AWARE

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FINAL REPORT

HCDE Senior Capstone Project

University of Washington, Seattle, WA 2015

TEAM MEMBERS

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Julia Chamberlain
Jonas Nocom

SPONSORS

Brian Espinosa, HTC
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1. OUR TEAM

Our team consists of 3 undergraduate seniors from the Human Centered Design & Engineering department at the University of Washington. Our team assembled in February of 2015 and worked collaboratively until June to create AWARE for our senior capstone project. With our expertise ranging from graphic design, ideation, user research, and product design, our team was able to capitalize on our individual strengths and positive group working dynamic. We also worked closely with our sponsor, HTC, and our peers and instructors in HCDE 493. Brian Espinosa of HTC especially helped guide our project by providing insight, inspiration, and valuable design critique at every stage in our process.

Ricky Basconcillo

Ricky's key role throughout the project was focused around design. With extensive knowledge of the user-centered design process and UI design, he was able to contribute to the overall development and design of AWARE. Additionally, his creativity

and background in cinematography helped develop the team's project video and poster.

Julia Chamberlain

Julia focused on turning information from the human-centered design process into practical and creative design decisions. She developed product ideation and 3D prototypes, user research surveys, multiple usability testing protocols, and research grounding the product's functionality to current medical technology.

Jonas Nocom

Jonas contributed throughout the entire process of the project. He is well balanced in terms of design and research and his primary role was conducting user research and usability testing. Based on his knowledge and experience of user research, he had the role of lead usability tester and conducted numerous user research and usability testing sessions that gathered valuable information for the development of AWARE.

2. EXECUTIVE SUMMARY

Design problem

Our team of three undergraduate HCDE students assembled under the common goal of applying wearable technology into new domains of integration with the body. This goal attracted the interest of our sponsor, HTC, who further challenged us to make a useful, simple wearable that was not for exercise. Under the guidance of our sponsors and peers, we chose to address the following design problem:

How can wearable technology benefit people who experience fatigue and a lack of energy throughout an average day?

We chose this topic because according to our research and our survey results, many people experience regular problems with daytime tiredness, people who experience fatigue are less safe in potentially dangerous situations such as driving, and a solution to this problem could help the user feel more in control, comfortable, and alert in order to lessen the distressing feeling of fatigue (Rogers). Another significant reason why we chose to create wearable technology for daytime tiredness was that there are few products on the market currently aimed at improving daytime tiredness, and the products that do exist are bulky and recognizable, making them poor candidates to wear in a professional environment.

Human-centered process

We applied a user-centered design process to this challenge by getting user input before starting the prototyping process, performing usability testing early and often, and constantly improving upon past 2D and 3D prototypes based on user input and contextual research. Through sketches, wireframes, mockups, and low, medium, and high fidelity 3D prototypes and renderings, we arrived at a well-researched refined design solution called AWARE.

Design solution

AWARE is a small wearable clip designed to attach to any wristband that can sense when the wearer is falling asleep and wake them up. The user can adjust a variety of settings for notifications and sensitivity and get access to information about their wakefulness patterns within an accompanying smartphone application. In addition to directly waking the user through vibration and sound, AWARE can notify the user of tips for staying awake naturally based on their body's tiredness patterns.

3. PROCESS

Product review

In the beginning of the design process, we created a survey to gauge the prevalence of our problem, looked at related products, and gathered ideas for our first prototype. The four products that we reviewed addressed the problem of daytime tiredness but most were unsuccessful in the market. All of the products were very noticeable and/or bulky, three were worn on the face in prominent locations, two of the products were only for specific situations, and only one gave the user healthy recommendations. Our review mostly served as a “what not to do” and a source of ideas to ask in our survey, specifically about wearable locations on the body.

