

FUTURIST REPORT SERIES

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SUMMER 2024

FUTURE OF SENSES

PRODUCED BY: **VSP GLOBAL INNOVATION CENTER**

CBINSIGHTS

VOL
8

Introducing the Future of Senses

The human experience is intimately connected to the five senses—sight, smell, hearing, taste, and touch.

These senses serve as our gateway to the world, allowing us to perceive our surroundings, engage with others, and savor life's moments. They work in harmony with our brain, providing vital information to keep us safe and thriving.

In today's rapidly advancing technological landscape, a wave of startups and researchers are innovating to enhance, extend, and digitize our senses. This movement is poised to revolutionize well-being, performance, and beyond. The burgeoning [Internet of Senses market](#), encompassing technologies that amplify and digitize sensory experiences, is projected to soar to \$83.6 billion by 2030, a significant leap from \$16.95 billion in 2023. Key technologies such as haptic devices* and virtual reality headsets are driving this shift, with the haptic industry set to [triple in size](#) by 2030 and spatial computing startups securing [substantial](#) equity funding.

This transformative wave is cascading through various sectors. In healthcare, sensory-driven diagnostics are revolutionizing

preventive care, from AI-powered retinal scans for early Alzheimer's detection to remote monitoring tools that track vocal biomarkers to predict cognitive decline. In retail and entertainment, AI-powered sensory experiences are blurring the boundaries between physical and digital realms, ushering in an era of immersive experiences and novel business models.

The future of sensory technology is characterized by inclusivity and innovation, with many advancements originating in assistive technology and still in early stages of development.

As a leader in health-focused vision care, VSP Vision™ is at the forefront of emerging sensory technology's impact on overall health. The VSP Global Innovation Center aims to understand how advancements in other senses can complement vision and enhance overall well-being and quality of life.

In this exclusive Futurist Report, the VSP® Global Innovation Center sheds light on the groundbreaking startups and research driving sensory technology forward. Delve into five key trends that are shaping the future of our senses and paving the way for a new era of human experience.

The five senses



Hearing: The ability to perceive sounds through the ears



Taste: The ability to perceive different flavors (sweet, salty, bitter, and sour) through taste buds on the tongue



Sight: The ability to see surroundings through the eyes



Smell: The ability to perceive odors through the nose



Touch: The ability to feel physical sensations through the skin and muscles



What is vision?

Vision, in part, derives meaning from light.* The process begins with the retina converting light rays into electrical signals, which are sent to the brain for processing.

Humans perceive up to [80% of all impressions](#) through sight, and vision accounts for 80% of learning. A VSP Vision Care [study](#) found that over 80% of people consider vision their most important sense, and 97% agree on the importance of healthy eyes.

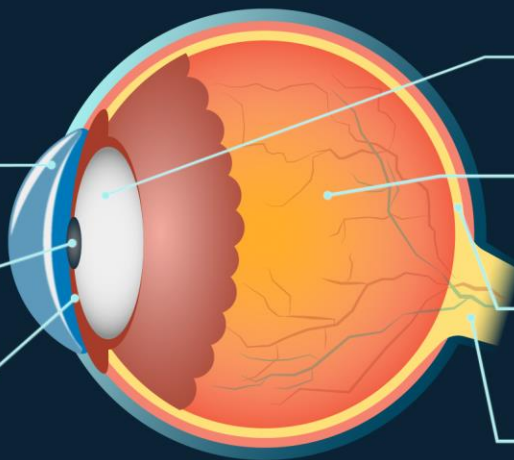
*Per the [Optometric Extension Program Foundation](#)

Elements of the eye:

Cornea: The cornea is the clear, outermost layer of the eye that helps the eye focus light to see clearly.

Pupil: The pupil is the opening at the center of the iris through which light passes. The iris adjusts the size of the pupil to control the amount of light that enters the eye.

Iris: The iris is the colored part of the eye that surrounds the pupil. It regulates the amount of light that enters the eye.



Lens: The lens is a clear part of the eye behind the iris that helps to focus light and images on the retina.

Vitreous gel: The vitreous gel is a transparent, colorless mass that fills the rear two-thirds of the eyeball, between the lens and the retina.

Retina: The retina is the light-sensitive tissue at the back of the eye and converts light into electrical impulses that are sent to the brain through the optic nerve.

Optic nerve: The optic nerve is the largest sensory nerve of the eye. It carries impulses for sight from the retina to the brain.

Five Transformative Trends



1

Tech-enabled senses heighten the human experience



2

Digitized senses unlock a value chain



3

The brain-to-sense relationship aids in disease detection



4

Sensory substitution technology supports disabilities



5

AI ensures safety through sensory technologies

Outline of Transformative Trends

Tech-enabled senses heighten the human experience

- New tech devices modulate sensory input and track movements to enhance human performance.
- Spatial computing and eye tracking simplify and optimize a variety of tasks, from breathing to surgery.
- Sensory devices help with pain management, stress, and other conditions to improve well-being and longevity.

Digitized senses unlock a value chain

- Multisensory specialty care takes off as optometrists and audiologists merge their services in a single practice.
- Immersive entertainment uses scent for even more realistic experiences.
- Haptic feedback improves customer engagement through immersive digital interactions.
- Businesses leverage multisensory marketing to build stronger emotional attachments with customers.

The brain-to-sense relationship aids in disease detection

- Promising retinal imaging technology provides a noninvasive way to test for cognitive decline.
- Researchers design taste and saliva tests to diagnose different conditions.
- Vocal biomarkers provide a new way to test for conditions such as dementia and other cognitive issues.
- Novel hearing tests simplify medical screening and make it more accessible.

Sensory substitution technology supports disabilities

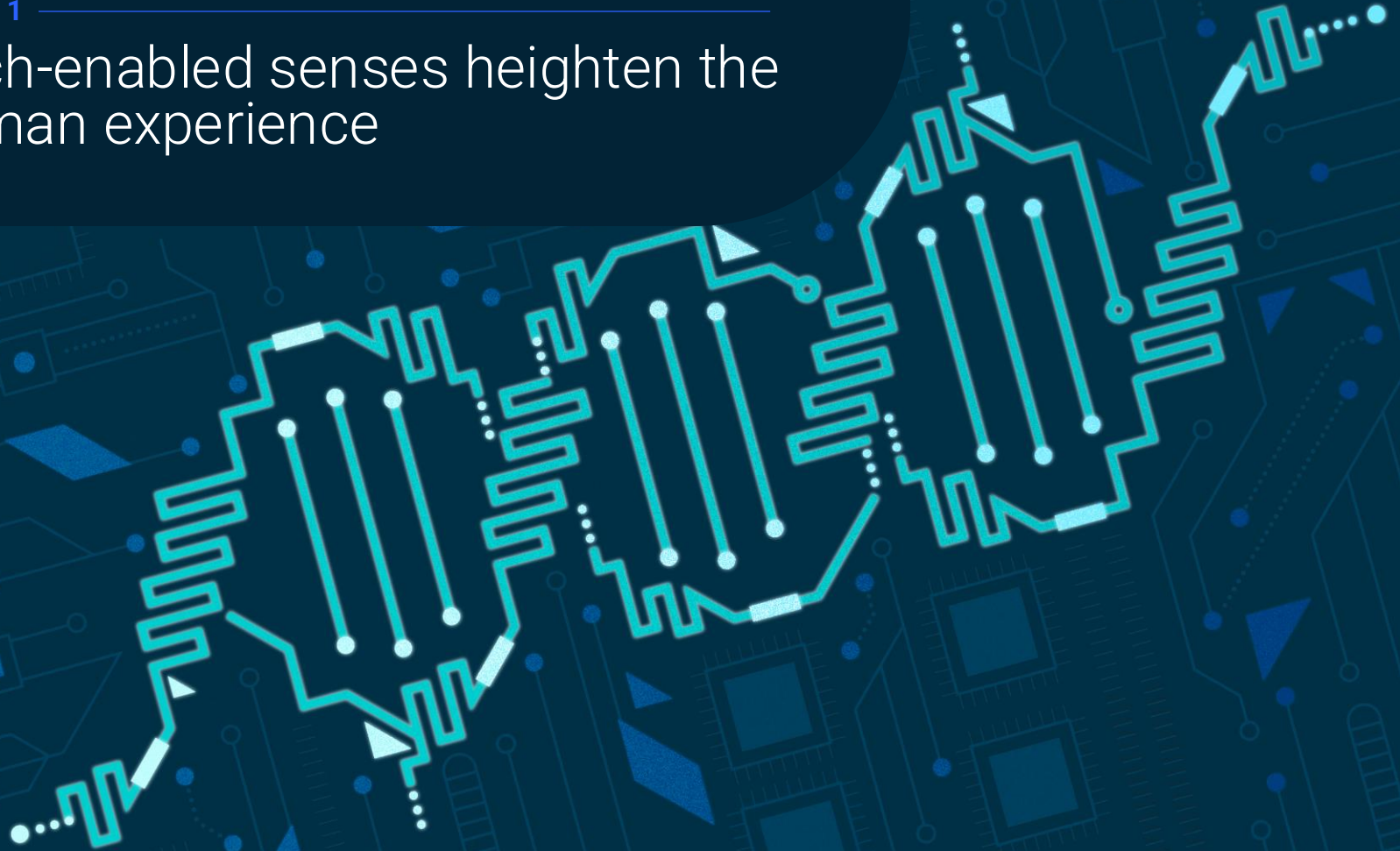
- Assistive technology helps people with vision impairments improve their visual acuity.
- People who are deaf and hard of hearing can access haptic devices that enhance hearing acuity through vibration.
- BCIs allow people with paralysis to use digital devices with their brain signals.
- Implants and nasal sprays are potential new treatments for the loss of taste and smell.

