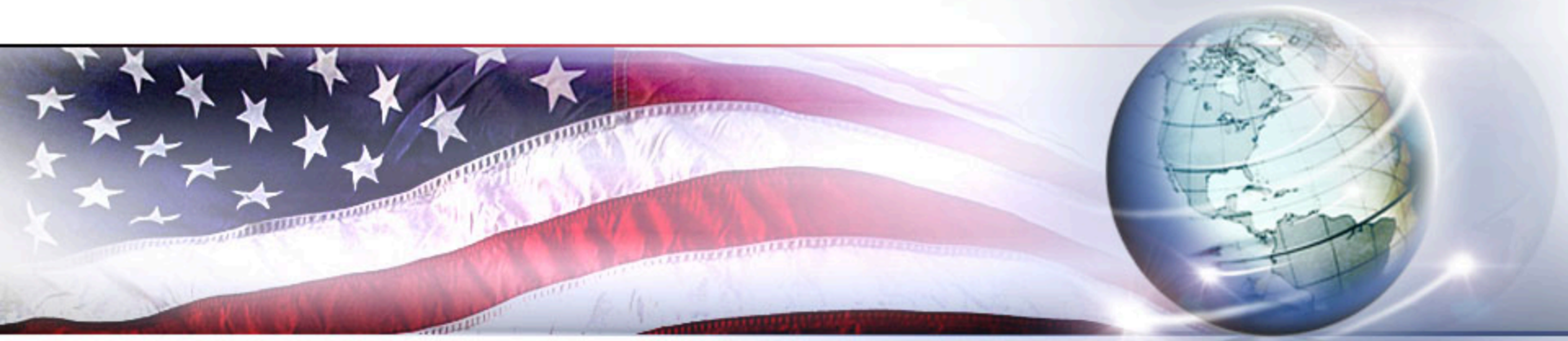
Enhancing Shipboard Maintenance with Augmented Reality



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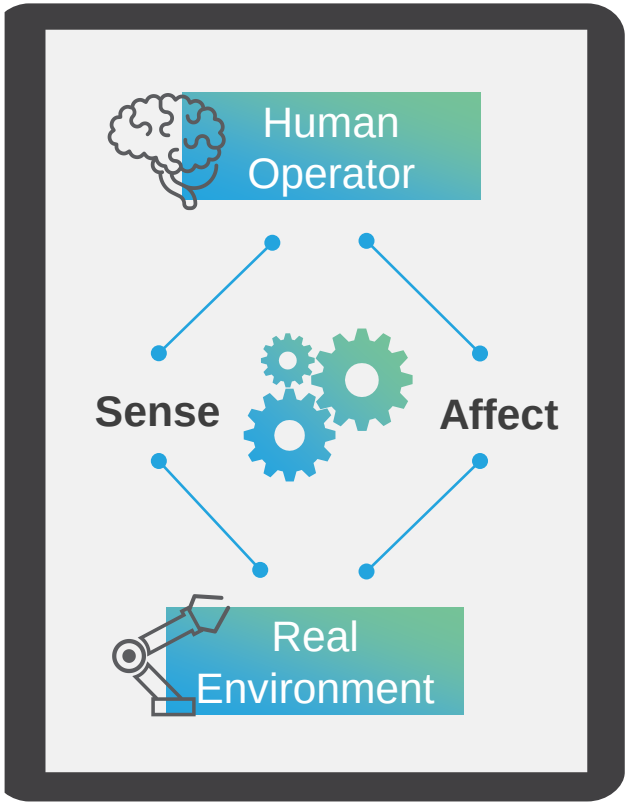
Agenda

- Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) Definitions
- Types of AR and practical use
- AR Enhancement for Mission Readiness
- Monitor/Tablet Based AR
- Enhancing Shipboard Maintenance with AR
- Smart Glasses
- AR Advantages/Benefits
- Required Tools/Software
- AR Benefits and Summary



