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Improvement Energy Consumption and Quality of Service in Wireless Multimedia Sensor Networks by Using Clustering Algorithms

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Abstract- Today, for human this needs to felt strongly that looked for a way of synchronous to technology and science. The use of information systems and communication technologies has enabled communities, while strived to acquire new knowledge, to served, advanced technology. By promoted the level of general knowledge and social awareness, the wider strata and groups of the population to enter the field of struggle for gained a position in the global arena.

Today, communication technologies provided the necessary field for fast and easy data transmission and allowed the transmission and accessed of information in a fraction of a second.

Multimedia, due to have several media types together and the simultaneous usability of the media, could be a good response to this human need. For new multimedia information and processing methods, wireless multimedia sensor networks had great potential and attractiveness.

One of the basic uses of these networks had related to environments that humans couldn't attend. The problems that multimedia wireless sensor networks face had the optimization of energy consumption in wireless sensor nodes; researchers had always been looked at ways to increase their lifespan and reduced energy consumption. For this reason, in this research, energy utilization in wireless multimedia sensor networks has been investigated.

Keywords- *Energy Consumption Improvement, Wireless Sensor Networks, Multimedia Networks, Multimedia Wireless Sensor*

I. INTRODUCTION

Today, with the advent of modern science and technology, the need for modern and low-tech technologies had been essential and necessary. Technologies that could be reached to the maximum amount of information required in the least possible time. In this regard, multimedia technologies could be counted the starting point for new ways of transferring concepts and information. Today, due to sensor networks had attracted many fans, due to their low cost and easy communication, and had been used in a variety of environments.

Wireless sensor networks consist of a number of sensor nodes. The energy of the nodes had limited and this energy had provided by the batteries in the nodes. Upon completion of these nodes, it had almost impossible to recharge or replace them. With regard to battery sensors, energy saving had one of the most important design parameters in wireless multimedia sensor networks. Therefore, improvement energy consumption in multimedia wireless sensor networks had been important and very important issue [1].

Clustering of sensor networks had one of the best ways that could greatly increase the lifespan of a network and reduced energy consumption. Therefore, the design of sensor networks should be optimized to increase network lifetime. In the present study, however, the present study had aimed at improvement energy consumption in wireless multimedia sensor networks. In this research, hierarchy-based protocols had proposed.

II. PROBLEM STATEMENT

Multimedia, due to the presence of several media types together and the simultaneous usability of the media, could be a good response to human needs [2]. Wireless sensor networks consist of small nodes with sensing, processing, and computing capabilities. One of the basic used of these networks related to for environments where humans couldn't be present, such as mountains, deserts, forests, rural areas, and inaccessible and hazardous areas. The problems that multimedia wireless sensor networks encountered had optimization energy consumption in wireless sensor nodes. So that the energy of the nodes could be saved so that during the operation there had no lack of nodal energy and cavity formation [3]. The energy of the sensor nodes had low; therefore, it had necessary to look for solutions to saved energy consumption in these nodes. Energy consumption had one of the major concerns in wireless sensor networks to expand network optimization [1]. This concern in multimedia wireless sensor networks had twofold [4]. In this research, we had tried to study the strengths and weaknesses of some of the algorithms to improvement energy consumption in wireless multimedia sensor networks.

III. THE PURPOSE OF THE RESEARCH

The main objective of this research had to measure energy efficiency in wireless multimedia sensor networks. In this way, this productivity resulted to in less nodes dropping in the network, less energy consumption and energy storage in the nodes, as well as lower latency in the nodes.

IV. BACKGROUND RESEARCH

In fact, examples that had now become commercially available had the result of efforts made in the early years of the research environment.

A. In fact, the first generation of sensor networks returns to the early 1970s used a hierarchical structure to receive a single signal.

B. The second generation of sensor networks had composed of low-power sensor nodes. Each node worked independently; at the same time, they exchanged data for processing data.

C. The third generation of sensor networks had born in the 1990s. They collected data used a sensor controller and a bus connection method to various data sources.

D. The fourth generation of sensors had characterized by the ability to self-organize and multiply [5].

V. WIRELESS MULTIMEDIA SENSOR NETWORKS

Using a variety of media, such as text, design, graphics, photos, audio, video, animation, and so forth, speak together as a multimedia message to better conveyed. These very small nodes, equipped with a camera, microphone and other types, incorporated accurate information into a comprehensive environmental monitoring system. A multimedia sensor node could be equipped with audio and video equipment. They could be scattered around different environments and had great performance in obtained and processed multimedia signals. Wireless multimedia sensor networks included a series of multimedia wireless sensor sensors, a sink node and multiple operating nodes [6].

