Grant Proposal

Funding OpenBCI™ Hardware and Accessories

Abstract

This proposal requests LKR 800,000 to acquire OpenBCI™ hardware, enabling the University of Moratuwa to develop a Brain-Computer Interface (BCI) for children with severe motor impairments or a serious loss of muscle control and movement ability. The BCI aims to restore communication and access to digital environments using brain signals. OpenBCI™'s offers an affordable, open-source platform that allows flexible prototyping and customization, making it suitable for developing novel applications in pediatric neurorehabilitation. Expected outcomes include a functional BCI prototype, enhanced patient independence, academic contributions, and a scalable framework for future neurorehabilitation.

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1. The Background Story

Imagine a bright, playful 4-year-old boy running, laughing, and playing with his friends at preschool. Life was full of energy and joy. Then, in what seemed like an ordinary viral infection, everything changed.

What started as a simple illness spread to his spinal cord, causing dangerous inflammation. This **blocked the nerves from his lower body, leaving him completely paralyzed below the neck**. As if that wasn't enough, the infection attacked his diaphragm, the muscle that helps us breathe. Suddenly, he could not breathe on his own. A ventilator became his lifeline.

Doctors recognized this as an extremely rare medical case. There was no quick cure, no single medicine that could fix him. The road to recovery, if possible, would take years, not weeks or months. **For the last two years, this little boy has been living in a body that won't move**. Doctors compared it to a form of locked-in syndrome where the child's mind is awake, but the body does not respond.

In the beginning, there was one bright side: he could still speak. Even in the ICU, he was talkative and cheerful, interacting with doctors and family. But slowly, he grew quiet. He stopped speaking altogether. Not because he couldn't, but because **he lost the will to communicate.** The long struggle, the isolation, the endless hospital stay, it all drained his spirit. His silence broke the hearts of his parents and even his doctors.

Then, something extraordinary happened. When shown his favorite cartoon, his face lit up. He reacted. For the first time in months, there was a spark of connection. That moment changed everything. **His doctors realized there was still hope if only there was a way to help him interact again.** But how do you help a child who cannot move, who cannot easily speak, to communicate? The answer lay in technology.

This is not just science, it is hope. It is a chance for a little boy, trapped in his body, to find his voice again.

This is not fiction. This is a true story, happening right now at Lady Ridgeway Hospital for Children. A dedicated team of doctors, led by **Prof. Jithangi Wanigasinghe**, a pediatric neurologist, reached out to the **Department of Electronic and Telecommunication Engineering, University of Moratuwa**, to create a system that could capture the boy's brain signals and turn them into communication.

2. Why This Project Matters?

Every child deserves the ability to learn, play, and connect with the world. Yet, for children with severe motor impairments, a **serious loss of muscle control and movement ability,** such as locked-in syndrome, even simple communication or access to education is an overwhelming challenge.

Our project at the Department of Electronic and Telecommunication Engineering at the University of Moratuwa is about changing this reality. We are developing a **Brain-Computer Interface (BCI)** that allows children to interact with digital environments, accessing **educational content, multimedia, and interactive tools** directly through their brain signals.

This is not just about one child. It is about building a pathway for many patients who are otherwise isolated and creating a technological framework that can grow into a **globally significant healthcare innovation**.

3. Who are we?

We are a team of four final-year engineering students from the **Department of Electronic and Telecommunication Engineering, University of Moratuwa**, Sri Lanka's leading technological university.
Our Team of final year undergraduates

- Chathura Nirmal Weerasinghe
- Jayamadu Gammune
- Dinujaya Wijewickrame
- Risini Dinara Kumarasinghe

Our work is guided by:

- **Dr. Joshua Pranjeevan Kulasingham** – Senior Lecturer at University of Moratuwa
- **Dr. Chamira Edussooriya** – Senior Lecturer at University of Moratuwa
- **Dr. Peshala Jayasekara** – Senior Lecturer at University of Moratuwa
- **Prof. Jithangi Wanigasinghe**– consultant neurologist at the University of Colombo.

