Guardian

COS 436: Human-Computer Interface Technology
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GP2 - User Research Results and Design Alternatives - November 16, 2017

Project Description

Every day millions of people commute to work or head outside for a run. But they don't feel safe. Guardian changes that. The goal of Guardian is to understand the perceptions of safety for pedestrians in an outdoor environment and design a system to increase feelings of safety. Personal security for people in an outdoor environment is an issue that many have attempted to solve over time. There are infrastructures, such as the police department or "blue light" system, or products, such as alert mobile apps, that attempt to improve security for people, but these are not foolproof. Slow response times and product functionality barriers prevent pedestrians and runners from feeling safe. Thus in order to develop an effective product, Guardian seeks to understand behaviors in all outdoor environments ranging from running to hiking to buying coffee on the way to work to walking home at night. Through user research, personal safety and traffic safety were identified as two major causes of concern for users. Guardian will focus on personal safety and capabilities of the system will include a discrete way for users to alert loved ones and the authorities in case of emergency, as well as tasks such as GPS tracking, discrete alert functionality, alerting multiple people, and a warning "false-alarm" that sends out an alert if the user doesn't turn off the function before a certain amount of time.

Requirements Summary

Our system has several requirements that are necessary for it to be functional for our users and problem space. First, people need to be able to access it quickly. The situations that our system will be designed to handle will be fast-moving scenarios that won't leave a lot of time to work with a system. Our system also needs to be able to be accessed under duress, ideally without requiring users to perform any high cognitive tasks. Again the problem space that our system is operating in could potentially be very threatening and alarming, so we need to make sure that users can use our system under these conditions. On that same note, our system needs to be able to be accessed discreetly to protect the safety of our users. Furthermore the system needs to be able to operate in an outdoor environment, where many factors such as weather, lighting, and noise can vary. Our users will frequently be outside with our system and we need to make sure it's equipped to handle any such condition. Another key requirement is that our system needs to be mobile, where it can be carried while users are commuting, exercising, or engaging in other variable activities. Similarly, our system will need to be able to be used for long periods of time as our users could be at work for eight or nine hours between commutes or could go outside to exercise for a few hours. Therefore we need to make sure that our system can handle being away from electricity for long periods of time.

User Research Summary

We collected data from 42 users on their perception of safety and their coping mechanisms during their daily activities. Our surveyed users are all between the ages of 18-25, 79.5% are female, and 85.7% live in Princeton. While around 25% of our users always or mostly feel safe during their daily activities, the rest of our users regularly or semi-regularly feel unsafe. More than 25% of respondents feel unsafe late at night. See Figure 1 for more information.

When we asked about coping mechanisms, 35% of users said they avoid or leave an unsafe situation. Another 20% have no real coping mechanism at all. As one user aptly put it, "Stay alert. Pray." See Figure 2 for more information.

