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RESEARCH ARTICLE

Quality-Based Image Communication for Wireless Sensor Networking

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Abstract— In Wireless multimedia sensor networks (WMSNs) have an rising variety of multimedia-based applications including image and video transmission. And types of applications, multimedia sensor nodes should ideally maximize perceptual quality and minimize energy expenditures in communication. For the required perceptual quality to be obtained, quality responsive routing is a key research area in WMSNs. On the other hand, mapping the system parameters to the end user's perceptual measures is a demanding task because of incomplete recognition metrics. Unfortunately, unless disputable assumptions and simplifications are made, optimal routing algorithm is not obedient. In this paper, we propose a novel image transmission structure to optimize both perceptual quality and energy expenditure in WMSNs. A wireless sensor network consists of spatially distributed sensors to monitor physical or environmental conditions, such as temperature, sound, pressure etc. and to kindly pass their data through the network to a major location.

Keywords :image quality; routing; PSNR; edge; entropy; image prioritization; WSN; WMSN

I. INTRODUCTION

With the currently advances in low-cost multimedia technologies, imaging sensors, and cameras, which may Ubiquitously capture multimedia content from the field, wireless multimedia sensor networks (WMSNs) have been proposed and drawn the immediate attention of the research community. Communication in WMSN is limited by restrictive factors such as high bandwidth demand, severe energy constraints, and application specific quality-of-service (QoS) requirements. A Wireless sensor network consists of sensor nodes that are powered by small irreplaceable batteries. These sensor nodes are densely deployed in the area to be monitored and sense and transmit data towards the base station. The majority of these studies focus on energy efficiency in different aspects, including preprocessing of the overlapped images, compression, and test bed design. Several QoS-based network layer algorithms are also studied in the field of wireless sensor networks (WSNs). In this category of protocols, the network tries to satisfy certain QoS metrics, for example, delay, energy, and bandwidth. In this paper, we propose a novel quality-aware image transmission framework for maximizing both perceptual quality and energy savings by allowing for content of the image data. The framework combines the use of an energy-aware and content-aware routing protocol with predefined intra-image identification metrics for QoS support. The integrated model provides a definition of the error tolerance of our methods quantitatively and consequently optimal trade-offs among resource utilization and application-specific QoS requirements. In this paper we have considered a heterogeneous cluster based wireless image sensor network architecture because it has advantages over homogeneous networks in image processing and transmission. In homogeneous networks all the sensor nodes are identical in terms of battery energy and hardware complexity. In a heterogeneous sensor network, two or more different types of nodes with different battery energy and functionality are used. The motivation being that the more complex hardware and the extra battery energy can be embedded in few cluster head nodes, thereby reducing the hardware cost of the rest of the network. However fixing the cluster head nodes means that role rotation is no longer possible. Clustered sensor networks could also be classified as single hop and multi-hop. A single hop network is one in which sensor nodes use single hopping to reach the cluster head. In multi-hop, network nodes use multi-hopping to reach the cluster head. In both cases, the cluster heads use single hopping to reach the base station. A wireless network allows mobile users to communicate without a physical connection such as a cable. Wireless networks now offer high data rates at a reasonable cost, which has led to their widespread use in recent years. A wireless network can be organized in several ways. For example, a fixed network infrastructure with access points might be used. With this approach, mobile nodes communicate with other nodes through the access points. Neighbours are defined as the nodes that are located within transmission range. Since work colleagues spend more time together, another protocol may use people at a place of work to forward a message. These types of routing are used in Mobile Social Networks (MSNs). The use of MSNs reduces the resource consumption since messages are only sent to nodes who share a relationship with the destination.