- **Mr. Kithimin Wickramsinghe** - MASc. Graduated from the University of British Columbia, Vancouver, Canada

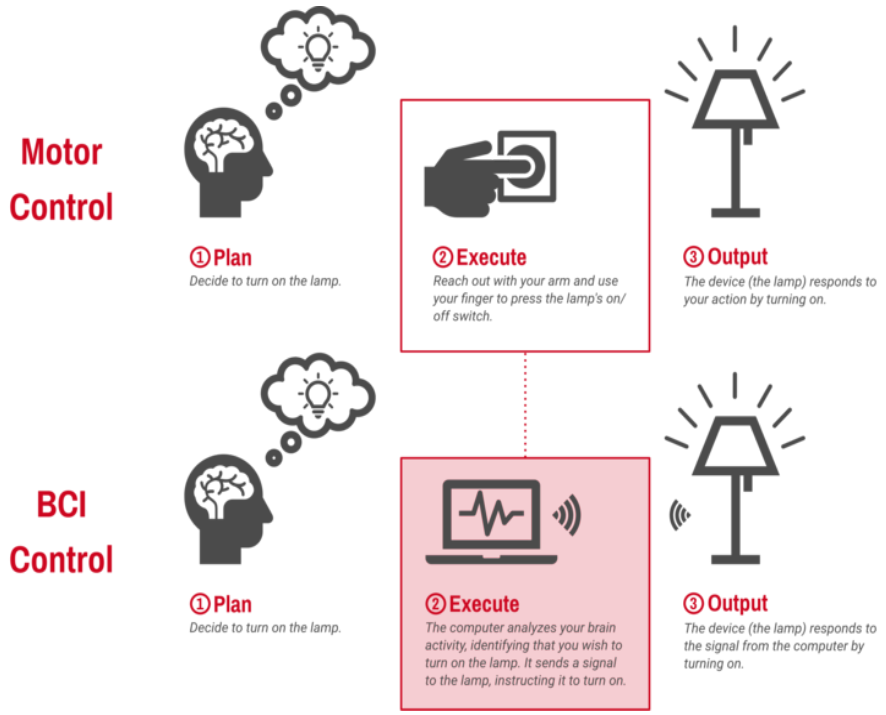
Our department has a proven history of impactful biomedical projects, including neonatal seizure detection systems and custom EEG devices [2]. With this expertise and mentorship, we are well-positioned to pioneer the next frontier in Sri Lankan healthcare technology: accessible, reliable Brain-Computer Interfaces.

1. *Department of Electronic and Telecommunication Engineering – Official Website of The Electronic and Telecommunication Engineering Department*

2. *Biomedical Research Group – Department of Electronic and Telecommunication Engineering*

3. What is BCI, and Why Do We Need It?

A Brain-Computer Interface (BCI) is a revolutionary technology that bridges the ultimate gap: direct **communication between the human brain and external devices**. By capturing your brain's own signals, typically through non-invasive electroencephalography (EEG) and translating them into precise digital commands, BCI lets you **control computers, applications, and entire systems** without a single physical movement. For children trapped by severe motor impairments, a serious loss of muscle control and movement ability, BCI isn't just an advancement; it's a lifeline. **It unlocks access to education, entertainment, and communication**, all through their own neural activity. More than just technology, BCI is the ultimate gateway to independence, learning, and true social inclusion, empowering patients to engage with the world in ways once unimaginable.



University of Calgary. (n.d.). BCI vs motor control wide [Digital image]. Cumming School of Medicine. Retrieved from https://cumming.ucalgary.ca

1. *Zhang et al. (2019) showed that children can rapidly learn and execute multiple tasks using simple EEG-based BCI systems, highlighting the promise for disabled pediatric populations.*

