Methods of Semantic Integrity Preservation in the Pattern Recognition Process

Iuliia Kim, ITMO University, Saint Petersburg, Russia
Anastasiia Matveeva, ITMO University, Saint Petersburg, Russia
Ilya Viksnin, ITMO University, Saint Petersburg, Russia
Roman Patrikeev, ITMO University, Saint Petersburg, Russia

ABSTRACT

In this article, much attention is paid to pattern recognition quality, especially the visual information semantic integrity preservation. The main purpose is to find the ways of its possible improvement to the three basic stages of the pattern recognition process: image preparation, image processing, and classification. To avoid semantic integrity violations of information, in the initial stage of the image analysis, normalization is proposed. In the second stage, a new clustering method was developed, based on particle swarm optimization and the k-means algorithm. In the final stage of the pattern recognition process the Haar classifier was used with normalized training samples. The proposed algorithm and only Haar classifier with non-normalized samples were tested on 500 blurred images: in 8% of samples both algorithms provided semantic integrity preservation and in 64% only the developed algorithm worked effectively.

KEYWORDS

Computer Vision, Information Security, Particle Swarm Optimization, Pattern Recognition, Semantic Integrity

1. INTRODUCTION

The field of machine learning, despite its recent appearance, has already spread in many aspects of human life, such as medical and technical diagnostics, augmented reality development, speech recognition and computer vision. This article is going to focus on computer vision, namely, pattern recognition and problems connected with its quality.

Computer vision is a wide area of theoretical investigations and technical methods connected with visual information processing for object detection, object tracking and object classification; it is a discipline studying the ways of obtaining and analyzing information from images. Computer vision is considered as one of the most prospective directions in the technical developments. It found an implementation in the field of sports (Thomas, Gade, Moeslund, Carr & Hilton, 2017) and assistive technologies (Leo, Medioni, Trivedi, Kanade & Farinella, 2017), namely:

- Elaboration of socially assistive robots for supporting peoples’ mental functions states computer vision tasks to make these robots able to adapt to various situations and react to surrounding changes;
- Computer vision techniques were used during the development process of intelligent wheelchairs;

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Computer vision is involved in the area of prosthetic limb control, which intends to use visual information recognition in order to select orientation, grasp shape, and size of the manipulated object.

Computer vision is able to automate and accelerate processes, for instance, production, transportation, monitoring, etc. In the epoch of high-level Industry 4.0 development, this field becomes more relevant, especially in the context of elaborating unmanned elements: robots, drones, vehicles. Computer vision was implemented for unmanned drones for landslide monitoring (Lucier, Jong & Turner, 2014). Their systems use SfM (Structure from Motion) algorithms and image correlation for accurate result provision.

Plans dedicated to unmanned vehicles are being developed actively and are on the verge of integrating it into the everyday life of society. For instance, project Spirit of Berlin was started in 2007 at the Free University of Berlin. As a base, it uses the car model Dodge Caravan. The car body is equipped with a GPS system and lasers that fix objects at a distance of 150 meters. In order to clarify the car position, the Kalman filter is used. Spirit of Berlin also builds the environment model with help of laser scanner, and this model is used for the further decision-making process based on the existing systems’ knowledge. The cars use general and omnidirectional cameras in analyzing road marking and surrounding objects. Two codirectional cameras are responsible for forming a stereo image of the environment. In the process of image recognition to extract object limits, the Sobel operator is used. After that, the obtained image is converted into a black and white format, which reduces the size of consumed memory and increases information processing speed. The car has two onboard computers, which cooperate with each other by dint of Ethernet communicators that raises system’s fault tolerance. One of the shortcomings of the project consists in the case that the image recognition algorithm does not work effectively if the road marking is not clearly notable.

In Italy a commercial project ARGO dedicated to the development of a car unmanned management system was initiated. A new prototype of car body equipped with cameras was created. The model focuses on using only two codirectional cameras in cooperation with board computer in order to minimize the costs for future users. The developed system proposes three work modes:

- Manual management, when the devices only track and store driver’s actions;
- Supervised management, which is intended to provide automatic driving except for emergency situations;
- Automatic management, when the car is completely under system control.

During car movement images obtained from the cameras are combined and then converted to binary format. Before the image is used for trajectory construction, noises and distortions are filtered. In case of visual information partial loss, the system analyzes previous stereo images and tries to recover missing details. A relevant disadvantage of the elaborated system is that it is rigidly tied to the recognition of road marking and asphalt roadway presence. It is not adapted to the conditions of road impassability.

The purpose of developing a car model, which does not depend on road and weather conditions, is pursued by Italian company VisLab. The essential otherness of its project consists of the need in presence of one manually driven vehicle. Autonomous cars are able to follow that vehicle, but they cannot move independently. Such a system can be useful in case of movement in organized columns. The cars are provided with cameras, detectors, scanners and sensors for getting information about leading car and environment. To process the acquired data each car system includes three computers: the first one is responsible for global positioning and routes constructing, the second – for analyzing data from panoramic cameras and laser sensors, the third – for the rest of the cameras. The developed system is able to tune detectors automatically according to current conditions of the environment.
Mining of Leaders in Mobile Telecom Social Networks
Mantian (Mandy) Hu (2017). *Big Data Applications in the Telecommunications Industry* (pp. 68-77).
[www.igi-global.com/chapter/mining-of-leaders-in-mobile-telecom-social-networks/174277?camid=4v1a](www.igi-global.com/chapter/mining-of-leaders-in-mobile-telecom-social-networks/174277?camid=4v1a)

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