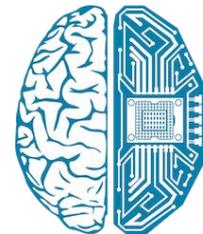


NeuroTech Industry Landscape Overview 2017

**Markets, Trends, Subsectors,
Key Players**



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Neurotechnology Science

Neurotechnology is used to understand and influence the brain and nervous system for the purposes of improving health, education, and cognition. It is a multidisciplinary field that is rapidly growing, and has more impact upon our lives with each passing day. It incorporates advancements in biology, neuroscience, medical imaging and computer science, providing many business opportunities for both established companies and startups.

Neurotechnology encompasses technologies such as diagnostic imaging and monitoring of the brain using fMRI or electroencephalography (EEG); neuropharmacology (drugs as antidepressants or painkillers); enhancements or replacements for sensory systems like cochlear implants or artificial eyes; brain-actuated limb prosthetics and neurostimulation (both invasive and non-invasive) to deliver stimulation to the nervous system like electrodes implanted deep in the brain of Parkinson's disease sufferers to help control some of their symptoms, and more.

The neurotech industry is growing rapidly, accounting for more than \$172 billion in revenues in 2015, with 9% growth [1]. Venture capitalists invested more than \$8.6 billion in new businesses in the sector, and more than 200 different investor groups participated in these financing deals.