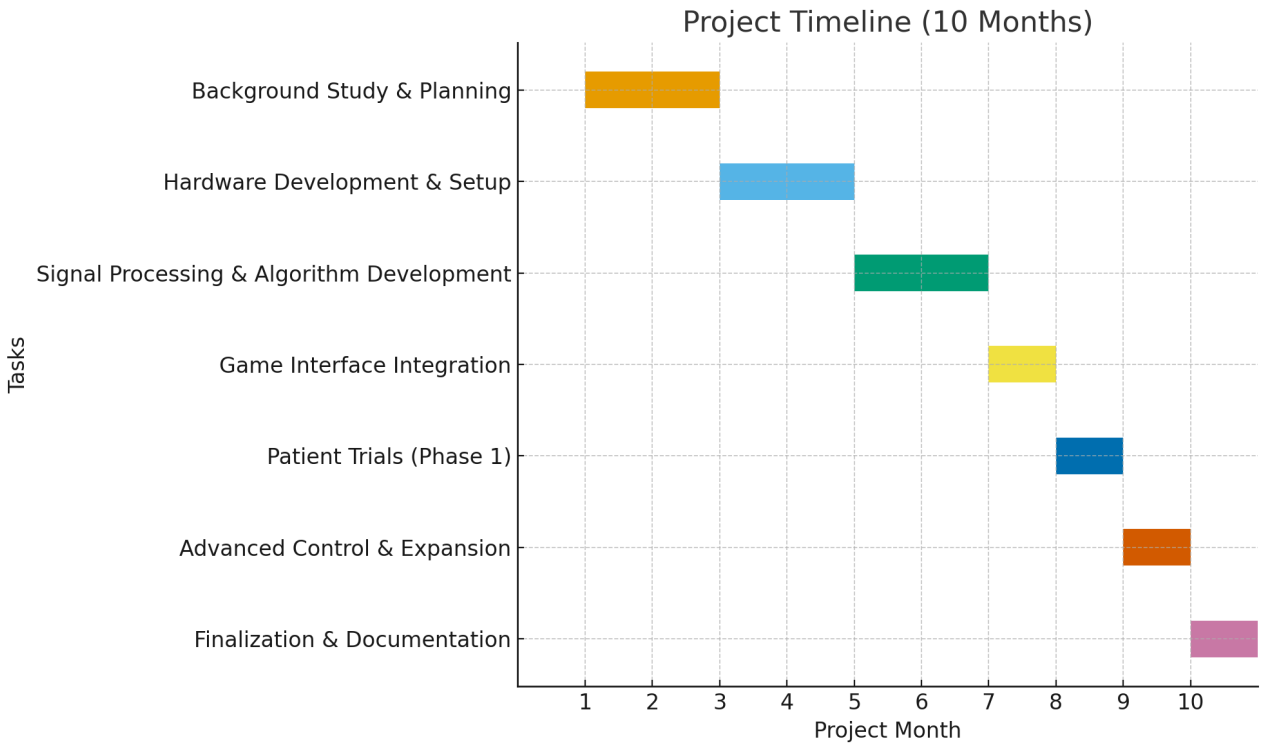
2. *Papanastasiou et al. (2020) found that BCIs can enhance students' attention, working memory, visuospatial skills, social and imaginative capacities—suggesting positive developmental impacts.*

4. Project Objectives

Our mission is clear, impactful, and game-changing:

- **Develop an EEG-based BCI system:** We will create a system enabling children with severe motor impairments to take control of an operating system interface using only their brain signals.
- **Demonstrate proof-of-concept:** We will prove real-world usability through a compelling, practical case study that showcases the BCI's transformative power.
- **Build a scalable framework:** Our solution isn't just for one; it can be extended to reach wider patient groups battling stroke, spinal cord injuries, or neurodegenerative diseases.
- **Contribute to academic knowledge:** We will drive innovation through research publications and elevate our department's capacity.

5. Project Timeline



6. Why We Need OpenBCI™

OpenBCI™ is an open-source platform designed for biosensing. Essentially, it is advanced technology for reading signals from the body, particularly the brain. It provides high-quality instruments, like the "Cyton board," that capture clear and detailed electrical signals from the brain with precision.

Reliable data is the foundation for any successful Brain-Computer Interface (BCI) project. In the past, when we tried to use improvised equipment in our department, we constantly faced problems with poor signal quality and unstable hardware. This severely limited our progress. **This is precisely why OpenBCI™ is so critical to our work.**

- **High-Quality Precision:** The Cyton boards are engineered to capture multi-channel EEG signals. This level of precision is crucial for ensuring that the brain's commands are interpreted accurately.
- **Pediatric Suitability:** The "Ultracortex headsets" are specifically designed to be adjustable, safe, and comfortable for children. This ensures that our young participants can wear them without discomfort.
- **Modularity for Future Research:** OpenBCI™'s flexible hardware allows us to easily test various BCI approaches (known as paradigms), such as SSVEP (using visual flickering stimuli), P300 (detecting specific brain responses to events), or Motor Imagery (interpreting imagined movements). This adaptability is key to ongoing research and expanding the system's capabilities.
- **Time & Cost Efficiency:** Instead of spending valuable months and significant resources on developing our own basic hardware from scratch, OpenBCI™ allows us to focus our efforts directly on the core innovation: refining the signal processing algorithms and designing user-friendly interfaces. This accelerates our progress and maximizes our impact.
- **Long-Term Value:** This isn't a one-time purchase. The OpenBCI™ hardware will become a permanent, shared resource within our Department. It will support numerous future Final Year Projects (FYPs), postgraduate research, and critical clinical collaborations for years to come.

