**Obstacle Detection System Requirements Specification**

*(The explanatory notes in italics should be removed in the submitted document)*

*The SRS should contain the sections and sub-sections as detailed below:*

**1. Scope.**

*This section shall be divided into the following paragraphs.*

* 1. **Identification.**

*This paragraph shall contain a full identification of the system to which this document applies (for example NS18).*

This document applies to the Obstacle Detection System (OBS), a sub-system of the Autonomous Vehicle System (AVS).

* 1. **Overview.**

*This paragraph shall briefly state the purpose of the system to which this document applies. It shall describe the general nature of the system; summarize the history of development, operation, and maintenance; identify current and planned operating sites; and list other relevant documents.*

The obstacle sensing system shall utilise the HC-SR04 Ultrasonic sensor Arduino module to calculate the distance to any objects within its range. Using the location and Euler angles data from the POZYX system it shall then calculate the grid reference containing the object, and output this to the navigation system.

* 1. **Document overview.**

*This paragraph shall summarize the purpose and contents of this document.*

This document shall outline the high-level system requirements of the Obstacle Detection System (ODS), which is a sub-system on the Autonomous Vehicle System (AVS).

**2. Referenced documents.**

*This section shall list the number, title, revision, and date of all documents referenced in this specification. Of particular importance is the relationship between the stakeholder’s requirements and the System Requirements Specification.*

**3. Requirements.**

*This section shall be divided into the following paragraphs to specify the system requirements, that is, those characteristics of the system that are conditions for its acceptance.*

*Each requirement must have the following information in whatever form is preferred. A table is shown and suggested as a convenient way of presenting the requirements.*

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| **Requirement ID:**  *AVS-ODS-01* | **Requirement Statement**  *Statement of requirement in the form of “The [insert name of system or sub-system] shall ……”*  The Obstacle Detection System shall detect obstacles inside the grid, in the range of 25cm – 300cm. |
| **Verification Method**  *Method of confirming that the system has met the requirement. Options include demonstration, test, analysis or inspection*  Test | **Verification Description**  *Based on verification method, a brief explanation as to the procedure associated with the verification.*  The ODS sensors’ range shall be tested on a non-integrated circuit (i.e. breadboard), by aiming them at a cardboard box at different ranges and angles, to confirm they are physically capable of the requirement.  Once integrated onto the AVS the ODS shall be tested while the AVS is both moving and stationery, by placing obstacles in known grid locations and confirming that the ODS outputs the correct gridspace. |
| **Traceability**  *Tracing this requirement back to the source document.* | **Rationale/explanation**  *An explanation or expansion as to why the system needs to do what the requirement says it needs to do. This may be a reminder or a note, or may simply expand on the traceability.* |
| **States/Modes applicability:**  *If the system needs to exist in different states or modes (see 3.1) then this captures what states or modes this requirement is relevant to.* | |
| **Requirement ID:**  *AVS-ODS-02* | **Requirement Statement**  *Statement of requirement in the form of “The [insert name of system or sub-system] shall ……”*  The Obstacle Detection System shall interface with the Location System receiving current location () and heading angle () as inputs. |
| **Verification Method**  *Method of confirming that the system has met the requirement. Options include demonstration, test, analysis or inspection*  Test | **Verification Description**  *Based on verification method, a brief explanation as to the procedure associated with the verification.*  Before full system integration, known input locations and heading angles shall be fed to the ODS to confirm the ODS receives correct inputs.  Upon full system integration, the same testing will occur to ensure geometry is correct. |
| **Traceability**  *Tracing this requirement back to the source document.* | **Rationale/explanation**  *An explanation or expansion as to why the system needs to do what the requirement says it needs to do. This may be a reminder or a note, or may simply expand on the traceability.* |
| **States/Modes applicability:**  *If the system needs to exist in different states or modes (see 3.1) then this captures what states or modes this requirement is relevant to.* | |