AI ensures safety through sensory technologies

- Companies develop AI smell detectors that can identify the presence of illnesses, food adulterants, and other potentially harmful chemicals.
- Electronic tongues analyze flavors using AI to simplify taste testing.
- AI-powered voice analysis fights deepfakes and other cybersecurity threats.
- Healthcare providers use AI to predict and detect falls.

TREND 1

Tech-enabled senses heighten the human experience



How is sensory technology enhancing performance and productivity?

Accessible like never before, sensory technologies and devices are revolutionizing human experiences by enhancing or even replacing natural senses. They come in various forms, from spatial computing headsets to everyday wearables like socks and t-shirts, empowering individuals to achieve new levels of performance, productivity, and well-being.

Among these innovations are neurostimulation technologies, discreetly wearable via small patches, which can enhance the acuity of different senses by stimulating nerves. This advancement can notably enhance an individual's sense of touch, hearing, and vision.

In professional settings, eye tracking technologies are playing a key role in enabling hands-free interaction with devices. By predicting users' needs in real-time, these technologies streamline workflows by automatically presenting the most relevant information and images on the screen.

In the realm of healthcare, sensory technologies such as virtual reality are proving invaluable for chronic pain management, mental health treatment, and addressing other conditions that affect quality of life.

Central to the purpose of these technologies is the enhancement of a person's closed-loop sensory processing system. This system functions by sensing, analyzing, and responding to information, ultimately refining human interactions with the world.

Corinna Lathan, CEO of mobility company De Oro Devices, highlights the potential of these advancements by stating, "Human performance can be enhanced at any point in this closed-loop system by amplifying sensory input, improving cognitive processing, or enhancing action-taking abilities. This concept is known as human enhancement."

"As AI, spatial computing and body-sensing technologies evolve to a point where tech appears to imitate human capabilities and seem invisible, what you'll see left are the people—empowered with new capabilities to accomplish things they once considered impossible."

Paul Daugherty, Chief Technology and Innovation Officer, Accenture
[Source]

Where is the momentum now?

Breakthroughs in sensory stimulation, eye tracking, and other sense technologies promise to bring the human experience to a new level.

Most of us are comfortable with the idea of human enhancement technology.



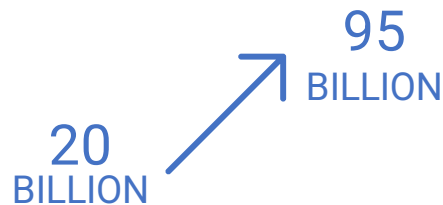
More than [95% of people](#) find human enhancement technologies appropriate for restoring vision, joint function, and other physical ailments. 88% of people are comfortable with these technologies supporting cognitive restorative applications.

The global wellness economy is growing.



Globally, humans are investing more in wellness services and technologies to strengthen their senses. From 2020 to 2022, the market saw [12% growth](#). By 2027, it's projected to reach \$8.5 trillion.

Human enhancement, also referred to as "biohacking," is nearly a \$100B market.



The biohacking market is [booming](#). The global market is currently valued at \$20B and is expected to grow nearly 20% over the next 8 years, reaching an estimated \$95B in 2032.

Companies working on enhancing the human experience

These sensory technologies improve human performance, productivity, and well-being, boosting the user's health and potential.

SENSORY PERFORMANCE TECHNOLOGY

 SHARPER SENSE

 sensoria HEALTH

 ELEMIND

 virtusan

SPATIAL COMPUTING AND EYE TRACKING

 pia

 IRISBOND

 tobii

SENSORY WELL-BEING SOLUTIONS

 appliedVR

 immersiv technologies

 cala

 oxfordvr

 XRHealth

 REALITY CENTER

 INNERSENSE

 Featured in this Report

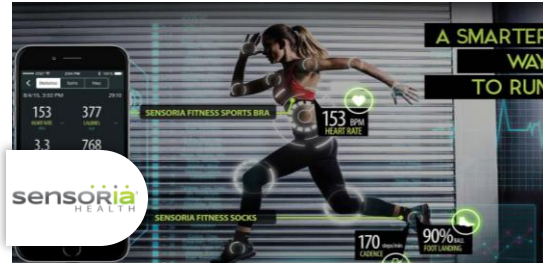
Sensory technology boosts human performance

By modulating sensory input and tracking movements, sensory technology enables better human performance – from improving fitness to the quality of sleep.



Total funding: [\\$769K](#)

- Sharper Sense is a New York-based neuromodulation startup developing a patch that enhances your sensory acuity: clearer hearing, vision, and touch.
- The patch delivers comfortable noninvasive electrical stimulation, targeted to activate neural circuitry that naturally enhances a user's senses when they are attentive and alert.
- In June 2024, the startup raised \$50K in seed funding from Plug & Play Tech Center.
- Launching first to early adopters in defense and sports before expanding across clinical, commercial, and consumer application.



Total funding: [n/a](#)

- Sensoria Fitness designs smart sportswear, from socks to t-shirts.
- Sensoria smart socks are infused with comfortable, textile pressure sensors that use touch to monitor a runner's foot-landing technique, alerting the user in real time if they're placing too much weight on their heel.
- The garment's sensors also monitor the user's heart rate, running cadence, and impact forces.
- The Sensoria Run App helps users track their performance and receive AI coaching.

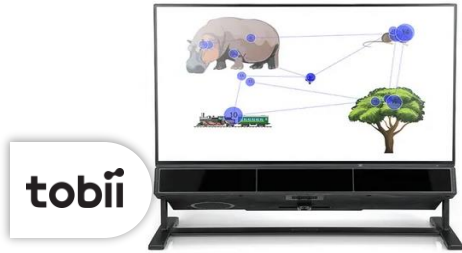


Total funding: [\\$12M](#)

- EleMind has developed a wearable neurotechnology device to improve sleep.
- The startup's wearable utilizes a proprietary algorithm and AI to read individual brainwaves and provide real-time guidance through tailored sound stimulation.
- The EleMind app provides sleep analytics, such as how much time the user spends in each sleep stage.

Spatial computing and eye tracking optimize productivity

Spatial computing, the ability of a computer to use the real world as its user interface, and eye tracking allow humans to be more productive by simplifying different tasks and collecting gaze data to optimize processes.



Total funding: [\\$71.11M](#)

- Tobii is a Sweden-based company that manufactures eye-tracking technology.
- The company's wearable eye tracker (Tobii Pro Glasses 3) collects gaze data and helps researchers, UX designers, and marketers analyze user behavior.
- The German Heart Center Berlin has used Tobii gaze data to optimize training and operative procedures.



Total funding: n/a

- Pia Health has developed a mobile app (Lungy) with interactive breathing exercises.
- The [Lungy app](#) tracks the user's breathing and generates visuals in real time.
- The app's breathing exercises reduce stress and anxiety while improving sleep.



Total funding: [\\$4.3M](#)

- IRISBOND develops eye tracking technology used in a variety of products.
- For example, the company partnered with vending machine manufacturer Azkoyen to develop an eye-controlled coffee maker.
- This technology can also be applied to improving manufacturing processes, driving safety, and more.

Sensory tech improves well-being and pain management

Technology that stimulates the senses reduces pain and regulates the nervous system.



