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Energy Efficient and Secure Image Transmission in WSN

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ABSTRACT: in our project we are proposing Wireless Sensor network with multimedia capabilities for image transmission. This is a network of interconnected devices, capable of retrieving images from the environment. The nodes, in this type of network, have very limited resources, in terms of processing unit, bandwidth and energy. Efficient coding of the image content is therefore important. In Wireless Sensors Network, many image compression algorithms are used. First we find shortest distance between source and destination for transmission in an network, compress the image using wavelet fractal image compression technique encrypt the image using AES algorithm and then transmit the image

KEYWORDS: WSNs, Bandwidth, Energy, wavelet fractal image compression, AES.

I. INTRODUCTION

Wireless sensor network (WSN) technology is promising and is therefore gaining popularity day by day in a wide area of different applications. The recent availability of inexpensive hardware has enabled the new research field of wireless sensor networks for transmission of multimedia files across the network. One of the challenging topics in wireless communication techniques to be used for WSN applications is energy efficiency. The life time of a wireless sensor node depends on available energy sources and its overall energy consumption. Further, increasing the capacity of batteries is not possible due to the small size requirement of the nodes.

In many applications based on image compression and transmission, intermediate nodes consuming much more energy to forwarding data toward the sink than nodes collecting and forwarding data such as temperature value. As the radio transceiver is one of the most power greedy components of sensor nodes, compression seems a natural answer to the image transmission problem over a WSN. The application of multimedia (image, video, etc.) on wireless sensor networks is being, these days, a great requirement for the research and industrial community. The current researches deal with image processing like data extraction, image
processing and analysis. Thus, the case of image compression and image transmission over WSN is not a new concept because there are many researchers who worked on it.

To minimize a given quantity of information, we use a compression method which is refers to the process of reducing the amount of data. The neighboring pixels are correlated and therefore contain redundant information. So, the solution is to find less correlated representation of the image. There are two fundamental components of compression which are the redundancy and irrelevancy reduction: first, aims to removing duplication from the signal source and second, remove parts of the signal that will not be noticed by the signal receiver. in order to be useful, a compression algorithm has a corresponding decompression algorithm that reproduces the original file once the compressed file is given. There are many types of compression algorithms developed.

II. RELATED WORK

Shilpy Ghai et.al [1], explains efficient utilization of energy and security has been a core area of research in wireless sensor networks. Sensor nodes used in a network are battery operated having low power capabilities. Batteries of these nodes cannot be recharged frequently in the field setting, so energy optimization becomes paramount in increasing the battery-life and, consequently, the network lifetime.

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Song et al [2], In order to save energy, mainly in a densely deployed WSN, many proposals adopt a distributed coding approach where neighbouring sensor nodes cooperate in performing image coding. However, a significant exchange of data, which would waste energy, may be necessary.

Maniezzo et al.[3], addressed the tradeoffs between computing and communication and show that there are an optimal number of nodes involved in a distributed coding process which minimizes the total energy consumption. Santha devi et.al[4], In this paper they have proposed a novel method to compress the image using improved wavelet based polyomino's lossless compression technique which increases the quality of image at receiving end. The compressed image is transmitted by Energy Efficient High Quality Image Transmission scheme (EEHQIT) to achieve energy efficient image transmissions in Wireless Sensor Networks (WSNs). However existence of noise makes the imaging system is a complicated task. In this scenario reducing noise using filter technique for achieving high quality compression image transmission is desired. To avoid noise in the compressed image, a scheme of spatial averaging filter is presented and tested on the transmitted compressed image. This approach removes the noise from the transmitted image by way of rebuilding the image to obtain the original image without loss of information.

III. PROPOSED SYSTEM

Figure1 shows the flowchart of our proposed system. It mainly includes

a. Network Initialization

Network initialization is to specify various network parameters before actually starting a network. The parameters include the working channel, the network identifier, and network address allocation.

b. Source and Destination nodes selection

In our proposed system, users will select the source and destination.

c. Path Selection

In path selection, we find shortest distance between identified source and destination nodes in the network. Dijkstra's algorithm finds shortest path from single source node to single destination node. Dijkstra's algorithm assigns tentative distance value to each node in network. Initially a value of zero is assigned to source node and infinity to other nodes. It divides the nodes into two sets: - tentative and permanent.

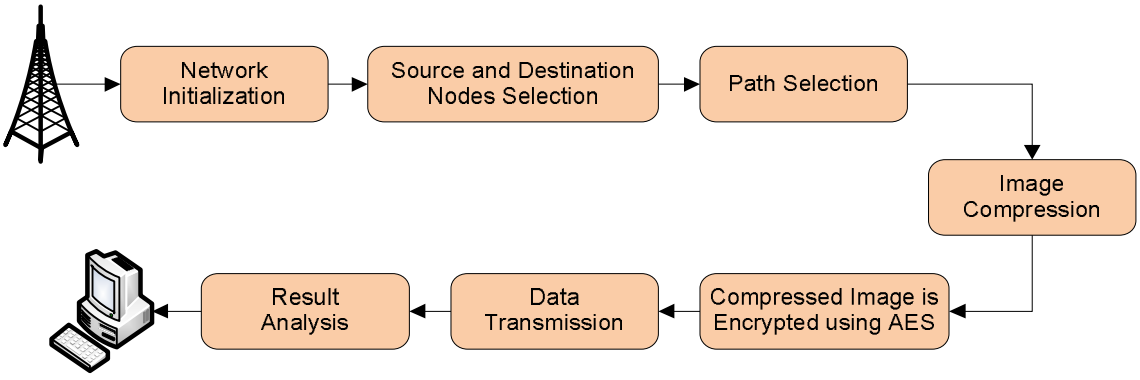

Figure1: Shows the architecture of our proposed system.

