Chapter 8
A Fully Automated Crop Disease Monitoring and Management System Based on IoT:
IoT-Based Disease Identification for Banana Leaf

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ABSTRACT

In recent years, the IoT has evolved and plays a significant role in many fields like smart city, precision farm, traffic signal control system, and so on. In this chapter, an IoT-based crop disease management (CDM) system is proposed that adopts statistical methods for identifying disease, recognizing a right pesticide, and recommending a right pesticide to farmers. The proposed CDM system monitors the agricultural crops with the help of a CCD camera. The camera continuously photographs the crops and sends them to a Raspberry PI processor, which is placed at a workstation and it is connected to the camera with the help of IoT components. The proposed CDM system analyses the crop leaf images, such as removes noise; segments region of interest (RoI), that is, diseased part of the leaf image; extracts features from the RoI; and identifies the disease and takes appropriate measures to control the disease. The proposed IoT-based CDM system was experimented, and the results obtained encourage both the farmers and the researchers in this field.

INTRODUCTION

The agriculture sector plays a noteworthy role in the development of the country's economy as such, it provides large-scale employment opportunities to people in countries like India, Colombia, USA, China, Brazil, etc. So, the growth of the agricultural sector is necessary for the development of the economic

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condition of a country. The UN Food and Agriculture Organization has reported that the world has to produce 70 percent more food in 2050 than it produced in 2006 to meet out the food demands of the growing population across the world. With the advent of the advanced technologies in both the agricultural industry and, information and communication technology, human society can produce enough food to meet the demand of more than 7 billion people. However, there exists a threaten to food security by a number of factors including climate change (Harvy et al., 2014), the decline in pollinators (Report of the Plenary of the Inter-governmental Science-Policy Platform on Biodiversity Ecosystem and Services on the work of its fourth session, 2016), plant diseases (Sanchez & Swaminathan, 2005), and some other factors. Plant diseases are not only a threat to food security at the global level but also cause disastrous for smallholder farmers whose livelihoods rely on healthy crops. In the developing countries like India, more than 80 percent of the agricultural production is generated by smallholder farmers (Strange & Scott, 2005), and a report suggests that there is a loss of more than 50% in yield due to pests and diseases (Tai et al., 2014). Moreover, a study reveals that around 50% of the people live in smallholder farming households making smallholder farmers as a group, that is, particularly vulnerable to pathogen-derived disruptions in food supply (UNEP, 2013). So, this is the right time to improve productivity and enhance the quality of the agricultural products, unless otherwise, the people will face food scarcity in the future across the world. But, unfortunately, the farmers face a lot of difficulties in day-to-day crop monitoring and management system like more use of pesticide and fertilizer, disturbance of insects, some types of plant diseases, food preservation, rainfall water scarcity, and so on. Particularly, nowadays, varieties of diseases attack crops so that it creates a huge amount of loss in yield and the farmers have to spend more money on curing the attack. Moreover, many farmers still use the traditional method of farming, which results in low yield; it could also be one of the main factors for the low yield.

To assist the farmers, that is, minimize the expenses and maximize the yield, the precision agriculture (PA) was formed in1929 in Illinois, USA. The PA adopts a management strategy that uses Information and Communication Technology (ICT) to bring data from multiple sources to make a decision associated with the increase of crop production. The PA has been developed not only in countries like the USA, European Union, and Australia where the average farm sizes are relatively large, but also in Japan, China, and Korea where average farm sizes are relatively small. Since the mid-1990s the PA concept has been widely used in research by academic groups and the agricultural companies by adopting ICT with the use of commercially available sensors, wireless sensors networks, controllers, software programs, and so on. The Scope of the PA has become wide and it has introduced new terms, such as precision citrus farming, precision horticulture, precision viticulture, precision livestock farming, and precision aquaculture, etc. For effective use of these new aspects of PA, recent technological advancements in data communication and data analysis, such as ICT, IoT, Pattern Recognition, Big Data Analytics, and Data Mining techniques, have been fused.

To overcome this problem, the farmers and the agro-chemical industries can adopt the futuristic of the Internet of Things (IoT) for analytics and greater production capabilities. Over a decade, there has been a swift development of the wireless sensor networks and new smart devices that can connect to the Internet and be controlled using applications remotely. This network of devices and other items embedded with sensors, electronics, software, and connectivity is called the Internet of Things. In recent years, the IoT has begun to play a noteworthy role in day-to-day activities by extending our concepts and ability to modify the environment around us. Particularly, the agro-chemical industrial and environmental domains apply the IoT in both disease diagnostics and control. Besides, it can provide information to the end-user