Multi-modal Event Standardization Platform of Biometric-Derived Human Performance Models in University Students

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Capturing biometric-based data from wearable sensors on the physical activities of Service Members while completing military missions in theater would greatly advance Digital Human Performance modeling efforts. However, there are several logistic, regulatory, and scientific challenges that must be overcome before it will be possible to develop and deploy solutions for collecting and integrating such data. Likewise, additional challenges remain when using this data to create predictive models of Human Performance that adhere to the data standards that are put in place to protect operational security. This research explores whether currently deployed data-collection products used by the Armed Services could integrate commercial-off-the-shelf wearable products into their architecture given the cybersecurity and networking limitations required to meet DoD specifications.

This study sought to leverage stand-alone clone of a Leidos-owned, pre-existing platform that is already being utilized in deployed settings by DoD Service Members. The product is a modular, open-source approach for tactical applications that ensures timely collection, processing, and delivery of mission critical information from the tactical edge to relevant stakeholders in a rapidly consumable form. At this time, the data captured during testing sessions is not saved and the project has yet to acquire permissions necessary to store information to a secure server that meets Defense Health Agency standards. However, despite these limitations, this Leidos-owned platform can be easily modified to serve as the technological infrastructure for our efforts, can operate on the limited bandwidth conditions experienced in theater, and has met the regulatory and cyber-security guidelines necessary to interact with the Android Tactical Assault Kit (ATAK).

This modified platform would be used to extract data from college students enrolled at university in the continental United States. These study participants are previously Active Duty Service Members and have agreed to return to duty and have extended their current contract after graduation. In this study, they will participate in an experimentally-controlled, physically challenging task designed to monitor the adaptive changes in physiology after engaging in repeated levels of exercise. The University partners working with our Leidos team have conducted and analyzed pilot data on participants engaged in activities based on the DoD Personnel Fitness Test. For this new effort, the participants will be outfitted with three

wearable products (a ring, watch, and patch) to collect a variety of physiological data, including heart rate variability, activity level, sleep patterns, and sweat output. The intent of this study is to capture lessons learned, and the shortcomings from, extracting data from wearable biometric sensor on this simple, but easy to implement, approach, as well as, identify insights on how a more customized data-integration product destined for down-range deployment should be built in the future.

At the same time, quality assurance testing and technical landscape reviews are being conducted by Leidos that will both assess (via field testing and literature reviews) which wearable products will perform best under different DoD specific use cases(e.g., a ring-based wearable might be good for capturing physiology measure while running, but may negatively affect grip positioning on a marksmanship test) or procedures that might be of interest to the different Branches of the Armed Forces.

Initial results suggest that the largest impediment to future, wide-spread adoption by the DoD of using commercial vendor created wearable sensors for Digital Human Modeling will be the un-willingness of said vendors to 1) release their rights to the raw data created from their device, and 2) provide detailed descriptions of the proprietary algorithms used to provide metrics of a user's data. Ultimately, the DoD cannot acquire and be the sole customer to a wearables company, meaning that wearables vendors must instead tailor their product and offerings as broad a client base as possible to remain commercially viable; under these conditions, it is not possible for commercial vendors to remain competitive and to satisfy DoD acquisition/ruggedization standards (e.g., manufacturing their products without Bluetooth hardware). As the technologies used by these vendors continues to mature and the price of the sub-components used to make these products decreases, it will one day be possible for federal entities to manufacture wearable devices that meet all the necessary standards required to outfit the entire Force; but not disrupt the private sector market. Until that day arrives, research in this arena will need to identify and produce solutions to problems with integrating wearables into currently deployed, data-collecting offerings so that the advantages of wearable sensors afforded to Digital Human Modeling and Force Readiness measures can be deployed to the Warfighter in a timely and efficient manner.