SynthSense

Team

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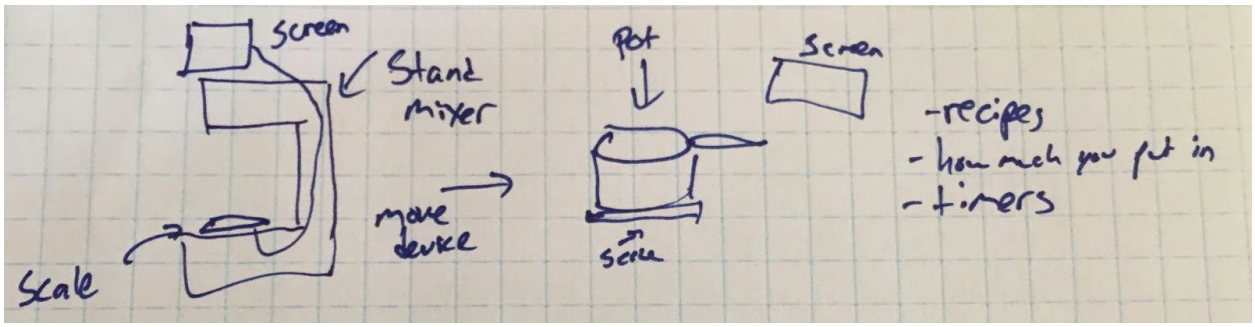
Ideas

1) Autiteach: Emotion translator for kids with Autism. Use Machine Vision to recognize facial expressions and superimpose description of emotion on real-time video on phone/tablet. Although autistic people are not able to inherently understand emotions, they can still learn to recognize what each means and how to respond to them.
2) MuscleIOT: Control the environment around you with remaining muscle control for paraplegics.
3) Pseudo-Mechanical Bots that overlay on existing controls, and trigger input devices in your home (light switches, curtains, outlets).
4) HighLife: Wearable camera that is triggered at predetermined times/high heart rates to capture peak moments of your life(for example, in dangerous situations/ for old people with heart conditions).
5) Travis: power plugs that monitors power usage and upload to an online dashboard which user can control power outputs and machine learning can be done on the data to minimize daily power consumption
6) Trashbot: smart trash cans that sorts and recycle garbage so you need multiple trash cans for different kind of trash.

7) Meditaid: Haptic feedback to aid in breathing control for meditation practice. The faster the heart rate & breathing rate, the higher the pulsing frequency. As the user enters the meditative state, the frequency and strength of vibrations is reduced.
8) Lucifer: haptic lucid dreaming tapper that taps your palm throughout the day in a timely manner. When user is in dreaming state, the lack of feedback provides a gateway to recognizing they are lucid dreaming.
9) Katara: Shower heads/ sink add-ons that track water temperature and water usage. Automatically adjusts water temperature and notify you when you use too much water.
10) Navi: A navigation dashboard with HUD display that integrates hand gestures and voice inputs(e.g. share your location with your friends without calling them or texting them while driving) that allows the for a safer driving experience.
11) VirtualKeyboard: Using Oculus VR and leapmotion/3Dcamera, we can project a keyboard on any surface and do some simple pose-tracking of fingers to simulate a keyboard to write onto an offline machine
12) ShotTime: A motion based timer for tracking curling shot time, to accurately gauge where a rock will end up or how much sweeping is required. It can report the times and motion data to an app that you could review at a later time to help improve your game.
13) Breathless: An adjustable sized container lid that when activated, will remove all air from a container (via vacuum) to keep food fresh for longer periods of time.
14) ScrewedUp: A remote controlled robotic screwdriver that can get into awkwardly tight/hard to reach places, controlled by iPhone to allow simple fixes that were otherwise difficult.
15) Auto[Computer]Desk: Augment a standard desk so that it can rotate to avoid bright light coming from the sun to avoid glare and unnecessary strain on someone’s eyes.

16) Self Moving Furniture: Computer controlled motors that wheel furniture around, allowing you to rearrange a room, without any effort, with a tablet. Perfect for a classroom setting where the teacher has to assign project groups or arrange a seating change.
17) Kitchen Augmentation: A device that can be used with multiple kitchen appliances to provide useful information to someone while they are cooking. It could include a scale in a heat-resistant package and a screen that can show recipes, and tell you when you have added enough of an ingredient, according to the recipe.