Total funding: [\\$68.7M](#)

- AppliedVR's immersive therapeutics platform helps people suffering from chronic pain.
- The FDA has authorized the company's [RelieVRx](#) program as a treatment for reducing lower back pain.
- The program contains 56 sessions that involve cognitive behavior therapy and other techniques for better pain management.



Total funding: [n/a](#)

- InMersiv Technologies is a Belgium-based company that has developed Sam, a multisensory therapeutic solution.
- The device consists of four square walls with screens. The patient can use a joystick to interact with the visuals.
- It improves the well-being of people with depression, anxiety, and other neurological conditions and illnesses.

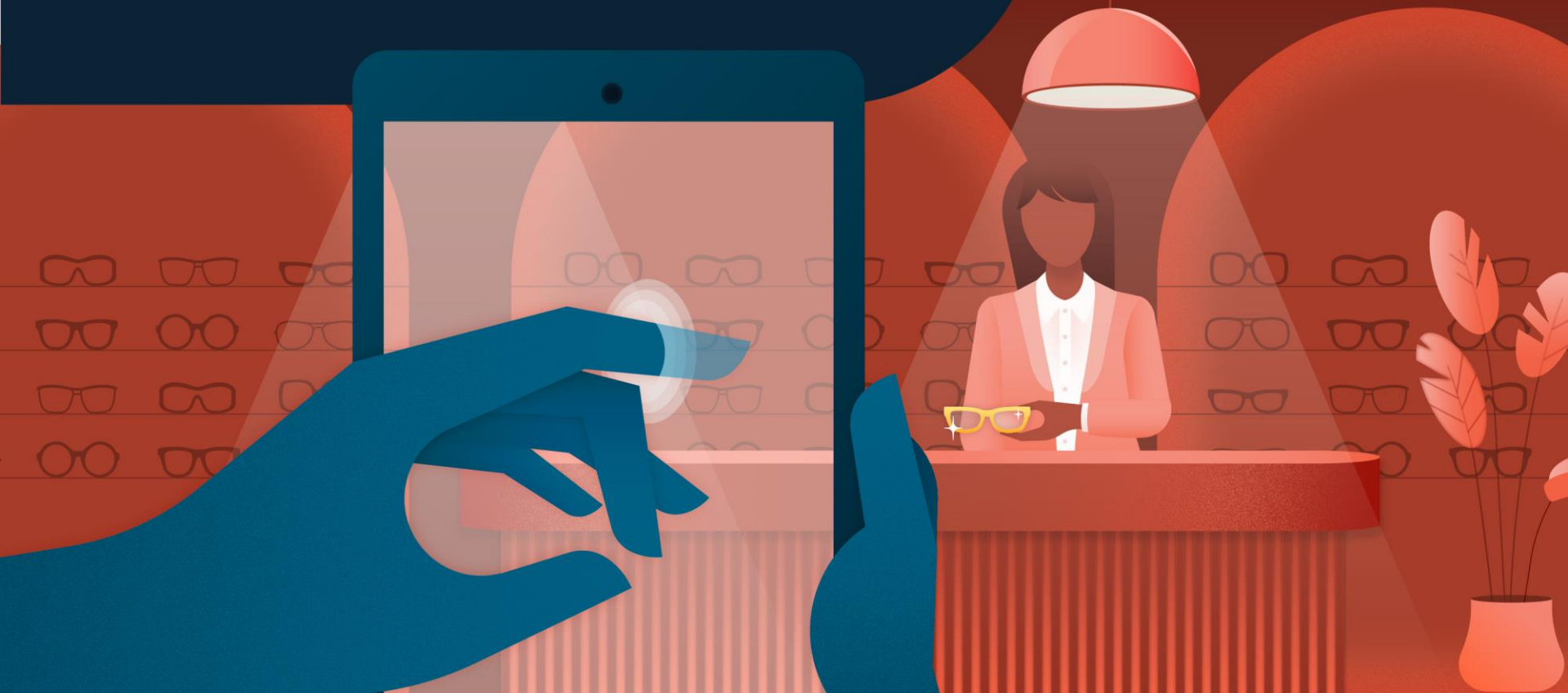


Total funding: [\\$157M](#)

- Cala is a California-based company that has developed Cala kiQ, a wearable device that delivers effective therapy for action hand tremor in people with essential tremor and Parkinson's disease.
- The device uses TAPS (Transcutaneous Afferent Patterned Stimulation) therapy, which is physician prescribed and clinically proven to reduce action hand tremors.
- Users receive access to an online patient portal featuring on-demand therapy and data insights that reveal treatment results over time.

TREND 2

Digitized senses unlock a value chain



How are digitized senses unlocking new models and customer experiences?

The *Internet of Senses*, a concept coined by Swedish tech giant Ericsson, describes the merging of the digital and physical, where multi-sensory experiences evolve to take people from *on* the internet to *into* it.

According to the Internet of Senses Institute, the digitization of hearing, sight, smell, taste, and touch has heralded in new business models, experiences, and ways of inhabiting the world.

In entertainment, scent-based technologies are bringing virtual and mixed reality environments to life, using AI to create smells based on what the user is seeing or experiencing, whether it's the ocean or a racetrack.

In advertising, brands are deploying multi-sensory campaigns to foster stronger emotional attachments in consumers. According to Mastercard CMO Raja Rajamannar, "engaging the five senses is key to cutting through the clutter and appealing to the hearts and minds of customers."

On the retail-front, haptic technology has emerged as a transformative enabler of immersive, tactile experiences within the realm of e-commerce, ushering in "a future characterized by heightened engagement, authenticity, and consumer satisfaction," explains Eduard Fildiroiu, Samsung's E-Commerce Platform Product Manager.

Lastly, in healthcare, the digitization of diagnostic screenings and tests, has helped allow for patients to receive multi-sensory care from within a single space, contributing to better outcomes and experiences.

"Digitized senses promises to revolutionize the way we experience the world and opens a realm of possibilities for businesses and engagement models," [summarizes](#) Kavita Pandya, Benelux practice lead for Accenture.

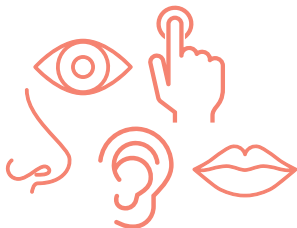
"In a world which is overloaded with information, you're trying to channel everything through two highways: audio and visual advertisements. Why not use all five sensory highways to drive that traffic through, and do it in a highly optimized fashion?"

Raja Rajamannar, CMO,
Mastercard
[\[Source\]](#)

Where is the momentum now?

As senses become increasingly digitized, companies explore innovative ways to reach and engage people.

Multisensory engagement is important to consumers.



Roughly 6 in 10 consumers want businesses to engage them with multisensory experiences, according to a [2023 VML report](#). And 8 in 10 expect businesses to provide multisensory engagement when delivering a new experience.

Technologies targeting the sense of smell sees positive growth projections.



The [global market of olfactory technology products](#) is projected to reach over \$4 billion by 2031, up from just \$324 million in 2022.

Multisensory care expands its footprint.



In Australia, optometry collective George & Matilda Eyecare [has hired audiologists](#) to provide more holistic care for both sight and hearing.

Businesses behind the evolution of digitized senses

New digitized sense solutions reshape how businesses interact with consumers.

MULTISENSORY SPECIALTY CARE



IMMERSIVE ENTERTAINMENT



HAPTIC FEEDBACK

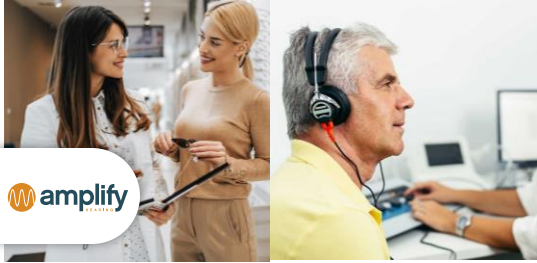


MULTISENSORY MARKETING



Multisensory specialty care enables holistic treatments

Age-related sensory impairments, such as combined hearing loss and vision issues, drive the need for integrated healthcare. This trend also influences cosmetic procedures, with medical professionals incorporating injectables.



Total funding: n/a

- Amplify Hearing connects independent optometrists with independent audiologists, providing eye care professionals with the tools, infrastructure and personnel to add hearing care to their practice.
- Amplify enables optometry clinics to offer hearing examinations, integrating care delivery and providing a better patient experience.



