Functional Specifications

Eden Robotics Project

Document Objectives:

Propose a functional specification for the G1G2 Eden Robotics project.

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History of changes

N° version	Date	Description of the change
1	03/12/2020	Creation of the first version of the CDCF
2	22/02/2021	Description of the functions related to the arms/hands.
3	09/06/2021	Clarification of validity criteria
4	12/10/2021	Adaptation to pigeon heart tomatoes
5	02/02/2022	Addition of the "comparison with reality" part in the table of main and constraint functions

1. Study case

Provide a solution to the labor problem in agriculture. Workers must be able to pick up tomatoes from other countries. The solution must be easily fixable and affordable for farmers.

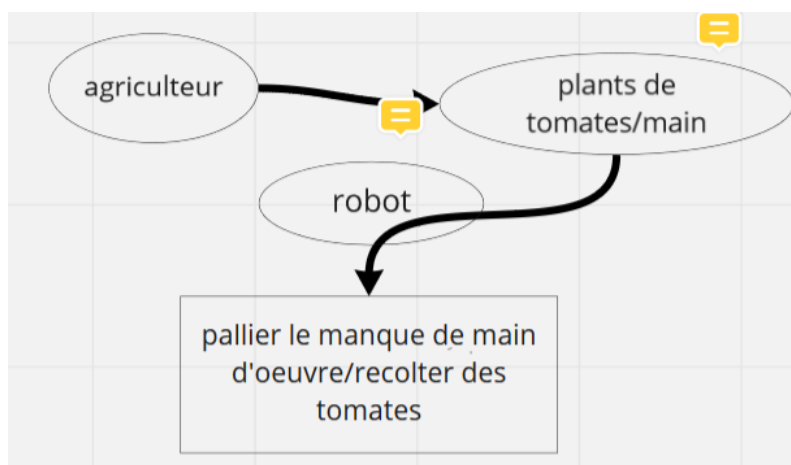# 2. Definition of the studied system.

2.1. Utilisateur final

The system is a service to farmers with tomato greenhouses.

2.1. Variété de tomate considérée

The robot is designed to pick cherry tomatoes of the pigeon heart variety, grown in greenhouses.

3. Definition of the need

3.1 Identification of the need

3.2. Validation of the need

- Why the need exists:
  - Lack of cheap labor in agriculture.
- Why the project exists:
  - To address this lack of labor
- Risks of the need changing or disappearing:
  - Stopping the consumption of tomatoes

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   ○   Disease that would ravage the tomato plants

   ○   Disappearance of the lack of labor

 ● Validate the need

4. Identification of functions

4.1. List of life situations studied

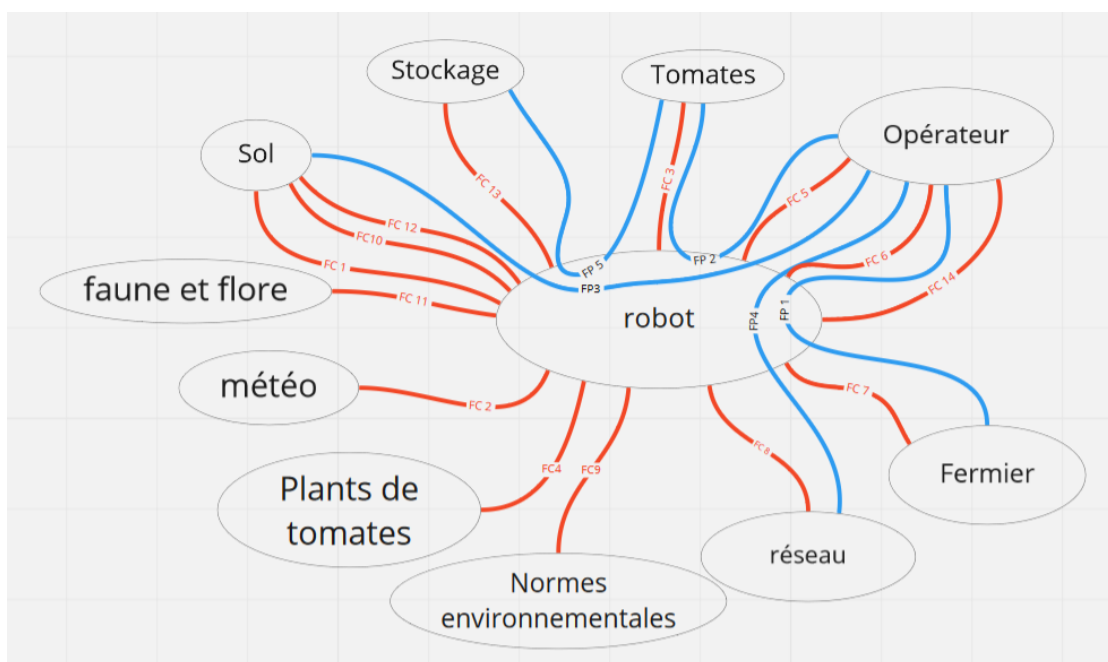Picking up tomatoes

Storage of tomatoes

Storing the robot

Moving the robot

Recycling the robot

Cleaning the robot

4.2. Life situation: Use

4.2.1. Octopus

4.2.2. Transfer functions

Transfer function	Assessment criterion	Level	Flexibility	Reality
PS 1: Be at least as efficient as a human	Picking time of a tomato	Moins de 10 secondes	F2	8-10 s
FP 2: Picking tomatoes	The tomatoes are detached from the plant	90% of the tomatoes from the plant	F1	75-80% of the time the tomato is not lost
PS 3: Being directed by the operator	Use of a joystick and correct movement	The robot obeys 90% of the commands	F1	Yes (99% of the time)
FP 4: Be remotely controlled	The operator can control the whole robot	500 m distance	F2	No

4.2.3. Constraint functions

Constraint function	Assessment criterion	Level	Flexibility	Reality
CF 1: Be able to reach all the tomatoes in a tree	be able to reach every tomato	98% of tomatoes reachable for a "standard" orchard 50cm high arm	F1	Accessibility zone achieved
FC 2 : Keep the tomatoes intact	Force exerted on the tomato	Fmax = 5 N	F1	F<5N
FC 3 : Avoid branches and tomatoes (fragility)	Degree of accuracy of the arm	Relative deviation < 1cm	F2	1 to 2 cm
FC 4 : Be easy to control	User's feeling	Handling in less than 2 hours	F3	Yes
FC 5: Be removable and adaptable	To be able to carry it in a medium size suitcase	Dimensions included in a cube of 1m50*1m*1m	F2	Yes

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FC 8: Transmit Information Correctly and Quickly	Response time to the transmission of information	Rep time <200ms	F1	Instantaneous local response time
FC 12 : The robot must be stable	The robot must not tip over	The outstretched arm must not tip over	F0	Yes
FC 13: Storage must be accessible by the robot	The robot can put the tomatoes in a storage device	Unloads tomatoes without injuring them	F2	Yes
FC 14: The robot must allow the operator to have a good viewing	Front view angle	Angle > 110	F1	Angles >110
FC 15 : Fit the shape of the tomato	Contact of all parts of the hand with the tomato	80% of the surface of the fingers in contact with the tomato	F0	Fingers have a good shape