Elan8

CUSTOMER REQUIREMENTS SPECIFICATION

Autonomous Floor Cleaning Robot

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Generated from the SysML v2 model of the product with Doc42. Tables, values and diagrams are read from the model at this revision; change the model, not this document.

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1 Introduction

1.1 Purpose

This specification records what a household expects from the autonomous floor cleaning robot developed by Elan8. It states the customer requirements in the customer's terms, before any design decision, and is the baseline against which the finished product is validated.

1.2 Scope

The product is a battery-powered robot that vacuums the floors of a home without supervision and returns to its docking station to recharge. This specification covers the robot, its docking station as seen by the robot, and the mobile application through which the user starts a mission and follows its progress.

The following are outside the scope:

- cloud services and remote access from outside the home;
- wet cleaning, stair climbing and outdoor use;
- product variants, accessories and consumables;
- manufacturing, packaging and regulatory approval.

1.3 Document conventions

This document is generated from the SysML v2 model of the robot. Tables, values and diagrams are read from the model at the revision stated on the title page, so they agree with it by construction; the surrounding text is written by the engineering team.

Requirements are identified by a stable number. The word *shall* marks a binding requirement.

Prefix	Identifies	Specified in
USR	Customer requirement	RVC-CRS-001
SYS	System requirement	RVC-SRS-001
BASE, PCB, FW, TOP, BIN, HAR	Module requirement	RVC-SDS-001
VER	Verification case	RVC-VVP-001
VAL	Validation case	RVC-VVP-001

1.4 Applicable and reference documents

The four documents of the robot form one set. Each holds one kind of information and refers to the others for the rest.

Number	Document	Answers
RVC-CRS-001	Customer Requirements Specification	What does the household need?
RVC-SRS-001	System Requirements Specification	What shall the robot do, and how well?
RVC-SDS-001	System Design Specification	How is the robot built to do it?
RVC-VVP-001	Verification and Validation Plan	How will we know that it does?

The structure and content of the set follow these guides, tailored to a product of this size:

- ISO/IEC/IEEE 29148:2018, *Systems and software engineering — Life cycle processes — Requirements engineering*, for the stakeholder and system requirements specifications.
- NASA/SP-2016-6105 Rev 2, *NASA Systems Engineering Handbook*, for the verification and validation plan and the requirements verification matrix.
- INCOSE, *Systems Engineering Handbook*, fifth edition, and INCOSE, *Guide to Writing Requirements*, for the separation of needs, requirements, design and verification, and for the wording of requirements.

