How it Works

A crop management system presents a complex, heterogeneous scenario. Building a system to allow communication between plants, artefacts (for example, irrigation pumps, sensors, lights) and people requires an interdisciplinary approach. The PLANTS project incorporates plant science, microelectronics, and software design and integration.

Plant signals are detected using an array of sensors placed around the crop. Miniaturised electronic systems collect and transmit data from the sensors. Software analyses this information and commands appropriate action from the artefacts.

Plant Signals

PLANTS will detect a number of plant signals, including leaf temperature, chlorophyll content, chlorophyll fluorescence and the release of volatile organic compounds. These signals can be used to determine the health of the plant. For each parameter, the threshold levels indicating plant stress are determined and incorporated into the software decision-making process.

The Hardware: Microelectronics

Sensors deployed in the PLANTS system are currently commercial, off-the-shelf examples. A key aim for PLANTS is to miniaturise the electronics used in association with the sensors. The system began using 100mm Field Programmable Gate Array (FPGA) boards and aims to progress to 25mm and 10mm modules, which will be wireless and battery-operated.

The Software: ePlantOS

ePlantOS enables plants to communicate with other components of the PLANTS system by converting their botanical signals (detected by sensors) to digital signals and into actions. ePlantOS assigns each physical entity in the crop a 'digital self' and encapsulates all its properties into a software abstraction called a 'plug'. The plugs of different components of the system can communicate when a 'synapse' – a virtual channel – is established between them. Users build their own 'worlds' of communicating elements. Decisions taken by the software (for example whether to irrigate) are based on the 'ontology', a directory of rules and definitions about plant parameters and characteristics.

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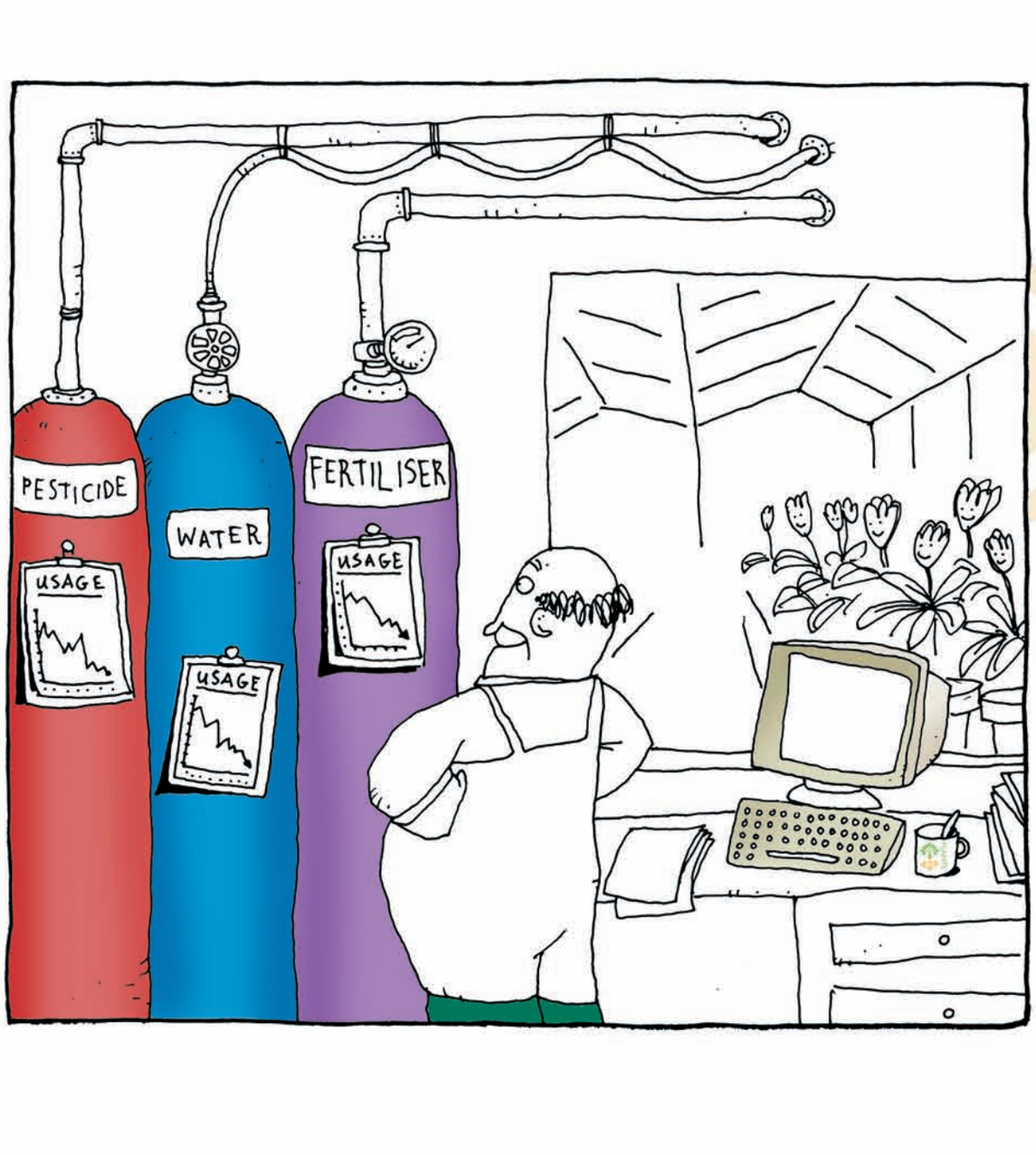
PLANTS

A new approach

The PLANTS approach offers a new way of managing crop production to reduce the environmental, social and economic costs inherent in modern agricultural systems.