Total funding: [n/a](#)

- MDHearing is a leading manufacturer of affordable, over-the-counter hearing aids.
- The company [partners with opticians](#), allowing customers to take a virtual hearing test in-store and then schedule a remote consultation they can do at home.



Total funding: n/a

- FL-based Facial Aesthetics for Dentists provides training for dentists in surgical and non-surgical facial rejuvenation skills.
- Participants can receive continuing education credits in Botox Mastery, Advanced Dermal Fillers, Microneedling: Beyond Basics, and more.

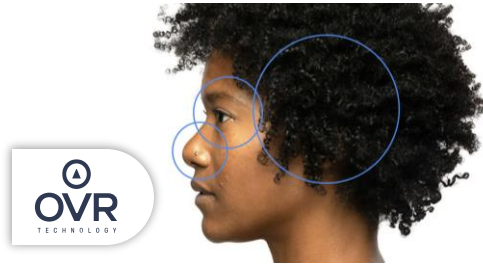
Immersive entertainment goes a step beyond 3D

Virtual and mixed reality now incorporate olfactory* products, enhancing the immersive experience.



Total funding: n/a

- GameScent is a device that releases different scents while a user plays a game.
- Scents such as gunfire, racing cars, and the ocean help users feel like they are inside the game.
- The device works with all gaming consoles and platforms.



Total funding: [n/a](#)

- OVR Technology manufactures ION, a wearable scent device.
- It connects to the user's smartphone, VR headset, or computer and delivers scents via a replaceable cartridge.
- The ION mobile app allows users to customize scents and share them with others.



Total funding: n/a

- This French-based company provides an accessory compatible with all virtual reality headsets that is designed to add a variety of scents to VR experiences.
- The company installs the device to its clients' headsets and provides support before, during and after each project.
- Olfy offers a perfume catalog that includes rose, mint, coffee and lemon.

Haptic feedback leaves lasting customer impressions

[Surface haptics](#) enhance customer engagement by allowing users to interact with objects through the screen, going beyond zoom. It also provides additional product information and boosts [purchase intentions](#).



Total funding: [\\$165.58M](#)

- Ultraleap is a UK-based company that develops hand-tracking cameras for touch-free digital interactions.
- The company's Ultraleap 3Di Stereo Hand Tracking Camera is designed for retail and digital out-of-home advertising solutions.
- The camera tracks the user's hand gestures, allowing them to interact with the display. For example, they can rotate an object to see it from all angles.
- For home use, Ultraleap offers Leap Motion Controller 2, which works with PCs, MacBooks, and XR devices.

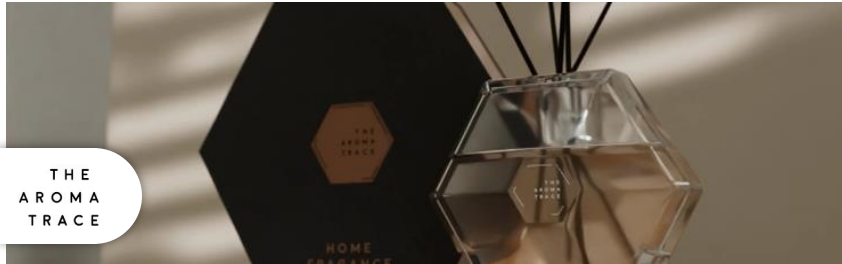


Total funding: [\\$3.89M](#)

- SenseGlove is a Netherlands-based company specializing in the development of advanced haptic feedback gloves designed for virtual reality applications across various industries.
- The company's Nova gloves features vibrotactile feedback and a wireless compact design that can create a multi-sensory experience for customers through product demonstrations and brand awareness.
- The company's Nova 2 gloves integrates active contact feedback that enables users to perceive a sensation of virtual reality objects in the palm of their hand.

Multisensory marketing drives customer retention

Marketing strategies that engage multiple senses garner a stronger emotional attachment, leading to higher customer retention and lifetime value.



Total funding: n/a

- The Aroma Trace is a Spain-based company that specializes in scent marketing. The company works with brands to develop customized scents that match their unique identities.
- The scents can be deployed in hotels, gyms, stores, restaurants, banks, and other establishments.
- The goal is to increase customers' dwell time by creating a pleasant environment, creating an opportunity to grow sales, and encouraging customers to return.

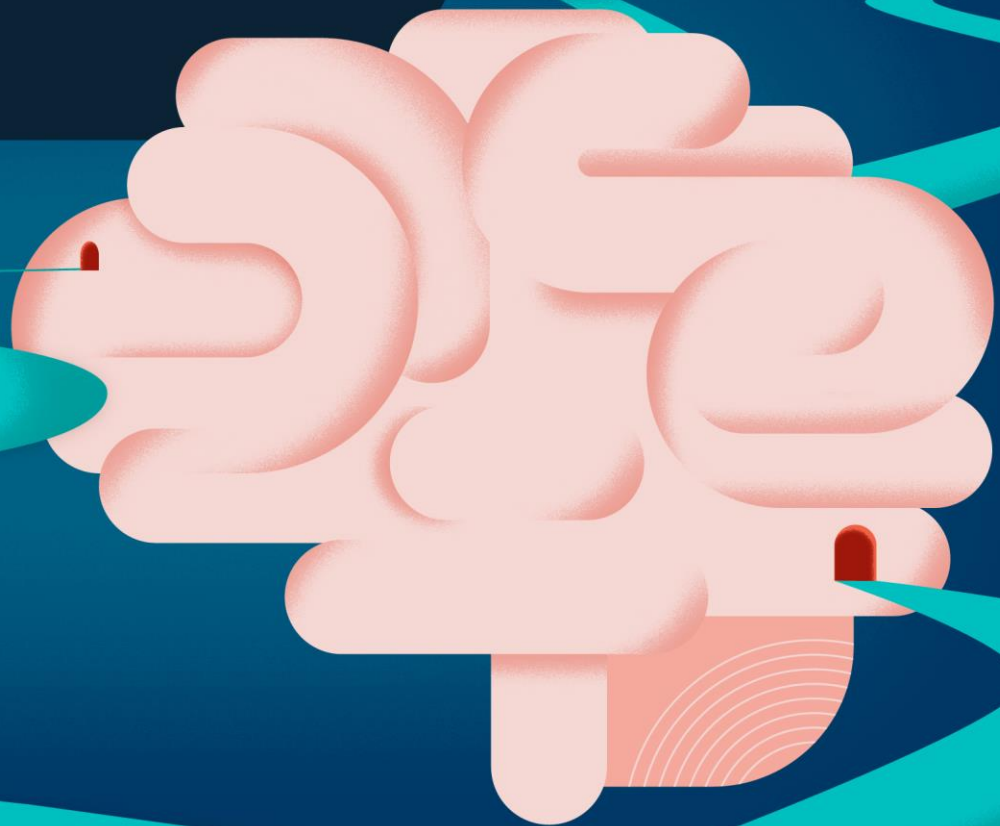


Total funding: [\\$476.14M](#)

- Epidemic Sound provides music and sound effects for video content creators.
- Users pay a monthly or yearly subscription and get access to a royalty-free sound library, which helps them create their sonic identity.
- The company has helped brands such as Levi's and Net-a-Porter use engaging music in their marketing campaigns and maintain an authentic sound.

TREND 3

The brain-to-sense relationship aids in disease detection



A heightened connection with the brain accelerates cognitive diagnostics

The eye has always been a window into full-body health, providing valuable insights on more than 270 systemic and chronic diseases, including diabetes, cardiovascular issues, aneurysms, blood cancers, and more.

Due to advancements in artificial intelligence, that number is also slated to rise. For example, medical imaging startups such as RetiSpec are using advanced AI for the early detection of neurodegenerative diseases through a retinal scan.

And it's not just the eye anymore. AI has helped unlock new information about the connection the other senses have to the brain, allowing for new sense-based diagnostic techniques and tools to emerge.

In England, researchers are [studying](#) the connection between Alzheimer's and two key senses, developing a device that allows doctors to closely examine a patient's perception of smell and taste and its relation to cognitive decline.

AI startups such as [CognoSpeak](#) are helping identify and monitor medical conditions through vocal biomarkers, analyzing a patient's responses to certain prompts and questions.

Lastly, as hearing tests can often serve as a vehicle for assessing brain health, new portable devices are helping scale access to these screenings, making early detection more equitable.

"The human eye is not just an organ for vision. It is also a window into the brain, reflecting our thoughts, emotions, and even the state of our cognitive health. And recent advancements in eye-tracking technology have made it possible to detect and analyze changes in brain health."

