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A Novel Approach on Efficient Data Transfer in Multimedia Communication Network

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Abstract
In the Wireless sensor networks, the main crucial part as we observe based on literature analysis managing Real-time data, load balancing, security of data, managing data, and also transmitting large (multimedia data) from source to destination using WMSN. Using the proposed system work on energy efficiency and robustness of the system and based on result analysis achieve the better result as compared to the existing system.
Introduction: The growth of wireless sensor networks during the past ten years has altered how data is gathered and retrieved from different areas. With the expansion of communication infrastructure, the requirement and use of Multimedia Wireless Sensor Networks is becoming more widespread on these days. These networks confront a number of difficulties in ensuring user data is secure, trustworthy, and private, just like any other WMSNs.
Objectives: This paper works on multimedia data transmission in WMSN and for that works on 3-bit LSB Embedding for transmitting large-size data with min energy consumption rate as compared to other methods like AES, ECC, etc.
Methods: 3-bit LSB Embedding will be done which provides secrecy of the data and then we will implement the Energy Efficient routing to the embedded multimedia data for WMSN .
Results: The shortest path optimization, using energy efficient routing protocol, by sensor nodes to transfer multimedia-data from source-node to destination-node achieved in WMSN. The average energy consumption and throughput of 400 multimedia sensor nodes transferring large amount multimedia-data transfer from source-to-destination WMSN. Existing work shows that it has high energy consumption and low throughput as compare to the proposed work.
Conclusions: In this paper, work on energy-efficient real time multimedia data trans receive using Wireless sensor network use 3-bit LSB data embedding in multimedia data transmission in a wireless sensor network for compress data. Based 3-bit LSB data embedding for digital audio, image, video, and 3D media. Given the tremendous developments in digital media communications ranging from conventional digital audio to immersive media, LSB data hiding plays an important role in providing high capacity and maintaining imperceptibility by considering mechanisms of the HAS and HVS. This paper uses a hybrid approach for secure data as well as compressing it using a 3-bit LSB embedding approach as well as for making energy optimization using a trust mechanism for set initial threshold values of parameters like min energy required, transmission power, location, transmission power, etc. in the transmission side source node and another surrounding node will be selected based on a parameter that we reserve than apply 3-bit LSB embedding on data and on the receiver and apply same de-embedding after selecting receiver node. And for establishing communication select the most appropriate and optimized path based on energy and location-based estimation. With the proposed structure we achieve significantly improve in results as achieve more throughput and less energy consumption as compared to the existing system.

Keywords: WMSN, Real-time Data, AES, ECC,3-bit LSB.

1. Introduction

Data processing and communication in WMSN consume more energy than other kinds of wireless sensor networks due to the massive volume of multimedia data produced by the sensor nodes [19] [13]. A wireless-sensor-network is made up of sensor

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nodes that are operated by smaller, non-replaceable batteries. Sensing and s data to the base station, these sensor nodes are widely dispersed throughout the region to be monitored [21]. Wireless multimedia sensor networks have advanced to the point that several studies, start-up businesses, etc. are investing in this technology. Due to its data-only delay-tolerant functionality and minimal bandwidth utilisation, this sensor is far more advanced than previous models [10]. Audio and video data often make up multimedia information. A series of visual frames make up video information, which is often coded in accordance with a particular standard, such as MPEGv2 [23]. WMSNs are a distinct category of sensor networks with nodes outfitted with cameras, microphones, and other sensors for creating multimedia content [11]. Researchers' attentions are being drawn to adaptive and secure video data streaming in the area of MWSNs [5]. Multimodal sensor networks can be used for a variety of purposes, including automated help for the elderly, automated law enforcement reporting, traffic management systems, and surveillance sensor networks [16][24] such as surveillance systems often include smart nodes that carry out in-network processing as well as sink stations that gather and combine the network data [18]. A WMSN typically contains of K-Multimedia-Sensor-Nodes (MSNs) and a Base-Station(BS) that monitors and gathers data from these nodes for processing and analysis [25]. Wireless sensor networks and wireless multimedia sensor networks, such as Greedy Perimeter Stateless Routing-GPSR, Real-time and Energy Aware QoS Routing Protocol-REAR, Temporary Ordered Routing Algorithm-TORA, and the Dynamic Source Routing-DSR protocol [8]. A variety of factors may be used to construct the WMSN architecture. Figure-1 depicts the WMNS architecture, which is inspired by nature [7].