In essence, OpenBCI™ transforms this project from a limited, single-purpose experiment into a **sustainable, high-impact research and healthcare innovation platform.**

1. *OpenBCI™ Cited in 686 projects and counting...OpenBCI™ | Citations*

7. Budget Justification

Budget (Estimated)

Item	Description	Unit Cost (USD)	Approx. Cost (LKR)	Qty	Subtotal (LKR)
OpenBCI™ Cyton Biosensing Board (8-channel)	High-resolution EEG signal acquisition	$1,249	~LKR 380,000	1	LKR 380,000
ThinkPulse™ Active Electrode Starter Kit	Reusable/Dry electrodes, cables, and spares	$499.99	~LKR 152,000	1	LKR 152,000
OpenBCI™ Ultracortex Mark IV Headset (assembled)	Electrode headset for EEG recording (size adjustable)	$499.99	~LKR 152,000	1	LKR 152,000
Misc. Accessories	Batteries, chargers, cables, replacement electrodes	$400	~LKR 122,000	1	LKR 122,000

Subtotal = LKR 806,000 (USD 2,649)

8. Expected Outcomes

1. Functional BCI Prototype
A reliable system that translates EEG signals into computer commands, enabling users to navigate an operating system, access educational content, and interact with digital tools.

2. Patient Empowerment
Children with severe motor impairments will gain access to learning, entertainment, and communication platforms, improving independence, inclusion, and quality of life.

3. Academic Growth
The project will generate research publications, establish BCI research at the University of Moratuwa, and provide a reusable platform for future student and postgraduate projects.

4. Future Potential
The framework lays the foundation for advanced applications, including robotic control, neurorehabilitation for stroke and spinal cord injuries, and next-generation assistive technologies.

1. *The pediatric BCI program emphasized positive emotional outcomes like increased independence and recognition from a family-centered perspective.* *ResearchGate+1*

9. Ethical Considerations

To ensure the highest standards of safety and ethical conduct, we have already initiated and applied for comprehensive ethics clearance for all testing sessions involving the child participant through the University's Ethics Committee. All interactions with the child will be strictly **non-invasive**, meaning no procedures will penetrate the skin or cause any physical discomfort. Furthermore, every session will be **supervised** by qualified healthcare professionals to monitor the child's well-being and respond immediately to any unforeseen circumstances. Crucially, all procedures will only proceed with **informed parental consent**, obtained through a clear and transparent process that ensures the parents fully understand the project's goals, procedures, potential benefits, and any minimal risks involved. This multi-layered approach guarantees the paramount safety and compliance throughout every stage of this groundbreaking research.

10. Societal Impact

This project is not only a technical breakthrough but also a **human-centered solution** with wide-reaching benefits:

- **Accessibility:** It gives children with motor impairments the ability to learn, play, and communicate, restoring independence and dignity.
- **Healthcare Innovation:** It shows how research can create affordable, world-class assistive technologies for patients who are otherwise overlooked.
- **Scalability:** While designed for paediatrics, the system can be adapted for adults with conditions such as stroke, spinal cord injuries, or neurodegenerative diseases.
- **Sustainable Research:** The OpenBCI™ hardware will remain as a departmental resource, supporting new generations of students and researchers in advancing biomedical engineering.

11. Sustainability of the Hardware

The OpenBCI™ equipment will remain with the **University of Moratuwa** as a shared research resource. Future projects, undergraduates, postgraduates, and clinical researchers will continue to benefit from this investment.

Thus, your support is not just funding a single project; it is building **lasting infrastructure** for biomedical research at the University of Moratuwa.

12. Why Fund This?

Your investment of **LKR 806,000** is more than a donation; it's a strategic partnership in human potential. By funding this project, you are directly:

- **Empowering Futures:** Giving children with severe motor impairments a serious loss of muscle control and movement ability the life-changing ability to learn, communicate, and engage with the world, restoring their independence and dignity.
- **Fueling Innovation:** Equipping Sri Lanka's brightest young engineers with cutting-edge tools, fostering a new generation of biomedical pioneers right here at the University of Moratuwa.
- **Building a Legacy:** Establishing a sustainable foundation for future medical innovation at the University of Moratuwa, creating technologies that will benefit countless patients for years to come.

