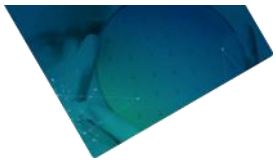
ARTICLE



PENTA CAVIAR project contributes to agriculture of the future

Algorithms based on machine learning for separation of crop and weeds in images

Paris, 20 May 2021 - Within CAVIAR, ImViA and MsEyeTech are developing software that can detect and localize crops and weeds for agricultural applications. Their project is based on multi-spectral (MS) imaging that uses visible and near-infrared (NIR) light, and a variety of techniques and methods for MS image analysis. Most important, it is using segmentation – a crucial image processing step that can separate weeds from crops even in complex images. The final goal is to create MS cameras for agricultural applications that can support more efficient and sustainable food production.

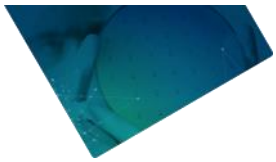
Worldwide, the agricultural industry faces demands for higher yields but also greater environmental protection. Precision agriculture, which uses technology to produce more crop with less water and fewer chemicals, and automating certain agricultural tasks, can help meet these challenges. But for both, imaging the crop and identifying what is in the images is a basic requirement. Here, segmentation is key for scene understanding ('seeing' what is visible in the image) and for agronomic analysis – for detecting crops, weeds and soil, as well as for image-guided operations in the field.

Indeed, agronomic image analysis – the processing of images taken in agricultural fields or greenhouses – is one of the major challenges in computer vision, particularly machine learning based approaches to the segmentation of these images. The project partners chose to use 'semantic segmentation' based on deep learning because it provides an accurate and effective segmentation of the crop and weeds. The process seeks to label different elements of the image into semantically meaningful objects (i.e. crop, leaves, connections etc...) and to classify and categorize each object into one of a set of pre-determined classes (e.g. crop, soil, weed). This results in a semantic relationship between the crop and weeds.

The process is challenging because each image contains several semantic relationships. The algorithm developed in this CAVIAR project begins by removing (visually) the soil from the images. It then separates the crop from the weed. This is an especially difficult task as crops and weeds are similar in shape and color, so this is where the deep semantic segmentation algorithm, based on deep learning techniques, is applied: the convolutional neural network is trained and then asked to do the separation.

The figure below illustrates how this works. An original color image containing a crop plant and a weed is given to the algorithm which, at the end of the process, returns two separate images: one of the crop plant and one of the weed. These images are then ready to be used in agricultural applications or by agricultural robots.

Fig. 1. Separation of crop and weed using the proposed algorithm (More details: https://www.youtube.com/watch?v=dNR4dE2Cp_M&t=2s).



Building on these processes, the project aims to develop MS systems that capture images in the visible and NIR ranges, de-mosaic and de-noise them, segment them into crop and weeds, and then provide localisation information for other machines, whether software applications or agricultural robots.

In creating these MS systems, the project is directly addressing the fundamental requirement for detection and monitoring systems in the growing areas of precision agriculture and automated agricultural operations. With MS imaging having proven its ability to extract important information, the software and techniques developed will enable weeds to be detected quickly and accurately – making a significant contribution to the use of new technologies in feeding the world and protecting natural resources.

About the PENTA programme

PENTA is a EUREKA cluster whose purpose is to catalyse research, development and innovation in areas of micro and nanoelectronics enabled systems and applications. Guided by the Electronic Components & Systems (ECS) Strategic Research and Innovation Agenda (SRIA) four technology layers, four cross-sectional technologies and six ECS key application areas, the PENTA programme enables the development of electronic solutions to help drive the digital economy through the formation of collaborative ecosystems along the ECS value chain. This creates the opportunity for rapid competitive exploitation and a strong impact on European societal challenges. PENTA supports SMEs, large corporations, research organisations and universities to work together in project consortia by facilitating access to funding, fostering collaborative work and creating consortia in areas of mutual industrial and National interest.

PENTA is managed by the Industry Association AENEAS

More on PENTA: http://www.penta-eureka.eu
More on AENEAS: https://aeneas-office.org

About the CAVIAR project
CAVIAR is a RD&I project consortium involving 9 partners from 4 countries. The project partners are: Grass Valley Nederland BV (Project leader), 3DHISTECH Ltd, AMS Sensors Belgium, Adimec Advanced Image Systems BV, EVS Broadcast Equipment Brussels (Belgium), EVS Broadcast Equipment SA, MS EYE TECH, TNO and Université de Bourgogne. Belgium, France, the Netherlands and Hungary Public Authorities are funding the project.

More about CAVIAR: https://caviar-project.org/