OBJECTIVE: Design and develop an augmented/mixed reality headset device able to integrate with current Navy Information Assurance (IA) infrastructure and can be usable at the Organizational (O-), Intermediate (I-), and Depot (D-) levels of maintenance aviation activities for the Navy and Marine Corps.

DESCRIPTION: There are several efforts, ongoing and planned, to develop technologies and functions that allow for augmented/mixed reality (AR/MR) devices to be applied to Navy and Marine Corps Maintainer use cases. Several of these efforts have proven successful in being able to view maintenance procedures on Commercial-off-the-Shelf (COTS) devices and being able to connect maintainers to engineering subject matter experts (SMEs) to assist in complex and irregular maintenance actions. To enable these functions and all of the existing and future capabilities provided by MR technologies, a hardware asset that meets the requirements of the Navy and Marine Corps network [Refs. 3, 4] and cyber infrastructure is necessary.

Although several COTS headsets currently exist, the Navy and Marine Corps environmental, cybersecurity, and data infrastructure requirements are unique and not addressed or targeted by existing augmented reality hardware. Existing MR hardware hosts standard operating systems and require a wireless connection to the internet to access several of its applications and to enable several features. Furthermore, existing hardware does not allow for DoD Common Access Card (CAC) readers or any secure methods of accessing the device using multifactor authentication. The proposed solution needs to allow all functionality within the headset (i.e., spatial cognition, displaying indications, sensor input, etc.), with a target Field-of-View of 50 degrees or more, weigh no more than 600 grams, and operate without requiring a network connection or having location information available.

A headset hardware solution is needed that allows the AR technology to be applied to the Navy and Marine Corps Maintainer use case, without needing to make changes to the current infrastructure. To enable this, a device that meets environmental requirements at each of the maintenance levels is required. The device would need to be ruggedized and marinized, without interfering with the maintainers visibility during their maintenance action and would also need to contain a display that is viewable in different maintenance locations (i.e., restricted data areas, weather conditions, and lighting conditions including direct sunlight). Furthermore, the device would need to perform its functions for 6-8 hours continuously without recharging.

The conditions required are as follows:

- MIL-STD-810G Environmental Conditions, Methods 501.5, 502.5, 509.5, 516.6
- Display viewable in direct sunlight and during night operations
- EMI Compliance: MIL-STD-461E

HERO Compliance: OD 30393 HERO Design Guide

A method of enabling two-factor authentication is necessary, since the device will contain secure data in the form of maintenance procedures, drawings, and models. Current COTS AR headsets do not provide a method for securely accessing the devices, other than entering a password.

Finally, the device host Navy security software on its operating system (OS), without reducing the functionality and performance of the actual device. Therefore, the OS would need to meet all of the cyber requirements of our operating systems [Refs. 3, 4], and be supportable for release of new versions and updates. Furthermore, the integration of the headset into the Navy security system should minimize the following latency sources: Off-host delay, Computational delay, Rendering delay, Display delay, Synchronization delay, and Frame-rate-induced delay.

A secondary objective would be for the software enabling this solution to be packaged hardware-agnostic, for use on different
iterations and versions of AR devices. Existing COTS AR devices require connection to a third-party network to function properly. The Navy is looking for a device tailored to fit the use case of the Navy and Marine Corps maintainer.

PHASE I: Design and demonstrate feasibility of a solution to address the requirements in the Description. Provide an Analysis of Alternatives with several conceptual designs defining and addressing each of the requirements listed in this Description. The designs must show software architecture as well as plans for accomplishing the two-factor authentication. The Phase I effort will include prototype plans to be developed under Phase II.

PHASE II: Design, develop, and demonstrate a prototype meeting the requirements in a lab or live environment. Work with the NAVAIR cybersecurity to ensure the development aligns with the cyber requirements and with a Navy internal development team to align the effort with software applications being developed and installed on this hardware solution. The hardware will be loaded with applications and will undergo functional testing, including Electromagnetic interference (EMI), environmental, and shock/drop tests.

PHASE III DUAL-USE APPLICATIONS: Support the testing of the developed solution at Organizational, Intermediate, and Depot levels of maintenance sites for completion of test, and transition to appropriate end users.

This SBIR topic provides benefits to the private sector by opening up the market to a far more customizable mixed/augmented reality headset. Current COTS configurations are severely restricted in terms of cyber capabilities and environmental qualifications. A ruggedized headset can easily have applications in a number of more complex factory environments. Improvements to visibility in high lighting conditions has applications to all other COTS headsets. This solution will be used in the defense and maintenance industries, with the possibility of providing benefits to the healthcare and automotive industry as well due to the added security capability.

REFERENCES:

4. Risk Management Framework: rmf.org

KEYWORDS: Augmented; Mixed; Reality; Head-mounted display (HMD); Display; Headset