The sensor nodes sent information from the surrounding environment to the operating node (node cluster). As long as operating nodes are known as cluster headers in their own cluster, it is the task of managing and collecting data from sensor nodes. Therefore, sensor nodes are known as source nodes and operating nodes as target nodes in each cluster. Due to the type of geographic location of the sensor nodes, some nodes could not directly sent their information to the cluster header. The fact that all sensor nodes need to found the least costly route to reach their cluster operating node is inevitable [6].

Sometimes there had only one path to reach the cluster. Since energy consumption, high energy efficiency, limited computing power, and memory availability had the challenges of these networks, the most important challenge for these networks had energy consumption and node service quality [6].

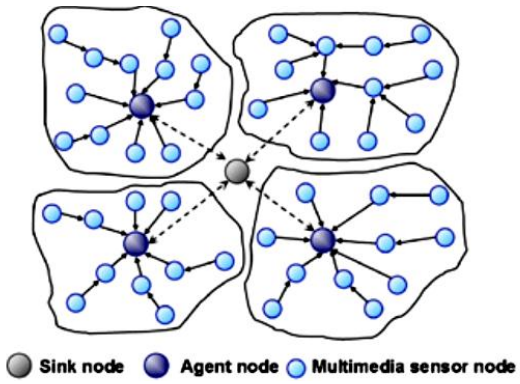

Figure 1. WMSN Network Architecture

Figure 1, showed the architecture of WMSN networks. Sensor nodes had clustered according to many criteria. Among these indicators had: communication range, number and type of sensors and geographic location. Each cluster had an operating node that manages sensor nodes within its cluster. Wireless multimedia sensor nodes had considerably less energy constraints than normal sensor nodes. In fact, the operating node had responsible for organizing sensor nodes and network management [6].

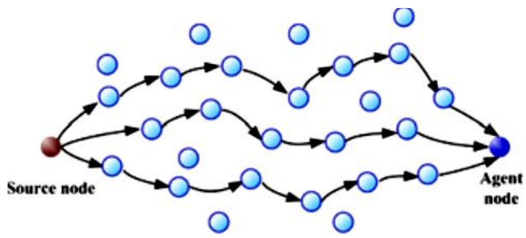

Figure 2. Routing from Node to Agent Node

In Fig. 2, the red point indicated the source node and the blue point, represented the operating node (slave cluster). This figure showed that there had three different paths from the source node to the agent node.

VI. THE WORK RESPECTIVE

In the year 2000, an algorithm called LEACH had developed, which found a special place between routing protocols in sensor networks, and so far, many optimizations had been made based on this algorithm. LEACH had the first cluster-based hierarchical routing protocol for wireless sensor networks that divided nodes into clusters [7].

LEACH delivered the energy load of the clusters in distribution and used the energy of each node as a priority for the design of clusters. Each node could play the role of a cluster based on a predefined probability. This probability had calculated based on the number of clusters in question and whether the corresponding node had been clustered in the past rotations. When clusters had identified, other nodes had connected to cluster heads that require at least energy to reach them. Then, for data transfer, cluster headers cluster their cluster nodes by assigning time slots [7].

HEED, had another widely used algorithm introduced in 2004. HEED used the combination of remaining energy and communication costs as a criterion for selecting cluster nodes. The remarkable point in designing HEED had that this algorithm assumed that the nodes differed in terms of energy consumption and the clusters had distributed well throughout the network. HEED had a distributed protocol that selected clusters independently of the distribution of nodes based on the main parameter of the residual energy value. In this protocol, a second parameter is also used which could be a node degree or a neighbor's neighbor.

VII. PROPOSED PROTOCOLS FOR IMPROVEMENT ENERGY CONSUMPTION AND QUALITY OF SERVICE IN NODS

This paper used hierarchical clustering protocols. The main purposed of hierarchy protocols (based on clustering) had actually to use a suitable method for optimal used of energy resources. In protocols based on hierarchical routing, nodes played different roles in the network. These protocols divided the network into a number of clusters. Each cluster had a cluster head; it had responsible for the connection between the nodes and the sink node. In fact, the main problem with clustering is interlinking. In wireless sensor networks, the main limitation for designed protocols is the limited energy of sensors. In fact, protocols that minimize power consumption in sensors had more relevant to wireless sensor networks [8].

