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# Technology description

Changing weather conditions, floods and droughts, environmental pollution and urbanization are great challenges farmers around the world are faced with. To cope with these problems, the 4TU Plantenna project has the goal to develop sensors to accurately monitor the health status of crops to enable precision farming. The individual sensors can be attached to the stem, leaf or root of a plant and are linked together in an automated network, the ‘internet of plants’. The information gained from this network of sensors can be used by the farmers to take the most effective measures to improve their yield and be less dependent on environmental effects under the influence of climate change. Because these sensors form a network, they enable the detailed monitoring of crops in high resolution and real-time. The vitalities of individual plants can be measured and the surrounding humidity can be assessed – a new approach called ‘precision farming’. This enables the farmer to optimize the use of plant fertilizer and water, enhance drought protection, and support decision making to improve environmental protection schemes and climate resilience.

Currently, the sensors are fabricated by standard, well-established cleanroom techniques using silicon-based materials and metals. The full functionality of the chip has been confirmed by recent prototypes. How long the sensors can be used depends on the type of crop, varying from various seasons for perennial plants like fruit trees to one cycle for annual plants like tomato plants. What happens to the sensors afterwards is not yet fully clear, whether they can be re-collected or will remain in the soil. Also, the best material for making the microchip for the final pilot is still explored within the project.

Aside from monitoring vitality of plants and humidity, the sensors can also measure the temperature in an orchard close to the plant itself. Because of this feature, the farmers can avoid the loss of young fruit buds due to frost in early spring nights. This is particularly useful for some local farmers in the Groningen region who have struggled with this problem for a long time.

**Scene 1**

The Dutch province Groningen has the highest area of land used for arable farming in the Netherlands (~840 km2) and accommodates a variety of orchard types, including apple, pear, plum and berries. In discussion with the municipality of Groningen and local farmers, the researchers of the Plantenna project are planning to run the first field tests of a sensor network measuring the temperature in the orchards of this province. Because the sensors will be attached to the stem of the fruit trees, the ecological safety of the device is important and the system needs to comply to environmental, food safety, and privacy regulations. Especially since the crop produced during the pilot is intended to be sold to regular supermarket customers. Additionally, feasibility of the implementation must be considered. If the trial is successful, the researchers hope that the sensors can move towards the next phase of production to become a real product. Therefore, the researchers have asked the municipality of Groningen to organize a meeting with several stakeholders. Next to the researchers themselves, a representative of the municipality of Groningen, a local farmer, and environmental- and regulatory authorities are invited. The goal of the meeting is to work out the details of the pilot and define its success-criteria. The focus lies on the safe design and secure implementation of this technology and on potential environmental and economic risks that this technology can introduce.