Information Technology Controlled Greenhouse: A System Architecture

Project Overview

Scientific Objectives

- Develop PROTOTYPE of smart greenhouse for scientific app.
- Test non-thermal plasma (NTP) technology
  - Sanitation of indoor air
  - Sanitation of irrigation water
  - Fixation of atmospheric nitrogen
- Develop mathematic yield model
Project Overview
The smart greenhouse
Project Overview
ICT infrastructure
Project Overview

Data analysis

- Active monitoring of cultivation system
- Optimize fertigation & climatic parameters
- Predictive models for plant development, water & nutrient absorption
  - Based on ordinary differential equations
  - Plant growth modeled at macroscopic level
- Data visible on dashboard
Project Status
Greenhouse design
Project Status
ICT infrastructure specification

- Heating, Ventilation, Air condition
- Digital sensors
- Analog sensors
- ADC
- RS485/RS232
- Controller
- Controller bus (intern)
- I/O
- Actuators (OUT)
- Alarms (IN)
- TCP/IP
- Server
- Router with Firewall
- Internet
- 80.1X
- Dashboard
- Touch screen mobile
Project Status
Use cases

Start/stop cultivation activity

Reconfiguration device type & phy location of sub-systems

Maintenance calibration and intervention data

Diary wellness, progress and plant morphology
Outlook

Development roadmap

- Greenhouse with **NTP, basic ICT** subsystems and essential **conventional** growing system: **Spring 2018**
- With **advanced ICT** subsystems: **Summer 2018**
- With **hydroponic culture**: **Fall 2018**
- **Collecting of data** for mathematical model: **Spring 2018- Summer 2019**
Outlook

Planned experiments (calib./valid. with three goals on different crops)

Development of provisional models for plant growth and nutrition
- Estimate leaf-area index, biomass accumulation and nutrition uptake

Development of sensing net for smart greenhouse monitoring and automation
- Optimize nutrient management (ion-specific sensors, closed-loop)
- Improve irrigation management (moisture sensors, pottet ornament plants)
- Verify plant crop requirements (pH, electro-cond., climate sensors)

NTP to treat irrigation water
Conclusions

- Project aims at building a prototype
- Different technologies serve different growing solutions
- Managed with high precision and efficiency
- Demonstrate many different precision cultivation solutions and possibilities for growers with different exigencies.
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