IoT solution for Plant Monitoring in Smart Agriculture

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ABSTRACT

Internet of Things (IoT) current solutions involving Cloud Computing facilities in the agricultural domain can provide different information on diseases and plant development during the phonological cycle. These solutions are needed to monitor drought, plant diseases, and plant growth and to enable the possibility to discover personalized solutions depending on the monitored parameters. This paper aims to illustrate how, using an IoT ADCON-based station for plant monitoring (grapevine), important sensor-collected data can be extracted and interpreted (e.g. variation of leaf wetness, soil and air humidity, air and soil temperature). Based on these values automatic or human decisions can be made in order to improve productivity in terms of grapes quality. The main advantages of the presented solution consist of solar panel supply and data reliability ensuring thus a power-efficient and productive agricultural process.

INTRODUCTION

In agricultural area crops need to be irrigated whenever necessary and only with the amount of water required at that certain time of irrigation. Precision agriculture (PA) is aimed to sustain and improve farms management by automation agricultural tasks. IoT platforms for precision agriculture can enhance the quality of the crops, by real time data acquisition, processing and decision making. These data are converted, thus, in useful information for the farmers. The current paper aims to describe an IoT ADCON-based solution and a decision support system for precision agriculture offering reliable data related to crucial parameters (such as leaf wetness) used in precision agriculture process.

SYSTEM ARCHITECUTURE

The Agri-Weather ADCON solution platform (Fig. 1) consisting in an A753 remote monitoring unit, SDI-12 temperature sensor, OTT-RLS level sensor, A850 data storage unit and addVANTAGE Pro platform. By Internet (Wi-Fi) means data collected by sensors from the vineyard are further accessible to the users through a Grafana interface.

