HORIZON 2020

The EU Framework Programme for Research and Innovation

SWEEPER

Sweet Pepper Harvesting Robot

GRANT AGREEMENT Number 644313

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Image Database #3

WP number: 5

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Document History

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References

Grant	EU Framework Programme for Research and Innovation Horizon 2020 Grant agreement no 644313 “Sweet Pepper Harvesting Robot” SWEEPER
DoA	Sweet Pepper Harvesting Robot GRANT AGREEMENT Number 644313 Annex 1 Description of Action
SWEEPER D1.1	Sweeper Data Management Plan, version 1, M6

Definitions - Abbreviations

Definitions or Abbreviations which are needed for understanding this document are listed here.

Abbreviation	Description
ORDP	Open Research Data Pilot

Data Management Plan

This project works according to the H2020 guidelines for Data Management, as set out in the Data Management Plan (D1.1). This deliverable also refers to the following data:

Data type	Description
Images	10500 RGB and Label images
Models	3D scenes, source of images.

Contents

Executive Summary

This deliverable reports on image database 3#, consisting of synthetic images generated from 3D models of plants and fruits based on empirical information. The database is intended for the advanced sensing algorithms with particular focus on obstacle detection.

1. Introduction

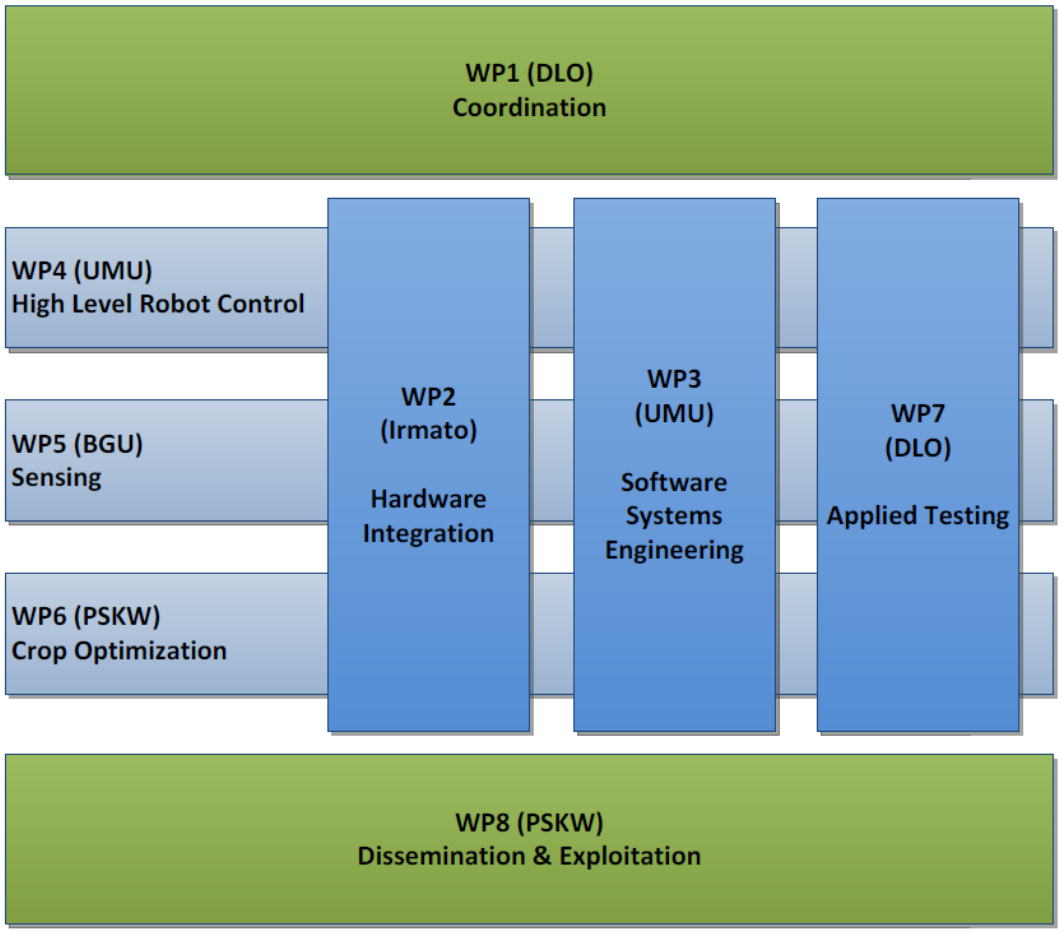
SWEEPER Project and Objectives

The Sweet Pepper Harvesting Robot (SWEEPER) research project is supported by the Horizon 2020 programme of European Union. The main objective of the SWEEPER project is to put the first generation greenhouse harvest robots onto the market [DoA-B; 1.1].

