Operational flow of an autonomous sweet pepper harvesting robot

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The Sweeper project

- EU H2020 project started Feb. 2015
- Develop a robot that can harvest sweet pepper fruits in green houses
  - UMU responsible for most software
  - BGU develops fruit detection algorithms
  - DLO responsible for system integration
- Our paper focuses on the operational flow of the robot for high level task planning.
**Background**

- Greenhouse production systems become more and more automated
- Major driving force:
  - Increasing labor costs
  - Lack of skilled workforce
Tight space -> no overview and hard to move
Workflow

Start

- Initialize HW and SW

Position platform in front of target

Search for fruit (move in a pattern)

- Search done?
  - Yes
  - No

- Found fruit?
  - Yes
  - All fruits picked?
    - Yes
    - No
    - Select fruit
  - No
    - Out of reach?
      - Yes
      - Move end effector toward fruit
  - No
    - Separate fruit and stem
    - Grasp fruit
    - Release fruit into container

- Move platform

- Yes
- No
State machine
The Main control program is implemented as a State machine that runs the main loop.

Each sub task is implemented as Behaviors.

Computational behaviors derive information like fruit location.

Acting behaviors control actuators (arm, gripper, cutter).

Each behavior is typically implemented as a ROS node.
Each state is normally conected to a behaviour that does the actual job.
Local error handling

- Detected and dealt with in the State machine

![Diagram of State machine with States: Fruit to basket, Pick fruit, Select fruit, and Out of reach transitions labeled.]
Error handling at system level

- Errors are detected by the Performance monitor and dealt with in the Error manager.
- Example: The camera stops working.
Video
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