Phytosensor
Phytosensing: using plants as a biological sensor, measuring physiological parameters, research field well-known from 80x

BIOTRON, Academy of Science, Kishinev, Moldova: end of 80x - begin of 90x, strong usage in agricultural purposes - optimization of production, fast tests of genetic hybrids

Long-term collaboration with Prof. Dr. habil. Sergey Maslobrod – "father" of plant electrophysiology, the institute of plant physiology and genetics, AS Kishinev
The *flora robotica* project develops and investigates bio-hybrid relationships between robots and natural plants and explore the potentials of plant-robot societies able to produce architectural artifacts and living spaces.

*The project is funded by European Commission under the programme Future and Emerging Technologies, H2020 Project no. 640959.*

The main goal of ASSISI project is to establish a robotic society that is able to develop communication channels to animal societies and bio-hybrid systems.

*The project is funded by European Commission under the programme Future and Emerging Technologies, EU-FP7 Project no. 601074*
Bio-hybrid plant. What is it?

A bio-hybrid plant is a combination of a biological organism and a bio-hybrid interface device. The biological organism is capable of interacting with humans, the environment, and technologies, allowing it to change and adapt its own living conditions. This interconnection enables the organism to integrate seamlessly with the broader ecosystem, enhancing its adaptability and resilience.
Sensors and information processing

**Electrophysiological sensors**
- differential bio-potential analyser
- differential tissue impedance spectrometer
- electrostimulation module

**Physiological sensors**
- leaf transpiration sensor
- sap flow sensor

**Embedded environmental sensors**
- environmental temperature, humidity, light
- air pressure
- RF power meter (450MHz-2.5GHz)
- 3D magnetic field/3D accelerometer

**External/optional sensors**
- Soil moisture, temperature
- CO2, O2, O3 (and other gas sensors)
- any I2C sensor

**(Phyto-)actuators**
- Irrigation, Light, Electrostimulation, CO2
- internal MOSFET switches
- external USB/I2C relay
- DMX512 interface
- Control of 6-24 DoF actuators

**Connectivity and interfaces**
- USB/Ethernet networks
- twitter and text message services
- (optional) GSM and Bluetooth
- speech TTS engine with flexible vocabulary

**Information processing**
- over 250 embedded processors for real-time signal analysis
- extended statistical module
- over 200 embedded actuators
- DA scripting language for sensor-actuator coupling
- Real-time data plot
- html-based plots for direct output in internet
Applications

Entertainment
• plant-human interactions, talking/singing plants
• automated indoor plant installations
• integration of plants with technology

Home
• pathogenicity detector, ‘living’ environmental sensor
• home plant guard
• experimentation tool for plant enthusiasts

Science
• studying plant physiology and electrophysiology
• plant learning and plant-plant interactions
• automated analysis of large physiological data

Agriculture/environment
• optimization of growth processes
• automatization based on physiological processes
• outdoor urban/forest biosensors
Real-time data processing
Example:
Electrophysiology
Example: tissue impedance spectroscopy
Example: transpiration data

Temperature and Humidity difference. (data24102016-1025 003). 60 points averaging. Time interval [11:01:00:00:00 - 11:08:00:00:00]

Temperature (Leaf - Air), °C

Relative Humidity (Leaf - Air), %

Time, (Hours)
Example of phyto-actuation
Imposed feedback loops based on measuring biopotentials

- If \( z > x \) turn light on
- Calculate z-score
- Read bio-potential

The plant self-regulates illumination in its own environment
Example of phyto-actuation

Control of 6-24 DoF actuators with DA scripts
Outdoor setup (tree) for urban/forest measurements

- Solar cell powering
- WiFi connectivity
- Waterproof IP66 packaging
explore the world of
Intelligent plants

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