Reduce energy consumption and send secure data wireless multimedia sensor networks using a combination of techniques for multi-layer watermark and deep learning

Nasim Heydari[1*], Behrouz Minaei –Bidgoli[2]
[1]Corresponding Author: n.heydari61@gmail.com
Post Graduate School of Computer Engineering,Iran University of Science and Technology (IUST)
[2]Assistant Professor,School of Computer Engineering,Iran University of Science and Technology (IUST)

Abstract:
As we know, wireless sensor networks are made up of a number of nodes that wirelessly communicate with each other and the sensor unit consists of several sensor nodes. Unlike earlier wireless sensor networks, wireless sensor networks are used to collect images and video multimedia. Since this type of network in both military applications and are used in applications civilian oversight, so their safety is of utmost importance. These networks, such as wireless sensor networks in each node with limited energy resources faced by the management of energy resources in them is important. In this paper, a new unsupervised algorithm for classification of multimedia messages and sliced them to move between nodes using machine learning is used. The proposed method consists of several steps that include: 1. the sensor node information in the image data using algorithms to securely add watermark resistant to attack .2- aggregate data are aggregated information. 3. In the main sensors, high-level features and deep learning algorithms provided by trained, then categorize images in the form of continuous pieces are sent over the network. As well as the segmentation of the images using deep learning algorithms have been proposed, the volume of multimedia packets at the network level has been reduced and data transfer speed is also increased. So in this article we have shown that the proposed method is a safe method for collecting data and in addition reduces the data volume transferred, and makes about 8.7% of energy consumption compared to other methods in wireless sensor networks, multimedia decrease.

Keywords
deep learning, watermarking method, wireless sensor networks, Huffman compression, and discrete cosine transform segmentation data

1. Introduction

Wireless sensor networks are made up of a number of nodes that wirelessly communicate with each other and the sensor units consist of several sensor nodes. Unlike earlier wireless sensor networks, wireless sensor networks are used to collect images and video multimedia. Since this type of network in both military applications and are used in applications civilian oversight, Therefore, security, forwarding data between nodes and reduce memory usage is very important. These networks, such as wireless sensor networks in each node are faced with limited energy resources. So in their management of energy resources is important. In (E. Elbasi, 2012) protocol based on the data collection methods watermark is provided for safe and efficient in terms of energy consumption per node guarantees. The proposed protocol sensor node security information in the image data using algorithms add watermark resistant to attack and data integration and aggregation of information are sent over the network. Carried out simulations based on discrete cosine transform techniques and Huffman code data
) E. Elbasi, 2012 in the aggregate Pictures. (
Shows that this protocol in terms of high efficiency and performance guarantees aggregating data safe and reduces the volume of data transferred over the network. (T.M Rahayu, 2014). As a method of saving, collecting heavily in wireless sensor networks (WSNs) have been studied (H. Rong-hua, 2014) So in Part 2 examined the work done in the past, in Section 3 describes the proposed approach and architecture, encryption and compression methods to provide safe and fast and charted the proposed approach focuses Finally, in Section 4 The results and in Section 5 final conclusions and recommendations will be examined next.

2. The previous records

Two major factors in hard watermarking (indivisible watermark of the picture) and the watermark is unobservable. There is a trade-off between hardness and is imperceptible so that the hard way more water is marking its Visibility and vice versa. Art and science of steganography embedded in a carrier medium is due to the significant progress it has made digital connections (Kumar & Madria, 2010). The main purpose of steganography is , security means the inability to prove the existence of the message, while in watermarking according to various applications, more resistance to change is important. Steganography and watermarking have each of the various applications and their specific areas. Watermarking is now visible and hidden in various functional branches and a strong need to be counted.

Manuscript received February 5, 2017
Manuscript revised February 20, 2017

Watermarking and secret software maker aims in illustration, design and is implemented and various algorithms to achieve security, authentication protocols by combining the capacities to respond to the challenge by adding resistance and watermarking and steganography have been used to cover various applications (Ehsan, 2012).

There are two main ways to watermark as follows:

• SDW (Spatial Domain Watermarking)

• TDW (Transform Domain Watermarking)

Many algorithms for secure data using watermark techniques have been proposed that we use the discrete cosine transform images.

In recent years, significant growth in wireless sensor networks have seen. These networks include small nodes with the ability to sense and have limitations in computing and energy. The important feature is that this kind of network where the man is not able to attend or the presence of human or environmental change behavior, environment, information can be provided to the user. One of the methods for optimum use of resources constrained sensor nodes (such as low processing speed, low memory, and limit) using techniques such as data aggregation, and data compression is. Collected data from neighboring nodes are always repeated and redundant and are very much correlated. In addition, the amount of data produced in large sensor networks for processing at the central station is very high. Therefore, methods for combining data to produce high-quality information on sensor nodes to reduce the number and rate of transmitted packets and therefore energy and consume less bandwidth is necessary. In (J Sen, 2012) a protocol called Secure energy-efficient data collection is presented by ESPDA.

