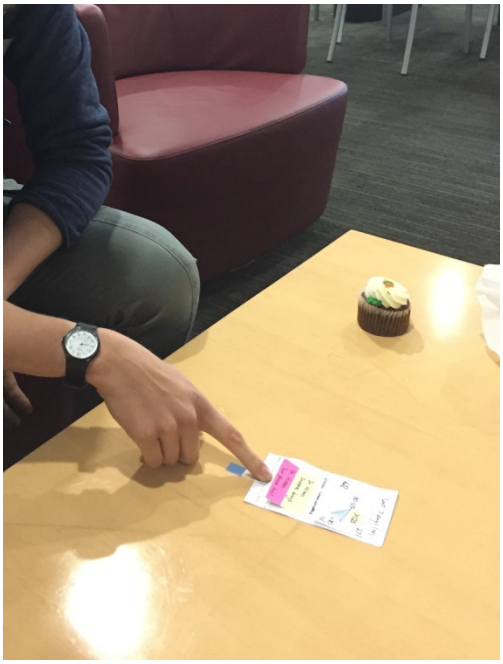


Figure 15 - Participant One accessing home screen

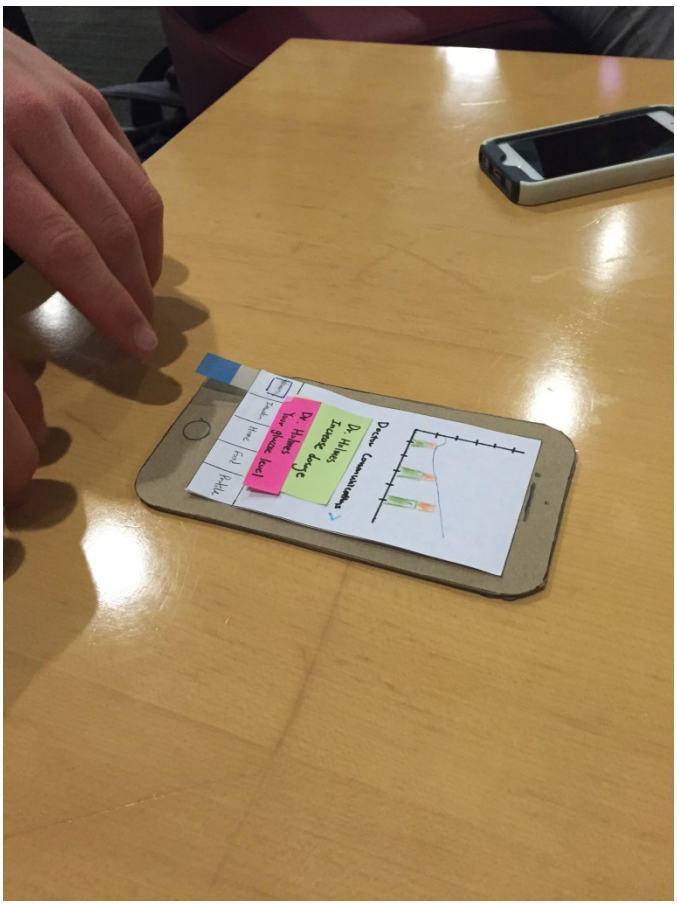


Figure 16 - Participant Two looking at home screen

Figure 17 - Participant Two looking at emergency care information screen

Figure 18 - Participant Three looking at emergency response screen

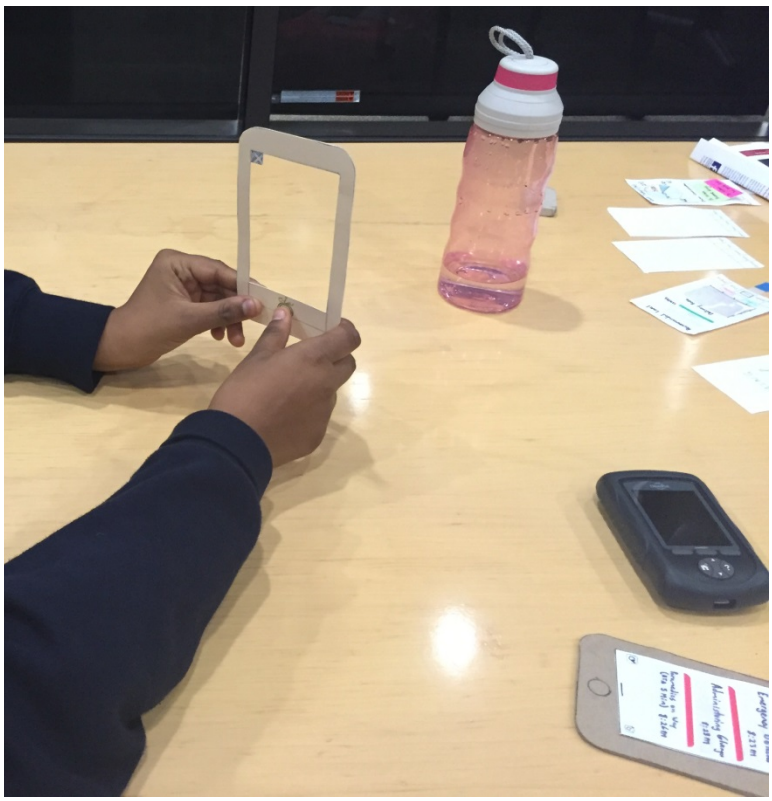


Figure 19 - Participant Three using the food camera

V. Results

From our observation/interview, OLA supports all of the necessary day-to-day tasks for a diabetic. While most of our user interface designs are self-explanatory and easily understood, some adjustments are required for additional clarity and convenience.

Measurements

The amount of user error is minimal (< 1 per task).

The average time spent on completing each task is as follows:

- Meal: ~50 seconds
- Changing dosage: ~90 sec
- Emergency: ~40 sec

We'll try to benchmark these numbers against traditional methods of diabetic care (e.g. using Glucometer and insulin/Glucagon needles).

VI. Discussion

Experimental results

1. Most of our user interface designs are self-explanatory and easily understood. Number of errors the participants made while interacting with the prototype is minimal, which indicates that they can understand the user interface easily without further learnings or instructions. Moreover, the average time they spent on completing each task is approximately 60 seconds with the highest being 90 seconds. This means that the participants did not trouble in understanding our user interface.
2. It is important to also realize that the total time spent performing each task is not necessarily the best indicator of the usefulness of the UI. For example, changing one's insulin dosages requires careful thought, so a user is likely to spend a couple of minutes reviewing the feedback provided by the doctor and the system before confirming any change.
3. Some adjustments are required for additional clarity and convenience. Even though most of the user interface is quite intuitive, the number of critical incidents illustrates that there are still some refinements that can be implemented for clarity and convenience.

Analysis of the result on how to refine the current user interface

1. Provide a graph/table to compare glucose level over same day/hour of each week and display current active insulin level (Figure 20).
2. Add buttons to call emergency contact and medical help in emergency care information screen (Figure 21).
3. Provide built-in options for insulin delivery rate (e.g. normal, square and dual wave) (Figure 22).
4. Warnings should be given when the pumps are not working properly.
5. Add additional instructions on the usage of food camera (Figure 23).
6. Provide dosage change implemented confirmation to the doctor.

