Chapter 6
Precision Agriculture: Automated Irrigation Management Platform Using Wireless Sensor Networks

Amine Dahane
Research Laboratory in Industrial Computing and Networks, University of Oran 1, Algeria

Bouabdellah Kechar
https://orcid.org/0000-0001-8635-4667
Research Laboratory in Industrial Computing and Networks, University of Oran 1, Algeria

Abou El Hassan Benyamina
LAPECI Laboratory, University of Oran 1, Algeria

Rabaie Benameur
Research Laboratory in Industrial Computing and Networks, University of Oran 1, Algeria

ABSTRACT

Agricultural areas are getting reduced due to human negligence in providing modern irrigation methods. As a result, reflections aiming to save water use in the water network management context have been developed over the years. In this chapter, the authors propose a platform for precision agriculture which allows collecting fundamental physical phenomena (soil moisture, air temperature, humidity, water level, water flow, luminous intensity) required for the precision agriculture, which will be carried out to calculate the water quantity needed for optimal irrigation. The platform consists of a sensor/actuator node, a desktop application, and a gateway switches relay that controls the water pump according to the requirement. It uses an algorithm developed with threshold values of temperature and soil moisture (Rawls and Turq formulas) to control water quantity. The proposal is a good starting point for a smart, sustainable, and low-cost irrigation solution.

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INTRODUCTION

Agriculture uses 85% of worldwide available freshwater resources, and this percentage will continue being dominant in water consumption because of population growth and increased food demand. There is an urgent need to create strategies based on science and technology (Gutiérrez, 2014) . The use of wireless sensor networks (WSNs) needin agriculture applications becomes a reality nowadays after the success of theoretical research contributions in the previous decade (Dahane, 2015). WSNs have recently motivated the information technology solutions adoption in crop fields within precision agriculture approaches, which contribute to the rational use of water, including technical, agronomic, managerial,… etc. Research studies on irrigation systems to achieve water savings in diverse crops from basic ones to more technologically advanced ones. To achieve water saving, irrigation system frameworks have been proposed, based on various techniques, e.g., thermal imaging, Crop Water Stress Index (CWSI), direct soil water measurements, etc.

Due to the recent advances in sensors to implement irrigation systems for agriculture, the evolution of WSN and the Internet of Things (IoT) technologies, that can be applied in the development of these systems,IoT takes a major role in the revolution of digital transformations. Today, we can, therefore, discuss the IoT applications in agriculture (See Fig. 1).

Rapid climate change affects not only agriculture, but also the agricultural system. In this crisis, IoT applications play a key role in improving agriculture. Sensors are installed outside and inside the agricultural domain. In the Intelligent Greenhouse System, IoT applications adjust the state of the climate according to the particular predefined instructions set. Above all, these sensors collect real-time data that helps control the automatic irrigation system in an intelligent greenhouse. In the livestock monitoring and management system, IoT applications have a major impact. Here, the location tracker is implemented in the livestock. They are tracked at grazing time. More importantly, the health conditions of all animals are recorded at the same time.

The agricultural drone is a crucial invention in the IoT field in agriculture. There are two types: Ground Drone and Aerial Drone.Agriculture drone benefits to the use ease, time-saving, crop health imaging, integrated GIS mapping and the ability to increase yields.

Collecting data from sensors helps defining the exact irrigation time. Although this is expected in many situations, IoT applications have facilitated timely water management. As a result, the water misuse is reducing day by day.Thus,IoT implements digitization in all possible sectors, especially in agriculture.

Within the farming activities that use water inputs, too known as watered farming, there are different conducts to convey the water. The different alternatives show different efficiency and, in a few cases, a particular way ought to be used for a particular corp. The particular irrigation practice has several forms that can be represented into categories (See Fig. 2): attending to the way of water is dispersed able to consider: (i) flood irrigation, (ii) shower water system, (iii) dribble water system, and (iv) nebulizer water system. Forthe existence of detecting frameworks ready to have: (i) water system without any thought, when the watersum isn't calculated or assessed, (ii) scheduled irrigation when the water is provided agreeing to the assessed needs in a period of the year, (iii) Ad hoc water system when the watersum is calculated based on the sensors measurements or prediction using artificial intelligence techniques. The tremendous larger part of the precision agriculture research area proposes usingpumps and valvesin order to convey the water in conjunction with sensors to degree natural parameters in arrange to calculate the water needs.