Smart Crop Protection System for Agriculture

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Despite the perception people may have regarding the agricultural process, the reality is that today's agriculture industry is data-centered, precise, and smarter than ever. The rapid emergence of the Internet-of-Things (IoT) based technologies redesigned almost every industry including “smart agriculture” which moved the industry from statistical to quantitative approaches. Such revolutionary changes are shaking the existing agriculture methods and creating new opportunities along a range of challenges. This article highlights the potential of wireless sensors and IoT in agriculture, as well as the challenges expected to be faced when integrating this technology with the traditional farming practices. IoT devices and communication techniques associated with wireless sensors encountered in agriculture applications are analyzed in detail. What sensors are available for specific agriculture application, like soil preparation, crop status, irrigation, insect and pest detection are listed. How this technology helping the growers throughout the crop stages, from sowing until harvesting, packing and transportation is explained. Furthermore, the use of unmanned aerial vehicles for crop surveillance and other favorable applications such as optimizing crop yield is considered in this article. State-of-the-art IoT-based architectures and platforms used in agriculture are also highlighted wherever suitable. Finally, based on this thorough review, we identify current and future trends of IoT in agriculture and highlight potential research challenges.

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The profit of greenhouse production is influenced by management activities (e.g., environmental control and plantation scheduling) as well as social conditions (e.g., price fluctuation). In China, the prevailing horticultural facility is the traditional solar greenhouse. The key existing problem is the lack of knowledge of growers, which in turn leads to inefficient management, low production, or unsalable products. To secure effective greenhouse management, the production planning system must account for the crop growing environment, grower's activities, and the market. This paper presents an agricultural cyber-physical-social system (CPSS) serving agricultural production management, with a case study on the solar greenhouse. The system inputs are derived from social and physical sensors, with the former collecting the price of agricultural products in a wholesale market, and the latter collecting the necessary environmental data in the solar greenhouse. Decision support for the cropping plan is provided by the artificial system, computational experiment, and parallel execution-based method, with description intelligence for estimating the crop development and harvest time, prediction intelligence for optimizing the planting time and area according to the expected targets (stable production or maximum gross profit), and prescription intelligence for online system training. The presented system fits the current technical and economic situation of horticulture in China. The application of agricultural CPSS could decrease waste in labor or fertilizer and support sustainable agricultural production.

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Many countries have rich resources of land, rivers, groundwater, environment, and fertilizers availability. Agriculture is the main source of income for several country’s people. Since the last few decades, there are few resource shortages, such as groundwater and river water. People are unaware of the proper utilization of available valuable resources, which leads to the use of more resources for less crop production. One of the solutions of this problem is to design and implement an Internet of Things (IoT)-based smart framework for agriculture. In this article, we have proposed a smart agriculture framework to monitor different types of low-cost IoT sensors devices, which collects data from soil, air, water, and insects and makes appropriate decisions based on the analysis of sensors data. The novel contribution of our proposed approach is to automate tasks of irrigation, fertigation, pest detection, and pesticide spray in a scientific way with minimal farmer’s intervention in one framework. This article contains detailed implementation steps and results of the smart irrigation module of our framework.

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In recent years, edge computing has become an essential technology for real-time application development by moving processing and storage capabilities close to end devices, thereby reducing latency, improving response time and ensuring secure data exchange. In this work, we focus on a Smart Agriculture application that aims to protect crops from ungulate attacks, and therefore to significantly reduce production losses, through the creation of virtual fences that take advantage of computer vision and ultrasound emission. Starting with an innovative device capable of generating ultrasound to drive away ungulates and thus protect crops from their attack, this work provides a comprehensive description of the design, development and assessment of an intelligent animal repulsion system that allows to detect and recognize the ungulates as well as generate ultrasonic signals tailored to each species of the ungulate. Taking into account the constraints coming from the rural environment in terms of energy supply and network connectivity, the proposed system is based on IoT platforms that provide a satisfactory compromise between performance, cost and energy consumption. More specifically, in this work, we deployed and evaluated various edge computing devices (Raspberry Pi, with or without a neural compute stick, and NVIDIA Jetson Nano) running real-time object detector (YOLO and Tiny-YOLO) with custom-trained models to identify the most suitable animal recognition HW/SW platform to be integrated with the ultrasound generator. Experimental results show the feasibility of the intelligent animal repelling system through the deployment of the animal detectors on power efficient edge computing devices without compromising the mean average precision and also satisfying real-time requirements. In addition, for each HW/SW platform, the experimental study provides a cost/performance analysis, as well as measurements of the average and peak CPU temperature. Best practices are also disc.