CHAPTER 1
The fundamentals of Internet of Things and Wireless sensor network

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ABSTRACT

Internet of Things (IoT) is a well-known term that has gained massive encouragement over a few years. The future of the human race will be significantly influenced by the application of IoT over the coming years. IoT has not only the capacity to improve the standards of living by giving control over the things but also converting the physical objects to intelligent or smart virtual devices. IoT is a diversified subject due to its varied meanings and perceptions and requires sound technical knowledge and understanding before its use. It will lead to the development of efficient mechanisms with high scalability and interoperability features among the things or objects. IoT is a reality that is progressing day by day, connecting billions of people and things to form a vast global network. IoT has applications in various domains like agriculture, industry, military, and personal spaces. There are potential research challenges and issues in IoT that act as a hurdle in the complete exploration of IoT in real-time implementation. Various organizations and enterprises have encouraged further research and study in IoT, which would prove essential in the global acceptance of IoT. WSNs have many advantages over traditional cable-based monitoring systems. WSNs are handy, cost effective, and reliable. A WSN consists of spatially distributed autonomous devices that use sensors to detect temperature, sound, and other parameters in different applications. Initially, WSNs were developed for military applications. Today, WSNs are used mostly for civilian applications, such as condition monitoring, health care, and traffic control. Furthermore, wireless sensor nodes can be used to detect vehicle berth occupancy in parking garages. Magnetometers can be used to detect vehicle presence in the hardware node. Microradars and magnetometers also can be used for vehicular tracking.

Keywords: *Multimedia transmission, energy efficiency, Wireless sensor network.*

INTRODUCTION

ISBN: 978-93-5782-920-5, www.aetsjournal.com ―Handbook of research in Big Data Analytics, Artificial intelligence and Machine learning

WSNs consist of a large number of resources, especially with low-cost sensor nodes, to establish a densely deployed network via the wireless communication module equipped on the nodes. Each sensor node is equipped with different sensors, computation units, and storage devices, which enable sensor nodes to sense, process, and transmit all kinds of monitored information. Freeway traffic information can be collected through video cameras and inductive loops on the road. WSNs are cost effective, reliable, accurate, and easy to deploy. Some characteristics of WSNs are sensing accuracy, area of coverage, fault tolerance, connectivity, minimal human interaction, operability in harsh environments, and dynamic sensor scheduling Multimedia wireless sensor networks important one is multimedia contents image, audio and video resolutions, but we are using low resolution cameras for surveillance, they are able to capture and transmit multimedia information.

A traditional WSN has some limitations such as storage, memory, processor, size, energy consumption. It is essential to maximize the lifetime of sensors and quality of service, it means, especially WSN used for multimedia information is having good quality level and increase quality and improve performance and lifetime [12]. Here we initially consider only multimedia contents that have certain timing limitation for its transmission because of encoding and decoding technique. Existing methods used MPEG-4 for compression technique. We have used MPEG-7 in your proposed system. These are advanced and also supported by existing formats. The sender and receiver have minimum time between the WSN transactions. So, we had chosen an efficient algorithm for path finding, compression and decompression. Proposed work requires high resolution images then sequence of images arranged in an order to build good quality video so initially frame size, maximum resolution, number of enhancement resolution layers and sampling period for frames all to be set default [15].

The capabilities of the receiver, network capabilities in the case of WSN have an important limitation factor with respect to the maximum video resolution allowed during a given transmission. Existing system 90◦C then destroyed the CH. Due to the reduced power equipped installed in the sensors, error links pose a main challenge in the design of transmission protocols in sensor networks other more when multimedia transmission is involved, the existence of jitter and delay is a traditional problem considered by many researchers [17]. Due to the existence of this energy consuming and low quality, error prone environment, recent research points out that the use of energy efficient transmissions in order to obtain acceptable multimedia quality. In this direction some decent proposals have been contributed. These contributions have mainly focused on the followings:

1. Create a cluster formation in the new scheme.

2. High resolution multimedia transmission.

3. Energy efficient network.

4. Increase the lifetime of the sensors.

5. Strong metals using out layer, it hasn't destroyed in case of fire.

A new cluster formation scheme is easy and efficient way to perform route discovering [13]. There are mainly three types of routing protocols in sensor networks are following.

Proactive routing (table-driven) protocols maintain a fresh list of routes by periodically distributing routing tables throughout the network. The shortcoming of this type of routing is a slow reaction on restructuring routes as after a link failure.