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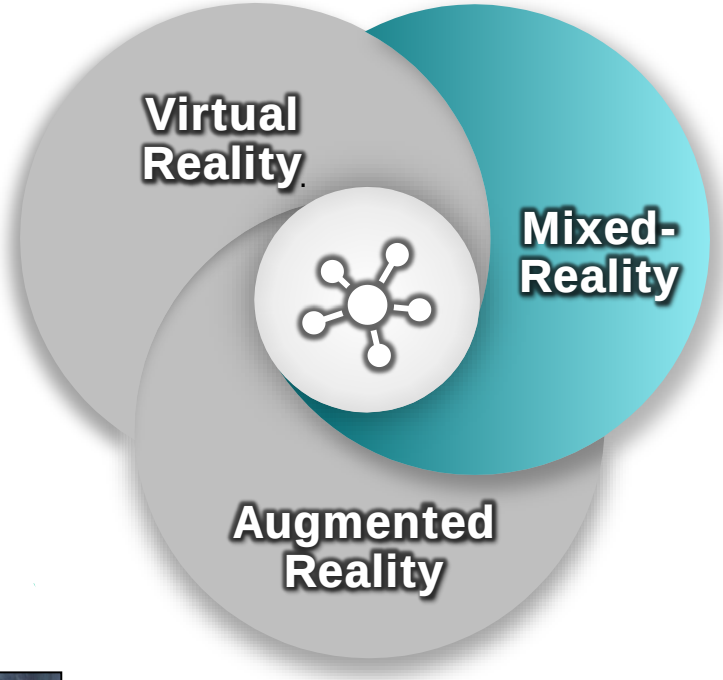
Virtual, Augmented, & Mixed Reality (VR, AR, MR) Definitions

Virtual Reality

Computer generated, interactive, 3D environment in which a person is immersed : virtual, interactive and absorbed

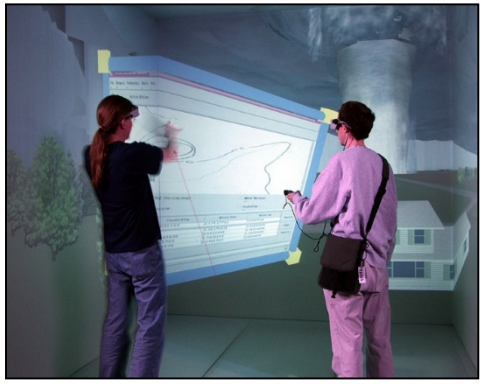
Augmented Reality

Supplements the real world with the virtual (computer generated) objects that appear to coexist in same space as the real world.

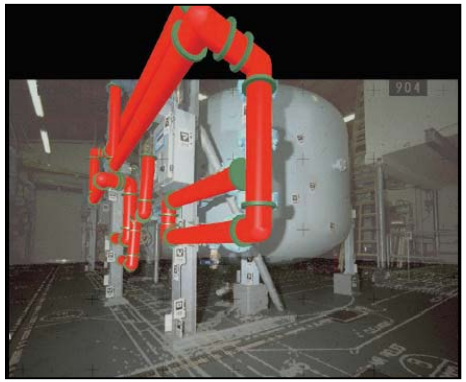


Mixed - Reality

An enhanced form of Augmented Reality (AR) where virtual objects are integrated into and responsive to the real world. Users navigate and affect change through both real and virtual spaces at the same time.



VR in Education



AR in Engineering

MR in Maintenance

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AR Type – Superimposition

- Uses object recognition in order to replace an entire object or a part of it with an augmented view.
- It allows implementation of augmented reality on existing images without modifying them.
- Example: In medicine, a doctor can use this technology to superimpose an X-ray view of a patient's broken arm bone on a real image to provide a clear understanding of what the bone's damage actually is.

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AR type – Projection Based

- **Projects digital images on physical objects in the physical space.**
- **Can be interactive and project a digital keyboard on your desk, or a dialer on your hand.**
- **One of the simplest forms is light projected on a surface that one can interact with**
- **Can be non-interactive, used to create projection of objects that you can position and see in depth**
  - Example: It might show you if your newly designed equipment will fit into the space you have allocated by projecting the equipment in front of you

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AR type – Recognition Based

- Scan any image or a marker such as QR code and it comes to life
- Includes object detection by a camera with sensors that use algorithms to search for various markers and characteristics
- Example: AR app detects and recognizes something called AR marker (i.e QR Code). Once it recognizes the marker, it replaces it with a corresponding object.
- Example: AR tech that recognizes an image based upon it's characteristics and adds a new object.

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AR type– Location Based

- Uses smart devices' location detection features.
- Example: Download the app and it will use your location by reading your smart device's GPS, compass and accelerometer and give you relevant information about what you're looking for / at on your screen.

