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Editorial

Special Issue on the Engineering of Smart Agriculture

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1. Introduction

The monograph presents an extract from the reality of smart agriculture, where the combination of modern technologies, innovative solutions, and sustainable approaches to food production classifies this part of science as highly interdisciplinary, multifaceted, and technologically advanced. Furthermore, innovative methods that are shaping the future of the food system are presented.

The need to increase productivity, optimize natural resources, and minimize environmental impact requires new approaches. In this context, smart agriculture is emerging as a solution that combines technology, data, and science to achieve sustainable, efficient, and innovative food production. This issue introduces the field of smart farming, which encompasses a range of advanced technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), robotics, automation, drones, and precision agriculture.

The use of these tools allows the monitoring and optimization of crop conditions, precise fertilization, minimization of water and energy usage, and improvement of crop quality and quantity. In addition, plant monitoring systems are described, which, by means of sensors and data analysis, provide farmers with valuable information about plant health, soil moisture, temperature, and other factors affecting crop growth. A significant part of this monograph deals with the automation of agricultural processes, where robots and machines undertake tasks with high precision and accuracy, contributing to the farmer's efficiency. It outlines how smart farming can contribute to reducing greenhouse gas emissions, minimizing water usage, reducing waste, and protecting biodiversity. Practical examples from different regions of the world where smart farming has already been successfully implemented, benefiting both farmers and consumers, are also highlighted. This monograph aims not only to provide an understanding of smart agriculture, but also to inspire the reader to think about the future of agriculture and the ways in which modern food production methods can be improved. By understanding the technological potential and being aware of the growing challenges, we are able to move towards a more sustainable, efficient, and resilient food system.

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2. Acknowledgments

This monograph delves into various aspects of intelligent agriculture research, covering studies of crop diseases, pest detection, plant nutrition, precision farming technologies, and post-harvest techniques using machine learning-based artificial intelligence algorithms. The diverse range of matters covered in the monograph emphasizes the multidisciplinary nature of modern agricultural research and ongoing efforts to improve yield, quality, and sustainability. This monograph provides a comprehensive overview of the latest research and technological advances in the field of agriculture, offering valuable insights and practical solutions from image processing methods for precise area measurement [1] to the design of adaptive algorithms for efficient rice harvesting [2]. It also analyzes the generation of meteorological sequences for simulating the growth of biological systems [3] and analytical methods for assessing forklift stability [4]. In addition, the resource use of deep learning models for weed detection in smart agriculture [5] and the impact of microbial preparations on yields and soil nutrients [6] are discussed. In addition, it examines the energy consumption and environmental impact of lettuce production [7] and the resistance to airflow in aerated wheat masses [8]. Finally, it investigates real-time plant classification using deep learning techniques [9] and the design of a controller for pH regulation of liquid fertilizers [10]. It includes research on the analysis and validation of a foreign material shaking machine for pepper harvesters [11], the effect of pulsed electric field conditioning on leaf-wood burning characteristics [12], and the detection and factors that induce *Stenocarpella* spp. survival in maize stubble and soil suppression [13]. Moreover, this monograph investigates the adoption and use of mobile internet technology in sustainable agriculture among wheat farmers [14], compression and heat generation by fungi in bulk maize with consideration of kernel cracking [15], and the implementation of a smart irrigation system with consideration of optimal energy management [16]. In addition, a method for extending the shelf life of apples after storage using low magnetic fields [17] and the theory of motion of a machine-tractor-trailer combination for harvesting beet tops [18] have been investigated. These studies provide valuable insights into innovative technologies, management practices, and theoretical frameworks that contribute to the development of agricultural practices, crop quality, and resource efficiency. One of the areas of interest in this monograph is the control of strawberry wilt disease caused by *Fusarium solani*, which is an economic challenge for strawberry producers in Mexico [19]. The in vitro efficacy of four fungicides against *F. solani* is being evaluated to identify effective means of controlling this devastating disease [19]. Similarly, the use of autonomous drones equipped with deep learning algorithms to detect *Spodoptera frugiperda*, a destructive pest of maize, based on foraging symptoms observed in RGB images, is being investigated [20]. This application of digital technologies has the potential to revolutionize pest detection in precision agriculture. The use of image processing and deep learning algorithms to identify root rot disease in Korean ginseng plants from RGB plant images has been proposed [21]. An inexpensive method for assessing the positioning accuracy of a global navigation satellite system was presented, providing a flexible framework for assessing the precision of agricultural machinery [22]. The efficiency of selective fertilization of leafy vegetables with manure was also investigated [23]. Other research has developed a device to measure the ground pressure of paddy fields using internet of things technology and wireless data transmission [24]. In addition, the effect of pulsed magnetic fields on the cation profile of sunflower, cress, and radish sprouts was investigated, revealing potential benefits for seed germination and nutrient content [25]. This monograph also discusses advances in agricultural machinery. Image recognition algorithms have been developed and compared, which play a key role in effectively distinguishing between different parts of the sweet pepper plant for automation purposes. Using techniques such as normalized difference vegetation index (NDVI) and local feature analysis, this study compares the performance of different algorithms. The results demonstrate the capabilities of these algorithms, with significant successes achieved by the convolutional neural network (CNN) approach [26]. An architecture potentially capable of optimizing productivity has been proposed, as it uses simulation software to optimize (i) climate control strategies related to crop microclimate control and (ii) crop management treatments [27]. The design of an intelligent recirculating variable flow aquaculture system, based on machine learning methods, is presented to optimize productivity while maintaining a clean and stable aquatic environment [28]. Furthermore, this monograph deals with the effects of UV-C radiation on the mechanical and physiological properties of potato tubers and various agro-products. The review highlights the dose-dependent nature of UV-C treatment and its potential to extend shelf life and improve quality [29]. Finally, this monograph looks at the effects of magnetic and electric fields on fruit yield, shelf life, and quality. The literature on the use of magnetic and electric fields in agricultural production is reviewed, highlighting their potential to improve plant growth, firmness, ripening, and nutrient content [30]. Overall, this monograph presents a comprehensive body of research that contributes to the development of agricultural practices, disease management, crop quality, and resource efficiency.

3. The Future of Smart Farming

The degree of technical sophistication of modern agriculture and the variety of information, mechatronic, and satellite systems used allow us to conclude that this will be one of those disciplines whose development will be progressive. The multi-disciplinary nature of the research allows for the concentration of experts from different fields in one place and the creation of joint scientific projects that complement each other. Therefore, this is the first of many monograph editions related to smart agriculture.

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