The project will achieve this by lifting up proven fundamental research results of a sweet pepper harvesting robot developed in the FP7 project CROPS, with a Technology Readiness to a market ready level (TRL = 9), which means the actual application of the technology is in its final form and under mission conditions, such as those encountered in operational test and evaluation environments.

The SWEEPER project is a partnership between Umea Universitet in Sweden, Ben Gurion University of Negev in Israel, Proefstation voor de Groenteteelt in Belgium and from the Netherlands Wageningen University & Research Centre, Irmato Industrial Solutions Veghel B.V. and sweet pepper grower De Tuindershoek BV.

The SWEEPER project is organized into 8 work packages as shown in the figure below.



Work package WP5

The sensing work package will deliver a robust pragmatic computer vision package to localize mature yellow and red fruits and its surrounding obstacles. An early milestone will ensure that a basic sensing framework can be tested and thereafter continuously improved after the first few months of the project start. This early stage will be based on results obtained in the CROPS project. For advanced sensing, a Lightfield camera will be added as primary sensing hardware on the end-effector. Basic software will be provided in an early stage and is based on CROPS algorithms adapted to data collected with the new SWEEPER system. Necessary adjustments to it are made to meet optical and greenhouse's constraints. Additional advanced computer vision algorithms will be developed to ensure progress in terms of robustness, accuracy and detection rate. To improve detection rates, sensing from the gripper will be performed from multiple viewpoints. Part of these algorithms will be elaborated on the results from the CROPS project.

Purpose of this deliverable

This deliverable reports on the goals, composition, and content of image database #3. The database is intended for the advanced sensing algorithms with particular focus on obstacle detection.

2. Synthetic Dataset Design

Unlike the first two dataset (D5.1 and D5.3), our 3rd dataset is synthetic (SWEEPER D1.1). Its main goal is to facilitate the obstacle detection software of the advance sensing system in WP5 when masses of labelled data are needed for machine learning algorithms but no resources in Sweeper are available to generate these supervised data manually. We do emphasize that the plant and fruit models used for the synthetic renderings are based on empirical plant measurements and on database #2 as a reference photographic dataset. Overall, the results are both photorealistic and loyal to the biological structure of the target objects.

To create the data, a 3D plant model was created based on 21 plant properties measured in plants in the greenhouse. The model was made in PlantFactory 2015, which allows generating random plants given plant property distributions.

The generated models were then imported in Blender render software. Here textures and colour information was added to the plants as well as arranging the plants in a realistic scene that corresponded to the greenhouse situation. A simulated camera and illumination were added that followed a path around a plant whilst shooting virtual images. This enabled us to render synthetic images together with the per-pixel class ground truth, including depth information.

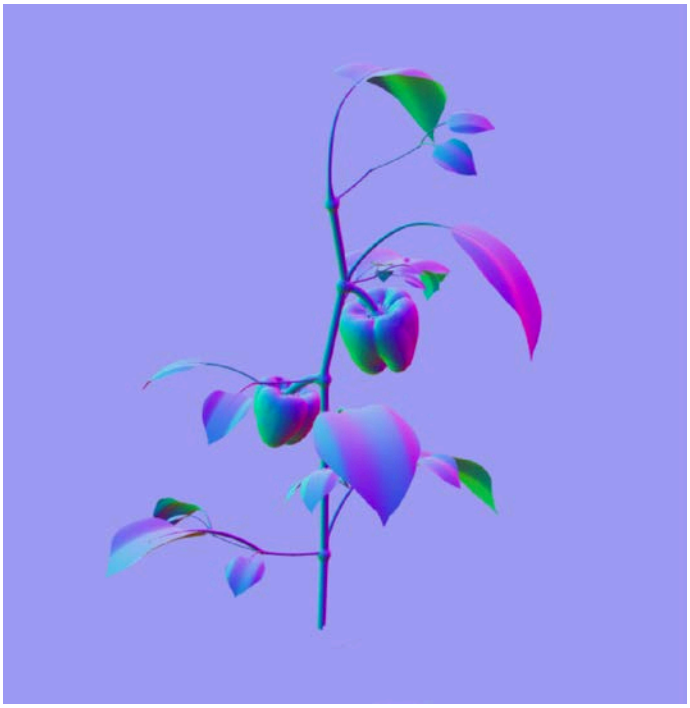


Figure 1: A randomly generated 3D plant mesh. Colour encodes surface normals.