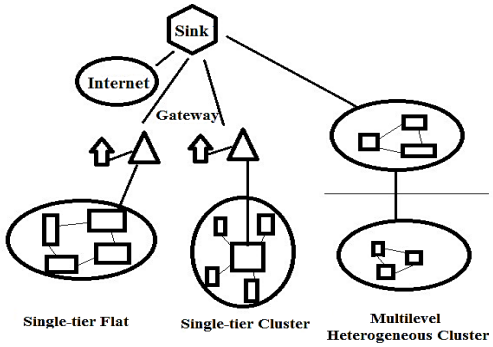

Figure 1: Architecture of WMSN [7]

Three categories make up the WMSN architecture: single flat level, single tire cluster, and multilayer. The primary model is the first one. It is homogenous and is made up of camera sensors for positioning the sink that is connected to the center of the stockpile. The second model is the single tire cluster model. Heterogeneous sensors make up this system. The group leader receives all the information. The primary model works in conjunction with this group leader. The multilevel heterogeneous sensor model is the third model. Scalar cameras carry out jobs in the first model, confusing assignments are carried out in the second level, and video sensors are connected to distant passageways in the final model [7]. It is necessary for the majority of WSN deployments in both civil and defense applications to gather and record characteristics like pressure, temperature, humidity, or the location of the targets in relation to their physical surroundings [6] [22].

The proposed framework's major goals are to increase network performance and mask the consequences that lost video packets have on the system. The bulk data of WMSNs are critical to handle. Hence, a design priority provides a reliable data transfer which also supports high data rates and application functionality for congestion control. A Sensor node in wireless multimedia sensor networks is outfitted with visual data gathering modules. It has been widely researched how to transfer multimedia from very resourceful sources, such multimedia servers, to destinations with limited resources, like wireless portable devices, etc.

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2. Objectives

The proposed framework's major goals are to increase network performance and mask the consequences that lost video packets have on the system.

The bulk of WMSNs applications are event-critical, hence WMSNs transport protocol design priorities reliable data transfer while also supporting high data rates and application functionality for congestion control.

3. Methods

Shailendra Aswale and Vijay R. Ghorpade, “Reliable and Energy-Aware Routing in Wireless Multimedia Sensor Network”, IEEE, 2017 [1], Smart sensor nodes make up well-known Wireless Multimedia Sensor Networks (WMSNs), which are capable of gathering scalar sensor data as well as audio and video from their surroundings. WMSNs are employed in several applications as a result of their widespread use. Due to the quantity of multimedia data that must be handled on a resource-constrained network, ensuring Quality of Service (QoS) is a difficult challenge. An energy-conscious and dependable routing approach is presented in this study, which identifies high-quality linkages along the path that are energy-conscious. Based on the distance, link quality, and remaining energy, the Upcoming forwarding node is chosen. The suggested method gives a superior Packet Delivery Ratio (PDR), and simulation results demonstrate that it balances node energy consumption to increase network lifespan.

Kriti Bansal, Aman Agrawal, Nency Bansal, “A Survey on Steganography using Least Significant bit (LSB) Embedding Approach”, IEEE, 2020 [2], It entails hiding private information in a data source. It may be used to a variety of industries, such as medicine, online commerce, defense, and many more. When keeping data privacy while communicating is necessary, it is employed. Data may be masked via steganography in content organization, images, audio, and video. The ability of a stenographic technique to keep the message as secret as is reasonably conceivable as well as the amount of information that may be concealed—which must be as much as is permitted—are important considerations. The LSB approach used in this sector is described in general terms in this paper.