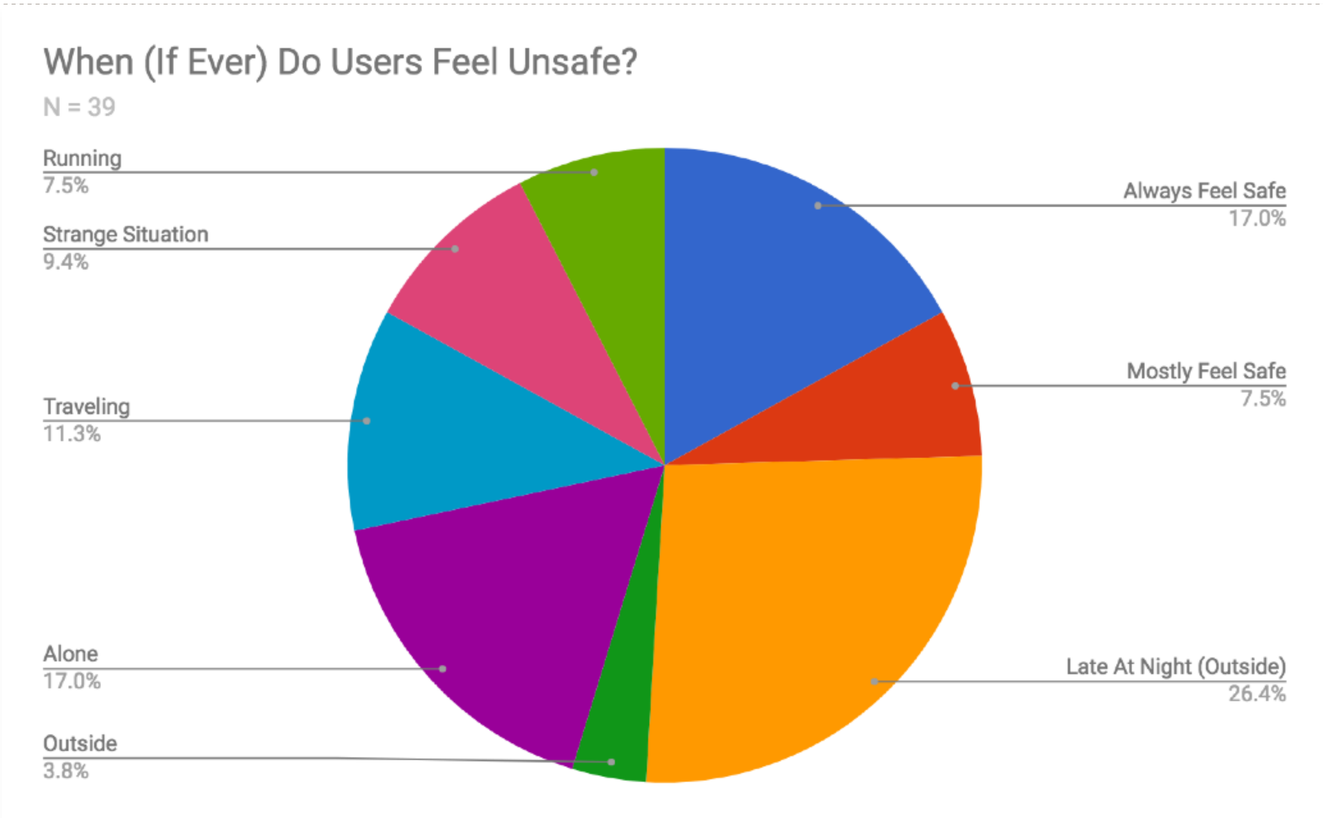

Figure 1: When (If Ever) Do Users Feel Unsafe?

