BackTrack

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CSE 440: Introduction to HCI
Autumn 2017

University of Washington

Problem and Solution Overview

Posture impacts many elements of our lives, from our physical and mental health to how we communicate and present ourselves to the world. In terms of physical health implications, bad posture can cause difficulty in respiration because there is less room for lung expansion, and often results in back pain due to the extra pressure on the spine. It can also impact mental health, as it has been found that people with better posture have more positive emotions than those with poor posture[1]. Posture also impacts the way the world sees us; people with good posture are seen as confident and energetic, whereas those with bad posture are viewed as tired and lacking confidence. Because of these advantages, many people want to have good posture. However, it is difficult to develop good posture, and takes a lot of cognizant effort. Bad posture is pervasive, with studying showing nearly 90 percent of the United States' population exhibit poor posture by leaning forward with their necks[2]. This project is aimed at helping people to get into the habit of keeping good posture, improving the way they work, how they feel, and how they are viewed by the world.

Our solution is called BackTrack, a wearable wristband that connects to existing smartwatches like the Apple Watch. It uses sensors, which are connect to the user's clothing, to tell what kind of posture they have. When the user calibrates the device at the beginning of the day to their "good" posture. Throughout the day, as they begin to slouch and develop bad posture, the BackTrack device will sense this and, if maintained for a duration of time, will gently squeeze the user's wrist to bring their attention to their subconsciously bad posture. If for any reason the device incorrectly corrects the user, they can help "train" the device by providing feedback by reporting these incorrect incidents. The BackTrack allows the user to participate in a wide range of activities, rather than keeping them tied down to a particular desk or computer. They can also look at their data through a web or phone application, to learn about what might be triggering their bad posture.

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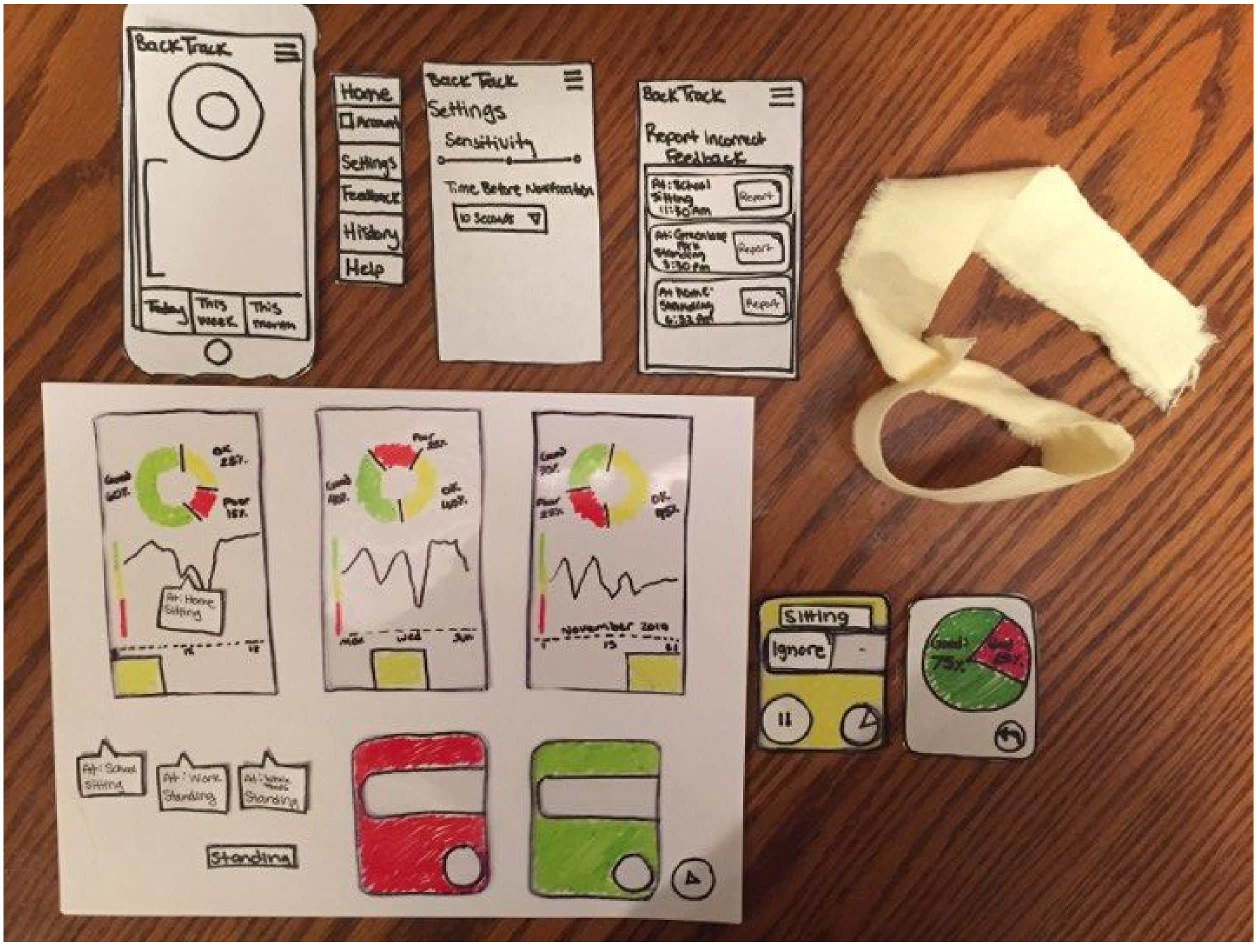
[1] Nair S et al. Do Slumped and Upright Postures Affect Stress Responses? A Randomized Trial. Health Psychol. 2015 Jun;34(6):632-41.
[2] http://www.goupstate.com/news/20100511/experts-say-posture-matters-the-good--and-the-bad

Initial Paper Prototype



Overview

Our paper prototype was meant to model three aspects of the design- the smartwatch interface, the mobile application interface, and the feedback mechanism of squeezing. We used paper and transparency cut outs to model parts of the interface, making it easy and fast to edit or replace parts. To mimic the wrist-squeeze for feedback, we used a strap of fabric that would be wrapped around the tester's wrist, and we could gently tighten from a distance.

Task 1: Awareness of “Posture Creep”

The app notifies you by squeezing your wrist and displaying a notification of poor posture on your wrist screen, and this happens “in the moment” (i.e. after it detects 10+ seconds of continuous poor posture). To review posture, tapping the pie chart icon on the wrist screen gives a pie chart with proportions of times with good posture and times with poor posture for the day, and the companion app has more options to view time vs. posture (e.g. over a longer period to see overall posture change over time, a line graph to view posture over the course of a day, etc.).

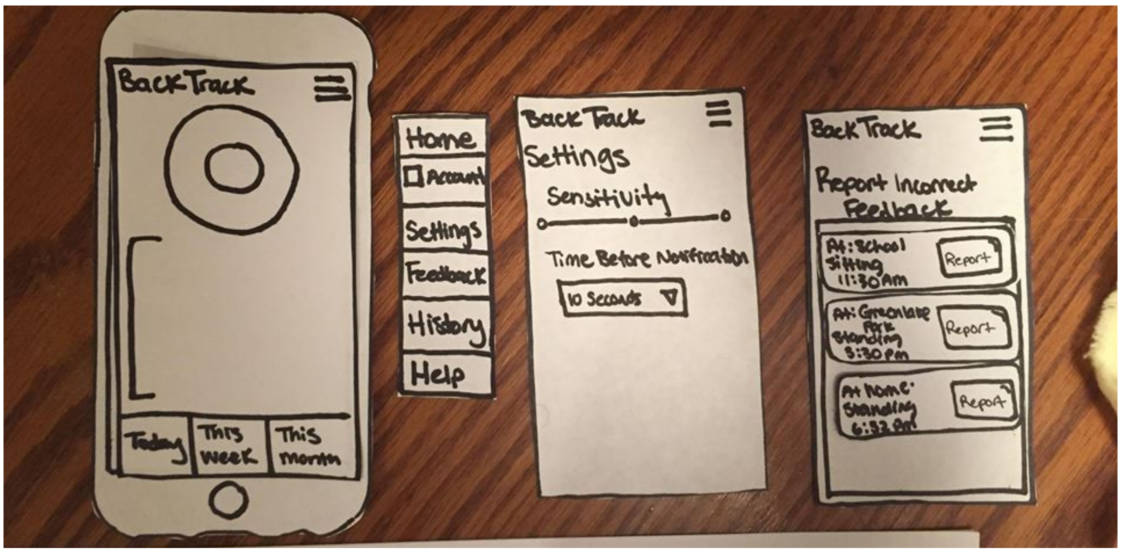
Task 2: Adapting to changing activities

The main screen has the current posture status displayed (e.g. good sitting posture, poor standing posture, etc.) for different positions, which allows for the user to recognize that the device is adjusting to different situations. When you get a notification of poor posture, you have the option to ignore the notification using the “ignore” slider instead of correcting your posture to train the app to recognize acceptable posture in different positions. In addition, you can pause the tracking by tapping the play/pause icon. Additionally, if a user feels as though they are receiving incorrect feedback they are able to report incorrect feedback, which also helps to train the app to be more accurate in interpreting different activities and postures.

