Round Robin Expert Consultation Notes

After the Round Robin exercise, take some time to reflect individually on the feedback your team received from the experts.

Bring these reflections to your next team meeting to discuss with your team members.

For each idea you pitched:

- Was the overall impression positive, negative, or mixed?
- What changes and/or additions were suggested by the expert panel?
- Respond to each of these suggestions with whether you agree or disagree, and why.

Reflections

Which project idea is most interesting to you? Why?

The Closed-Loop System for Treatment and Prevention of Bruxism stands out as the most intriguing project idea for its approach to addressing a common but often overlooked condition. This system presents a proactive solution to bruxism, a problem that affects a significant portion of the population, leading to dental damage, discomfort, and a reduced quality of life. The use of EMG sensors to accurately detect bruxism episodes in real-time, combined with a mechanism to trigger vibrations for muscle relaxation, showcases a thoughtful integration of technology for health improvement. Furthermore, the addition of an app for managing grinding habits extends the utility of this system beyond immediate relief, promoting long-term behavioral change and self-awareness among users.

What makes this project particularly interesting is that it addresses the critical need for an effective management system that is both proactive and user-friendly. The focus on empowering users to take control of their condition, coupled with the system's potential to reduce treatment costs and alleviate pain and discomfort, positions it as a highly beneficial innovation in the dental healthcare field. Additionally, this project raises intriguing questions about the accuracy and reliability of bruxism detection in various sleep conditions, as well as the device's comfort and long-term usability, which are crucial factors for user adoption and satisfaction.

Which project sounds the most achievable to you? Why?

Given the 8-week timeline for the capstone project, the Closed-Loop System for Treatment and Prevention of Bruxism stands out as the most achievable project for the following reasons:

1.Clear Problem Statement and Target Audience: The project addresses a well-defined problem — bruxism, or involuntary teeth grinding. The target users are individuals suffering from bruxism, making the project's goals and outcomes focused and measurable. This clarity helps in planning and executing the project efficiently.

2.Use of Existing Technology: The project leverages EMG sensors to detect bruxism episodes, a technology that is already well-understood and available. This means the team can focus more on application and less on foundational research, speeding up development. The use of vibrations for muscle relaxation is also a tried-and-tested approach, reducing the risk of unforeseen technical challenges.

3.Software Development: The development of the accompanying app for managing grinding habits, while non-trivial, is a relatively straightforward software project. Given the prevalence of app development skills and resources, creating a functional prototype within the 8-week period is realistic. This app would mainly focus on user interaction with the data collected by the EMG sensors, a task that is well within the capabilities of most engineering teams.

4.Behavioral Modification Aspect: Part of the project's impact comes from encouraging users to modify their behavior, a process that can begin as soon as the user starts interacting with the system. This means that even early, less polished versions of the system can still provide valuable feedback to users, allowing for iterative improvements based on user experience within the project timeframe.

5.Prototype Focus: For a capstone project, the goal is often to produce a working prototype rather than a market-ready product. The Closed-Loop System for Treatment and Prevention of Bruxism lends itself well to this approach, as a basic yet functional prototype can be developed to demonstrate the concept. The prototype would need to integrate the EMG sensors with a simple feedback mechanism, a task that is achievable within the tight deadline.

Considering these factors, the Bruxism project is not only interesting but also well-suited to the constraints of the capstone project. It balances technical challenge with practical achievability, making it a strong candidate for successful completion within the 8-week period.

Which project ideas sounds the most broadly interesting and commercializable to you? Why?

The Closed-Loop System for Treatment and Prevention of Bruxism not only stands out as a particularly interesting project but also as one with significant commercial potential for the following reasons:

1.Wide Target Market: Bruxism affects a large portion of the population worldwide, with varying degrees of severity. The broad prevalence of the condition means that the system addresses a substantial market, including individuals who might not have been diagnosed formally but experience symptoms, as well as those seeking preventive measures against potential dental issues.

2.Unique Selling Proposition (USP): The project proposes a proactive and non-invasive solution to a common health issue. Unlike many existing treatments that are reactive (e.g., mouthguards used during sleep), this system aims to prevent the occurrence of bruxism episodes in the first place by detecting early signs and intervening. This preventative approach can reduce long-term dental health issues, making it an attractive option for consumers.