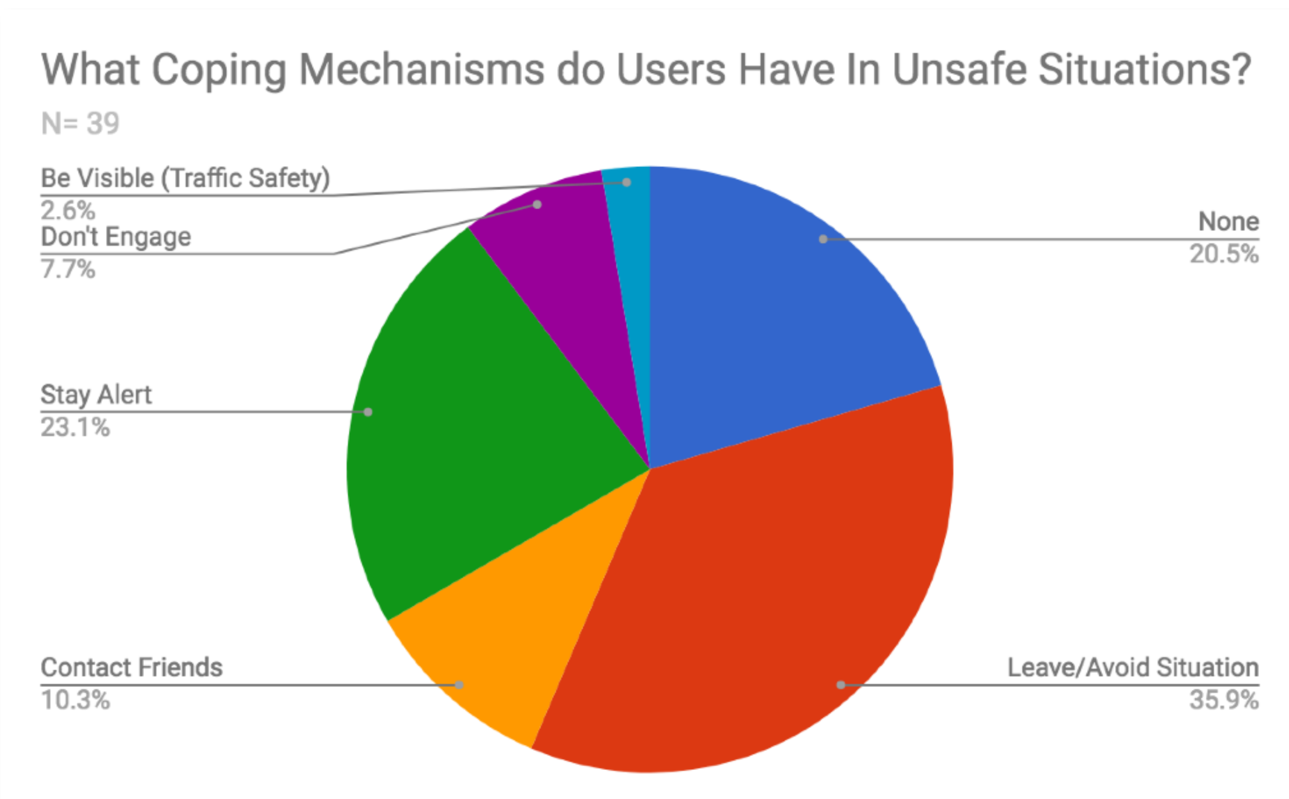

Figure 2: What Coping Mechanisms Do Users Have in Unsafe Situations?

Design Methodology

Our design methodology incorporated formative research methods in order to gather data, towards better understanding our users and user needs. At the very outset we observed runners and joggers around campus and the township of Princeton, in order to better visualize the range of motions undertaken in the task. Observing users also allows researchers to study the unaltered behavior of users that may have otherwise been influenced by the presence of observers. After observing potential adopters in the field, the group engaged in contextual inquiry with users, first asking a standard set of questions and then observing the user in the task of either walking or jogging. In addition to observing, researchers interviewed users while performing tasks in the work environment. The goal of this research method was to better elucidate the needs and pain points that users experience; contextual inquiry gives researchers the ability to collect direct user feedback with as little interference from the interviewer as possible. This also may lead to more realistic responses than the data gathered from non-intrusive observation. Finally, the group sent out surveys to participants in order to learn what is important to users, information regarding their travels, and to elicit user-defined notions and interpretations of safety. Surveys also enabled us to better identify our users and their own definition of safety, and what they look for in a product such as Guardian. Incorporating surveys into our research methods helped us quantify feedback, and understand the distribution of user responses with respect to various factors such as gender and location.

Design Space

Difficult Requirements

Each individual requirement can be fully satisfied at the expense of another requirement. For this reason, the difficulty in designing lies in optimizing requirement satisfaction. For example, it is difficult to both design a solution that has a long battery life while also keeping it portable and relatively small. This is why a small device such as a wearable is better in terms of portability but is lacking on a battery life front and functionality. Another issue is related to durability. Our users will be using our solution in a wide range of environments which means that the design has to be robust enough to withstand most environmental factors. However, designing a holy grail life-proof device would compromise on aesthetics, portability and accessibility. Since all users have a different preference as to what they prefer and value most, it is almost impossible to design the perfect product.

Tradeoffs

We considered allowing SOS messages to be visible to those nearby because of the benefits of them as more people can come to help a person in danger with potentially faster response times. However that function could be used to lure a helper and inflict harm. We questioned whether or not we should sound a loud alarm when SOS message is sent. We decided not to do so to maintain discretion for the user, even though an alarm could work to scare off the assailant.

Easiest Tasks

One of our main focuses is to make the solution easily accessible as that could be the difference between life or death for a user. Current security mobile applications require the user to unlock their phone and to activate the service manually. But this is not possible under an emergency. It is surprising because we noticed that this was the easiest task to accomplish. We had to build-in a threshold of "taps" or "presses" to differentiate between an accidental service activation and an intentional one. But once we agreed on that, activating a system through low cognitive and one-handed tasks was very easy to support.