A. EEQAR

To improve energy efficiency and quality of service, this topology had based on cellular structure. This algorithm had one of the hierarchical clustering algorithms. To achieve better performance, the cluster structure had formed on the basis of cellular topology. The purpose of the EEQAR algorithm design had to improve energy efficiency provided that the QoS had guaranteed. Each node knows only its remaining energy, due to the interconnection of the neighboring nodes together to replace the information, their consumption will increase; this had not a suitable method for updated the remaining energy at high frequencies. Here, energy data will be sent along with data transfer; in multimedia networks, the multimedia sensor node had often equipped with more than one type of sensor, which could monitor and collect various types of data [6].

This means that each node selected its front node. In order to realize the goal of optimization, it had necessary to construct an optimization factor table to store relevant information for routing research from the source node to the agent node. This structure had shown in Table 1.

TABLE I. OPTIMIZATION FACTOR

Neighbor	Trust Value	Energy Level	Correlation
S_1	$T(s_i,s_1)$	$E(s_i,s_1)$	$C(s_i,s_j)$
S_2	$T(s_i,s_2)$	$E(s_i,s_2)$	$C(s_i,s_2)$
. . .	. . .	. . .	. . .
s_j	$T(s_i,s_j)$	$E(s_i,s_j)$	$C(s_i,s_j)$

Each column showed the different requirements of the program. Each row corresponded to a neighboring node. In this table, there had three types of values, and each value represents an optimization factor in the EEQAR protocol. T(s_i , s_j) showed the correct value of the service quality of the node s_i to the node s_j. E (s_i ,s_j) showed the energy level of the node s_i and the nodess_j. C (s_i ,s_j) showed the relationship between node s_i and node s_j. These values could be exchanged between two neighboring nodes without general information. The energy level between the nodes s_i and s_j had the remaining energy of node s_j and had calculated as follows:

$$E(s_i , s_j) = \frac{E_r(s_j)}{E_{int}} \quad (1)$$

$E_r(s_j)$, Showed the remaining energy of node s_j . E_{int} Showed the initial energy of the sensor node. Each node known only its remaining energy. The communication of neighboring nodes will increase with the exchange of this information. The information that had left to update the energy had not suitable at high frequencies. Here, energy information will be transmitted by transmitting information. The basis of the optimization factor table had based on the fact that each node finds its front node. During data gathering, front nodes need to be strengthened to receive data. Therefore, the creation of a energy cavity due to the energy consumption of the nodes participating in the routing operation had inevitable.

In EEQAR, cellular topology will have a complete changeover after each round. The position of the agent node will be changed and the displacement of the distance could be adjusted as a constant value according to the density of the node and the cluster region. It could also be generated randomly before each move. The task of the sensor nodes changes with the sensor node state. The drawbacks of this method, the high energy remaining in the node, the lack of high-residual energy updates, the creation of energy cavity [6].

B. TPGF

The protocol, in fact, had introduced to manage quality of service traffic and to solve service quality challenges in wireless multimedia sensor networks [9]. This protocol had one of the first protocols to introduce the concept of multimodality. Multicast routing had a promising way to address QoS constraints and network lifetime concerns. Multimode routing rarely causes loss and delay in the sink node, resulted in energy degradation. To overcome these issues, the AMCMR Multimode Routing Protocol is proposed to minimize losses, energy consumption and delays.

How the TPGF protocol works, is:

This protocol focuses on the maximum number of distinct paths in the end-to-end delay conditions. The first part of the algorithm had responsible for finding the path that provides the guaranteed path while avoiding the energy cavity. This section consists of two steps:

1. Greedy Forwarding

The node of the transfer of information always selected the next node closest to the node among all neighboring nodes.

2. Go back and mark

This step solved the problem of locking the nodes. The second stage of the routing protocol had responsible for optimizing the paths found by reducing the number of steps. This optimization consists of only one method: label-based optimization, which had responsible for eliminating all the cycles that can be displayed in the routing path.