Ki Siadatan, VP at Silverado and Health & Aging Futurist

[\[Source\]](#)

Where is the momentum now?

Emerging startups are developing different sense-based technologies to scale early detection. Early diagnosis of cognitive disorders and neurodevelopmental conditions allows patients and families to start treatment early and make important preparations for the future.

Vision's connection to the brain assists in early detection of cognitive issues



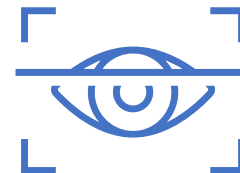
Scientists funded by the National Institute on Aging, using data from a [Health and Retirement study](#), recently made the case for including vision impairment as a risk factor for dementia. In fact, these scientists estimate that nearly 100,000 dementia cases in the U.S. could have possibly been prevented with existing vision treatments.

Startups using smell to detect diseases are on the rise



Several startups leveraging the nose's connection to the brain to detect diseases are attracting venture capital. [Koniku](#), which has raised over \$49M in equity funding, has developed an AI-enabled "odor surveillance system" to diagnose diseases and maintain health. [NoZe](#), a digital smell detection company that screens for various medical conditions such as tuberculosis, has raised \$16M.

AI-enabled screening technologies supercharge retina-based diagnostics



According to research from market intelligence platform CB Insights, AI-enabled screening technologies, companies using artificial intelligence for the automated detection of various eye conditions and diseases, have [raised](#) over \$1.8B in equity funding since 2020.

Startups strengthening the brain-to-sense relationship

New diagnostic technologies accelerate cognitive testing and make it accessible to more patients.

AI RETINAL DIAGNOSTICS

RetiSpec 

innodem 
neurosciences

SALIVA-BASED DIAGNOSTICS

AMPERA 

VOCAL AND OPTICAL BIOMARKERS

Cogno Speak 

WINTERLIGHT 

AUDIOLOGY AND HEARING TESTS

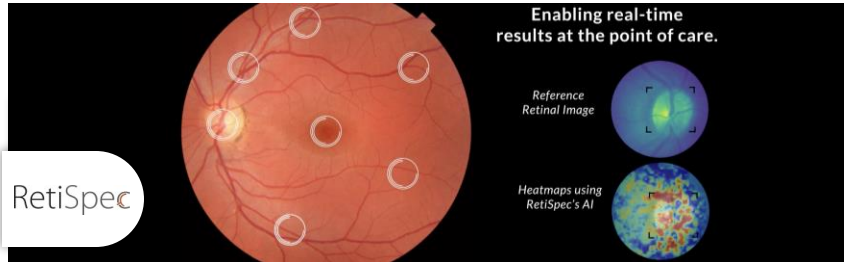
MindAffect 

uSound 
AUDIOMETRO

hearX 

Startups deploy AI to unlock more whole health insights through the eye

The sense of sight allows us to extract information on disease progression and cognitive function. Alzheimer's, for example, has been linked to changes in the retina and AI-enabled software is now being developed to detect and monitor diseases more easily and at scale.



Total funding: [n/a](#)

- RetiSpec uses AI-powered retinal imaging to support early Alzheimer's detection.
- The technology (currently available for research purposes only) analyzes images of the patient's retina taken with retinal imaging cameras.
- The AI aims to predict amyloid burden (a biomarker of Alzheimer's) and support earlier detection of the illness before other symptoms appear.



Total funding: [\\$6.76M](#)

- Innodem Neurosciences' technology measures gaze mapping and eye movement biomarkers, which aid in analyzing cognitive function.
- One of its software solutions (Eye-Tracking Neurological Assessment for Multiple Sclerosis or ETNA-MS) allows patients to undergo a visual test using a mobile app on an iPad Pro.
- The app uploads captured images to a cloud platform where they are processed by AI. Then, a healthcare provider can analyze the results.

Saliva-based diagnostics and taste tests assist with cognitive disorder discovery

Some illnesses impact our sense of smell and taste, such as Alzheimer's disease, which has been [linked to taste disorders](#). Now, researchers are developing novel ways of using these senses to support diagnostics.



Total funding: n/a

- Ampera Life is a biotechnology startup that has developed a biosensor platform to test for various diseases and infections, including dementia and COVID-19.
- For example, it [detected amyloids](#) present in the brain fluid of patients with Alzheimer's and Parkinson's disease.
- The California-based startup aims for the biosensor to detect amyloids in saliva, urine, and other body fluids.

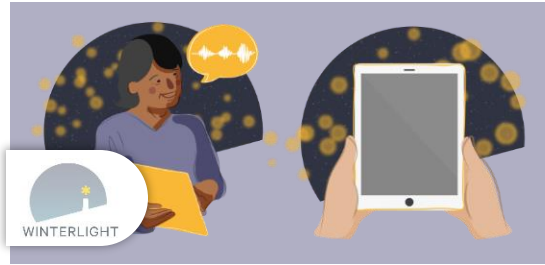


Total funding: n/a

- Scientists at the University of Warwick are researching the connection between Alzheimer's and the sense of smell and taste.
- Preliminary research findings indicate that people with Alzheimer's detect flavors differently.
- The research team has developed artificial food flavors using a device called [FlavoSim](#). It allows for precise flavor modification, enabling doctors to closely examine their patient's perception of smell and taste.

Vocal biomarkers help spot and monitor medical conditions

Certain medical conditions cause speech patterns to change. But to the human ear, these changes are difficult to spot – especially if the condition is in its early stages. By developing vocal biomarkers, tech companies are helping healthcare providers assess patients with more efficiency.



Total funding: [\\$4.74M](#)

- Winterlight Labs, which was [acquired](#) by Cambridge Cognition in 2023, has developed a speech analysis platform to detect symptoms of psychiatric and neurodegenerative disorders such as schizophrenia and Parkinson's disease.
- The platform identifies more than 550 features of a patient's speech and language patterns, allowing it to detect even small anomalies. It supports English, German, Spanish, and French.



Total funding: n/a

- CognoSpeak, an AI tool developed by researchers at the University of Sheffield, evaluates a patient's communication and cognitive skills, assisting with diagnosing different memory disorders.
- The tool features a virtual agent that speaks to a patient, asking questions to test their memory and cognitive abilities. Then, it analyzes the patient's responses to find indicators of dementia.
- CognoSpeak is designed to work in a web browser, allowing patients to take the test in the comfort of their homes.



Total funding: n/a

- [Klick Health](#), a life sciences commercialization agency, has created Voice 2 Diabetes, an AI-enabled device that can detect diabetes in people's voices.
- The AI tool screens for Type 2 diabetes through voice analysis, offering a non-invasive alternative to traditional blood tests and has achieved up to 89% accuracy for women and 86% for men.
- In June 2024, Voice 2 Diabetes [won](#) the Innovation Grand Prix at the 2024 Cannes Lions International Festival of Creativity.

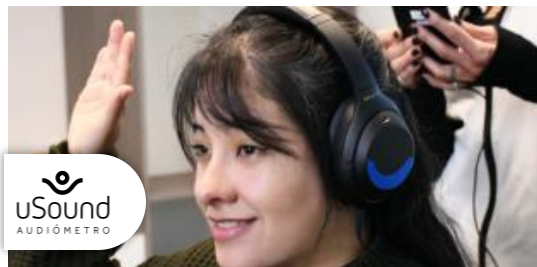
Hearing tests enable easier medical screening at any age

Hearing issues may signal broader health concerns: [New research](#) shows infants later diagnosed with autism have slower brain stem responses to sound. Innovations in hearing tests by health tech firms are enhancing the diagnosis of various conditions, promoting accessibility and equity.



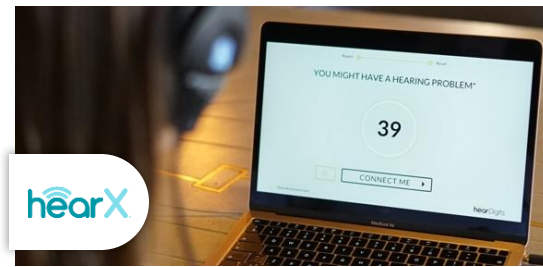
Total funding: [\\$3.51M](#)

- MindAffect has developed a hearing diagnostic system (called Aurora) that uses brain signals to test hearing.
- This solution does not rely on the patient's response, which allows young children, people with disabilities, and other patients who cannot use traditional hearing tests to get checked.
- With Aurora, healthcare providers can more easily diagnose hearing loss that may also indicate the presence of another medical condition.



