

## **Technology 1: Object Detection through Machine Learning Frameworks (written by Tutku Gizem Guder)**

### **1) Identify the standards body responsible for standardization**

There are 3 standards bodies that handle the standardization of different aspects of object detection. Although IEEE and ISO handle functionality related aspects, Khronos Group focuses on open source related functions.

- *IEEE (Institute of Electrical and Electronics Engineers)* – Sets standards for image processing and neural network frameworks.
- *ISO (International Organization for Standardization)* – Provides standards for image and video processing.
- *Khronos Group* – Maintains OpenCV-related standards (e.g., OpenVX for vision acceleration).

### **2) What is the official standard number/identification?**

I provide two standard identifications; however, we focus on using the ISO/IEC standard, and the ONNX is listed below as informative.

- *ISO/IEC 14496-2* – This is an important standard for image and video processing used in machine learning frameworks like OpenCV. It defines compression and object representation formats. (ISO/IEC, 2025)
- *ONNX (Open Neural Network Exchange)* – While ONNX is an open-source standard, it follows the ML Model Interchange Format guidelines to ensure compatibility across AI frameworks.

### **3) What is the official name of the standard?**

- *ISO/IEC 14496-2: Information technology — Coding of audio-visual objects Part:2 Visual* – Used in OpenCV for image and video compression, which is critical in object detection.
- *ONNX Open Format Specification* – Defines a model exchange format for machine learning frameworks.

## **Technology 2: LiDAR Sensor for Mapping (written by Tutku Gizem Guder)**

### **1) Identify the standards body responsible for standardization**

LiDAR (Light Detection and Ranging) is an acronym that refers to a mapping technology that creates accurate 3D models of an environment. For ensuring consistency and cooperative operation in LiDAR data obtainment, processing, and utilization, some standards have been created for this technology by several organizations:

- *ASTM International (American Society for Testing and Materials)* – is an organization that sets the standards for LiDAR's data classification, to ensure a continuous and smooth operation in LiDAR's data is processing and use.
- *ISO (International Organization for Standardization)* – Involved in the development of general standards for geographic information systems (GIS), which may include LiDAR data.

### **2) What is the official standard number/identification?**

The standardization can help us to find cohesion of the captured and processed data, especially for tasks like mapping, terrain modeling, and environmental monitoring.

- *ASTM E3125-17* – This is the primary standard guide for LiDAR data classification. It defines the procedures for processing LiDAR point clouds into categorized data, such as ground, vegetation, and buildings. (ASTM, 2022)
- *ISO 19157:2013* – This is related to data quality for geographic information, including LiDAR datasets. (ISO, 2013)

### **3) What is the official name of the standard?**

- *ASTM E3125-17* – Standard Test Method for Evaluating the Point-to-Point Distance Measurement Performance of Spherical Coordinate 3D Imaging Systems in the Medium Range
- *ISO 19157:2013* – Geographic Information – Data Quality

## References:

ASTM. (2022). “Standard Test Method for Evaluating the Point-to-Point Distance Measurement Performance of Spherical Coordinate 3D Imaging Systems in the Medium Range.” ASTM International. Available at: <https://doi.org/10.1520/e3125-17>.

ISO. (2023). *ISO 19157:2013*. [online] ISO. Available at: <https://www.iso.org/standard/32575.html>.

ISO/IEC. (2025). *ISO/IEC 14496-2:2004*. [online] ISO. Available at: <https://www.iso.org/standard/39259.html>.

### Technology 3: SQL (written by Matthew Wyatt)

- 1) The standards body responsible for standardization is the **International Organization for Standardization (ISO)**.
- 2) The official standard number/identification is **ISO/IEC 9075**.
- 3) The official name of the standard is “**Information technology - Database languages - SQL**.”

### Technology 4: DNS (written by Matthew Wyatt)

- 1) The standards body responsible for standardization is the **Internet Engineering Task Force (IETF)**.
- 2) The official standard number/identification is **RFC 1035**; RFC 1034 specifies the concepts and facilities that provide a domain style namespace for DNS while RFC 1035 specifies the protocol and data format details of DNS.
- 3) The official name of the standard is “**Domain names - implementation and specification**.”

## References:

<https://www.iso.org/standard/76583.html>

<https://www.ietf.org/rfc/rfc1035.txt>

### **Technology 5: Wi-Fi - Wireless Local Area Network (WLAN) (written by Brenden Martins)**

- 1) The standards body pertaining to Wi-Fi responsible for standardization is the **Institute of Electrical and Electronics Engineers (IEEE)**.
- 2) The official standard number is **IEEE 802.11-2020**.
- 3) The official name for Wi-Fi is **Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications**.

### **Technology 6: Unreal Engine 4.27 (written by Brenden Martins)**

- 1) The standards body pertaining to Unreal Engine 4.27 is not one of an ISO/IEEE standard since it is proprietary, but still follows various industry standards for game engines and simulations through **Epic Games** such as **OpenGL** for graphics rendering, **Vulkan** for the high-performance graphics API, **DirectX 12** which is the Windows-based graphics compute, and **PhysX**.
- 2) This also means that while Unreal Engine is proprietary, the standard numbers which apply are, **ISO/IEC 14882** for OpenGL and **ISO/IEC 23360** for Vulkan. DirectX12 is a Microsoft Standard and doesn't have a standard number, just as PhysX is an open source standard by NVIDIA.
- 3) The official name is **Unreal Engine 4.27**.

