

Chapter 11

Enhancing the Classification of Eye Bacteria Using Bagging to Multilayer Perceptron and Decision Tree

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ABSTRACT

Eye bacteria are vital to the diagnosis of eye disease, which makes the classification of such bacteria necessary and important. This chapter aims to classify different kinds of eye bacteria after the data were collected by an Electronic Nose. First the Multi-layer perceptron (MLP) and decision tree (DT) were introduced as the algorithm and the base classifiers. After that, the bagging technique was introduced to both algorithms and showed that the accuracy of the MLP had been significantly improved. Moreover, bagging to the DT not only reduced the misclassification rate, but enabled DT to select the most important features, and thus, decreased the dimension of the data facilitating an enhanced training and testing process.

DOI: 10.4018/978-1-61520-915-6.ch011

INTRODUCTION

The eye is one of the main human organs which links to the inner body and is continuously exposed to a harsh outside environment, where it is continually in contact with pathogenic airborne organisms. Although the eyelid may help to protect the eye, the warm, moist, enclosed environment between the conjunctiva and the eyelid also enables contaminating bacteria to establish an infection. The number of organisms responsible for infection of the eye is relatively small but they can proliferate rapidly and cause serious and irreversible damage to the eyes, which makes rapid diagnosis essential. Usually this kind of diagnosis is based on the study of the symptoms, such as changes in bodily appearance, feel, functions and so on. Since different diseases produce distinctive and specific characteristic odors, smelling the bacteria becomes a significant part of diagnosis.

Fortunately, after 20 years of development, electronic noses (ENs) have been very successful in detection applications in the areas of health and safety, and the task of diagnosing medical conditions through analyzing odors. This is because an electronic nose is an instrument, which comprises an array of electro chemical sensors with partial specificity and an appropriate pattern recognition system, capable of recognizing simple or complex odors. Many of the initial applications of ENs were concerned with the detection and classification of bacteria, which suggests that ENs can be used for medical diagnosis purposes in the detection of bacteria associated with eye diseases.

In this chapter, we focus on the use of the Cyranose 320 (Cyranose Sciences Inc.) for the detection of bacteria responsible for eye infections using pure laboratory cultures. This project represents a joint collaboration between researchers from the University of Warwick and Doctors from Heartlands Hospital and Micropathology Ltd., a medical laboratory specializing in the detection of these pathogens (Boilot et al., 2002).

EXPERIMENT AND DATA COLLECTION

Instrumentation

The most common bacterial eye infection is conjunctivitis. Organisms such as *Staphylococcus aureus*, *Haemophilus influenzae*, *Streptococcus pneumoniae* and *Escherichia coli* have been associated with this condition. Although the number of organisms responsible for infection of the eye is relatively small, the damage caused may be irreversible which makes rapid diagnosis essential. Techniques such as neural network based ENs, which can almost instantly detect and classify odorous

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