Omed Khalind and Benjamin Aziz, “LSB Steganography with Improved Embedding Efficiency and Undetectability”, Computer Science & Information Technology, 2015 [3]. The

approach comparations two of the designated pixel value for embedding at a time with two bits of the secret communication, assuming there is always one mismatch amongst the two and using the second LSB of the first-pixel value to retain the index of the disparity.

Xuan-Thuan Nguyen, Hong-Thu Nguyen, Cong-Kha Pham, "A Reliable Protocol for Multimedia Transmission Over Wireless Sensor Networks", IEEE, 2015 [4], The growth of wireless sensor networks during the past ten years has altered how data is gathered and retrieved from area monitoring. The collection of data, though, may be restricted to more sophisticated uses like tracking, object identification, and monitoring. Because of this, research into wireless multimedia sensor networks (WMSNs) has progressed quickly up to this point. In contrast to external sounds, the dependability issue in this research is focused on delivering sustained data through WMSNs for extended periods of time. This reliable transport protocol (RTP) combines an error-correction technique with a modified automated repeat request error-control.
Jan, Xiangjian He*, Priyadarsi Nanda, "Data Sharing in Secure Multimedia-wireless-sensor-networks", IEEE, 2016 [5]. In this research, they put out a brand-new quality-driven clustering-based approach for MWSN streaming data authentication. Cluster Heads are chosen from the nodes with the highest energy (CHs). The CHs gather data from member nodes and transmit it to the Base Station (BS), delaying the premature death of member nodes with low energy and extending the life of the underlying network. The suggested method preserves the transmitted data's quality while also authenticating the streaming data. An energy-efficient and distortion-free real-time data streaming is provided by the suggested data authentication approach when combined with an error concealment technique.

In this proposed research work we have followed the given below sequential execution steps as below:

3.1 Multipath Data Transfer Protocol

Routing protocols for sensor networks were found to be focused on communication among nodes utilizing a single way through the survey of routing protocols, it was discovered. For a wireless multimedia sensor network, algorithms must be created that can execute flexible communication with a minimum amount of energy use, a small amount of bandwidth, and a short execution time. RS-encoded data is transmitted using this approach via several paths. Common nodes, which gather sensing data, and sink nodes (monitoring nodes), which receive, store, and analyse data from common-nodes, are the two different types of sensor nodes. During the algorithm, the source node senses the data and transmits it to the destination node. Route setup phase and Data transmission phase are the two distinct processes that make up the algorithm. The local database is updated and a route is built up during the route setup phase using control messages sent through relay nodes depending on predetermined settings [14].

The first problem with transmitting compressed images is that they are sensitive to packet faults. A dependable transmission protocol is therefore required at the application layer to guarantee that all picture packets are transmitted and received accurately and in the proper sequence [13].

3.2 Least-Significant-Bit(LSB) Embedding

LSB data concealing is a technique that embeds secret bits into a cover object using LSB insertion or manipulation. The LSBs only convey tiny information, and slight changes in these bits are unnoticeable to the Human-Auditory-System(HAS) and Human-Visual-System(HVS), which is the basis for LSB data hiding in respect to applications in digital media. Large capacity for data hiding is achieved because to the rising data volumes associated with digital media, such as high-definition photos and videos. The simplest and most straightforward way of data concealing in digital media, LSB data hiding is resistant to human attacks since tiny quality degradation cannot be seen. However, current steganalysis can use the noise produced by LSB data masking to defeat such strategies by statistical analysis. As a result, research has been focused on creating effective LSB data concealment strategies in order to fend off sophisticated steganalysis [12]. Figureure 2 shows the general Data-Hiding-Model in which, our real data in form of audio, image or video can be encrypted with the below mentioned-technique in Figure-2.

