Chapter 17
Sustainable and Autonomous Soil Irrigation:
Agro Smart Solution

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ABSTRACT

Water scarcity is probably one of the most serious problems that humanity will have to face globally. For that reason, it will certainly be urgent to try to define practices and find solutions that, in a first phase, allow to mitigate the problem, but whose ultimate objective will be to overcome the situation. This chapter presents an irrigation system set on an internet of things platform, able to act in real time according to the atmospheric conditions. Through parameterized and automated systems, it is possible to stop the irrigation. Later, using sensors, the system may or may not be activated in case the levels of soil moisture and luminosity do not respond to the parameterized needs. It is an efficient and sustainable solution that is available for all agriculture irrigation systems. To test the proposed solution, unit tests were conducted, and a group of tests with all sensors connected was also considered. This system implements an alternative method for the data flow and its monitoring, including the fact that the system is aware of the user.

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INTRODUCTION

The responsible and efficient use of available water resources is a key factor for the survival of human species. The overuse of water resources derived from growing per capita use (Rijsberman, 2006) and the generalization of its uncontrolled or inefficient use remains the core problem. Climate change scenarios may also accentuate some of the scarcity problems in the near future (Bates et al., 2008). Intensive agriculture, urban growth, and industrial proliferation are also responsible for the contamination of water, reducing the water availability. Fortunately, the efficient use of water has the potential to improve, as available technology, such as IoT, wireless communication, monitoring and intelligent control systems can be applied in areas like precision agriculture and smart irrigation (Bwambale et al., 2022).

In order to also contribute to the solution of the problem, we have proposed an IoT Autonomous Irrigation System - Agro Smart (Santos et al., 2022) - a system envisioned to reduce the use and waste of water resources and to autonomously monitor and activate the irrigation system, considering captured data, such as soil moisture, luminosity, temperature, among others. Consequently, it is intended that there will be irrigation only when the culture needs it. During the day, with high temperatures and luminosity, there will be a waste due to the thermal movement of molecules from the liquid to the gaseous state, so the system prefers night irrigation, only when soil moisture levels justify it. In the development of the system the dimensions of sustainability were considered (Seghezzo, 2009) and the project followed good practices for sustainable development. The sustainability of software development is a process of extreme importance. It is important to prioritize the minimization of the use of resources, including the reutilization of source code. According to (Becker et al., 2015) and based on the Karlskrona Manifest, sustainability is systemic, sustainability has multiple dimensions and transcends multiple disciplines, applies to a system as well as its contexts, requires action on multiple levels, system visibility is a necessary pre-condition for sustainability design, and requires long-term thinking. The work under study represents a different strand of data than others presented. Agro Smart represents an innovative approach compared to existing solutions due to its integration with IoT technology, efficient use of water resources, and emphasis on sustainability. The system's originality lies in its unique combination of autonomous monitoring, irrigation control, and real-time environmental data consideration, making it a highly adaptable and responsive solution.

The chapter is organized as follows. Next section discusses the state of the art, followed by a section that mentions the work methodologies, namely the agile methodology and the scrum development methodology. Then we will expose the system design, particularly the requirements analysis, the characterization of the ubiquitous system, the functional and non-functional requirements, and the sequence of activities. Next we will describe the developed system, the architecture, the LoRaWAN network, the sensorial network, the management platform, the client application, security, and hardware components. Next section discusses and analyzes the achieved results. Finally, we end the chapter with some conclusions that are drawn from the developed work and mention the work that is intended to be done in the future.

STATE OF THE ART

The implementation of technology in agriculture is not a recent topic. And areas such as precision agriculture, and especially smart irrigation, could be the way to the solution (Bwambale et al., 2022). Over the years, models have been designed and projected to increase efficiency and minimize human labor.