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AR type – Outlining

- Uses object recognition to work, and might look a bit like a projection based AR.
- Example: whenever you're parking your modern car in the dark, outlining AR recognizes the boundaries of the road and outlines them for you.
- Example: Also used in architecture and engineering to outline buildings and their supporting pillars.
- Example: Football broadcasting to show yards required for a 1st Down.

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AR – Practical Uses

- **Augmented reality (AR) is a field of computer research which deals with the combination of real-world and computer-generated data.**
- **Most of the AR research is currently concerned with the use of video imagery which is digitally processed and augmented by adding computer-generated graphics.**
- **Simply put AR Systems:**
  - Combine real and virtual world aspects
  - Are interactive in real-time
  - Are registered in three dimensions

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AR Enhancement for Mission Readiness

- **Shipboard Training**

AR training tools for operators overlay digital information in physical spaces allowing users to stand physically experiencing an equipment simulation while virtually interacting with the equipment.

- **Classroom Training**

AR can be used to superimpose displays on participant guides or disperse them through AR symbols in the learning space to enhance group learning.

- **Equipment Maintenance & Remote Support**

With heads-up, hands-free video calling on some AR equipment, technicians can collaborate with remote experts on their mobile device to troubleshoot issues in context.

CACI's Augmented Reality is a force multiplier with real-time application to empower technicians to solve problems faster!

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Monitor/Tablet Based Augmented Reality

- Uses object recognition in order to replace an entire object or a part of it with an augmented view.
- Allows implementation of augmented reality on existing images without modifying them.
  - AR Labels are overlaid on Equipment Components in order to easily Identify them for Maintenance
  - Equipment Status provided for each Component as it is scanned by the AR Device
  - Failed Components are replaced using AR as tool

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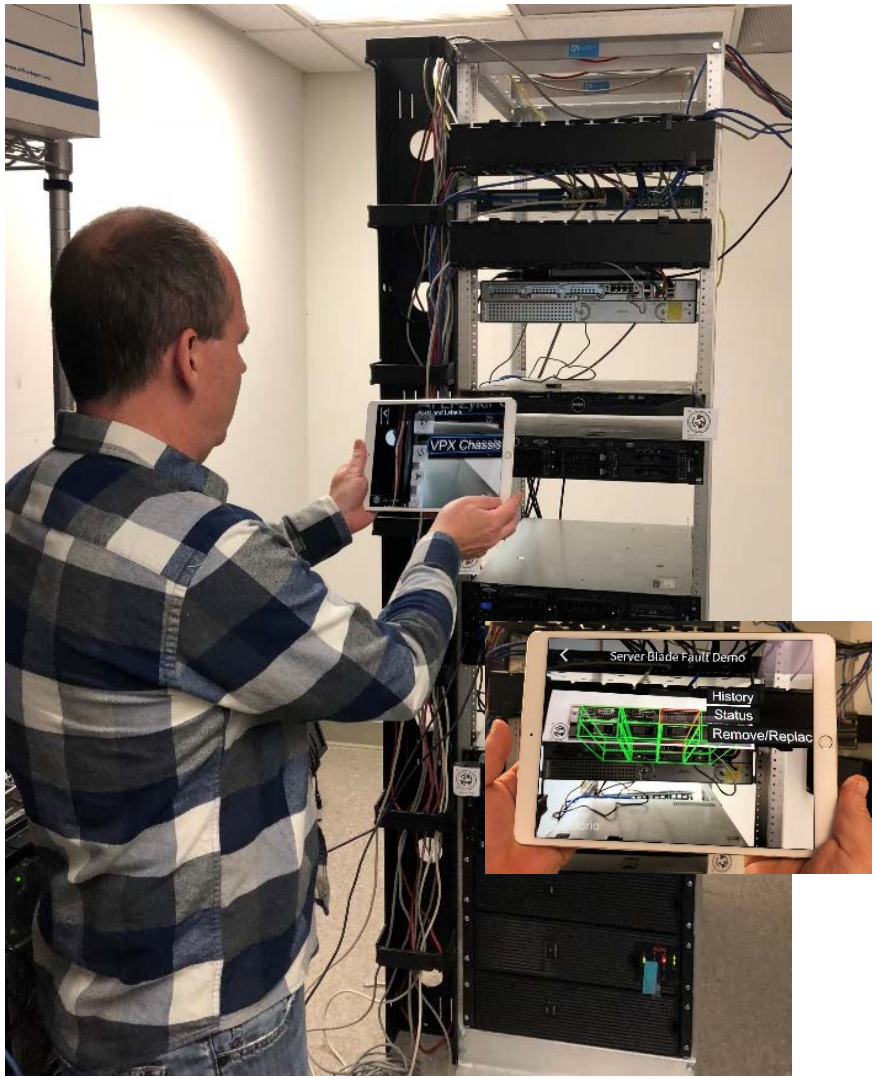
Enhancing Shipboard Maintenance with Augmented Reality