By detecting early signs of plant stress, agricultural inputs (such as water, fertiliser, pesticide, light) can be delivered efficiently when and where problems are first detected.



Through the precision delivery of inputs, PLANTS seeks to minimise wastage of resources and reduce environmental and human-health impacts.

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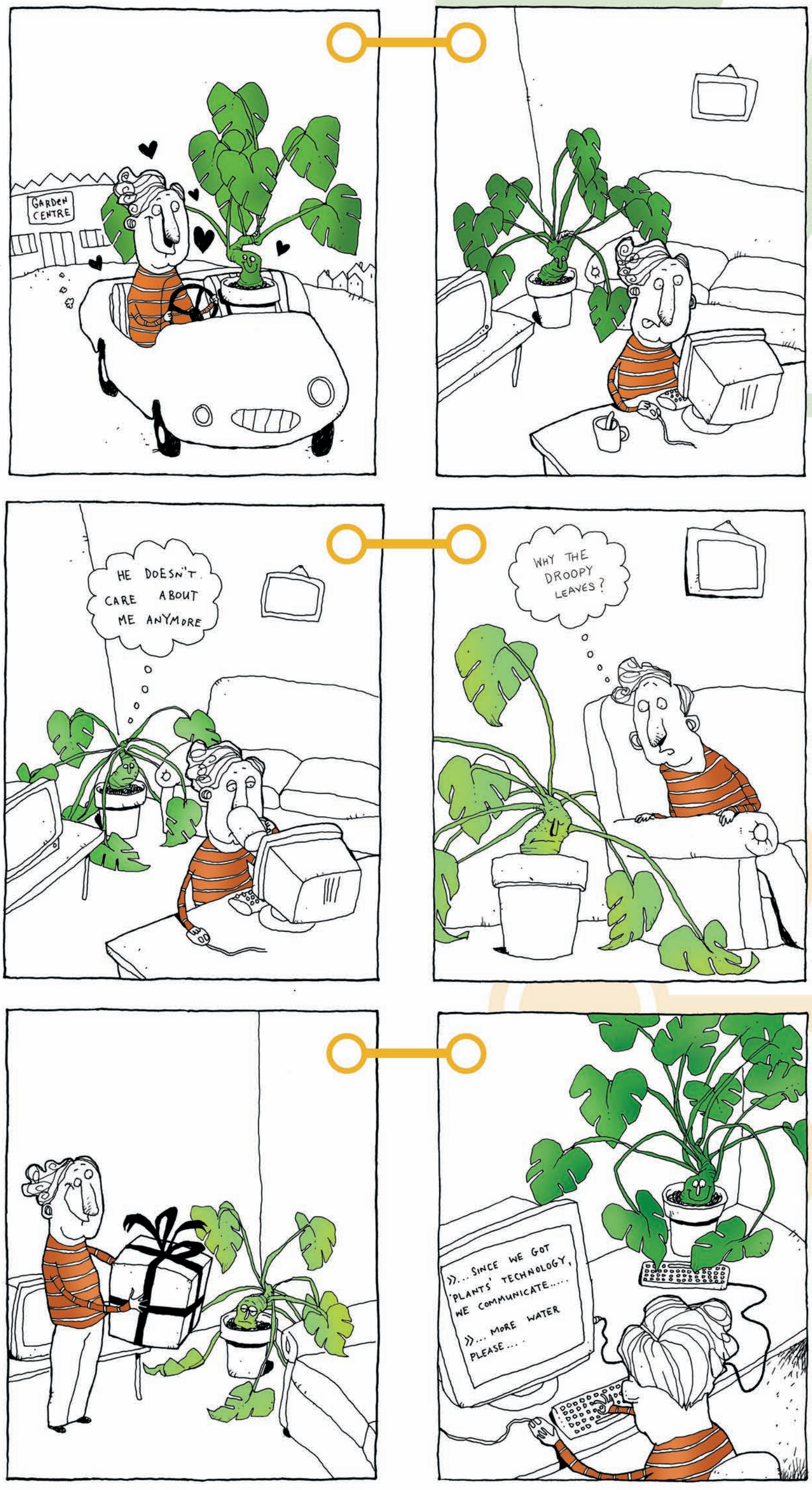
PLANTS technology

The PLANTS technology demonstrated at this exhibition shows how changes in leaf temperature can be detected by an infra-red thermal-imaging camera and assessed by ePlantOS software. In conjunction with data from moisture and ambient temperature probes, the leaf temperature data is used to determine whether irrigation or misting of the plant is required. The software then triggers the appropriate response.

PLANTS technology is designed to permit optimal plant growth with minimal inputs, thus aiding the development of more efficient growing systems. Current research focuses on glasshouse crop management, but further applications include plant growth in extreme environments, hydroponic systems, domestic situations and broader agricultural and horticultural systems.



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Plants take control of their environment

PLANTS

By tuning into the subtle signals that plants produce in response to their environments, PLANTS technology interprets and automatically responds to a plant's needs.

Plants sense and respond to the environment around them. Plants growing towards the light or wilting through lack of water are examples of this. These are dramatic examples; many plant responses are more subtle (for example, changes in leaf temperature or chlorophyll content) and may not be visible to the naked eye.

The PLANTS technology detects these discreet signals, which alert the system to early signs of a plant's stress. This activates a response according to the plant's needs. Thus, plant signals are the trigger for remedial actions.

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