Testing Process

Heuristic Evaluations

We began our evaluation process with heuristic evaluations. We used Nielsen's "10 Heuristics for User Interface Design," to assess our design, and tested it twice- once with a group from class, and another time with a software consultant who often works with interface design. As discussed in class, this allowed us to make obvious changes before moving on to the more resource intensive user testing process. After conducting heuristic evaluations, we conducted three usability tests using our updated paper prototype.



Initial User Test Design

We selected our participants from our target user group, students or young professionals who might spend extended periods in front of a screen. We chose three participants, 2 male and 1 female, all UW students with ages ranging from 23-30.

We conducted our testing at our participants' places of work, so for UW students this meant an apartment or library.

We began the test by introducing the participant to our design and its purpose, familiarizing them with the idea of a paper prototype, and asking them to put on the "wristband" and making sure it was comfortable/not too tight.

Once we were ready to start, we started our first task: Avoiding posture creep. We had the participants sitting at their workspace in a chair, with the wristband on. For our first participants they were not actively doing anything, and for our last we asked them to do "work" on their phone. We initiated the task by asking our participants to try not to focus on posture, hoping to observe “posture creep” occurring naturally. However, all of our participants were highly aware of their posture due to the nature of the testing situation, and eventually with all the participants we had to ask them to model “Okay” and “Poor” posture. During the testing, we were watching for whether the response from the device (squeeze and screen change) elicited a change in posture.

For our second task: adapting to different activities, we had the participant stand up, achieve “good” posture while standing, and then sit back again. We watched how they achieved this, and whether they were able to recognize that the device was aware of the change in activity.

Finally, because our tasks went really quickly, we gave the participants time to just play around with the paper prototype. We felt this was important because our tasks were more focused on the experience of using the device rather than intensive use of the interface, and this gave the users a chance to comment on the mobile app and watch interface. This part was coupled with an informal interview where we discussed likes and dislikes of the design.

Difficulties in Creating Test

Creating a user testing plan was particularly difficult for our project for several reasons. Our first difficulty we faced was in creating tests for a design that was intended to not to require too much attention and be invisible most of the time. We knew whatever tasks we asked our users to do, we would miss out on testing how “invisible” it was, because we are only testing the device in its active state, not when the user isn’t interacting with it.

A second difficulty was that for our designated tasks, especially our first task, avoiding posture creep, a key part of the task is the user not being conscious of their posture- something which we knew would be difficult to achieve in a short period of time, with a multiple testers nearby, and someone holding a strip of fabric attached to their wrist.   We knew that ultimately the artificialness of the test and the user’s situational awareness would be problematic, and considered ways to accommodate or work around this in our testing.

A third problem we faced was that our tasks — avoiding posture creep and adapting to different activities — are instantaneously achieved and require very little action by the user. We want our tasks to be effortless (making the device as unobtrusive as possible), but we still needed tasks to test. This concept of what a “task” is for a device reminding you about your posture has been a struggle throughout this project, and was something we needed to consider before creating our testing plan.

A fourth problem was that the fabric ‘squeeze’ was inherently distracting. I think we got much more natural results than if we had replicated it by squeezing their wrist with our hands, but it still inhibited their movement and served to keep them conscious of their posture. It is difficult to tell whether this was a problem with the testing, or an effect that the actual device would have as well.

Alterations to Test Plan to Address Challenges

We were unable to address the first challenge, the problem that most of the time our design is "invisible" and how to test for how unobtrusive it was. If we'd had more time, it might have been interesting to try a different testing technique

We intended to test our participants somewhere they are likely to be completing work- for example a desk at home, or in a library. We hoped that by placing them in their 'natural' work environment, it would help to relieve the second difficulty of overwhelming awareness of posture during testing, by placing them in an environment where they might authentically be distracted by their work or surroundings. We found this insufficient to make participants forget about their posture. For our third participant, we asked him to use his phone during the test, to create an additional distraction from the conscious attention to posture. This wasn't successful either as the participant was not able to really do authentic 'work' during the test. Ultimately we were not able to really find a sufficient way to overcome this. If we were to do more tests, I think we could develop an artificial task to ask participants to do- something that took a lot of mental focus. We had just allowed them to choose what they were doing, but I think if we gave them something it might help to redirect their attention off of posture.

For the third challenge- the instantaneous nature of the tasks- we tried to counteract this by extending the post-task part of the test by allowing them to try different parts of the app and explore our prototype, as well as through the interview at the end of the test. This worked fairly well and we got a lot of good feedback, so we spent more time on this part as the tests went on. If we had more time, it would have been nice to formalize another few tasks to help the participants "play around" with the prototype, and create a more structured interview.

Testing Results

Heuristic Evaluation Results & Changes

We conducted our heuristic evaluations with both a group from class, and another time with a software consultant who often works with interface design in his work.

For our first heuristic evaluation (group from class), our evaluators gave their feedback in more of a free form manner, rather than clearly sticking to the list of heuristics. We were able to align them with Nielsen's heuristics and found the following:

- <u>#2 Match between system and the real world:</u> Stop or power instead of pause to better indicate what the buttons means

- #3 User control and freedom: There was concern that for the report feedback that it didn't give users an undo option if they mistakenly reported an error. There was also concern about how often feedback would be given, if it would overwhelm the report feedback stream.
- #4 Consistency and Standards: We were alerted to several consistency errors, including using poor in some places and bad in others to describe poor posture, using both pie and doughnut charts on the watch vs. the mobile app, and using two types of navigation- a hamburger menu and tabbed navigation.
- #5 Error Prevention/#8 Aesthetic and minimalist design: One evaluator brought up a concern about the location tracking on the app taking up too much battery. We weren't sure where this fell, but it seems as though it would be important to prevent users from draining their batteries unknowingly, as well as (maybe not in terms of an interface) but not using battery resources for unnecessary information.

The second heuristic evaluator, a software consultant often working with UI design, gave feedback that was more focused on using Nielsen's heuristics. We received the following feedback:

- #4 Consistency and Standards: Our evaluator brought up several consistency issues. On the app, you can click for more detailed info about location/activity on the "today" tab, but this pattern doesn't hold for week/month. Another issue was data granularity- the large line graph made it appear as though there is many different ratings of posture (along a continuous Y axis) vs. the watch interface/pie chart which makes it look as though there are three discrete postures. One aspect of our design that was not able to be conveyed in the paper prototype was that the colors gradually shifted in a gradient rather than being discrete, which we felt adequately answered this problem.
- #3 User control and freedom: Our evaluator brought up the question of Once you hit ignore, how long does it ignore for? It was unclear whether if goes off if it the bad posture again or if it waits a certain amount of time. We also were suggested to support an undo if you were to swipe ignore by acciden**t.**
- #5 Error Prevention: One point our evaluator brought up was what happens if it cannot get an accurate idea of your posture, or if the device breaks? He also suggested that the size of the touch targets in the watch might cause problems, that three targets in such a small area might be hard to accurately touch.
- #6 Recognition rather than recall: He mentioned that settings were hidden to the user, and had to be discovered under the menu. If they were something people adjust based on activity (more or less sensitive at different times/locations/activities), it might be difficult for them to have to remember where to find it each time. He also mentioned that the feedback reporting was hidden as well, which might make it less likely for users to actually remember to use the feature.

Through this heuristic evaluation, we got feedback of some inconsistency and unclear in design. We refined some of them but leave some as they were because we want to see how it actually be in using in the real task for usability testing. The problems mentioned are these:

- Language consistency: Since we were using two devices, smart phone for application and watch, we should use the same terms for the same circumstances. We made a choice on which language we would use to describe things. We also decided on a 'visual' language, making the charts on both doughnut style instead of pie charts.

