Sixth Sense Ascot: Extending and augmenting senses

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Figure 1: The Sixth Sense Ascot being worn. Photography by the author.

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“Wearable devices take in information that is not easily accessible.. and translate them into patterns of vibrations on the body. With practice, these associations become automatic and a new sense is born.” - NeoSensory

Abstract

The Sixth Sense Ascot (SSA, Figure 1) is a lightweight wearable designed to enhance the wearer’s comfort and awareness when in a crowded space. Many people report discomfort or panic when in tight confines or surrounded by strangers. The SSA features ultrasonic sonar sensors, pointing to an area outside the wearer’s field of vision, and vibration motors nestled beside the wearer’s neck. The vibration motors pulse at a rate which varies according to the sonar sensors’ readings which give the wearer a sense of the physicality of the space behind them which they cannot see. The SSA is a proof of concept of the efficacy of wearables as a means of augmenting the senses of the human body through means as simple and inexpensive as an arduino and vibration motors.

Author Keywords

Sonar; ultrasonic; haptic; wearable; multisensory; prototyping; arduino; fashion; social; .

Introduction

We are at our most comfortable when we feel that we are in control, and we exert what agency we have based on the data our senses can take in.

But what if our senses don't supply us with enough? Many people are uncomfortable in confined quarters, or in crowds, or underground, where their senses are confused and cannot be reliably applied to exerting control over their space.

The Sixth Sense Ascot (SSA) augment's the wearer's senses, granting them eyes in the back of their head, in a manner of speaking. Ultrasonic socar delivers data about the space outside the wearer's vision in the form of haptic feedback via motors nestled next to the wearer's neck. In this way the wearer has more sensory data to apply toward their own safety and control.

Wearable Self-Care

The first iteration of the SSA was conceived of as a support garment intended to ease the panic of an individual expeirencing agoraphobic panic in a crowd setting. It was conceived of as including massaging vibrations, heating pads, and shape-memory alloy causing a compression hug, (Figure 3) inspired by such existing wearables as those made by CalmWear[1], which would work together to approximate the feeling of being hugged, and thus, telegraph safety.

Figure 2: The Sixth Sense Ascot.

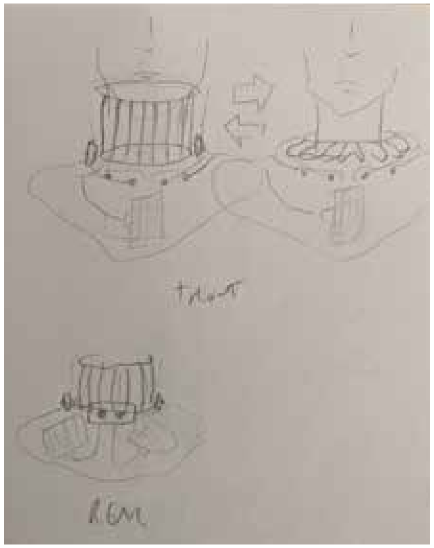

Figure 3: Early sketches of the “Wearable Hug” which would become the SSA

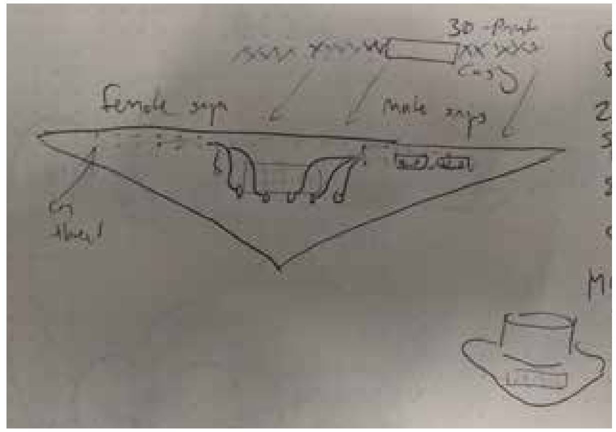

Figure 4: Sketch of the wearable with the “hug” features removed.

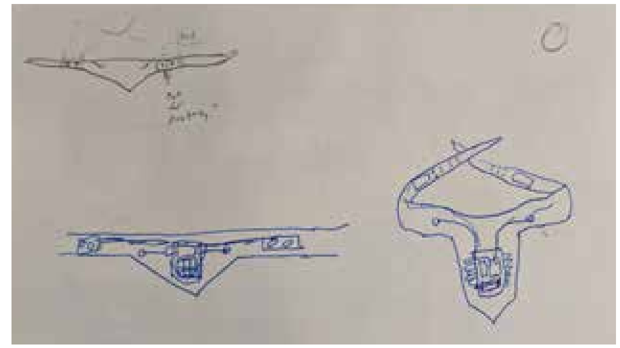

Figure 5: Final refined sketch of the SSA. There only one set of vibration motors, down from three.