- Algorithm

STEP 1: Let S be the source node and D be the destination node.
STEP 2: Assign tentative distance value to all nodes. Set zero for source node and infinity for all other nodes.
STEP 3: Make S as permanent and label it as P-node
STEP 4: Examine each neighbor node of the node that was the last permanent node
STEP 5: Make each neighbor node of last permanent node as tentative node and insert them into tentative list if not present in it.
STEP 6: Select the node with least tentative distance value.

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STEP 7: If selected node is destination node i.e. optimal path has been found or its tentative distance value is infinite i.e. no path is available, and then End.
STEP 7: Else If selected node's energy>= threshold value then accept data, make this node as permanent and go to step STEP 8: Else send reject signal to sender node
STEP 9:Sender node after getting reject signal will choose the next neighbor node with least tentative distance value excluding he node which had send the reject signal to sender node. Go to step 3.

d. Image Compression:

Wavelets fractal transformation is functions defined over a finite interval and having an average value of zero. The main purpose of wavelet transform is to represent any arbitrary function as a superposition of a set of such wavelets or basis functions. The discrete wavelet transform of a finite length signal X(n) having N components is expressed by an NxN matrix.

For the compression of image, firstly the DWT is applied in the image using threshold value. Threshold values neglects the certain wavelet coefficients, for doing this one has to decide the value of threshold. Value of threshold affects the quality of compressed image. There are two types of threshold hard and soft threshold. Here we are applying

Hard Threshold: If x is the set of wavelet coefficients, then threshold value t is given by,

$$T(t;x) = \begin{cases} 0 & \text{if } |x| < t \\ x & \text{Otherwise} \end{cases} \quad (1)$$

i.e. all the values of x which are less than threshold t are equated to zero

Soft Threshold: In this case, all the coefficients x lesser than threshold t are mapped to zero. Then t subtracted from all x,t. This condition is depicted by following equation:

$$T(t;x) = \begin{cases} 0 & \text{if } x < t \\ \text{sig}(x)(|x| - t) & \text{Otherwise} \end{cases} \quad (2)$$

e. Compressed Image is encrypted using AES

The encryption technique proposed in this paper is AES algorithm. The AES algorithm operates on a 4x4 column major order matrix which is known as "the state". The key size used for an AES cipher specifies the number of repetitions of transformation rounds that convert the input, called the plaintext, into the final output, called the cipher key. The main loop of AES technique performs the following functions:

1. SubBytes ( )
2. ShiftRows ( )
3. MixColumns( )
4. AddRoundKey( )

The AES algorithm is implemented as follows:

1) Key Expansion
   Round keys are derived from the cipher key using Rijndael's key schedule.
2) Initial Round
   AddRoundKey: each byte of the state is combined with the round key using bitwise XOR.
3) Rounds
   1) SubBytes: a non-linear substitution step where each byte is replaced with another according to a lookup table.
   2) ShiftRows: a transposition step where each row of the state is shifted cyclically a certain number of steps.
   3) MixColumns: a mixing operation which operates on the columns of the state, combining the four bytes in each column.
   4) AddRoundKey
4) Final Round
   a. SubBytes
   b. ShiftRows

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c. AddRoundKey

Data Embedding After the compression of image, the data and image is encrypted using AES algorithm. The compressed pixel of the image creates a large space to accommodate the additional data. The encrypted data will be embedded in the encrypted compressed image. The data is embedded into the space created by the compressed pixels of the image. After embedding the generated file is assigned with extension ".jpg".

IV. RESULTS

In this section explains the output of our proposed system. Input image is as shown in figure3 (a).First step is to compress the image using wavelet fractional image compression technique. the result is as shown in figure 3(b)Compressed image is then encrypted using AES algorithm, result is as shown in figure3 (c).next step is image decrypted at receiver end, if the user has data-hiding key and image decryption key then he will be able to decrypt only the image not the original secret data. The decrypted image will be similar to the original image as shown in figure3 (d).