### **Technology 7. Simulation Platform - Microsoft AirSim**

- 1) The standards body pertaining to Microsoft AirSim is "**Microsoft Research**" (not an international standard but widely used for drone simulation)
- 2) While there is no official ISO standard; AirSim follows Microsoft's internal software practices.
- 3) The official name is simply AirSim, although it was formerly known as "**Aerial Informatics and Robotics Simulation**".

## References

Unreal engine 4.27 release notes | Unreal engine 4.27 documentation | epic developer community. (n.d.). [https://dev.epicgames.com/documentation/en-us/unreal-engine/unreal-engine-4.27-release-notes?application\\_version=4.27](https://dev.epicgames.com/documentation/en-us/unreal-engine/unreal-engine-4.27-release-notes?application_version=4.27)

*IEEE SA - IEEE Standard for Information Technology--Telecommunications and information exchange between systems - local and metropolitan area networks--specific requirements - part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications.* IEEE Standards Association. (n.d.). <https://standards.ieee.org/ieee/802.11/7028/>

Cureton, D. (2023, June 5). *Microsoft's Project AirSim explores drone metaverse.* XR Today. <https://www.xrtoday.com/mixed-reality/microsofts-project-airsim-explores-drone-metaverse/>

## Technology 8: JavaScript (written by Matthew Paternoster)

- Standards Body: Ecma International
- Standard Number: ECMA-262
- Official Name: ECMAScript Language Specification
- Purpose: JavaScript is the core programming language used for implementing the interactive drone control interface. The ECMAScript standard defines the syntax, semantics, and core APIs that make up the JavaScript language, enabling cross-platform compatibility across different browsers and runtime environments.

### **Technology 9: React (written by Matthew Paternoster)**

- Standards Body: While React itself is maintained by Facebook (Meta), it builds upon and follows Web Component standards from W3C
- Standard Number: Not a formal standard itself, but aligns with W3C Web Components standards
- Official Name: React JavaScript Library (following W3C Web Components principles)
- Purpose: React is used to create the component-based user interface for the drone coordination system, organizing the drone feed, status displays, and controls in a structured, reusable manner that follows modern web development patterns.

### **References:**

*ECMA International. (2023). Standard ECMA-262: ECMAScript® 2023 Language Specification (14th Edition). <https://www.ecma-international.org/publications/standards/Ecma-262.htm>*

*React (2023). React 18 Documentation. <https://react.dev/blog/2023/03/16/introducing-react-dev>*

*World Wide Web Consortium (W3C). (2019). Web Components specifications (Shadow DOM, Custom Elements, HTML Templates). <https://github.com/w3c/webcomponents/>*

### **Technology 10: Drone Subsystem Control (written by Tarek Kayali)**

#### **1. Identify the standards body responsible for standardization**

*Drone subsystem control involves various aspects such as flight control, communication protocols, and power management. The following organizations oversee relevant standards:*

- **IEEE (Institute of Electrical and Electronics Engineers)** – Defines control system standards for UAVs (Unmanned Aerial Vehicles), including communication protocols and power management.
- **RTCA (Radio Technical Commission for Aeronautics)** – Sets standards for avionics and control systems in unmanned aircraft.

- **ISO (International Organization for Standardization)** – Provides safety, operational, and reliability standards for drone control systems.

2. **What is the official standard number/identification?**

Several standards apply to drone control systems, including:

- **IEEE 1937-2018** – Standard for Unmanned Aircraft Systems (UAS) Control and Data Interfaces.
- **RTCA DO-178C** – Software Considerations in Airborne Systems and Equipment Certification.
- **ISO 21384-3:2019** – Unmanned Aircraft Systems – Operational procedures.

3. **What is the official name of the standard?**

- **IEEE 1937-2018** – "Standard for Unmanned Aircraft Systems (UAS) Control and Data Interfaces."
- **RTCA DO-178C** – "Software Considerations in Airborne Systems and Equipment Certification."
- **ISO 21384-3:2019** – "Unmanned Aircraft Systems – Part 3: Operational procedures."

*References:*

- IEEE. (2018). "IEEE 1937-2018: Standard for Unmanned Aircraft Systems (UAS) Control and Data Interfaces."
- RTCA. (2012). "RTCA DO-178C: Software Considerations in Airborne Systems and Equipment Certification."
- ISO. (2019). "ISO 21384-3:2019: Unmanned Aircraft Systems – Operational Procedures."

Group Member	Contribution Percentage	Related Technologies
Brenden Martins (3D Simulated Environment Subsystem)	20%	AirSim, Unreal Engine 4.27, and Wi-Fi
Matthew Paternoster (User Interface)	20%	JavaScript, React
Matthew Wyatt (Data Management)	20%	