What more attention in the field of data integration implementations was that simple methods such as min / max / average are not used to integrate multimedia data? In the latest methods (Nassiri, Nat. Sch. Of Appl. Sci., Latif, Toumanari, & Maoulainine, 2012) Security data are included within the images. So aggregated data done in the form Huffman compression algorithm. The proposed protocol jpeg format images received and divided into blocks and each of these blocks is done discrete cosine transform. Recent aggregate data using the Huffman compression algorithm to compress the data.

Digital watermarking data hiding is in close relationship with watermarking. However, depending on the applications, the differences are also observed. Therefore, at the same time that the same concepts can be used in watermarking algorithms for evaluation, objective information on the structure of water marking is the Digital Watermarking. The main objective in Watermarking security means the inability to prove the existence of the message while in watermarking according to different applications, more resistance to change is important. If watermarking systems are classified in terms of their resistance to various attacks, there will be three categories resistant watermarking system (Grace C.-W. Ting, 2009), moderately resistant watermarking systems (Hazem Munawer Al-Otum, 2014) and fragile watermarking systems (Raghu Gantasala, 2009)

Watermarking secret documents are in place systems that range, Divided into three ways to arrange these three methods are based approach LBS (Chun-Ya Tseng, 2014), block-based methods and statistical methods based on image characteristics (Chun-Ya Tseng, 2014). Watermark protocol is presented based on the data collection methods for safe and efficient in terms of energy consumption in each node is guaranteed. The proposed protocol sensor node security information in the image data using algorithms add watermark resistant to attack and data integration and aggregation of information are sent over the network. Among the criteria used to assess the efficiency and quality of the technique used to be considered Include the amount of background noise to signal ratio between the original image and watermark can be studied, Or the ratio of the number of pixels matching similarities in the two different images are compared and the number of pixels in the images obtained are compared. It is natural that new techniques should work towards more efficient and criteria.

Cox and colleagues in 1997, mining latent image using an algorithm cosine transfer offer that helps to provide secure transmission of images (Cox I. J., 1997).

Rector and his colleagues in 1997 as a generalized algorithm provided Watermark using this algorithm could convert that instead of hiding the scope of the special character of their domain that this will be significantly reduced complexity (Piva A., 1997). Also Dogas and colleagues in 1998, offered a secret method WAVELET-based mining (Dugad R., 1998). Skiing and his colleagues in 2006, offered an algorithm based on geometric constants and February methods (Eskicioglu, 2006).

In (Angela D'Angelo, 2010) one of the main techniques of text performance watermarking line shift coding method is studied on Persian texts. The method of improving the efficiency of this method applied during the Persian orthography. Why do we use Watermarking? The growth in digital technology over the past decade, send and store electronic media has increased because the duplication of data without any loss of quality and with very low cost is possible. The use of digital works without any regard to copyright, is possible to manipulate documents easily.

Eduardo and his colleagues in 2013, presented a watermark-based smart way to automate some parameters in the mining latent image. They were eventually successful integration of methods that improves the

optimizer PSO proposed method to reach the accuracy and ultimately 97.7% (E Vellasques, 2013).
Germany and colleagues in 2016, a compilation techniques and methods of discrete cosine in the hidden watermark in the form of messages received video. The proposed method was compared with other methods by which the results have been satisfactory.

3. The proposed method

In Figure 1 architecture proposal provide an overview of the operations and processes performed suggested methods as well as how to communicate with each other entities in the system operating is presented.

3.1 The proposed architecture

in this section we examine the architecture and flowcharts proposal. According to this architecture, image source node to the destination node send multimedia wireless sensor networks. At the core of wireless sensor network using the algorithm become watermark and cosine algorithms and compression algorithms Hoffman, hiding operation, compression and aggregation and finally sent to the node integration to manage and reduce energy consumption. In section (3-2) we review the proposed technique and how to apply the technique of hidden text and image on another image, the procedures for collecting data and images collected compress, decompress and decrypt data at the end of multimedia in the wireless sensor network in three layers to enhance security, reduce energy consumption and reduce the amount of storage nodes in different layers.