Hardest Tasks

The hardest tasks included ensuring a high enough connectivity so the user can send an SOS call and making sure the product works well in outdoor environments. Our application does not control the availability of service, and so it was very difficult to come up with ways to circumnavigate that factor. It would be ineffective to have an SOS call that doesn't send because the user is in a dead zone. Likewise, controlling for all outdoor environments including extreme weather is very difficult. However, our product needs to work in all situations and so we plan to come up with ways to protect the reliability of the product.

Changes

After receiving feedback from users as a result of our poster presentation, we recognized the prevalence of traffic safety as a concern that most users experience. As a result, we incorporated traffic safety and situational awareness as potential criteria for us to evaluate our products with. We discussed focusing on both personal safety and traffic safety in all of our final prototypes, but eventually we decided to design different prototypes for each problem. We did this because it covers all possible scenarios in the problem space without having “feature creep” within our own designs. We also thought about including a camera function in the discrete alert that could record surroundings during the event, but in the end we decided to keep our design as simple and light as possible so that it remains discrete.

Design Summary

The design alternatives we considered can be classified into four distinct categories. The first category groups ideas that relate to a map or rely on a cartographic model of key features. The idea behind these designs was to provide users with a resource to easily locate help or find safer ways to run. For example, one solution involved a map of all blue light emergency phones on campus, so that users can stay informed of one avenue in which they can reach assistance when outside. Another alternative provided users with a map of the safer routes on or around campus to run; these routes were determined by factors such as whether they were well lit at night, frequently travelled by others, or regularly patrolled by campus security. These cartographic designs were not pursued because they did not achieve a sense of active security, and are only applicable in scenarios where users are running in areas the map covers. The maps did not allow for the flexibility of running in any location.

The second classification of alternatives aimed to replicate the running experience, whilst removing potential danger to users. One such example was a virtual reality product that allowed users to mimic running outside. This idea, however, was rejected as it robbed users of the potential benefits of running or walking outdoors. At the same time, it would not be possible to implement for users who go outdoors to commute or reach their destination on foot.

The third class of ideas modified existing technologies to provide a list of user-specified contacts with their location at given intervals. One design that falls under this category places a tracker on the user, and updates contacts with the user's location once the user has moved a specific distance (e.g. 15 ft) away from the last reported location. Another design required users to press a button within specified time intervals (i.e. pressing a button every 15 minutes) in order to mark themselves as safe; failure to press the button would result in the product alerting contacts and providing the user's location. These ideas were discarded as they are not active, but rather passive ways for users to feel safe. In addition, a primary concern for this group of designs was that it may trigger more anxiety and place more stress on users, and may ultimately bring more harm than good to the user experience.

Finally, the last group of design ideas focused on non-technology related solutions. An example that falls under this category is equipping users with a substance such as pepper spray, so that they are able to actively defend themselves should they encounter a hostile situation. These ideas were rejected as they did not cover a large portion of scenarios where the users needed a way to communicate with others. Furthermore, while they may provide a way for users to protect themselves from assault, they also give rise to ethical issues and liabilities on behalf of the users.

The reason why we decided to pursue the Guardian App, GuardianGear, and DefenderBot relies on the common advantages that all three designs bring to users. Each enables users to communicate with others. Unlike the concept of pepper spray for self-defense situations, a device which enables users to communicate with the outside world becomes invaluable in numerous scenarios, such as when users are injured, trapped, or lost. All three proposed designs also provide users with active means to feel secure; that is, users are in control, and are capable of alerting others of their own accord, whenever they choose to do so - there is no set time interval before the product activates or notifies others. One final advantage these three designs have is that they all allow users to notify others easily and discreetly. They all incorporate designs such that users can operate the system simply and quickly under duress, and can be initiated without drawing further attention to users.

Designs

Guardian App

Description: Guardian app is a software that would allow mobile phone owners to send a distress message to pre-selected emergency contacts (see Figure 3). To maintain discreteness and improve safety for the user, the SOS mechanism is triggered by pressing the power button consecutively. After the appropriate consecutive taps of the power button, video recording and GPS are turned on. First, video recording is accessed so that in an emergency, the user can capture potentially crucial visual and auditory information about the assailant and the environment. Second, GPS functionality is turned on to obtain the exact location of the attack so the rescuers know where to go. This information is sent to pre-selected emergency contacts that can coordinate a rescue plan and direct resources accordingly.

