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| Augmented Reality Functional Requirements: | <i>Standard Number</i> |
| Hardware | ##### |

**Augmented Reality
Hardware Functional Requirements
for Industrial Industry Use Cases**

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Foreword

This document was prepared by members of Digital Manufacturing and Design Innovation Institute (DMDII) on November 17th 2016.

DMDII is a public-private partnership of companies dedicated to the advancement of manufacturing.

The functional requirements listed herein are in the nature of recommendations to all augmented reality (AR) hardware suppliers concerned.

The development of these functional requirements was accomplished by DMDII members through a consensus process.

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1.0 Introduction

The rapid increase in the use of AR hardware in the industrial industry resulted in a need for an industry-accepted functional requirement. “Augmented Reality Functional Requirements: Hardware,” was written to satisfy those needs.

This document provides the AR hardware manufacturer community with guidance for developing hardware in a consistent manner with an acceptable level of performance for the industrial industry. As augmented reality hardware use increases, technology evolves and experience is gained in the application of AR hardware this documented will be reviewed and revised. Appendix A contains a history of this document.

2.0 Purpose

The purpose of this document is to provide guidance to the AR hardware manufacturers for the production of AR hardware for industrial industries.

3.0 Goal

This document lays out the industrial industries goals for the AR hardware capabilities, so that users will have a quality experience and choose their own device to utilized AR software and generated content.

4.0 Definitions

AR – Augmented Reality

SME – Subject Matter Expert

Worker – Person that is utilizing the AR hardware to consume the AR software content.

User – Person using the software tools to generate the AR content.

Administrator – Person that sets up SMEs and worker accounts for a specific application of the generated software content.

Federation – Authentication via LDAP / Active Directory

5.0 Relationship to other documents

In addition to the “Augmented Reality Functional Requirements: Hardware,” a companion document “Augmented Reality Functional Requirements: AR Software & Content Generation” was created to provide guidance to the AR software and content generation tool manufacturers.

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6.0 AR Hardware Functional Requirements:

6.1 Battery Life

6.1.1 Under typical use, the device battery life shall be at minimum 12 hours.

6.1.2 Alternatively, if the battery can be “hot swapped” (changed without the device losing power, or having to be reset) device battery life shall be a minimum of 6 hours.

6.1.2.1 The period of time to swap the device batteries shall take less than 5 minutes

6.1.2.2 The device batteries must be swappable while wearing gloves

6.1.2.3 The device batteries must be swappable while in the working industrial environment.

6.1.3 The device shall be wireless. (It should not be tethered to a battery pack, or processing pack)

6.2 Connectivity

6.2.1 The device shall support the latest low power Bluetooth wireless connectivity standard.

6.2.2 The device shall support the latest low power Wi-Fi wireless 802.11 standard.

6.2.3 The device may support the latest GSM cellular device standard.

6.2.4 The device shall support person to person communication while working in the industrial environment.

6.3 Field of View

6.3.1 The device shall provide a 3D view (the images for both eyes are fully overlapping, just offset to provide the perception of 3D).

6.3.2 The device shall provide a minimum 85 degree field of vision in both directions (vertical and horizontal) where AR content can be displayed.

6.3.3 The device shall have the ability to automatically adjust to the users Inter Pupillary Distance (IPD).

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6.3.4 The device shall NOT obscure the user's peripheral vision (side, and up/down).

6.4 On-board Storage

6.4.1 The device shall have a minimum on-board memory storage of 128Gb.

6.4.2 The device shall support memory storage encryption, for security of the content.

6.5 On-board OS

6.5.1 The device shall support a web browser.

6.5.2 The device shall require the worker to authenticate.

6.5.2.1 The device shall support federation.

6.6 Environmental

6.6.1 The device shall work in ambient temperatures 0°C to 50°C.

6.6.2 The device displays shall provide visible (easy to read) displays while in full ambient light conditions.

6.6.3 The device shall be able to auto adjust brightness from a full ambient light condition, to a dark condition, and vice versa in 1 seconds.

6.6.4 The device shall work in environmental requirements documented in IP 64f.

6.7 Inputs / Outputs

6.7.1 Accelerometer

6.7.1.1 The device shall have an accelerometer that provides information to the software about gaze, and position.

6.7.2 Button

6.7.2.1 The device shall support connection to a wearable Bluetooth button.

6.7.3 Eye Tracking

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6.7.3.1 The device shall support eye tracking as a method of gaze, for software user interface commands.

6.7.4 GPS

6.7.4.1 The device shall have a GPS that provides information to the software about position.

6.7.5 Mouse / Touch Pad

6.7.5.1 The device shall support connection to a Bluetooth mouse / Touch Pad style device.

6.7.5.1.1 The device shall support an independent device for pointer control (for example, a smart device acting as a track pad).

6.7.6 Microphone

6.7.6.1 The device shall be wireless

6.7.6.2 The device microphone shall be directional (including jaw bone, throat, ear canal).

6.7.6.3 The device microphone shall have background noise cancelling

6.7.6.4 The device microphone shall be intrinsically safe

6.7.6.5 The device microphone shall work in ambient temperatures 0°C to 50°C.

6.7.7 Sound

6.7.7.1 Shall be available in wired or wireless

6.7.7.2 Shall serve as hearing protection for the wearer, complying with OSHA standards.

6.7.8 Display

6.7.8.1 The device shall support a minimum resolution of 1920x1080.

6.7.8.2 The device shall support full color.

6.7.8.3 The device shall deliver 120Hz refresh rate.

6.8 Safety

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6.8.1 The device shall be intrinsically safe.

6.8.1.1 The manufacturer may choose to sell both intrinsically safe certified and non-intrinsically safe products.

6.8.2 The device shall be able to be worn while wearing required safety head gear (hard hat or bump cap).

6.8.3 The device shall meet OSHA and MSHA requirements for safety glasses.

6.8.3.1 The device shall have an option to meet side shield safety requirements.

6.9 Visual Tracking

6.9.1 The device AR objects shall be scaled and anchored to the physical world without the requirement for an image target.

Note: For example enable the use of SLAM or other environment tracking solutions.

6.9.2 The device AR object positioning accuracy shall be within ± 5 mm.

6.9.3 The device shall be able to scan QR code (of 2 by 2 inches) from a minimum of 5 feet from a ± 60 degree off-axis.

Note: Optical and/or software zooming maybe utilized.

6.10 Wear Ability / Comfort

6.10.1 The device weight worn on the head shall not exceed 125 grams.

6.10.2 The device external temperature shall not exceed 35 degC against the user's skin.

6.10.3 The device shall support the addition of prescription lenses.

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Appendix A

| Version: | Change Description | Responsible |
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| 1 | Initial release of the Augmented Reality Functional Requirements | CLF, LEJ, RRJ |
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