18) PillPauper: A container that holds medicine, daily supplements and dispense appropriate amount of medication configured by health professionals.
19) Light measurement - [related to research] combines IR and visible spectrum cameras, with a spectrometer, light meter, and IMU in an integrated package that is able to determine how much energy a given light fixture is consuming.
20) SynthSense (described in more detail later)

Idea Selection

We chose to develop SynthSense because it has the potential to have a very meaningful impact in the lives of the visually impaired. Moreover, human augmentation is a fascinating field. We want to push the limits of our neuroplasticity. Finally, our skillset gives us a high probability of success on this particular project. We have experience on machine vision, software engineering for scientific computing, HCI, cognitive neuroscience, embedded systems, and rapid prototyping.

Project Description

Target User Group

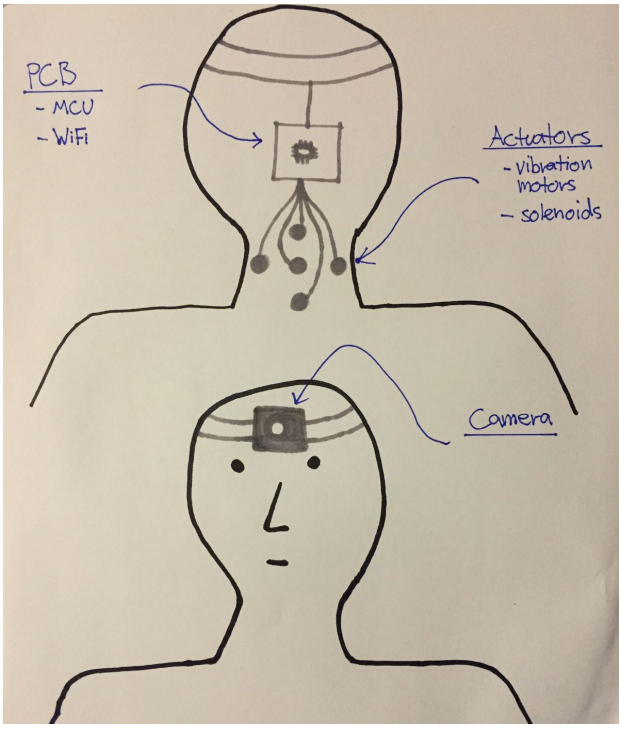
People with heavy visual impairment and blind people. This target user group usually has a hard time avoiding obstacles without assistive canes/ or guide dogs. Even with the help, blind people can still run into objects such as low-hanging tree branches or slip on objects such as socks, banana peels, etc. Moreover, they usually have to keep a memory map of the surroundings. They need an alternate feedback system that provides a more direct, comprehensive, on-the-go information about the surroundings. This system can be used to reassure blind people when they navigate and try to make sense of the environments.