3.Potential for Behavioral Change: Beyond immediate physical intervention, the system offers the chance for users to gain insights into their condition and adopt healthier habits. This aspect could be particularly appealing to a market segment interested in holistic health approaches, adding to the product's differentiation.

4.Cost-Effectiveness and Accessibility: The project's potential to reduce the need for extensive dental repairs or treatments could position it as a cost-effective solution for managing bruxism. By providing an accessible, early intervention tool, the system could appeal to insurance companies and healthcare providers as a means to lower long-term treatment costs.

5.Scalability: Starting with a focus on bruxism, the underlying technology and approach could potentially be adapted to address other involuntary muscle activity disorders, broadening the system's market reach. This scalability enhances its commercial viability, opening avenues for future product development and expansion.

6.Regulatory Pathway Clarity: As a non-invasive device, the closed-loop system may face a relatively straightforward regulatory pathway, especially if classified as a wellness device. This clarity can expedite time-to-market and reduce initial development costs, making it an attractive investment opportunity.

What are your reservations about each project?

Closed-Loop System for Treatment and Prevention of Bruxism

•**Technical Complexity and Accuracy**: Ensuring the system accurately detects bruxism episodes under various conditions without false positives or negatives is crucial. Technical challenges in achieving high accuracy in real-time detection and response could impact user trust and effectiveness.
•**User Compliance and Comfort**: The device's continuous wear, especially during sleep, raises concerns about user comfort and long-term compliance. It must be designed to be comfortable and non-intrusive to encourage regular use.
•**Data Privacy and Security**: Collecting and analyzing personal health data, including EMG readings, necessitates robust data protection measures to maintain user privacy and comply with regulations like HIPAA.
•**Market Differentiation**: With existing solutions such as mouthguards and medication, the system needs a clear value proposition that demonstrates superiority in effectiveness, convenience, or cost to capture market share.

Visually Expressing Thoughts using EEG-based System

•**Interpretation Accuracy**: Translating EEG signals into visual representations that accurately reflect a user's thoughts or emotions is extremely challenging due to the complexity of brain activity and the subjective nature of thought and emotion.
•**User Expectations**: Managing user expectations around the system's ability to "read minds" is essential. There is a risk of disappointment if the output does not match users' expectations or if it oversimplifies complex thoughts and emotions.
•**Ethical Considerations**: The technology raises ethical concerns, including privacy issues and the potential for misuse in extracting or interpreting thoughts without consent. Ensuring ethical use is paramount.
•**Technical and Scientific Viability**: The current state of EEG technology and AI might not be sufficiently advanced to achieve the project's ambitious goals, especially within an 8-week timeframe.

A Closed-Loop System for Treating Freeze of Gait in Parkinson's Disease

•**Clinical Validation**: Demonstrating the system's efficacy in preventing or mitigating Freeze of Gait (FOG) episodes requires extensive clinical trials, which can be time-consuming and costly.
•**User Adaptation**: Patients with Parkinson's Disease have varying symptoms and responsiveness to treatments. The system must be highly adaptable and customizable to individual needs.
•**Safety Concerns**: For users with mobility issues, especially those prone to falls, the device must be proven safe and must not introduce any risk of harm or distraction during use.

EMG and IMU Data for Therapy Mapping

•**Complexity in Interpretation**: Accurately interpreting EMG and IMU data to track and measure therapy progress involves sophisticated analysis techniques and could vary significantly between individuals.
•**Integration into Clinical Practice**: Convincing physical therapists and clinics to adopt this technology may be challenging without clear evidence of improved outcomes or efficiency.
•**Cost and Accessibility**: Developing a cost-effective solution that is accessible to a wide range of therapy settings, including low-resource environments, is crucial for broad adoption.

