EXCELLENT PUBLISHERS

International Journal of Current Research and Academic Review

ISSN: 2347-3215 Volume 2 Number 10 (October-2014) pp. 12-16

www.ijcrar.com

Multimedia Sensor Networks with Clustered Hierarchical Data De-duplication

E.Shailini[1*] and V.Gopinath[2]

Department of CSE, Ramachandra College of Engineering, Vatluru, India

Corresponding author

KEYWORDS

Clustering, De-duplication, Framing, Surveillance systems, Unsupervised classification

A B S T R A C T

The ever-increasing importance towards observation of objects in various applications has made the researchers to contribute for the needs of effective object tracking and surveillance. Lot of focus is made into the wireless sensor network based automatic surveillance systems to cater the needs of hazardous application fields where human intervention is risky. The literature in this domain portrays various approaches to cater the needs of respective applications. With the miniaturization of electronics and sophisticated communication systems, an on board video recording systems are available off the shelf. The nodes mounted with the video recorder are deployed in an adhoc manner in the application field area. Better surveillance is possible with continuous video recording in the field area. The main challenge is to handle the amount of data generated in view of resource constrained wireless sensor networks. We have proposed a novel approach by framing and de-duplicating the recorded video in order to decrease the transmission overhead as well as storage space at the application sinks with the help of Independence Test.

Introduction

Traditionally, wireless sensor networks are meant for capturing the localized information of a particular scenario, monitoring physical or environmental conditions such as temperature, sound, pressure, etc. In the due course of time the scope of wireless sensor networks is increased many fold. Its applications range through defense, industrial automation, environmental monitoring, healthcare monitoring, personalized civilian applications, visual surveillance for automatic object detection, such as real-time traffic monitoring, vehicle parking control, intrusion detection, and so on. With the miniaturization of the electronics and the sensing elements, the sensing capability of the building block of the sensor network is increased in many dimensions. Many commercial nodes are available with sophisticated wireless routing protocols, plug and play options with multiple sensors on board, wide increase of communication and computation capabilities in concurrence with miniaturization.

With the advent of new routing protocols and communication interfaces now the sensor networks are becoming an integral part of the internet work increasing the scale of wireless sensor networks. The modern sensor networks are bi-directional, also enabling control of sensor activity. For surveillance and tracking we need sensor nodes capable of recording video and audio. These sensor nodes consisting of camera and audio recording facility, etc., will be generally called as multimedia sensor nodes. The very nature of this kind of multimedia data will be different from the traditional sensor data. The characteristics such as storage requirements, computational complexity and transmission over head, power requirements, and bandwidth requirements will be different from normal sensor data. Some literature is available on handling this kind of data in wireless sensor networks. Still we have to probe into many research problems to cater the needs of emerging wireless sensor network application areas. Fundamentally, we need to concentrate on reducing the redundancy in the source data at the field sensor nodes where the multimedia data is generated (Akyildiz *et al.*, 2007). We need to develop a network model which consist additional capabilities. The data in-network processing technology (Al-Karaki *et al.*, 2009; Yang *et al.*, 2013), as one of the key technologies used to save bandwidth and network energy in data-centered WMSN, can eliminate the redundancy of source data and minimize the data traffic between nodes by applying data fusion technology or data compression. The data fusion technology uses different routing methods to combine data packages and eliminate redundant data from them. This technology relies on three basic modules: routing algorithm, data fusion, and data presentation (Al-Karaki *et al.*, 2009). However, in addition to the advantage of high data aggregation, the application of data fusion technology may also lose raw data structure, while data compression can prevent this problem. Data compression has been applied to WMSN, and the compression algorithm can be divided into two categories: distributed data compression scheme and local data compression scheme.

In our approach, we have considered the adhoc deployment of the wireless motes having the self mounted video recording system. Instead of streaming the recorded video to the sink node, at regular intervals the recorded video is sliced into several frames using decision based framing approach. In this, during the selected time boundary the video is converted into numerous number of image frames. Each frame is inspected for a variation with respect to other frames and a reference is established instead of transmitting the complete frame again. In a second step, the images which are dissimilar to each other are also made into small chunks and verified for the similarity again. The reference index is developed for the duplicate chunks instead of transmitting the same chunks repeatedly. This phenomenon can be treated as in node de-duplication. Further the same task is performed at the cluster head for de-duplicating the data without loss of generality. This can be treated as in cluster de-duplication. The third level of de-duplication is performed at gateway nodes called in network de-duplication. Since the huge amount of data is collected at the sink node, we can make use of the data storage to handle huge data. The traditional de-duplication approaches are used to de-duplicate the data at the data storage without loss of generality.

In this paper, we introduced Independent Test on Frames in Section I. Nomenclature of Tracking Frames in Section II. Multimedia Sensor Networks with Clustered Hierarchical Data De-duplication approaches in the section III. The Section IV deals with the experimental results of the proposed system are highlighted. Finally, the conclusion and future perceptive are discussed in Section V.

Independent test on frames

Let X is a normal random vector. The components are independent if they are uncorrelated. i.e.., Cov(X_i, X_j) =0 then they are uncorrelated so the two components X_i and X_j are independent.

In this paper we used this extraordinary property in the following two cases:

1. We have to compare all shapes of frames and check whether all are belongs to one input image or not. In this case if they are not uncorrelated then all shape of frames belongs to one particular frame. i.e., Cov(X_i, X_j) $\neq$ 0 and X_i, $X_j \in$ C (X_i, X_j are from shapes of frames) so that means they are not independent, which means that which have relation between these shape of frames.