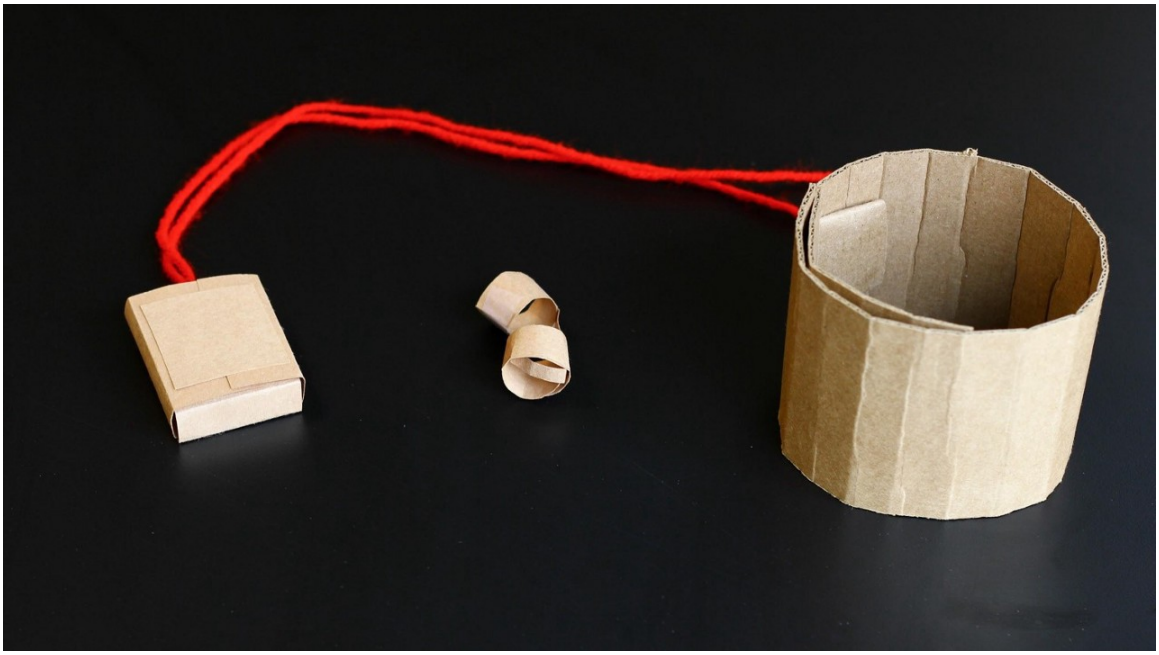
User research survey

We created a ten-question online survey to better understand the problem of daytime tiredness and its effects on our potential users, and also to gauge interest in a wearable solution. 75 people responded to the survey and our respondents fit well within our target population of sleep-deprived students and professionals. The survey results drove design by showing us that many people would likely use the wearable every day for extended periods of time therefore it would need to be comfortable and easy to clean, and also that people most preferred wearables for the wrist and also preferred concealed wearables and least preferred headbands.

Low-fidelity 3D prototype

Based on the information we gathered from our product review and the results from our survey, we started designing AWARE. Our low-fidelity prototypes emerged from group whiteboard brainstorming sessions, product ideation, and sketches. Made out of paper, tape, and string, the purpose of these prototypes were to bring our ideas and sketches to life, try out the 3D forms most preferred

in the survey, and get early feedback from potential users. The three prototype forms we tested were a ring, a necklace or adhesive patch, and an armband or wristband.



