Computer Vision System to Classify Ships Considering Geometric Properties

Luis J. Flores-Guarneros and Liliana I. Barbosa-Santillán and Juan J. Sánchez-Escobar

Centro de Estudios Científicos Superiores y de Bachillerato High Kipling School, Mexico

Universidad de Guadalajara, Mexico

Centro de Enseñanza Técnica Industrial, Mexico

Abstract - These days, the transcontinental commercial relationships are increasing the necessity of using marine transport media and enhancing the security on board. Due to its huge financial and security consequences, illegal commerce is an important issue to look at. It is important to identify those ships that are not qualified and not have the equipment to be used as a cargo ships. This task could be hard and pricey to be done for Human beings due to the fact it is mandatory to be monitoring and controlling the marine flow all the time. Fortunately, computer vision has been developed as a powerful tool to help human beings in several tasks, which imply to use a censorial mechanism of perception to process information from the scene. In this context, computer vision can improve human capabilities of recognition trough image processing. This method increase the amount of information processed lessening the difficulty and the cost of carrying it out. Besides, it avoids the necessity of having a human being to monitor and develop the recognition process. In this work it is proposed a system using computer vision algorithms to process and prepare the image to go through a Procrustes analysis in order to classify ships and identify which are being used illegally as cargo ships. The Procrustes analysis is focused on study the relation between geometric measures of an object to classify it. The attempt to implement this theory as a recognition algorithm in the system fits good because of the security guidelines of the case. This work is in progress but the first part shows acceptable results about the implementation of Procrustes analysis theory to create a recognition algorithm.

Keywords – Computer Vision, Geometric Properties, recognition algorithm.

I. INTRODUCTION

Computer vision is a science focused on the development of automatic systems to simulate the biological visual perception system (F.Schenk, 2002) (H.Sossa-Azuela, 2013). The principal purpose of this science is to allow machines to make decisions recognizing and identifying objects around them. The computer vision systems are based on algorithms to analyze information extracted from digital images. These algorithms can obtain information about physical and structural characteristics such as the shape, the color and some metrics. Computer vision systems are used in many different sciences to help scientists to make and to support decisions. The results of a shape analysis could diagnose a disease, confirm the identity of a person or classify a group of products.

Port security is a International Maritime Organization (IMO) mandate in the format that The International Ship and Port Facility Security Code (ISPS) code provides a standardized, consistent framework for managing risk and permitting the meaningful exchange and evaluation of information between contracting governments, companies, port facilities, and ships. On the increase of imports and exports in the world, the handling of goods via sea has grown exponentially. For example, by comparing the costs required to improve the transit of shipping between sea and air. We find that these are doubled in a factor 1 to 12 resulting in really costly decisions.

During the 2017 it required 17 % assemblies sent from aerial form that represented a significant decrease in the total expected gain. Since it is worth mentioning that even being only 17 % of all the material acquired at the level of transport costs. Its impact us an expense above the expected higher than 90 %, almost double was spent only on air shipments against the rest of the shipments. The taxonomy of the boats and by their measures can identify what type of ship it is. For example: container ships, bulk carriers, oil and chemical tankers, gas carriers, passenger ships, offshore service vessels and tugs, yachts, dredgers, fishing vessels, navy

 DOI : 10.18231/2454-9150.2018.0933

ships, cargo ships, roll-on, roll-off ships, inland navigation vessels and so on. Recognizing the ports are rules for pleasure boats Which are very different from those of cargo ships. So, identifying a satellite vessel according to its geometric properties can indicate if a fishing boat is in a protected area or if a cargo ship is on a beach of pleasure.

In computer vision, there are some techniques to analyze the morphological structure of an object so that is possible to classify it by considering only its shape. Some other authors explain the necessity of applying quantitative methods (based on metrics) to get accurate results. Procrustes method as a quantitative theory for shape analysis shows the benefits of its implementation in the general image identification process. Thus the present work defines the guidelines to develop a shape analyzing system to get a correct pattern recognition and classification of ships by considering geometric properties. The system will implement computer vision algorithms to process 2D digital images of ships and to approach the aim.