Problem Description & Context

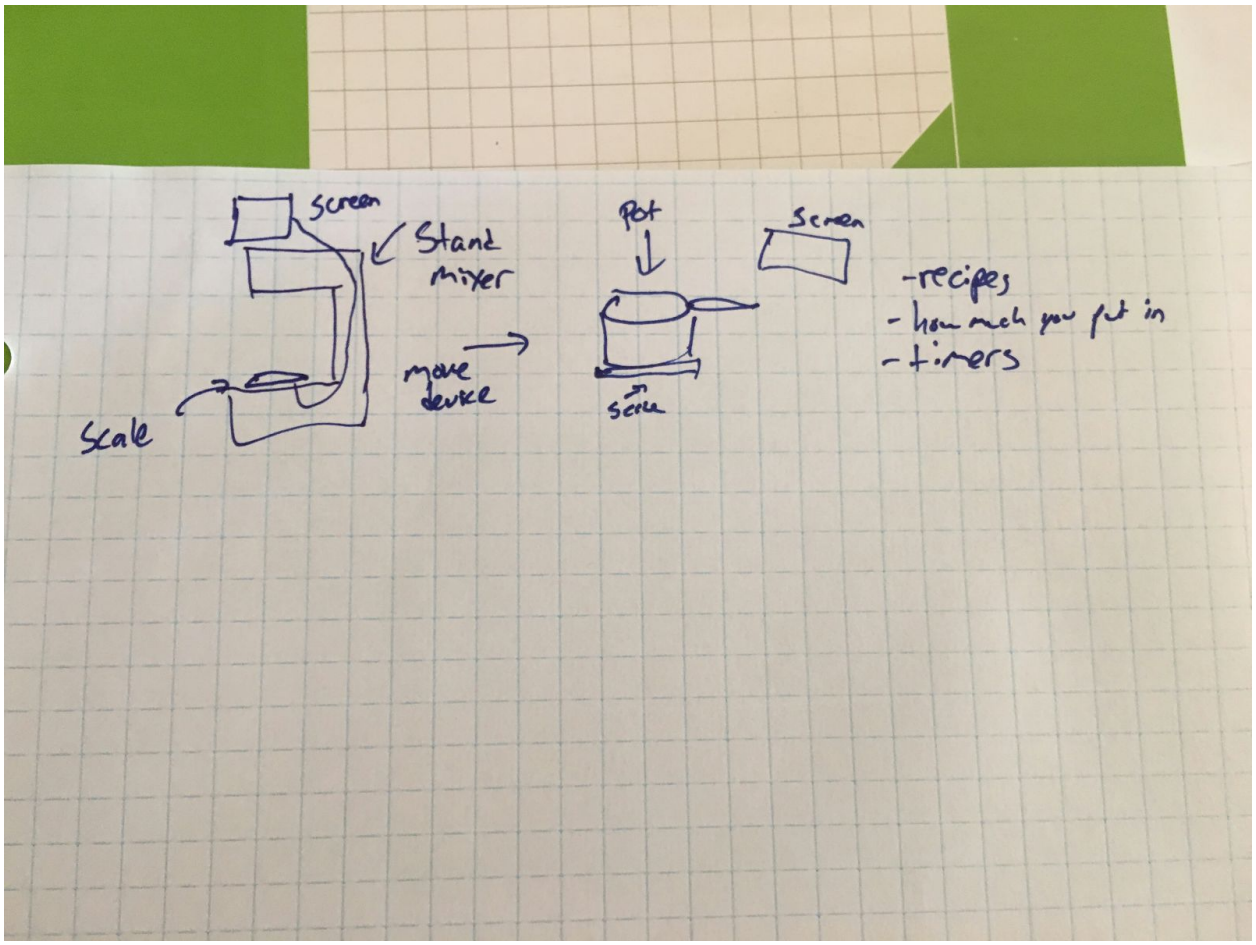
We're tackling the problem of navigation for the visually impaired. In situations where there is a lot of extra noise, our target user group can no longer rely on auditory feedback as the only source of obstacle detections. In a crowded place especially, it becomes increasingly difficult to rely on tactile and auditory feedback. Related and complementary solutions such as white canes or guide dogs do exists. Although they alleviate the problem, they do not give a direct feedback to the user and also have respective shortcomings. Using a white cane can only detect things on the ground level and it's inconvenient to bring a guide dog around everywhere.

Why an Interactive Device?

We want to translate visual feedback from cameras to tactile feedback for the visually impaired. We can redirect their sense by utilizing cross-modal neuroplasticity. That is, replacing their visual stream of spatial information with the sense of touch. We can achieve this by having a depth-camera that runs visual processing to locate obstacles and alerts the blind user by tapping the corresponding directions on his or her neck. An interactive device is a good solution for this problem because our target user group naturally lacks the much needed interaction to make sense of their surroundings. An interactive device will deliver a direct and



much more efficient feedback to the user, making them more self-reliant when it comes to walking around.



Open Technical Questions

The current idea we have for the implementing SynthSense involves a depth camera and actuators placed around a user's neck. We need to see if it is possible to get a depth camera that works with an embedded platform, or if not if we need to implement one ourselves using stereo cameras. Again, we need to see if we have enough computing power to do this.

Tactile Plasticity

- What areas of the body have demonstrated the most potential for increasing their tactile acuity? How much can they change?
- Have some areas shown to have higher neuroplasticity rate? For these areas, which one is the most sensitive?
- Finally, has the precision of the devices tested so far exceeded the precision of the sensory area? The big picture question we are trying to answer is whether the bottleneck is at the hardware, or at

the sensory acuity of the body itself.

Feedback Delivery

- How much information can we provide without reaching cognitive overload?
- What is the optimal actuation system to provide clear feedback while maintaining comfort for the user?
- Can we find actuators that are cheap/fast/strong enough to give a user sufficient input about the scene?