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Using Cloud IOT for disease prevention in precision agriculture

Karim Foughali[a]* , Karim Fathallah[b], Ali Frihida[b]

[a]Communication System Laboratory Sys'Com, National Engineering School Of Tunis, University Tunis El Manar, Tunisia
[b]National Engineering School Of Tunis, University Tunis El Manar, Tunisia

Abstract

The application of decision support system (DSS) for potato late blight disease prevention has proven its benefit. In fact the DSS permits efficiency, minimizes cost and environment impact by estimating the exact requirement fungicide quantity to apply. This prediction using weather condition based late blight forecast model. The required weather information is collected from costly weather station or imprecise historical data. However, with the emergence of the IOT, huge number of low cost and low power sensors nodes can easily be deployed in farmlands in order to gather a precise climate data. Moreover, the collected data can be forwarded by Internet connection to the so called cloud IOT framework. In this paper we present a new prototype of late blight prevention decision support system based on sensor network and cloud IOT.

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1. Introduction

Potato late blight has always been the most dangerous disease for potatoes in our regions[1]. Since its appearance, late blight has continued to worry producers. Since the mid 1970s, its impact on crop productivity and quality has been steadily increasing. The disease is declared earlier than in the past, the aggressiveness is higher and the control strategies put in place are regularly exceeded by the scale of the problem. Phytophthora infestans can destroy the foliage in a few days. it can contaminate tubers and make them unfit for marketing: the loss can be complete and

* Corresponding author. Tel.: +21696488622; fax: +0-000-000-0000 .
E-mail address: Foughali.karim@gmail.com

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very quick. To fight this terrible disease, farmers are forced to devote a significant part of their means of production, including the repeated use of phytosanitary products. The economic consequences (cost of products and their application on crops), environmental (risks of drift of fungicidal slurries, quantities and risks of the products themselves), social (time of monitoring and implementation of means of protection by farmers) and societal (image of agriculture damaged by the repeated presence of spraying equipment in the fields) are important It is also necessary to take into account the losses caused to the crops by the mildew in spite of this fungicidal protection. Historically, it has been considered that fungicides are sufficient to control this pathogen, this statement having shown in recent years certain limits, especially during wetter summers or difficult conditions at the beginning of the season (winter without frost, presence of many regrowths in other cultures, problem of piles of sorting gap, ...). The frequency of years with very strong pressures of mildew is higher and higher.

The ever-increasing aggressiveness of late blight populations, coupled with the almost widespread use of susceptible varieties, is leading to serious contamination of crops despite the repeated and massive use of plant protection products. In this context, thanks to the information they integrate , Decision Support Systems (DSS) help farmers implement effective treatment programs.

These allow farmers to increase the effectiveness of control methods without increasing the risks. In other words, the DSS do not systematically seek to reduce the number of treatments but to control the mildew effectively (with a sufficiently wide margin of safety). DSS increases the effectiveness of control methods and can also be used to justify the application of fungicides.

The latter DSS require the collection of weather data from a costly weather station infrastructure or based of historical data. With the climatic change, historical data has become more and more useful in order to a precise forecasting of the climatic condition. Moreover in developed countries we can't rely on weather forecasting infrastructure in order to receive more precise climatic information.

Based on the latter observation the state of art DSS can't be useful in North African countries. The advent of the Internet of Things enabled the interconnection of tremendous numbers of tiny and low cost climatic sensors. This offers the possibility to farmers' community to deploy a low-cost weather station network on their farmlands.

Moreover a new emerged service like Cloud-IOT enables a freely accessible web-service which permits a plug and play of the remotely deployed sensors. The objectives of this study were to develop and implement a Cloud-IOT DSS for late blight enabling the use of location-specific weather data to drive disease forecasters and a mechanistic model of the late blight disease, in order to provide real-time (in-season) support for late blight management.

2. Related works

IOT in agriculture

In order to increase agricultural production, several IOT platforms have been developed for crop monitoring, disease prediction, and control of water consumption in irrigation. In [2] Balamurugan et al proposed an IOT application to control the evolution of temperature and soil moisture from sensor network deployed in the agricultural field using an IOT platform based on Raspberry Pi thus scavenging the analysis and monitoring the data received. In [3] Min-ShengLiao et al have developed an IOT application for monitoring environmental factors in orchids greenhouse agricultural field. This application integrates a system based on the image processing of orchid leaves allowing the follow-up and analysis of leaf growth in real time. In [4] Payero et al proposed a low-cost IOT application for monitoring soil moisture in a wheat field. This system is based on a network of sensors and an IOT platform, the latter displays in real-time the values of soil moisture.

Light blight DSS

In the field of agriculture, several decisions support systems have been implemented to help farmers control their crops and to implement effective treatment programs against diseases specifically against late blight disease. Among them can be mentioned PLANT-Plus[5], MILEOS[6], NegFry[7], ProPhy[8] these models are based on climatic variables to predict late blight and in case of infection, evaluate and measure the evolution of the disease. In our study we will

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