

# TECH SCAN

## BRAIN CHIP IN HEALTHCARE





Brain-chip and brain-computer interface (BCI) technologies are emerging healthcare tools that restore communication, mobility, and neurological function by converting brain signals into commands for devices like prosthetics, robotic limbs, and speech systems. Today, these systems are actively deployed in healthcare to re-animate paralyzed limbs via mind-controlled exoskeletons, restore conversational speech to ALS patients, suppress epileptic seizures, and halt Parkinson's tremors.

India is positioning itself in the neurotechnology landscape by transitioning from consumer EEG to clinical-grade devices. Strengths lie in brain-signal processing, low-power electronics, rehabilitation robotics, and assistive technologies, supported by the India Semiconductor Mission (ISM 2.0), IISc Bangalore, IITs, National Institute of Mental Health and Neuro Sciences (NIMHANS) and startups.

From an IP perspective, BCIs offer strong patent opportunities in hardware, software, signal processing, and medical systems. Key areas include neural electrodes, implantable chips, AI decoding algorithms, neuromodulation systems, and rehabilitation technologies. India's strategic advantage lies in protecting software-driven solutions and cost-effective device designs, enabling strong positions in neurorehabilitation and assistive care.

# INNOVATION TIMELINE

## Foundational Neurophysiology Era

**1791**

Galvani demonstrates bioelectricity.

## Early Neural Engineering & Non-Invasive Paradigms

**1924–1929**

Berger records the first human EEG.

**1973**

Vidal introduces the BCI concept.

**1988**

Farwell and Donchin develop the P300 speller.

**1991**

Wolpaw demonstrates EEG-based cursor control.

## First Clinical & Invasive Implants

**1997**

Deep brain stimulation approved for clinical use.

**2004–2006**

BrainGate demonstrates intracortical BCI control in humans.

## Wireless, Endovascular & AI Scale-Up

**2019**

Synchron introduces an endovascular BCI.

**2021**

BrainGate achieves high-bandwidth wireless intracortical communication.

**2023**

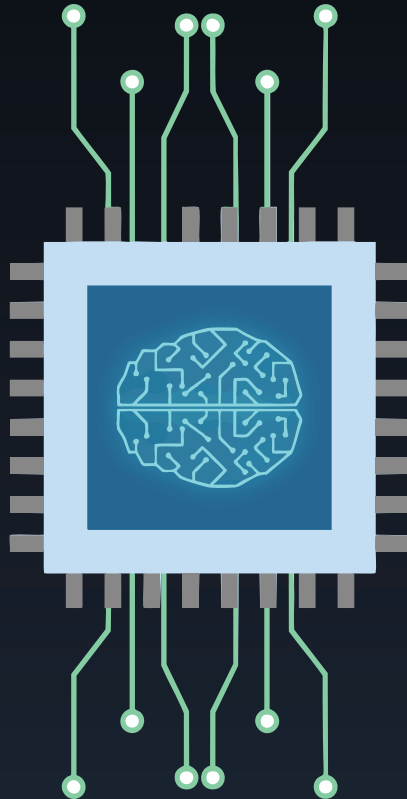
Speech neuroprostheses decode attempted speech into text.

**2024**

Neuralink performs its first human implantation.

**2026 onward**

AI-driven adaptive sensing–decoding–stimulation systems.



## Multi-Sensory & Closed-Loop Frontiers

**2012**

BrainGate controls a multi-degree-of-freedom robotic arm.

**2013**

Responsive neurostimulation introduces closed-loop therapy.

**2016**

Fully implanted BCIs reach independent home use in ALS.

