I. BACKGROUND

The High Performance Computing and Visualization Group (HPCVG), is located in the Applied and Computational Mathematics Division (ACMD) in the Information Technology Laboratory (ITL) of the National Institute of Standards and Technology (NIST). The Group develops novel algorithms and implementations for parallel and distributed computation, as well as innovative techniques for immersive scientific visualization in a variety of local and distributed hardware environments. They also develop and utilize techniques and tools of mathematical analysis, parallel and distributed computing, machine learning, and visualization to improve measurement science, including the extension of traditional measurement science to the virtual world. This is all in support of the NIST mission: "To promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve our quality of life."

HPCVG owns and operates a CAVE (CAVE Automatic Visualization Environment) for its immersive visualization work at the NIST Gaithersburg, MD site. A CAVE is a real-time hardware system that enables the user to see perspective-based true 3D images. For this to function correctly, the hardware system must be designed with real-time capability that enables viewing of real-time images.

This Immersive Visualization Environment (IVE), along with the software that the Group develops, is on a critical path for all research in the Group. Its role is critical in HPCVG's High Performance Computing work as it serves to speed code development and enable quick checking for errors as well as validation tests. It enables the visualization, measurement on visualizations, and analysis of results. This has led to solving critical outstanding problems in industry and contributing to the creation of standard reference materials and data. For example, it played a crucial role in the development of the standard reference materials for cement paste, mortar, and concrete.

The CAVE has come to the end of its life as the display system can no longer be maintained. In order to ensure continuity of research efforts and to keep pace with the rapid advancement of technology in this area, it is important that the IVE be upgraded.

II. REQUIREMENTS

A. Minimum Requirements – *Dual* view capable display

The contractor shall provide: One (1) immersive visualization system meeting or exceeding the following minimum specifications:

Dual-view capability display - ability to support two users with unique head tracked stereoscopic view with the following details:

- Vendor Direct View No larger than 1.25mm LED

- Wall Display System
  Direct View LED with no larger than 1.25mm pixel pitch
  11' 6" +/- 6” Wide x 8' 6" +/- 4” High
  2,880 x 2,000, Pixel Resolution (minimum)
  4,000:1 Contrast Ratio
  50,000 Hour Light Source
  240hz dual-view stereo

- Floor Display System
  Direct View LED with no larger than 1.25mm pixel pitch
  11' 6" +/- 6” Wide x 3' 0" +/- 4” Deep
  2,880 x 744 Resolution (minimum)
  4,000:1 Contrast Ratio
  50,000 Hour Light Source
  240hz dual-view stereo

- Structural System
  Capable of holding the Direct View LED display as a free-standing structure
  Pixel gaps between display surfaces should be no more than 2mm.
  As part of its capability narrative, vendor shall specify the floor holding capacity required by the display and structure.

- Cabling System
  Capable of reaching the rack as indicated in diagram
  Cables should be designed to reach rack under a raised floor system

- Tracking System
  6-DOF position tracking throughout the CAVE, and extending at least 8’ back from the front wall for these objects:
    - Three (3) glasses frames (all unique)
    - Three (3) hand-held input controllers (all unique) capable of minimum of one joystick (X/Y) input and 4 button input activations
    - Two (2) wrist/ankle trackers (all unique)
    - Two (2) additional rigid body trackers (all unique)
  All required tracking and calibration software
  Tracking precision (measured >1m from screen surfaces) should be at least 0.5mm and 0.5° RMS
  Capable of producing VRPN output

- 3D System
  Twelve pair Active Shutter Dual-view Stereoscopic Glasses
  RF Stereo signal Emitter
  System Synchronization

- Desktop Console System
  Minimum On/Off control button
  Monitor Extension System providing connectors to two UHD (3840x2160) monitors on control desk

- Computer System – NIST supplied
  To ensure the computer system that drives the display meets all NIST security regulations, NIST will procure the system outside of this requirement. The following actions shall be taken:
  1: Vendor shall provide the minimum computer requirements required to drive the display as part of its capability narrative.
  2: NIST will provide the said computer system for configuration and testing.
  3: Vendor shall demonstrate to NIST correct display & tracking of computer by the end of the installation at NIST.

- Equipment Rack
  Equipment Rack with Caster Base
  Side Panels and Locking Front
  Equipment Cooling System
  Cable Management System
  Power Distribution System
  Shelving, Blanks, and Vents

- Power and cooling requirements:
  As part of its capability narrative, vendor shall specify the electrical power requirements for display, rack equipment and computer.
  As part of its capability narrative, vendor shall specify the heat generation of display and rack equipment.

- Application Software – NIST supplied
  Software compatibility requirements for the display include: Vrui, VRPN, FreeVR, ParaView, LidarViewer, OpenSceneGraph, and OpenGL.

- System testing:
  - The vendor shall be responsible for installing and then demonstrating the entire working system at the NIST installation site.
  - As part of the vendor's demonstration the following system tests shall be performed by the vendor:
    - Stereographically display polygonal models such as the industry standard Utah Teapot and Stanford Bunny.
    - Tracking system capable of simultaneously tracking the 6-DOF position of the head of three (3) individual viewers, along with three (3) hand-held controllers, plus at least two (2) other rigid body objects.
    - Demonstration of **dual-view** stereoscopic rendering and display.

- Standard Warranty:
  90 days after user acceptance. This includes, as necessary, parts warranty, shipping, on-site labor, and any travel-related expenses.

Site Preparation Location:

CAVE room Dimensions

- The CAVE room consists of 4 modules: 44'x22' => 968 sq feet

The location of the Display system is shown on the included drawing (i.e. Display System Drawing)

III. Delivery

Delivery shall occur within 4 months after receipt of order (ARO). Further, the contractor shall install the system at NIST and provide the required demonstration within 4 weeks after delivery.

IV. Delivery Address

The National Institute of Standards and Technology
100 Bureau Drive, Building 225,
Room B141
Gaithersburg, MD 20899-1640