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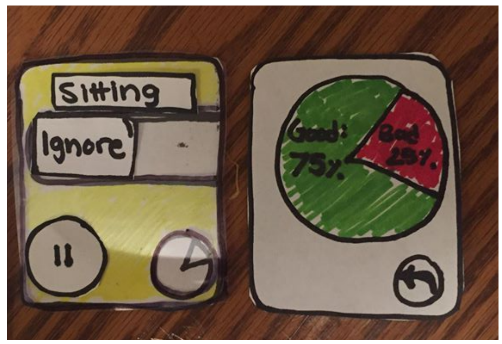
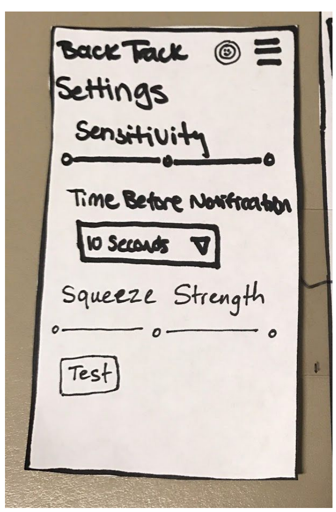
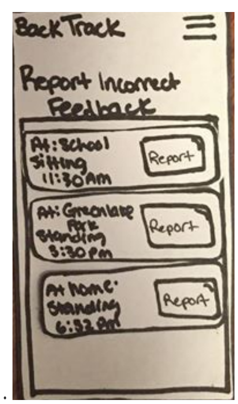


- Reporting Feedback: This was unclear and difficult for user to understand what would happen if the button was clicked. At the same time, there was no way to undo the clicked button. To clear this up, we decided increase user control of over the settings and allow them to test it- both to see the squeeze strength as well as to get a sense of how long it takes to initiate a squeeze upon recognizing bad posture. We also added an "undo" to the report feedback, to allow users to undo feedback that was mistakenly ignored.





Usability Test #1:

The participant was a 23 year old male grad student in CSE at UW. Yuqian Sun and Mike Stepanovic conducted the test in an Odegaard study room, where students are often found doing computer work. Yuqian played computer, Mike answered help questions. Once the participant realized that we were tracking posture, he became hyper-aware of the test and actively prevented bad posture. We had to ask him to simulate bad posture in order to be able to test the functionality of the app.

- Account: Participant mentioned why there was an account in the menu. This made us to think about the function of having an account. We concluded that account is not a main function of the app but useful when users want to access to the record with different device. Therefore, we added a small "account photo" icon, which transitions to a logout state so that the data isn't device specific.
- "Feedback reporting": The problem that this was difficult for user to understand had also been mentioned in the heuristic evaluation. We changed the name to "event log", and user have the option to "trash" items there and undo, which we felt made the training aspect more intuitive.
- Visual of Record: The participant A calendar and scrolling options for the graph for data viewing were also added, along with a radio setting for customizing time.
- Settings: We also noticed that the participant had a difficult time distinguishing between "sensitivity" and "squeeze strength", so we separated that in the settings.

Usability Test #2:

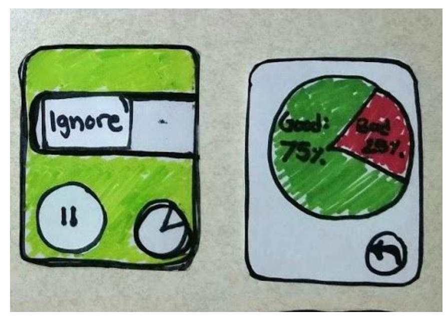
The participant was a 24 year old female senior at the University of Washington. The test was conducted the test at her apartment, Stevens Court, where the participant often study. Like our first usability testing, we again were again unable to get the participant to naturally model bad posture while being observed, so we asked the participant to simulate to bad posture and good posture for the first task.

- Home: User couldn't go back to the "home" screen. Therefore we added a home button to pull down menu.
- Color: To make it more easy to get the posture tendency, we added the color to the calendar view so that user can figure how their posture is on the day, duration. Also, the color of the watch screen should go away when the tracking was paused. User suggested the color gradually transitioning between green, yellow and red is better.
- Screen of watch: She said it was better if she could know how to correct the posture to be good posture by watching at the watch.
- She also mentioned how to get the neck posture and accuracy of sensor by attaching the sensor to clothes. We haven't decided how exactly to address these last considerations at this point.

Usability Test #3:

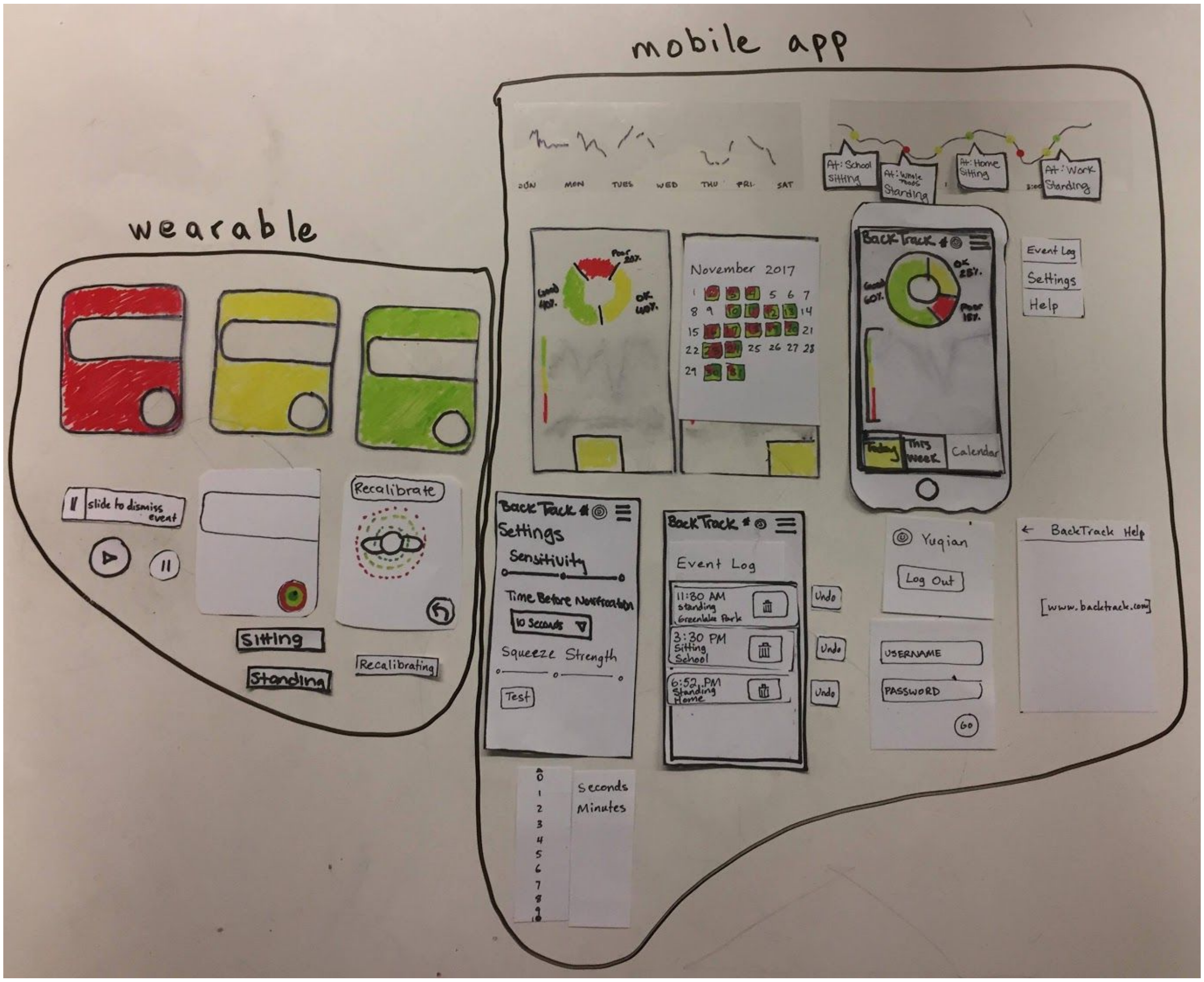
Our third participant was a 30 year old graduate student at the Information School at UW. We conducted the test in Allen Library, which was a normal study location for this participant. This was the only test where we asked the participant to actively do something (they chose to 'work' on their phone) while we did the first part of the test. We found this did nothing to solve our problem of participants being consciously aware of their posture, as the participant never really focused on their phone because we were all standing around observing them use our device. After the second task, this participant wanted to explore the prototype more extensively than our other users, and the informal interview was extended to discuss their thoughts during this period. We had done this with the first two participants, but for this test we encouraged it a bit more and it was beneficial to getting information outside of the two main tasks.