Total funding: [\\$50K](#)

- uSound is an Argentina-based company that manufactures audiometers, machines that measure hearing acuity.
- The company's audiometer is lightweight and portable, allowing it to be used anywhere.
- It also does not require a soundproof cabin because the audiometer works with noise-cancellation headphones.

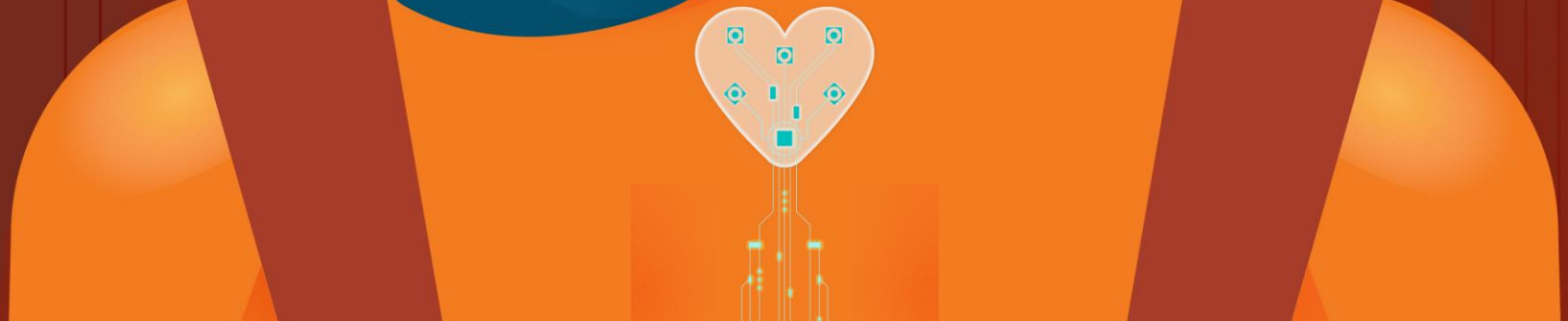


Total funding: [\\$17.1M](#)

- hearX designs digital hearing solutions, from clinical tests to self-testing products.
- hearScreen is the company's portable audiometer product. It's designed to work on a smartphone and can be used to perform hearing tests on children and adults.
- The entire test takes up to two minutes and supports English, Spanish, and French.

TREND 4

Sensory substitution technology supports disabilities



How is sensory substitution tech helping people with disabilities?

Sensory disabilities, or sensory impairments, can affect one or more of the senses, impacting access to visual, auditory, and other key information.

Emerging technologies, such as virtual and mixed reality headsets and AI-enabled haptics devices, are transforming the landscape of sensory substitution for individuals with disabilities.

Through innovations like Neosensory's wrist band that translates sound into vibrations for those with hearing loss, or low vision glasses such as Ayes equipped with AI-enabled navigation technology, these advancements are bridging the gap between different senses.

Moreover, the progress in brain-to-computer interface is establishing a direct pathway between the brain's electrical signals and external devices, empowering individuals with limited mobility to control digital prosthetics using their thoughts.

Chloe Duckworth, CEO and Founder of haptic startup Valance Vibrations, emphasizes the significance of these assistive technologies in providing alternative avenues for processing information, mitigating sensory impairments, enhancing experiences, and broadening communication and exploration possibilities.

“Sensory substitution is a non-invasive technique for circumventing the loss of one sense by feeding its information through another channel. We leveraged this technique to develop a non-invasive, low-cost method to allow people with deafness or hearing impairments to perceive auditory information via small vibrations on their skin.”

David Eagleman, Co-founder and
CEO, Neosensory

[\[Source\]](#)

Where is the momentum now?

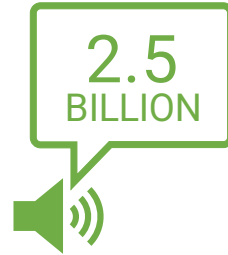
From experiencing sound to regaining the ability to smell, assistive technologies are helping individuals with different sense impairments be more independent and in tune with their surroundings.

Health-related technology is becoming more common among Americans age 55 and older.



Almost [50% of Americans are implementing health technologies](#) into their everyday life due to general aging, while 28% and 22% do so due to mobility and hearing impairments, respectively.

Assistive products are in high demand.



UNICEF and the World Health Organization estimate over [2.5 billion people](#) worldwide need at least one assistive product, such as hearing aids or communication apps.

The global assistive technology market is seeing steady growth.



The assistive technology market—currently valued at \$22B—is projected to grow to [\\$31.22 billion](#) by 2030.

Companies driving innovation in sensory substitution tech

From touch to hearing, assistive products alleviate sensory impairments and empower people with disabilities.

AR & MR FOR LOW VISION

eSight[★]
BY GENTEX CORPORATION

AYES[★]

Eyedaptic[★]

HAPTIC TECH FOR THE DEAF

CUTE[★]
CUTECIRCUIT

MEDICAL
ENVOY[★]

neosensory[★]

BRAIN-TO-COMPUTER INTERFACES (BCIs)

synchron[★]

BRAIN[★]
GATE
FORMING THOUGHT INTO ACTION

NEURALINK[★]

SMELL REHABILITATION TECH

cyrano[★]
THERAPEUTICS

Sensory Restoration[★]
TECHNOLOGIES

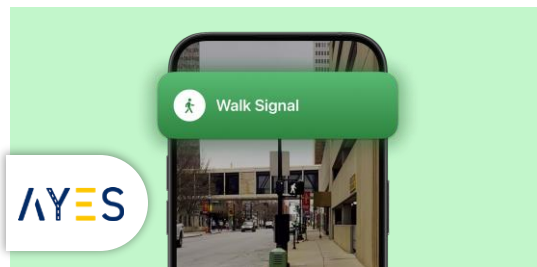
AR & MR* help people with low vision perform everyday tasks

Older adults with impaired vision are [more likely to experience](#) walking difficulties, falls, and fractures. New developments in assistive technology aim to ease the challenges of low vision by helping users perform tasks safely and independently.



Total funding: [\\$14.34M](#)

- eSight manufactures smart eyeglasses for people with significant vision loss.
- The electronic glasses record the wearer's surroundings and display them on two OLED screens, improving visual acuity.
- The average user's vision ranges from 20/60 to 20/800. With eSight, many users achieve 20/20 vision.



Total funding: [\\$1.14M](#)

- Ayes is a Delaware-based startup that has developed an AI pedestrian navigation app.
- It alerts users to pedestrian signals, sidewalks, road closures, and other traffic information.
- The app works without an internet or cellular connection.

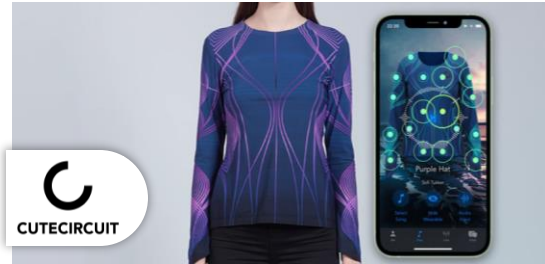


Total funding: [\\$550K](#)

- Eyedaptic designs AR smart glasses for patients with age-related macular degeneration and other vision conditions.
- The EYE5 glasses are lightweight and include facial detection.
- Users can adjust the brightness levels to suit different lighting conditions.
- The glasses work best during stationary activities such as reading or watching TV.

Haptics support those who are deaf or hard of hearing through touch

People who are deaf and hard of hearing have benefited immensely from digital hearing aids. New haptic technologies take these benefits one step further by leveraging touch to enhance the user's hearing.



Total funding: [n/a](#)

- CuteCircuit is a fashion brand that developed the SoundShirt – a shirt that delivers touch sensations using real-time sounds.
- So far, the shirts have been used for experiencing live music (in-person and virtual), video games, and soccer matches.
- The shirt contains 28 microactuators, which wirelessly transmit the audio information and allow the wearer to feel the sensations on different parts of their torso.



Total funding: [\\$23.22M](#)

- Envoy Medical is a hearing health device company.
- Among other hearing aids, the company manufactures bone conduction devices (Esteem implant) which transmit sound vibrations to the patient's inner ear.
- The implant's battery lasts an average of 5 years, after which it can be replaced in an outpatient setting.

