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DISTRIBUTED COMPUTER VISION SYSTEM - THE THEORY AND AN IMPLEMENTATION

Abstract: This paper describes the principles of distributed computer vision system design. Required and recommended data manipulation techniques are also briefly described.

Nowadays, computer vision systems still consume a lot of the precious mobile robots' CPU time. Unsupervised learning is still unreachable for machines. Using a computer cluster as an enhancement of robot's „intelligence" could solve this problem, but the input data of robot's vision system, i.e. images from its camera, produce extremely high volume of the traffic. No parallel algorithm could manage it.

For this reason, a new image manipulation technique was developed and a set of practical experiments was conducted.

The input video frames were converted [1] using DWT transform in a similar way to JPEG2000's image conversion guidelines. Constant value of the threshold parameter was replaced with a function defining its value [1] (an approach named POI – Point-of-Interest). The "DWT, POI"-converted images are additionally compressed using RLE (Run-Length Encoding) and entropy-coding [2] for better use of zeroes appearing in the coefficient matrices after the DWT transform. The proposed image manipulation procedure gives relatively good results by affecting the communication time of sending a video frame to a remote cluster node. The execution time of a single "MPI_Send()" function on average took 20 ms [3] for uncompressed raw data and 0,5 ms for the proposed data representation [3].

Implementing the proposed in [1] POI conception is appropriate only for selected AV-based vision systems (Active Vision). Any other vision processing algorithms may require the image to be of the highest possible quality.

As usually in AV-based systems, it is necessary to modify the location of the area of interest (in this case – the coordinates of the POI) in order to analyze larger area of the input image.

Unlike in all known AV-based systems, the new POI coordinates are passed as a feedback signal from high-level and mid-level recognition layers of the image understanding algorithm. All participating parallel image recognition/ /understanding procedures can request any new POI coordinates and the input node's POI algorithm manages the requests and defines a new POI coordinates.

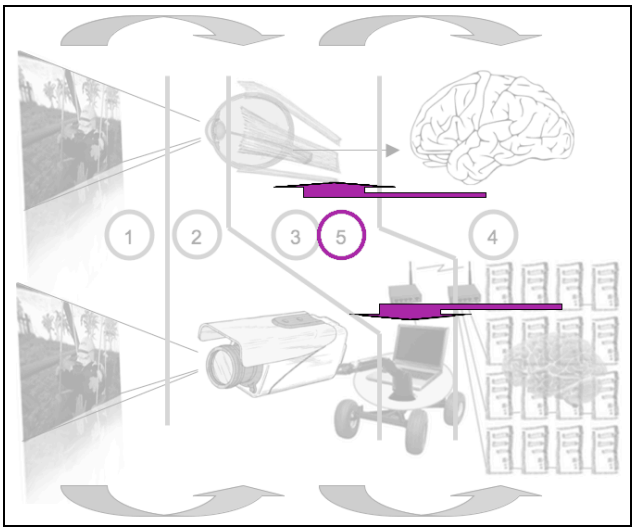

Fig. 1. The feedback of the proposed virtual saccades control algorithm

The idea of artificial yellow spot presented in [3] significantly reduces data size while preserving the highest possible image quality in the Point-of-Interest area. The control system for virtual saccades proposed in this paper becomes the basis for all image manipulation and image understanding algorithms. This in turn enables the possibility of using a computer cluster for computer vision purposes – a distributed computer vision system.

REFERENCES

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