



Wearable Technologies Workshop Challenge Request

April 29 & 30, 2019

hosted by NASA at the Johnson Space Center

Challenge Title: VIVE VR Sweat Protection & Sensor Capability

Organization Name: NASA Johnson Space Center

Team Assignments Available: 3



Summary of the Challenge and Team Project

Background:

NASA Johnson Space Center's ER3 group hosts the countermeasures systems for crew on-orbit exercise including ARED (Advanced Resistive Exercise Device), T2 (Treadmill 2), CEVIS (Cycle Ergometer with Vibration Isolation and Stabilization), and MED-2 (Miniature Exercise Device – 2). The group also supports development of the next generation of advanced exercise architecture and systems. As part of this advanced work, we are examining the addition of VR (current gen HTC VIVE Pro) for gamification to increase the immersive properties of the system. In our early testing, we have faced significant issue with sweat accumulation resulting in failure to units. This will only be exacerbated with microgravity conditions and impacts of surface tension of water that is not overcome by gravitational loads.

Problem Statement:

Develop a solution set for the HTC VIVE Pro headset that:

- a) Mitigates sweat accumulated during exercise efforts to prevent interaction with unprotected internal circuitry/electronics of headset and wifi connection attachment
- b) Addition of sensing technology that analyzes sweat metabolic waste products and other physiological/environmental agents or performance metrics
- c) Provide communication protocol over BLE from sensing device (preferred) or post-session data download

Important Design Considerations (These can be discussed, and possibly negotiated, in more detail after the Team has been assigned):

- a) Does not require destructive modification to the hardware that would otherwise void any warranty scenarios for other failure modes not related to sweat
- b) Any sort of fan solution should consider the impacts of microgravity affects to water and its physical properties

- c) Communication of sensing data over BLE is extremely preferred in order to interact with other resources such as MoBI (Modular Bluetooth Integrator) – this hardware will be provided to assist with developing data management plans
 - d) Should not interfere with any of the current adjustment mechanisms for the headset or any other moving surface of interest such as the lift function of the earphones (may limit the upper Velcro strap if this can be set before installation easily for a new user)
 - e) Sensing device data sampling rate is not a fixed element but the higher the sampling rate (dependent on the metric) the more we can use the data in correlations to other sensing inputs
 - f) If the data download is intended to happen post session through a USB or other method, ensure the process is simple or a executable program is defined to quickly acquire data
 - g) Data output should be in .csv format
 - h) Solution should be machine washable or developed with solutions with antimicrobial capabilities to prevent mold and bacteria development in extended life
 - i) Sweat sensor should be removable for replacement or repair efforts with minimal tooling (ideally no tooling)
 - j) Batteries should be replaceable, rechargeable using standard interfaces, and have at least a 2-hour battery life
- **further clarification and redefinition of these requirements is possible and will be actively discussed with selected teams, we are only providing these requirements as a starting point for discussion and want to keep the solution possibilities open to innovative approaches*

What funding and/or resources can be provided to each Team? (The details of the payment arrangements must be negotiated with the Team.)

No extraneous funding will be provided but access to support and lab space for testing is available through the NASA JSC ER3 PSION (Physiology-Sensing, Intelligent Optimization Nucleus) Lab located at the Johnson Space Center in Houston, TX.

Deliverables (the final product the Team is to provide – such as a report, garment, user evaluation, ...):

A sweat mitigation hardware or softgoods system integrated with sweat sensing capabilities. *(See below for further specifics)*

How Will the Results Be Used?

This solution will be immediately applied to our VR head units for testing in the PSION Lab and may also result in a request for more quantities for the other VR groups in NASA JSC's ER (Software, Robotics, and Simulations) Division and other cross-organizational entities. The sweat sensing data will be correlated to the information received off our other in lab sensors as part of our work to develop a deep neural assessment trainer tool (i.e. Artificial Intelligence Coach) that informs crew of performance standards, helps determine exercise effectivity and impacts, and informs crew surgeons and other research support.

The current exercise VR system is used for our WHTRBT (Wearable Hybrid Training with Reality Blended Technologies) project. As part of this testbed, we perform exercise protocols that include integrated application of our motorized hardware systems to better inform design needs for future technologies and architecture.

What deliverables (if any) are to be transferred to the organization at the end of the project?

Final deliverables will include:

1. Quantity (3) or greater sweat maintenance units
2. Quantity (3) or greater sweat sensors and necessary support hardware
3. Users guide for sweat sensing technologies or any other data/pairing requirements, as well as appropriate installation, maintenance, and care practices
4. Report discussing the design process, defining the requirements applied for development, records of testing (with accessible data files for integration verification with PSION resources, e.g. MoBI), and the final specs of the solution set
5. CAD files of the design or other such drawings or models used to develop the hardware for integration into upper level working volume models for vehicle design needs
6. Vendor, part number, and other such important specifications of any COTs elements or applied hardware for future repair or development of more units