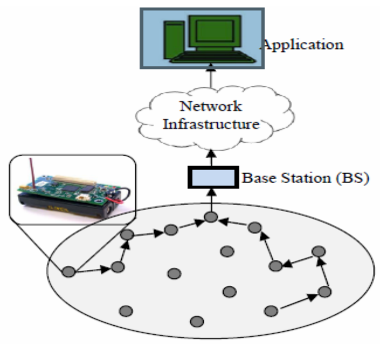

Fig.1 wireless node networking

II. ASSUMPTIONS

As per early researches have been reported in the literature regarding the energy efficiency by using various algorithms and protocols. In, the optimization of energy efficient protocols is discussed with the sleep and wakeup strategies in solar-powered wireless sensor networks under QoS constraints. Our previous work exploited multiple route paths with consideration of rate adaptation, adaptive modulation and coding (AMC), and power control (PC) techniques based on channel state information (CSI) and residual energy information (REI). These multiple route paths offer path diversities and protect image transmission. The research carried out in proposed a joint source channel coding approach for energy efficient JPEG2000 image transmission in WSNs, by applying different error resilient coding protection to different levels or layers of bit streams. Researches carried out in and investigated the tradeoff between energy consumption and image quality.

III. BACKGROUND AND MOTIVATION

A common problem in many wireless networks is varying and poor link quality of the channel between the communicating nodes during communication, a reduction in the link quality increases the number of retransmissions between the nodes to transfer useful information. The increased retransmissions have a significant impact on WSNs which consists of resource-constrained sensor nodes. The code dissemination protocol in TinyOS, Deluge, uses a fixed packet size to transmit the code image between the wireless sensor nodes and is susceptible to increased packet loss under poor link quality conditions. For the same code image size, due to the increased packet loss rate, the code dissemination protocol in TinyOS will need more retransmission bytes to disseminate code image as analyzed in Section V. This, in turn will the total code dissemination time between the nodes. The code dissemination protocol included in TinyOS distributions is a page-by-page transmission protocol, where a code image is split into pages of 1024 bytes. Each page is divided into an equal number of packets with a packet size set by the user. If the base station has a newer version of the code image, it advertises this information to the network. Upon receiving the advertisement, nodes in the network send a request for a particular page. If there is packet loss during the transfer of the page from the base station, the receiver makes a for the lost packets until all of the packets are received. For instance, consider that there are two receiver nodes which are one hop away from the base station and the first node has a channel with good link quality and second node has a channel with poor link quality. Then, during the dissemination process from the base station, the first node receives all the packets with less retransmission rounds when compared to the second node. The first node, before sending a request message for the next page, has to wait until the second node receives all the packets of the current page. Thus, the code dissemination time for the entire network will be affected by the increased retransmissions of the node with the poor link.

A. QOS based routing Protocols

This section refers to QoS-based routing protocols used for supporting real-time communication over bandwidth and energy-constrained WMSNs. In this category of protocols, the network tries to satisfy certain QoS metrics, for example, delay, energy, and bandwidth. SPEED is a hop-by-hop routing algorithm supporting real-time any cast for packet transmission. Because SPEED does not need routing tables, it has minimal control packet overheads. The SPEED protocol uses periodic beacon packets between neighbors. Two types of beacons are used for delay estimation and congestion (backpressure) detection to adapt network fluctuations. With the use of geographic information, packets are forwarded only to the nodes, which are closer to the destination. Among the eligible closer nodes, the ones that have the least estimated delay have a higher probability of being chosen as an intermediate node. If there are no nodes fulfilling the delay constraint, the packet is dropped. SPEED supports real-time communication over WSNs by providing guarantees on the maximum delay. A new architecture including various technologies such as WSNs, embedded multimedia system, and node mobility is investigated in. This architecture is called the mobile multimedia sensor networks, which is used to deliver multimedia streams by satisfying QoS requirements of the application. In this study, a new routing algorithm is also proposed, which is called the mobile multimedia geographic routing. When the mobile sensor nodes move in the network, the mobile multimedia geographic routing aims to provide QoS requirements in an energy-efficient manner.