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| **Requirement ID:**  *AVS-ODS-03* | **Requirement Statement**  *Statement of requirement in the form of “The [insert name of system or sub-system] shall ……”*  The Obstacle Detection System shall convert inputs from the range sensors and the Location System into a grid reference representing the location of an obstacle. |
| **Verification Method**  *Method of confirming that the system has met the requirement. Options include demonstration, test, analysis or inspection*  Test | **Verification Description**  *Based on verification method, a brief explanation as to the procedure associated with the verification.*  Before full integration the Location System and ODS shall be interfaced in the test grid, with a number of obstacles at different known grid locations. The full system will be emulated by connecting outputting the ODS output grid references to a Serial Monitor, confirming correct locations from each of the sensors in their respective directions. |
| **Traceability**  *Tracing this requirement back to the source document.* | **Rationale/explanation**  *An explanation or expansion as to why the system needs to do what the requirement says it needs to do. This may be a reminder or a note, or may simply expand on the traceability.* |
| **States/Modes applicability:**  *If the system needs to exist in different states or modes (see 3.1) then this captures what states or modes this requirement is relevant to.* | |

|  |  |
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| **Requirement ID:**  *AVS-ODS-04* | **Requirement Statement**  *Statement of requirement in the form of “The [insert name of system or sub-system] shall ……”*  The Obstacle Detection System shall interface with the Navigation System, outputting the correct grid references of all in range obstacles to the Navigation System. |
| **Verification Method**  *Method of confirming that the system has met the requirement. Options include demonstration, test, analysis or inspection*  Test | **Verification Description**  *Based on verification method, a brief explanation as to the procedure associated with the verification.*  Before full system integration, and after the first stage testing of requirement AVS-ODS-03 is verified, the Location System and ODS shall be interfaced with the Navigation System and placed in the test grid, with obstacles at known locations, confirming that the in range obstacles are added to the Navigation System’s obstacle list. |
| **Traceability**  *Tracing this requirement back to the source document.* | **Rationale/explanation**  *An explanation or expansion as to why the system needs to do what the requirement says it needs to do. This may be a reminder or a note, or may simply expand on the traceability.* |
| **States/Modes applicability:**  *If the system needs to exist in different states or modes (see 3.1) then this captures what states or modes this requirement is relevant to.* | |

*The degree of detail to be provided should be guided by the following rule: Include those characteristics of the system that are conditions for acceptance; defer to design descriptions those characteristics that the team is willing to leave up to the design team. If there are no requirements in a given paragraph, the paragraph shall state “Not Used”. If a given requirement fits into more than one paragraph, it should be stated once and referenced from the other paragraphs.*

**3.1 Required states and modes.**

*If the system is required to operate in more than one state or mode having requirements distinct from other states or modes, this paragraph shall identify and define each state and mode. Examples of states and modes might include: transportation, search-ready, maintenance, degraded, test, training. The distinction between states and modes is arbitrary. The system may be described in terms of states only, modes only, states within modes, modes within states, or any other scheme that is useful. If states and/or modes are required, each requirement or group of requirements in this specification shall be correlated to the states and modes. The correlation may be indicated by a table or other method in this paragraph, in an appendix referenced from this paragraph, or by annotation of the requirements in the paragraphs where they appear.*

**3.2 Function and performance requirements.**

*This paragraph shall be divided into subparagraphs to itemize the requirements associated with each function of the system.*

**3.2.x XXXX Requirements.**

*This paragraph shall identify a required system function/performance and shall itemize the requirements associated with that function. If the function can be more clearly specified by dividing it into constituent capabilities, the constituent functionality shall be specified in subparagraphs. The requirements shall specify required behaviour of the system and shall include applicable performance levels, such as acceleration rates, distances, times, accuracy, capacities, and so on. The requirements shall include, as applicable, required behaviour under unexpected, un-allowed, or "out of bounds" conditions, and any provisions to be incorporated into the system to provide continuity of operations in the event of emergencies. Some example requirements are listed below:*

**3.2.x Cornering Requirements**

**3.2.x Braking requirements**

**3.2.x Speed related requirements**

**3.2.x Linear acceleration requirements**

**3.2.x Battery efficiency requirements**

**3.2.x Vertical step/bumps/clearance requirements**

**3.2.x Range and endurance requirements**

**3.2.x Starting requirements**

**3.2.x Shut down requirements (normal)**

**3.2.x Shut down requirements (emergency)**

**3.3 External interface requirements.**

*This paragraph shall be divided into subparagraphs to specify the requirements, if any, for the system’s external interfaces.*

**3.3.1 Interface identification and diagrams.**

*This paragraph shall identify the required external interfaces of the system. The identification of each interface shall include an identifier and shall name the interfacing entities. One or more interface diagrams shall be provided to depict the interfaces.*