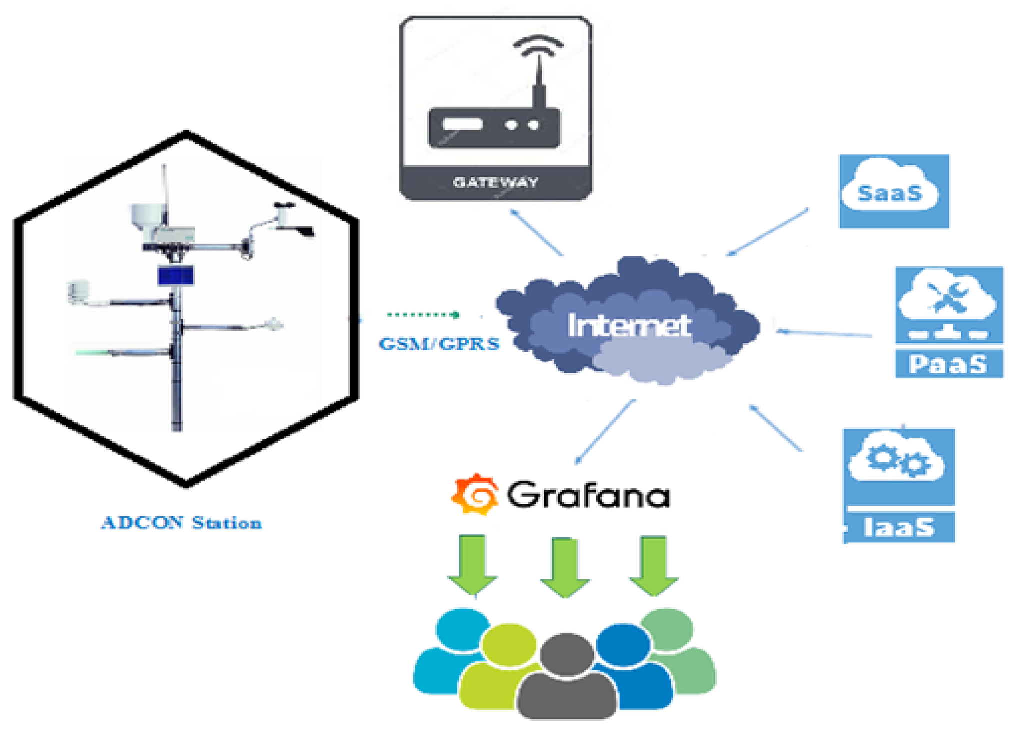


Fig. 1 Architecture of IoT ADCON-based system

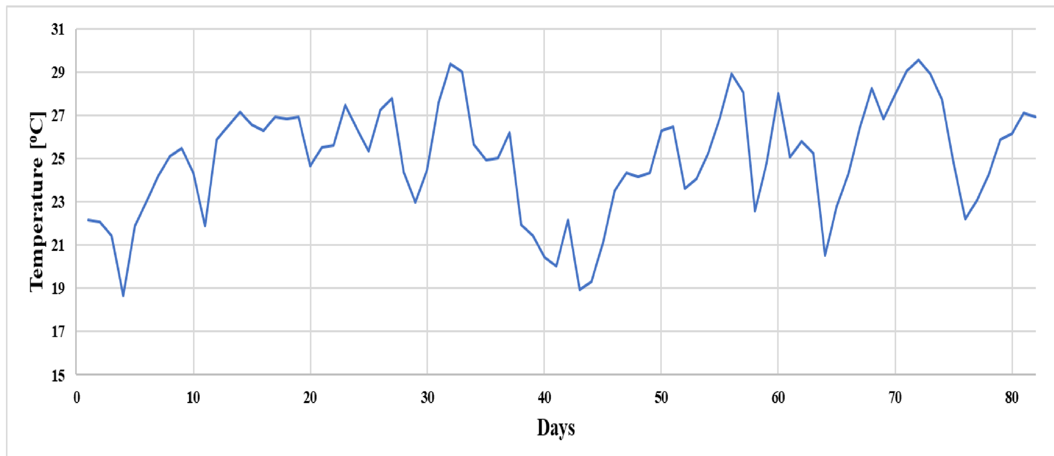
Data from sensors are sent to Cloud and cloud computing services are divided into 3 categories:

- Infrastructure as a service (IaaS): refers to the IT infrastructure: operating systems (Amazon Web Services, Cisco Metapod, Microsoft Azure), servers and virtual machines (VMs), storage, networks;
- Platform as a Service (PaaS): is used for applications, and other development, while providing cloud components to software. Among PaaS Use-Case there are increases developer productivity and utilization rates while also decreasing an application's time-to-market ;
- Software-as-a-Service (SaaS): ensures the capability provided to the consumer is to use the provider's applications by running on a cloud infrastructure .

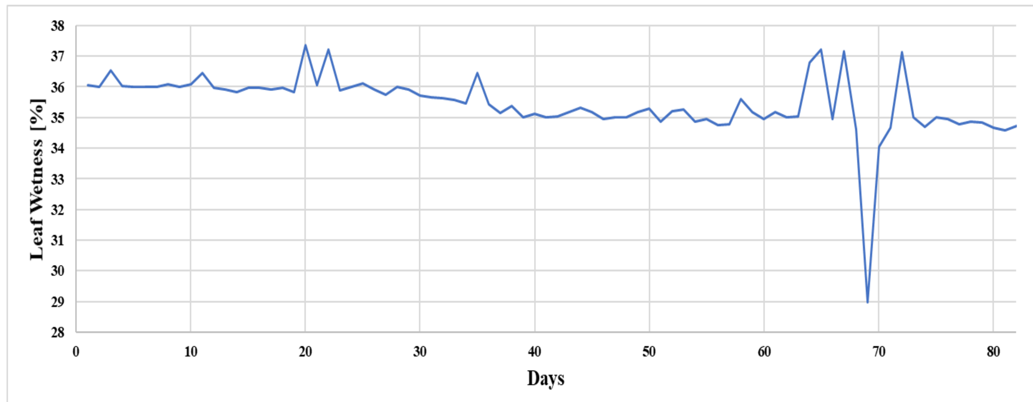
The ADCON system for precision agriculture is a Decision Support System (DSS) that monitors microclimate conditions in the vineyard to predict the spread of grapevine pests and diseases.

EXPERIMENTAL RESULTS

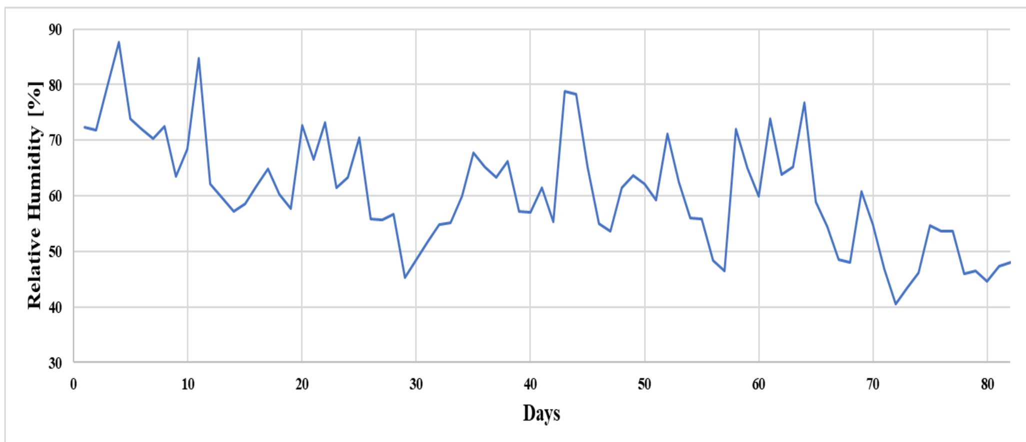
The analysis of the impact of meteorological parameters on agriculture was realized in a vineyard area located in a region close to Bucharest, using ADCON monitoring stations for summer season. The data acquired from the agricultural sensors (temperature, leaf wetness, relative humidity of air and soil and temperature of soil) were centralized into a database and were used to highlight the impact of measured parameters on crops.



