

# Soinik Ghosh

PhD Researcher • Biomedical Engineer • Neuro-AI Developer



📍 Indian Institute of Technology (BHU), Varanasi / Kolkata, India

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📄 Google Scholar | 🌐 Personal Website (Portfolio)

## Research Profile

I am a PhD researcher in Biomedical Engineering working at the intersection of **neuroscience, biomedical signal processing, and artificial intelligence**. My work focuses on **AI-driven analysis of neural and biomedical time-series data**, including **EEG-based seizure forecasting, Alzheimer's and dementia diagnosis, and biomarker detection for neurological disorders**. I develop **disease-specific AI frameworks and brain-inspired computational models** to capture neural dynamics and improve diagnostic reliability and interpretability. In parallel, I design **AI-enabled biomedical systems and devices, deploy AI models in production**, integrating advanced signal processing with real-world healthcare technologies for physiological monitoring and assistive applications.

## Education

### Indian Institute of Technology (BHU) Varanasi

PhD in Biomedical Engineering (CGPA: 9.6/10)

Varanasi, India

2023 – Present

Focus: Biomedical Signal & Image Processing, BCI, AI, Mathematical Modelling.

### University of Calcutta

M.Sc in Physiology (Neuroscience Specialization) – First Class – CGPA: 7.4/10

Kolkata, India

2019 – 2021

Thesis: "Neuropsychophysiological Behaviour of Adenosine: Crosstalks between Neurotransmitters"

### Surendranath College, University of Calcutta

B.Sc in Human Physiology (Honours)

Kolkata, India

2016 – 2019

## Skills & Expertise

<b>Computational &amp; AI:</b>	PyTorch, Deep Learning, Graph Neural Networks (GNNs), Generative Models, AI Agents, Computer Vision, Signal (EEG/ECG) & Image Processing
<b>Development:</b>	Software Development, Hardware + Software + AI integration, Python, MATLAB, C++, C#, Java, HTML/CSS, React, Typescript, GCP, UI/UX
<b>Engineering:</b>	Biomedical Device Design, Hardware PCB Design, BCI Systems, IoT & Embedded Systems, Edge AI, VR/XR (Unity).
<b>Wet Lab &amp; Biology:</b>	Cell Culture, Molecular Biology, Experimental Design, Animal Studies.

## Projects

### Towards Reliable Seizure Forecasting & Diagnosis with Non-Invasive Biosignals

IIT-BHU, IMS-BHU

Developing advanced Epileptic Seizure Forecasting algorithms with probabilistic frameworks, aiming to improve Epilepsy Diagnosis and patient quality of life through timely intervention.

### A Generative AI model for Patient-specific high-fidelity Synthetic EEG data Generation

IIT-BHU

Developing a Diffusion-based Generative AI model for high-fidelity Synthetic EEG data Generation, particularly for Seizure Patients. GenEEG (Computers in Biology & Medicine, 2025, IF: 6.3)

### Interictal Network Dynamics - Characterizing IEDs as Dynamic Network Events

IIT-BHU, IMS-BHU

Interictal Epileptiform Discharges as Dynamic Network Events: A Multimodal Source-Connectivity Approach with Graph Neural Networks.

### Neuro-ADEPT: A Neuro-Adaptive Deep Learning Framework for EEG Analysis and Neurological Disorder Modeling

IIT-BHU

Brain inspired neural network architecture design for interpretable seizure risk stratification. [Github repository](#)

### GemSAM: An Agentic Framework for Explainable Multi-Modal Medical Image Analysis on Edge

Google DeepMind, Kaggle MedGemma Impact

Challenge 2026

[Github repository](#)

### Motor Imagery-based Prosthetic Arm Control in real time with EEG & BCI

IIT-BHU

Designing a BCI system translating motor imagery EEG signals into intuitive real-time control for prosthetic arms.

### VR-infused robotic exo-suit for Stroke Rehabilitation

IIT-BHU

Creating an immersive VR environment with a robotic exoskeleton for engaging stroke patient rehabilitation. (PRAGATI Hackathon 2023 Winner)

### Non-invasive Ultrasound imaging with multiple sensors and AI for accessible cardiovascular disease detection

Smart India Hackathon (Winner)

Developing a non-invasive ultrasound imaging solution for improved cardiovascular disease detection methods.

### CogniDhi: AI-powered cognitive health platform & personalized brain fitness for all ages

Stanford Longevity Design Challenge 2025–26

Early detection of cognitive decline and personalised AI tasks for enhancing weaker brain functionalities, with a social platform for networking and professional help.

**HippoSphere AI: Automated Monitoring and Behavioral Analysis of Captive Pygmy Hippopotamuses** *Moodeng AI Challenge, MIT Media Lab*  
Automated Monitoring and Behavioral Analysis of Captive Animals Using Lightweight Deep Learning and Sustainable Computer Vision.

[Github repository](#)

## Experience Startups

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### Full-Time Research Scholar & Teaching Assistant

*IIT-BHU*

Doctoral research (BCI, Neuroscience, AI); Responsibilities: Experimental Design, Data Collection & Analysis, Algorithm Development, Scientific Writing, Teaching.

### Co-Founder of 'Hridae Medical Technologies'

*Medical Devices Start Up*

Engineer & Developer, working on Cardiovascular health and Neurotechnologies.

## Publications

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- **Ghosh, S.,** et al. *GenEEG: Improving epileptic EEG detection through patient-adaptive latent diffusion and continual learning.*
- **Ghosh, S.,** et al. *A Probabilistic Framework for Epileptic Seizure Forecasting Combining Dynamic State Transitions and Patient-Adaptive AI with EEG and ECG.* (Journal Article, In peer-review).
- **Ghosh, S.** *Decoding the Neural Dynamics of Motor Imagery and Execution: An EEG-Based Investigation into Conscious Hand Movement Representation.* Mind, Brain and Consciousness Conference 2025 (In Press, Springer).
- *Real-Time Brain Signals Monitoring System Using Single-Channel EEG for BCI Applications.* IEEE AKGEC 2024.
- *Development of a Haptic Exo-Suit with Tactile Feedback in Hand Rehabilitation.* IEEE INSPECT 2024.
- **Ghosh, S.** *Neuro-ADEPT: A Neuro-Adaptive Deep Learning Framework for EEG Analysis and Neurological Disorder Modeling.* (IEEE EMBC 2026, Under review).
- *A Hybrid Classical-Quantum Model for Enhanced MRI-Based Brain Tumor Classification Using Transfer Learning and Quantum Neural Networks* (IEEE ICCSAI 2025)

## Honors, Awards & Training

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- **Winner, Smart India Hackathon 2024 (Hardware Edition):** Govt. of India.
- **2nd Runner Up, PRAGATI Hackathon 2023:** TIH Dristi IHUB & IIT Jodhpur.
- **GATE Qualified 2023 (Life Sciences):** All India Rank 1313.
- **Workshop: g.tec BCI & Neurotechnology Spring School 2025 (Austria):** Advanced training in invasive/non-invasive BCI.
- **Workshop: Neurogati/CNS Lab - Brain Modeling (IIT Madras):** Computational modeling of human brain & Brain-inspired AI models.
- **Workshop: SERB KARYASHALA (IIT Roorkee):** AI in Human Brain-Computer Interaction.
- **Skill Development Program (CSIR-IICB):** Molecular Cloning, Protein Expression & Characterization.

## Beyond Science

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**Arts & Cinema:** Independent filmmaker and screenwriter; Multi-instrumentalist and music composer.

**Other Interests:** Storytelling, creative writing, wildlife exploration, photography and mindfulness.