Chapter 17
Disease Monitoring of Cucumber in Polyhouse Through IoT-Based Mobile Application

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ABSTRACT

Most countries have an economy that is dependent on agriculture—either in a magnificent or small way, from employment generation to national income contribution—implying that agriculture is inevitable. Polyhouse farming is a new and widely accepted method of farming in the present days. The polyhouse is made in such a way that it can provide water and fertilizers in required amounts in a controlled manner, which can result in high yields. Polyhouse requires severe monitoring of crops as stagnant air, and lack of air circulation will lead to breeding of insects and materialistic loss. Hence, this chapter proposes an IoT-based disease-monitoring prototype for an agricultural/polyhouse application. The prototype is designed and tested to identify the disease onset in cucumbers. This work initially focuses on recognizing the critical cucumber diseases in polyhouse using NodeMCU and Raspberry-Pi-based hardware model. The decisions to be made and the major changes in the sensed parameters if any will be intimated to the farmers using a specifically designed mobile application.

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INTRODUCTION

Agriculture is the primary support for our country's economy; it contributes around 26% of India's GDP, and provides employment to about 60% population. Recently, Indian agriculture has been greatly influenced by the global climatic variations. These variations in the climatic conditions has led to an increase in the temperature of about 2-3°C which impacts the agricultural process and practices. On the other hand, crops are being affected by diseases due to pests. The losses due to weeds, diseases and pests have been estimated to be around 40% in the tropics and semi tropics. Similar conditions prevail in other parts of the world too, but with varying intensity levels. These problems necessitate an efficient technology so that the crop productivity, sustainability of farming and profitability can be considerably improved under varying environmental conditions. One such emerging technology is the polyhouse technology.

Polyhouse technology is an approach that helps the plants to experience a suitable environment enabling reasonable non hindering growth. It is indispensable to safeguard the crops from undesirable environmental circumstances that are caused due to variations in wind, rainfall, coldness, extreme temperature, excessive radiation, diseases and insects. Thus, crop cultivation in a polyhouse is a suitable choice which also allows precision farming and overcomes the limitations of space and disadvantages of climate change. Crops to be cultivated in the polyhouse are carefully chosen based on of the size of the polyhouse structure, crop production economics and income generated (profit). To be region specific, the high value vegetable crops viz., tomato, capsicum, brinjal and chilli have been more popular for cultivation in polyhouse in Tamil Nadu, India. They are also cultivating hybrid variety of cucumber and flower crop of marigold in large scale.

Cucumber (Cucumis sativus) is a plant belonging to the Cucurbitaceae family, which is cultivated widely in India. Diseases in polyhouse cultivated cucumber varieties have the characteristics of high disease rate, fast and frequent infection (Tian et al., 2008). The onset of disease will reduce the crop cultivation and degrade the quality of product. It is practically difficult to detect or classify various plant diseases through naked eye even by experts. Moreover, manual inspection also demands regular observation of the crops by skilled persons. This will be tedious and costly while done in large scale farms. Hence, there is a crucial need for the development of a disease monitoring system to detect the changes in the environmental parameters and identify the onset of plant diseases.

Recently, Precision farming is evolving which is capable of handling disparities in productivity within a field and maximizing financial returns. This is accomplished by the use of automatically programmed data collection followed by documentation and finally utilizing the collected data to carry out strategic decisions for farm management by means of sensing and communication technology. IoT enabled Wireless sensor networks play a major role in precision farming with the following advantages:

- Ability to control weather, nutrient supply and irrigation in an economical way so as to yield the best crop condition, strengthen the efficiency of production while at the same time reducing the cost and furnishing the real time information.
- Prospective potential for inspecting a larger area with better sampling intensities.
- Capability of forming a well automated agriculture system with improved resolution.

Hence cost effective user friendly IoT based solutions for polyhouse cultivation has a wider scope. This work initially focuses on recognizing the environmental conditions and symptoms that leads to the major cucumber diseases namely Red Spider Mites, White Flies, Aphids, and Potassium deficiency.