|  |  |
| --- | --- |
| Project | **Specification of Sensor Interface for Cyber and Physical World**  <https://sagroups.ieee.org/2888/ **>>** |
| Title | **Editor’s Input for improving P2888.1™/D1 Draft Standard for Specification of Sensor Interface for Cyber and Physical World** |
| DCN | **2888-20-0027-00-0001** |
| Date Submitted | **July 20, 2020** |
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| Re: |  |
| Abstract | Integrated version of P2888.1 D1 with input contributions from the Session 2 |
| Purpose | To improve P2888.1 D1 |
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P2888.1™/D1   
Draft Standard for Specification of Sensor Interface for Cyber and Physical World

Developed by the

Standard Activities Board (SAB)

of the

IEEE Computer Society

Approved <Date Approved>

IEEE SA Standards Board

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[[1]](#footnote-1)•

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Kyoungro Yoon, Chair

Sang-Kyun Kim, Vice Chair

SangKwon Jeong

Participant2

Participant3

Participant4

Participant5

Participant6

Participant7

Participant8

Participant9

The following members of the <individual/entity> Standards Association balloting group voted on this<opt\_trial-use><gde./rec. prac./std.>. Balloters may have voted for approval, disapproval, or abstention.

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Balloter4

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Balloter6

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Balloter9

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<Name>, Chair

<Name>, Vice Chair

<Name>, Past Chair

**Konstantinos Karachalios**, Secretary

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SBMember7

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SBMember9

\*Member Emeritus

Introduction

This introduction is not part of P<designation>/D<draft\_number>, Draft<opt\_Trial-Use><Gde./Rec. Prac./Std.> for <Complete Title Matching PAR>.

<Select this text and type or paste introduction text>

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Draft Standard for Specification of Sensor Interface for Cyber and Physical World

1. Overview
   1. Scope
   2. Purpose
   3. Word usage

***<This subclause is mandatory and shall appear after the Scope and Purpose (if included).>***

The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (shall equals is required to).[[2]](#footnote-2),[[3]](#footnote-3)

The word *should* indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required (should equals is recommended that).

The word *may* is used to indicate a course of action permissible within the limits of the standard (may equals is permitted to).

The word *can* is used for statements of possibility and capability, whether material, physical, or causal (can equals is able to).

1. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

1. Definitions, acronyms, and abbreviations
   1. Definitions

For the purposes of this document, the following terms and definitions apply. The IEEE Standards Dictionary Online should be consulted for terms not defined in this clause. [[4]](#footnote-4)

* 1. Acronyms and abbreviations

1. Data formats for interfacing sensors
   1. Root schema structure
      1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + 1. Syntax

|  |
| --- |
| {  "$schema": "http://json-schema.org/draft-07/schema#",  "title": "Sensor data",  "description": "Schema for sensor data",  "type": "object",  "properties": {  "timeStamp": {"type": "datetime"},  "sensedInfoBaseAttributes": {  "$ref": "#/definitions/sensedInfoBaseAttributes"  },    // This is where the properties of each type of sensor data is declared by reference.  // For Example,  // "microphoneSensorType": {  // "$ref": "#/definitions/microphoneSensorType"  // },  },  "additionalProperties": false,  "required": [  "sensedInfoBaseAttributes"  ],  "minProperties": 2,  "maxProperties": 3,  "definitions": {  "sensedInfoBaseAttributes": {  "additionalProperties": false,  "type": "object",  "properties": {  "id": {"type": "string"},  "sensorIdRef": {"type": "string"},  "linkedList": {"type": "string"},  "groupID": {"type": "string"},  "activate": {"type": "boolean"},  "priority": {"type": "integer","minimum": 0}  }  },  // This is where the properties of each type of sensor data is actually defined.  // For Example,  // "microphoneSensorType": {  // …  // },  }  } |

* + 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* 1. Common class
     1. General

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* + 1. Syntax

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* 1. Data format for individual sensors
     1. General

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* + 1. Location and Position Related Sensors
       1. General

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* + - 1. GPS
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "GPS" : {  "title" : "GPS Scheme",  "type" : "object",  "properties" : {  "Latitude" : {"type" : "number"},  "Longitude" : {"type" : "number"}  }  } |