- Home: We found that the user frequently use this button to go back to the home so we add home icon at the top. This reduces the process of pushing menu button to go back to the home.
- Nodes on the graph: Through these three usability testing, we found that no user tried to click the graph to see the detail. Therefore, we added the nodes on the graph to indicate they were clickable.
- "Dismiss the event": User can dismiss the event by sliding the button on the watch. The participant said the text on the button and design of the screen were confusing. Therefore we change the text on the button from "ignore" to "slide to dismiss the event".
- Change the graph to current pose: Probably our largest change made from our usability testing was getting rid of the graph on the watch, and replacing it with a top-down view of the user, giving them real-time feedback on their posture. This participant was confused because the graph had been a secondary screen on the watch, but was the the home screen on the app. This was coupled with confusion about what we thought was 'good posture,' which we hadn't had a participant vocalize yet but we witnessed a bit of confusion when asked to mimic good/okay/poor posture. This solution helped the participant to know the status of their current posture, as well as preventing incorrect conclusions from being drawn about the home screen relationships.



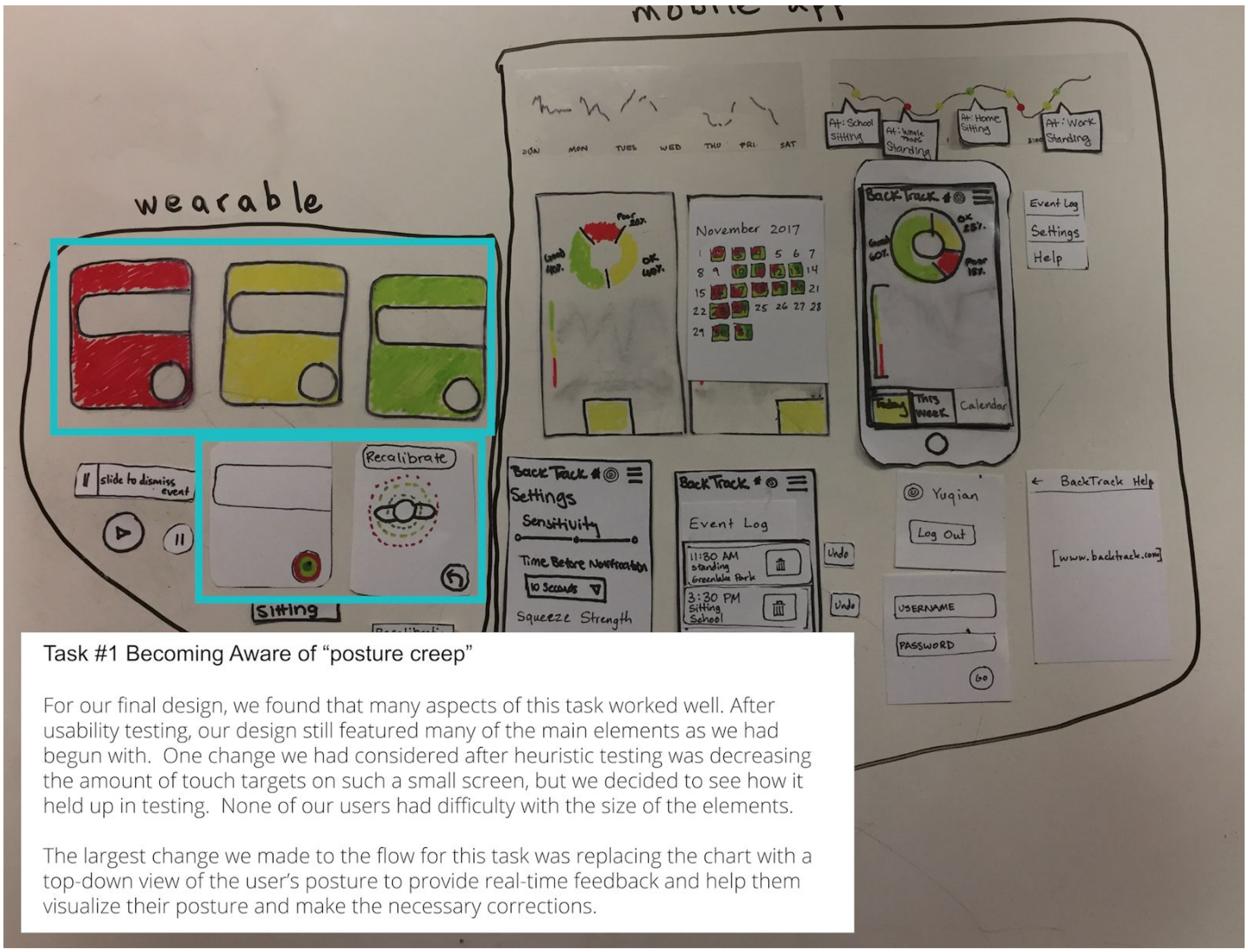
Final Paper Prototype

Overview



This was our final paper prototype we created. Under the wearable section, we have the three primary color screens for poor, okay, and good posture. We had changed the wording on the slide to get rid of the notification several times because everyone seemed to think something different, and ultimately landed on “slide to dismiss event” because it was a fairly standard design/wording choice we found in Apple products, and some of the main products we imagine our device working with are Apple Watches and iPhones. Also under wearables, we added a new top-down view for users to receive real-time feedback on their posture and allow them to figure out how to correct it, as well as recalibrate their device if they felt it wasn’t correct. We also changed the button icon in the bottom right to reflect this new screen.

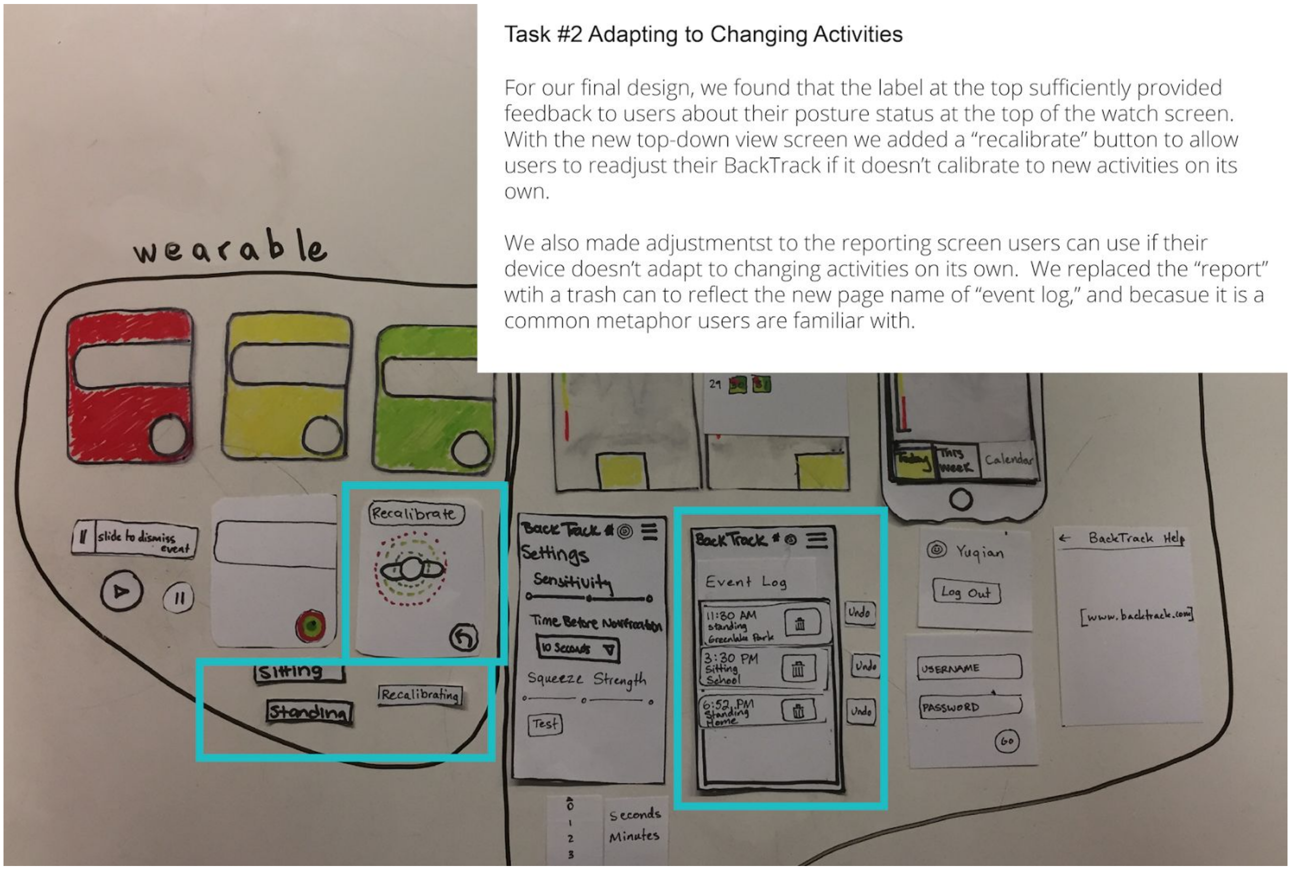
For the mobile application, we changed the tabbed screens for day, week, month slightly, keeping the navigation the same, but changing the interaction and visualization for week and month. This was something that had come up in our heuristic evaluation and we hadn't changed, but found in testing that it was confusing. We also added "nodes" for local max and mins to the daily graph since it wasn't clear to users that they could tap points for more information. Other changes included the addition of account information and design of the event log.



