Coffee Leaf Rust Detection Using Genetic Algorithm

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***Abstract*—In Brazil, most of the productive coffee plants is susceptible to rust, a severe disease caused by a pathogenic fungi which attacks the leaves of coffee plants, thus causing a drop in coffee production of up to 45%. To address this problem this paper proposes a genetic algorithm-based solution to identify rust in coffee leaves, thus contributing to a better combat of its fungus and less use of pesticides. We use the genetic algorithm to compute an optimal convolutional kernel mask that emphasizing color and texture features of the fungus infection in the leaf. Comparison with data provided by experts indicated that our approach represents and feasible solution for the problem of identifying rust.**

***Index Terms*—texture analysis, genetic algorithm, coffee leaf rust.**

I. Introduction

According to [1], rust is a severe disease for coffee. It is caused by an endophytic fungus that lives on almost all leaves of adult coffee, especially in older ones. It appears on the underside of leaves as yellow-orange and powdery points, as shown in Figure 1. In Brazil, most of the productive coffee plants is susceptible to rust and if not controlled, it can cause a drop in coffee production of up to 45% [2], [3].

Fig. 1. Coffee leaf infected with rust.

Literature shows many studies evaluating the efficacy of pesticides and alternative products in the fight against rust [4], [5]. However, chemical interventions should be scheduled in advance. In this sense, computational methods play an important role in the task of identification of rust and other diseases that attack the leaf of a plant. The use of image processing techniques can speed up the identification process, detect infections in early stages, or to provide an easy to use system, thus eliminating the need for an expert in the field. In [6] the authors developed a tool for counting insects in rice plantations, obtaining 85% detection. The work in [7] developed a spray robot that uses image processing to detect different types of diseases and to decide which pesticide to apply to the leaf. In [8] is proposed an algorithm for automatic identification of different non-greenhouse insects based on image analysis.

Since coffee leaf rust is characterized as yellow-orange and powdery points we propose a genetic algorithm approach to compute an optimal convolutional kernel mask that emphasizing color and texture features of the fungus infection in the leaf. By applying this convolutional kernel mask, the resulting image can be easily segmented by using a simple threshold to detect rust infection. In order to evaluate our methodology we compared it with data provided by experts and report the Dice coefficient achieved.

The remainder of this paper is organized as follows. In Section II we describe the image dataset used, how genetic algorithm works and segmentation by thresholding. Section III describes how we trained our genetic algorithm to create a convolutional kernel mask to segment coffee leaf rust and the use of Dice coefficient to evaluate results. We report the achieved results in Section IV. Conclusions and future work are presented in Section V.

II. Material and Methods

A. Dataset

For the experiments we collected 159 images from coffee leaves affect by rust. We placed each leaf over a white paper and the image was manually acquired using a Sony Cyber-shot DSC-W210 digital camera with 12.1 Megapixel sensor resolution. The resulting image has 2340×4160 pixels size, as shown in Figure 2(a).

To assess the quality of the segmentation obtained by our approach it was necessary that all points of infection were

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