[1] <https://www.neurotechindustry.org/access-to-capital>

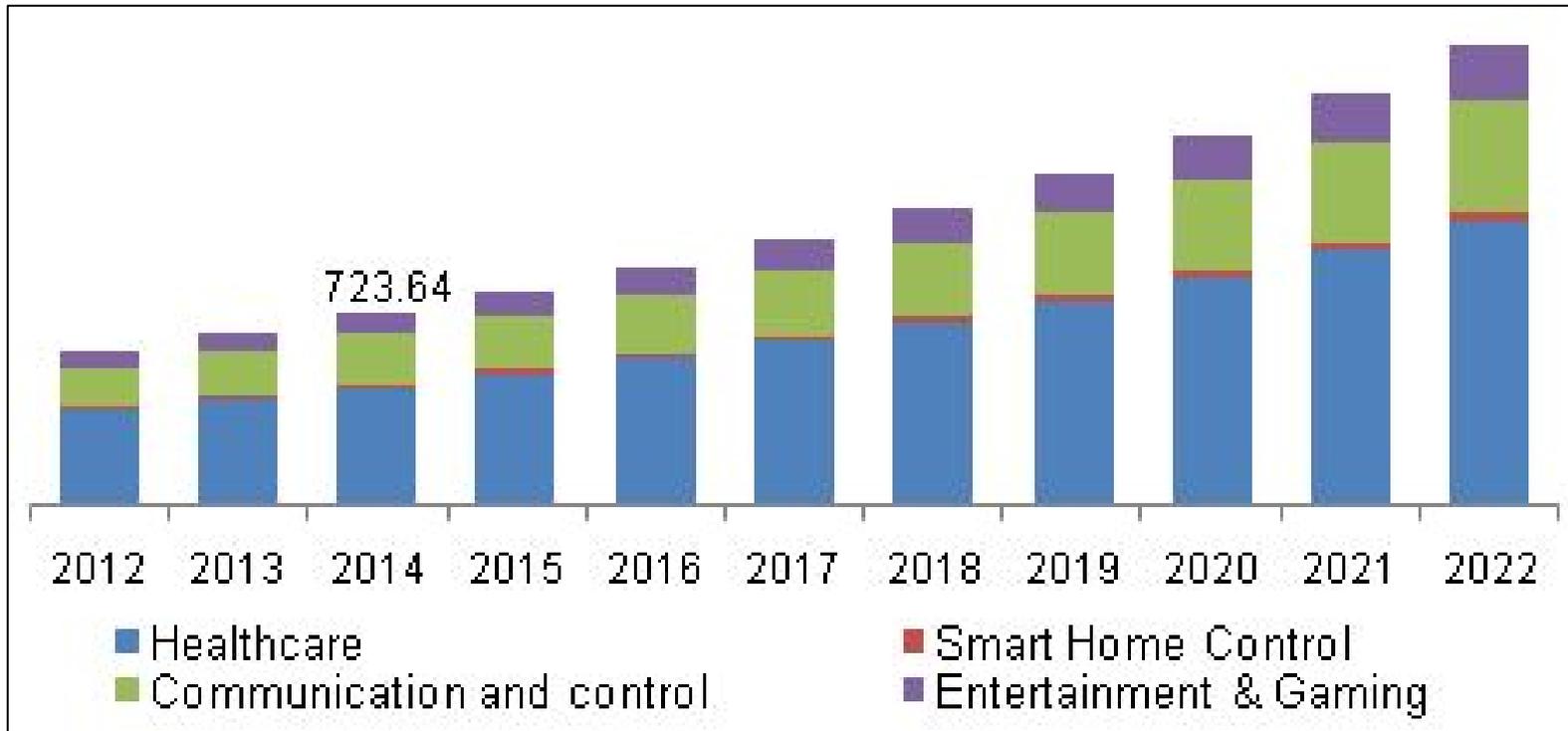
The Rise of Neurotechnology Industry

The growth of financing in neurotechnology is 31% while the average growth for life science investment in general is 12%. Private capital funds invested more than \$19 billion in neurotech companies since the year 2000.

The investment in neurotech is relatively small in comparison with other areas of medicine and biotech but it can have a profound impact in our lives. Neurotechnology has existed for almost a century (EEG was discovered in the early 1930s) but has evolved rapidly in the last two decades. Brain imaging techniques like fMRI have brought a revolution by allowing monitoring the brain activity in almost real time during many experimental conditions.

Modern neurotechnology can image almost all aspects of brain activity and control to some extent certain functions: it can alleviate symptoms of depression, an increase or decrease of activation as experienced in ADHD, help with sleep deprivation and enhance sleep depth or ameliorate insomnia, reduce epileptic seizures or tremors in Parkinson's disease, assist with rehabilitation after a stroke and create a sensory-motor loop with brain controlled limb prosthetics.

The future of this industry will see advanced control of neurological disorders and conditions, modulation of brain states (from mood to attention to learning itself), and other applications that only time itself will reveal.



Source: <https://www.grandviewresearch.com/industry-analysis/brain-computer-interfaces-market>

Global brain computer interface market, by application, 2012 - 2022 (USD Million)