Task #1 Becoming Aware of "posture creep"

For our final design, we found that many aspects of this task worked well. After usability testing, our design still featured many of the main elements as we had begun with. One change we had considered after heuristic testing was decreasing the amount of touch targets on such a small screen, but we decided to see how it held up in testing. None of our users had difficulty with the size of the elements.

The largest change we made to the flow for this task was replacing the chart with a top-down view of the user's posture to provide real-time feedback and help them visualize their posture and make the necessary corrections.



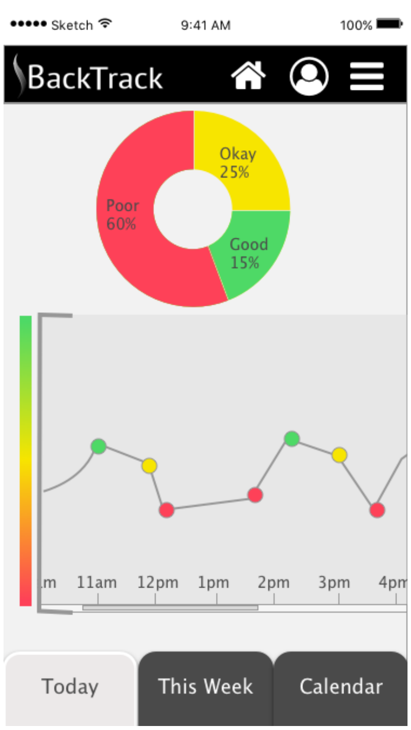
Task #2 Adapting to Changing Activities

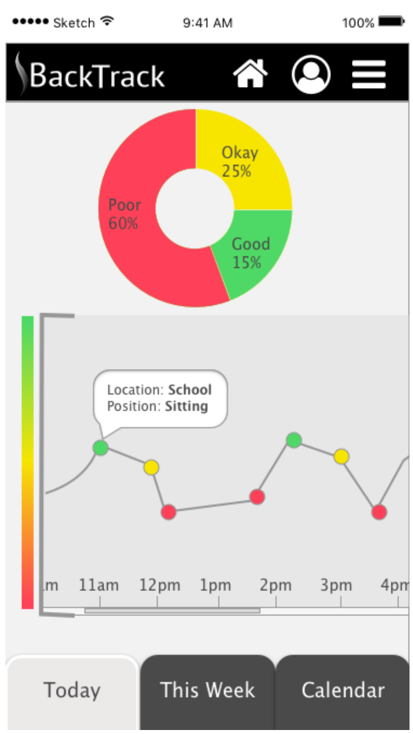
For our final design, we found that the label at the top sufficiently provided feedback to users about their posture status at the top of the watch screen. With the new top-down view screen we added a "recalibrate" button to allow users to readjust their BackTrack if it doesn't calibrate to new activities on its own.

We also made adjustmentst to the reporting screen users can use if their device doesn't adapt to changing activities on its own. We replaced the "report" wtih a trash can to reflect the new page name of "event log," and becasue it is a common metaphor users are familiar with.