* + - * 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - 1. Three-axis accelerometer
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "ThreeAxisAccelerometers" : {  "title" : "3-Axis-Accelerometers ",  "type" : "object",  "properties" : {  "X" : {"type" : "number"},  "Y" : {"type" : "number"},  "Z" : {"type" : "number"}  }  } |

|  |
| --- |
| Editor’s Note: Basic three-dimensional vector should be in the common classes. Should refer it here. |

* + - * 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - 1. Three-axis Gyroscope
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "ThreeAxisGyroscope" : {  "title" : "3-Axis-Gyroscopes",  "type" : "object",  "properties" : {  "X" : {"type" : "number"},  "Y" : {"type" : "number"},  "Z" : {"type" : "number"}  }  } |

|  |
| --- |
| Editor’s Note: Basic three-dimensional vector should be in the common classes. Should refer it here. |

* + - * 1. Semantics

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* + - * 1. Examples

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* + - 1. Magnetic field
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "MagneticField" : {  "title" : "Magnetic-Field",  "type" : "object",  "properties" : {  "X" : {"type" : "number"},  "Y" : {"type" : "number"},  "Z" : {"type" : "number"}  }  } |

|  |
| --- |
| Editor’s Note: Basic three-dimensional vector should be in the common classes. Should refer it here. |

* + - * 1. Semantics

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* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - 1. Barometer
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "Barometer" : {  "title" : "Barometer",  "type" : "object",  "properties" : {  "Value" : {"type" : "number"},  "Unit" : {"type" : "string"}  }  } |

* + - * 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - 1. Compass Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "compassSensorType": {  "title": "Compass",  "type": "object",  "properties": {  "azimuth": {  "type": "number",  "minimum": 0,  "maximum": 360  },  "unit": {  "$ref": "#/definitions/unitType"  }  },  "additionalProperties": false  }, |

* + - * 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - 1. Orientation Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "orientationSensorType": {  "title": "orientation",  "type": "object",  "properties": {  "orientation": {  "type": "array",  "items": {  "type": "number",  "minItems": 3,  "maxItems": 3  },  },  "unit": {  "$ref": "#/definitions/unitType"  }  },  "additionalProperties": false  }, |

* + - * 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - 1. Position Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "positionSensorType": {  "type": "object",  "properties": {  "position": {  "$ref": "#/definitions/float3DVectorType"  },  "unit": {  "$ref": "#/definitions/unitType"  }  }  }, |

* + - * 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - 1. Distance Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "distanceSensorType": {  "type": "object",  "properties": {  "value": {  "type": "number"  },  "unit": {  "$ref": "#/definitions/unitType"  }  }  }, |

* + - * 1. Semantics

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* + - * 1. Examples

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* + 1. Environment Related Sensors
       1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - 1. Light Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "lightSensorType": {  "type": "object",  "properties": {  "value": {  "$ref:": "#/definitions/colorWType"  },  "unit": {  "$ref": "#/definitions/unitType"  },  "color": {  "%ref": "#/definitions/colorType"  },  "colorValue": {  "%ref": "#/definitions/colorValueType"  },  "model": {  "$ref": "#/definitions/colorSpaceType"  }  }  },  "colorWType": {  "type": "array",  "items": [  {  "type": "number"  },  {  "type": "string",  "pattern": "#[0-9A-Fa-f]{2}"  }  ]  },  "colorValueType": {  "type": "array",  "items": [  {  "type": "number",  }  ],  "minItems": 3,  "maxItems": 3  },  "colorSpaceType": {  "type": "string",  "enum": [  "XYZ",  "Yxy",  "Lab",  "Lch",  "LUV",  "HunterLab"  ]  }, |

* + - * 1. Semantics

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* + - * 1. Examples

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* + - 1. Ambient Noise Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "ambientNoiseSensorType": {  "type": "object",  "properties": {  "lifespan": {  "type": "number"  },  "value": {  "type": "number"  },  "unit": {  "$ref": "#/definitions/unitType"  }  }  } |

* + - * 1. Semantics

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* + - * 1. Examples

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* + - 1. Temperature Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "temperatureSensorType": {  "type": "object",  "properties": {  "value": {  "type": "number"  },  "unit": {  "$ref": "#/definitions/unitType"  }  }  }, |

* + - * 1. Semantics

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* + - * 1. Examples

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* + - 1. Humidity Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "humiditySensorType": {  "type": "object",  "properties": {  "value": {  "type": "number"  },  "unit": {  "$ref": "#/definitions/unitType"  }  }  }, |