In return for your pivotal support, your organization **will receive acknowledgment in all project-related academic publications and at any future media appearances or public demonstrations** of the project. This is an opportunity to align your name with BCI research, life-changing technology, and a profoundly positive societal impact.

13. Contact Us

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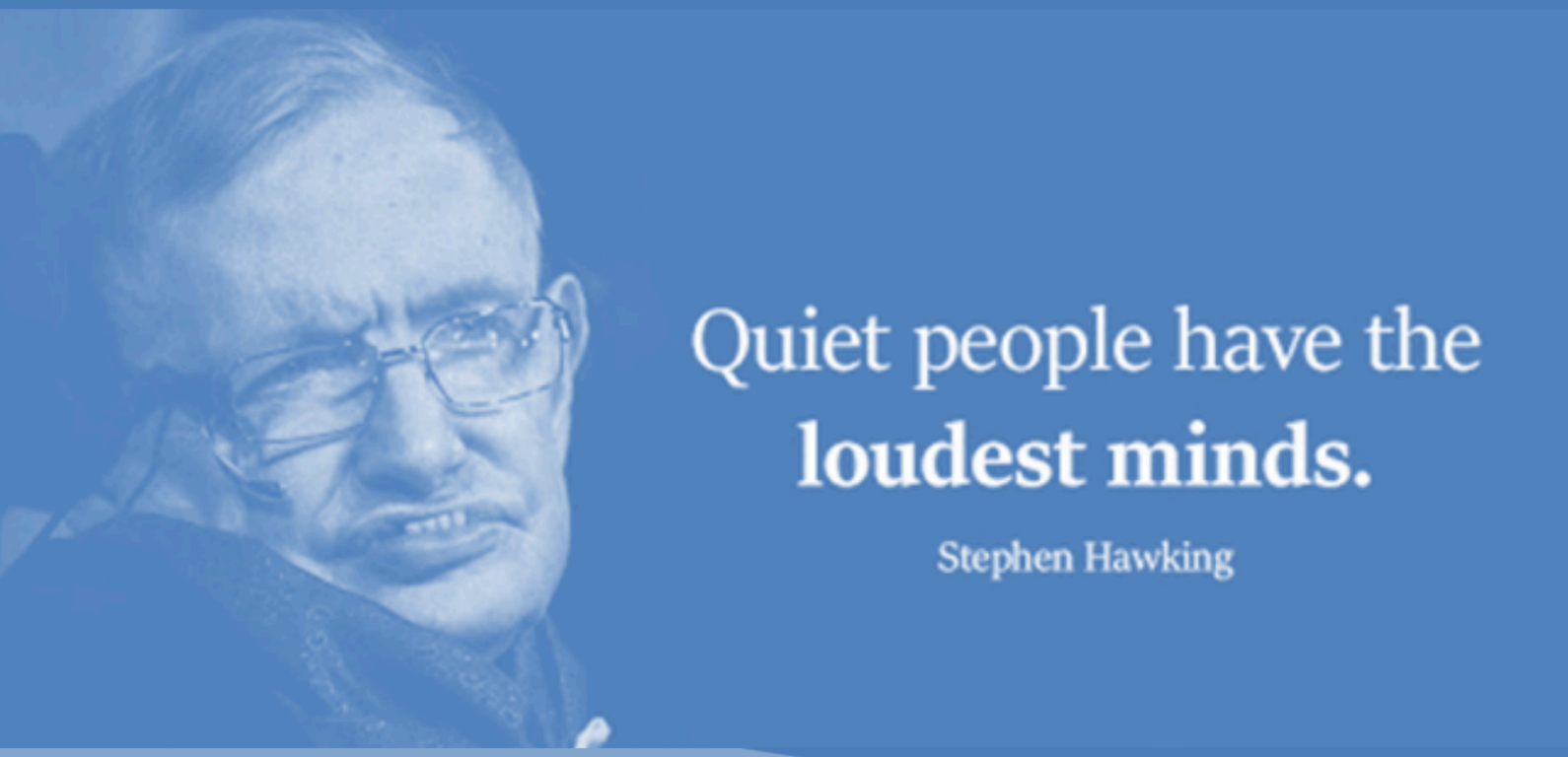

"These loudest minds often remain unheard, not because they are silent, but because the world lacks the tools to listen. This project is about building those tools."