Exploration

User research interviews with people who suffer from fear of crowds conducted by the author caused the project to be reconsidered. Rather than focus on a wearable that tried to treat panic, the SSA was conceived as a wearable that could empower a wearer and help them feel informed about their surroundings, and thus safer, and thus prevent or at least help to mitigate panic attacks.

The “hug” angle was removed, as some of its components (such as heat and enclosure) could exacerbate symptoms of panic rather than treat them. On the advice of Kate Hartman and Lee Jones, the number of features and actuators were limited to a single set (Figures 4 and 5).

A shawl or ascot shape was decided upon in order to keep weight distributed comfortably as well as help the wearable be subtle when worn, tucked into a shirt or jacket.

Initial concept of the haptic sonar build (Figure 4) had six vibration motors, intended to provide a multiple-degree field of feedback. After some testing, extra vibration motors were removed. Single vibration motors were decided to be strong enough to be felt, but subtle enough as to not be distracting, and a wide field of feedback was considered too difficult to program using the materials available and the time constraints.

Thus the final wearable and features would be a slim neck-hanging device utilizing two ultrasonic sonar sensors that return pulses of haptic feedback to indicate the the wearer the proximity of things outside their field of vision.

Figure 6: The Sunu and its tracker peripheral.

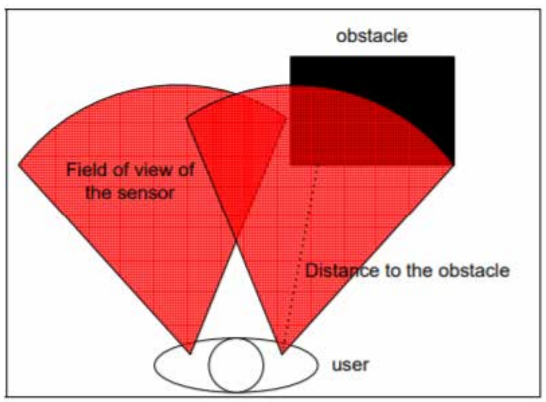

Figure 7: Wearable Object Detection System.

Related Works

Related works include the Sunu (Figure 6), by Fabiola Suárez. Explicitiy designed as a tool to aid users with visual impairments, Sunu is an ultrasonic sensor, like the SSA, worn on the wrist. It vibrates a haptic pulse on the user's wrist based on the proximity of objects and walls nearly. It also has a tracker tag peripheral which can be attached to an object and used by Sunu as a homing beacon.

It has multiple settings for indoors and outdoors, allowing for its range and sensitivity to be adjusted on the fly. It is also augmentative, working in tandem with other sensory assitance devices such as a cane or guide dog.

The concept of the augmentative wearable is particularly applicable to the SSA, as it is not designed to replace a sense but to augment the existing ones. Furthermore, the ability to adjust the feedback of the wearable for comfort based on distict physicalities of multiple spaces is a feature identified as being important, but lacking at this time, in the SSA.

The Wearable Object Detection System (WODS, Figure 7) by Cardin, Thalmann and Vexo presents a similar structure to the SSA. It takes the form of two ultrasonic sonar sensors and two vibration motors, like the SSA, embedded in a t-shirt on the shoulders and arms respectively. Unlike the SSA, the sensors in the WODS point forward, effectively augmenting or replacing the wearer's sight. Like the SSA, the WODS is intended to be used "without any conscious effort, as an extension of [the wearer's] own body functions" (Cardin et al). WODS is an effective case study into the efficacy of incorporating the senses granted by a wearable like SSA into the body's unconscious.

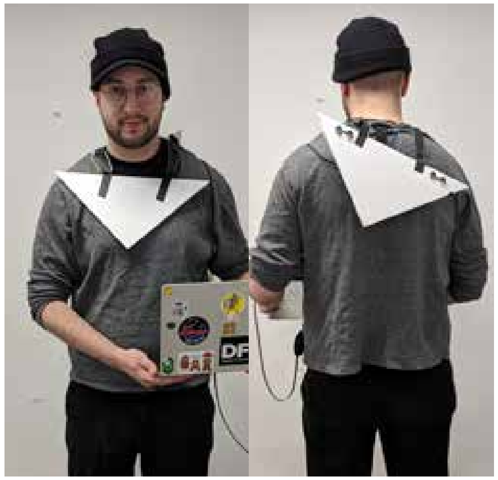

Figure 8: First wearable prototype of the SSA.

Prototype

The first wearable prototype of the SSA (FIgure 8) was made using an Arduino Uno, two sonar sensors, two vibration motors, foam core, and electrical tape, powered via USB to a laptop. Solving the coding problem of two separate variable timers for switching the pulse on and switching the pulse off based on sensor readings had been difficult, and required testing to get a sense of the distances and vibration lengths and strengths required.

