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An improved algorithm of median flow for visual object tracking and its implementation on ARM platform

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Abstract An improved algorithm of median flow used for visual object tracking is described. The improvement consists in adaptive selection of aperture window size and number of pyramid levels at optical flow estimation. It can increase the tracking efficiency as compared to the basic algorithm, especially when dealing with small and low-contrast objects. The proposed version of the algorithm has been implemented using OpenCV library and tested on OMAP 35x EVM and BeagleBoard-xM based on Texas Instruments OMAP3530 and DM3730 processors, respectively. Analysis of improved median flow was performed over actual video sequences. The results obtained show versatility and computational robustness of the algorithm, which makes it promising for embedded application based on ARM processors.

Keywords Object tracking · Optical flow · ARM implementation

1 Introduction

Nowadays the visual tracking algorithms are widely used in human–machine interfaces (to control a computer by means of gestures), in videoanalytics (to follow the object automatically keeping it in view of the camera), in driver assistance systems (to monitor the road situation to prevent traffic accidents), in robotics (to track the surrounding movable objects and provide the robot with adaptability to a changing environment) etc., which points to importance for further research in this field. It should be noted, however, that in the above applications we often have to seek for trade offs among reliability, operation speed, power consumption, size and mass, or cost of the whole system. The man–machine interfaces, for instance, are in large demand for modern multimedia systems—widely produced and, hence, not too expensive. As for vehicle, airborne, or robotics equipment, the main requirements here are power consumption and weight. Unfortunately, the general-purpose computers are rather expensive, heavy, power-consuming (which may lead to overheat), and hardly suitable for such applications.

Thus, the implementation of tracking system algorithms becomes of particular interest in a low-cost and reliable embedded processors and systems-on-chip (SoC). The most widespread hardware of this type is the processors based on ARM platform. Nowadays, this platform has become typical for smartphones, tablets PCs, smart TVs, and is being introduced into other electronic devices. In this connection, the paper is devoted to investigation of ARM platform. Unfortunately, its computational capabilities of modern systems-on-chip are often insufficient for implementation of some complex algorithms. For example, the well-known robust algorithms such as ensemble tracking [1, 7, 2], approaches based on support vector machine (SVM) [16], on principal component analysis (PCA) [12], or on special features of SIFT [11] and SURF [3], are able to run in real-time only on modern powerful desktops. At the same time more fast algorithms are less reliable and therefore, are less universal under certain conditions. For example, Camshift [4] works well only on color videos. Thus, development of reliable and fast tracking algorithms still remains an open problem.

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