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"Efficient Event Driven Sensing in WMSN Using Zernike Moment"

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Abstract

Image based sensing in wireless multimedia sensor network (WMSN) is mainly depend on the capability of the deployed scheme to ensure low-power consumption. In depth, the approach of periodic image transmission to the end user, even after compression, will shortly exhaust the energy of the sensors and dramatically reduces the network life time. Thus, detecting an event of interest and extracting the useful information's to decide at source node will avoid flooding the network with unusable data and contributes to extend the whole network life-time. The efficiency of this approach for image-based sensing, in severely resource-constrained sensors, heavily depends on the complexity of the designed sensing scheme.

The main contribution of this paper is to present a low-complexity scheme using Zernike Moment to detect a new object and to recognize the appearance of a specific target before sending a notification to the end user. The paper presents the specification of the proposed scheme and its implementation on wireless multimedia sensors. It addresses the performance's evaluation in terms of time and energy consumption. The results show the high accuracy of the proposed approach to efficiently recognize the target and notify the end user with interesting performance that overcomes the efficiency of other similar sensing approaches proposed in the literature.

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Keywords: WMSN, multimedia sensing, object recognition, low-power.

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1. Introduction

Wireless Multimedia Sensor Networks (WMSN) represent an extension of the scalar sensing in Wireless Sensor Networks (WSN) to enable capturing, retrieving, and processing in real time the multimedia information. The design of WMSN is influenced by many factors such as: sensors energy and resources, Quality-of-Service requirements and highly bandwidth demand[2].

Tracking and monitoring target based on multimedia streams need a highly data volumes for processing and transmitting which hazard the energy saving. As a result, power conservation is the main concern for designer of these applications since the energy consumption is proportional to the size of the transmitted data.

Obviously, compression techniques has a significant impact on the reduction of data stream. However, these compressions techniques were reported to be complex and not adequate for low-power processing. Another approach is to reduce the power consumption by reduce the size of transmitted data stream in WMSN. This accomplish by determine at sensor node whether the captured image contains phenomena that would be of interest to the end user or not. This approach would not only reduce the power consumption at the source mote, also it promise a highly impact to significantly unloading the network from useless information.

However, the viability of this approach depends on the efficiency of the scheme that is implemented to process the image at the source sensor. Therefore, a big research effort is required to design a low complexity scheme that is appropriates for sensors capability.

Thus, the main contribution of this paper is to present a new scheme for sensing with multimedia capabilities. The proposed image sensing scheme is based on the idea of event detection before data communication using Zernike moment. The novelty of this scheme is to reduce the communication overhead and per-node power consumption while ensuring efficient notification to the end user. The paper focuses on the specification of the new sensing scheme for target detection and recognition. It addresses performances to this scheme for efficient detection and low-energy processing. Comparison with related solutions shows the powerful of the proposed idea.

2. Related Works

In literature there are many contributions that addressed the design of efficient low complexity techniques for object recognition. Yang et al[7], classified approaches of shape-based feature's extraction and representation according to their processing methods. Different functions were presented such as: One-dimensional function for shape representation, Polygonal approximation, spatial interrelation feature, Moments, Scale space approaches and Shape transform domains. In this survey, the Moments techniques were described to be very efficient and accurate for object recognition. Different other research contributions attested about the efficiency of using Zernike moment for feature's extraction and for enhancing the accuracy[4, 27]. Bashkara et al, presented in[11] a framework using the Zernike moment to extract feature of Telugu characters in scanned OCR document then he compare it to feature extracted using Hu moments. Also Karbhari et al, [12] have proved Zernike moment efficiency in detection for Marathi language script. An interesting work was presented by H. Marouf et al[13]. In their approach, they enhanced the face recognition system to find identical twins. The presented method is based on Zernike moment applied with AdaBoost method to detect the face location. In this work, a face recognition scheme based on Zernike moment and Hermite Kernels to cope with facial expressions was developed. The results have shown high ratio of successful identification. X. Yuan et al[15], presented an excellent digital image watermarking scheme based on feature extraction and local Zernike moment transformation. They applied their scheme to images decomposed into binary patches. The presented approach have shown interesting results when tested for geometric distortion and rotation. In M. Hitam et al[16] and Oluleye et al[17], prove the efficiency of Zernike moment as feature extractor method for image retrieval. In their experiment, they have concluded that Zernike moment is fast computed and proves highly capability of object identification.

In the context of wireless multimedia sensor networks Belongi et al. [18], presented a simple and accurate scheme for object matching based on distance between shapes while Vasuhi et al [19], used the Haar wavelet for object feature extraction. In both works, they did not addressed the power consumption. Zuo et al[20], presented a distributed two-hop clustered image transmitting scheme. Their method is a trade-off between computation and processing load