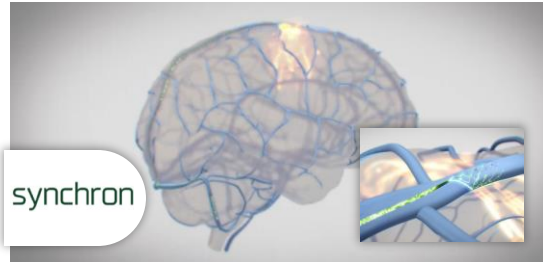


Total funding: [\\$14.2M](#)

- Neosensory has designed a hearing aid called Clarify for people with high-frequency hearing loss.
- Clarify is worn around the wrist and looks like a smartwatch.
- It detects high-frequency sounds and then vibrates to alert the user. After about three weeks, the brain starts to combine inputs from the ear and wrist, improving the user's hearing.

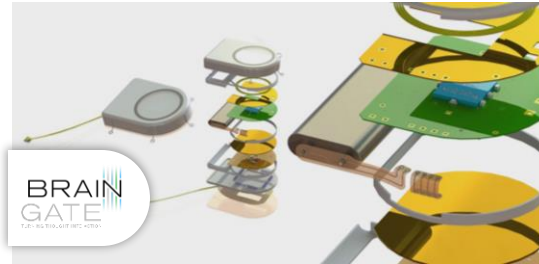
BCIs empower patients with limited mobility

[15+ million people globally](#) have spinal cord injuries from illness or trauma. Emerging brain-computer (BCI) interface startups create direct brain-to-device links, empowering those with limited mobility to use digital prosthetics through their thoughts.



Total funding: [\\$135.7M](#)

- Synchron is a medical device startup that has developed a BCI that helps patients control digital devices with their thoughts.
- The BCI uses an endovascular approach to connect with the brain, avoiding invasive surgery.
- This is done via a device called a Stentrode, which is inserted into the blood vessels and transmits raw brain data.



Total funding: [n/a](#)

- BrainGate is researching BCIs that assist people who have lost limbs or had an injury or illness that impacted their mobility and communication skills.
- By placing micro-electrodes into the brain, BrainGate allows patients to move a computer cursor with their thoughts.
- Early research has also shown the technology allows patients to control prosthetic limbs.



Total funding: [\\$679.7M](#)

- Neuralink is working on a BCI to help people with quadriplegia use computers and mobile devices.
- Neuralink's N1 Implant is placed into the brain tissue and transmits neural signals. Then, the BCI translates them into actions.
- The N1 Implant uses convenient wireless charging — [one patient](#) charges it by wearing a hat that has an embedded charger.

Long-COVID patients receive smell and taste rehabilitation

Although millions of people were affected by a loss of smell and taste before the COVID pandemic, that number has grown significantly, increasing the need to restore taste and smell.



cyrano
THERAPEUTICS

Total funding: [\\$21.8M](#)

- Cyrano Therapeutics is a Florida-based startup that has developed the first pharmaceutical therapy for hyposmia, a decreased sense of smell and taste.
- The company is currently enrolling patients in a clinical trial evaluating the safety and efficacy of its hyposmia treatment, CYR-064.
- The clinical trial will include roughly 150 subjects.



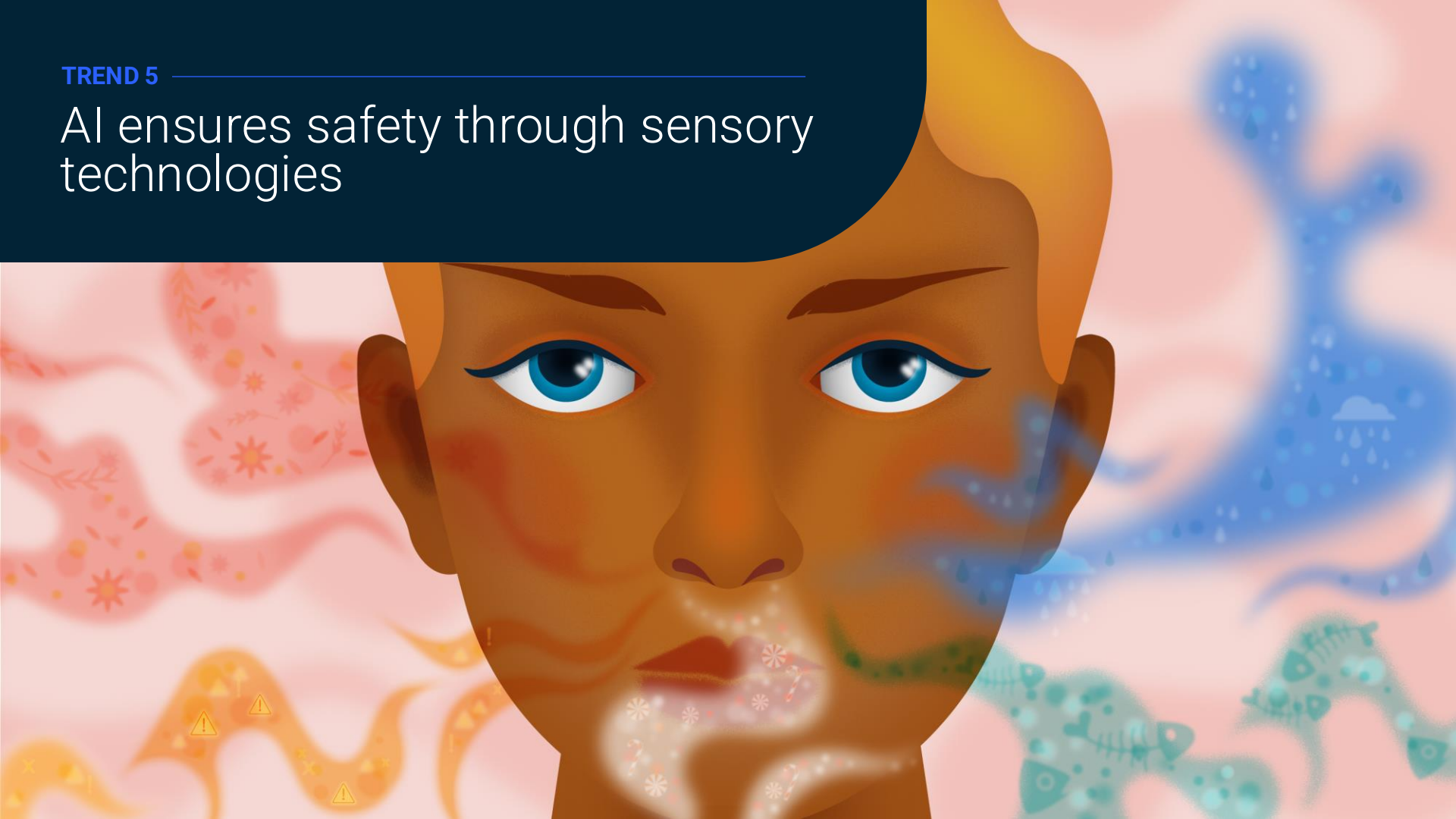
Sensory Restoration
TECHNOLOGIES

Total funding: n/a

- Sensory Restoration Technologies is developing an Olfactory Implant System (OIS) as a treatment for anosmia, the loss of smell.
- According to the company, OIS works similarly to cochlear implants.
- The OIS device works by detecting a smell, translating it into a code, and sending it to the olfactory cortex, which stimulates the brain to perceive smells again.

TREND 5

AI ensures safety through sensory technologies



How are artificially intelligent senses improving human health and security?

When combined with sensory technologies, AI becomes a formidable asset in safeguarding human health and enhancing security.

AI-driven sensory technology processes inputs like sound or smell to convert them into valuable information. For instance, AI security startups utilize voice authentication technology to identify deepfake calls, while advancements in olfactory tech enable computers to detect odors, improving food safety protocols and enhancing bomb detection capabilities.

Alex Wiltschko, CEO of AI olfactory startup Osmo, [envisions a future](#) where digitizing smell aids in early disease detection, rapid pandemic tracking, increased food production, early spoilage detection, pest control, and more.

Moreover, AI-driven "electronic tongues" streamline flavor analysis and simplify food and drug testing processes.

Lastly, proprioception, known as the "sixth sense" for understanding movement and positioning, benefits from ambient remote monitoring technologies. These systems analyze body movements, aiding healthcare professionals in identifying and preventing falls among elderly patients.

While AI is often depicted negatively in fiction, its role in enhancing sensory capabilities for human protection portrays it as a valuable ally in ensuring safety and well-being.

"The human eye is good, but not at observing fast changes. If someone walks 10-15 feet, you only have about 10 to 15 seconds to see what is happening. Our AI knows when a high fall risk patient is getting up on average 30 to 65 seconds before they actually do."