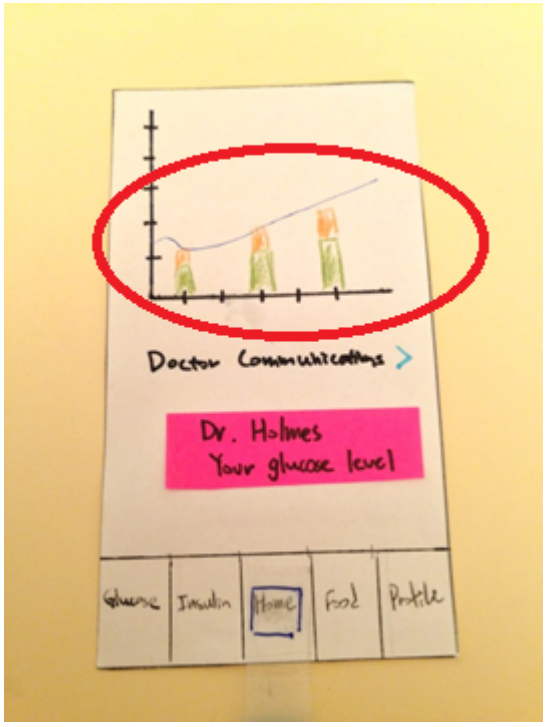


Figure 20 - Home screen change

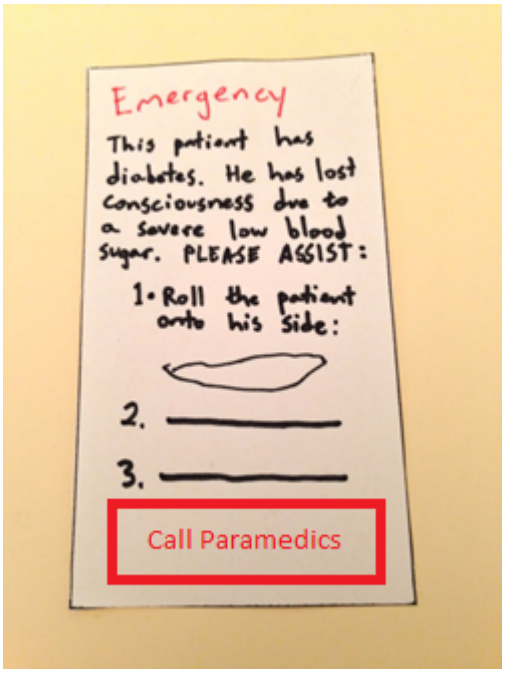


Figure 21 - Emergency care information screen change

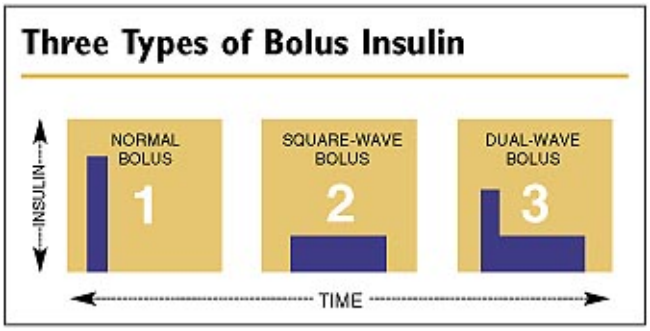


Figure 22 - Multiple insulin delivery rates

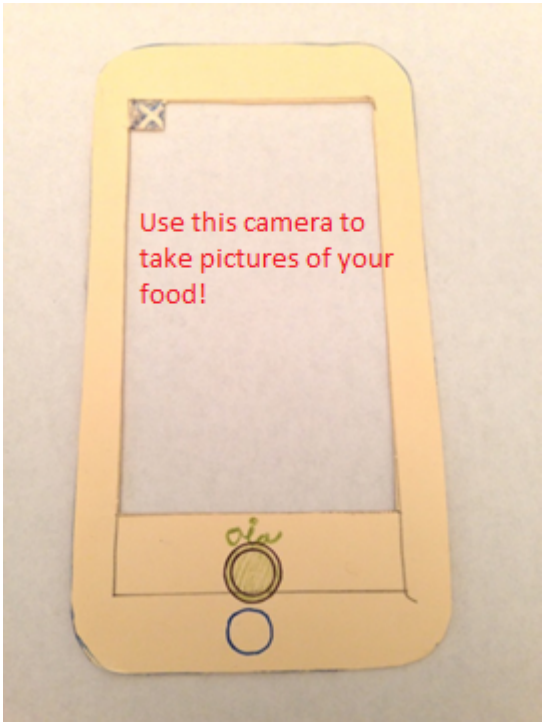


Figure 23 - Food camera change

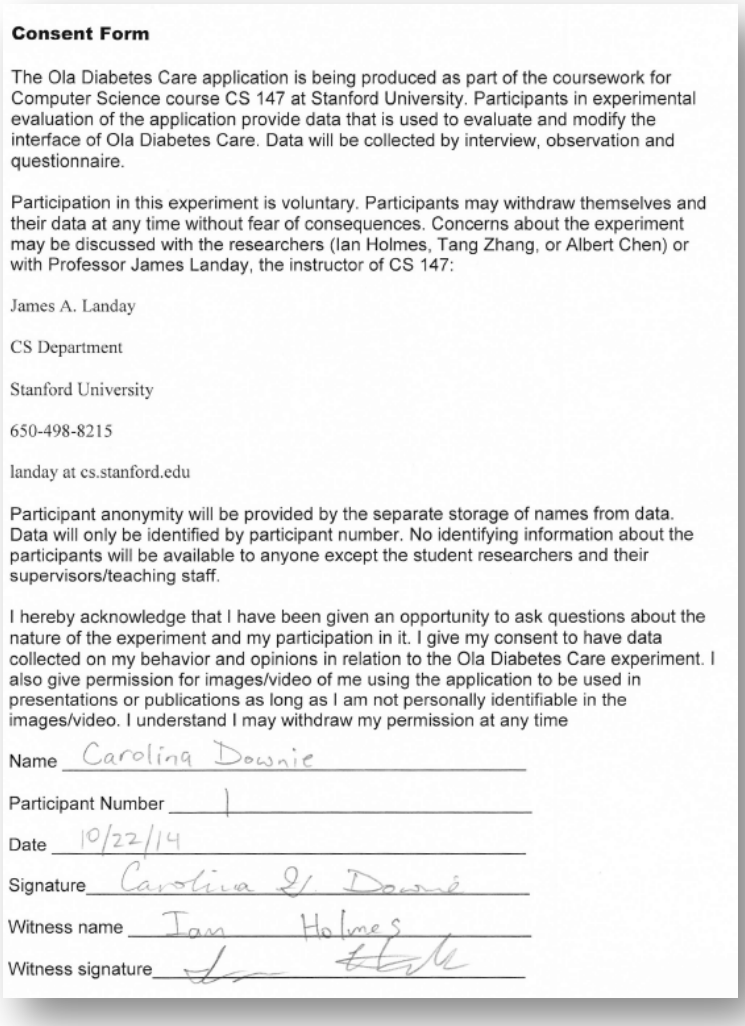
Aspects that the experiment might not reveal

Given the time and space constraint, there are some aspects that might not be fully revealed:

1. Emergency task cannot be completely simulated.
2. The fact that it takes time for "computer" to respond to user input also impacts the calculation of time spent on each task.

VII. Appendices

Consent forms



Consent Form

The Ola Diabetes Care application is being produced as part of the coursework for Computer Science course CS 147 at Stanford University. Participants in experimental evaluation of the application provide data that is used to evaluate and modify the interface of Ola Diabetes Care. Data will be collected by interview, observation and questionnaire.

Participation in this experiment is voluntary. Participants may withdraw themselves and their data at any time without fear of consequences. Concerns about the experiment may be discussed with the researchers (Ian Holmes, Tang Zhang, or Albert Chen) or with Professor James Landay, the instructor of CS 147:

James A. Landay

CS Department

Stanford University

650-498-8215

landay at cs.stanford.edu

Participant anonymity will be provided by the separate storage of names from data. Data will only be identified by participant number. No identifying information about the participants will be available to anyone except the student researchers and their supervisors/teaching staff.

I hereby acknowledge that I have been given an opportunity to ask questions about the nature of the experiment and my participation in it. I give my consent to have data collected on my behavior and opinions in relation to the Ola Diabetes Care experiment. I also give permission for images/video of me using the application to be used in presentations or publications as long as I am not personally identifiable in the images/video. I understand I may withdraw my permission at any time