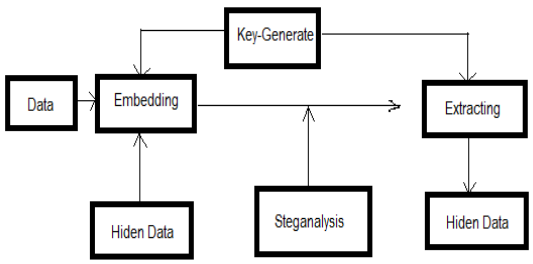

Figure 2: Data Embedding Model

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Vol 44 No. 7
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3.3 Route Selection

Execution Steps:

1) Broadcast data on relay condition.
2) Select the best and optimum path based on the forwarded list (based on location, time, and energy of node)
3) Send data based on path selection.
4) Update the forwarded list.
5) Choose the optimum path accordingly.

Consider that nodes list R1, R2, R3, R4, and R5 energy-efficient nodes which carry packets from source node S to destination node D. S broadcasts a packet first. The forwarder nodes could change into energy-efficient nodes R1, R2, and R3. Furthermore, R4 and R5 might turn become low-power efficient nodes if R2 is selected as a prospective forwarder. The data packets are forwarded to destination node D if R5 is the intermediate node in a similar manner, as per Figure-3.

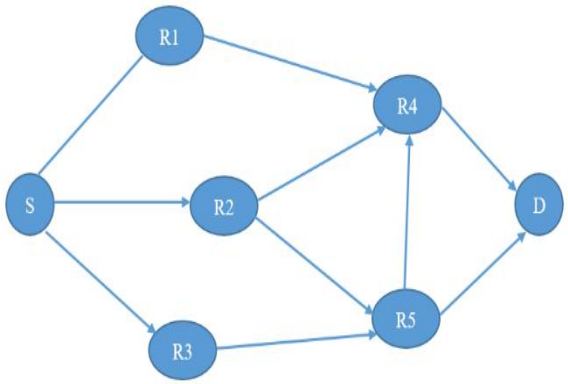

Figure 3: Route Selection

Total Transmission Power at the Lowest Level The route that consumes the least amount of total energy for transmission along the route is chosen via routing. More specifically, the following equation computes the total energy used along path Pl based on the procedure for each node and its distance D.

$$P_l = \sum_{i=0}^{D-1} P(n_i, n_{i+1}) \quad \text{.....(1)}$$

Where, P(no, nD) stands for the min power(transmission) required for two nodes. and no, and nD, respectively, are the source and destination nodes. The selected route Pk is the one that meets the criteria listed below.

$$P_k = \min\{P_l : l \in A\} \quad \text{.....(2)}$$

Where, A is the set of entirely the conceivable routes.

The energy consumption of a member node is expressed as:

$$ECN = lE_r + l\varepsilon d^2 \quad \text{.....(3)}$$

The area covered by every cluster is A2/k on average. The dispersal density of nodes in WSNs is ρ(x,y). The probable value d2 is given as:

$$E(d^2) = \iint (x^2 + y^2)\rho(x,y)dxdy = \iint r^2\rho(r,\theta)drd\theta \quad \text{.....(4)}$$

