Scorpions: Classification of poisonous species using shape features

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***Abstract*—All around the world, poisonous scorpions are still considered as a public health issue. The scorpion's species can be determined by its physical characteristics. Different methods have been applied to differentiate among different insects, such as bugs, bees and moths. However, none have been applied to distinguish between different scorpion species. This paper presents a procedure to distinguish between two different species of scorpions (Centruroides limpidus and Centruroides noxius) using image processing techniques and three different machine-learning methods. First, the live scorpion is distinguished from the photograph image using a dynamic separation threshold obtaining its area and contour. A shape vector is obtained from both, area and contour, calculating the following features: aspect ratio, rectangularity, compactness, roundness, solidity and eccentricity. Finally, artificial neuronal network, classification and regression tree, and random forest classifiers are used to differentiate between both species. All three classifiers were evaluated by accuracy, sensitivity and specificity. Experimental results are reported and discussed. The best performance was obtained from the Random Forest algorithm with 82.5 percentage of accuracy.**

***Keywords*—Scorpions, species classification, shape feature, random forest.**

I. Introduction

Scorpions can be found almost everywhere in the world. They are classified in 18 different families and around 1500 species. Only the scorpions from Buthidae family are consider dangerous to people and only 12 species can produce serious envenomation or death [1].

Some of the most dangerous scorpions belong to the Centruroides genus. They can be found in most of the North American continent, especially in Mexico and in the south of the United States of America. In Mexico, the incidence of scorpion sting has reach around 600 stings per 100,000 inhabitants, around 93% of the sting take place in urban cities, however, in small communities the risk is nearly 12 times higher than in the cities [1]. In 2012, the American Association of Poison Control Center (AAPCC) counted around twenty thousand reports of scorpion sting in the USA [2]. In Mexico, the number of scorpion sting reported to the Epidemiology Department was over 300 thousand in 2014 [3]. However, the lethality of the venom differs between different species of scorpions. Thus identifying the scorpions species is important to know how dangerous the scorpion could be to humans. A system that can identify poisonous scorpion could help decrease the risk of fatalities in rural areas.

An identification of poisonous scorpion from a non poisonous can be performed knowing its morphology. For example, venomous scorpion has thick tails and thin pincers, and they are typically light colored (blond). In the other hand, non venomous scorpion have thin tails and broad pincers, and they are dark colored (black).

This paper aims to distinguishing between two different Centruroides species using three different machine-learning techniques. The two studied species are the C. limpidus shown in Figure 1(a) and the C. noxius in Figure 1(b). C. limpidus is typical located in the center and pacific coast of Mexico and C. noxius is located in north of Mexico. Both scorpion belong to the same genus and today the challenge of autonomous system is to identify species from genus [4].

(a) Centruroides limpidus. (b) Centruroides noxius.

Fig. 1. Photographs of the two studies scorpions.

To the best of our knowledge, there has not been any attempt to identify automatically the scorpions species using machine-learning algorithms. However, there are different systems that identify spiders, insects and other animal species.

In the present work, we address the problem of identify two different species of scorpions. Shape features from the contour and area images provide information to classify the scorpions species. This paper proposes a methodology to obtain the most relevant shape features. To validate the approach, experiments are carried out using a set of photographs of living scorpion.

The present manuscript is structured as follows: The initial section deals with a short revision about the related work. Next, an explanation of the implemented methodology. Third, description of the experimental method used for measuring