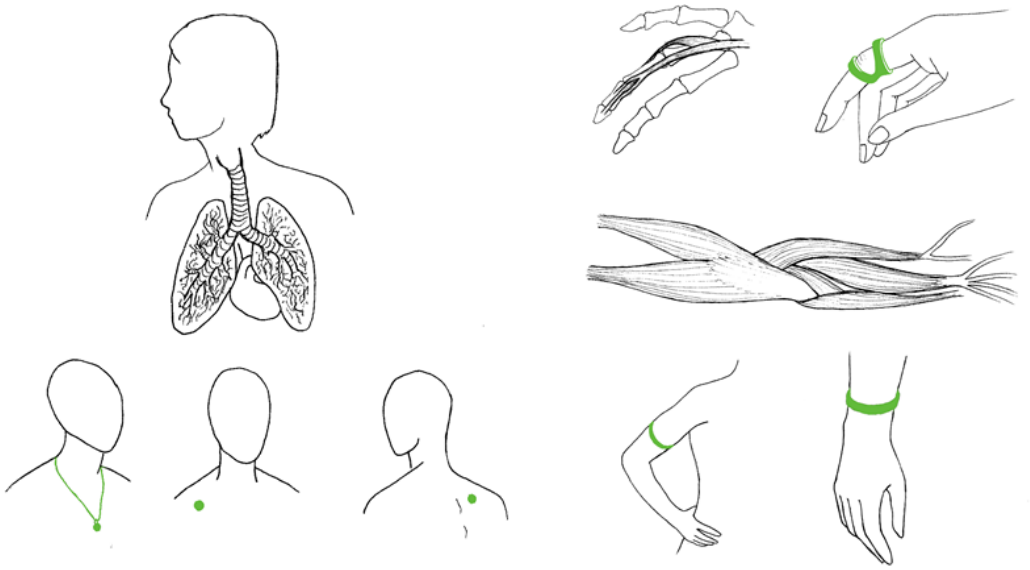
Guerrilla usability testing

We conducted four 15-minute guerrilla style usability tests of our 3D low-fidelity prototypes. The key takeaways from early testing were that armbands and wristbands were the most preferred form, bulk was a major problem with our wide armband prototype, and that participants were very concerned about how noticeable the device would be and if they could wear it under clothing.



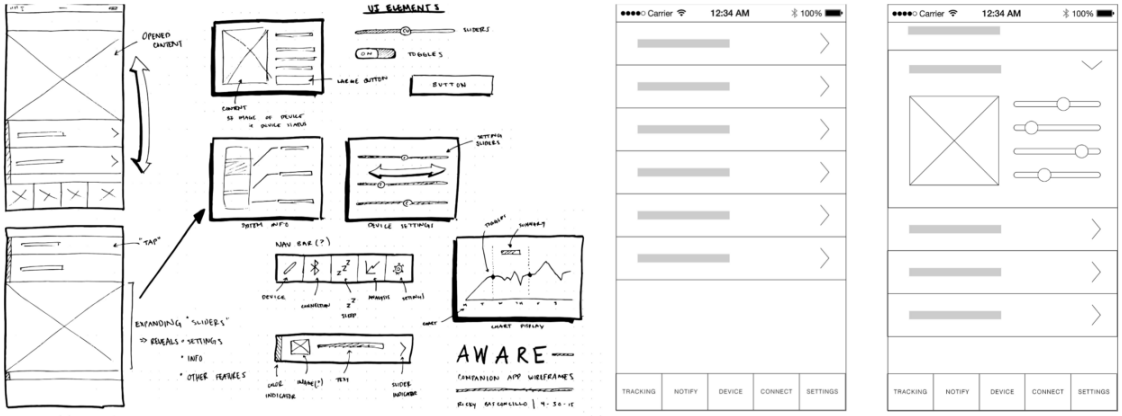
Physiology research

Before making our medium-fidelity prototypes, we performed research on the physiological changes of the human body as it falls asleep. Many sensors that the medical community uses to conduct sleep studies is bodily intrusive, bulky, and/or noticeable. Also, many medical sensors are only good at detecting the changes between non-REM and REM sleep. The sensor technology we chose was tailored to the boundary between awake and asleep and was as unobtrusive and discreet as possible.



Med-fi 3D prototype and application

Our medium-fidelity prototype is a small clip made of modeling clay that attaches to a velcro wristband. In our medium-fidelity prototype, we shrunk the size of the wearable by deciding to create an accompanying smartphone application where the user could customize the device and view information, this addressed the size concerns from our users and kept the device itself from getting too cluttered. A toggle switch was added to the side of the clip to enable the user to be able to quickly deactivate the device because our peers reminded us that people would take off the device if it was perceived as too annoying, and later we also allowed the user to control sensitivity for this reason.



Usability testing

We performed usability testing on the medium fidelity prototype and app screens by employing the “Wizard of Oz” technique where though the current prototype is not functional on its own, normal use is simulated with the help of other systems, such as a phone worn on an armband vibrating to simulate an alert. After asking background questions, testing multiple different scenarios and states of the wearable and app, we arrived at a few key points that drove further design. Users felt comfortable with the clip form and small size of the wearable, users continued to place high importance on a discreet design and preferred vibration to sound for this reason, and while they could guess that the toggle represented an on/off or mode change, they didn’t know why or what the states were.