Brainwave Controlled Music Synthesizer and LED Display

•**Technical Feasibility**: Both projects rely on interpreting brainwave data, a field that is still in its infancy. The complexity of translating EEG signals into meaningful outputs (music synthesis or LED display patterns) poses significant technical challenges.
•**User Experience**: Creating an intuitive and satisfying user experience that meets the expectations of users with diverse needs and abilities is critical. There's a risk the novelty could wear off if the system doesn't provide lasting value or engagement.
•**Privacy and Security**: Similar to the bruxism project, collecting EEG data raises privacy concerns. Users must trust that their neurological data is handled securely and ethically.
•**Market Readiness**: Assessing the market readiness for such novel uses of EEG technology is difficult. While there is potential, the actual demand and willingness to pay for these innovative but unproven applications are uncertain.

Which project would you choose if it were entirely your decision? Why?

Closed Loop System for Treatment and Prevention of Bruxism for the following reasons:

1.Broad Impact and Need: This project targets bruxism, a widespread issue, offering a preventive and innovative solution that could benefit many.
2.Technical Challenge and Learning Opportunity: Developing a system that uses EMG sensors for real-time detection and intervention presents a rich technical challenge. It offers an excellent learning opportunity in fields such as signal processing, machine learning, and mobile app development.
3.Feasibility and Scope: Considering the constraints of an 8-week timeline, the project is ambitious yet achievable. It allows for the creation of a functional prototype focusing on key features (detection, intervention, and user feedback via an app), providing a solid foundation for further development.
4.Commercial Viability: The project's focus on a common health issue, combined with its innovative approach and integration with mobile technology, makes it highly commercializable. There's a clear market for solutions that offer preventive health measures in an accessible, user-friendly manner. The potential for scaling and adapting the technology to other applications further enhances its commercial appeal.
5.Personal Interest and Motivation: I've already dedicated some work to this project over the last year, giving me a foundational understanding and a vested interest in seeing its development through to the next stages. This prior experience not only makes the project more feasible but also deepens my commitment to its success.

Team Skills Assessment

During the brainstorming phase, you considered problems and possible solutions of interest to your team. However, when choosing your project, it is important to consider the skills that your team has, the skills that you may need to acquire, and the time constraints of the course. This exercise is designed to help you realistically evaluate what your team can accomplish.

Make a comprehensive list of the skills represented by each member of your team. Think about different categories of skills (e.g., neuroscience, software, hardware, presentation, business, etc.). Be specific.