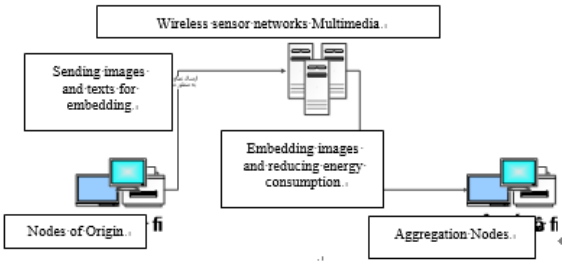


Figure 1: Architecture of the proposed method

3.2 Outlines the proposed approach

this section is divided into several parts in each of the algorithms and results are described and discussed. Wireless sensor networks Multimedia has a series of challenges that are out there, including limited resources, sensors, memory, power consumption data transfer rate and so on. To address these limitations in the proposed method uses a series of techniques such as watermarks, compression Hoffman, Cosine and deep learning is used at various stages.
In the proposed method of wireless multimedia sensor network is divided into four different layers have theoretical algorithms used in each layer.
Then in the second layer, received aggregation nodes of the image data to be encrypted and hidden and gather them from all the sensors using techniques such as discrete cosine transform data encryption method.
In the third layer, deep learning algorithms applied to the image encrypted in accordance with the characteristics of high-level training and ultimately the safety level categories of multimedia data is segmented them. Then, using Huffman compression algorithm compresses the image data and sends to the third layer the base station or BS.
In the fourth layer, the base station receives the compressed data is decompressed. The hidden data is decoded and used. Then, each of the layers to examine what further action is taken inside.

3.3. Hidden the image in the proposed method

As mentioned in the first layer sensors, wireless sensor networks, multimedia data received their required environments, and action to embed and hide their data in the form of images. In the following algorithm is used to hide text within pictures or other images in order to maintain security and prevent attackers are provided.
To embed data security the first image RGB image is converted to YUV image. RGB color model is based on three primary colors and other colors in this model are created by combining these three colors. And the first name of the primary colors of red, green and blue are taken. In the YUV color model, a color is expressed by a brightness and color components.
In the following algorithm using watermark techniques embed images taken place. The next algorithm is embedded in the text in the image.

```
function varargout=watermark_img(varargin)
if length(varargin)<2
   return
elseif length(varargin)==3
   rand('seed',varargin{3});
   p=randperm(32);
end
img=varargin{1};
img_logo=varargin{2};
dim=size(img_logo);
if prod(size(img)) >= (prod(dim)*8+32)
      len=prod(dim)+4;
      im_w=img_logo(:);
      im=img(:);
      im=bitand(im,uint8(ones(length(im),1)*254));
      dim3=dec2bin(dim(3),2);
      for j=1:2
         bin=dec2bin(dim(j),15);
         for i=1:15
            index=(j-1)*15 +i;
            if(bin(i)=='1')
               if length(varargin)==3
```

```
            im(p(index))=bitset(im(p(index)),1);
          else
          im(index)=bitset(im(index),1);
          end
        end
      end
      %
      if dim3(j)=='1'
        if length(varargin)==3
          im(p(30+j))=bitset(im(p(30+j)),1);
        else
        im(30+j)=bitset(im(30+j),1);
        end
      end
    end
    k=4;
    if length(varargin)==3
      p=randperm(length(im_w)*8)+32;
    end
    while k<len,
      k=k+1;
      for j=1:8
        index=(k-1)*8 + j;
        b=bitget(im_w(k-4),j);
        if(b==1)
          if length(varargin)==3
            im(p(index-32))=bitset(im(p(index-32)),1);
          else
          im(index)=bitset(im(index),1);
          end
        end
      end
    end
    [x,y,z]=size(img);
    varargout{1}=reshape(im,x,y,z);
    varargout{2}='WATERMARK INSERITO!';
else
    varargout{2}='Immagine contenitore insufficiente a
contenere il Watermark';
end
end
```

Algorithm 1: Algorithm using the watermark embedded image

3.4 deep learning algorithm

in this part of the algorithm for classification levels used multimedia messages as well as data segmentation task is to be followed. It should be noted that due to the popularity of deep learning algorithms SAE, in this paper the third stage of the algorithm is used. (Bengio, 2007). SAE deep learning algorithm is a neural network that is composed of several layers. This algorithm is commonly used to train unsupervised or data that are not readily identifiable class or type is used. Procedure is that the algorithm rebound photo- and having classified the type of message, and to send media segmentation between nodes sends to the master node.