B. File-Sharing in Mobile Systems

Recently, several companies have started to offer file-sharing software for mobile phones that allow users to share ring-tones, music, games, photos, and video. In mobile P2P systems, content exchange is driven by the users' social interactions – people encounter each other in social settings and they use their cell-phones to exchange content. To understand these systems' behavior, we need to understand to what extent content propagation is driven by friend versus stranger encounters. In this section, we examine the performance of several file exchange protocols in a mobile P2P file-sharing system from a social networking perspective. Our findings illustrate that mobile P2P systems cannot rely on friend encounters to deliver content to their users. Although such a scheme could provide a natural set of incentives to a system, it would significantly penalize the users' query hit rate. Instead, like the file-sharing systems present on the Internet, P2P systems in mobile environments must rely on developing alternate incentive schemes to ensure that peers contribute their content.

IV. PROCESSES IMAGE TRANSMISSION

Most routing protocols consider more than one quality metric (packet loss, setback, etc.) to form a cost function. The choice of the weights for these metrics needs to be with care undertaken and is often subject to dynamic network conditions. Hence, our work tries to shift this decision making process and tuning from the user end to the network. Our research efforts on human-visual-system-based perceptual quality and corresponding network performance metrics are given in. The idea is that if a relation can be defined between perceptual image quality and network parameters, then the network can be tuned adaptively in a way to achieve the required perceptual quality. Hence, the perceptual quality is seen as the packet loss and its resulting peak signal to noise ratio (PSNR) reductions experienced at the sink. With the use of this relation between packet loss and PSNR, an operational threshold image loss tolerance level supporting required perceptual quality should be defined. This threshold determines the number of packets that can safely be dropped during single raw image transmission while keeping the required quality. However, among these packets, some will be carrying more informative parts of the image than others. Network tuning can further be enhanced by utilizing this additional information. The proposed transmission structure imposes a cost-effective prioritization step for the images that are to be transmitted over WSN.

C. Images with Quasi-Sparse Histograms

One of the major drawbacks of global offline or online histogram packing is that if even of the intensity values appear only once or just a few numbers of times in the image, they will be considered by the histogram packing procedure as having equal importance as those that occur most frequently. In other words, images having "quasi-spares' histograms cannot benefit from this method. After off-line histogram packing this image occupies 8401 bytes, instead of 8822 bytes when encoded normally with JPEG-LS (a gain of 4.8%). The analysis of the packed histogram of the "yahoo" image reveals that it still maintains a sparse appearance, even after been packed. However, in a strict sense, it is not sparse, because all bins concerning intensities lower that 156 are non-zero, although some of them account only for a few occurrences. Based on this observation it seems reasonable to ask the following questions. Is there a way to avoid the intensities that have a very low number of occurrences and, therefore, to transform the quasi-sparse histograms in histograms that are strictly sparse?? If this is feasible, is it advantageous in terms of overall compression gain? To investigate how this characteristic can be used to improve compression we propose the following approaches. Let P(Ii) denote the number of occurrences of intensity Ii in a given image, where [P(Ii) = NaNc is the total number of pixels of that image, Nr and Nc being the number of rows and columns, respectively. Let us also consider the set I= {I0, I1,......,Is-1)) of the S<Nr intensities (Nr is the number of different intensities in the image), with P(Ii)>P(IJ), Therefore, I is the set of the S most used intensities. Moreover, we assume with loss of generality that Ii<Ij, Ai,i. Then, the following one-to-one order-preserving mapping in N0 is constructed.

h= (I0-0, I1-1, ..., Is-1-SS-1))

The algorithm proceeds as follows. If the image sample being processed, x belongs to the set I, then the packing procedure generates a output value y=h(x). Otherwise, i.e., if xe I, then the packing procedure generates an output value y= S and stores x (for example, in an auxiliary file). Therefore, when a given intensity that does not belong to the mapping is found, an escape symbol is generated. In our implementation, we use S as the escape symbol, i.e. the first integer not in the co-domain of h. The success of this method depends, fundamentally, on how the increase in bit-rate generated due to storing the value of x €X is compensates by a more "compression-friendly" histogram packed image. The curves represent compression gain in relation to normal JPEG-LS encoding. Concerning the examples given with image "yahoo", the best result was obtained using a mapping with the 28 most frequent intensities (i.e.,S=28), corresponding to an overall compressed size if 6 849 bytes. i.e. and improvement of 22.4% over normal (unpacked) compression, far better than the 4.8% obtained with off-line histogram packing.