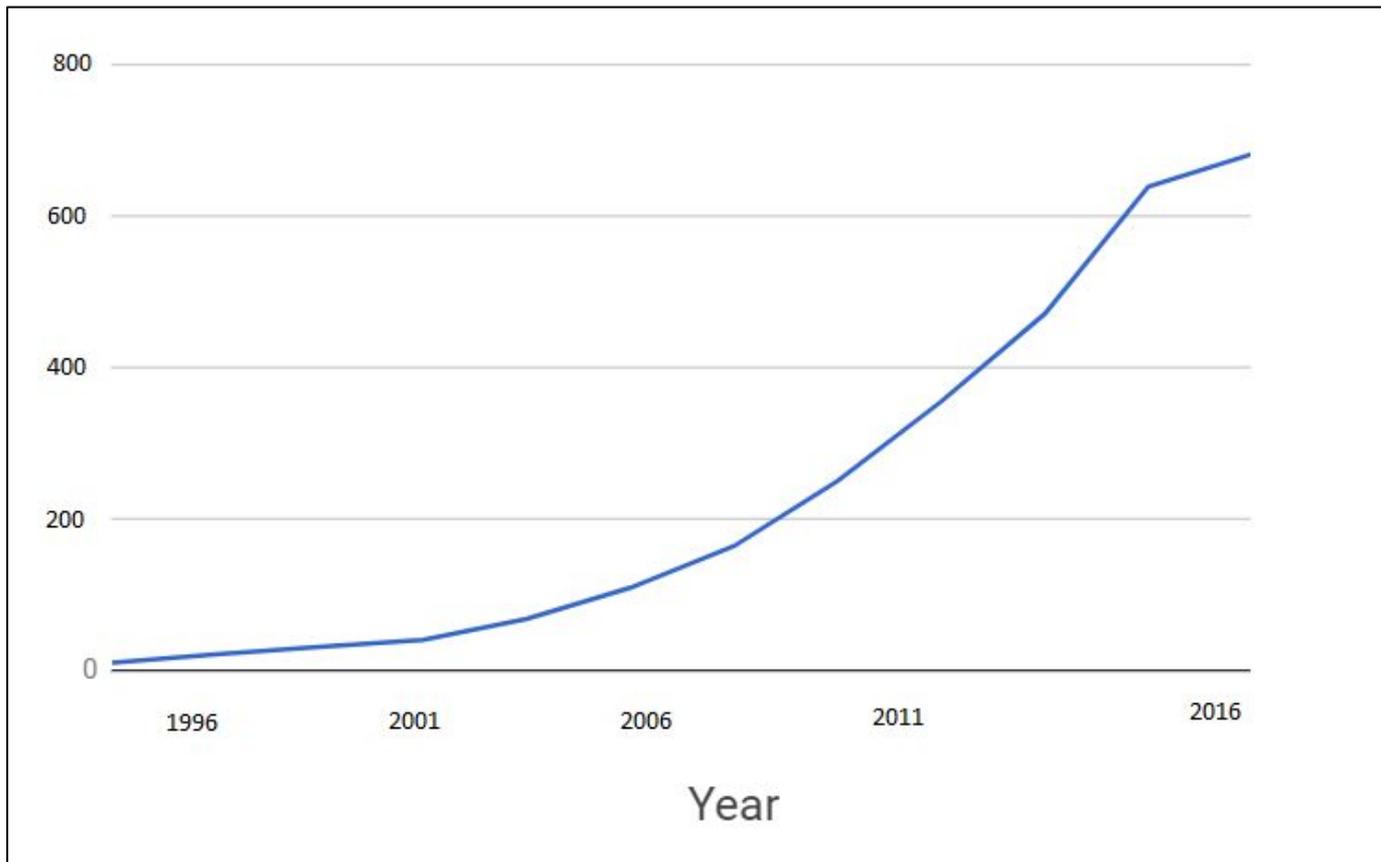
Crowdfunding - BCI/EEG

| | | | | |
|-------|--------------------------------|--------------|-----------------|--------------------|
| 2012: | InteraXon Muse | \$288 000 | (1,614 backers) | Meditation |
| 2012: | NeuroDreamer | \$66 500 | (351 backers) | Sleep |
| 2013: | Melon | \$290 000 | (2,723 backers) | Brain Insight |
| 2013: | OpenBCI #1 | \$215 000 | (947 backers) | Makers / Education |
| 2013: | Emotiv Insight | \$1 650 000 | (4,459 backers) | Brain Insight |
| 2014: | FocusBand | \$84 000 | (210 backers) | Brain Insight |
| 2014: | Aurora iWinks | \$239 000 | (1,428 backers) | Sleep |
| 2015: | Kokoon | \$1 900 000 | (8,489 backers) | Sleep |
| 2015: | OpenBCI #2 | \$169 000 | (644 backers) | Makers / Education |
| 2015: | Neuroon | \$438 000 | (1,944 backers) | Sleep |
| 2016: | Neeuro | \$80 730 | (486 backers) | Brain Training |
| 2016: | iBand+ | €644 249 | (3,958 backers) | Sleep |
| 2016: | Sleep Shepherd | \$864 089 | (794 backers) | Sleep |
| 2016: | Super Brain II | \$70 000 x2* | (132 backers) | Sleep |
| 2016: | Melomind | €169 420 | (858 backers) | Relax / Stress |
| 2016: | Aware | \$150 952 | (717 backers) | Hearable |