3.4 Flow of Proposed System

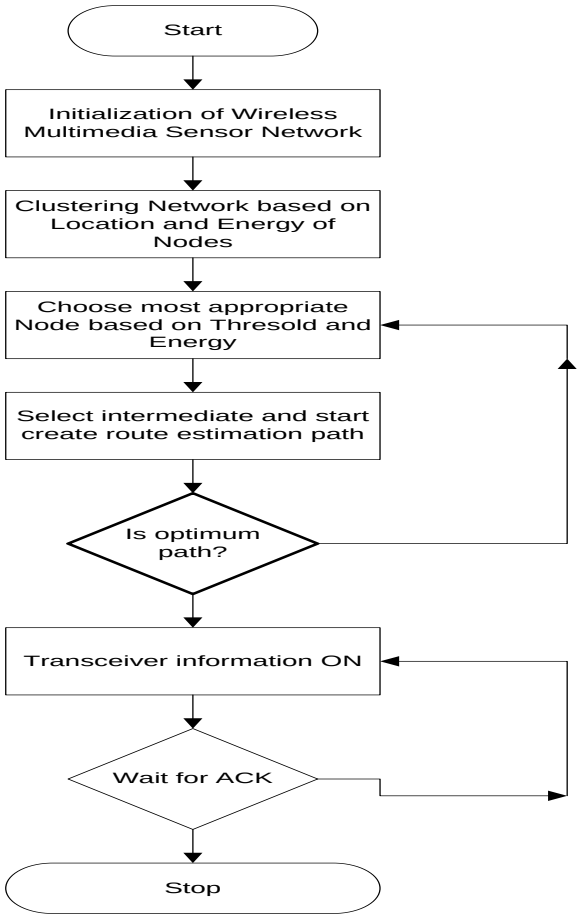

Figure 4: Flow of system

From the Figure-4, System flow Steps: -

1) In this step load data and set initial parameters like Energy, Area, Number of nodes, etc.
2) Allocate Energy on each node for communication.
3) Apply Energy Optimisation Function after selecting an appropriate path from the start node to the end node.
4) Select a specific node for transferring data from source to destination based on the route selection path which depends on the

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energy of the node, time, location, and Threshold value of the node.

5) Use a Random Mobility modal for transferring data from the source to the destination node so node movement will be random for choosing the destination node.
6) Once the optimum path is selected apply the Dual Random LSB Method on information to the source side.
7) On the Destination node apply the same process for de-embedded data using the Dual Random LSB approach.
8) So using the LSB Approach data size will be reduced and communication becomes faster via the Route Selection path so it becomes energy efficient Routing scheme.
9) Wait for the Acknowledgement signal once it receives data then the embedding process is done and transmits new data.
10) Work on Result Analysis and calculate Resulted Parameter.

In wireless networks, packets are typically routed over the least expensive path between the source and the destination. It is possible to build the lowest-cost pathways from sensor nodes to base stations by identifying them in the lowest-cost shortest path tree linking all network nodes (routed at the base station). the data packets to the base station over 8 of these minimum-cost channels is effective. However, routing data via the least expensive pathways might overburden wireless networks near the base station if the nodes are continually producing data and the bandwidth is limited. The wireless channel bandwidth constraints must thus be taken into account by the routing protocol; otherwise, the packets may be routed through heavily crowded connections and pathways. As a result, there will be more congestion, more delays, and packet losses. These factors will force packets to be retransmitted, which will increase energy usage.

3.5 Energy Efficient Routing Scheme of 3-bit Embedding data for WMSN

The Proposed method attempts to build an effective routing protocol by taking into account all the metrics relevant to maintaining link stability and extending the life of the network because the routing protocol is crucial to increasing the performance of the MWSN (Multimedia Wireless Sensor Network). Energy consumption (Econ), which is a critical factor determining the network's lifetime because sensors are battery-powered and have a finite amount of battery life.

Input WMSN nodes
Output Routes
Begin
Gather Node Identification N={N1,N2,N3,....Ni)
For each Node(N=/Ni)
Gather Node details {Rien, U Distn, U DistSN, U Disttgt, U Ss, U tr tL}
Apply 3-bit LSB Embedding on data
Set thresold value
Node Location
Evaluate the Node details
Select Nodes with Max {Rien, U Ss, U tr tL} U min{Dist}
Update Node table based of Node movement
Next Node
Stop
If routing necessary
Generate {pkt ID, source ID and destination ID} to the neighbour Nodes
For each neighbour
Extract {Rien, U Distn, U DistSN, U Disttgt, U Ss, U tr tL}
Evaluate values
Determine routes
Update routing teble
Next Node
Apply 3-bit LSB De-Embedding on data
End
Gather routes from routing table
For every route
Apply FPN
Evaluate optimal routes
Compute {Sd, Lc, Bu, TrN}