The TPGF algorithm could be run repeatedly and, on each repetition, display a distinct and new path. This protocol could support three features that should generally be included in any routing protocol. Multimedia transfers in WMSNs include:

1. Use of a multimode to transmit,

2. Avoid holes,

3. Select the shortest route.

When no next neighboring node had available for data transmission, the sensor node returns to the node of the previous step and, by signaling itself as a locked node, attempts to find another available node. The optimal route had a path with a minimum number of nodes and a circular path removal [10]. This method guaranteed the route if it had available. The drawback of this approach had that it had necessary to construct a complete map of the network topology by choosing the optimal route between the source and destination, which limits the compatibility of this method on a large scale and had a high density [9].

Other problems with this protocol included:

The protocol rarely takes into account the losses and delays and downsides of the sink node, and because of the existence of additional paths, this protocol had a lot of overhead. The other weaknesses of this protocol had that it always uses the same paths discovered for later next transmissions, and thus reduces network lifetime [9].

C. AMCMR

This protocol used routing tables for sensor nodes. In fact, it used multimode routing such as the high protocol. To overcome the loss rates and latency in the sink node, the AMCMR Multipath Routing Protocol had proposed to minimize losses, energy consumption and delays.

Sensor nodes are classified into two categories:

Active, Passive

In idle mode, the node had idle and went into sleep mode. This will increase energy storage and network lifetime. Each node of the sensor had capable of creating, maintaining or updating the routing table with different paths to the sink node. This table contains an entry that included the following [8].

1. p_{id} , id specified the path that identified the previous passed node in this path from the source to the sink node.

2. N_n,Specified the next step towards the sink node in this path.

3. Q_m , the estimated for the quality parameter had calculated for this route, which had based on the cost function [6]. The routing algorithm had as follows:

1. At first, all nodes had in active state.

2. The new one sent a p_{id} as a request to the origin.

3. If Q_m New Node> Q_m had previous; p_{id} New Node had stored in the routing table; Otherwise, p_{id} of the new Node will be ignored.

4. Get Q_m all neighboring source nodes.

5. The bar with the largest Q_m had selected for data transfer.

6. The remaining remains went to sleep, except for the previous and next knobs [8].

VIII. PARAMETERS USED IN THIS RESEARCH

Character simulation had performed using NS-2 software. The parameters that are considered for simulation had as follows:

TABLE II. SIMULATION PARAMETER

Parameters Name	Value
No. of Nodes	100
Area Size	500 * 500
Mac	802.11
No. of clusters	6
Simulation Time	50 sec
Traffic Source	CBR and Video
Packet Size	512
Transmit Power	0.660 w
Receiving Power	0.395 w
Idle Power	0.335 w
Initial Energy	10.1 J
Transmission Range	75 m
Simulation Time	25,50,75 and 100 sec

IX. SIMULATION CHART

The end-to-end delay had calculated based on all remaining data packets from source to destination. In the QAR algorithm, each node knows its remaining energy; therefore, energy must be consumed to know the energy of the neighboring nodes. Increasing the delay time in 50 seconds had due to energy consumption to know the remaining energy in the neighboring nodes.

The increase of the initial delay time in the TPGF algorithm had due to the fact that the algorithm used multimode routing to select the shortest path, and this increase had due to finding the closest node to the agent node.

Increasing the latency of the AMCMR algorithm had due to the multithreading of this algorithm and to find the optimal route. Increasing the initial delay in 50 seconds had to find the available routes and find the best route. Also, this delay could be due to the high cost of clustering by the CH, which, inevitably, has to be linked to the discovery of this CH.

The reason for the low tilt of the AMCMR algorithm in comparison with the TPGF algorithm could be because the TPGF algorithm had not consider the delay and degradation of the sink node, and this factor could affect the delay increase of 50 seconds, but this delay had considered in AMCMR. Therefore, the initial delay had a slope less than the delay in the TPGF algorithm.

Fig. 3 showed that the latency of the AMCMR algorithm had much less than the delay in the QAR and TPGF algorithms. Also, with increasing time, the delay had linearly increasing initially; then it reached a constant value. This had because, for delayed paths, the amount of delayed weight in the protocol had increasing.

