Abstract

Nowadays, more and more object recognition jobs are solved with Convolutions Neural Networks (CNN). Because it deals with fast recognition and execution speed, accumulative neural networks have advanced most computer vision tasks, both existing ones, and new ones. In this article, I propose to implement a traffic sign recognition algorithm using a convolutional neural network. The paper also shows several CNN architectures, compared with each other. Nerve training networking is done using the TensorFlow library. The entire traffic sign detection and recognition process are done in real-time on the GPU. Test results confirmed the high efficiency of the developed computer vision system.

1. Introduction

The processing speed of modern microcontrollers has allowed many car manufacturers to install computer vision systems in cars. These systems greatly improve safety and take an important step on the road to autonomous driving. Among other tasks to be solved by computer vision, the traffic sign recognition (TSR) problem is one of the most well-known and is of interest to many researchers in the development and research. apply into reality. However, the main problems of these systems are the low detection accuracy and high requirements for hardware computing performance, as well as the inability of some systems to classify traffic signs from different types of traffic in different countries.

The identification of traffic signs is usually solved in two steps: identification of the sign area and identification of the sign type. Have various localization methods. I propose to implement traffic sign localization and image preprocessing algorithms, done in real-time. Therefore, in the classification phase, a simple pattern matching algorithm was used. Combined with the localization stage, this algorithm results in an end result of 82% accuracy of traffic sign recognition. The dataset from the traffic set is used to train and test the developed algorithms.

While testing the technology developed to detect and classify traffic signs under real-world conditions, i.e. using video from the camera installed on the windshield, the terminal technology shows a significant reduction in efficiency. Studies have shown that such a reduction arises due to drastic variations in the brightness as well as the noise of the captured camera image. Contrast and rotation in images of localized traffic signs. Therefore, a simple classification algorithm like pattern matching cannot achieve high-quality recognition because of a limited set of predefined templates. To improve system performance, the algorithm that gives good results can be combined with recognition using convolutional neural networks has been widely applied in recent years.

In this paper, we describe a modified front-end technology for real-time detection and recognition of traffic signs. The system was developed using the speed received from the camera placed on the vehicle. This allows predicting not only the presence of object but also its exact scale and coordinates in the neighboring frame. Therefore, the accuracy of detection increases, while the computational complexity remains the same. The classification of localized objects implemented using a built-in neural network (CNN). One of the dominant ideas in this post is the description design process for a convolutional neural network. The use of GPU enables real-time processing frames in the video sequence.

2. Traffic Sign Position and Tracking

The technology developed for traffic sign recognition consists of three steps: preprocessing, localization, and classification. During image preprocessing, the HSV color space is used to extract red and blue pixels from an image. Because of errors in image acquisition and the presence of small colored objects, some spot-like noise occurs in the image when applying a threshold filter. Within the scope of this research paper, we do not talk too much about this color space because it is so superior and appropriate that has been proven by many previous studies. GPU, the acceleration speed reaches 60-80 times compared to the norma execution on the CPU. Frame size is 1920x1080 pixels. Using a GPU allows for one video frame within 7-10 ms, meeting the requirement of real-time video processing. This is one of the key points and needs to be focused on to achieve high-speed processing. The localization method is a modified general Hough transform, which has been developed considering time constraints for handling a single frame. The algorithm renders the results efficiently and works well with pre-processed images. Tracking using the vehicle's current speed value improved the system's performance, as the search area in adjacent frames can be significantly reduced. Classification, is the last step, make sure that the whole process has been done successfully.

3. Traffic Sign Classification

3.1. Convolutional Neural Networks

Classification by artificial neural network is a very popular approach to solving predefined pattern recognition problems. A neural network is a mathematical model based on the connection through neural units together - artificial neurons - inspired by biological neural networks. Normally, neurons are organized into layers, and connections are established between neurons only from adjacent layers.

The input low-level feature vector is fed into the first layer and, moved from layer to layer, converted to a high-level feature vector. The number of neurons of the output layer is by the number of classifiers of the output classes. Therefore, the output vector is the probability vector that the possibility that the input vector belongs to a corresponding class.

3.2. Proposed Implementation

To solve the traffic sign recognition task, we used the TensorFlow deep learning library. Training and testing were implemented using the data set from the transport ministry. The developed method can classify the 27 most common types of traffic signs. There are some rules about how to build a network architecture. Even so, the network architecture design process is mostly neural. The layers are selected in such a way that the data size is reduced from layer to layer. But without any stipulation about class-specific macro parameters.The depth of the network should correlate with the amount of data. Huge network and scarce data will probably create too much model.

4. Conclusions

This paper considers the implementation of the classification algorithm for the task of recognizing localized traffic signs in Vietnam. Combined with the optimized steps from previous methods, the proposed method for traffic signs. The classification gives very good results: 85% of the images are classified correctly. The proposed classification solution is implemented using TensorFlow library. The use of my TSR algorithms allows the processing of video streams in real-time with high resolution and thus at longer distances and with better quality than similar TSR systems on the current market. The developed method is performed on a device with a high-speed processor.