# ISEIC'2024 Proposal Template

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## A. Proposal Information

| | |
|---|---|
| **Project title** | NeuroSynth Innovators |
| **Project Challenge Area** | Nanotechnology |
| **School / College / University** | Qena STEM School |
| **Department/Faculty (for University)** | |
| **Industrial partner (if any)** | Neurology doctors and national hospitals |

## B. Advisor Information

| | |
|---|---|
| **Advisor Name** | Randa Hosni Mohamed Abd Elrahim |
| **Title** | Dr. |
| **Work Address** | Faculty of Education - Ain Shams University |
| **Mobile** | 01001741800 |
| **E-mail** | randahosni7@gmail.com |
| **Brief summary of expertise** | Doctorate in Educational Psychology |

## C. Project Members Information

| # | Full Name | year grade | Strengths (special skills and capabilities) | Mobile number | Email |
|---|---|---|---|---|---|
| 1 | Amr Mohammed Tawfik Ahmed | Grade 10 | programmer | 01001185869 | Amrelkhooly08@gmail.com |
| 2 | AbdElrahman Samy Mohammed Mostafa | Grade 10 | searcher | 01018784768 | Abdosamy43752@gmail.com |
| 3 | Laila Omar Hassan Sleem | Grade 11 | Designer | 01025846069 | omarlaila985@gmail.com |
| 4 | Gannat Harby Hassan Mohammed | Grade 11 | writer | 01114295895 | gannatharyp@gmail.com |
| 5 | Farha Khaled Ahmed Abdelmoaty | Grade 11 | programmer | 01154396705 | Frhtkhald159@gmail.com |

* Please note that the first name will be referred to as the main **CONTACT PERSON** for the whole group.

## D. Project Description

Applicants shall provide a brief description of their project. This description should include the following **according to the distribution of scores**:s

| 1. Overview | (20 point) |
|---|---|
| (i) Problem definition, (ii) approach and tools/techniques, (iii) overview of system modules (v) **references** and (iv) **possibility to make research paper** | |

**(i) Problem definition:** Many diseases affects the nerve cells and may kill them, While the big problem that they do not grow again, So that the nervous system is one of the most sensitive systems.

**(ii) Approach and tools/techniques:** We have used carbon fiber string and put them together in the shape of loom to act the cell membrane controlled with a micro servo motor, feeling with electric wave using a detecting sensor that will be found in each cell to give the signal that the servo depends on. All of that is controlled by an Arduino pro micro that will be ultra minimized.

**(iii) Overview of system modules:**

**Introduction:**
Our project aims to create an electronic nerve cell, merging principles of neuroscience with electrical engineering to replicate the functionality of biological nerve cells.
**System Architecture:**
The architecture mimics biological nerve cells, comprising sensory input, integration, and output modules, replicating signal transmission in electronic form.
**Modules:**
1. *Sensory Input Module:* Captures stimuli and converts data into electrical signals.
2. *Integration Module:* Processes signals, mimicking synaptic integration.
3. *Output Module:* Transmits electronic responses to connected systems.
**Interactions:**
Modules communicate through electronic pathways, replicating synapse-like connections for signal transmission and integration.
**Dependencies:**
Modules rely on each other for coherent signal processing; input accuracy influences integration, and output responsiveness depends on successful integration.
**User Interfaces:**
While lacking a traditional interface, the project may include tools for configuring input and monitoring electronic signals.
**Data Flow:**
Signals flow through the system from input to integration, replicating synaptic transmission observed in biological nerve cells.
**Error Handling:**
The project includes error detection, correction, and recovery mechanisms to ensure robust signal processing.
**Security:**
Security measures focus on preventing unauthorized access and ensuring the confidentiality of data flow.
**Testing and Quality Assurance:**
A comprehensive testing approach validates signal processing accuracy, system responsiveness, and adherence to predefined standards.
**Conclusion:**
The project represents a convergence of biology and electronics, offering potential applications in neuroproteins, brain-machine interfaces, and artificial intelligence, contributing to advancements in neuroscience and electrical engineering.