Fabrication

After determining pleasant strengths, frequencies, and ranges for the vibrations - frequent and strong enough to be useful but not so much as to be irritating - fabrication commenced on the second prototype.

Fabric was chosen based on its feel as well as the visual echo of its pattern to sound and sonar. A 3d printed PLA plastic form (Figure 9) was made using Tinkercad to hold the SSA's components in place, which was sewed into the wearable in a pouch that rests low on the body. The Arduino Uno was replaced with an Arduino Micro, and a 9V battery used as the power supply. Snaps were hand-sewed into the arms of the SSA with conductive thread and connected to the circuit in such a way that they served as the on/off switch for the device. It would switch on when snapped together and remain off when not.

A series of tests were conducted before final assembly to determine how users might want to wear the device. (Figure 10). Tests determined that the device still functioned as intended when worn with the arms, housing the sonar sensors, arranged in multiple ways. However, this put reponsibility for the functioning of the device on the wearer, who in tests constantly checked and re-checked their devices.

Figure 9: The interior of the SSA ready to be sewn together.

Figure 10: Wearability Tests

Wearability testing also demonstrated that the device's functioning could be impaired by poor posture, which tended to point the sonar sensors at angles that did not return useful data, such as the ceiling. Furthermore, long hair worn down blocks the sensors, preventing the SSA from functioning.

Of note during the prototyping process was the discovery of a means of affixing small electronics resistant to sewing. An artisan who asked to be credited by their Instagram handle @quiltgardening suggested using fabric Band-Aids to keep bundles of wires and vibration motors affixed, as they both stick and can be effectively sewn through (Figure 11).

Implementation

The SSA was completed by being machine-sewed and finally worn in public for a combined total of approximately 5 hours. There were no instances of social discomfort or negative reactions from others. The SSA performed well, reliably relating data about the space behind the wearer, while being light and comfortable to wear.

The SSA performs best when detecting solid walls, but it is also good at detecting and warning the wearer when there is a change in the way things are oriented behind them. This is the situation it was reported to be the most useful.

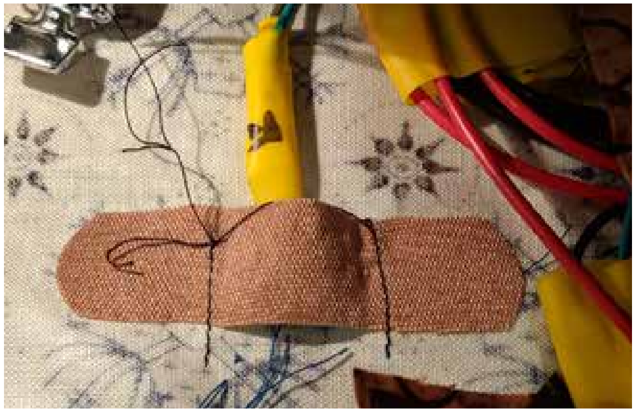

Figure 11: The fabric Band-Aid solution.

Future Work

The next steps for the SSA are to simplify the design so it can be fabricated, diagnosed, and fixed in case of failure more simply. After that, it will undergo a series of tests to determine its efficacy.

Participants:

People with problems turning their necks. People with visual impairments. People with fear of crowds.

Apparatus:

A course featuring structures of various sizes.

Procedure:

Participants would move through the course, recording when and how they detected each structure. They would move through the course backwards. They would move through the course forwards, then backwards. They would move through the course forwards, then backwards, while technicians secretly change the course layout.

Conclusion

The Sixth Sense Ascot is an effective augment to the wearer's senses. It provides extra data that can be used to navigate and inform the wearer's decisions.

It is not an effective treatment for panic in crowd situations. It requires revision to the way it is designed and fabricated to accomodate a wider range of wearer's physicalities, and it requires more testing and fine-tuning before its full potential can be explored.

REFERENCES

1. CalmWear. "About Calmwear." CalmWear, ca.calmwear.net/pages/about-calmwear.

2. Cardin, S., et. al. Wearable Obstacle Detection System for visually impaired People. Ecole Polytechnique Fédérale de Lausanne (EPFL) CH-1015 Lausanne, Switzerland.

3. "Expanding Perception." NeoSensory, neosensory.com/.

4. Fusiello, A., et al. "A Multimodal Electronic Travel Aid Device." *Proceedings. Fourth IEEE International Conference on Multimodal Interfaces*, doi:10.1109/icmi.2002.1166966.

5. Suárez, F. (2015, November 16). Sunu - Ultrasonic wearable to heighten perception. Retrieved from https://www.indiegogo.com/projects/sunu-ultrasonic-wearable-to-heighten-perception#/