Figure 5: Algorithm

In the above Fiugre-5, the distance (Dist), which could be the distance between network nodes (DistN), the distance from a node to the sink node (DistSN), or the distance from a node to the target (Disttgt), is one parameter that indirectly affects the energy consumption. This is because the DistN, DistSN, or Disttgt would cause a delay in the conveyance, increasing the utilization of the energy. The node mobility Econ is the next factor that indirectly affects the economy because highly mobile sensor nodes, if deployed, could abruptly quit a network, disrupting connections and opening the door to network re-organization, which increases energy consumption.

3.6 Dual Random LSB Method

The conventional least significant bit (LSB) approach is related to the idea that since the majority of the info in every example of audio is obtainable on MSBs rather than LSBs, one must replace the LSB with a secret message bit in order

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to conceal any information in audio. In order to extract the message, an attacker must be able to recognize the pattern of bit alteration. The dual randomness LSB technique is suggested as a solution to this issue with the traditional LSB approach. By adding two layers of randomization, secrecy is obtained in this approach. The initial randomness occurs while choosing audio samples, and it is governed by the first three MSBs of the chosen samples. The first two MSBs of the selected samples govern the second randomness that is introduced when choosing the bits to be replaced in the selected samples. Below Figure-6 is a description of the message embedding algorithm utilizing the dual randomness LSB approach [17]:

3.7 3-bit LSB Embedding Approach

```
Input: [1,1,1,0,0,1,0,1] as a sample
Output: [1,1,1,0,0,1,0,1] as an output
Len =8;
x=8-bit of the input sample
y=7-bit of the input sample
z=6-bit of the input sample
Cmsgbi(j) = array variable of input
for j=1:1: len
if (sample(x)==0 && sample(y)==0 && sample(z)==0)
sample=Cmsgbi(j);
sample (1) =Cmsgbi(j+1);
Mbi (i, :)=sample;
k=4;
s5=Mbi (i+1, :);
sample=s5;
i=i+1;
        end
Input ++
        end
```

Figure : 6 Pseudocode

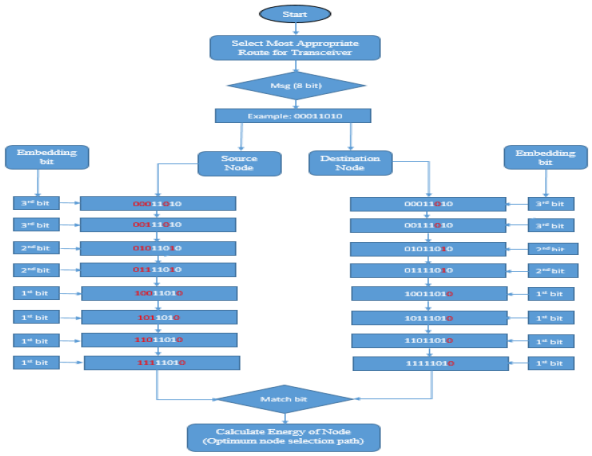

Figure 7: Flow chart of LSB Embedding

Each node N = {N1, N2..... Ni} in the network is given an identification number, and each piece of information to be sent is given a packet identification {Pkt1, Pkt2... Pktn}in Figure-7. Each node stores details of completed transactions as well as information about failed previous transactions or conveyances. To ensure the node's trust, the specifics of the completed transaction are gathered. In order to use the nodes most effectively for transmission, information on their mobility, residual energy (Ri_{en}), $Dist_N$, $Dist_{SN}$, and $Dist_{tgt}$ is obtained. Identify Optimal Routes as in equation (5):

$$Rien = TOT_{en} - ((\sum PKT=1\ T_{ren} + Fwd_{en} + P_{ren} + R_{een}) + \sum (R_{oen} + N_{sen})) \quad \text{..... (5)}$$

