Background & Market Research

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Autism, or autism spectrum disorder (ASD) is a neurological developmental disorder that is characterized by one's problems with communication, learning and behavior (National Institute of Mental Health, 2024). People with autism are often more affected by sensory overload because their brains process sensory information differently (Marco et al., 2011). Consequently, they can have trouble filtering or receiving external stimuli. This often leads to distress, anxiety and decreased brain functionality. In a neurotypical individual, the brain can tune out irrelevant sensory information, such as background noise or faint smells. However, in the brain of a person with autism, all information is perceived in a different manner than that of neurotypical individuals. Brain processing can occur in various ways; some individuals with autism experience hypersensitivity which is when their brain overreacts to external stimuli, or hyposensitivity, when their brain under reacts to stimuli.

Sensory overload, an event in which the brain is overwhelmed by too much sensory information and struggles to process it, often leads to feelings of stress, anxiety, or even panic among subjects (Schedyt et al., 2017). Although this is an issue that people who don't have autism also face, it has a much stronger effect on people with autism and therefore must be addressed in order to maintain the health and safety of various communities. Sensory overload can have devastating effects and in order to mitigate the damage that is done by such a destructive disorder, it must be detected as soon as possible. A caretaker of a person with autism may not be able to immediately identify when sensory overload is occurring. Therefore, the implementation of an assistive technology device is required for safety and quick detection of sensory overload episodes. Different people have varying sensory thresholds, which influence their susceptibility to sensory overload episodes (Melnick et al., 2013). The five senses play an important role in triggering sensory overload and factor into the triggers of people with autism. For example, excessive visual input significantly contributes to sensory overload by overwhelming the brain with too much information, making it difficult to focus and provoking both physical and emotional responses. Specifically, bright lights, crowded or cluttered spaces may all cause anxiety and distress, overall increasing the risk of sensory overload in people with autism. Sound is another major trigger, as loud and overwhelming noise can overwhelm the brain and lead to freeze responses as a general coping mechanism (MacLennan et al., 2021). Additionally, strong odors usually have the same effect: over stimulating the brain and contributing to sensory overload episodes. These specific triggers vary from person to person due to both genetics and tolerance thresholds; nonetheless, the outcome is an overwhelmed brain which results in physical discomfort and behavioral changes.

Sensory overload impacts daily life by making it difficult for individuals with autism to participate in activities, navigate environments, and engage in social situations due to the various sounds, smells, crowded places, and lighting that trigger them(Vries, 2021). It is detrimental to the mental health and capabilities of people with autism due to how it diminishes their brain's functionality in certain environments and restricts their freedom to only areas in which there are no provocative stimuli. To prevent these circumstances from arising, assistive technology can be implemented in order to alert caretakers of when certain harmful stimuli could be present in the user's surroundings. Such a device could lay the foundations for people with autism to be better equipped to enter environments in which they may face a sensory overload episode, in a safer manner.

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Device 1: AngelSense

AngelSense is an assistive technology that serves as a monitoring and alerting system designed for children with special needs, including those on the autism spectrum. This app was mainly designed to assist caretakers as they monitor children with autism since many children have difficulty speaking and communicating their location to others. It comes with a wearable device with an auto-pickup speakerphone and SOS button, a proactive monitoring & alerting system, and an app for caregivers . The wearable device is a GPS tracker that is sensory-friendly and non-removable. The app connects to this device and automatically lets the caretaker know exactly where the individual is by sending proactive alerts when they leave a designated safe zone, enter a new area, or deviate from a planned route. Moreover, the app automatically alerts potential at-risk situations when assistance may be needed (AngelSense, 2025).

Looking at the cost and scope, AngelSense can be used not just for individuals with autism but many others as well. Parents who may be worried about their child's location can use this device as well as caretakers who take care of the elderly, etc. The problem is that because this device can be used by a large population, it does not take into consideration problems a certain group of people may face. For example, people with autism tend to not be fond of wearable devices, and therefore the device would need to consist of features that help prevent this. Although our device will be designed specifically for individuals who experience sensory overload (which is mainly people on the autism spectrum), the device will take into consideration the problems an autistic individual faces and the design will be developed based on the needs of this population. Another serious limitation that people may encounter is the cost. AngelSense is bought on either a monthly or annual plan where an individual has to pay approximately 50 dollars per month or about 600 dollars per year. This price may be problematic for people as they may not have enough money to afford this device which leaves caretakers and parents with no alternatives to track an individual. Our device will be sure to be cost-friendly, allowing our product to be used by any individuals especially those who may not be able to afford more expensive options. AngelSense also incorporates simple features to allow the device to be user-friendly especially for people with autism. One example of this is their SOS button. In order to respond to call requests, the individual can accept the call with a single press of a button. Having too many buttons can be confusing and overwhelm the user, especially users who experience autism. Similar to this, our design will be simple and easy to use so that individuals will autism can use the device while still being comfortable.