Name Carolina Downie

Participant Number 1

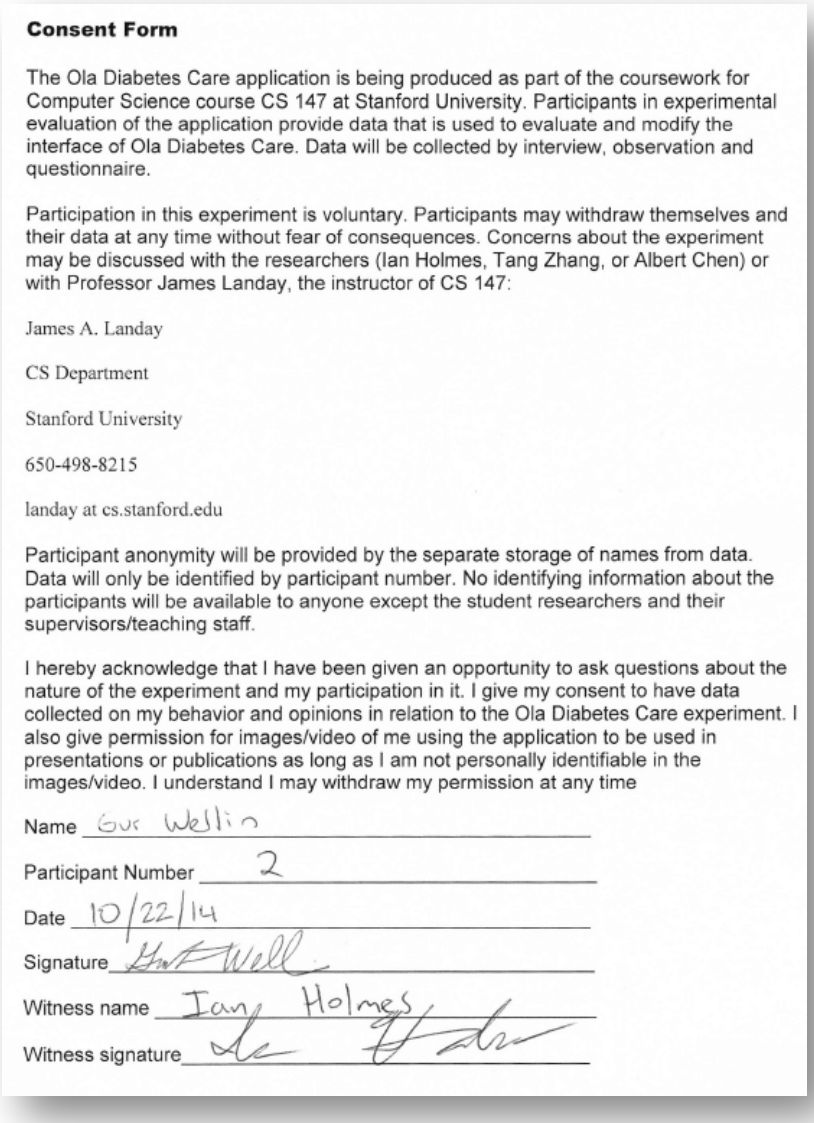
Date 10/22/14

Signature Carolina D. Downie

Witness name Ian Holmes

Witness signature

Figure 24 - Consent form for Participant One



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Name Gus Wellin

Participant Number 2

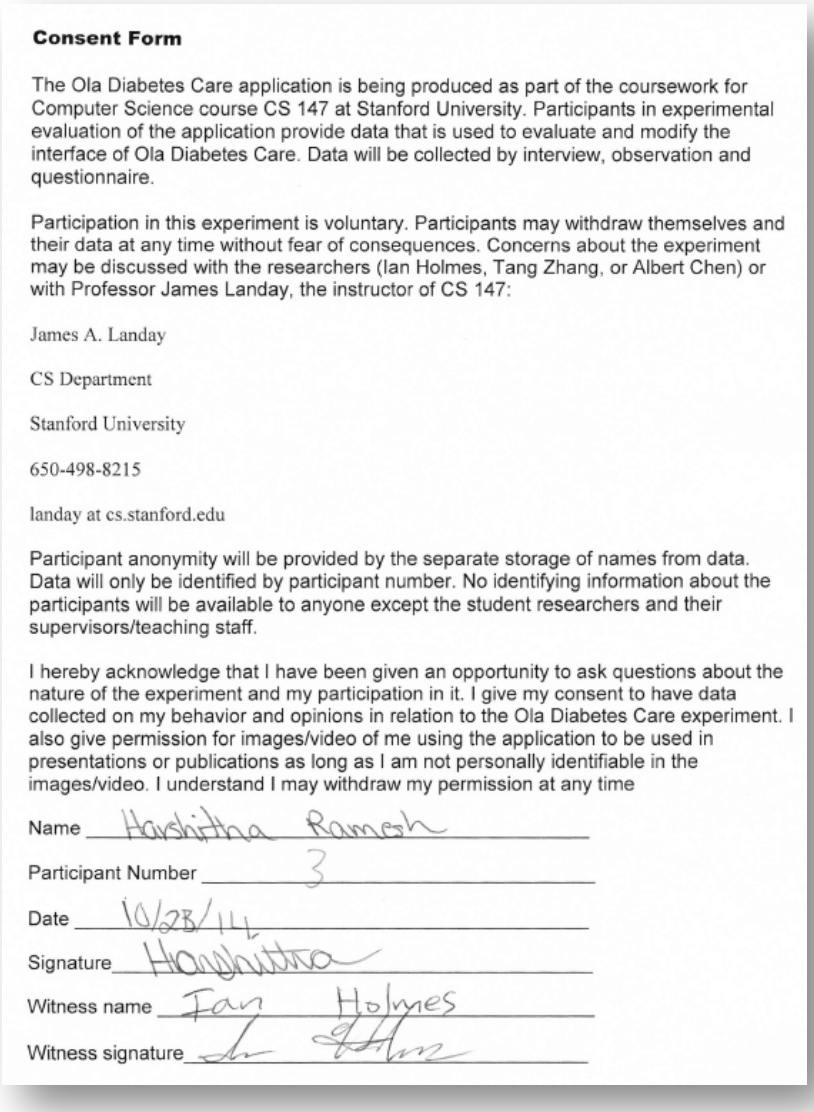
Date 10/22/14

Signature Gus Wellin

Witness name Ian Holmes

Witness signature

Figure 25 - Consent form for Participant Two



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Name Harshitha Ramesh

Participant Number 3

Date 10/28/14

Signature Harshitha

Witness name Ian Holmes

Witness signature

Figure 26 - Consent form for Participant Three

Script

Introduction of the team and what we are doing and demo the system to show interaction with paper prototype (do not show how to perform the tasks).

Show the following:

- Turn on phone.
- Launch OLA.
- Show home tab - and explain what is shown on screen.
- Explain the bottom tabs.

- Show glucose history graphic change (interaction).

Scenario 1 - Eating a meal

Suppose you (the user) are just sitting down for breakfast (which your roommate/significant other just made for you). How would you go about counting the amount of carbs and the associated insulin intake required?

Scenario 2 - Changing dosage

Suppose you've changed your diet (e.g. became a vegetarian) and you've experienced a greater number of low blood sugar events during the past month. Your physician noticed this and wants to make an adjustment to your basal rate.

Scenario 3 - Emergency care

Suppose your friend who is diabetic experienced a severe low blood sugar event and has passed out in his room alone. You came by his room and found him unconscious with his phone buzzing nearby.

Raw data (notes from testing interview)

Participant 1

- Observations
    - Like
        - Food camera for counting carbohydrates.
        - Emergency care information - think they are very accurate.
    - Dislike
