An Energy Efficient Distributed Algorithm for Image Slicing in Wireless Sensor Networks

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***Abstract*—We propose and implement a distributed algorithm that removes redundancies in images viewed by multiple camera equipped wireless sensors. Nodes accept requests from observers and run the algorithm if they are viewing the requested area. The scheme removes all redundant pixels, compresses the image using a publicly available algorithm called SCZ and then transmits the sliced image. The sliced images are then reassembled at the base station. The TinyOS - TOSSIM implementation results are encouraging with the scheme proving to be at least 5 times more energy efficient than the baseline. The scheme is robust since almost all possible parameters such as location, orientation and distance from the object are considered. The system is implemented on TinyOS platform and the results are obtained with the assistance of the TOSSIM- T2 simulator.**

***Index Terms*—Energy efficiency, Image data processing, Image transmission.**

I. Introduction and Motivation

In recent years, advances in ultra low power devices and high data rate radios have made it possible to realize visual monitoring of the environment. The latest motes from crossbow [1] such as IRIS, and MICAZ platforms are capable of communication data rates up to 250 Kbps. Exploiting these device level advances in radio , ultra compact camera interfaces are available. The WiSNAP [4] developed a 352 x 288 (CIF) resolution with 15 frames per second (fps) module. There are similar attempts by researchers at UCLA [2] for the popular MICA2 platform. The researchers at Yale [3] have integrated an image sensor from Ominivision OV7649. All these system devices seem to be designed for local processing and much less wireless transmission. In eCAM [5] an in-camera hardware compression with a simple MAC running on the Eco node offers 1Mbps for a RF range of 10 meters. Networks formed by such image sensors are key to gathering information needed by smart environments. They promise to cater a large variety of applications like precision agriculture(plant monitoring), security systems(surveillance), traffic monitoring, habitat monitoring, etc.

In view of the above advances, the key issue in WSNs; the problem of energy efficiency and node life time takes more prominence. In particular, with visual monitoring, it now becomes extremely important to device mechanisms to save as much energy as possible for image transmission during a catastrophic event such as, say a fire. During such events, the nodes have to transmit the image or video even at the cost of death of the node. We are motivated to design one such energy efficient image slicing and transmission scheme.

II. Results

The results of the slicing and compression are shown in table I. The first row indicates the results when a node does not have any neighbors(0 neighbors). The node has to send the complete picture it is currently viewing for the given orientation at a given distance. In the event of finding 5 neighbors, the node now transmits only 49.8KB of data as compared to 297KB. Clearly, there is a significant savings in communication energy. Our algorithm is robust since it handles node location, orientation and distance to the object.

TABLE I
Compressed image Size

No of Neighbors	Sliced Image Size (KB)	Compressed image size (KB)
0	297.1	66.6
1	148.6	34.4
2	98.8	23.8
3	74.3	18.6
4	59.1	15.1
5	49.8	12.9

References

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