4. CONTEXTS OF USE

Primary context of use

To keep the wearer awake in important situations. This group of users includes drivers, office professionals and students, and medical professionals as we found in our survey.

Secondary context of use

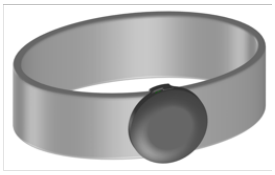
To build healthy habits that naturally keep the wearer awake in everyday situations. Eventually, the user may grow annoyed by being alerted, yet still want to be kept awake by the system. Our sponsor also pointed out that most sleep wearables only tell their users to get more sleep, and that our competitors fall short when it comes to providing actionable data that can be implemented immediately.

Tertiary context of use

To track data on your wakefulness levels throughout the day and night. We chose this context because this functionality is already available in our technology, and also letting the user put the device in sleep mode will allow the user to continue wearing the device as long as they like.

5. DESIGN SPECIFICATION

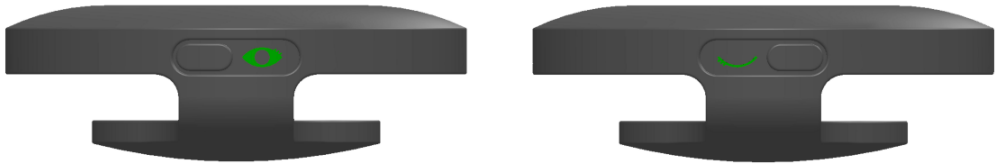
AWARE is a design solution encompassing a wearable device and accompanying smartphone application. Overall, AWARE puts the user in control of their own wakefulness in a seamless, customized way, the functionality has the potential to save lives and encourage healthy habits, and this design could revolutionize how the wearable tech industry detects the user's state of alertness.



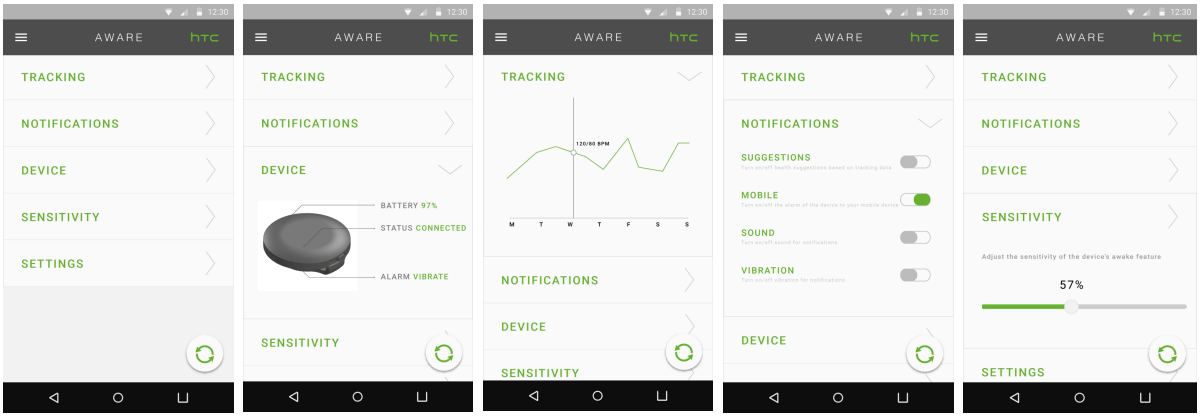
Wearable device

The wearable device is a small clip designed to be attached to a wristband and worn against the inside of the wrist. We chose a small clip design for its versatility and concealment. The clip can be attached to any wristband, bracelet, watchband, or even the strap of another wearable. In a professional context of use, wearing a large or noticeable wearable for daytime tiredness may give the wearer a bad reputation for being sleepy on the job, but not with our discreet design. The top of the clip contains a toggle switch between awake mode and sleep mode and the domed bottom of the clip contains multiple sensors that come into contact with the wearer's skin. It's made out of comfortable medical-

grade material because we determined from our survey that many of our potential users might wear it all day for multiple days per week.



Application



The application contains all of the settings and information about the device in a clear, understated user interface. The major sections of the app are Tracking, Notifications, Device, and Sensitivity.