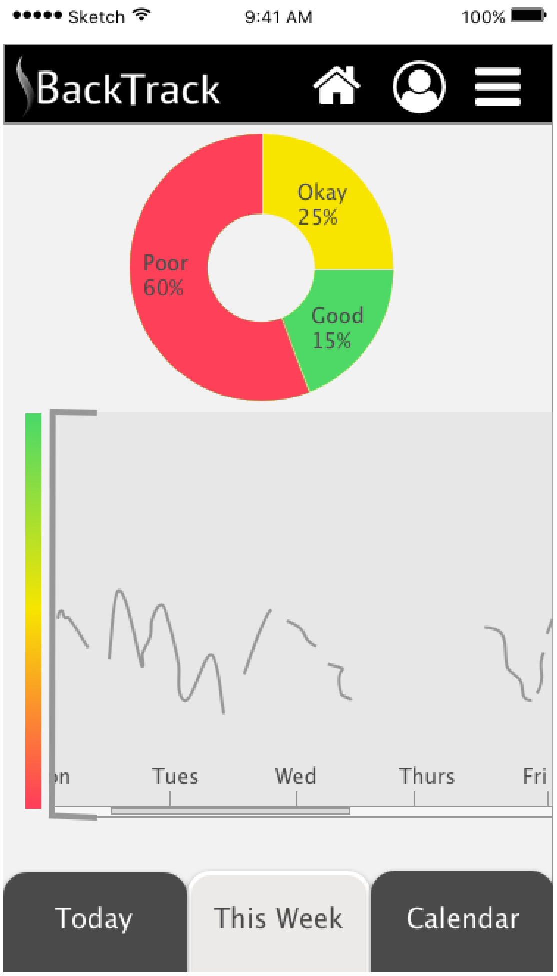
Digital Mockup

Design Overview: Version 1

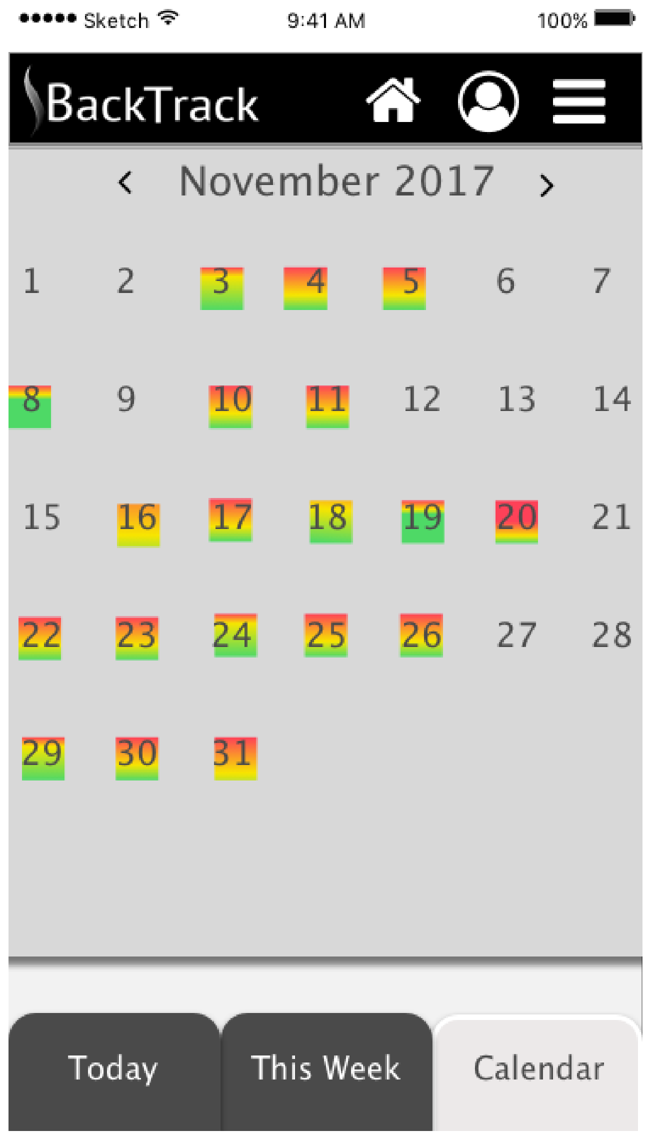




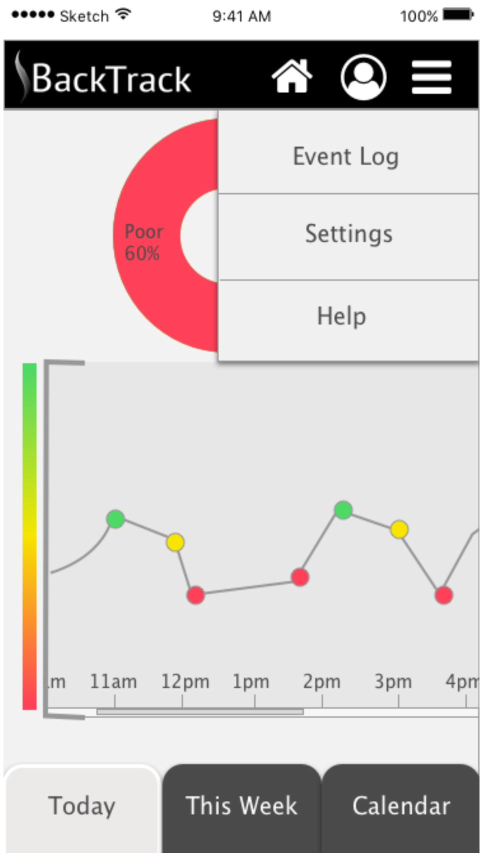
The main screen of the app. Displays today's posture in a donut graph and a clickable line graph. The node shows critical event with color representing posture. Clicking points on the line graph brings up more information about that time with location and position (sitting or standing).



Tapping “this week” in the bottom nav brings up the same information, but for the entire week. The break of line graph means user stops recording at that time. User can scroll to see the graph.

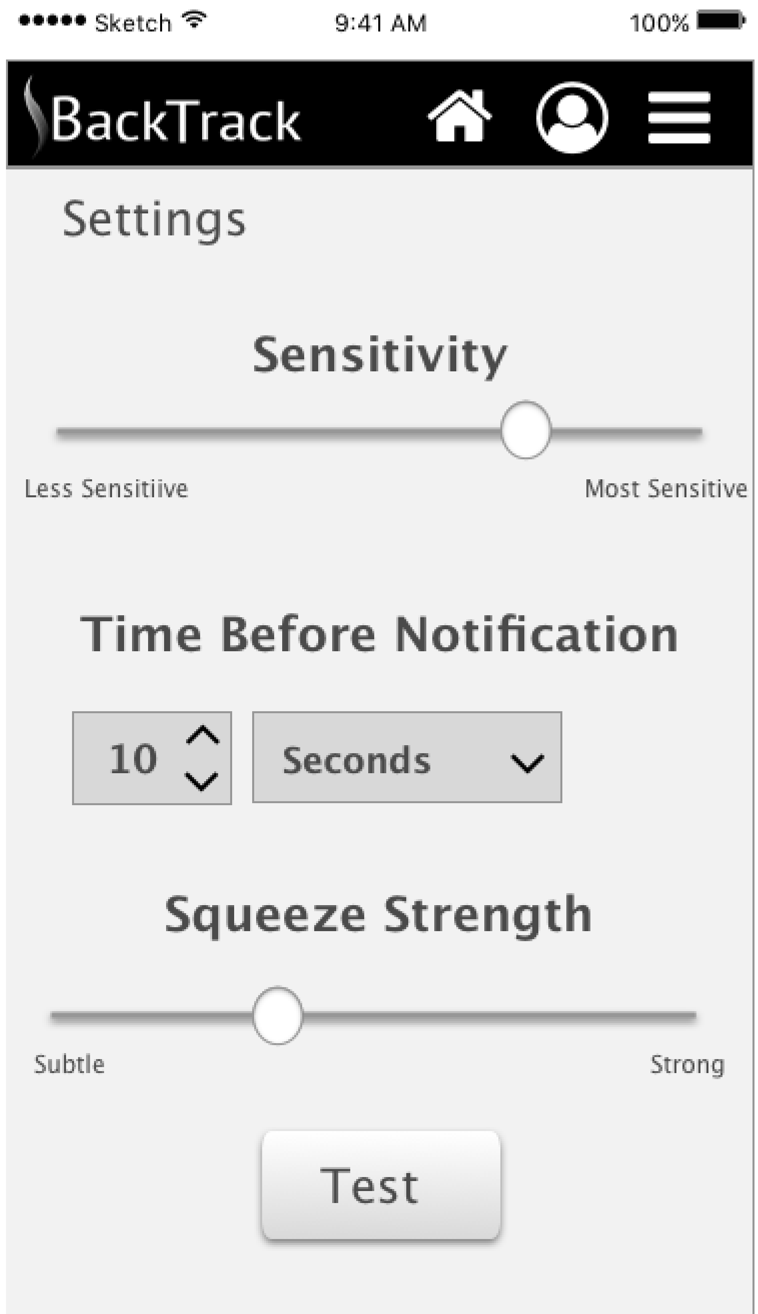


Clicking the calendar button in the bottom nav displays a monthly calendar with color gradients for the days for posture.



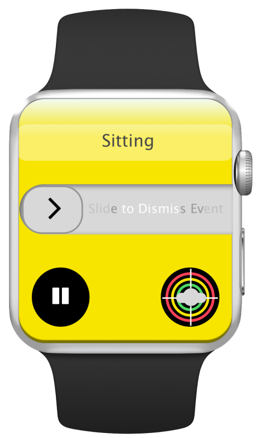
Tapping the hamburger menu on the top right brings up a way to go to the event log, settings, and help.

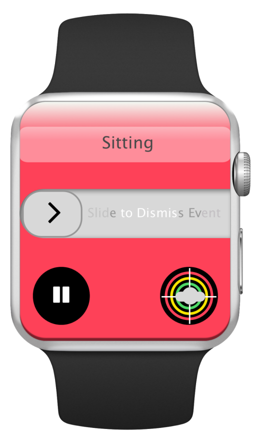
Reviewing the event log. Tapping the trash can icon allows the user to remove a posture event from the log, training BackTrack to avoid triggering on events like that. Grays out the event and shows an undo button.



The settings menu allows for configuring sensitivity, time in poor posture before receiving a squeeze notification, and the strength of the squeeze. User can test the setting by clicking the “Test” button.

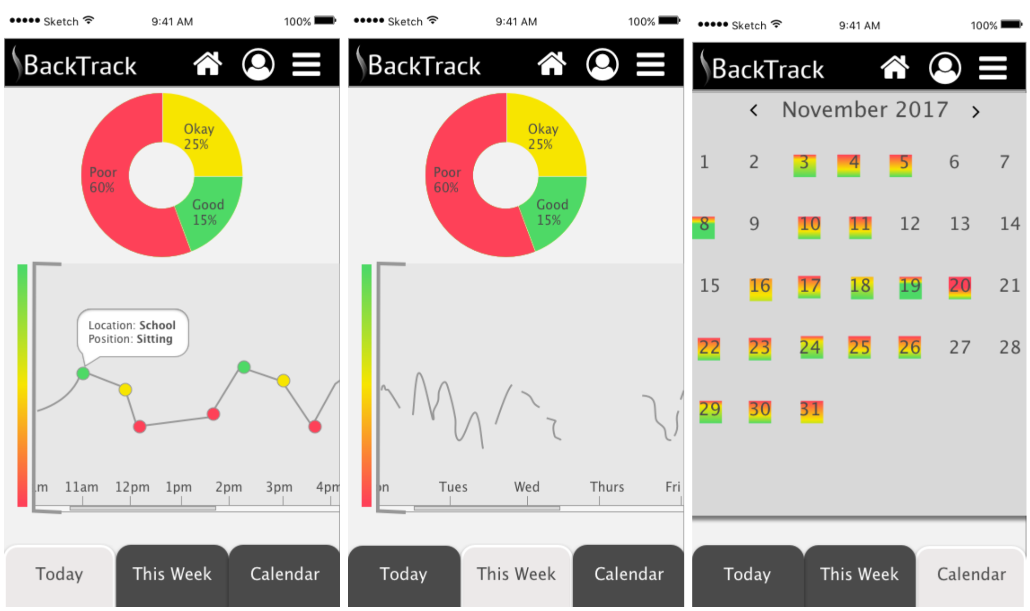
Task 1: Becoming Aware of "Posture Creep"





These screens show the flow for posture creep. These actually required very few changes from the original paper prototype. For the slide, we copied the iOS design for slide because we wanted it to be something users were familiar with. One difficulty we faced was that we imagined the watch having a gradient of color rather than three discrete colors. Due to the static nature of both paper and images, we haven't been able to capture that aspect of the design yet.