The residual energy of the nodes also referred to as the remaining energy of the nodes, is determined by subtracting the TOTen (total energy available in the node) from the average energy used for transmission (Tren), forwarding (Fwden), processing (Pren), and receiving the forwarded information (Reen), as well as the energy used for node selection (Nsen) and route selection (Roen). Always choose nodes with the highest Rien to increase the network's lifespan and decrease link failures.

In order to reduce the delay in the conveyance, the distance between the nodes is always anticipated to be small. For instance, for a source node (Sn), the neighbouring node (Nn) retains a very small one with its target node (tgtn) picked as the next forwarding node. Therefore, the following equation (6) is used to calculate the distance to choose the nodes with the smallest distance.

$$Dist = \{ ist\ N_n > distS_n \},\ \{distN_n < disttgt_n \} \quad \text{.....(6)}$$

4. Results

Table: 1 Proposed Simulation Parameters

Parameters	Value
No. of nodes	400
Network-Topology	1000 x 1000 m2
Simulation Time	100 s
CH Power Ratio	0.01
Packet Size	2 Mb
Cluster head	10
Simulation Platform	MATLAB
Simulation Plots	Energy Consumption and Throughput

In the Result analysis part of the proposed work using parameters like the number of nodes,

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simulation area, simulation time, cluster head power ratio, and packet size parameters for initializing and validating the proposed system shown in Table:1.

Figure 8 and 9 shows the shortest path optimization by sensor nodes to transfer multimedia-data from source-node to destination-node. Figure 10 and 11 shows the average energy consumption and throughput of 400 multimedia sensor nodes transferring large amount multimedia-data transfer from source-to-destination WMSN. Existing work shows that it has high energy consumption and low throughput as compare to the proposed work as shown in Figures.