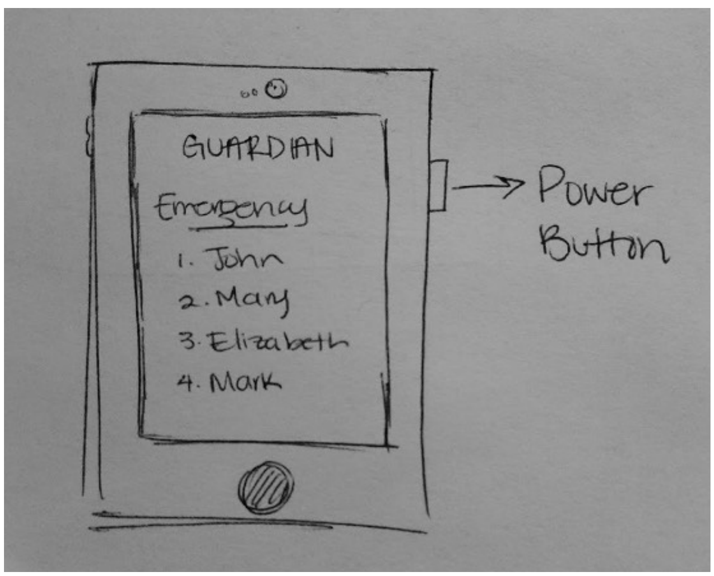

Figure 3: Guardian App

User Scenario: In 2014, Carlesha Freeland-Gaither was abducted in Philadelphia late at night. At the time of her abduction, she was holding her phone in her right hand yet as her arms were tightly constrained by her abductor, she was unable to use her device to ask for help. With Guardian App, Carlesha would have been able to send an SOS message to her emergency contacts using only her right hand by pressing the power button in her phone. As she struggled, she could have strategically angled her phone to capture the face of her assailant to expedite his recognition and capture. In addition, the responders would have known the exact location of abduction. Fortunately, Carlesha was rescued, yet it took hours of sorting through public camera recordings to connect the dots and identify the attacker. Guardian App can help the hundreds of women and men like Carlesha that are assaulted every year.

Design Assessment: Guardian App is easily accessible as it only requires the user to press the home button consecutively a few times. Since access to the app does not require unlocking, it can be done quickly with one hand which is ideal under duress as it does not require the user to perform high cognitive tasks. In addition, because it does not require the user typing or calling for help, it is highly discrete and could potentially allow the user to hide their phone and keep it for GPS tracking. This is a feature that many of our users find valuable since calling or texting is highly problematic in an emergency situation. Unfortunately, because the app runs on a mobile device, it is limited by the weaknesses and shortcomings of the device such as battery life, susceptibility to water and high heat, and difficult to carry during workouts or jogs, as many said in our surveys.

GuardianGear

Description: Guardian gear combines the software of the Guardian app with the small size and discreteness of common accessories (see Figure 4). GuardianGear functions as a panic button disguised as wearables that, when pressed, will act according to the predetermined configurations selected by the user. Pressing the wearable is the equivalent of pressing the power button in the Guardian app. Figure 5 shows a few of the designs that are available to the user.