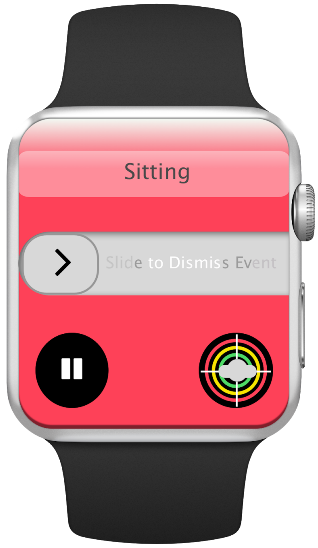
From the main screen, users can check their current posture, or recalibrate the BackTrack. As mentioned with the above calibration flow, the only major change we made here was the addition of highlighting/thickness to inform the user of their posture status.



Also, users can check their posture from the record of smartphone application. They can get the personal tendency of posture from the color gradient and line graph. Besides, by clicking at the node, they can get detailed information.

Task 2: Adapting to changing activities

This task includes several screens. The task includes being able to monitor posture in different activities, so the main watch screens identify the user's current activity. This was something that we had included in our paper prototype, changing to reflect the activity (e.g. sitting, standing, running, etc.)



In addition to allowing users to check the status of their activity, they can also dismiss the event in the case that it isn't needed or is incorrect.

We imagined Task #2 might need support in dealing with errors. For this, on the screen allowing users to check their posture from Tast #1 also has a calibration option, so users can correct the system.

This can also be done through our event log, where users can delete incorrect notifications. This for this we added a greying out effect in our digital mockup that helps to signify to the user that the action delete has been performed.

Discussion: Digital to Paper

Overall, the transition from paper to digital prototype went fairly smoothly. Through our paper prototype, we had a fairly strong idea of what we wanted the flow of the experience to be, which helped in that we knew exactly what screens we would need for our flows. However, the major challenge was once we started to put together a more refined prototype, we were forced to make visual design decisions that we hadn't really considered before. While we had to decide on things like color and fonts, the more difficult part came identifying what might get lost in translation between paper and digital prototypes. One task we faced was making sure that the affordances that were clear in the digital screens. An example of this is the sliding mechanism for the graphs on our application. It was quite clear in the paper prototype that there was more information that could be revealed by sliding the transparency across. On a screen, however, there needs to be an affordance to allow the user know recognize that there is information being hidden, and the action needed to reveal that information. To do this, we added a scroll bar, as well as having the information on the edges partially displayed, suggesting that they should slide to reveal this.

One thing we noticed during testing was that participants didn't know when to "begin" using the device, and also were unsure as to what posture counted as "good." A way we addressed this in the digital mock-up was adding the calibration screen, which shows on startup. The calibration screen has a silhouette of a person and 3 differently colored circles, and the user needs to hold their body to line up the silhouette in the green circle to calibrate. One difficulty we found in translating it from paper to digital prototype was thinking about how to show interactions. We wanted to have some sort of feedback to confirm the recognition of the posture, which we took for granted in the paper prototype where the action of the "computer" showed confirmation. Here we instead showed a highlighted/thickened circle to show the status of the posture, which would brighten (center screen) and then confirm (right screen). After calibration, the watch app transitions to the "main screen".

Design Overview: Version 2

After we received feedback on our screens, we decided to make several changes. The most significant change we made was the way we visualized the user's posture. We had previously decided on doing a top-down view of the user to help them adjust their posture, but we received feedback that this was not a very intuitive way to convey this information. In our second iteration of our digital mock up, we changed the visualization to a side-view of the posture. This would help the user understand better interpret the status of their posture because it uses the spine shape people are familiar with, and would also help with Task #2, adapting to different activities, because it would provide confirmation to the user that the device was aware of the current task. For the interaction we imagined the line indicating the user's current position indicated by the colored line, with a grey ideal line to match it up to. When the two are aligned, the line glows and brightens to indicate to the user that they have achieved proper posture.

Screens for observing posture while in use

Calibration on Open Screen Flow

Another change we made to our initial design was to add an additional encoding method to the watch screens indicating posture status. Our first iteration of the design only had color encoding, which would make it difficult for people with color deficiencies to use the design, particularly since our design relies heavily on the differences between green and red. Other parts of the design use red and green (like the line graph, pie chart, or posture indication line) but these all have another way to understand them (heighth and the pop ups, the poor/okay/good labels, or the relative position of the posture lines, respectively). We used face emotion icons because they are a well understood metaphor to represent the positiveness of an idea. We also changed the button at the bottom for the posture view to reflect the updated design from above.

One final change we made to our designs was just to add a pause symbol to the pause screen, just to make it clear what the screen is for and provide feedback that is easier to interpret that the device is paused.

Discussion

I. From the process of iterative design, we learned that no matter how good you think a design is, there are always things that could be improved. Iterative design works so well because we start with a guess, and then from there we figure out what works, what doesn't, and then we make a better guess and repeat the process. Furthermore, we were able to make dramatic improvements to the design by maintaining low-fidelity sketches until the start of usability testing. It was surprising how much our design improved after we thought we had reached a peak amount of feedback.

II. The process of iterative design had a huge impact on the way that we approached design users and tasks. At first, we were designing for all college students and desk workers, and vaguely for anyone who could improve their posture (i.e. everyone). As we went through design iterations, we drilled down our design tasks for people who are actively trying to improve posture: people who likely experience bad posture throughout the day and actively wish to improve it.

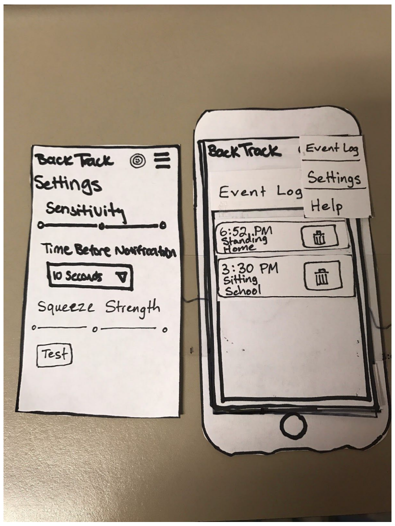
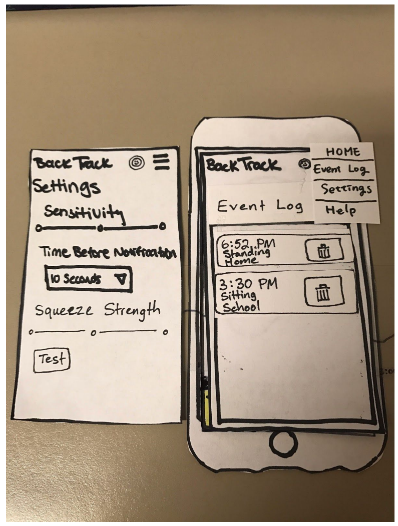
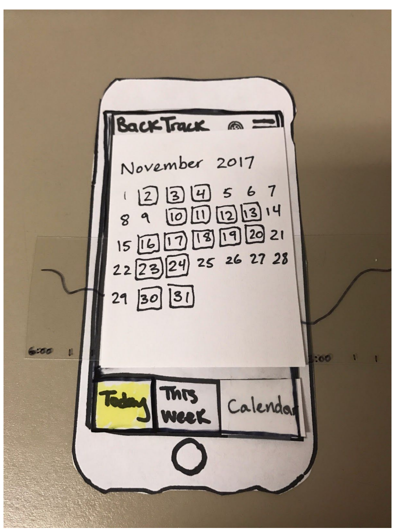
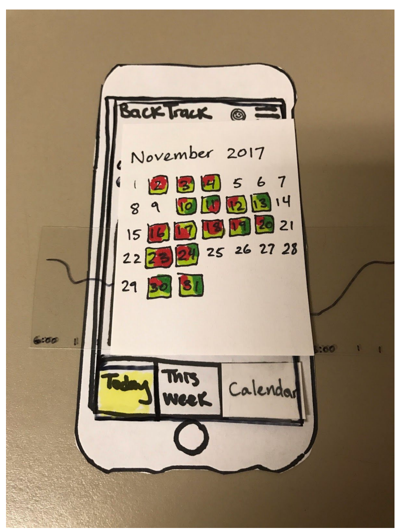
III. Because posture we chose as a target the design solve is unconsciously made, it is difficult to design the task. Therefore, we let the participant to try to be good posture, bad posture and experience checking the record of the posture using application. We haven't changed overall tasks used in the usability tests.