# PATENTABLE COMPONENTS

## Signal Acquisition

### a. Invasive

- Electrocorticography (ECoG) Arrays
- Penetrating Microelectrodes / Probes
- Biocompatible Metal Electrodes
- Advanced Nanomaterials

### b. Non-Invasive

- Wet Electrode EEG Caps
- Dry Electrode EEG Caps
- Functional Near-Infrared Spectroscopy (fNIRS) Optodes
- Magnetoencephalography (MEG) Dewars
- Functional Magnetic Resonance Imaging (fMRI) Coils

## Preprocessing

- Analog Hardware Filtering
- Programmable Gain Amplifiers
- Microcontrollers (MCU) / FPGAs
- Impedance Matching & Protection Layers

## Feature Extraction

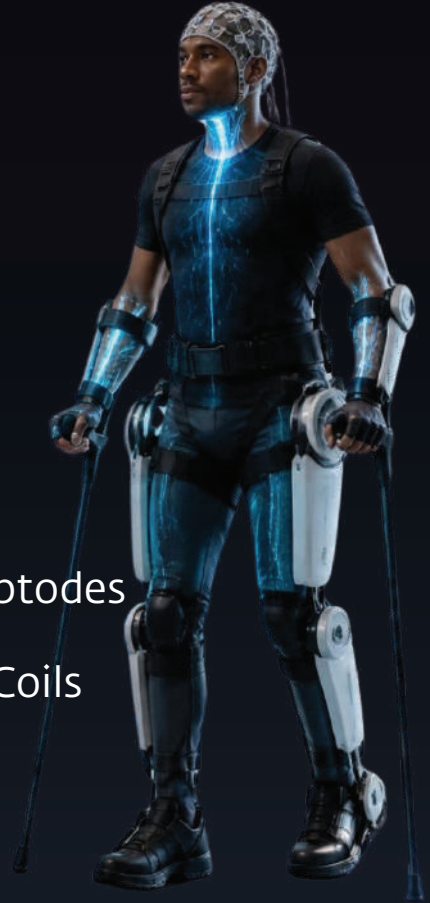
- Edge Graphic Processing Units (GPUs) & AI Accelerators
- Digital Signal Processors (DSPs) & Microcontrollers (MCUs)
- Application-Specific Integrated Circuits (ASICs) & Neuromorphic Chips

## Signal Translation

- Implanted Ultra-Low Power Neural Decoders (ASICs)
- Multi-core Neural Processing Units (NPU)