2. After succeeded from step 1, among all shapes of frames we have to test which shape is a match with the input frames. In this case we have to test the independency property between input frame and the shapes of images. i.e.., Cov (X_i, X_j) $\neq$0. Here if we find any one of the shape is not independent to input frame, which means it is the target inference for the input frame (Fig. 1).

Fig.1 Tracking object frames

Nomenclature of tracking frames

The video recorded by the nodes is considered as the input data set and the frames are generated within selected time duration. The frames generated should be classified for the purpose of identification of the duplicate images. We have identified the dissimilarity based image selection is the suitable approach. Here we have applied for Instance, a set of dissimilarity pairs D = {(i, j). For (i, j) $\in$ D, the two points xi, xj may be both unlabeled, or one labeled and the other unlabeled.

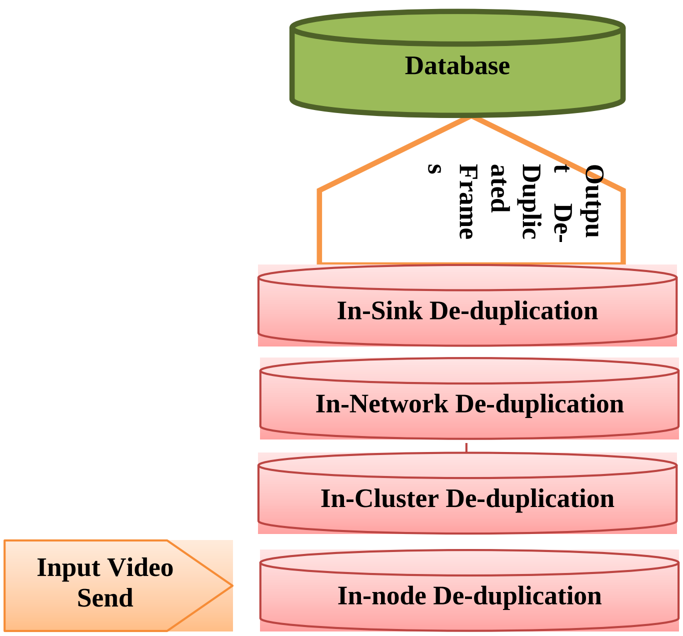
Frame work for the de-duplication process

After the conversion of frames the redundant frames from the frame pool has to be removed by forming the reference pointers to the existing frame without loss of generality. The frames are to be compared with each other in order to eliminate the redundant frames from the pool of frames obtained after slicing the video.

In view of the resource constrained wireless sensor networks the de-duplication process is performed at all levels of the network hierarchy in order to decrease the transmission overhead and minimize the storage requirements at all levels of the hierarchy. The de-duplication is performed by using both the similarity based and dissimilarity based approaches at appropriate places of the network hierarchy.

More over the image data is not transmitted from one level of hierarchy to the other level, instead by using finger print pre transmission technology we will generate a digital signature for the image chunks made at the node level and they will be transmitted for the comparison purposes at various levels of the hierarchy (Fig. 2).

Fig.2 Frame work for the de-duplication process



The image processing techniques will aid in forming the chunks of images and clustering the images into approaches using maximum likelihood techniques to find the similarity between the chunks. We will implement the multivariate analysis to verify the dissimilarity among the set of cluster images. By performing this task at various levels we can achieve lot of energy conservation at all the levels of the network hierarchy.

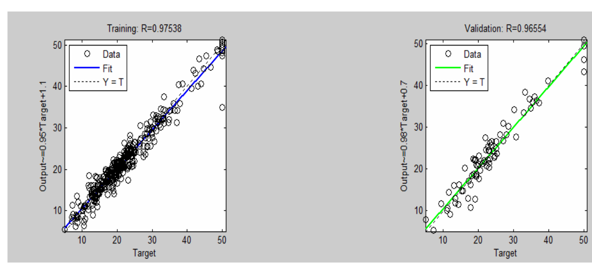
Further because the sensor networks are wireless and bandwidth constrained, our approach will help to decrease the traffic and the congestion in the network. We have performed the traffic analysis using existing patterns and evaluated the congestion rate in the network. The storage requirements of the nodes are very less because we are not transmitting the complete image, instead we are using the digital signatures of the chunks of images to evaluate the similarity and dissimilarity among the images.

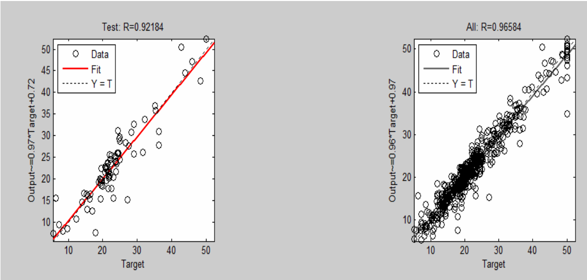
With our consideration of the recorded video as the input dataset instead of the set of images taken rapidly we are able to achieve the continuous monitoring of the sensor field area of any surveillance application and also a particular object detection system. With this the accuracy of the application monitoring can be drastically increased. The de-duplication ratio is evaluated for the data set obtained in the overall network.

Experimental Results

The experimental results produced on video sequence of frames, the correlation frames. In this regard, Regression R Values measure the correlation between outputs and targets. An R value of 1 means a close relationship, 0 a random relationship (Fig. 3).

Fig.3 Sequence of frames regression rate





Conclusion

In this Paper, to handle the amount of data generated in view of resource constrained wireless sensor networks. The proposed a new approach by framing and de-duplicating the recorded video in order to decrease the transmission overhead as well as storage space at the application sinks with the help of Independence Test. The Regression Test conducted on Frames.

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