System Maintainability Example

I am a CRYPTOLOGIC TECHNICIAN, MAINTENANCE (CTM), and I NEED to be able to quickly diagnose and resolve problems so that the ship will be protected by maximizing system reliability

Requirements:

- **Display alerts for system faults, failures, or anomalous behavior**
- **Help the CTM identify the source of the fault or failure using Augmented Reality (AR)**
- **Guide the CTM through the process to correct the fault or failure using AR**
- **Verify that the fault/failure has been corrected**



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Smart Glasses Used for Equipment Maintenance

- Wearable computer glasses that add information alongside or to what the wearer sees
- Sometimes defined as wearable computer glasses that are able to change their optical properties at runtime.
- Superimposing information onto a field of view is achieved through an optical head-mounted display (OHMD) or embedded wireless glasses with transparent heads-up display (HUD) or augmented reality (AR) overlay that has the capability of reflecting projected digital images as well as allowing the user to see through it, or see better with it
- Similar to Head-Up Displays (HUDs) commonly used in military aircraft.
- Advantages compared to Tablet Based AR:
  - Allows Hands-free Operation
  - Increased Processing Power
  - Ease of Operation

Microsoft Hololens

DAQRI Smart Glasses

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AR Advantages

Effectively Utilize People

- Connect with remote experts
- Provide targeted information at the time its needed
- Increases people and process performance
- Decreased costs emerging from human error and inefficiency
- Reduce time traveling
- Train more effectively

Increase Production

- Improve accuracy and quality of work
- Reduce rework
- Generates considerable cost reduction (planned and actual cost)
- Improves coordination and supervision
- Utilizes AI to optimize predictive maintenance in smart environment (using algorithms and sensors)

Improve Safety

- Provide checklists, inspection and audits
- Log data, incidents and incident investigation
- Deploy thermal imaging and other warning sensors
- Reduce exposure to travel risks

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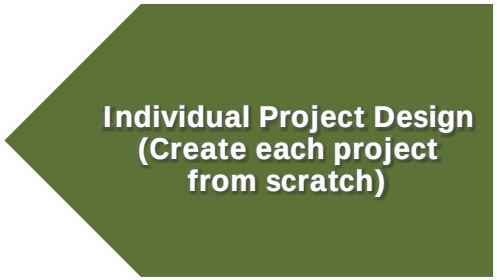
AR – What Does it Take to Build It?

- **Infrastructure:**
  - The 3rd party APIs integration
  - Access to enterprise data
  - Setup and basic controls
  - Data storage
  - Encryption
  - Scalability

- **Design:**
  - Wireframe creation
  - 3D graphic models
  - UI/UX design
  - Visual design
  - Animation



Augmented Reality produces intangible results, requiring minimal investment for maximum results!

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AR Tools/Software

- **UNITY 2018**
  - Most widely used VR development platform
  - over 91% experiences are Made with Unity
  - 25+ platforms across mobile, desktop, console, TV, VR, AR and the Web
  - Reach the widest audience and feel confident that your IP is future-proof, no matter how the industry

- **VUFORIA**
  - Most widely used platform for image recognition
  - Support for leading phones, tablets, and eyewear
  - Developers can easily add advanced computer vision functionality to Android, iOS, and UWP apps, to create AR experiences that realistically interact with objects and the environment

- **C# Programming Language**
  - Unity Scripting Language

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AR Benefits & Summary

- **Augmented Reality (AR)**
  - Increases people and process performance
  - Decreased costs emerging from human error and inefficiency
  - Solves the problem of remote troubleshooting and eliminates mistakes made through poor communication
  - Applications- operation, maintenance and remote support, training, quality control an safety management
  - Generates considerable cost reduction (planned and actual cost)
  - Utilizes Artificial Intelligence (AI) to optimize predictive maintenance in smart environments (using algorithms and sensors)

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Questions?