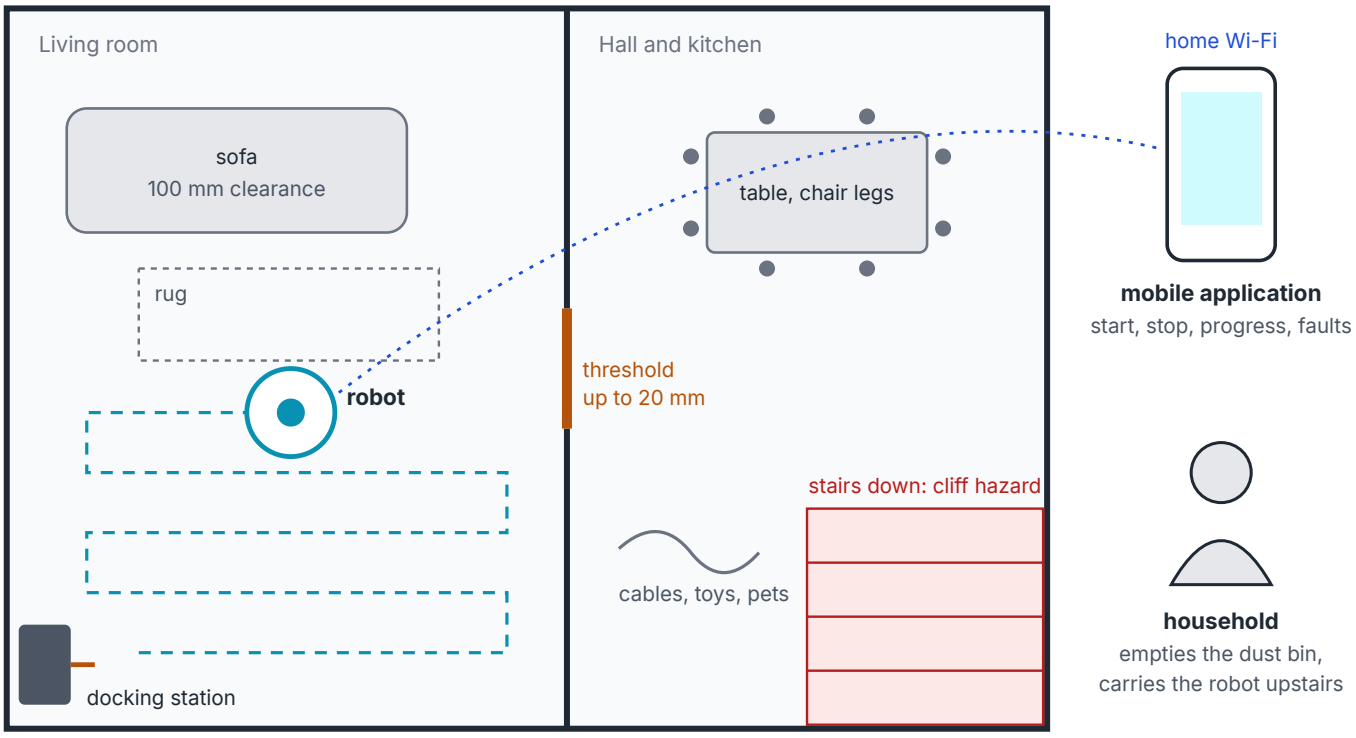
2 Stakeholders and operating context

The customer is a household. Four parties take part in normal use, and each is represented in the model:

- the **user**, who starts, pauses and stops cleaning and wants to know what the robot is doing (*User*);
- the **mobile application**, the user's means of control and feedback, which works on the home network without an internet connection by default (*MobileApp*);
- the **docking station**, which charges the robot and emits the homing beacon it follows back (*DockingStation*);
- the **home**, with its floors, furniture, stairs, people and pets (*ResidentialEnvironment*).

The figure below shows the reference home these requirements were written against.

Other stakeholders are the service technician, who needs to diagnose faults, and Elan8 as manufacturer, which is accountable for the safety of the product. Their needs are covered by the safety and feedback requirements in this revision.



Dashed green: coverage path. The map of the home stays on the robot unless the household consents to sharing it.

Figure 1: The reference home, the parties in it and the conditions the robot meets

2.1 Operating context

The robot and the external parties it exchanges power, signals and information with.