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Reactive routing protocols establish a route on demand by flooding the network with route request packets, which would generally cost less energy when compared with the former one. However, this type of routing (Reactive/on-demand) will result in a high latency time due to route finding process, which cannot be tolerated for alarm delivery [20].

Geographic routing is a routing principle that relies on geographic position information.

We have used a hybrid of both proactive and reactive routing tables already driven the routes stored in cluster heads and then events occur CH (cluster head) triggered by sensor and route discovered link error followed by alternatively table based route changed will select other optimum listed route. This has reduced the route, discovering energy for the reason that compares others. Hence, increase network lifetime and image quality improvement [22]. We use a high resolution camera to capture and recording increase a pixel value, then automatically increase the quality. For the Multimedia transmission, we brought in the DWT for transmission and compression using Huffman algorithm.

RELATED WORK

Low-Energy Adaptive Clustering Hierarchy (LEACH) [3] achieves low energy dissipation and latency without compromising the application-specific quality. Once in a while, the nodes perform cluster creation, CH election, and data collection [1]. LEACH forms clusters by using a distributed scheme. The main drawback of LEACH, concerns the use of a single-hop communication between CHs and BS, which is not suitable for large-scale WMSNs.

Periodic data transmissions are unnecessary, thus causing an ineffective expenditure of energy [11]. Moreover, this approach generates high signaling over-head to create clusters, which decreases the network lifetime and consumes scarce sensor node resources. Energy Efficiency QoS Assurance Routing in Wireless Multimedia Sensor Networks (EEQAR) [4] introduces a social network analysis to optimize network performance. EEQAR focuses on how to build energy efficient QOS assurance routing for WMSNs. However, EEQAR does not use a link quality estimator to select reliable routes, generating an extra overhead for route discovery for intra-cluster communication. It does not evaluate the video quality level.

A Power efficient Multimedia Routing (PEMUR) [5] aims to provide an efficient video communication based on a combination of hierarchical routing protocol and video packet scheduling models [7]. The protocol creates clusters in a centralized way by using a combination of beacon, schedule, advertise, identify and join messages.

The main drawback of PEMUR is that it only uses the remaining energy to find routes (not link quality), which makes the proposal unreliable. Thus PEMUR does not assure the transmission of videos with QoS/QoE support. The proposal assumes that the BS can communicate with all nodes by using single-hop communication, which is not realistic for large sensor networks.

The protocol uses a centralized scheme to create clusters, which increases signaling overhead and decreases network lifetime [9]. MEVI also to Multi-hop hierarchical routing protocol for efficient video communication (MEVI) multi-hop communication scheme creates a cluster high overhead and cross layer based to select the routes, but RD process perform again and again systems idle time so its decrease lifetime of the MEVI. MEMVI introduced the cross layer based cluster formation scheme will be increasing the lifetime of the system, compression, technique increase speed of transmission CH is using camera pixels video formats increase high resolution [8].

PROPOSED WORK

Multi-hop hierarchical routing protocol for efficient multimedia communication (MEMVI) contributions in the following ways

- Cluster formation in efficient manner
- Available optimum routes based route selection method
- CH triggered based on event occurrence signal passed by the non-CH;
- Multimedia transmission performed event oriented.
- New mode inserted for sensors for power savings.

SYSTEM MODEL

Proposed system consists of the different parts shown in the fig. 1. The nodes have heterogeneous capabilities and are divided into the following classes.

NON-CLUSTER HEAD (SENSOR MOTE)

Non-multimedia-aware nodes, restricted in terms of energy supply, processing and memory. On the other hand, non-CHs use for simple tasks, such as detecting scalar physical measurements).

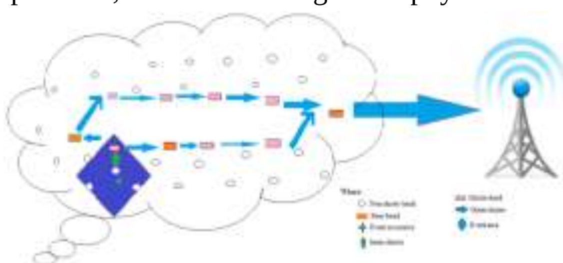

Figure 1. System overview

Non-multimedia-aware nodes have source nodes and multimedia-aware powerful nodes are destination nodes. Considering the low cost of the network, the total number of multimedia transmission nodes should be as few as possible [18].