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is.	wearing options.	monitoring.

Device 2: Noise-cancelling headphones

Since sensory overload is commonly experienced by 90% of individuals with autism, noise-canceling headphones can help people who want peace in a noisy place. Sensory overload can happen when there is too much noise and causes the affected individual to panic and immediately become anxious. These noise-canceling headphones improve the quality of life for lots of people with autism and other disorders.

Limitations: People who use noise-cancelling headphones tend to face social isolation. Using noise-canceling headphones can limit the individual from necessary social interactions since the device creates a "bubble" that isolates the person. Additionally, comfort may also be a limitation due to the headphones not being customizable and the material not being the most comfortable. Lastly, this device cannot detect sensory overload. Since the goal of our project is to develop a device that can detect sensory overload, noise-canceling headphones do not fulfill that requirement. The device should be able to allow the user to input sensory parameters such as lighting and noise level so that the device can create a threshold to compare surroundings to. Currently, noise-cancelling headphones are not suitable to detect sensory overload.

Device 3: The Halo



The function of Halo is to track emotional well-being by analyzing voice, tone, and standard fitness tracking features. It analyzes sleep patterns and heart rate to detect the emotions of a person. The device includes a microphone to record snippets and then is analyzed using machine learning to identify the emotional state of the person. It looks into vocal qualities like pitch, intensity, tempo and rhythm that factor into a person's emotions. The device costs \$99.99 plus \$3.99/month subscription – which can be too expensive for people to afford. People with autism can use this device to keep track of their emotions and health.

Limitations: This device can only be used for emotion sensing, which can sometimes vary from a person's sensory experience. Many people on the spectrum express their emotions differently from neurotypical people. However, the Halo's AI is trained to only identify neurotypical patterns, which could possibly misunderstand the user's tone – leading to inaccurate feedback and data. This ties to our functionality requirements as the Halo doesn't detect sensory overload - it is limited to identifying basic emotions based on sleep, heart rate and voice patterns. Additionally, since the cost of the device is expensive and there is an additional subscription cost, the user may not be able to afford the Halo. Affordability is an important factor to consider because people with autism may come from different financial backgrounds.

Works Cited

- AngelSense. (2025, March 26). Assistive technology for autism & special needs order now! https://www.angelsense.com/
- Carr, A. (2020, August 31). Amazon's New Wearable Will Know If I'm Angry. Is That Weird? Bloomberg. <u>https://www.bloomberg.com/news/newsletters/2020-08-31/amazon-s-halo-</u> wearable-can-read-emotions-is-that-too-weird

De Vries, B. (2021). Autism and the right to a Hypersensitivity-Friendly workspace. *Public Health Ethics*, *14*(3), 281–287. https://doi.org/10.1093/phe/phab021

Exploring the Benefits of Headphones for Autistic People. (2024). Yellowbusaba.com. https://www.yellowbusaba.com/post/why-do-autistic-people-wear-headphones

- MacLennan, K., O'Brien, S., & Tavassoli, T. (2021). In Our Own Words: the Complex Sensory Experiences of Autistic Adults. *Journal of Autism and Developmental Disorders*, 52(7). https://doi.org/10.1007/s10803-021-05186-3
- Marco, E. J., Hinkley, L. B. N., Hill, S. S., & Nagarajan, S. S. (2011). Sensory Processing in Autism: A Review of Neurophysiologic Findings. *Pediatric Research*, 69(5 Part 2), 48– 54. <u>https://doi.org/10.1203/pdr.0b013e3182130c54</u>
- Melnick, Michael D., Harrison, Bryan R., Park, S., Bennetto, L., & Tadin, D. (2013). A Strong Interactive Link between Sensory Discriminations and Intelligence. *Current Biology*, 23(11), 1013–1017. <u>https://doi.org/10.1016/j.cub.2013.04.053</u>

National Institute of Mental Health. (2024, December). *Autism spectrum disorder*. National Institute of Mental Health; National Institute of Mental Health . https://www.nimh.nih.gov/health/topics/autism-spectrum-disorders-asd Schedyt, S., Staub, M., Frauenfelder, F., Nielsen, G., Behrens, J., & Needham, I. (2017, April). Sensory overload: A concept analysis. National Library of Medicine. <u>https://pubmed.ncbi.nlm.nih.gov/28185369/</u>