## Control Devices

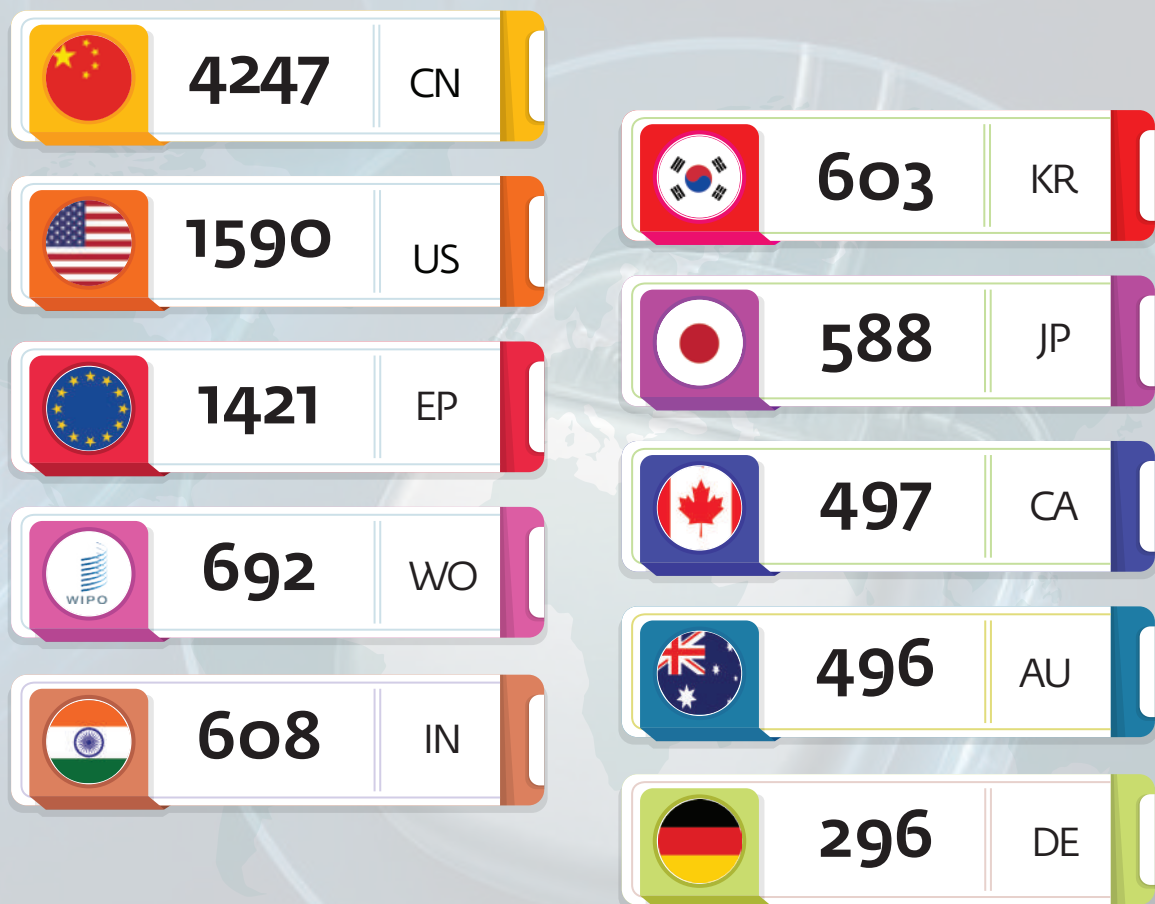
- Neuroprosthetics & Robotic Manipulators
- Mobility & Assistive Machinery
- Communication & Environmental Interfaces
- Closed-Loop Neuromodulators (Therapeutic Controllers)