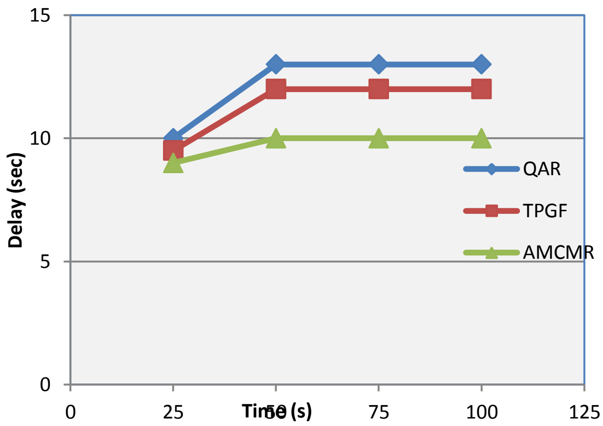

Figure 3. Delay-Time

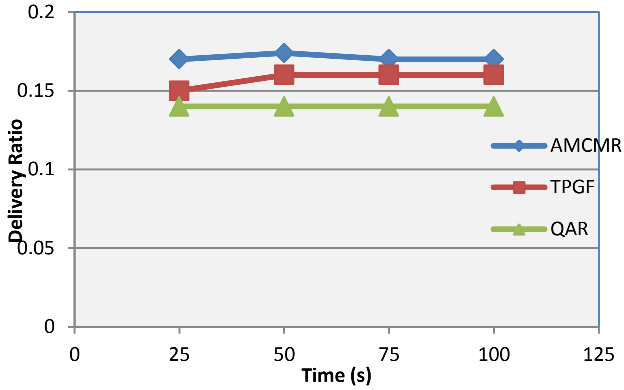

Figure 4. Delivery Ratio-Time

In the QAR algorithm, as seen, packet delivery rates had the same at different times. In the TPGF algorithm, packet delivery rates have increased due to multimodality and optimal route finding. Also, in the AMCMR algorithm, there had also a slight increase in 50 seconds. In the AMCMR algorithm, the reason for a slight decrease of 75 seconds could be due to the effect of considering the delay and degradation of the sink node in the algorithm. Fig 4 indicated that the ratio of delivered packets in the AMCMR algorithm had more than the QAR and TPGF algorithms.

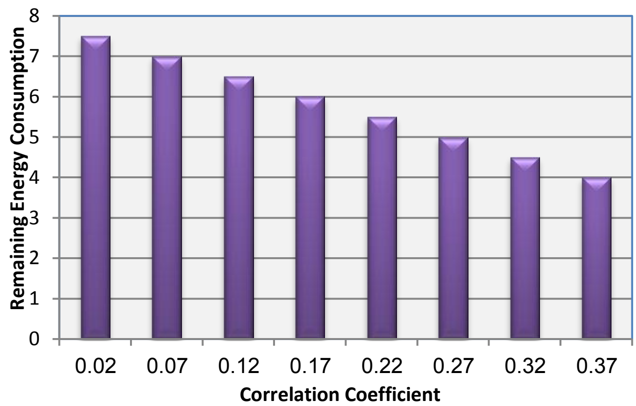

Figure 5. Remaining energy consumption with different correlation coefficients

Fig 5 showed the remaining energy consumption with different correlation coefficients. Correlation coefficient means the number of connections between two nodes. This diagram also showed that the remaining energy consumption in the simulation is very low, which indicated a good balance of the algorithm. In addition, the energy consumption ratio had reduced by increasing the correlation coefficient.

X. CONCLUTION

In this research, different topologies had presented to improve the quality of service and optimize energy consumption in wireless multimedia sensor networks. The EEQAR topology, based on the cluster hierarchy, created a cavity in the network. The next proposed topology had TPGF, which used two-phase for network routing; its bugs had overhead and the need to build a complete map for network routing.

The next protocol, AMCMR, used routing tables to find the route in the network. Compared to the QAR and TPGF protocols, packet delays and energy consumption, packet shrinkage and packet delivery have increased.

Simulation results showed that, compared to the EEQAR and TPGF algorithms, the TPGF algorithm had a lower latency than the EEQAR algorithm, and the AMCMR algorithm had a much lower end-to-end latency compared to EEQAR and TPGF algorithms.

Also, the ratio of delivered packets, compared with the two EEQAR and TPGF algorithms, delivered more packets than the EEQAR algorithm, and in the AMCMR algorithm, the packets had more targeted than the EEQAR and TPGF algorithms.

In terms of energy remaining, simulation also showed this energy very low, which indicated a good balance of the algorithm. In addition, the energy consumption ratio had reduced by increasing the correlation coefficient. The simulation results indicate that the proposed algorithm had a lower latency and energy consumption than similar algorithms and had a higher packet delivery rate than EEQAR and TPGF algorithms.

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