D. Images with nearby Sparse Histograms

Generally, image data are not stationary. Therefore, a (global) histogram may not express correctly how intensities are used in different parts of the image. To illustrate this problem we refer to Kodak images.
(768 rows x 512 columns, with different intensity values).A simple analysis of this histogram would probably lead us to the conclusion that, due to its quasi-sparse appearance, the method described in the previous section would be the most appropriate, in order to obtain improvements concerning the compression of this image. In fact, it is not. Unfortunately, a simple inspection of the degree of sparseness that a given histogram exhibits is not enough to infer the impact of histogram packing in the loss less compression of an image. As can be observed, using analysis windows of 1024 0r 4096 pixels, the mean number of different intensities that is used simultaneously is significantly smaller (les than 10) than the number given by a global histogram analysis (249). For larger window sizes this number grows rapidly. To explore this characteristic, we implemented a packing procedure which, basically, performs off-line histogram packing on consecutive image segments of predefined size. In effect, the normal JPEG-LS encoding of the Kodak images requires 58 792 bytes, while offline histogram packing is only able to improve this number by 0.3%. However, using the local histogram packing approach, this number increases to 18.6% for Ws = 65 536, to 27.4% or Ws = 16 384, to 31.2% for Ws = 4096 and to 42.1% using Ws = 1024. Moreover for Ws = 672, i.e., the number of pixels per image row, the improvement goes to a dramatic 60.6% (23 164 bytes), instead of the 58 792 bytes required by normal JPEG-LS).

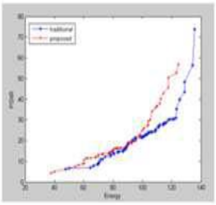

Fig.1

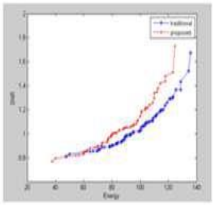

Fig.2

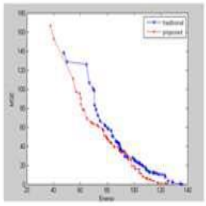

Fig.3

E. Projected Scheme

Our technique, SIMAGE, which builds upon the code dissemination protocol of TinyOS, Deluge, was implemented and tested in a network of MICAz sensor motes. SIMAGE has two specific features. First, is the dynamic, adaptive packet size estimation, which determines an optimal packet size for transmitting a page using the LQI values of the request messages. Second, it provides security for code dissemination with energy efficient, stream cipher RC4 encryption and integrity using the CBC-MAC. The details of the implementations are explained below.

F. Reproduction And Analysis

In this section, we aim to find the overlapped images to be transmitted to the base station with low energy using the correlation coefficient. In the existing system images are transmitted through multiple paths. We have proposed a system which uses UEP in order to reduce the energy of transmission. Matlab 2010 is used for the implementation. Fig 4. shows the variation of PSNR and Energy consumption for various blocks. Peak Signal-to-Noise Ratio, the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation. PSNR is usually expressed in terms of the logarithmic decibel scale. The signal in this case is the original data, and the noise is the error introduced by compression. A higher PSNR generally indicates that the reconstruction is of higher quality, in some cases the reverse may be true. As shown in the fig.2 in the proposed system the PSNR value of a particular block is found to be higher than the existing system with minimal energy consumption. Fig 3. shows the variation of SNR and Energy consumption for various blocks. Signal-to-noise ratio is a measure that compares the level of a desired signal to the level of background noise. While SNR is commonly quoted for electrical signals, it can be applied to any form of signal. The SNR is defined as shown in the fig.2 in the proposed system the PSNR value of a particular block is found to be higher than the existing system with minimal energy consumption. Fig 3. shows the variation of SNR and Energy consumption for various blocks. Signal-to-noise ratio is a measure that compares the level of a desired signal to the level of background noise. While SNR is commonly quoted for electrical signals, it can be applied to any form of signal. The SNR is defined as As shown in the fig.3 in the proposed system the SNR value of a particular block is found to be higher than the existing system with minimal energy consumption. Thus from the above graphs it is clear that the proposed system is energy efficient and secure than the existing one. We analyze two typical scenarios of image transmission across a multi-hop wireless network: Case 1, intermediate nodes act only as relays; Case 2, intermediate nodes may fuse multiple images into a single image before relaying.