II. System to Classify Ships Considering Geometric Properties

An abstraction of the general image processing methodology could be appreciated in the diagram of Figure 1. This methodology defined the order in which different algorithms should be implemented for the recognition process (Trembley & Manohar, 2002) (Cuevas, 2010) (Pajares & de la Cruz, 2002). For this reason it could be used to guide the research approach presented in this paper. The final phase is related to the recognition process. Once the landmarks have been located, a recognition algorithm is trained to recognize the patterns and classify the images into different groups. At this point is where the algorithm based on Procrustes analysis will be implemented to have a reduction in the time wasted in recognition process. Procrustes analysis is based on the calculation and modification of an index called "centroid's size", which helps standardizing the metrics of an object depicted on an image before starting a metrical shape analysis (Toro-Ibacache, Manriquez-Soto, & Suazo-Galdames, 2010) (Torcida & Perez, 2012). This index could be estimated by using equation 1, where all d_i are the length of each diagonal formed from the centroid to each key point.

$$SC =) d_i^{\,2} \; i=1$$

Sample images

As mentioned before, the principal aim of this work is to verify the results of the object classification based on the shape by applying Procrustes analysis. To accomplish that aim two sets of images were selected, but the only condition to apply this technique is to have shape patterns for object recognition. The first set of images was used to create a system to identify and classify cargo ships to help with the monitoring and security tasks by analyzing pictures taken via satellite. This system should have considered the metrics internationally established. The second set includes images of basic geometric figures (squares and rectangles) with controlled conditions about colour intensity. The second set only had the purpose to validate the application of Procrustes analysis for shape classification.

III. Results and Discussion

Considering the general photo-identification process shown before, the images of cargo ships go through out a pre-processing to adequate each image to get a good segmentation process and finally get the key points used by the algorithm to implement the Procrustes analysis. In Figure 2 are shown the results obtained in each stage of the process before the recognition. The set on geometric figure images was used to validate the implementation of the Procrustes analysis algorithm. Figure 3 shows the pattern generated by the algorithm based on the geometric information of each figure, which is used to train a basic classification algorithm. The results of the classification process implementing the Procrustes analysis are shown in Figure 4.

References

[1] Cuevas, E. (2010). Procesamiento digital de imágenes con matlab y simulink (1st ed.). Alfaomega.

[2] F.Schenk, T. (2002). Fotogrametría digital (1st ed.). Marcombo. H.Sossa-Azuela, J. (2013). Visión artificial (1st ed.). Ra-Ma.

[3] Pajares, G., & de la Cruz, J. M. (2002). Visión por computador (1st ed.). Alfaomega. Torcida, S., & Perez, S. I. (2012, December). Análisis de procrustes y el estudio de la variación morfológica. Revista Argentina de Antropología Biológica, 14 (1), 131-141.

[4] Toro-Ibacache, M. V., Manriquez-Soto, G., & Suazo-Galdames, I. (2010). Morfometría geométrica y el estudio de las formas biológicas: de la morfometría descriptiva a la morfología cuantitativa. Int. J. Morphol., 28 (4), 977-990.

[5] Trembley, J. P., & Manohar, R. (2002). Matemáticas discretas con aplicación a las ciencias de la computación (1st ed.). CECSA.

Acknowledgment

This work has been supported by the Sciences Research Council (CONACyT) through the research project number 262756 called "The use of GNSS data for tracking maritime flow for sea security".

