• Software development and integration
• Hardware to software interface
• Control of the robot arm

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How everything fits together

“Software blows life into the dead hardware”
Software overview

Software is used for:

- **Top-level control**
  - Deciding how to move the arm, when to grip, when to move platform ...

- **Image analysis**
  - Finding the peppers in the images
  - Finding the stems in the images

- **Low-level control**
  - Get data from sensors such as cameras
  - Control the arm, gripper, and platform

- **Communicate with the operator**

Software is also used in a simulator to speed up development
Simplified flowchart for top-level control

1. Start
2. Move to next waypoint
3. Waypoints left?
   - Yes: Take image
     - Fruit detection
       - Select fruit
         - Fruits left?
           - No: Harvest fruit
             - Yes: Move to fruit
           - Yes: Fruit unreachable?
             - No: Move to fruit
4. End
A simulation environment was built using ROS MoveIt and visualized using RViz, a 3D visualization tool for ROS. Speeds up program development, integration, and testing.
Controlling a robot arm with x joints

- **Main task:**
  - How should the joints be set to move the gripper to a wanted position?

- **Problems:**
  - There are several ways to be in the same position!
  - Some are very bad and cause crazy movements of the robot arm

- **Solution:**
  - “Motion planning”
How to harvest the fruit

- When a fruit is found in the camera image
  1. Move around the fruit until the stem is behind
  2. “Visual servoing” towards fruit:
     - Center the fruit in the camera image
     - Move a small steps towards the fruit, until close enough
  3. Harvest by moving the knife down to cut the peduncle
User interface

- Gives feedback to the user and enables start and stop of the robot
- Also allows for easy testing of some functionality
  - E.g. Platform, gripper
Team

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