**(v) References and Background research:**

Zhang, Anqi. "One Step Closer to Cyborgs: The Development of Artificial Nerves." Harvard University, Daniel Utter, 13 Aug. 2018, https://sitn.hms.harvard.edu/flash/2018/artificial-nerves/#:~:text=An%20artificial%20sensory%20nerve%20consists,neurons%2C%20and%20synapses%2C%20respectively. Accessed 14 Dec. 2023.
Melvin, C. (2019, December 3). World first as artificial neurons developed to cure chronic diseases. University of Bath. https://www.bath.ac.uk/announcements/world-first-as-artificial-neurons-developed-to-cure-chronic-diseases/
Kirschbaum, R. (2022, April). A critical review of carbon fiber and related products from an industrial perspective. https://www.sciencedirect.com/journal/advanced-industrial-and-engineering-polymer-research. https://www.sciencedirect.com/science/article/pii/S2542504822000100

**Harikesh, P. C. (2022, February 22). Organic electrochemical neurons and synapses with ion mediated spiking. https://www.nature.com/articles/s41467-022-28483-6**

**(iv) Possibility to make research paper: 1. *Neuronal Structure and Function:***
**- Detailing the anatomy of neurons, including dendrites, axons, and synapses.**
**- Exploring the transmission of electric signals (action potentials) within neurons.**
**2. *Neurotransmitters and Signaling:***
**- Investigating the role of neurotransmitters in inter-neuronal communication.**
**- Examining how different neurotransmitters contribute to specific functions or disorders.**
**3. *Neuroplasticity:***
**- Studying the ability of neurons to adapt and change in response to experiences or injury.**
**- Exploring implications for learning, memory, and rehabilitation.**
**4. *Neurological Disorders:***
**- Investigating the involvement of neurons in neurological disorders like Alzheimer's, Parkinson's, or epilepsy.**
**- Assessing potential therapeutic interventions targeting electric nerve cell function.**
**5. *Emerging Technologies:***
**- Discussing advancements in neuroscience technology, such as optogenetics or brain-computer interfaces.**
**- Exploring how these technologies enhance our understanding of electric nerve cell behavior.**
**6. *Ethical Considerations:***
**- Addressing ethical implications of neuroscientific research, especially concerning interventions in neural processes.**
**7. *Comparative Neurology:***
**- Comparing electric nerve cells across different species to understand evolutionary aspects.**
**- Analyzing the similarities and differences in neuronal function between humans and other animals.**
**8. *Neuronal Development:***
**- Examining the processes involved in the development of electric nerve cells from embryonic stages to maturity.**
**- Investigating factors influencing proper neuronal development.**

| 2. Impact | (20 point) |
|---|---|
| Why do you consider this project? What is its impact on community/market/end user/ **sustainable development of Egypt 2030…?** | |
| **"Neurons" are primarily responsible for our feelings, reactions, and interactions with the outside world. The basic units of the nervous system, neurons are in charge of information processing, signal transmission, and muscular control. Notwithstanding their crucial function, neurons are incapable of proliferating or replacing themselves. Consequently, any disruption or injury to the neurons would result in serious illnesses such as Parkinson's and Batten disorders. In order to replace the biological neuron, we set out to create an artificial neuron that performs the same job.**<br>**The artificial neuron will revolutionize neuroscience by serving as the cornerstone for the discovery of therapies for neurological disorders. As a result, it will be necessary in numerous medical specialties that will yield substantial financial gains. As previously mentioned, artificial neurons will be used as a treatment for various diseases; consequently, they will play a significant role in Egypt's efforts to achieve a healthy lifestyle. By the end of 2030, artificial neurons may be widely used and highly developed to ensure that there are no risks to human health.** | |

| 3. Novelty and Features | (20 point) |
|---|---|
| Explain (i) novelty (ii) features, and (iii) related products, if any. | |

**The development of a nanoneuron holds great promise for revolutionary medical interventions. To enable seamless integration into the human body, the nanoneuron must be meticulously designed to match the size of natural neurons. This ensures that it can navigate through the intricate network of the human nervous system.**

**For effective replacement of damaged cells, the nanoneuron should possess the ability to seamlessly integrate with the existing nerve tissue. To facilitate this entanglement, it becomes imperative to incorporate a structure that mimics the natural connection between cells. Introducing elements derived from the human body, such as nerve tissue, can enhance the compatibility and promote successful integration.**

**However, the human body's natural defense mechanisms might perceive the nanoneuron as a foreign entity. To overcome this challenge, a comprehensive approach involves developing specialized medications. These medications play a crucial role in persuading the body to recognize the artificial nerve as a native component, preventing any immune response that might reject the intervention.**

## 4. Deliverables

What is the project final outcome (HW device, SW package, simulation ...)? Do you foresee any potential marketing or customers? **(20 point)**

**Artificial neural networks and neuromorphic computing are active research and development areas. Hardware and software solutions inspired by the structure and function of the human nervous system are being developed by researchers and technologists.**