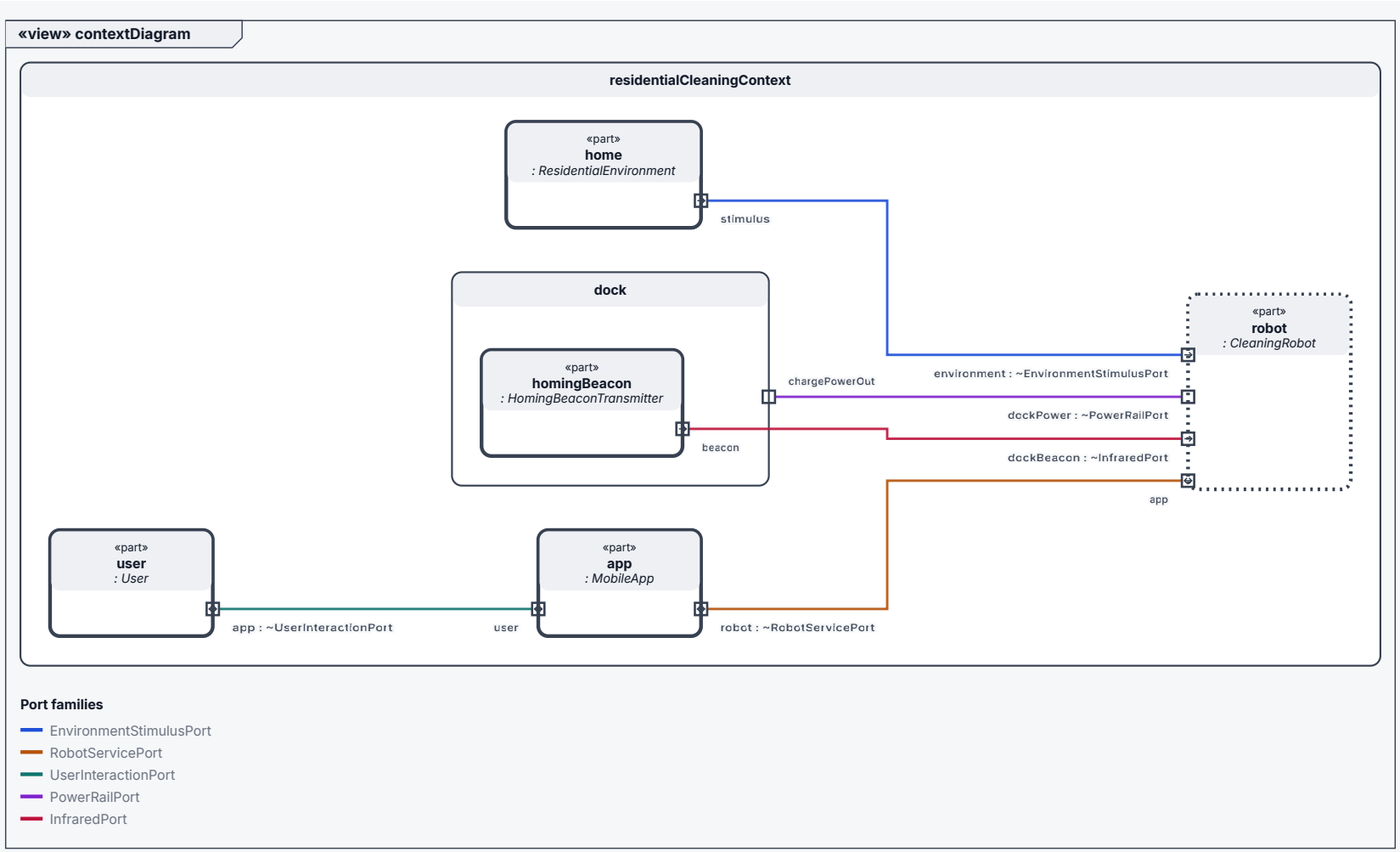


Figure 2: Operating context

3 Operational scenarios

Four scenarios describe how the household expects the robot to behave. They are the basis for the customer requirements and for validating the finished product.

Autonomous cleaning. The user starts a mission. The robot maps the home, cleans the reachable floor, reports its progress and returns to the dock when it has finished (*runAutonomousCleaning*).

Unexpected obstacle. Furniture, a toy or a cable blocks the planned path. The robot detects it, plans around it and continues without collision (*avoidUnexpectedObstacle*).

Low battery. The battery runs low before the mission is complete. The robot stops cleaning, returns to the dock and recharges without help (*returnForLowBattery*).

Stair edge. The robot approaches a drop such as the top of a staircase. It stops before a wheel crosses the edge and tells the user what happened (*respondToCliffHazard*).

4 Customer requirements

Each requirement is a need of the household, stated in the household's terms and identified by a stable number. None of them says how the product meets it or how that is measured: the system requirements that make each need measurable are in RVC-SRS-001.

ID	Requirement	Text
USR-001	Whole-home cleaning in one run	We want to start the robot once and have it clean the floors of our whole home, about 80 m², without recharging halfway or leaving large areas untouched.
USR-002	Unattended docking and charging	We do not want to carry the robot to its charger. It should find its dock by itself before the battery is empty and be ready again for the next day.
USR-003	Reliable navigation at home	Our home changes: chairs move, doors open and close, toys lie on the floor. The robot should still know where it is and where it has already cleaned.
USR-004	Mission progress and fault feedback	We want to see on our phone what the robot is doing, how far it is, and why it stopped when it needs help.
USR-005	Privacy of the home map	The map of our home is private. It stays in our home unless we explicitly agree to share it.
USR-006	Cleaning under furniture	Most dust collects under the sofa and the beds. The robot has to fit under furniture with about 10 cm of clearance.
USR-007	Quiet operation	The robot often runs while someone is at home. A conversation or a phone call in the same room must remain possible.
USR-008	Easy routine maintenance	Emptying the dust bin should be the only routine job, needed at most once per cleaning run, and it should take no tools.
USR-009	Thresholds between rooms	Our rooms are separated by door thresholds and the edges of rugs. The robot should cross them instead of getting stuck or skipping rooms.
USR-010	Carrying between floors	We have two floors and one robot. One person has to be able to carry it upstairs in one hand.
USR-SAFE-001	Safe operation in the household	The robot runs while we are out or busy. It must not fall down the stairs, push over or damage things, hurt children or pets, or become a fire risk while it charges.

5 Constraints and assumptions

The customer requirements assume the following conditions of use. A requirement is not claimed outside them.

- The robot is used indoors, in a home, on hard floors and low-pile carpet.
- The docking station is connected to mains power and placed against a wall with free floor in front of it.
- Doors between the rooms to be cleaned are open, and the floor is free of liquids.
- The mobile application is installed on a device on the same home network as the robot.

The following constraints apply to any solution:

- The robot must be safe to operate around people and pets without supervision.
- Maps of the home are personal data. They stay on the robot and in the home unless the user explicitly agrees to share them.
- The product is designed around components that are commercially available from more than one distributor.

6 Validation and open points

A customer requirement is met when a household gets what it describes, in a home, from a production-representative robot. That is validation, and it is planned in RVC-VVP-001, which names a validation case for every requirement of this specification. Verifying the system requirements of RVC-SRS-001 is necessary but not sufficient.

No validation has been carried out for this revision.

Open points:

- The size and layout of the reference homes used for validation are to be agreed.
- The needs of the service technician are covered only through fault reporting; dedicated service requirements may be added.
- The noise the household accepts is stated as holding a conversation in the same room; the measurable limit is in RVC-SRS-001 and is to be confirmed with a user panel.