The Internet of Plants
Sensing Plant Growth Parameters for Autonomous Greenhouse Control

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Introduction

Agriculture and food constitute a hugely significant element of the Irish economy in terms of jobs and exports, and its long-term competitiveness and sustainability is a priority concern of national policy. The continuous development and application of new knowledge and new technologies is crucial to the realisation of national policy objectives for the sector. Nano/micro system technology has the potential to enable significant developments in food production and next generation farming practice through the provision of real time data from smart sensing systems. This poster demonstrates a complete IoT enabled agricultural eco system to enable precision management of resources in an agricultural setting. The Tyndall Smart sensing system for Security in Agriculture, Food, and the Environment (SAFE) is based on low power consumption, smart nano-wire and wireless communications embedded systems

Key Parameters for Precision Agriculture

Soil Temperature: Below certain temperatures (5.5^{o}C for rye grass) plants stop growing. Soil temperature also controls microbial activity in soil, thus at lower temperatures the microbial community reduces the rate of nutrient mineralisation (fertiliser for plants), reduces greenhouse gas emissions and reduces carbon sequestration.

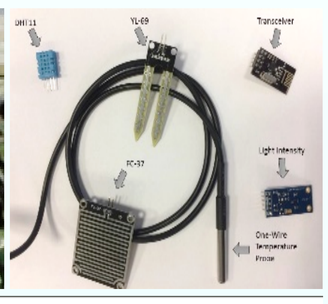
Soil Moisture Levels: Soil moisture is often expressed as soil moisture deficit which is dryness. Above a deficit of 30 or 40mm plant growth declines linearly with increasing deficit. Thus knowing both soil temperature and moisture enables crop growth to be estimated.

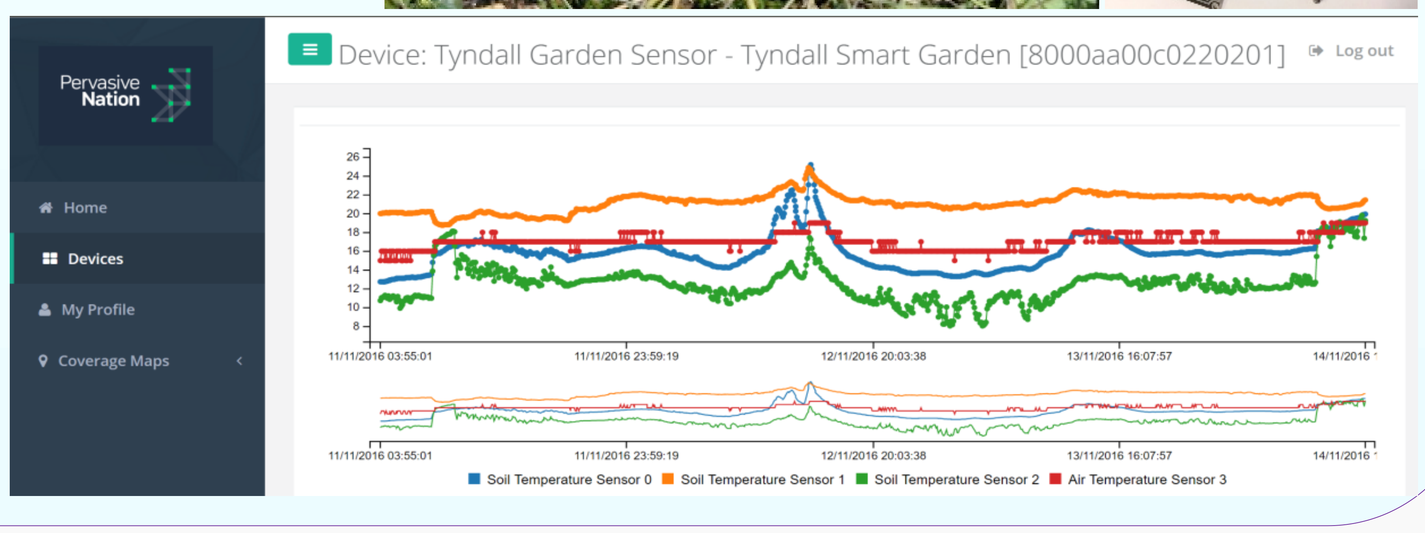
Rainfall Measurement: Rainfall is heavily linked to soil moisture. Soil moisture reflects rainfall and soil properties. Improved spatial prediction of rainfall would help to better predict soil moisture changes. Rainfall would also help to predict when water pollution or crop growth restricts are likely to happen and provide the basis for farm/field specific advice.

Solar radiation levels: Light (and photosynthesis) is directly linked to crop growth. This is measured by nationally at a very coarse scale and on farm sensors enable field/farm specific estimates taking in to account the farm landscape position. In addition losses of nitrogen via ammonia volatilisation is strongly and positively linked to solar radiation.

Deployment and Results

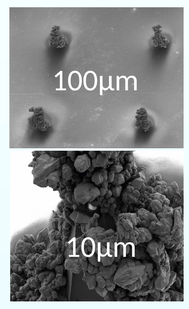
LoRa®

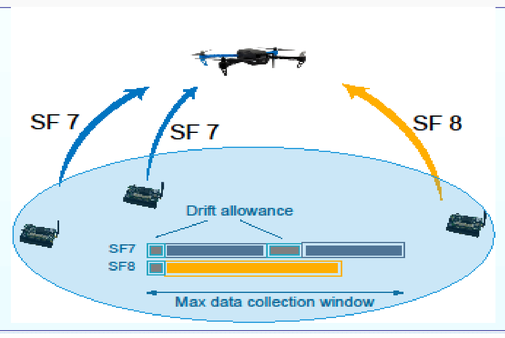




Ongoing and Future Work

Reliable and energy efficient data collection scheduling technique
AI methods using drones and image analysis to detect diseases
Electrochemical Nano-sensors to measure PH, Nitrates, and Phosphates





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