**Depending on the individual aims and objectives, the final output of a project in this domain may differ. It could entail the creation of specialised hardware devices (neuromorphic chips), software packages for mimicking neural networks, or even integrated systems combining hardware and software.**

**Potential clients and marketing for such a product could include:**

**1. Universities and Research institutes: Universities and research institutes working on neuroscience, artificial intelligence, and neuromorphic computing may be interested in employing such technology for their study.**

**2. Technology Companies: Companies in the technology industry, especially those focused on artificial intelligence, robotics, and autonomous systems, may be interested in implementing artificial nerve technologies into their products.**

**3. Medical Industry: There may be medical applications such as prostheses, rehabilitation devices, or assistive technology for those with neurological problems.**

**4. IoT and Edge Computing: In the Internet of Things (IoT) arena, neuromorphic computing may find applications in edge devices for real-time processing and decision-making.**

**5. Government and Defence: Agencies interested in advanced computing technology for defence and security applications could also be potential customers.**

**Such a project's success would be determined by its technological capabilities, scalability, cost-effectiveness, and capacity to solve unique demands in various industries.**

| 5. Role of the Industrial Partner (if any) | (20 point) |
|---|---|
| What is the type of support to be provided by the industrial partner (technical, financial, access…)? | |
| **-From a medical perspective:**<br>**artificial neurons will take the role of destroyed neurons, marking the first steps towards the discovery of cures for certain illnesses like batten disease.**<br>**-From the economic perspective:**<br>**Many hospitals will need artificial neurons, which will offer significant financial advantages.** | |

| 6. Estimated Expenses | | | | | | | (20 point) |
|---|---|---|---|---|---|---|---|
| An estimate of the itemized costs: Equipment & tools; printing | | | | | | | |
| **Item** | **Type (Hardware/ Software/ Other)** | **Specifications (brief description)** | **Justification (why is this item needed?)** | **Vendor/Source** | **Unit Cost** | **No. of Items** | **Total Cost of Items** |
| Carbon fiber | Hardware | A material consisting of thin, strong crystalline filaments of carbon, essentially carbon atoms bonded together in long chains. | To simulate the cell membrane of the nerve cell | Amazon | $15.00 | 2 x 2 Twill 3k 50" x 36" / 127 cm 5.7oz/193gsm | $15.00 |
| Arduino | Hardware | It's the Control Center that controls the entire cell operating system. It accommodates a variety of sensors, actuators, and shields. | It controls Micro servo motor and electric current Sensor, so it's the one who runs the entire cell. | Lampatronics | $5.99 | 1 | $5.99 |
| Electric current sensor | Hardware | Detect the flow of current along an electric current by measuring the magnetic field that is generated by | The electric current sensor in artificial nerves is crucial for monitoring and regulating | Amazon | $5.30 | 2 | $10.60 |

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|---|---|---|---|---|---|---|---|
| | | the flow of the electric current. | electrical impulses, ensuring accurate and controlled signals for optimal functionality. | | | | |
| Micro servo motor | Hardware | Micro servo motors are compact electromechanical devices used for precise control of angular or linear movements in hobbyist projects, robotics, and electronics, providing feedback on load position. | Controlling the membraned carbon fiber | Amazon | $3.56 | 1 | $3.56 |
| Total cost | | | | | | | $35.15 |

## بيانات المشروع باللغة العربية

| رقم المشروع | اسم المشروع | اسم المشرف | أسماء الفريق (5) | الجامعة / الكلية / المدرسة | كيف يمكن الاستفادة من المشروع في المجالات المختلفة (زراعة / صناعة / طبية /عسكرية/.....) |
|---|---|---|---|---|---|
| 164 | NeuroSynth Innovators | دكتور رندا حسني محمد عبدالرحيم | عمرو محمد توفيق أحمد<br>عبدالرحمن سامي محمد مصطفى<br>ليلى عمر حسن سليم<br>جنات حربي حسن محمد<br>فرحة خالد احمد عبد المعطي | مدرسة المتفوقين للعلوم و التكنولوجيا بقنا | فائدة المشروع الذي سنقوم به ( فائدة طبيه )هو أنه يستبدل الخلايا العصبية التالفة في جسم الإنسان ويعمل تماما كما يعمل، وهو ما سيربط الخلايا العصبية الأساسية في جسم الإنسان، وهذا ما سيجعل التحكم الاصطناعي مثل التحكم الطبيعي الأطراف الصناعية، وهذا ما يعوض الشخص الذي يضع طرفًا صناعيًا ويشعره بأنه إنسان طبيعي. |