3.5 Huffman compression algorithm for image compression

the following algorithm show compress process of the received images from the aggregation node. As is clear from the following algorithm Huffman compression algorithm is modeled and reduce size of images in approximately 7 times of the original size.

```
function [huff entropy avglength
redundancy]=huffman(alpha,prob)
s=sum(prob);
s=roundn(s,-4);
la=length(alpha);
lp=length(prob);
if (la==lp & s==1)
    entropy=prob.*log2(prob);
    entropy=-sum(entropy);
    pos=1:lp;
]    prs idx]=sort(prob,'descend;('
    npos=pos(idx;(
    idx=find(prs==min(prs;(((:)
    tp=npos(idx;(
    tp=sort(tp,'descend;('
    npos(idx)=tp;
    codebook(1:lp;{''}=(
    ps=npos;
    np=lp;
    cb=zeros([lp-1 3;([
    cnt=lp+1;
    prb=prs;
    for i=1:lp-1
        fst=ps(np-1;(
        sec=ps(np          ;(
          if fst<=lp  codebook(fst)=strcat('0',codebook(fst;((
          else  codebook=encod(fst,cb,codebook,'0',lp          ;(

          if sec<=lp  codebook(sec)=strcat('1',codebook(sec;((
          else  codebook=encod(sec,cb,codebook,'1',lp;(
        cb(i,1)=cnt;
        cb(i,2)=fst;
        cb(i,3)=sec;
        if np>2
          ps=ps(1:np-2;(
          ps(np-1)=cnt;
          cnt=cnt+1;
          prbt=prb(1:np-2;(
          prbt(np-1)=prb(np-1)+prb(np;(
          prb=prbt;
]          prb idx]=sort(prb,'descend;('
          ps=ps(idx;(
          idx=find(prb==prbt(np-1;((
          tp=ps(idx;(
          tp=sort(tp,'descend;('
          ps(idx)=tp;
          np=np-1;
        end
    end
end
```

Algorithm 2: Huffman compression algorithm to compress images

According to the description provided 2 algorithms is implemented in the third quarter and to reduce the size of images and increase the speed of data transmission in wireless multimedia sensor network can be used.

The image compression method using Hoffman we have about 7 times better compression than other methods (including conventional). In the proposed method as a simple example, we have tested a picture 5 * 5 and we have used the compression algorithm to compress the image. Picture tested in normal and no compression needs for storage space to 256 bits, for using this method, the required space is only 41 bits. Thus, the proposed method improves the compression space using the techniques discussed is about 6.2 times. Below the improvements proposed in terms of the amount of storage space for each node sink shown the wireless sensor network multimedia to compress and send data to the original BS.

In our proposed protocol discrete cosine transform method and the Huffman code to aggregate and compress images have been used to reduce the storage space needed, Compared to previous methods (E. Elbise, 2012) have described significant improvement.

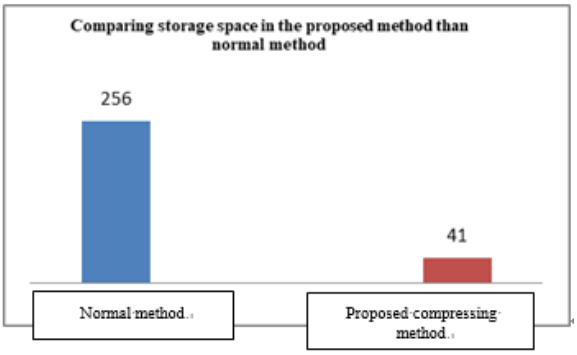


Figure 2: Graph comparing the proposed method with normal methods for compressing images

3.6 The flowchart of the proposed method

as seen in the following flowchart, at first all nodes of the original environment of required data collected. Each sensor embedded in images or hides your data and sink nodes transmit to write home base. Sink or aggregation of information received and then to BS or base station sends encryption and compression. Finally, the base station decrypt the data and used it.