Team Members	Skills

See survey and data for team member skills

Survey:
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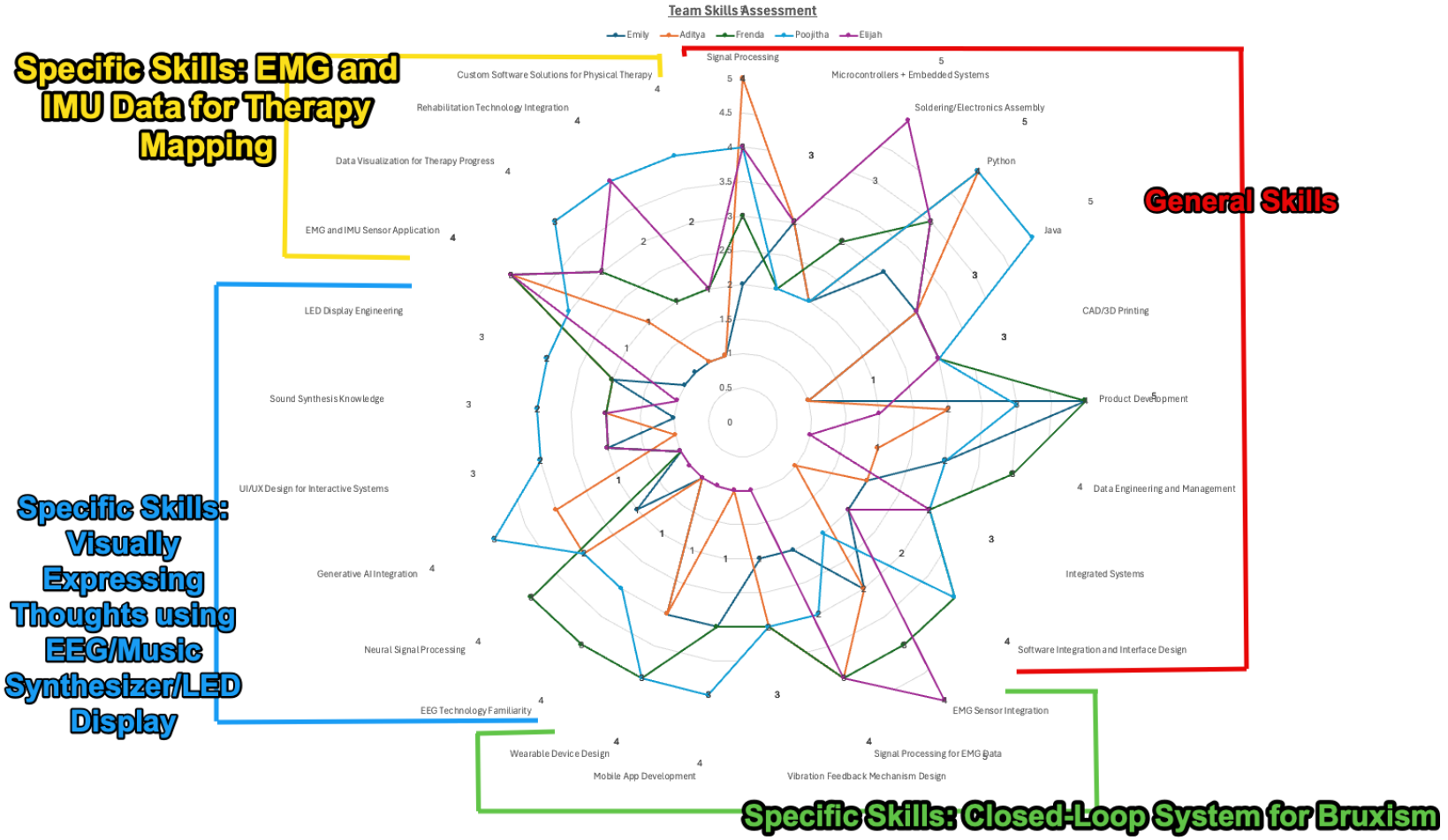
Data:
https://docs.google.com/spreadsheets/d/1Im14Rf7UqpG5MJ9H6SWqvztDHemijDAXunGzgHzIPxA/edit#gid=267555230

Turn your list into a map or diagram (like a density plot or a concept map).
Use this visual representation to help you identify your team's strengths and weaknesses.



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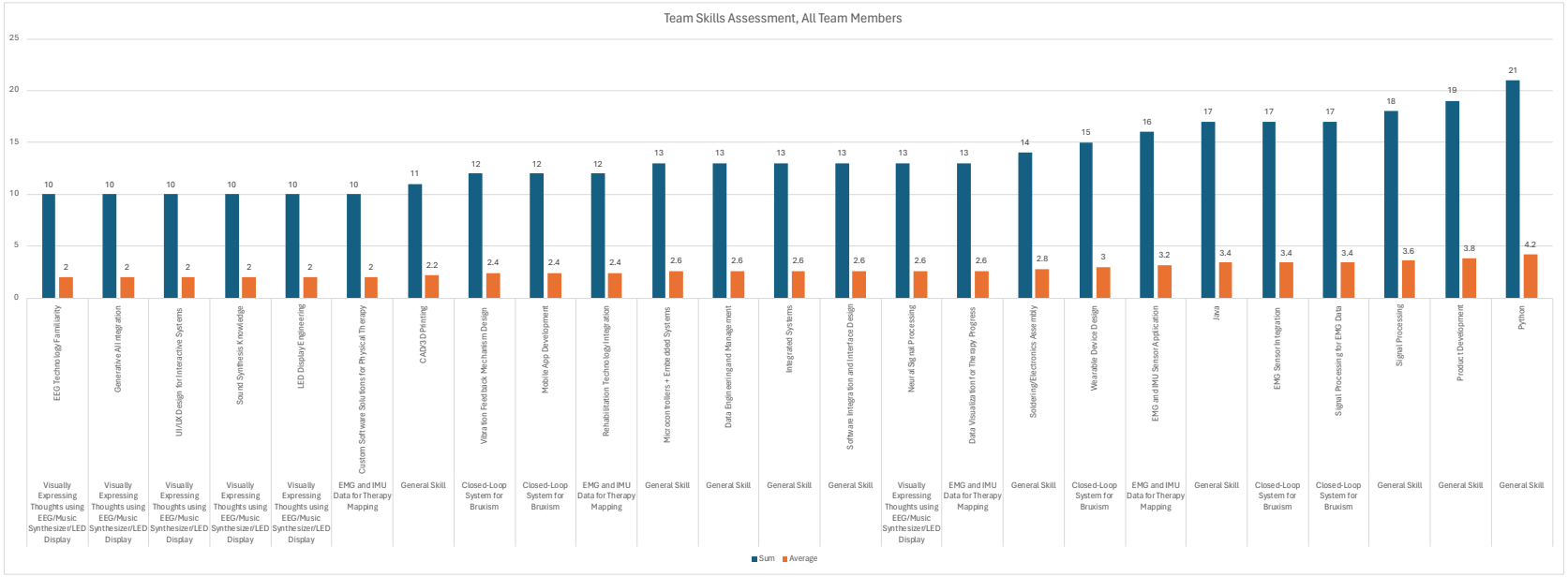