## PATENT STATISTICS



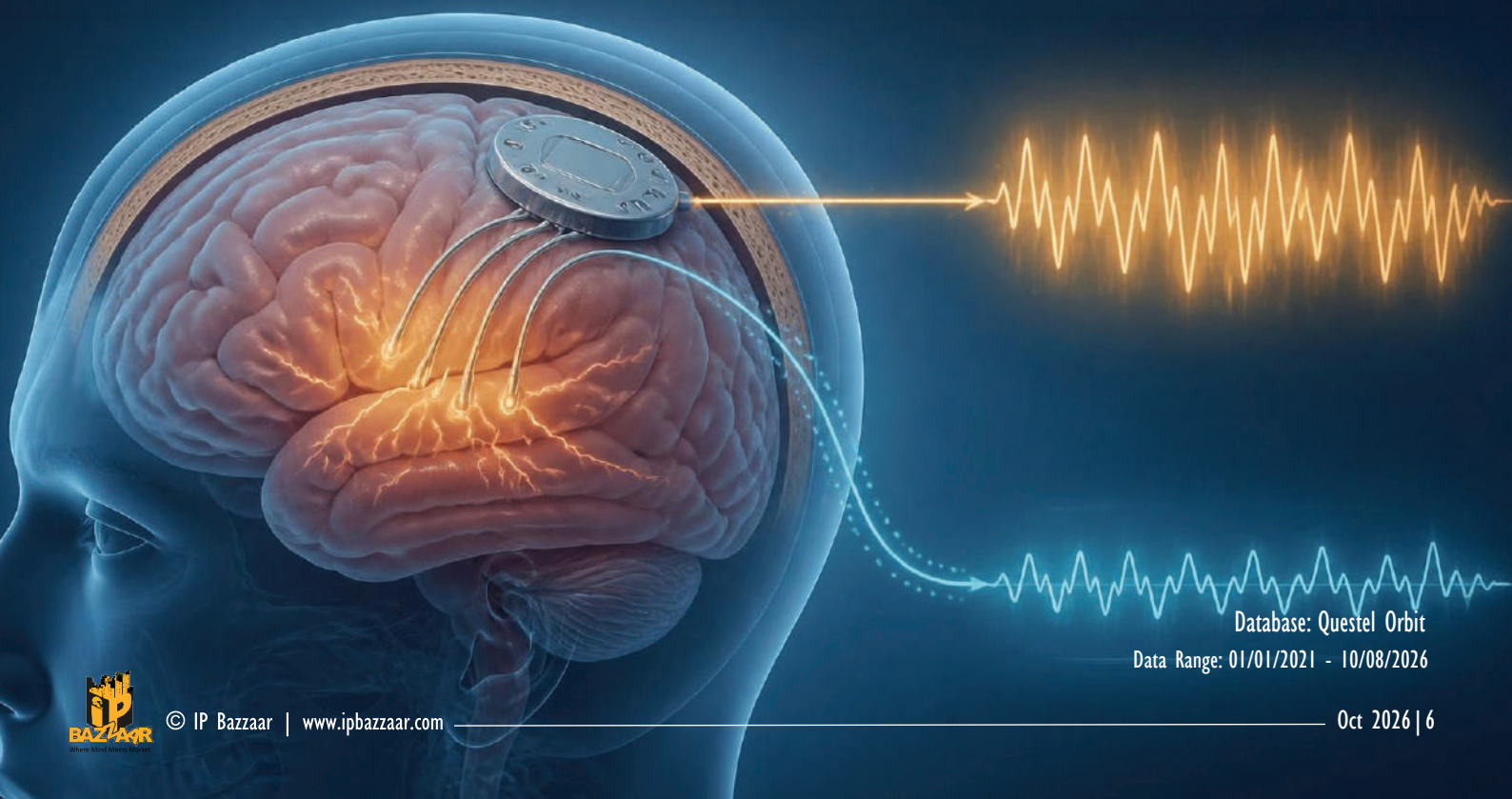
## PATENT LANDSCAPE



Database: Questel Orbit

Data Range: 01/01/2021 - 10/08/2026

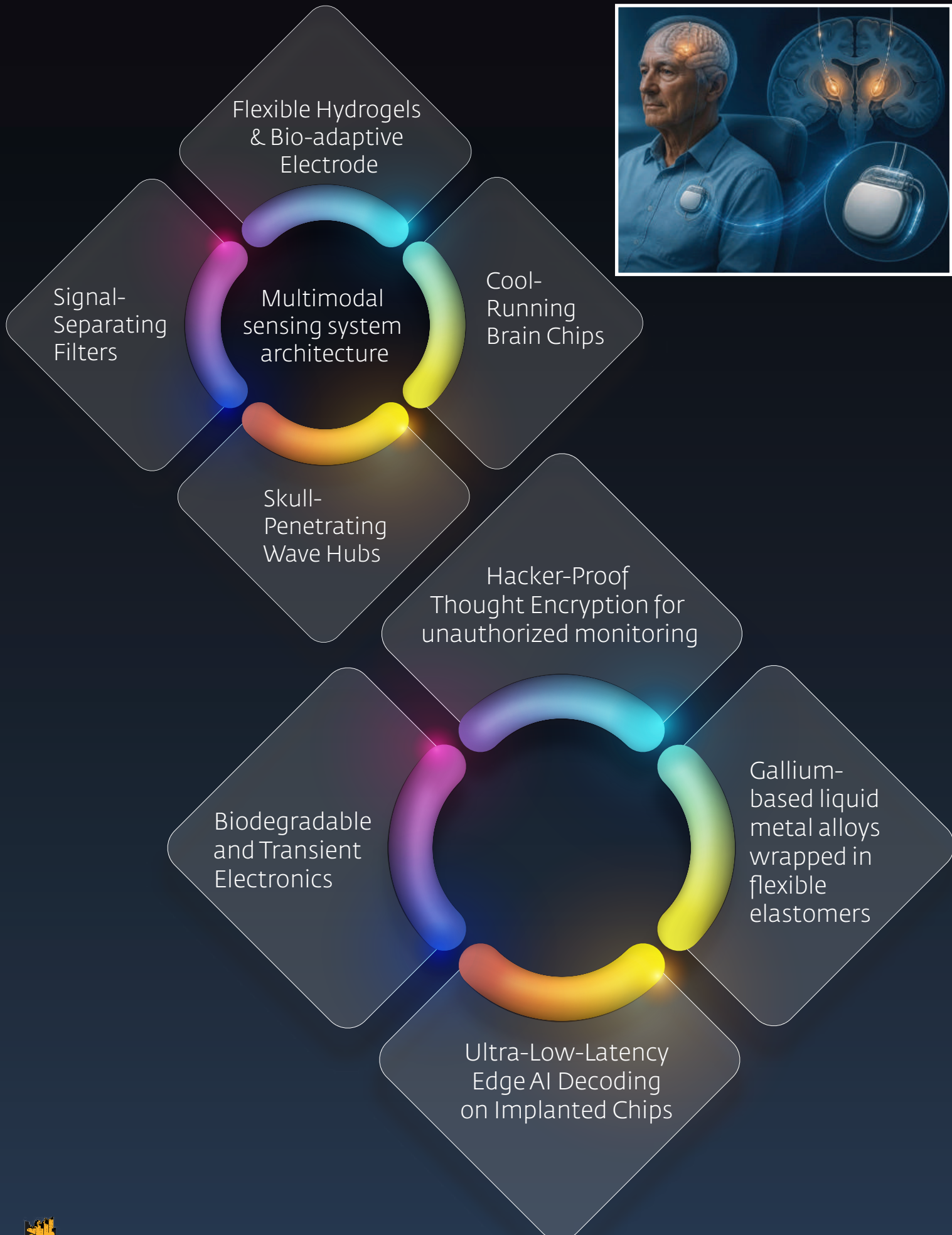
# TOP APPLICANTS



# NOTABLE INNOVATIONS

| Patent Application | Priority date | Title                                                                                          | Assignee                               |
|--------------------|---------------|------------------------------------------------------------------------------------------------|----------------------------------------|
| USRE35653          | 1987-11-17    | In vivo delivery of neurotransmitters by implanted, encapsulated cells                         | NEUROTECH                              |
| US 5,215,088       | 1989-11-07    | Three-dimensional electrode device                                                             | UNIVERSITY OF UTAH RESEARCH FOUNDATION |
| US 5,638,826       | 1995-06-01    | Communication method and system using brain waves for multidimensional control                 | HEALTH RESEARCH                        |
| US6421569          | 1999-05-21    | Cochlear implant electrode array                                                               | COCHLEAR                               |
| US8883716          | 2003-12-01    | Method for treating damaged tissue of the CNS                                                  | MEDTRONIC                              |
| JP4876988          | 2007-03-13    | Brain computer interface apparatus                                                             | NEC                                    |
| US8843217          | 2013-09-13    | Combined vestibular and cochlear implant and method                                            | NUROTONE MEDICAL                       |
| US20200069207      | 2015-12-15    | Neural Implant with Wireless Power Transfer                                                    | NEURAL SIGNALS                         |
| US 12,554,326      | 2020-04-01    | Systems and methods for controlling a device using detected changes in a neural-related signal | SYNCHRON AUSTRALIA                     |
| US20240386571      | 2023-05-18    | Vascular Segmentation and Avoidance Using Imaging                                              | NEURALINK                              |

# WHITESPACES



If you would like to learn more about any of these areas or have specific questions, we're here to provide further information and insights. Our team is dedicated to driving progress and staying at the forefront of Brain Chip in Healthcare.

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