Deepak Gaddipati, Founder,
VirtuSense, a fall risk analysis and
prevention startup
[\[Source\]](#)

Where is the momentum now?

AI-powered sense technology is already making strides in cybersecurity, healthcare, and many other applications

Machine learning helps with fall risk assessment.



The El Camino Hospital in California applied machine learning to detect high-risk patients, reducing [hospital fall rates by 39%](#).

Computers have learned to recognize odors better than humans.



In [a 2023 study](#), a machine-learning model was better at odor recognition for 53% of the tested scent molecules.

AI-powered security solutions, including those with voice detection, attract investor attention.



In the first nine months of 2023, AI security startups received [\\$130.7 million in funding](#), according to Pitchbook data.

Companies behind the groundbreaking AI sense technology

Artificially intelligent senses enhance health and security across food product development, deepfake detection, and fall risk prediction

AI-ENABLED SMELLING

osmo 

SCENTIANBIO 

KONIKU 

IliasAI 

NOZE 

ELECTRONIC TONGUES

Alpha MOS 

CYBERSECURITY AND PRIVACY

Pindrop 

VOICEVANTAGE 

validsoft 

Aware

FALL PREVENTION AND DETECTION

SafelyYou 

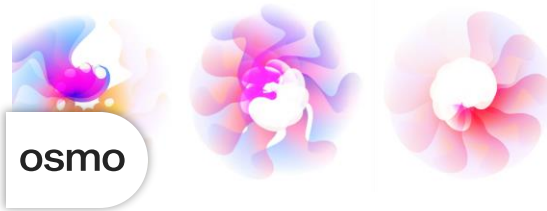
VIRTUSENSE™ 

Cera+ 

OneStep  AvaSure

AI smell detectors signal risks to human safety

Advanced AI olfactory technology holds the promise of identifying illnesses, noxious food scents, and other odors signaling potential risks to human health and safety.



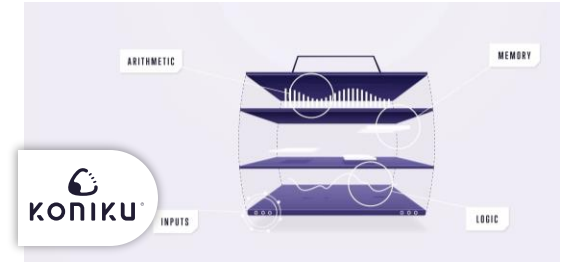
Total funding: [\\$63.5M](#)

- Osmo, a company spun out of Google's research labs, is a Massachusetts-based startup developing technology to give computers the sense of smell.
- The company's AI scent platform can read, analyze, map, and write scents.
- This technology has applications in many industries, including designing better threat detection systems.



Total funding: [\\$4.48M](#)

- Scentian Bio has developed sensor technology that uses insect smell receptors.
- According to the [company](#), these biosensors are several thousand times more sensitive than a dog's nose.
- This technology allows food and beverage manufacturers to detect unpleasant flavors and adulterants.



Total funding: [\\$1.85M](#)

- Koniku develops smell cyborgs, devices that combine silicon with synthetic biology to detect volatile organic compounds in the air.
- The company's goal is to enable users to monitor their health and detect potential illnesses in real time.

Electronic tongues use AI to analyze flavors

AI-powered electronic tongues mimic our sense of taste, simplifying food and medicine testing while improving safety. In a [Washington State University experiment](#), an electronic tongue detected wine contamination four weeks before humans.



Total funding: [n/a](#)

- Alpha MOS develops sensory analysis products, including electronic noses, tongues, and eyes.
- The electronic tongue analyzes different organic and inorganic compounds that impact taste.
- It can also rank product samples using the intensity of different flavors, such as saltiness or bitterness.



Total funding: [n/a](#)

- Students at the Universitas Gadjah Mada in Indonesia have designed an electronic tongue that analyzes water quality.
- The tongue detects minerals and heavy metals, helping avoid the consumption of unsafe water that could lead to health issues.

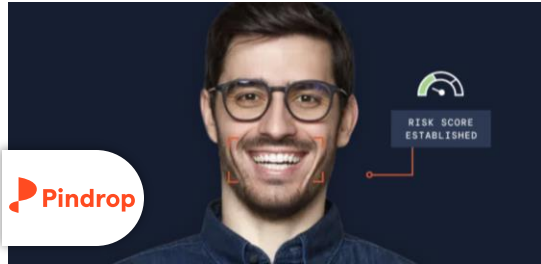


Total funding: [n/a](#)

- A research team at UCL has designed an e-tongue to test the bitterness of medication to improve treatment adherence.
- Currently, the team is using an AI model to predict the bitterness of drugs in development.
- The e-tongue could potentially expedite drug development as researchers could carry out taste tests more quickly.

AI voice analysis boosts cybersecurity and privacy

To counter evolving cybersecurity threats, businesses are adopting biometric voice authentication systems and AI voice verification tools to thwart unauthorized access attempts by threat actors.



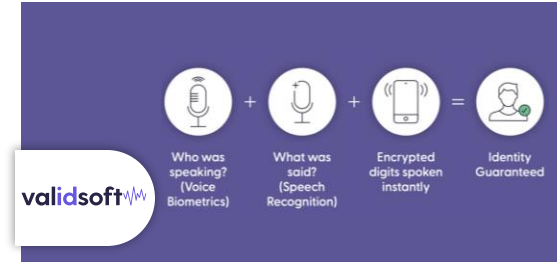
Total funding: [\\$233.52M](#)

- Pindrop is a cybersecurity company that offers voice security and identity verification products.
- Pindrop's AI analyzes a person's voice and flags the presence of patterns that are an indicator of machine-generated speech.
- This allows it to detect deepfakes in real time and automatically generates a liveliness score.



Total funding: [n/a](#)

- VoiceVantage (owned by THC Technologies Corporation) specializes in voice biometrics.
- With VoiceCheck, businesses can implement voice verification into their security application of choice.
- The entire verification process takes less than 1.4 milliseconds.



Total funding: [\\$11.47M](#)

- ValidSoft is a voice-based authentication provider.
- The software helps contact centers, employers, and enterprises protect themselves against threat actors.
- ValidSoft technology can identify acoustic characteristics undetectable to the human ear, providing an extra layer of security.

Healthcare providers leverage AI to detect and predict falls

Proprioception, known as the sixth sense for body awareness, diminishes with age, elevating the risk of falls and potential harm. AI technology enables care providers to predict and prevent falls efficiently, reducing the likelihood of serious injuries or fatalities.



Total funding: [\\$90.12M](#)

- SafelyYou is an AI-powered fall detection solution.
- Using AI cameras, SafelyYou detects falls in real time and immediately alerts medical staff.
- It stores the video of the incident for later review, improving fall prevention by [40%, on average](#).



Total funding: [n/a](#)

- VirtuSense is a healthcare technology company with products used in ambulances and acute and post-acute care.
- [VSTBalance](#) uses AI to detect patients with mobility issues and generate a tailored fall risk score.
- The product can reduce falls by up to 73%.



Total funding: [\\$411.69M](#)

- Cera is a provider of home healthcare solutions, such as live-in care.
- Carers use the Cera SmartCare app to manage visits and track patients.
- The app uses AI to predict fall risk based on different factors, such as poor sleep, with an [83% accuracy rate](#).



Our Call to Innovators

The trends highlighted in this report show how the future of senses will drive and optimize human performance, productivity, and well-being. The startups and technologies behind these trends are helping digitize and augment the senses, creating new business models, experiences, diagnostic techniques, and more.

At VSP Vision™, we are constantly reimagining the way eye care and eyewear are delivered to the world. To fulfill this promise, the VSP® Global Innovation Center (GIC) is actively seeking new startups and technologies to collaborate with on forward-looking innovations, especially around access. Interested in connecting? Let's talk.

GET IN TOUCH WITH US AT
globalinnovationcenter@vsp.com

About the Producers



About VSP® Global Innovation Center

At VSP Vision™, our purpose is to empower human potential through sight. As the first and only national not-for-profit vision benefits company, VSP has been the leader in health-focused vision care, providing affordable access to eye care and eyewear for more than 85 million members through a network of more than 41,000 providers.

The VSP® Global Innovation Center is VSP's lens into the future.

Through emerging technologies, new business exploration, and strategic connections within the innovation ecosystem; a hub for reimagining the way eye care and eyewear are delivered to the world.

To learn more, please visit www.vspglobal.com/innovation



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