Case 1: no isolating data processing

A sensor generates k bits of raw image data after receiving a query from the processing center which specified the required image quality. It compresses this image at wavelet transform level L to achieve compression ratio then sends the image to the processing center via a multi-hop path. In this case, the intermediate nodes do nothing except forwarding data to the processing center.

Case 2: transitional data processing

In general details of intermediate data processing clearly depend on the specific characteristics of applications, we try to identify some common principles that can be applied to sensor networks across various applications. In order to save communication energy, a cluster head may locally compress (or, more perfectly, combine) the images from different sensors together, thus reducing the total number of bits to be transmitted. To the best of our knowledge, estimation of correspondence between a set of images is a fundamental and difficult problem in computer vision, which is not in the scope of this paper. However, the cluster head must first de-compress the data to process it *and* then re-compress it again before transmitting it to the next cluster. To account for fusion at intermediate nodes in this case, we assume that when the total incoming data size at an intermediate cluster head is k bits, the output will be k bits. It is worth that the above analysis does not account for the energy degenerate in generating the raw.

V. NECESSITIES AND GOALS

Many encounter-based designs do not consider even basic security and privacy requirements along with functionality and performance. Others fail to meet these requirements even though they were created with the explicit goal of satisfying them. Below, we explore some requirements for idealized secure encounter-based social networks. While this list is by no means complete, it can be used as a preliminary guide for evaluating past and future designs.

G. Security Purpose

Here we outline some of the desired security features of encounter-based social networks. Note that these requirements are generic in the sense that they may apply to disperse systems which combine human interaction, susceptible private information, and network communication. The security requirements we expect in these systems are as follows.(*i*) privacy or unlinkability. The privacy of two parties sharing an encounter must be protected, even from others in the vicinity who may also participate in simultaneous encounters. In this case, privacy means that an external adversary (even one taking part in the come across or colluding with a “bulletin board” or assignation server to be used in latter phase) who is not one of the two users of interest should not be able to conclusively determine that two users have made a connection. (*ii*) Authenticity, *meaning* that when two users decide to make a connection, they should be assured that messages indeed originate from each other. (*iii*) Confidentiality, meaning that information exchanged between two users should be accessible only to them.

H. Functional Purpose

The following are generic functional supplies in the context of large-scale distributed systems that are also desirable for an encounter-based social network. (*i*) Availability. As such, the infrastructure to exchange encounter information should be accessible usually. The unavailability of individual users should not affect the availability of other users. Since the time at which encounter parties check for potential encounters associated with their activities could be arbitrary, the encounter-based social network is more sensitive to availability than conventional social networks. (*ii*) Scalability. With typical social networks being large in size, any potential social network design, including those based on encounters, should scale to support a large number of simultaneous users. This requires minimizing dependence on a centralized entity.

VI. CONCLUSION

In this paper, we intend an image transmission structure to satisfy the application QoS requirements in WMSN. Before the image transmission, the structure decides on the image failure patience in terms of the required perceptual quality (PSNR). associated image sensor within a Wireless Sensor Network can transmit the overlapped section to the cluster head optimally and the methods in which the overlapped images can be sent through several paths. The replication result of PSNR Vs Energy utilization graph shows that our system considerably transmits good quality images when compare to the accessible system.

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