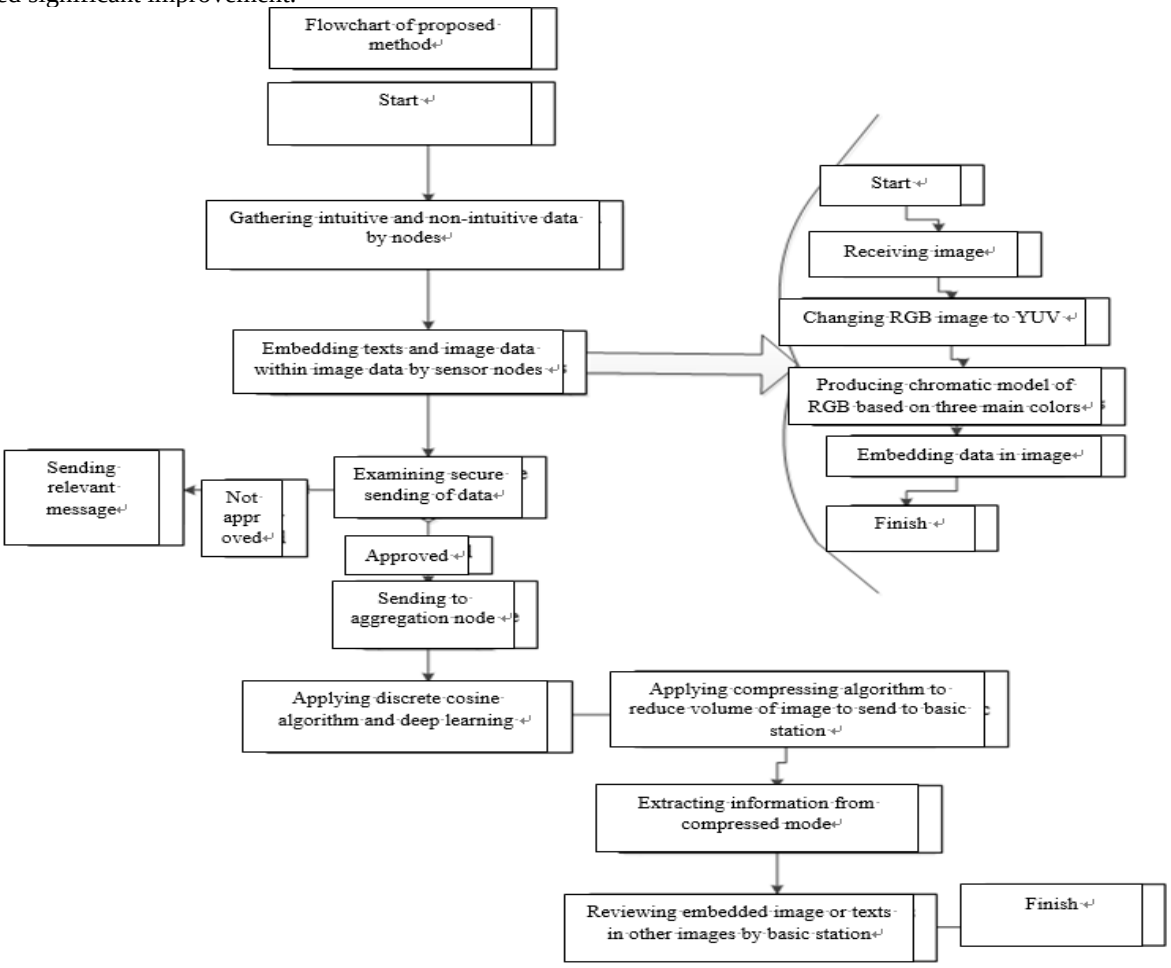


Figure 3: Flowchart of the proposed method

So using encryption techniques, compression and aggregation of data we have been able to maximize security in wireless sensor networks and by using a combination of deep learning techniques, watermark and Huffman compression significant reduction in energy consumption and memory usage and increased security in data transmission have nodes in different layers.

4. Experimental Results

in this section, the proposed method of improving multimedia on wireless sensor networks conducted in the field compared with other methods will be compared. Thus, according to the results of the simulations carried out, can be seen, Which is embedded integration and data as well as the proposed methodology resistance against all kinds of wireless sensor network multimedia proposed for the top 60% and mean method presented in this paper is resistant against all kinds is about 72%.

The proposed method for performance analysis and the resistance against possible attacks on its performance images that contain important data are investigated. Therefore, before the study results some points should be provided about the criteria PSNR. PSNR as a measure of the quality of this picture is used in the watermarking process. This factor is the ratio between the maximum signals obtained on the size and amount of background noise calculated by using the following formula:

PSNR = 20 * $\log_{10}$ (255/RMSE)

RMSE is above the average error in the formula. The results are displayed, after the attacks PSNR values such as compression jpeg, histogram modeling, low-pass filter, high pass filter, resizing, Gaussian noise, gamma correction, resizing and contrast adjustment. PSNR factor for them shows that the proposed method provides good results in terms of quality.

In the figure below the resistance of the proposed method has been shown in multiple attacks:

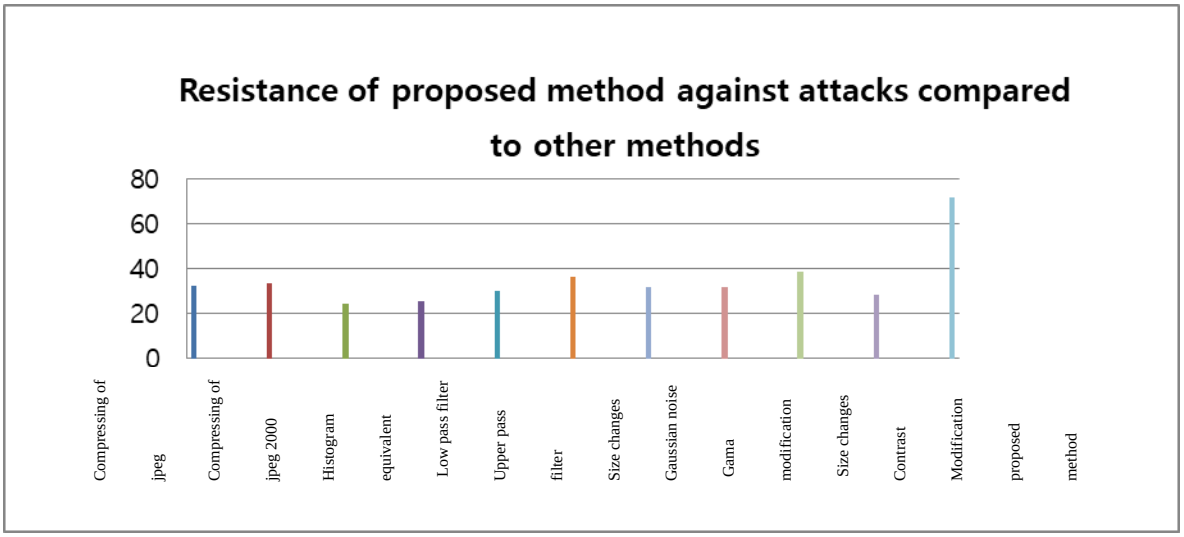


Figure 4: Graph comparing the quality of the proposed approach against a variety of attacks based on criteria PSNR

Also in the following figure the difference watermark images after a variety of possible attacks is shown in wireless sensor networks multimedia. The above methods including techniques that are believed to multimedia wireless sensor networks to reduce energy consumption as well as providing a safe environment to exchange information used that in (E. Elbasi, 2012) they examined more.

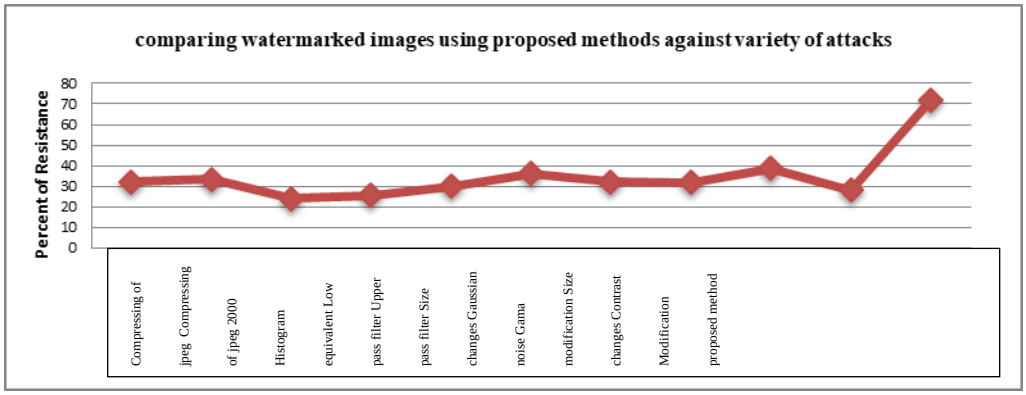


Figure 5: Compare watermark images after the attacks on the proposed approach

As well as in Figure 5-3 resembles the image watermark for robustness against all kinds of multimedia on wireless sensor networks and the extracted image after a variety of acts it is shown. Therefore, to show the similarity between images, the similarity obtained by the following formula:

The similarity between the two images match = number of pixels in the image / (number of pixels matches in the two images + number of the different pixels in the two images (

It is obvious that this ratio is equal to 1 for the original image**.**

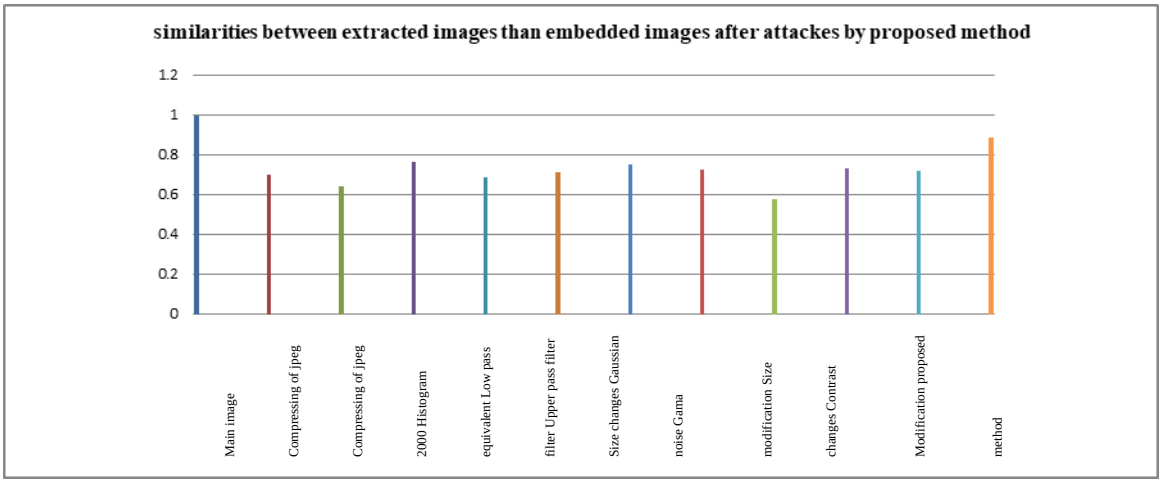


Figure 6: The similarities are extracted to images embedded in the base station after the attack on the proposed approach

Thus, according to the chart above can be seen that embedded integration of data as well as the proposed methodology resistance against all kinds of wireless sensor network multimedia proposed for the top 60% and the mean resistant proposed method in this paper is about 72%.