AS the next part of experimental results we have performed performance anyslsis using energy and end-to-end delay parameters. And results are plotted using graphs.

a. Energy: The Energy of the route is used find out the total energy consumed over the entire route. The Energy Consumption between two nodes is given by

$$E_c = 2E_{TX} + E_{gen}d^{\gamma} \qquad (3)$$

b. Delay:

Delay is the average time taken by a data packet to reach the destination. It also includes the delay caused by route discovery process and data packet transmission. Only the data packets that successfully delivered to destinations that counted. The lower value of end to end delay means the better performance of the protocol. Graph 2 describes end-to-end delay our proposed system .It is calculated using:

$$\sum(\text{arrive time} - \text{send time}) / \sum \text{Number of connections.} \quad (4)$$

Graph in Figure 3(e) shows the comparison graph for energy consumption vs number of nodes between existing and proposed method and In figure3 (f) shows the graph for end-to-end delay vs number of nodes.

(a)

(b)

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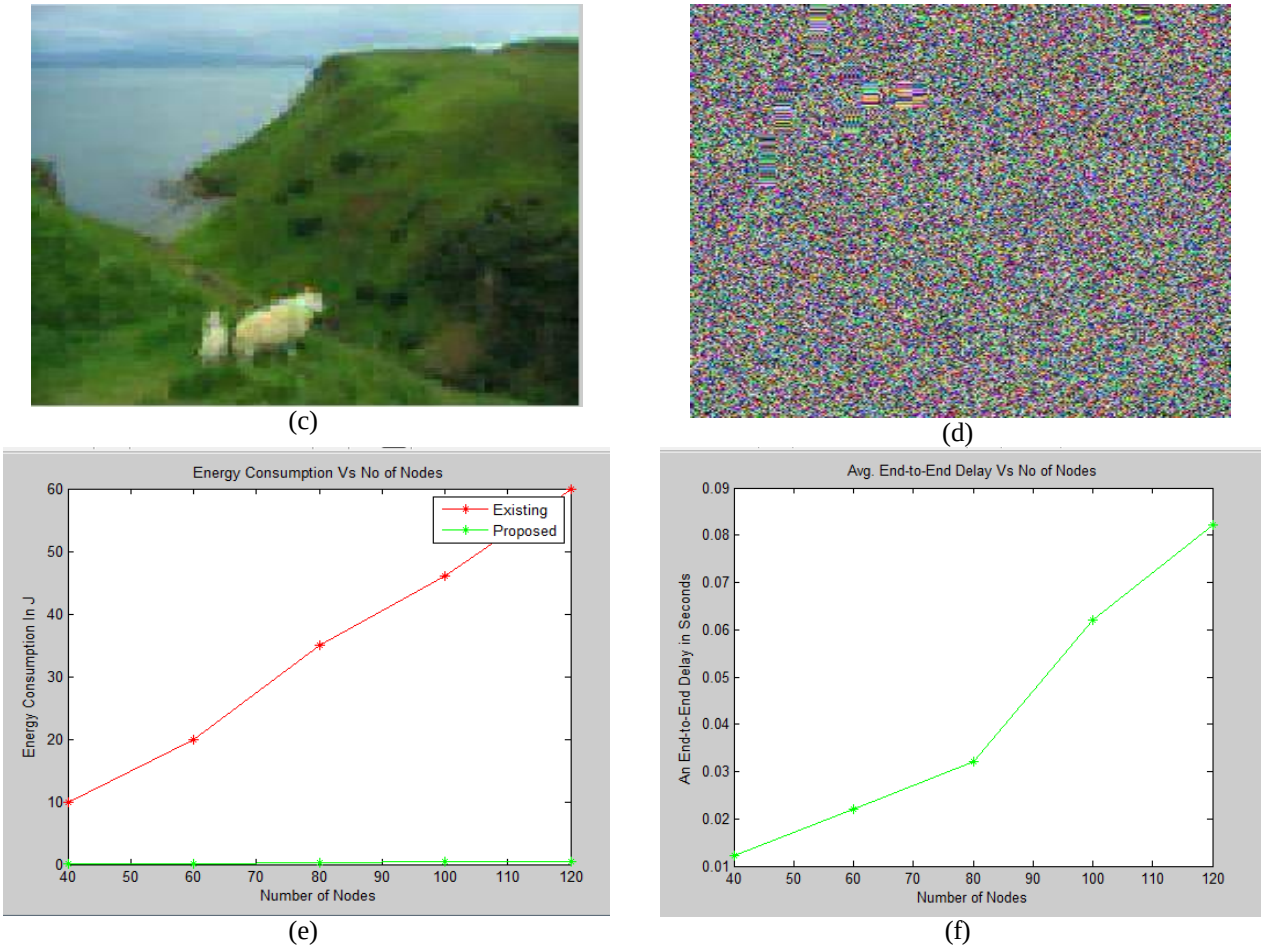

Figure 3: (a) Input Image, (b) Compressed Image, (c) Encrypted Image, (d) Decrypted Image (e) Graph for Energy Consumption (f) Graph for End-to-End Delay

V. CONCLUSION

JPEG images from attacks with minimum overhead for Wireless Sensor Networks (WSNs). Since data resulting from DCT transform is correlated with each other, however, the unencrypted data in selective encryption approaches can give attackers some hint for guessing the encrypted data. In this paper, we proposed away to apply full encryption to image transmission over WSNs. Based on the experimental results, we show that the proposed approach can ensure both the higher security level and the energy-efficiency at a sensor with acceptable image quality.

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