Jan Bontsema
Wageningen University and Research Centre

CROPS: Clever Robots for CROPS

Precision Farming EXPO

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

CROPS
### Partners

<table>
<thead>
<tr>
<th></th>
<th>Name</th>
<th>Country</th>
<th>Type</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>WUR Greenhouse Horticulture</td>
<td>WUR</td>
<td>NL</td>
<td>Research Institute</td>
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<tr>
<td>2</td>
<td>University of Leuven BIOSYST-MeBioS (Mechatronics Biostatistics and Sensors)</td>
<td>KULEUVEN</td>
<td>BE</td>
<td>University</td>
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<tr>
<td>3</td>
<td>Ben-Gurion University of the Negev Dept. of Industrial Eng. and Mngmt</td>
<td>BGU</td>
<td>IL</td>
<td>University</td>
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<tr>
<td>4</td>
<td>University of Ljubljana Faculty of mechanical engineering</td>
<td>UNILJ</td>
<td>SI</td>
<td>University</td>
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<td>5</td>
<td>Umeå University Department of Computing Science</td>
<td>UMU</td>
<td>SE</td>
<td>University</td>
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<td>6</td>
<td>Università degli Studi di Milano Department of Agricultural Engineering</td>
<td>UNIMI</td>
<td>IT</td>
<td>University</td>
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<td>7</td>
<td>Instituto de Automatica Industrial CSIC ES Research Institute</td>
<td>CSIC</td>
<td>ES</td>
<td>Research Institute</td>
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<td>8</td>
<td>Technical University Munich Institute of Applied Mechanics</td>
<td>TUM</td>
<td>DE</td>
<td>University</td>
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<td>9</td>
<td>Case New Holland Belgium N.V.</td>
<td>CNH</td>
<td>BE</td>
<td>Multinational Industry</td>
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<td>10</td>
<td>INIA Quilamapu</td>
<td>INIA</td>
<td>CL</td>
<td>Research Institute</td>
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<td>11</td>
<td>Force-A</td>
<td>FORCE-A</td>
<td>FR</td>
<td>SME</td>
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<td>FESTO</td>
<td>DE</td>
<td>Multinational Industry</td>
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<td>Swedish University of Agricultural Sciences</td>
<td>SLU</td>
<td>SE</td>
<td>University</td>
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<td>14</td>
<td>JENTJENS Machinetechniek B.V. (left the consortium mid 2013)</td>
<td>JENTJENS</td>
<td>NL</td>
<td>SME</td>
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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
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 (TÜBİTAK) System Engineering and Architecture
WP3 (CIRIS) Sensor Fusion and Learning
WP4 (TÜBİTAK) Manipulators & End-effectors
WP5 (Bosphorus) Cooperative Control
WP7 (UL) Machine Learning
WP8 (KULeuven) Sensor Fusion and Learning
WP9 (Bosphorus) Training
WP10 (TÜBİTAK) Dissemination
WP11 (TÜBİTAK) Demonstration
WP12 (TÜBİTAK) Economics and Exploitation
CROPS: universal robot platform

Implemented hard-and software architecture

Main partners:
Sensing

Main partners:

Sensing ripeness and diseases

Multiplex Mx330, disease detection (Force-A)

Ripeness sensor based on fluorescence measurement (Force-A)
Manipulators

First prototype, also used for precision spraying

Second prototype, used for sweet pepper harvesting

Main partner: \textit{CROP\textsuperscript{b}S}
Endeckctors

Sweet pepper

Grapes

Apples

Spraying

Main partners:
FESTO
LEUVE
WAGENINGEN UR

Adaptive sensor fusion and learning for grasping

- adaptive sensor fusion

- determining successful grasp poses

Main partners:
Ben-Gurion University of the Negev
CROPBS
Sweet pepper harvesting

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

Platform for sweet pepper harvester
Main partner: CROPS
Apple harvesting

Wall of fruit

Main partners

Platform for apple harvester. Robot is inside

Main partners

Apple harvesting (laboratory)
Apple harvesting (orchard)

Grape harvester

Open crop

Gripper for grapes

Main partners:

[Images and logos of partners]
Canopy optimised sprayer

Design

Implementation

Main partners:  

Canopy optimised sprayer

Canopy optimised sprayer

CROPB's
Precision spraying

Spraying only the infected spots

Main partners:

Precision spraying
Forestry

Obstacle avoidance, f.e. humans

Main partners:

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: - beginning and end of row = 5%</td>
<td>One sprayer = € 61.475</td>
</tr>
<tr>
<td></td>
<td>- uneven distribution = 12%</td>
<td></td>
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<tr>
<td></td>
<td>- saving varying leaves density = 15%</td>
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</table>
Follow up

**FESTO**

Finray fingers, 3D-printing

Application for food industry, injection molding

Follow up

**Force A**

Ripeness sensor using optical fiber

Before

After

Before

After

2.5m optical fiber

30 cm

2 m
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