* + - * 1. Semantics

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* + - * 1. Examples

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* + - 1. Wind Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "windSensorType": {  "$ref": "#/definitions/velocitySensorType"  },  "velocitySensorType": {  "type": "object",  "properties": {  "velocity": {  "$ref": "#/definitions/float3DVectorType"  },  "unit": {  "$ref": "#/definitions/unitType"  }  }  }, |

* + - * 1. Semantics

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* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - 1. Gas Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "gasSensorType": {  "type": "object",  "properties": {  "gasType": {  "type": "string",  "enum": [  "carbon monoxide",  "carbon dioxide",  "sulfurous acid",  "nitrogen oxide",  "oxygen",  "ozone",  "hydrogen",  "VOC",  "ethanol",  "propane",  "methane",  "butane",  "formaldehyde",  "Radon222"  ]  },  "value": {  "type": "number"  },  "unit": {  "$ref": "#/definitions/unitType"  }  } |

* + - * 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - 1. Dust Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "dustSensorType": {  "type": "object",  "properties": {  "value": {  "type": "number"  },  "unit": {  "$ref": "#/definitions/unitType"  }  }  }, |

* + - * 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

Editor’s Note: There are couple of types in the Dust depending on the size? May need to check.

* + - 1. Weather
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "weather" : {  "title" : "Weather Information Scheme",  "type" : "object",  "properties" : {  "Region" : {"type" : "string"},  "Date" : {"type" : "string"},  "Atmospheric-Condition" : {"type" : "string"},  "Temperature" : {  "Value" : {"type" : "number"},  "Unit" : {"type" : "string"}  },  "Wind" : {  "Direction" : {"type" : "string"},  "Speed" : {  "Value" : {"type" : "number"},  "Unit" : {"type" : "string"}  }  },  "Precipitation" : {  "Value" : {"type" : "number"},  "Unit" : {"type" : "string"}  },  "Pressure" : {  "Value" : {"type" : "number"},  "Unit" : {"type" : "string"}  },  "Sunrise" : {"type" : "string"},  "Sunset" : {"type" : "string"}  }  } |

* + - * 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + 1. Biosensors
       1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - 1. Blood pressure Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "bloodPressureSensorType": {  "type": "object",  "properties": {  "systolicBP": {  "type": "number"  },  "diastolicBP": {  "type": "number"  },  "MAP": {  "type": "number"  },  "unit": {  "$ref": "#/definitions/unitType"  }  }  }, |

* + - * 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - 1. Heart rate Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "heartRateSensorType": {  "type": "object",  "properties": {  "value": {  "type": "number"  },  "unit": {  "$ref": "#/definitions/unitType"  }  },  "required": {  "value"  }  }, |

* + - * 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + 1. Audio-Visual Sensors
       1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - 1. Micorphone Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "microphoneSensorType": {  "type": "object",  "properties": {  "orientation": {  "$ref": "#/definitions/float3DVectorType"  },  "location": {  "$ref": "#/definitions/float3DVectorType"  },  "audioData": {  "$ref": "#/definitions/rawAudioType"  }  },  "additionalProperties": false  },  "rawAudioType": {  "type": "object",  "properties": {  "sample\_rate": {  "$ref": "#/definitions/sampleRateType"  },  "byte\_order": {  "$ref": "#/definitions/byteOrderType"  },  "sign": {  "$ref": "#/definitions/signType"  },  "resolution": {  "$ref": "#/definitions/resolutionType"  }  },  "additionalProperties": false  },  "sampleRateType": {  "type": "number",  "enum": [  8.0,  11.025,  16.0,  22.05,  32.0,  44.056,  44.1,  47.25,  48.0,  50.0,  50.4,  88.2,  96.0,  176.4,  192.0,  352.8,  2822.4,  5644.8  ]  },  "byteOrderType": {  "type": "string",  "enum": [  "littleEndian",  "bigEndian"  ]  },  "signType": {  "type": "string",  "enum": [  "signed",  "unsigned"  ]  },  "resolutionType": {  "type": "integer",  "enum": [  4,  8,  12,  16,  20,  24,  32,  48,  64  ]  }, |