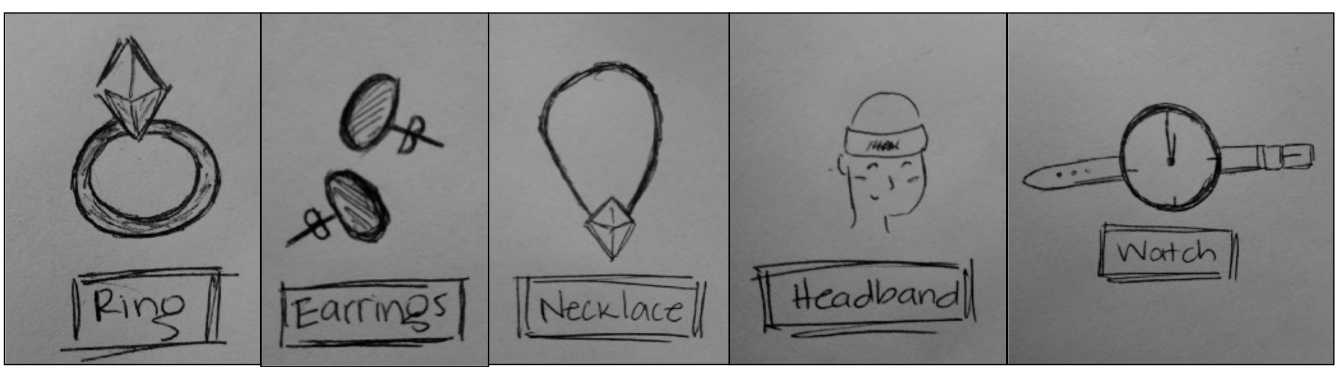

Figure 4: Diverse Designs for GuardianGear

User Scenario: Lily is out on a typical night run through her favorite route. As usual, she is only wearing her smartwatch, which is also a GuardianGear, to keep track of her progress. Suddenly, she realizes two dark figures seem to be following her but she is not sure. She moves her left arm, the one with her watch, towards her body and taps it against her leg multiple times consecutively. This triggers one of her SOS environments connected to her GuardianGear to activate and send an alert message to her predetermined emergency contacts. This particular environment she created is specific for her runs and warns her contacts of potential danger she might be in. Her configuration gives her approximately 15 minutes after the SOS message is sent to get back to her phone and inform her contacts that the danger has passed. If she does not get in touch within the timeframe, her contacts will know to contact the authorities for help.

Design Assessment: GuardianGear is highly portable and hands-free, crucial for many of our users that do not have immediate access to their mobile phones at all times, making the activation of the SOS system quite simple as it only requires consecutive taps to the gear. Most of the runners that replied to our survey mentioned that they only carry their a wearable fitness tracker or watch. Enabling GuardianGear can be done quickly, discretely and without performing high cognitive tasks or needing both hands. Unfortunately, because size is a constraint, it has less functionality and accuracy than an app running on mobile phone. For example, you can only send SOS messages which means you can't call your emergency contacts to update them on your safety status. In addition, while it is portable and disguisable, it is susceptible to high pressures of water and can break if enough force is exerted on it. Battery life is also shorter.

DefenderBot Class

Description: These designs were created to address the issue of "traffic safety" for runners and pedestrians. When we interviewed some of our respondents we realized that a consistent threat to pedestrians was traffic. On that note, we designed two classes of personal robots (DefenderBots) that could move with the user and alert them to oncoming traffic. The first robot is "TRAF-K" (pronounced "traffic"): this robot runs in front of the user on the path. It halts at intersections and emits a variety of noises if it senses oncoming traffic. It also has a headlight that lets runners/pedestrians maneuver in the dark. The second robot is "CPT-R" (pronounced "copter"). It flies over the user and provides a spotlight on the user. It makes noises and changes the spotlight to red if the user is approaching oncoming traffic. See Figures 5 and 6 for a more detailed view.