        - Instruction about administering Glucagon is ambiguous. Add clarification that OLA system did the delivery.
    - Suggestions
        - Thinks insulin delivery rate does not need to be customized.
- Measurements
    - Error count
        - 1 (swipe instead of tap on doctor communiqué)
    - Time
        - Meal: ~50 seconds
        - Changing dosage: ~88 sec
        - Emergency: ~35 sec
- Critical incidents
    - Free-form input for insulin delivery rate - can lead to errors.

Participant 2

- Observations
  - Like
    - It is convenient to use camera to calculate carbs.
    - Emergency care is very useful because he has experience of passing out due to low blood sugar and people do not have a good idea of what they should do.
  - Dislike
    - Does not care too much about customizing insulin delivery rate.
  - Suggestions
    - There could be a section showing the active insulin level and blood sugar.
    - A table or chart that compares glucose level over same day/hour of each week could be helpful for decision on changing dosages.
- Measurements
  - Error count
    - None
  - Time
    - Meal: ~40 seconds
    - Changing dosage: ~97 sec
    - Emergency: ~38 sec
- Critical incidents
  - The meaning of feedback button is not very clear.

Participant 3

- Observations
  - Like
    - Emergency instruction is useful for somebody who does not know diabetes very well.
  - Dislike
    - There is no confirmation message telling that doctor is informed of the dosage change.
  - Suggestions
    - There could be a button on the emergency page to call medical help and emergency contact
    - More information about the x-axis and y-axis of insulin rate graph could be provided.

- Measurements
    - Error count
        - 1 (tap on the emergency notification instead of swiping to view.)
    - Time
        - Meal: ~59 seconds
        - Changing dosage: ~85 sec
        - Emergency: ~45 sec
- Critical incidents
    - Feel a little confused on what to do with the food camera.
    - A little confused about how to view the emergency notifications.