The following table Information on energy consumption random playback method and cluster tree versatility with the proposed method by simulations which carried out by programming in MATLAB and OPNET is shown.

Table 1: Comparison of the proposed method with other methods of energy

Millisecond	0	0.5	1	2	3
Suggested method	0.000025	0.00002	0.00002	0.00021	0.00021
Random playback method	0.000025	0.00022	0.00023	0.00024	0.00025
Clustering method	0.000025	0.00015	0.00017	0.00022	0.00022

The following diagram is achieved according to Table 1 that clearly shows that the improvement of the proposed method.

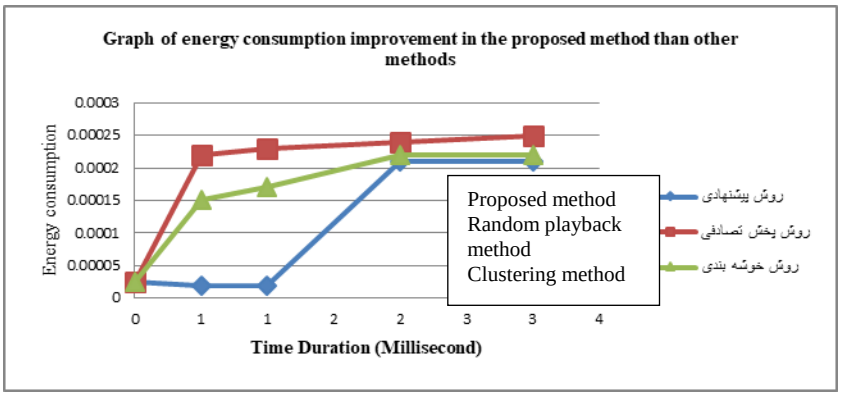


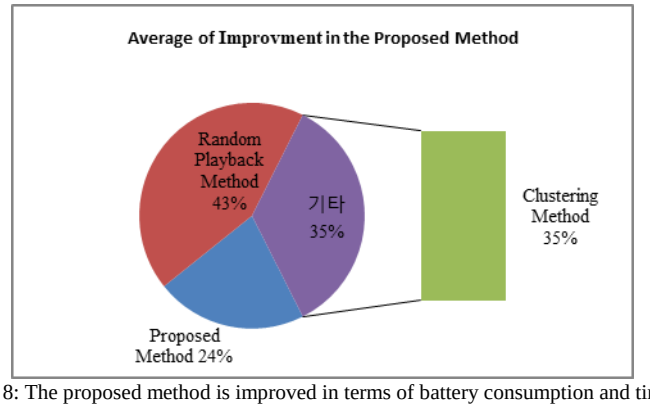
Figure 7: Average net energy consumption

Figure 7 compares the average energy consumption for the proposed network and random playback with the clustering tree-pays. As expected random playback mode with the highest energy consumption respectively. Therefore, the method proposed in this thesis compared the two methods have been utilized better and less energy consumption as well.

Table 2: The energy consumption of the proposed method with other methods

methods	The average improvement of the proposed method
suggested method	0.000097
Random playback method	0.000193
Clustering Methods	0.000157

In addition to the robustness of the proposed method, the reduction of energy consumption is achieved with this method which is shown in the diagram above. According to better the proposed method than other methods in terms of signals and data from the nodes to the base station, the improvement of the proposed method is shown in Figure 5-5.



. Figure 8: The proposed method is improved in terms of battery consumption and time data

Therefore, the proposed method compared to average as referenced better about 8.7%.

In addition to compressing images and messages increases data transfer speeds, memory consumption reduced. In the proposed method for using Huffman compression techniques to reduce the volume of data exchanged, we considered for an average of 2.5 bits per character that this amount is normally can be adjusted to 8. With this interpretation, according to the figure below we see that the proposed method compared to other methods uses very little memory.

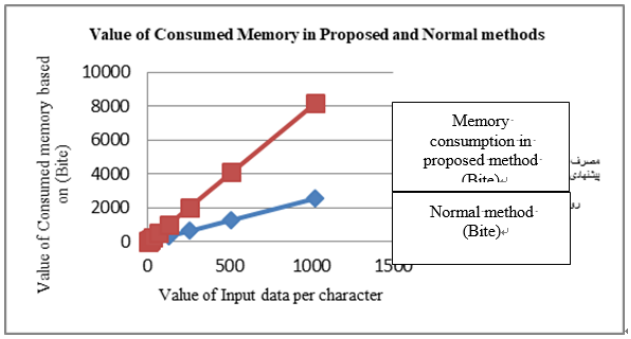


Figure 9: The proposed method to reduce memory size

So the proposed method compared to the conventional method used in approximately 31.25% improvement that is significant.