According to the sensed environmental conditions, e.g. temperature, humidity and others, multimedia retrieval and transmission are triggered. . This implies the following operating modes.

ALWAYS ON MODE

"Always on" mode, embedded systems consist of devices that are continuously powered and in a running state. In these systems, the average power requirements are most likely in the sub-milliamp power range, which directly limits the microcontroller's achievable processing performance.
Fortunately, next-generation embedded microcontrollers can dynamically control their clock switching frequency to help reduce active current consumption when higher computing power is not needed.

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STANDBY MODE

In "standby" mode, the system is either on, or in a low-power inactive mode. For these systems, both active and standby current consumption is very important. In most "standby" mode systems, the embedded microcontroller can retain all of its internal states and the contents of its memory because it is still powered, although at a greatly reduced current draw. Additionally, the microcontroller could wake up in a few microseconds.

These types of systems typically spend most of their time in this low-power mode, but they also require fast startup capabilities to catch an external or time-critical event. Keeping the memory powered helps to keep both the software parameters and the current state of the application software intact. Typical startup times from this power mode are usually in the 5 to 10 µs range.

DEEP SLEEP MODE

In "deep sleep" or "hibernation" mode, the system is either fully on, or in an extreme, power-saving mode. This mode is of particular interest because it achieves maximum energy savings by entirely powering down the embedded microcontroller core, including the on-chip memory [16]. Therefore, any critical information must be written to non-volatile memory prior to entering "deep sleep" mode.

This mode reduces the power consumption of the microcontroller to an absolute minimum, sometimes as low as 20 nA. Additionally, all memory parameters need to be reinitialized after wake-up, which adds to the overall wake-up reaction time. Typical startup times from this mode are usually in the 200 to 300 µs range.

In extreme low-power saving mode systems, battery life (ref Table 1) is often determined by the current consumption of the other components in the circuit. Care should therefore be taken to look at not only the current consumed by the microcontroller, but also the current consumption of the other components of the Printed Circuit Board (PCB). For example, designers can use ceramic capacitors instead of tantalum capacitors where possible, as the latter typically have larger leakage currents. Designers can also determine which other circuits are powered in the low-power state of the application [19].

This approach provides a very low "on" duty cycle scheme and only draws 600 nA for the majority of the device's operation, ensuring extremely long battery life as listed in Table 1 .

Peak RF Transceiver Current	19 mA
Display Update Current	1.45 mA
MCU "Sleep" Current	100 nA
32KHz Oscillator Current	900 nA
Number of Wake Up Events for Calendar Update	86,400 times per day
Charge in "Sleep" Mode as Percent of Total	96.45 percent
Battery Life Estimate	1.03 years

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Table 1: Usage scenario for a 3 V CR2032 coin cell with 225 mA/h capacity and self- discharge at 1 percent per year.

Given above is for normal battery, but we use solar power also so it's increase lifetime 90% comparing existing system.

CLUSTER HEAD (CAMERA NODE)

Multimedia transmission involves camera nodes, equipped with solar energy source, video camera and higher memory and processing capabilities. Usually, CHs are used to transmit and receive packets both inside and outside of the cluster, and to perform complex tasks. In MEMVI, CHs are used for routing, slot allocation, synchronizing non-CH transmissions, multimedia retrieval and data aggregation [14]. The CH should be a powerful node, and thus MEMVI considers that multimedia-transmission nodes act as CHs.

STORED HEAD (EVENT BASED NEIGHBOUR)

SH perform the operation in the cluster formation scheme event occurred area nearest CH triggered to perform multimedia capturing operation and then data send nearest neighbour based closely linked CH can act as stored head (SH) why because CH destroyed the hard threshold increase (temperature more than 60◦C) then fired and destroyed the CH. CH having information also lose so we directly forwarded info stored nearest neighbour and base station nearest other not stored, it is increasing transmission speed automatic acknowledgement (AACK) reduce the error in transaction.

BASE STATION

The base station also important one in the WSN it stored to computing all the information gathered from the entire network and scheduling the operations performed in one by one order. BS monitoring the admin and perform operations.

FRAME DESIGN

MEMVI is designed for WSN applications used to send real-time videos in case of an event occurrence, then aware to protect the environment. In any emergency cases destroy the environment, its show the real impact of the event in the environment [10].