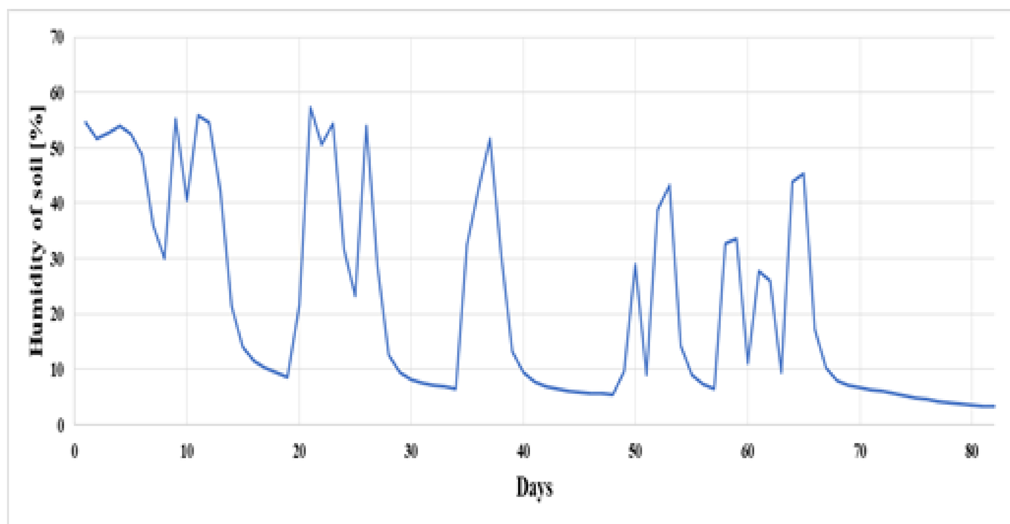
Variation of air temperature



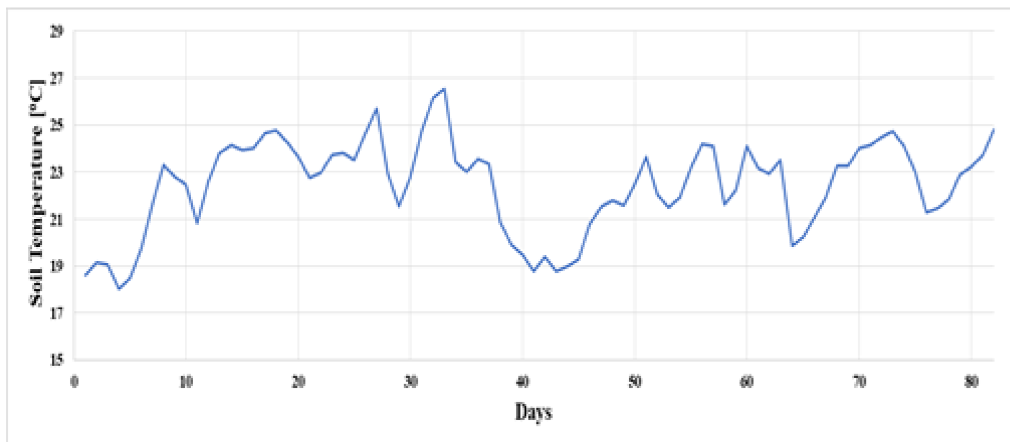
Variation of leaf wetness



Variation of relative humidity of air



Variation of relative humidity of soil



Variation of relative humidity of soil

Conclusions

Using fixed and mobile sensors, together with mobile devices such as smartphones and tablets, the farmers gather data in various formats regarding the impact of soil and ambient parameters on grapes. The results are sent back to the farmers to improve the agricultural process, also allowing remote actuating of the irrigation systems. The platform system performs automatic and continuous monitoring of the air temperature and humidity, leaf wetness, soil temperature and moisture throughout seeding to harvesting. The existence of these data transmission systems highlights the knowledge of the soil-plant-atmosphere interactions needed to optimize agricultural production. One advantage of the system consists in the use of solar energy that powers the entire system, along with dedicated sensors. **As future work, we envision testing the system for denial of service (DoS) attacks. We will focus on implementing DoS attacks to limit data transmission between ADCON and the server, and as well, to prevent a legitimate user, a farmer, accessing their data from the server.**

Acknowledgments

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