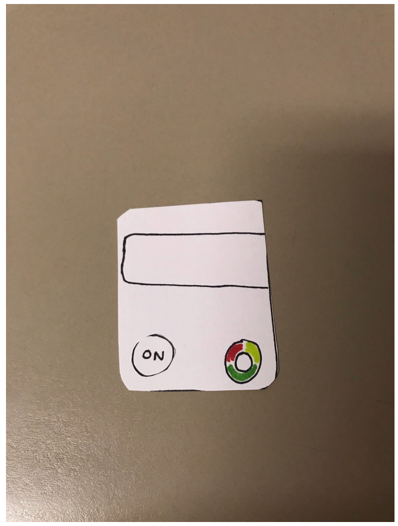
IV. We could've used more iterations on our design, but were limited for time. We decided to move on to usability testing after only 3 heuristic evaluations. Having at least twice that would've enabled us to feel more confident about our design before beginning usability testing, at which point it was clear that we hadn't considered a few key components of the design (would the wristband squeeze with a proportional strength to the user's deviation from good posture? Does "sensitivity" mean overall wristband squeeze strength or back sensor sensitivity?)

Appendix

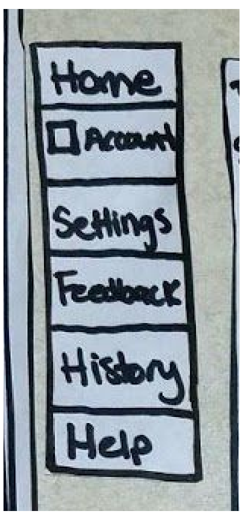
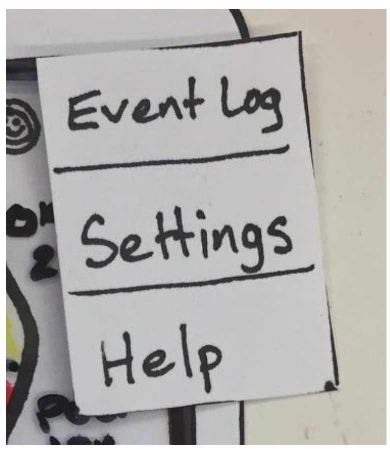
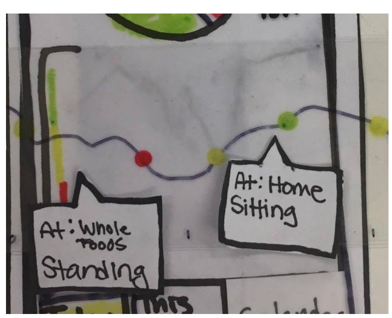
Usability Test:

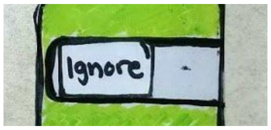
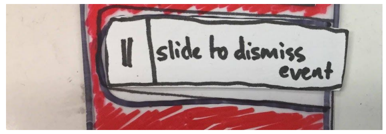
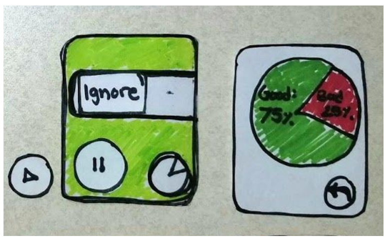
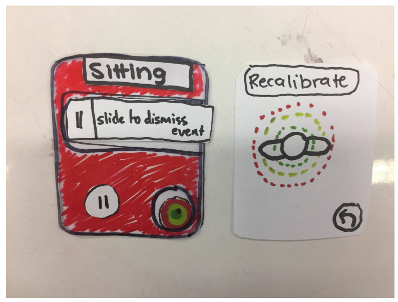
Usability Testing 2:

<table>
<tr><th>Before</th><th>After</th><th>Incidents</th></tr>
<tr><td>
</td><td>
</td><td>Add Home button to menu
At the usability testing, participants couldn’t go back to home (the screen with today’s record) from settings and event log. To solve this problem, we added home button to menu.</td></tr>
<tr><td>
</td><td>
</td><td>Add color to calendar
This revision enables user to see the overall changes and tendency among the month from the color.</td></tr>
</table>

<table>
<tr>
<td>
</td>
<td>
</td>
<td>Change the screen color when the record is stopped
The color had stayed the same with the one just before stopping record. It was strange if the posture was bad and the watch still showed good posture when the record was stopped. This improvement solve this conflict.</td>
</tr>
</table>

Usability Testing 3:

<table>
<tr>
<th>Before</th>
<th>After</th>
<th>Incidents</th>
</tr>
<tr>
<td>
</td>
<td>
</td>
<td>Delete Home button in the menu and add home button icon at the top
In the previous design, user need to push the menu button for many times to go back to home. This enables user to easily go back to home screen.</td>
</tr>
<tr>
<td>
</td>
<td>
</td>
<td>Add nodes to the record graph
During the observation, we found that many users didn't aware that they could see the detail by clicking the graph. These nodes can be an affordance for clicking to see detail.</td>
</tr>
</table>

		**Change the design of dismiss the event on the wearable device** Participant mentioned that the past design of showing stop on the screen was confusing. We changed the design to slider for dismissing the event.
		**Change the graph to current pose** In the previous design, the circle graph was shown at the right bottom. Participant said this made him to feel the home screen on the app was not home screen because the same graph was shown. Also, In the usability study, participant said it was better if this device can tell how the posture was bad. Therefore, we change the design to the figure of people seeing from the top.

Heuristic Evaluation 1

All team members facilitated evaluation; Food Waste team conducted evaluation.

	Relevant Portion of Prototype	Heuristic	Severity	Revision
1	Visualizations on app/watch	4	2	Language on visualizations- “poor” vs. “bad”, pie vs. doughnut charts, different types of navigation (menu vs. tabbed nav)
2	Reporting Feedback	3	3	Wider time frames for reporting- how many does a user want to show up
3	Reporting Feedback	3	2	How to undo reports?
4	Location information	5	4/5?	Too battery intensive?

Heuristic Evaluation 2

Ashley Lindsey facilitated evaluation; local UX professional conducted evaluation.

	Relevant Portion of Prototype	**Heuristic**	**Severity**	**Revision**
1	Visualizations on app/watch	4	2	Can click more information on “today” visualization, but not on week or month, or on watch
2	Data visualizations	4	2	The granularity of the line chart (continuous) doesn’t match the bar charts (discrete, 3 categories)
3	Ignore Button	3	3	Unclear if user ignores how long it ignores it for
4	Ignore button	3	3	Unclear what happens if it is hit by accident, any undo?
5	Sensors	9	4	What kind of error might appear if the sensors can’t properly identify user’s posture
6	Touch targets on watch	5	4	Too many touch targets for size of watch screen
7	Settings	6	2	Settings- especially sensitivity- might be something that gets adjusted a lot, and it’s hidden under the menu
8	Sensitivity	7	2	Some users might want a way to set a different sensitivity for each location/activity
9	Feedback	6	2	Feedback is hidden under menu, which makes it hard to find if it’s something you want users to do frequently

Usability Testing

Test #1

	Relevant Portion of Prototype	Heuristic	Severity	Revision
1	‘Help’ menu item	10	4	Add help screen and documentation
2	‘History’ menu item	4, 8	2	How is this different from ‘home’? Maybe add a calendar screen
3	Line graph	3	1	Make this horiz. scrollable
4	‘Time before notification’ setting	3	1	Need to make dropdown menu with options
5	‘Account’ menu item	8	1	Need to add a screen. Is this just for cloud data saving functionality?
6	‘Report’ option under Feedback	2, 4	2	Does ‘report’ mean reporting an issue to BackTrack HQ? What is being reported? Maybe the button should say ‘calibrate’
7	Posture pie chart	3	0	Tapping it does nothing
8	Feedback learning mechanism	5	4	Need to undo training options… or else the band could learn to never squeeze at all
9	Squeeze intensity	1	2	Do we need to add a squeeze gradient?
10	Wrist screen ‘ignore’ button	2	3	Is this used to train the ML system or to stop tracking?
11	Wrist screen	8	1	This should be much smaller
12	‘Sensitivity’ setting	5	1	Does this setting adjust squeeze strength or posture tracking sensitivity?
13	‘Settings’ -- squeeze duration?	1	1	This should be a setting.