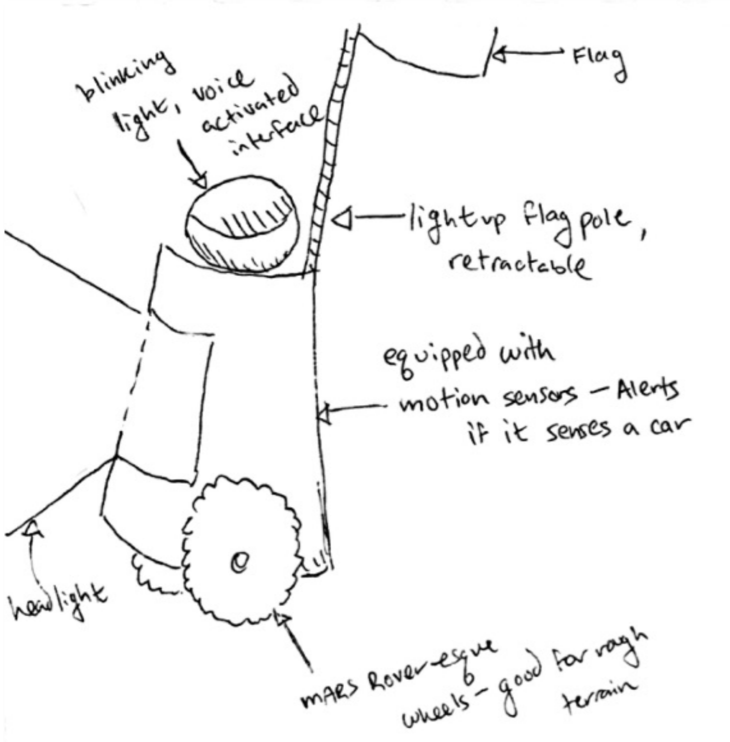

Figure 5: TRAF-K (DefenderBot Terrain Class)

User Scenario: Jerry Wei is running with a TRF-K DefenderBot. It is night, and Jerry is thinking about his HCI assignment and not paying attention to the road ahead of him. The TRF-K DefenderBot suddenly stops, flashes red from its helmet light, and beeps insistently at Jerry. Jerry halts and realizes he was about to run into oncoming traffic! "Thanks DefenderBot!" Jerry says, and waits for the signal to turn green. As he continues his run, Jerry runs a little faster. The DefenderBot recognizes his movement and speeds up to keep pace with him. As Jerry turns onto a trail, the DefenderBot follows. It is able to easily maneuver on muddy terrain with its Mars Rover class wheels.

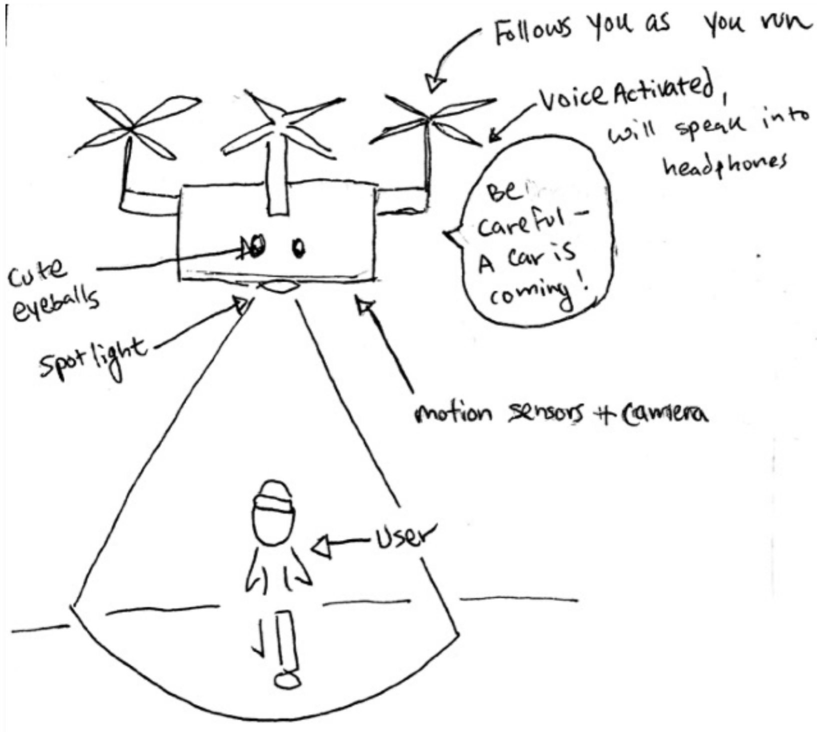

Figure 6: CPT-R (DefenderBot Aerial Class)

Design Assessment: The main advantage of this design is the WALL-E nostalgia it provokes. Instead of making our robots discrete, we make them loud and proud-- almost like pets. Of course, it also achieves the traffic safety related tasks: it provides lighting in unclear conditions, it is able to navigate rough terrain (either by having very sturdy wheels or by being aerial), it senses motion and alerts the user to oncoming traffic through multiple methods including lights, sound, and physical motion in the user's field of view. The disadvantage is that making a marketable and reliable DefenderBot would have significantly higher cost-to-entry than any of the other designs. Some users we talked to in focus interviews agreed. One user thought that the COPT-R design was somewhat intrusive and distracting. DefenderBot would need to go through intensive R&D before it could be ready for market. This makes it less practical going forward in the design process- we will likely put aside this idea in favor of more feasible prototypes.