



PHOENIX

(Power and Hardware Optimization through Engineering, Networking, and Integrated eXploration)

ELECOMP Capstone Design Project 2026-2027

Sponsoring Company:

Cranium Inc.
864 Nittany Court
Allentown, PA, 18104

Company Overview:

Cranium is a startup technology company that proposes a ruggedized, AI-enabled Helmet platform designed to deliver real-time detection and localization of tactical anomalies via multimodal sensor fusion. By processing acoustic, thermal, visual, and RF cues directly at the edge, the system enhances operator survivability and situational clarity.

Technical Director:

Mark Mulder
Chief Product Office (CPO)
iceman@craniuminc.com
www.linkedin.com/in/mark-mulder-8a3979a





Project Motivation:

THE PROBLEM: FRAGMENTATION & FAILURE

COGNITIVE -CHAIN FAILURE, COGNITIVE BURDEN, EQUIPMENT OVERLOAD, FAILED IVAS.

COGNITION COLLAPSE



COGNITIVE
BURDEN



EQUIPMENT
OVERLOAD



BIOMETRIC
TRACKING



TBI/ Concussion

FOG OF WAR KILL-CHAIN

DATA SATURATION

LEGACY SYSTEM



NO INTEROPERABILITY

FAILED SOLUTIONS



IVAS IS DEAD

Our Special Forces Warfighters, Elite Law Enforcement Officers, and First Responders are woefully unprepared for the environments we ask them to enter. We now have an abundance of sensor, communication, and computational data available to them to enhance their capabilities and likelihood of mission success and survival. However, that data is delivered through disparate systems (i.e. multiple pieces of equipment) making it fundamentally impossible to monitor all of them simultaneously ... all while trying to survive on the battlefield, in a gang drug-house raid, or in a burning building.

The net result is a failure to deliver that data where it is needed, to whom it is needed, and when it is needed. Failure to deliver in any one of these ways is a total failure ... and we've managed to build a system that fails at all three. In short, we have failed the best people our society has to offer, and that is simply not acceptable.



Anticipated Best Outcome:

The Cranium Capstone Team would design and analyze the electrical layout of the system focusing on the power management, power consumption, and battery capacity requirements. These tasks would be accomplished through a combination of both theoretical (simulation, calculation, datasheet guidance, etc) and empirical (hardware measurement) methodologies.

Project Details:

The Cranium Technical Director will provide a detailed list of hardware required to be included in the system, and the Cranium Capstone Team will design and analyze the electrical layout of the system.

For any hardware that the Cranium Capstone Team desires to use but is not specified by the Cranium Technical Director, the system must use American-made COTS components with full sourcing disclosed to and approved by the Cranium Technical Director prior to acquisition.

The overall system must be carried by the User, with most of the critical hardware within the Helmet. Therefore, several of the key design considerations are:

- Maximize Efficiency
 - Extend battery life/minimize battery capacity requirements
- Minimize Heat Generation
 - Excessive heat requires active cooling (which is another failure point and increases battery capacity requirements)
 - Reduces the level of User comfort in warm/hot environments
- Reduce Weight
 - Weight within the Helmet increases User neck strain
 - Increased weight in the Helmet increases the inertial mass of the Helmet, making it more difficult for the User to run, jump, and dive when critically necessary
 - Increased weight on the User's body reduces the carrying capacity of ammunition or other equipment



This must all be accomplished within the framework of the following competing design considerations:

- Data Processing Speed
 - The Helmet is a data acquisition, processing, and delivery tool. Failure to readily process, analyze, and deliver data where needed is a mission failure. The worst possible outcome is intermittent success, where the User learns that he cannot rely on the technology in the Helmet.
- Field Serviceability
 - All of our Helmets will be first deployed in some of the harshest environments imaginable. Therefore, there will be damage and hardware failures. These components must be easily swappable within a secure base environment, ideally without the need of any special tools.
- Compact Design
 - The tighter the Helmet is to the contour of the User's head, the better the User will be able to navigate the terrain (e.g. tree branches, tight spaces in buildings, entry/exit of vehicles). In order to minimize the size of the Helmet, the hardware must be really compact. Creative solutions for minimizing space are necessary.

Please note that cost is not a primary design consideration. We are delivering a critical technology to our elite Warfighters, Law Enforcement Officers, and First Responders. Our target Customers understand that this comes at a cost. While we always want to be conscious of cost, optimizing performance is the primary design consideration.



Composition of Team:

3 Electrical Engineers **(US CITIZENSHIP REQUIRED)**

Skills Required:

Electrical Engineering Skills Required:

- Direct Current Principles and Circuits
- Simulation Software (e.g., TINA-TI, Multisim, or LT-Spice)
- Datasheet analysis and power consumption estimation
- Laboratory experience with test equipment (DC power supplies, Oscilloscopes, etc.)
- Power consumption testing

Other Electrical Engineering Skills of Interest:

- Thermal analysis experience
- Wireless Networks
- RF testing



Anticipated Best Outcome's Impact on Company's Business, and Economic Impact

The Cranium Capstone Team will be integral in the development of future hardware implementation. We are in a race to a future that science-fiction has been speculating about and dreaming of for decades. We are now at the tipping point in history where science-fiction will transition to reality. This is a tough challenge, but it now within the realm of what's possible. You will be a part of making this a reality!

Broader Implications of the Best Outcome on the Company's Industry:

When we deliver a Cranium Helmet to our nation's best Warfighters, Law Enforcement Officers, and First Responders, you will be contributing members of the team responsible for helping deliver the critical information they need to quickly and effectively do their jobs, and come home safely!



Appendix A: AI Use Policy – [Insert Project Name]

Allowed

- Students may use AI tools for
 - ☒ brainstorming support
 - ☒ concept development
 - ☒ literature and publicly available documentation review
 - ☐ software development
 - ☐ debugging
 - ☐ data analysis
 - ☒ test development
 - ☐ non-proprietary paragraph editing
 - ☒ non-proprietary single-slide formatting
 - ☐ preparation of project deliverables
 - ☒ note taking or transcription of meetings
 - ☐ Others: (none)

Not Allowed

- Using AI in violation of university policies, applicable laws, or course-specific rules identified by capstone instruction team and project-specific rules identified by the technical directors.
- Entering proprietary, confidential, personally identifiable, security-sensitive, or otherwise restricted information into an AI system without authorization.



- Submitting AI-assisted work without understanding, reviewing, verifying, and appropriately disclosing its use.
- Submitting entire documents or presentations to an AI system for editing or formatting.
- Any unchecked items from the allowed list above.

Requirements

- If any use is allowed, AI tools may only be used to enhance, but not replace, students' technical reasoning, engineering judgment, and understanding. Students must be able to explain, justify, and defend all submitted designs, code, analyses, test results, documentation, and conclusions.
- During the first two weeks of the project, the student team shall work with the Technical Directors to: identify any proprietary or confidential information that may be involved in the project; determine what information may or may not be shared with AI systems; identify the AI tools, models, accounts, and configurations approved for project use; and document any project-specific restrictions or approval requirements.
- Students shall transparently document the uses of AI using the URI CYPHER AI Usage Marking guidelines (<https://web.uri.edu/cypher/ai-marking/>). A workshop is planned for September to familiarize students with these guidelines.
- Students retain full professional responsibility for all design decisions, analyses, implementations, testing, documentation, presentations, and final deliverables, regardless of whether AI tools contributed to the work.