



## Enhancing Augmented and Mixed Reality with Remote GPU Rendering for Energy Applications

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**Cyber-Physical Systems Leader** 

# Context System Architecture Applications



## **Energy Innovation Center (EIC)**

The Time to Invent is Now



At BHGE, we strive to create disruptive technology capable of changing the future. To be an accelerator for the energy industry. Our customers benefit from faster access to new ideas that aim to reduce costs and increase productivity.

Our innovation ecosystem connects into every facet of our company. We are able to directly support BHGE product lines, or commercialize breakthrough technologies through starts ups and incubators.

The time to invent smarter ways to bring energy to the world is NOW.

Growth

Incubations

**Strategic** 

**Partnerships** 

Innovation

Pipeline

### **Evolving & Adapting The Way We Work**



#### **Reduce Cost... Increased Productivity... Enable Sustainability**



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## **Cyber-Physical Programs at EIC – Leveraging Nvidia**



#### **Mobile Oilfield Analytics**

- Jetson TX2 / AGX Xavier
- DeepStream





#### Wellsite Intelligence

- Jetson TX2 + DeepStream
- Human-in-the-loop training tool

#### Enhanced AR & MR

- Nvidia GeForce & Quadro
- NvPipe / NVENC



## **Extended Reality Technologies in the Oil & Gas Industry**

 Highest portability
 AR
 (ARKit-compatible iOS devices, ARCore-compatible Android devices)

 MR
 (Microsoft HoloLens, Magic Leap One)

 Highest user immersion
 VR
 (HTC Vive, Oculus Rift)



- Increasing interest in XR within O&G industry
- Portability & physical contextualization highly preferred
- Some VR adoption for training & AR for field service
- Ideal solution for many applications: high-fidelity 3D content on mobile devices



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## Context System Architecture Applications



## **Key Feature Requirements**





## **Initial On-Premises Architecture**



Key breakthrough in developing our solution was leveraging dedicated Nvidia encoders + NvPipe library



## **Multiplayer Streaming**



#### **Concurrent NVENC session limits**

- GeForce capped at two, Quadro unlimited
- 4 simultaneous users with 720p30 streams (Microsoft HoloLens)



#### Shared coordinate systems

- Fiducial markers or physical spawn points with recalibration
- Unity cameras shrouded by avatar corresponding to player location



#### **Connecting multiple servers**

- Unity Multiplayer API used to pass player locations between servers
- Avatar locations shared across all machines



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## **Cloud Solution**





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## **Architecture Improvements**



Microsoft 3DStreamingToolkit

(github.com/3DStreamingToolkit/3DStreamingToolkit)



## **Inputs & Interaction Methods**









#### **Native Client Inputs**

• Client-side touch, voice commands and Bluetooth controllers

#### **RGB & Depth Camera Tracking**

• Real-time 3D point cloud reconstruction, pose tracking

#### **Virtual Touch**

• Hand tracking with haptic feedback



## **Data Types**



#### **RGB Photogrammetry**



#### Lidar





- 3D viewer app for collaborative asset import from library, with placement and movement capability client-side
- Pre-process asset as Unity package for rapid import
- MQTT broker for collecting IoT data on server and visualizing



# Context System Architecture Applications



## **Digital Enablement with Enhanced MR**

#### Without software platform



#### With software platform







## The BHGE Threat Response Drill – Health, Safety & Environment





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## **Threat Response Drill Environment**





- To-scale environment of coiled tubing worksite
- Actual models used where available or built assets from scratch based off site visits
- More than 80 million polys in scene

BAKER

a GE company







#### **Gamified Threat Response Drills**

- Highly interactive multiplayer simulations with defined user roles and scoring
- Demo mode with interactive, timed hazard identification



## **XR Applications Across BHGE**





#### Looking ahead:

- Enhanced AR deployment at the edge
- Architectural improvements
- Operationalizing



# We invent smarter ways to bring energy to the world.