* + - * 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - 1. Color Camera Sensor
         1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Syntax

|  |
| --- |
| "colorCameraSensorType": {  "type": "object",  "properties": {  "cameraSensor": {  "$ref": "#/definitions/cameraSensorType"  },  "rawVideo": {  "$ref": "#/definitions/rawVideoType"  }  }  },  "rawVideoType": {  "type": "object",  "properties": {  "videoData16": {  "type": "string"  },  "videoData64": {  "type": "string"  },  "width": {  "type": "integer"  },  "height": {  "type": "integer"  },  "bit\_depth": {  "type": "integer"  },  "stride": {  "type": "integer"  },  "coding4CC": {  "type": "integer"  },  "fps": {  "type": "integer"  },  "use\_frame\_packing": {  "type": "integer"  },  "frame\_packing": {  "type": "integer"  }  }  },  "cameraSensorType": {  "type": "object",  "properties": {  "cameraOrientation": {  "$ref": "#/definitions/orientationSensorType"  },  "cameraLocation": {  "$ref": "#/definitions/globalPositionSensorType"  },  "cameraAltitude": {  "$ref": "#/definitions/altitudeSensorType"  },  "focalLength": {  "type": "number"  },  "aperture": {  "type": "number"  },  "shutterSpeed": {  "type": "number"  },  "filter": {  "type": "string",  "enum": [  "UV",  "Polarizing",  "NB",  "Diffusion",  "Star"  ]  }  },  "additionalProperties": false  },  "globalPositionSensorType": {  "type": "object",  "properties": {  "longitude": {  "type": "number",  "minimum": -180.0,  "maximum": 180.0  },  "latitude": {  "type": "number",  "minimum": -90.0,  "maximum": 90.0  }  },  "required": [  "longitude",  "latitude"  ],  "additionalProperties": false  }, |

* + - * 1. Semantics

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* + - * 1. Examples

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* 1. Data format for recognizing sensor characteristics(capabilities?)

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

We need this section if we have some sensors of which settings can be changed.

* 1. Data format to sensors for sensor setting

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

We need this section to change the setting of a sensor. (Such sensors usually have their capabilities defined.)

1. Application programming interface for smart sensors
   1. General

For the purposes of this document, the following terms and definitions apply. The IEEE Standards

* 1. API for individual sensors
     1. General
     2. Microphone sensor

Table 1 - Microphone API

|  |  |
| --- | --- |
| Nested Classes | |
| Modifier and Type | Method and Description |
|  |  |
| Constructor | |
| Constructor and Description | |
| Microphone() | |
| *Default constructor.* | |
|  | |
| Microphone(String id) | |
|  | |
| Microphone(String id, String serverIPAddress, integer serverPort) | |
|  | |
| Fields | |
| Modifier and Type | Field and Description |
|  |  |
| Methods | |
| Modifier and Type | Method and Description |
| JSONObject | getMicrophoneSensorData() |
|  | *This function returns sensor data from a microphone in JSON format.* |
|  |  |

* + 1. Color camera sensor

Table 2 – Color Camera API

|  |  |
| --- | --- |
| Nested Classes | |
| Modifier and Type | Method and Description |
|  |  |
| Constructor | |
| Constructor and Description | |
| ColorCamera() | |
| *Default constructor.* | |
|  | |
| ColorCamera(String id) | |
|  | |
| ColorCamera(String id, String serverIPAddress, integer serverPort) | |
|  | |
| Fields | |
| Modifier and Type | Field and Description |
|  |  |
| Methods | |
| Modifier and Type | Method and Description |
| JSONObject | getColorCameraSensorData() |
|  | *This function returns sensor data from a ColorCamera in JSON format.* |
|  |  |

# **(informative)** Bibliography

Bibliographical references are resources that provide additional or helpful material but do not need to be understood or used to implement this standard. Reference to these resources is made for informational use only.

1. The Institute of Electrical and Electronics Engineers, Inc.

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2. The use of the word *must* is deprecated and cannot be used when stating mandatory requirements, *must* is used only to describe unavoidable situations. [↑](#footnote-ref-2)
3. The use of *will* is deprecated and cannot be used when stating mandatory requirements, *will* is only used in statements of fact. [↑](#footnote-ref-3)
4. IEEE Standards Dictionary Online is available at: <http://dictionary.ieee.org>. An IEEE Account is required for access to the dictionary, and one can be created at no charge on the dictionary sign-in page. [↑](#footnote-ref-4)