This scenario is suitable for theft detection in financial buildings and other areas. MEMVI relies on hierarchical network architecture with heterogeneous nodes, as recommended in to reduce the overall communication overhead, maximize the network lifetime, and improve multimedia transmission quality. There are two thresholds to change the operational mode, named soft and hard thresholds.

The soft threshold is triggered when a possibility of an event occurrence is detected. The hard threshold is triggered when an event already happened. In the normal mode, the CHs are not continuously sending video, with the aim of saving energy and extending the network lifetime [8].

For this mode, the non-CHs are continuously sending the sensed environmental conditions to the BS. If one of the sensed values is higher than a soft threshold, multimedia content is requested. On the other hand, when an event was detected, such as a sensed value higher than a hard threshold, the nodes do not need to save energy, due to the importance and urgency of transmitting video information. In case of some events the nodes could even be destroyed, e.g. by a fire. Thus, the nodes need to provide as much as possible information to the system administrator.

MEMVI considers that data transmission consists of two phases:

(i) non-CH of CH (inner-cluster communication);

(ii) Non-CH to CHs and between CH and BS (Outer -cluster communication).

The inner-cluster communication comprises a Frame structure, as illustrated in Figure 2. The protocol contains a set of parameters for inner-cluster communication, which are as follows:

(i) Time-slot duration (t slot), which indicates the time interval during which a node can transmit,

(ii) Frame structure size (n), which indicates the number of contained time-slots;

(iii) The total amount of time in a frame structure called Round (R).

All the frame structure has the same size, which means that they contain the same number of time-slots. The number of slots and their duration depends on the type of application [21]. It is desirable that each node allocates enough slots to satisfy the required application, such as bandwidth and delay.

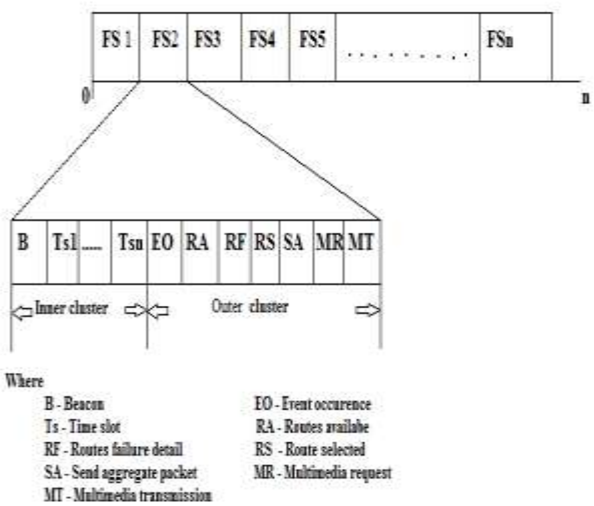

Figure.2. Inner-cluster communication Frame structure

INNER CLUSTER COMMUNICATION

The nodes have created clusters and the non-CHs send the sensed values to their CH during their time-slot. The details of Inner-Cluster Communication are shown in Figure 2. Non-CHs remain in hibernate mode until the beginning of a new frame structure, which is started CH triggered by a beacon message sent by a CH. MEVI considers that the beacon contains a slot map, reporting which slots are idle or busy.

Compared with other related protocols, the beacon message is a combination of schedule and beacon messages. And failure or error occurred CH send separately to the BS. Non-CH send the signal to CH based on the length (LS Length selection) it means minimum value have CH is nearest and then selected to start the operating process frequently. The LS is calculated based on the following parameters used every beacon message, LS, degree of variability used. We discussed to analysis CH idle, error, busy process based details send and separate route selected.

Once the Route selected, then automatically turn off the other sensors based on the signal send triggered are having CH and non-CH involve this operation. MEMVI considers that the nodes are created clusters in an opportunistic way. Since, to the non-CHs allocate a slot, they send only their data packet during the selected slot. This is in contrast to existing routing protocols, where nodes have to exchange beacon, join and schedule messages, before sending their data packets. The CH receives the data packets and assigns a time-slot according to the following rule. If only one node tries to allocate the slot, the slot will be successfully allocated. Otherwise, the CH will assign the slot at random to one of the candidate nodes. After finishing “n” slots it starts the outer-cluster phase.

The non-CHs wait for the next beacon, which will enable them to recognize a valid transmission in the selected slot. If this holds, that means the slot is allocated, and the non-CH should send the sensed data in the allocated slot. Otherwise, the non-CH must repeat the procedure until a slot assignment is obtained [23].