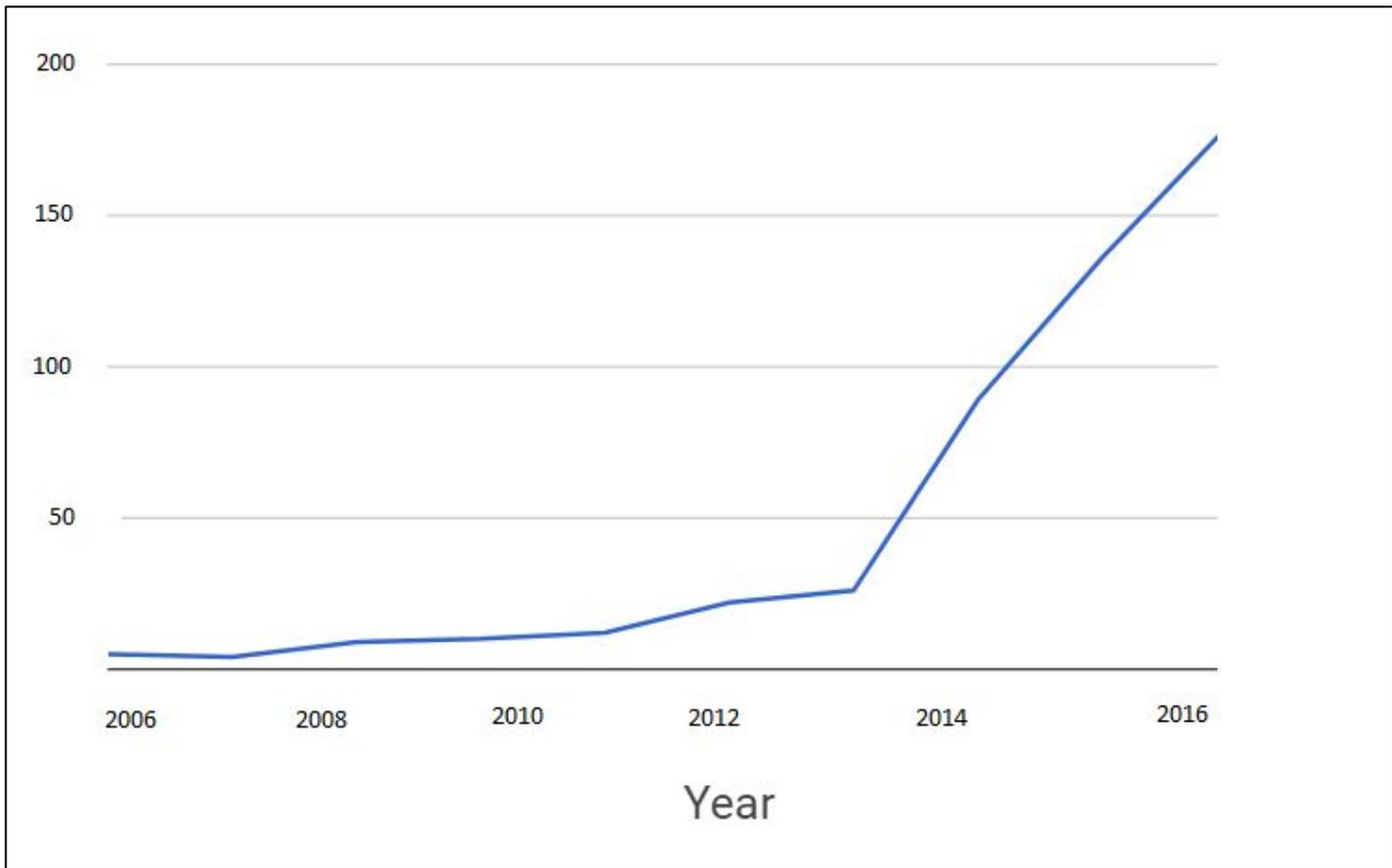


Crowdfunding for BCI & EEG Products.

