Attempt Towards The Cyborg-Plant
Robotic Response to Water Stress in Avocados

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Abstract

This preliminary work pinpoints the ability of a robot to react in response to environmental stress in a plant in order to stabilize the state of the plant. We capture the morphological and physiological changes of the avocado, under drought stress, by measuring the position of the leaves and the electrical potential within the trunk. A watering event (irrigation) is autonomously triggered when the measurements indicate that the plant suffers from drought. Once the robot detects that the avocado has received enough water, the irrigation is stopped and the cycle restarts.

Objective

Controlling robots in complex environments is not trivial, yet living organisms face complexity and successfully deal with it. Our aim is to investigate techniques to import the plasticity and adaptability of a living organism into a device architecture. The study of plant-robot close-loop interactions reveals ways of exploiting plant intelligence in order to achieve this integration.

Experimental Setup

- Avocado plant (Persea americana)
- 6 infrared distance sensors
- 2 biopotential electrodes
- Arduino microcontroller
- Servo controlled valve
- Water reservoir
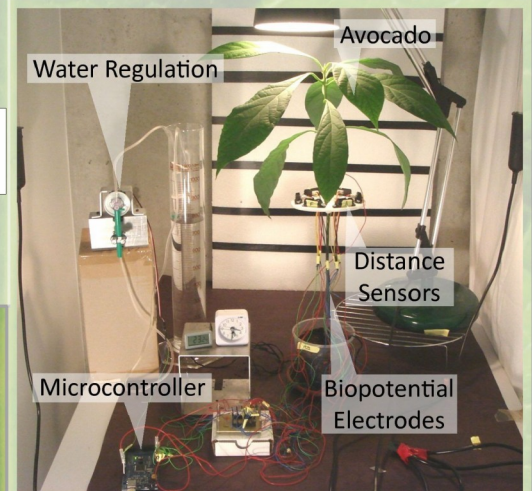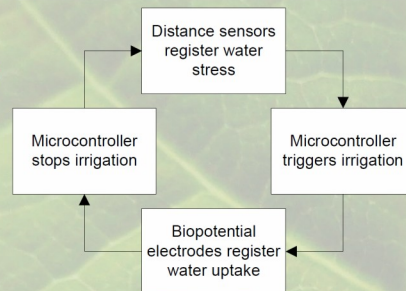
Results
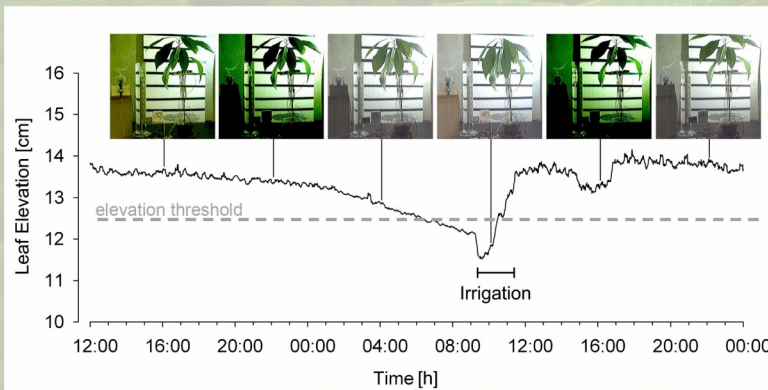
The measurements in the plot were recorded from a single exemplary distance sensor over 36 hours. The elevation of the canopy decreases over time and triggers autonomously an irrigation event when an elevation threshold is exceeded. The water uptake causes a quick morphological recovery of the plant. Because the electrodes were not able to record a significant change of the plant's biopotential the irrigation stopped automatically after two hours.

Conclusions

- **The autonomous system can detect water stress and trigger an irrigation event.**
- **The biopotential did not change significantly.**
- **Plant-robot interaction can be a useful case study for organism-machine adaptability.**

References

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