3. Data

In total 10500 images were rendered in 6 scenes with 42 unique plants. Figure 2 shows three examples.

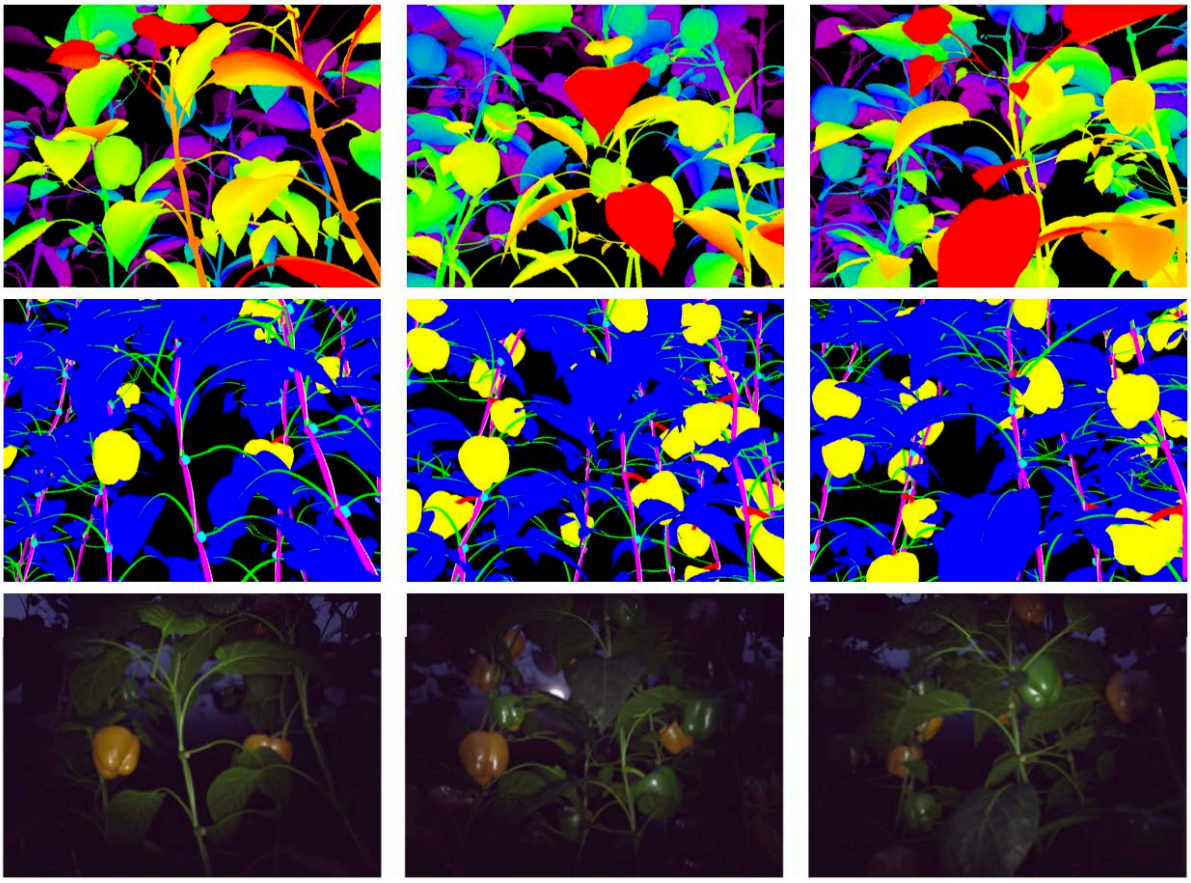


Figure 2: Example images of the synthetic and real dataset and their corresponding ground truth labels. The three rows contain column pairs of i) synthetic ground truth depth label ii) class label and iii) colour images.

4. Public access

The dataset and the source files are publicly released at DOI[1]
http://dx.doi.org/10.4121/uuid:884958f5-b868-46e1-b3d8-a0b5d91b02c0

[1] The dataset will be released under this DOI under the conditions described in the Data Management Plan (final version to be available at M36).