Source: <https://medium.com/neurotechx/eeg-bci-crowdfunding-landscape-cfdb0da08937>



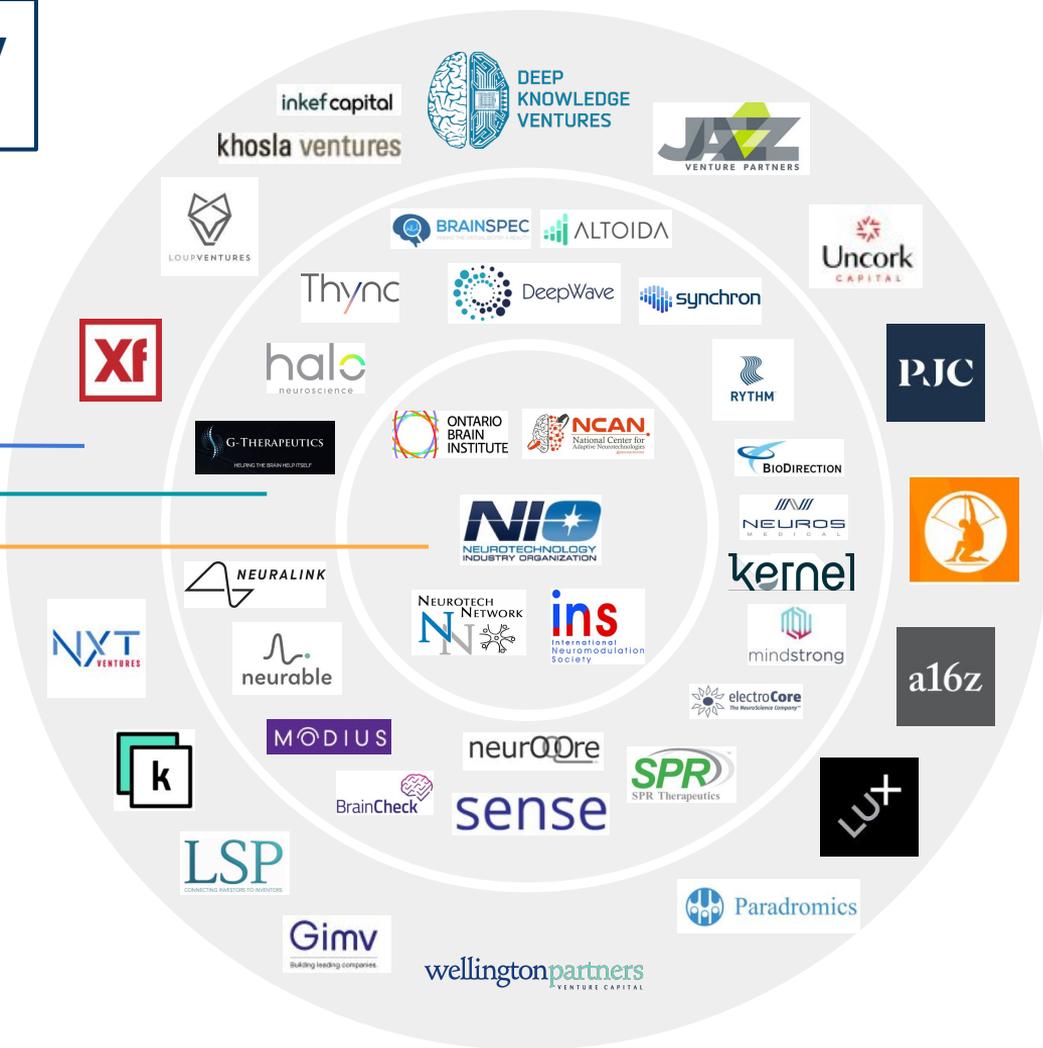
Number of scientific papers on brain-computer interface on PubMed



**Number of scientific papers containing the word
"neurotechnology" on PubMed**

NeuroTech Industry Landscape 2017

- INVESTORS
- STARTUPS
- NONPROFITS



SleepTech: a Growing Sector of NeuroTech

- One particularly powerful neurotech subsector emerging today is SleepTech.
- Sleep is the gateway to health, affecting myriad bodily processes, in particular memory, cognition, mood, and cardiometabolic health.
- While this subsector is still young, with relatively few key players and companies, it is a sector poised to experience massive growth over the next few years.

