Open Schools Journal for Open Science

Vol 8, No 2 (2025)

Vol. 8 No. 2 (2025): Open Schools Journal for Open Science - Special Issue -IDEA Conference Proceedings

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doi: 10.12681/osj.43778

To cite this article:

Lavant, A., Lalagkas, R., & Lymperopoulou, I. (2025). 2024: LAST YEAR'S BIGGEST INNOVATIONS IN HEALTH. *Open Schools Journal for Open Science*, *8*(2). https://doi.org/10.12681/osj.43778

2024: LAST YEAR'S BIGGEST INNOVATIONS IN HEALTH

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Abstract
The year 2024 witnessed ground-breaking advancements in healthcare technology, with new innovations reshaping the way we approach patient care and treatment. From brain implants that boost neural activity to artificial devices that can mimic the functions of a heart, these innovations have the capability to help numerous people in need. This paper explores the most significant of these technological breakthroughs and the individual stories behind them.
Key words: *innovation, artificial intelligence, neurotechnology, microchip, implant*

1. Introduction

The paper is essentially made up of three interconnecting parts – three different inventions, that each, in their way, enhances outcomes, reduces costs, and improves accessibility.

- The first invention is the Neuralink Microchip, a brain implant that achieves seamless communication between the human brain and digital devices.
- The second invention is the Double Neural Bypass, an external neural path that reconnects the brain with the other body parts in the event of paralysis
- The third invention is the BiVACOR Total Artificial Heart, an implantable replacement for patients suffering biventricular heart failure.

2. Neuralink

a) Introduction

Neuralink is a neurotechnology company founded by Elon Musk. Its aim is to provide help to those with kinetic disabilities and has already done so by launching a special neurochip that can enable them to control electronic devices around them just using their brain. This groundbreaking concept has changed the way many scientists around the word view technology in the health industry.

b) The structure of the chip

The neurochip consists of six parts. The first part is called the threads, they are super thin, and they are the ones responsible for recording neural activity, this part is also key so that the brain damage during the implantation is minimized. Then, there are the chips and electronics. They prosses the neural signals and wirelessly transmit the data to the neuralink app. The third part is the battery, the neurochips battery is so special that it can be charged via a wireless charger that can be used anywhere. Finally, there is also the biocompatible enclosure, this is one of the most important parts, because it withstands physiological conditions several times harder than those in human body.

c) The surgical robot

The surgical robot has been designed to reliably and efficiently insert the threads exactly where they need to be, which is a specific area in the top of our head. The use of a special robot is inevitable because of the thinness of the threads, the human hands cannot handle inserting such delicate and thin structures.

d) Results and the general idea

This revolutionary invention was founded to help people with kinetic disabilities in their everyday lives. The neurochip restores personal control over limbs, prosthetics, or communication devices and enables users to control devices solely through thought. That is because it records and decodes neural signals from individual neurons and then transmits them back into the brain using electrical stimulation. The fact that this is possible continues to fascinate us and is a reminder that technology evolves rapidly.

e) Conclusion

Neuralink has a very optimistic goal and is only one of the many examples that prove to us that technology, if used correctly, can do marvels. There is a lot of people who are interested in doing the implantation and the number constantly increases. But there is also scrutiny about how safe is actually, which leads to the question: What if everyone invests in n Neuralink? Will our brain control the neurochip, or the opposite?

3. Double Neural Bypass

a) Introduction

The Double Neural Bypass is an invention which was created last year thanks to one person – Keith Thomas. Keith actually suffers from paralysis due to a diving accident he had, leading to him being completely unable to move neck-down and being fully catered for by his sister, Michelle. However, in order for Keith's contribution to the invention of the Double Neural Bypass to become perfectly clear, a deeper understanding of this new pioneering technology -and the problem it aims to solve- is needed.

b) The problem

The reason we can move different parts of our body when we will to do so, is because the messages that our brain produces travel with the help of the neural system to the appropriate receivers or muscles, that then comply. When it comes to paraplegic people the problem is the following: Since their spinal cord is damaged, the neural paths that are inside of it are actually inoperable. Therefore, while paraplegic people can often move parts of their face, the messages that the brain sends cannot be relayed waist-down.

c) The technology

This groundbreaking invention combines brain-computer interfaces with neurostimulation to overcome this barrier. Five microchips are implanted in the brain's motor and sensory regions. These chips act as an electronic bridge, allowing brain signals to be interpreted by AI algorithms and sent to the connected computer. This way an external neural path is created. In short, the brain creates a signal, which is then captured by the implants, decoded by a computer, and used to instruct the body to move.

d) Keith's Experience

The project began when a team from Northwell Health's Feinstein Institutes for Medical Research contacted Keith. Unlike previous efforts, their goal was to allow both movement and sensation, hence the "double" in the name of the invention. After undergoing surgery, Keith woke up with a chip implanted in his head. With the help of proper scientific equipment and researchers monitoring him at all times, he was able to actually move his hand for the first time since the accident, touch his sister's hand, and experience the sensation of touch through a very emotional handshake.

Photo 1: *Keith's and Michelle's first handshake with the help of the Bypass*

e) Conclusion

This innovation paves the way for future studies and inventions in neuroprosthetics, a rapidly evolving field of brain-computer interfaces. Since the start of the experiment, Keith improved over 100% in arm strength, but the Bypass also restored sensations, which can last even without it being turned on. This development holds promise for further advancements in medicine and opens new possibilities for those with paralysis.

4. BiVACOR Total Artificial Heart

The BiVACOR Total Artificial Heart (TAH) is an implantable mechanical device designed for patients with biventricular heart failure. It functions as both a short- and long-term heart replacement, especially for patients awaiting transplant.

It utilizes centrifugal rotary pumps and magnetic levitation (MAGLEV) technology to replace both ventricles. A dual-sided rotor, suspended between two chambers, propels blood through both the systemic and pulmonary circuits.

Features (P.S.D.S.P.):

- Powerful
- Smart
- Durable
- Small
- Portable

Testing and Results:

- Durability tests involved immersing the pumps in saline for a year
- Implanted successfully in five calves for 30 days
- First human implantation: July 2024 at Baylor St. Luke's – patient survived 8 days on the device before a heart transplant
- Second human case: November 2024 at Duke Medical Institution

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