5 .Conclusion and Future offers.

In this article we provide a secure protocol for integrating the wireless sensor network data based on multimedia watermarking techniques and deep learning, The proposed algorithm based on a Huffman compression for data reduction and received by the node Federator to send to the base station, Discrete cosine transform techniques were used in order to resist the attacks of encrypted images, the sensors reduce energy consumption and extend the life of our network The proposed protocol data sensor nodes within the images using algorithms to embed watermarking resistant to attack, And aggregation nodes and aggregation of this data, compress and send to the base station.

Finally, the base station can decode the data and images watermark to break apart these. The main idea of this paper is to synthesize deep learning in the multimedia message is multi-layered. Finally, analysis and simulation results indicate that the proposed methods for data aggregation method is safe and in addition reduces the data volume transferred and makes about 8.7% decrease of energy consumption compared to other methods in wireless sensor networks, multimedia.

Some of the suggestions in this part of the future that can be developed as an idea or suggestion for improvement or production method we present is a newer method. Some of these suggestions include:

- For better and more efficient use of energy sensors in wireless sensor networks multimedia cluster of tree matching techniques can be used in the future.
- The use of other methods of compression and aggregation of data for fast transfer of multimedia messages in wireless sensor networks
- Integrating encryption techniques with image optimization algorithms like PSO or artificial bee colony algorithm can be considered for future proposals to develop the proposed approach or create a new way.

References

Angela D'Angelo, G. C. (2010). Watermark-Based Authentication. *Springe*, 365-402.

Bengio, Y. L. (2007). Greedy layer-wise training of deep networks. *Advances in neural information processing systems*, 153–160.

Chun-Ya Tseng, J.-H. W. (2014). Dual imaging-based reversible hiding technique using LSB matching. *Sciencedirect*, 1563 – 1571.

Cox I. J., K. J. (1997). Secure Spread Spectrum Watermarking for Multimedia. *IEEE Transactions on Image Processing*, 1673-1687.

Dugad R., R. K. (1998). A New WaveletBased Scheme for Watermarking Images. *International Conference on Image Processing (ICIP 1998)*, 419-423.

E Vellasques, R. S. (2013). Fast intelligent watermarking of heterogeneous image streams through mixture modeling of PSO populations. *Applied Soft Computing*, 3130–3148.

E. Elbasi. (2012). Secure data aggregation in wireless Multimedia Sensor Networks via watermarking. *Application of Information and Communication Technologies (AICT), IEEE 6th International Conference*, 50-62.

Ehsan, S. M. (2012). A survey on Energy-Efficient Routing Techniques wireless multimedia sensor Networks Communications Surveys & Tutorials. *IEEE*.

Eskicioglu, M. E. (2006). A DWT-based Robust Semi-blind Image Watermarking Algorithm Using Two Bands. *IS&T/SPIE's 18th Symposium on Electronic Imaging, Security, Steganography, and Watermarking of ultimedia Contents VIII Conference*.

Grace C.-W. Ting. (2009). Attacks on a robust watermarking scheme based on self-reference image. *Sciencedirect*, 1–2.

H. Rong-hua, D. X.-m. (2014). Mutual Defense Scheme for Secure Data Aggregation in Wireless Sensor Networks. *International Journal of Distributed Sensor Networks*, 50-62.

Hazem Munawer Al-Otum. (2014). Semi-fragile watermarking for grayscale image authentication and tamper detection based on an adjusted expanded-bit multiscale quantization-based technique. *Sciencedirect*.

J Sen. (2012). Secure and Energy-Efficient and secure pattern based data aggregation for wireless sensor Networks. *Computer Communications ACM*, 446-455.

Kumar, V., & Madria, S. (2010). Secure aggregation for wireless Networks. *springer*, 77-107.

Nassiri, B., Nat. Sch. of Appl. Sci., U. I., Latif, R., Toumanari, A., & Maoulainine, F. ,. (2012). Secure transmission of medical images by watermarking technique", . *Complex Systems (ICCS), IEEE 2012 International Conference*.

Piva A., B. M. (1997). DCTbased Watermark Recovering without Resorting to the Uncorrupted Orijinal Image. *Proceedings of the 1997 International Conference on Image Processing (ICIP '97),Washington*.

Raghu Gantasala, M. V. (2009). Technique in Semi-fragile Digital Watermarking for Image Authentication. *Springer*, 244-255.

T.M Rahayu, S. L. (2014). Security analysis of secure data aggregation protocols in wireless sensor networks. *IEEE*, 471 – 474.