Major Benefits of Improved Sleep:

- Memory
- Learning
- Mood
- Alertness
- Focus

Comparison of NeuroTech Companies

| Company | Scientific publications covering their core science | Clinical trials validating their product | Aspirations for medical devices market | Neuroscientists on management team | Total disclosed funding | Sleep Tech |
|-----------------------|---|--|--|------------------------------------|-------------------------|------------|
| Kernel | - | - | + | + | 100M | - |
| G Therapeutics | + | + | + | + | 40.8M | - |
| Rythm | + | + | - | + | 22.5M | + |
| Thync | + | + | - | + | 13M | + |
| Halo Neuroscience | - | - | - | + | 10.7M | - |
| Synchron | + | + | + | + | 10M | - |
| BrainCo | - | - | - | + | 5.55M | - |
| Neurable | - | - | - | + | 2.33M | - |
| Neuralink | - | - | - | + | 27M | - |
| DeepWave Technologies | + | + | + | + | Seed | + |

What to Expect in the Next Few Years

- The global neurotechnology industry has witnessed the substantial expansion during the past five years, while in 2016-2017 there was a boom in powerful new techniques for imaging, analyzing and modulating neural activity.
- There are 2 major areas within the NeuroTech industry: brain-computer interfaces, which can be considered to be related to the IT & AI industries, and advanced NeuroTech approaches to HealthTech.
- In 2018-2020 we will observe the convergence of NeuroTech, AI, and SleepTech for personalized precision medicine.
- SleepTech is one of the most promising sectors of the NeuroTech industry and will have major impact on heart health, cardiometabolic health and diabetes.
- Many projects that had high level of consumer orientation 1-2 years ago now seem to be overestimated and failed to meet expectations.
- In 2018 we will see new neurotech industry players with strong scientific foundation, strong core IP, and achievable MVPs. The key players will be developing wearable devices enhancing sleep, cognition, and cardiometabolic health.
- Now is the best time for investors to enter the NeuroTech for advanced HealthTech industry.

NeuroTech Companies Profiles



About:

Kernel is an early-stage brain-machine interface company formed by Bryan Johnson, founder of the online payments company Braintree and the OS Fund. While originally intending to build memory prostheses which would allow for the external storage and subsequent upload of human memories into the hippocampus, the company has since pivoted and is now working on a way to measure and stimulate the electrical impulses of many neurons at once. The technology will be used clinically for diseases such as depression or Alzheimer's.

Select Investors: Bryan Johnson (founder, Braintree)

Total Disclosed Funding: \$100M

Website: <https://kernel.co/>

Mission:

Kernel is a company originally created by the founder of Braintree, Bryan Johnson, to develop implantable prosthetic devices capable of providing an interface between the brain and hardware to assist, supplement, and augment functions related to memory in individuals suffering from congenital or degenerative neurological disfunction. Currently, Kernel has narrowed the focus of its efforts on devising a method that allows the concurrent measurement and stimulation of groups of neurons to assist in the clinical treatment of diseases as disparate as Alzheimer's or depression.



About:

G-Therapeutics, based in Switzerland, is developing an implantable neurostimulation device that delivers specific bursts of electrical stimulation in order to facilitate the activation of leg muscles. The device is initially intended for patients suffering from spinal injuries resulting in varying degrees of lower-limb paralysis. The complete therapy combines electrical spinal cord stimulation with gravity-assisted physical training in order to promote remodeling of the neural circuits required for mobility.

Select Investors: INKEF Capital, Life Sciences Partners, Wellington Partners, Gimv

Total Disclosed Funding: \$40.8M

Website: <https://www.gtherapeutics.com/>

Mission:

Swiss company G-Therapeutics is designing a unique therapy method that combines the use of a neuro-stimulating implant with motion feedback and gravity-assisted training to assist in the regeneration of neuronal pathways for patients who have lost use of their legs as a result of spinal cord injuries.

**About:**

Rythm, founded in France and now based in San Francisco, is a neurotechnology startup that has developed a sleep-monitoring head-mounted, wearable called the Dreem. The device uses EEG electrodes to monitor and analyze brain activity during the course of sleep. It then uses “bone conduction technology” to modulate brain activity via emitting subtle sounds at precise moments that enhance the overall quality of deep sleep. The device is linked to an app that displays sleep metrics and personalized tips based on the user’s sleep habits.