 DOI : 10.18231/2454-9150.2018.0933

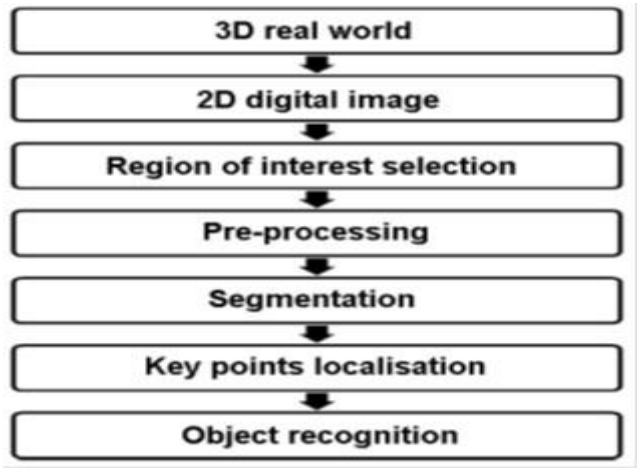

Figure 1. General image-processing methodology

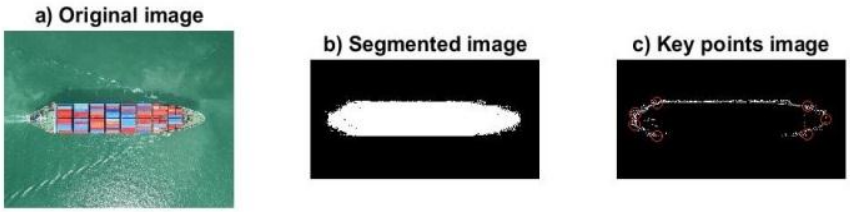

Figure 2. General photo-identification process applied to cargo ships images.

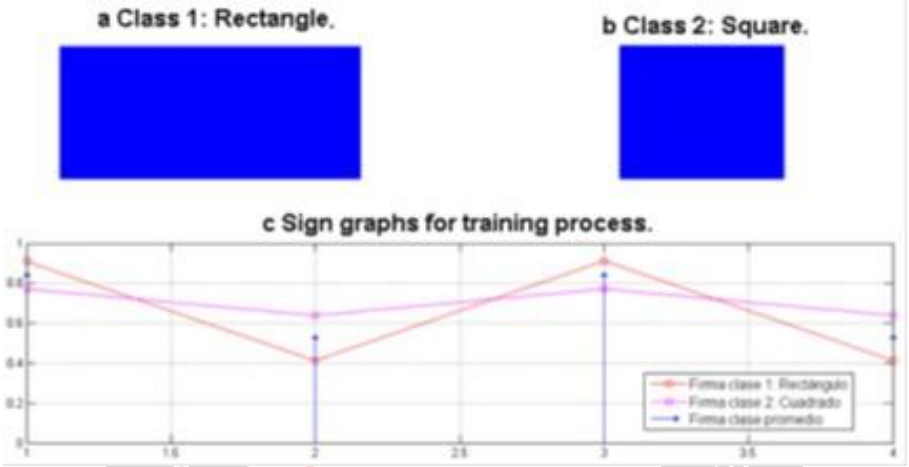

Figure 3. Income information for classification process and generated patterns for each

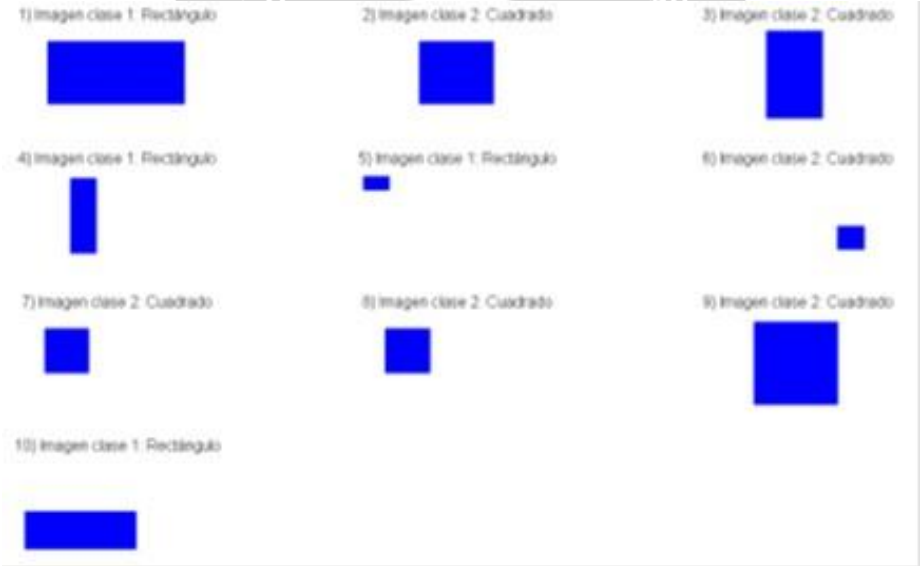

Figure 4. Results and images of classification process

 DOI : 10.18231/2454-9150.2018.0933