**3.3.x (Project-unique identifier of interface).**

*This paragraph (beginning with 3.3.2) shall identify a system external interface by project-unique identifier, shall briefly identify the interfacing entities, and shall be divided into subparagraphs as needed to state the requirements imposed on the system to achieve the interface. Some example external interfaces are listed below:*

**3.3.x [insert name of system or sub-system] and vehicle chassis**

**3.3.x [insert name of system or sub-system] and DC motor**

**3.3.x [insert name of system or sub-system] and servo motor**

**3.4 Safety requirements.**

*This paragraph shall specify the system requirements, if any, concerned with preventing or minimizing unintended hazards to personnel, property, and the physical environment.*

**3.5 Security requirements.**

*This paragraph shall specify the system requirements, if any, concerned with maintaining security of the system.*

**3.6 System environment requirements.**

*This paragraph shall specify the requirements, if any, regarding the environment in which the system must operate. Examples include the environmental conditions that the system must withstand during transportation, storage, and operation, such as conditions in the natural environment (operating surfaces, wind, rain, temperature, humidity, geographic location), and the induced environment (motion, shock, noise, electromagnetic radiation).*

**3.7 System quality factors.**

*This paragraph shall specify the requirements, if any, pertaining to system quality factors. Examples include quantitative requirements concerning reliability (the ability to perform with correct, consistent results -- such as mean time between failure for equipment), maintainability (the ability to be easily serviced, repaired, or corrected), availability (the ability to be accessed and operated when needed), flexibility (the ability to be easily adapted to changing requirements), usability (the ability to be easily learned and used), transportability (the ability to be easily transported from one geographic location to another), and manufacturability (ease with which the system can be produced within the constraints of the production capability).*

**3.8 Appearance and surface finishing requirements.**

*This section shall specify the requirements, if any, for packaging, labelling, surface finishing and appearance of the system and its components.*

**3.9 Design and construction constraints.**

*This paragraph shall specify the requirements, if any, that constrain the design and construction of the system. This paragraph shall include the physical requirements imposed on the system in the Project Brief. Examples include requirements concerning:*

* 1. *Use of a particular system architecture or requirements on the architecture, such as required use of the Arduino microcontroller.*
  2. *Use of particular design or construction standards; workmanship requirements and production techniques.*
  3. *Physical characteristics of the system (such as weight limits, dimensional limits, colour, protective coatings); interchangeability of parts; ability to be transported from one location to another; ability to be carried or set up by one, or a given number of, persons.*
  4. *Materials that can and cannot be used;*
  5. *Use of nameplates, part marking, serial and lot number marking, and other identifying markings*
  6. *Flexibility and expandability that must be provided to support anticipated areas of growth or changes in technology, threat, or mission*

*Some example constraints are listed below:*

**3.9.x Arduino microcontroller**

**3.9.x Battery constraints**

**3.10- Personnel-related requirements**.

*This paragraph shall specify the system requirements included to accommodate the number, skill levels, training needs, or other information about the personnel who will operate or support the system. Also included shall be the human factors engineering requirements, if any, imposed on the system. These requirements shall include, as applicable, considerations for the capabilities and limitations of humans, foreseeable human errors under both normal and extreme conditions, and specific areas where the effects of human error would be particularly serious. Examples include requirements for colour and duration of displays, physical placement of controls, critical indicators or buttons, and use of auditory signals.*

**3.11 Training-related requirements.**

*This paragraph shall specify the system requirements, if any, pertaining to the system providing training. For example, does the system need to have any functionality specifically focused on training operators or support personnel?*

**3.12 Support-related requirements.**

*This paragraph shall specify the system requirements, if any, concerned with support considerations. These considerations may include: maintenance, transportation modes, supply-related requirements, and impact on existing support and test equipment.*

**3.13 Other requirements.**

*This paragraph shall specify additional system requirements, if any, not covered in the previous paragraphs.*

**6. Notes.**

*This section shall contain any general information that aids in understanding this document (e.g., background information, glossary, rationale). This section shall contain an alphabetical listing of all acronyms, abbreviations, and their meanings as used in this document and a list of any terms and definitions needed to understand this document.*

**A. Appendices.**

*Appendices may be used to provide information published separately for convenience in document maintenance (e.g., charts). As applicable, each appendix shall be referenced in the main body of the document where the data would normally have been provided. Appendices may be bound as separate documents for ease in handling. Appendices shall be lettered alphabetically (A, B, etc.).*