Jan Bontsema
Wageningen University and Research Centre

CROPS: Clever Robots for CROPS

Wednesday, March 18th, 2015

This project has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 246252

The partners
<table>
<thead>
<tr>
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<th>Partners</th>
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<tbody>
<tr>
<td>1</td>
<td>WUR Greenhouse Horticulture</td>
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<td>2</td>
<td>University of Leuven BIOSYST-MeBioS (Mechatronics Biostatistics and Sensors)</td>
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<td>3</td>
<td>Ben-Gurion University of the Negev Dept. of Industrial Eng. and Mngmt</td>
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<td>4</td>
<td>University of Ljubljana Faculty of mechanical engineering</td>
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<td>5</td>
<td>Umeå University Department of Computing Science</td>
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<td>6</td>
<td>Università degli Studi di Milano Department of Agricultural Engineering</td>
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<td>7</td>
<td>Instituto de Automatica Industrial</td>
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### Partners

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<th>Technical University Munich Institute of Applied Mechanics</th>
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<tr>
<td>8</td>
<td>TUM</td>
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<td>Case New Holland Belgium N.V.</td>
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<td>9</td>
<td>CNH</td>
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<td>10</td>
<td>INIA Quilamapu</td>
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<td>11</td>
<td>Force-A</td>
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<td>12</td>
<td>Festo AG</td>
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<td>13</td>
<td>Swedish University of Agricultural Sciences</td>
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<td>14</td>
<td>JENTJENS Machinetechnik B.V. (left the consortium mid 2013)</td>
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<td>15</td>
<td>JENTJENS</td>
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3. Crops

4. Crops
Some fact and figures

- FP7 EU project within Theme NMP: Nanotechnologies, Materials and new Production Technologies
- Type of funding scheme: Large-scale integrating Project
- Call: Automation and robotics for sustainable crop and forestry management
- Start date: Oct. 1st 2010, end date: Sept. 30th 2014

Some fact and figures

- Budget: 10.2 million Euro
- EU financial contribution 7.6 million Euro for a period of 48 months
- 13 (was 14) partners from 10 countries
The people

Objective

Intelligent sensing and manipulation for sustainable production and harvesting of high value crops.
Applications (demonstrators)

Sweet pepper, apples, grapes, precision spraying, obstacle avoidance in forestry

Workpackages

WP1 (TUM) Systems Engineering and Architecture

WP2 (ICMC) eForestry Benchmarking

WP3 (TUM) Precision Cultivation (sweet pepper)

WP4 (DECO) Sensor Fusion and Learning

WP5 (ICMC) Enrichment of Cultivation (trees)

WP6 (ICMC) Demonstration

WP7 (ICMC) Dissemination

WP8 (ICMC) Economics and Exploitation
CROPS: universal robot platform

Implemented hard-and software architecture
Sensing

Main partners:

Sensing ripeness and diseases

Multiplex Mx330, disease detection (Force-A)

Ripeness sensor based on fluorescence measurement (Force-A)

Main partners:
**Manipulators**

First prototype, also used for precision spraying

Second prototype, used for sweet pepper harvesting

Main partner: TUM

CROPS
**Endeffectors**

- **Sweet pepper**
- **Grapes**
- **Apples**

**Main partners:**
- **FESTO**
- **LEUVEN**
- **WAGENINGEN**

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**Adaptive sensor fusion and learning for grasping**

- **Adaptive sensor fusion**
- **Determining successful grasp poses**

**Main partners:**
- **Crops**
- **Crops**
- **Crops**

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**Endeffectors**

- **Sweet pepper**
- **Grapes**
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**Adaptive sensor fusion and learning for grasping**

- **Adaptive sensor fusion**
- **Determining successful grasp poses**

**Main partners:**
- **Crops**
- **Crops**
- **Crops**

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Sweet pepper harvesting

Platform for sweet pepper harvester
Main partner: 

This part was co-funded by the Dutch Horticultural Product Board and the Dutch Ministry of Economical Affairs

Sweet pepper harvesting

Main partner: 

CROP B S
Apple harvesting

Wall of fruit
Main partners:

Platform for apple harvester. Robot is inside

Apple harvesting (laboratory)
Apple harvesting (orchard)

Grape harvester

Open crop

Gripper for grapes

Main partners:
Precision spraying

Spraying only the infected spots

Main partners:

Precision spraying

Main partners:
Forestry

Obstacle avoidance, f.e. humans

Main partners:

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Economics

Simulation tool developed to calculate the investment space

<table>
<thead>
<tr>
<th>Application</th>
<th>Desired Robot Performance</th>
<th>Investment space</th>
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<tbody>
<tr>
<td>Sweet pepper harvester</td>
<td>Cycle time to harvest one sweet pepper = 6 sec</td>
<td>One robot system and one manipulator = € 196,000</td>
</tr>
<tr>
<td>Apple Harvester</td>
<td>Cycle time to harvest one apple = 6 sec</td>
<td>One robot system and two manipulators = € 74,500</td>
</tr>
<tr>
<td>Canopy optimised spraying</td>
<td>Spray saving due to:</td>
<td>One sprayer = € 61,475</td>
</tr>
<tr>
<td></td>
<td>- beginning and end of row = 5%</td>
<td></td>
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<tr>
<td></td>
<td>- uneven distribution = 12%</td>
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<tr>
<td></td>
<td>- saving varying leaves density = 15%</td>
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Follow up

**FESTO**

Finray fingers, 3D-printing

Application for food industry, injection molding

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Follow up

**ForceA**

Before

After

Happiness sensor using optical fiber

2.5 m optical fiber

3 m optical fiber

Before

After
Follow up

- New EU- project

Sweet Pepper Harvesting Robot
Jan Bontsema, coordinator

Partners:

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 644313
SWEEPER: sweet pepper harvesting robot

- Some facts:
- Budget: M€ 4.6
- EC-contribution M€ 4.0
- H2020 EU project within the program Industrial Leadership, Information and Communication Technologies
- Call: ICT-23-2014: Robotics, Innovation Action (Robotics Use case)

Website: www.crops-robots.eu
Website: www.sweeper-robot.eu

Thank you for your attention
jan.bontsema@wur.nl