The user can see their body's patterns of daytime tiredness when they're awake and their sleep data as well.

The user can specify how they want to be awoken and if they would like to be notified of wakefulness tips based on their body's daytime tiredness patterns.

The app provides information about the device's battery life, the connection across the device and the phone, and what mode the device is currently set to.

The user can adjust the sensitivity of the device to their preferences and their body, meaning a user can make it more sensitive in a potentially dangerous situation or less sensitive if the device is alerting them too often.

Features

AWARE has the capability to...

1. **Sense when you're falling asleep and wake you up.** This happens when the device is toggled into awake mode.
2. **Wake you up either through vibration and/or sound, on the device and/or your phone.** These settings can be found within the Notifications part of the app.
3. **Track your wakefulness throughout the day and your sleep at night.** Unlike other sleep tracking wearables, AWARE is tailored to detect the boundary between being awake and asleep, not just the difference between your regular sleep and REM sleep.
4. **Track your body's sleep patterns without waking you up.** This happens when the device is toggled into sleep mode. Sleep mode means that the device will cease to alert you as you rest and still keep track of the same wakefulness data the app measures in the daytime.
5. **Track your body's sleep patterns without waking you up.** Imagine getting sleepy every afternoon at 3. AWARE would be able to detect that pattern and suggest you take a walk at 2:30, pre-empting the sleepiness before it takes hold, waking you up without an alert, and building healthy habits to stay awake naturally.
6. **Track your body's sleep patterns without waking you up.** Imagine driving a car late at night when you're feeling tired. You can increase the sensitivity of AWARE to avoid feeling even slightly tired behind the wheel.

How it works

The device is worn attached to a wristband and located on the inside of the wrist. A combination of three sensors detect the signs that your body is about to fall asleep, such as a rapid drop in body temperature, major decreases across the cardiovascular and respiratory systems, and a lack of motion. The vein present

under the wrist ensures a medical-grade reading on your awakeness from a photoplethysmography (PPG) sensor that measures heart and breathing activity. This location is also naturally discreet and easy to hide under a shirt sleeve.

6. REFLECTION

Opportunities for improvement

There are few aspects of our process that we would do slightly differently in the future. We would have liked to have more time dedicated to conducting usability testing and refining our design based on research findings. Having more time to spend on recruiting and testing participants would have allowed us to gather more detailed data that could focus our design further, also research insights would be more supported through additional testing. Furthermore, we would like to develop a higher-fidelity prototype of our wearable using digital fabrication and a prototype kit such as an Arduino. We would then be able to conduct our testing in a real, not simulated, environment with a working prototype. In addition, the 3D model would be as close to our final design as possible so we could more accurately test the form factor and ergonomics of the device on users. Overall, increased access to users and fully-functional prototyping would allow our design to be even more focused and refined.

The future of AWARE

Since discreetness is important to our users, the ultimate application of this project would be integrating it inside of the band or strap of all wearables for the wrist. Being able to implement our design within any wearable would be an easy method for getting this product into the hands of more users. We hope in the

future we can possibly create a network of systems in which our device can be implemented. We also see the potential for our product to be adapted to the transportation field. For example, automobile drivers, train conductors, or ship captains could have have the device connected to their mode of transport. When the user begins to fall asleep, the wearable would detect that change in status and alert the user in addition to the wearable waking them up, and it could also possibly affect the vehicle itself, either by slowing down or stopping completely. There is a wide market for having a safety net for sleep-related accidents, transportation is just the beginning, many other fields such as medicine, construction, or monitoring systems like air traffic control could also benefit from this design solution.

Our strengths

A big strength of our project was our extensive research on sleep that helped guide our design decisions. Determining the changes that occur when users begin to fall asleep helped our team understand where to focus our design. Another strength of our team was how well-balanced we were collectively and how we complemented each other's strengths and weaknesses. Though we all had a working foundation in every part of the user-centered design process, each team member had a special focus in either design, research, or testing. This made our work well-rounded throughout the entire design process. Lastly, one of our greatest strengths that drove our project forward was our ability to gather user input early and often. We were even able to obtain user feedback prior to the ideation phase of development in the form of our survey. Having users be involved in our design process as early as possible enabled our team to truly let the user drive our end goals.

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