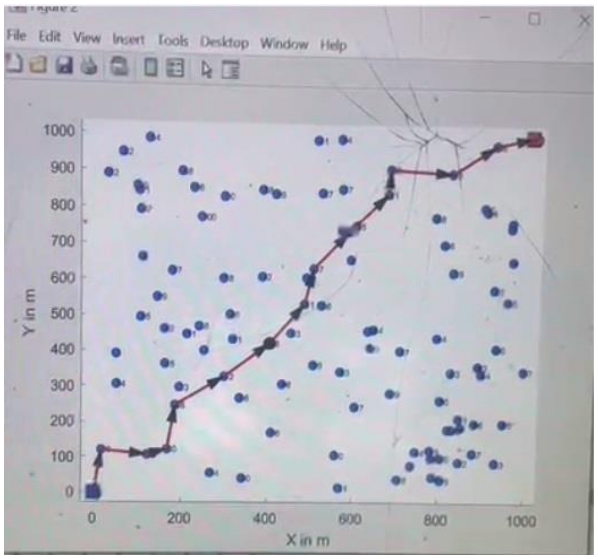

Figure 8: Shortest Path optimization route1

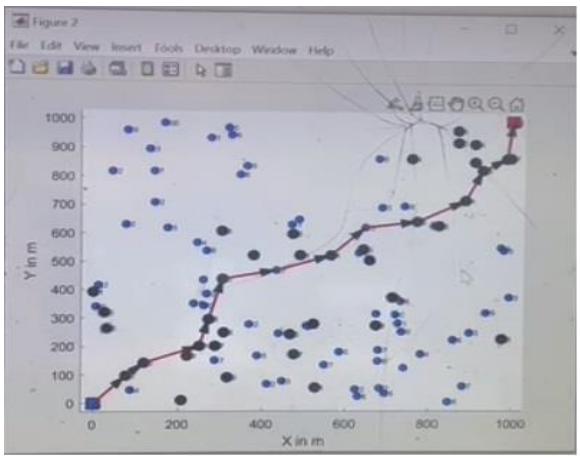

Figure 9: Shortest Path optimization route2

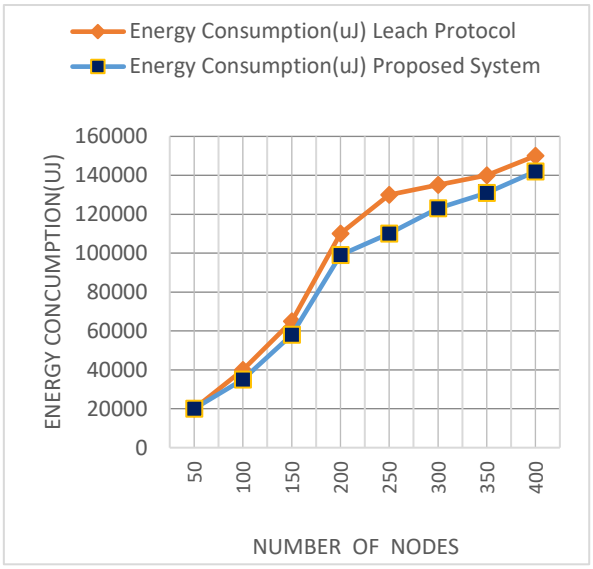

Figure 10: Energy Consumption of 400 nodes

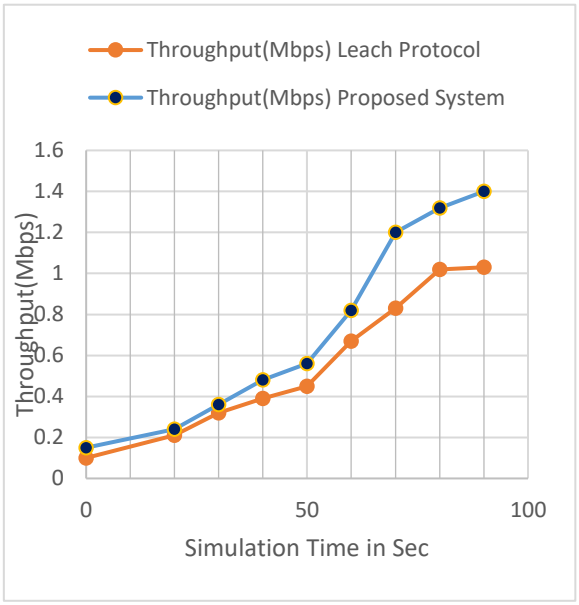

Figure 11: Throughput for 90s Simulation Time

5. Discussion

In this paper, work on energy-efficient real time multimedia data trans receive using Wireless sensor network use 3-bit LSB data embedding in multimedia data transmission in a wireless sensor network for compress data. Based 3-bit LSB data embedding for digital audio, image, video, and 3D media. Given the tremendous developments in digital media communications ranging from conventional digital audio to immersive media, LSB data hiding plays an important role in providing high capacity and maintaining imperceptibility by considering mechanisms of the HAS and HVS. This paper uses a hybrid approach

for secure data as well as compressing it using a 3-bit lsb embedding approach as well as for making energy optimization using a trust mechanism for set initial threshold values of parameters like min energy required, transmission power, location, transmission power, etc. in the transmission side source node and another surrounding node will be selected based on a parameter that we reserve than apply 3-bit lsb embedding on data and on the receiver and apply same de-embedding after selecting receiver node. And for establishing communication select the most appropriate and optimized path based on energy and location-based estimation. With the proposed structure we achieve significantly improve in results as achieve more throughputs and less energy consumption as compared to the existing system.

Future

In the future, this LSB technique can be apply to different routing protocols for more data transfer as compared to the existing system.

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