

Business and Stakeholder Needs and Requirements Document writing guidelines

Include the following information in your document:

Title Page

Title of the document, and your student details (name, ID)

Mission Statement

What is the mission/purpose of the system? (page 87 of the textbook)

e.g. *"This project aims to produce a prototype of a robotic system capable of autonomously navigating rural Queensland farmland and dispensing herbicide onto the Prickly Acacia Trees. The robot would be a low cost, highly effective way of controlling and eventually eradicating the weed."*

Stakeholders

List the key stakeholders (at least five) involved with the system, and for each stakeholder you must justify why they are of importance to the development of the system. (page 83 of the textbook)

e.g. *"The key stakeholders involved with this system are:*

- *Farmers in rural Queensland – Their knowledge of the rural Queensland farmland terrain will influence how the robot chassis is developed*
- *Dr John Smith – As a biologist with specialist knowledge in Prickly Acacia trees, he may be able to help with the computer vision system (used to locate the trees)*
- *..."*

External Constrains

List down any external constraints (legal requirements, standards, availability of resources etc) that will influence design decisions. (page 86 of the textbook)

e.g. *"The external constraints which will affect this system are:*

- *Availability of wireless connectivity to the robot in some parts of rural Queensland*
- *The maximum legal amount of data sent between the robot and the base station is limited to 100KB per day.*
- *According to the authorities in rural Queensland, the robot is not allowed to operate at night time for safety reasons*
- *..."*

Goals and Objectives

These are the top-level requirements of the system (refer to page 109 of the textbook)

e.g. *"This system must be able to:*

- *Identify targets using satellite imagery and mark them for the robot to find*
- *Navigate autonomously to destinations*
- *Dispense 'poison' once it has arrived at a target tree*

- Detect when the onboard 'poison' supply has run out
- Stay operational for >1 hour
- Distinguish between a target plant and a non-target plant"

Operational Scenarios

Describe the typical use case for the system i.e how the system will be used. (page 91 of the textbook)

e.g. *"The robot will receive a command from the user to patrol a given area for acacia. After it has received a patrol area, the robot will process GPS imagery for acacia and mark them individually. These marked acacia trees will be used to plan efficient pathing between base location and target trees. Once the path has been planned, the robot will set out to the first target. Using onboard sensors, it will navigate the terrain efficiently. After arriving at the target, the robot will verify that it is indeed a target with machine vision. After verification is complete, it will dispense pellets which will soak into the ground after rain. The robot will keep track of trees that have and have not been poisoned. This will make it simple to check where regrowth is occurring and what areas are being cleared. Once the robot runs out of poison, it will return to a base station where it can be refilled. The robot will need to withstand heavy rain, wind and dust. It will use solar power to recharge it's batteries and it should last a minimum of six months between services and should be able to run 24/7 during this period (subject to when it has enough sun to recharge)."*

Validation Criteria

Describe how the system will be tested. (page 93 of the textbook)

e.g. *"There are three main criteria that the prototype needs to meet for it to be considered feasible project. The robot needs to be able to identify targets, the robot needs to navigate to the targets and the robot needs to dispense poison on the targets. The following tests will be used to validate the prototype against these criteria.*

Target identification - The robot will be taught to identify a proof-of-concept target. It will need to confirm that it has identified the target with a high percentage of accuracy which will be verifiable by a human observer.

Dispensing poison - The robot will need to dispense an appropriate amount of poison for the tree size and mark trees that have been poisoned, so that it doesn't poison the same tree twice.

Dispensing of the poison will be validated if it can accurately and repetitively place pellets around a target tree.

Autonomous Navigation - The robot will need to identify roughly where the targets are, and efficiently plan a path between them. The path following requirement will be tested by giving the robot a satellite image, which it will need to plot and navigate a course between identified objects."

Life Cycle Concepts

Include details of design considerations/what the product will look like during each life cycle phase (page 95 of the textbook)

e.g. *"Pre-acquisition phase - This phase is where we identify the needs and purpose of the robot. The feasibility of this system will be investigated, as well as its possible impact on the environment.*

A plan will be drawn up of key concepts that have to be demonstrated for the robot to be considered successful, how they will be achieved and their relevance. Preliminary designs of the robot will be sketched or drawn using CAD software.

Acquisition phase - In this phase, the design of robot will commence, with the requirements firmly agreed on. We will discuss how each part of the prototype will come together, which will involve sourcing of parts and materials needed to complete project. We will have to solve potential design issues that arise while also looking for optimisations that could be made. During this process, we will have to keep in mind the budgets we are working with, both money and time wise, and produce a working prototype.

Utilization phase – After successful verification and validation of the system, the robot will be deployed onto the farmlands. We will study its operation for possible improvements while also refining the prototype, determining what needs to be added for the next version or if something needs to be removed.

Retirement phase – The robot will be removed from the field and stripped for parts during this phase. The batteries will be disposed of at the nearest battery recycling company. Alternatively, the robot can be sold to universities as a teaching tool in autonomous navigation courses.”

Trade studies

Give details of where similar systems are used elsewhere and what can we learn from them. (page 108 of the textbook)

e.g. “Robots are becoming increasingly more utilised in performing agricultural tasks. There are many autonomous systems designed to perform a range of associated functions. Harvesting robots use a variety of sensors and machine vision to maintain soil conditions, detect the ripeness of produce and use robotic arms and instruments to interact with crops. More closely related to this project are the existing automated robots applied to weed control. Systems such as Hortibot and AgBot for example, are designed to detect different types of weeds and remove them either mechanically or by applying herbicides. These systems also use a range of navigational equipment to traverse fields and crop rows. From these established systems we can determine the most effective and efficient methods of navigation, construction and the key concepts used in modelling an autonomous robot.”

Context diagram

Include a context diagram with clearly defined system boundaries and external interfaces. (page 99 of the textbook)

Include a list of any references used in your document.