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Choose Your Project

You cannot make progress until you make a decision about your project. This is the time to decide by engaging in the processes of restating, prioritizing, and choosing.

Restate
Restate each project idea using the expert feedback and outline the major steps/skills that are necessary to achieve each one.

A Closed-Loop System for Treatment and Prevention of Bruxism
Restated Idea with Expert Feedback: Develop a targeted, doable solution for bruxism management using EMG sensors on the jaw to detect involuntary teeth grinding in real-time. The system will trigger vibrations for muscle relaxation and include an app for managing grinding habits. Experts recommend ensuring the device is comfortable, exploring the user's willingness to wear the device, and investigating the effectiveness of vibration for symptom management.
Major Steps/Skills:
- EMG Sensor Integration: Design and test EMG sensors for accurate detection of bruxism episodes.
- Vibration Mechanism: Develop a mechanism to deliver gentle vibrations upon detection of grinding to help relax jaw muscles.
- App Development: Create an application to provide users with insights and tools for managing their condition, including feedback from the sensor.
- User Comfort and Design: Ensure the device is comfortable for overnight use, potentially through ergonomic design and materials research.
- Data Analysis and Machine Learning: Use data analytics to understand grinding patterns and improve detection algorithms.
- User Research and Testing: Conduct research on user willingness and titrate the strength of vibration based on feedback and efficacy studies.

Visually Expressing Thoughts using EEG-based System
Restated Idea with Expert Feedback: Construct an EEG-based system that processes brain signals to generate visual representations of thoughts using generative AI art models, targeted towards aiding mental health therapy and creative processes. Consider simplifying the concept, such as focusing on music synthesization for spinal cord injury patients for creative expression, as EEG processing is complex and its clinical relevance uncertain.
Major Steps/Skills:
- EEG Technology Integration: Select and integrate an EEG headset with sufficient resolution and channel count for the project.
- Signal Processing and AI Integration: Develop algorithms to process EEG data and translate it into prompts for AI-generated art or music synthesization.
- User Interface Design: Create an intuitive interface for both therapists and artists to use the system effectively.
- Validation and Testing: Validate the system's effectiveness in representing thoughts or emotions visually, with considerations for user satisfaction and potential frustration.
- Ethical and Privacy Considerations: Address privacy concerns related to EEG data and ethical implications of brainwave interpretation.

EMG and IMU Data for Therapy Mapping
Restated Idea with Expert Feedback: Create an EMG and IMU sleeve to accurately track and map muscle changes during therapy sessions for patients undergoing upper extremity rehabilitation. The system will focus on providing quantifiable data to therapists for better assessment and personalized therapy plans. Feedback highlights the importance of ensuring easy placement and consistency of sensor placement, along with developing algorithms for classifying different movements and analyzing them for therapeutic insights.
Major Steps/Skills:
- Sensor Sleeve Development: Design an adjustable sensor sleeve that is comfortable and easy to position correctly each day.
- Data Processing and Machine Learning: Develop signal processing and machine learning algorithms to classify movements and analyze therapy progress.
- User Interface for Therapists and Patients: Design separate interfaces for therapists and patients that are intuitive and provide meaningful feedback.
- Hardware and Software Integration: Integrate the sensor data with software for real-time analysis and feedback.
- Prototyping and User Testing: Prototype the device and conduct user testing with therapists and patients to refine the design and functionality.