Select Investors: Innovation Commission 2030, Laurent Alexandre, MAIF Avenir, Xavier Niel

Total Disclosed Funding: \$22.5M

Website: <https://dreem.com>

Mission:

San Francisco’s Rythm is a Parisian company that has developed a wearable device, Dreem, consisting of a headband with embedded EEG sensors to monitor brain activity during sleep. The device analyzes the data and delivers sound stimulation at the appropriate time to improve sleep quality. An app for Android and iOS can be also be used to control the device and wake up the wearer gently at a predetermined time.



About:

Thync has developed a small, wearable “pod” that attaches to the back of the neck and uses neurostimulation to combat stress and promote better sleep. Their lead product, the Thync Relax Pro, uses low levels of electrical stimulation to activate nerve pathways in the head and neck. According to the company, these pathways communicate with areas of the brain to help control stress levels and sleep quality. The product is intended specifically for consumers who frequently suffer from stress and consequently struggle to sleep.

Select Investors: Khosla Ventures, Andreessen Horowitz, Noosphere Ventures

Total Disclosed Funding: \$13M

Website: <https://www.thync.com/>

Mission:

Los Gatos based Thync produces a wearable device that attaches to the back of the neck through replaceable sticky pads and delivers neurostimulation to specific nerve pathways to lessen stress and promote deeper sleep. Their lead product, the Think Relax Pro, uses low level electrical stimuli controlled by the user through a phone app. The user can either choose a relaxing program to combat anxiety, or one designed to improve sleep .



About:

Halo Neuroscience, based in San Francisco, has developed a brain-stimulating device called the Halo Sport. The device sends weak electrical pulses into the consumer's brain in order to enhance the efficiency of physical training. The product is based on the concept of neuropriming, i.e. using electrical stimulation to increase plasticity in the brain prior to an activity. As per the company, when paired with physical training, this results in increased strength, endurance, and muscle memory.

Select Investors: Andreessen Horowitz, Lux Venture Capital, SoftTech VC, Jazz Venture Partners, Kima Ventures, Xfund

Total Disclosed Funding: \$10.7M

Website: <https://www.haloneuro.com/>

Mission:

Halo Neuroscience has produced the Halo Sport, a device contained in a functional headphone set that sends low-level electrical impulses directed to the motor cortex to improve the efficiency of sport training by enhancing muscle memory through a priming effect that promotes neuroplasticity. When the user is training, the electrical signals are timed to reach the cortex slightly ahead of the desired motion, priming it and increasing its resulting strength and precision. According to the company, this principle can also aid training musicians.



About:

Synchron is developing an implantable device called the Stentrode system that will provide a safe way for paralyzed patients to achieve direct brain control of mobility-assistive devices. The system involves a small and flexible device that can pass through cerebral blood vessels to implant in the brain where it will be able to interpret electrical data emitted by neurons. The company is currently preparing for early-stage clinical trials in order to evaluate the safety and feasibility of the device to enable patient-directed brain control.

Select Investors: DARPA, U.S. Department of Defense, Neurotechnology Investors

Total Disclosed Funding: \$10M

Website: <http://www.synchronmed.com/>

Mission:

Synchron is developing the Stentrode, an implantable device meant to interface with the motor cortex and restore mobility to patients who suffer from movement disorders including paralysis and epilepsy, by providing a way to interpret and relay signals from the brain to assistive technologies. The Stentrode is meant to be implanted through the blood vessels of the brain and the start of clinical trials is imminent.



BrainCo

your brain controls everything

About:

BrainCo, a product of the Harvard Innovation Lab, specializes in brain-machine interface wearables. The company currently develops two products, the Focus Series and the Lucy Series. The Focus is a wearable headband that monitors brainwaves to provide real-time classroom attention feedback to teachers. The Lucy, another headband, is intended to allow the user to directly interact with electronic devices such as toys or robotic appliances using only brain signals .

Select Investors: Boston Angel Club, Hantan Capital, Wandai Capital

Total Disclosed Funding: \$5.55M

Website: <http://www.brainco.tech/#/>

Mission:

BrainCo is developing two wearable products: the Focus, a headband that measures brainwaves to assess student's attention in the classroom and provide real time feedback to teachers, and the Lucy, a headband that allows the user to control smart household appliances and toys with their brain signals through an app installed on their phone. The company website lists these products available for preorder.



