Application of the AgroNIT Smart-farming and Decision-support Platform to Support the Cultivation of Major Tree Crops in Thessaly, Greece - Abstract

Ioannis Moutsinas [1,2], Persefoni Maletsika [1], Vasileios Zafeiris [2], Fotini Oikonomou [2], Georgios Tziokas [2], Argyrios Serafeim [2], Apostolos Apostolaras [2], George D. Nanos [1] and Thanasis Korakis [2]

[1] *Laboratory of Pomology, School of Agricultural Sciences, University of Thessaly, Volos, 38446, Greece*
[2] *Department of Electrical and Computer Engineering, University of Thessaly, Volos, 38221, Greece*

Summary

AgroNIT is an integrated IoT framework designed to incubate and evaluate innovative field-based solutions that aim to improve the sustainability and efficiency of key management practices. It serves as a hybrid smart-farming service platform, as well as a large-scale Living Laboratory (testbed). In this study the AgroNIT smart-farming platform was adapted and deployed *in-situ* to support key cultivation practices of four major tree crops in the plain of Thessaly, Greece. AgroNIT features energy-autonomous mesh Wireless Sensor Networks (WSN), Cloud Computing and Decision-Support Systems employing Big Data Analysis and Artificial Intelligence methods. The deployed WSN testbed consists of 47 custom-made IoT sensing devices (end nodes) and 4G gateway nodes deployed at 25 different fields distributed across the regions of Agia and Tyrnavos in Thessaly, Greece, covering a total area of more than 250 ha. Leveraging its end nodes, AgroNIT enables the collection and transmittance of highly heterogenous data (i.e., numerical, and visual) to the proprietary Cloud, via the internet, in real-time. The Cloud is a data aggregation and data analytics service, whose purpose is to extract knowledge from raw data by employing big data analysis & time series data algorithms, as well as machine-/deep-learning methods. The produced knowledge contributes to more sustainable crop management through precise determination of (i) real crop needs, (ii) critical tree phenological stages, (iii) fruit ripening rate, (iv) yield prediction, and (v) potential perils due to biotic or abiotic factors. This paper presents three case studies that aim to show how a typical tree grower as well as an agricultural scientist can exploit the advanced tools and services offered by AgroNIT to facilitate the decision-making process as well as the design and assessment of new site- and crop-specific cultivation protocols. Specifically, the case studies focus on (a) the assessment of the phenological responses of a pear cultivar grown in two different regions; (b) the determination of real crop water needs and potential water-savings with the use of a custom-made smart irrigation model for pear and apple; (c) providing the means to remotely quantify the maturity rate of pear fruits to optimize harvest scheduling. Using AgroNIT the determination of the phenophases' length combined with the quantification of the chilling and growing degree hours accumulated by two pear crops during a 3-year period is enabled. Their comparative analysis allows for the assessment of the spatial and temporal climate variability effect on crop phenological responses. Additionally, based on AgroNIT's recommendations on optimal irrigation management, the potential water savings are estimated to reach 12 and 56% in use cases 1 and 2, respectively. Lastly, the image processing tools incorporated into AgroNIT show great potential in realizing remote estimation of fruit size and its color palette, which can be used as indices to assess fruit maturity rate in order to optimize crop management and harvest scheduling.

Proceedings of HAICTA 2022, September 22–25, 2022, Athens, Greece
EMAIL: moutsinasg@gmail.com (A.1); pmalets@uth.gr (A.2); vaszafei@gmail.com (A.3); fotinioik@gmail.com (A.4); ge.tziokas@gmail.com (A.5); argser98@gmail.com (A.6); apaposto@gmail.com (A.7); gnanos@uth.gr (A.8); korakis@uth.gr (A.9)
ORCID: 0000-0001-8693-6229 (A. 1); 0000-0001-9631-4802 (A. 2); 0000-0002-6053-5985 (A. 7); 0000-0002-0892-4502 (A. 8); 0000-0003-0162-335X (A. 9)

Keywords
Malus domestica, *Pyrus communis*, smart farming, sustainable production, IoT, Wireless Sensor Networks, decision-support systems, phenology, irrigation, harvesting