Brainwave Controlled Music Synthesizer
Restated Idea with Expert Feedback: Design a Brainwave-Enabled Music Synthesizer (BEMS) that uses EEG signals to control music synthesis parameters, enabling users, especially those with physical disabilities, to create music by thinking. Experts caution about the complexity of accurately translating EEG signals and the extensive training required for users, suggesting a focus on simple, intuitive controls and ensuring a meaningful feedback loop for creative expression.
Major Steps/Skills:
- EEG Signal Processing: Develop algorithms to decode brainwave patterns and translate them into musical parameters.
- Synthesizer Design: Design a synthesizer interface that is intuitive and allows for the creative expression of thoughts into music.
- User Training and Feedback Mechanisms: Implement training protocols for users to effectively control the synthesizer and design feedback mechanisms to aid in learning.
- Privacy and Data Security: Ensure the system adheres to data protection standards to safeguard user information.
- Accessibility and Affordability: Address challenges related to making the technology accessible and affordable to a broad audience.

Prioritize

As a group, make a list of your priorities for the project (e.g., how confident are you that you can get it done vs. how interesting is it, etc.)

Criterion	Weight	Closed-Loop System for Bruxism Average Score	Visually Expressing Thoughts using EEG Average Score	EMG and IMU Data for Therapy Mapping Average Score	A Closed-Loop System for Freeze of Gait Average Score	Brainwave Controlled Music Synthesizer Average Score	Brainwave Controlled LED Display Average Score	Closed-Loop System for Bruxism Weighted	Visually Expressing Thoughts using EEG Weighted	EMG and IMU Data for Therapy Mapping Weighted	A Closed-Loop System for Freeze of Gait Weighted	Brainwave Controlled Music Synthesizer Weighted	Brainwave Controlled LED Display Weighted
Feasibility	18%	5	2.4	2.8	2	2.8	3.4	0.89	0.43	0.50	0.36	0.50	0.61
Technical Viability	14%	5	2.2	3.2	2	3.6	3.6	0.69	0.30	0.44	0.28	0.50	0.50
Impact and Relevance	11%	4.8	2	4.2	3.8	2.4	2	0.51	0.21	0.44	0.40	0.25	0.21
Innovation and Originality	7%	4	3.8	4	3.6	3	2.6	0.29	0.28	0.29	0.26	0.22	0.19
User Experience and Design	8%	4.4	2.6	3.4	2.4	3.8	3.4	0.37	0.22	0.28	0.20	0.32	0.28
Marketability and Commercial Potential	8%	5	2.2	3.4	3.4	2.6	2.4	0.38	0.17	0.26	0.26	0.20	0.18
Research and Learning Opportunity	13%	4.8	4.6	4	4.4	3.6	3.4	0.65	0.62	0.54	0.59	0.48	0.46
Ethical Considerations and Social Responsibility	5%	4.8	3.2	4.2	4	3.8	3.8	0.24	0.16	0.21	0.20	0.19	0.19
Budget and Resource Allocation	8%	4.8	3.2	2.8	2.4	3.6	3.6	0.37	0.24	0.21	0.18	0.27	0.27
Personal Interest and Passion	8%	4.4	3.8	3	2.4	2.6	2.6	0.37	0.32	0.25	0.20	0.22	0.22
Total	**100%**							**4.75**	**2.95**	**3.44**	**2.94**	**3.15**	**3.11**
Rank								**1**	**5**	**2**	**6**	**3**	**4**

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Choose

Identify the project that optimizes these priorities.

Project	Weighted Score	Rank
Closed-Loop System for Bruxism	4.75	1
EMG and IMU Data for Therapy Mapping	3.44	2
Brainwave Controlled Music Synthesizer	3.15	3
Brainwave Controlled LED Display	3.11	4
Visually Expressing Thoughts using EEG	2.95	5
A Closed-Loop System for Freeze of Gait	2.94	6

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