About:

Neurable is developing brain-computer interfaces that allow people to control software and devices using only their brain activity. The software makes use of machine learning methods in order to reduce the lag time between analysis of neural activity and output, potentially reducing it down to real-time. While the company eventually intends to allow patients unable to communicate to have greater control over their environment, it is initially targeting the AR/VR gaming industry.

Select Investors: Loup Ventures, NXT Ventures, PJC, BOSS Syndicate.

Total Disclosed Funding: \$2.33M

Website: <http://www.neurable.com/>

Mission:

Neurable is a company that is developing devices and software for use in virtual and augmented reality environments. These devices allow the users to control their virtual environment exclusively with their brainwaves. Early applications are aimed at the gaming community, but could be expanded to mixed reality environments with private and workplace applications at corporate and consumer level.



About:

Neuralink, the secretive brain child of electric car, solar power, and space pioneer Elon Musk, is working on building brain implants to directly link human minds to computers. The company has hired a diverse team of engineers ranging from the young brain-machine interface expert Max Hodak to leading neurosurgeon and electrical engineering PhD Ben Rapoport. While information regarding their specific approach is limited, it is understood that the company's goal is to make AI an extension of the human brain, essentially creating a symbiotic human-AI relationship.

Select Investors: Elon Musk

Total Disclosed Funding: 27M

Website: <https://www.neuralink.com/>

Mission:

Neuralink, a company owned by Elon Musk, the founder of Tesla and SpaceX is hiring many leading specialists, from leading engineers to neurosurgeons, to work on a project that purportedly is aimed at creating implantable devices that will enable the uploading and downloading of information to and from the brain in a manner similar to that of "neural lace", a sci-fi concept envisioned by author Iain M. Banks. These devices would provide a permanent brain-machine interface, initially meant to overcome the limitations of users due to injury or trauma, and later to offer elective AI enhancement to users with normal brain function. Details of the project have not yet been released.



About:

Deep Wave is enhancing memory and cognition by enhancing the process of Slow Wave Sleep (SWS), or “deep sleep” through technology out of Northwestern University and funded through Military and Google X grants, and the underlying technology has been covered in top scientific journals along with high-profile media including Time Magazine, WSJ, Smithsonian, FOX News, Huffington Post and several others. SWS is the most restorative phase of sleep and is responsible for memory consolidation (i.e. transferring memories from short term to long term storage). Using a patented algorithm, Deep Wave’s founding scientist, Dr. Giovanni Santostasi, has been able to enhance SWS using sound alone, and individuals upon which it was tested have shown dramatic improvements in memory as a result of using the device for just one night. He first tested the amount that users’ scores on memory tests improved before and after sleep to measure the amount of memory enhancement occurring during a normal night’s sleep. The device uses EEG to detect individual brain waves and to synchronize the delivery of sound to each individual brain wave, which is one of the principal factors behind the device’s ability to enhance the memory-strengthening effect of SWS by 200-400%.

Select Investors: Deep Knowledge Life Sciences

Total Disclosed Funding: N/A

Website: <https://www.deepwave.tech/>

Mission:

DeepWave technologies have been developed through years of neuroscience research by top talents in the field, including scientists from Northwestern University Medical School. Used in conjunction, they form the core of a non-pharmacological, non-invasive approach to enhancing slow-wave sleep (SWS) and its therapeutic benefits. Based on its original technologies, DeepWave’s patent-pending solution uses an EEG-based wearable to accurately detect the different stages of sleep. Once SWS is detected, the wearable delivers a pulse of pink noise to stimulate the brain waves, optimizing this deepest and most restorative phase of sleep. By improving sleep quality, DeepWave’s solution dramatically boosts memory and learning, increases focus and reduces stress. Research also proves that sounder sleep can significantly reduce the risk for stroke, depression, heart attack, hypertension, obesity and diabetes. Basically, when you sleep better, you think smarter and live healthier.



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