The non-CHs change to another CH, only if another CH has a higher LS value. The non-CHs turn on their radio, only during the period when the CHs send beacons and in their slot. If the CH detects that a slot has not been used for the last y frame structure (called idleness of a slot), it will considered as idle.

OUTER CLUSTER COMMUNICATION

The outer-cluster communication is the process of CHs and the BS are communicating with each other. This period is used by the CHs to send the aggregate and multimedia data packets to the BS, and the BS can request multimedia content for a CH. MEMVI uses the collected information from the environment to take appropriate decisions with regard to multimedia trans-mission. Thus, MEMVI has two operational modes that change according the sensed environmental value. If the CH detects the sensed value higher than a hard threshold, such as temperature higher than 60◦C, the CH should start the event mode by sending an event message in an Event Occurrence (EO) period. The neighborhood CHs forwards the message to inform all the network nodes about the event occurrence mode.

After all CHs have become aware of the event occurrence, mode, the multimedia transmission (MT) period starts. There, the CH will retrieve and send the multimedia content to the BS using multi-hops. On the other hand, if the CHs do not receive any event message during the EO period, it means that the network is in a normal mode, which works as follows. Daily once RF process will be proceeded RF (route failure detail) consist of three aspects essential.

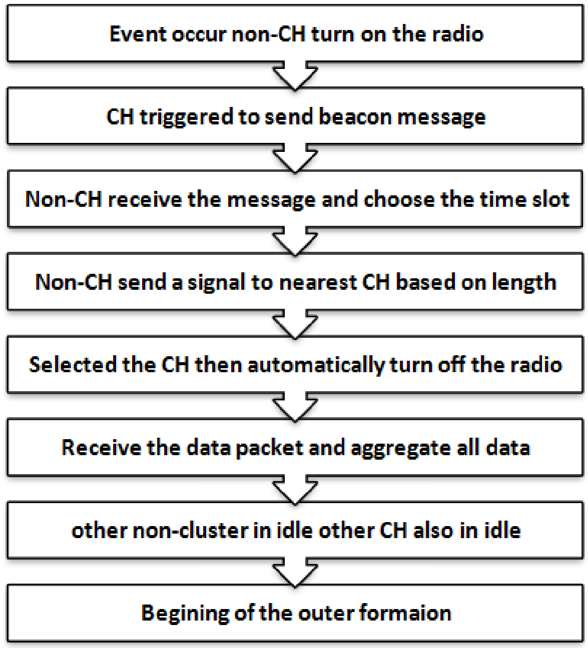

Fig.3: The cluster formation algorithm

Route discovery (RD) process worked based on the RF method detail report contain full detailed error links. And then proceed.

Route maintenance (RM) may be in the form of application updates and CH, sensor replacement.

Route correction (RC) to be CH and SENSORS data transmission related error will be corrected. Two types of messages used (i) AREQ (ii) AACK.

$$HQ = \alpha \times \frac{E_{min}}{E_{max}} + \beta \times \frac{CT_{min}}{CT_{max}} + \gamma \times \frac{LI_{min}}{LI_{max}} \times HC$$

High quality is based on the following are CT (compression time) it is computing time of multimedia contents DWT method will be used so, reduced the computing timing. E has an energy categorized “E min” means energy need minimum based on the contents. “E max” means contents high, then energy increased. LI (length index) means the distance between the two cluster heads. A distance reduced, then quality automatically increased and power will be reduced more.”Existing system model they use 4:1 it means four sensors then one CH but now we introduced the model additionally used more CH it will reduce the covering time, computing period etc.,

PERFORMANCE EVALUATION

Simulation experiments were conducted to analyze the performance of MEMVI by using the network simulator-2 which is a WSN simulator based on Omnet++ simulator. Castalia includes the implementation of temperature sensor behaviour. However, it does not have a video sensor. Thus, Evalvid was adapted to Castalia, to enable multimedia transmissions. Simulations were carried out and repeated 20 times to have a confidence interval of 98%. The following simulation parameters as shown in Table I were used. The use case of a multimedia-aware fire detection system in an Amazon rainforest was considered. The Container video sequence with a SCIF resolution was chosen from the Video Trace Library. Container is the video with similar motion and complexity as expected for a fire detection system. An analysis in terms of the number of nodes that is Alive after some rounds and a well-known video quality metric (SSIM and VQM) were performed. The results shown in this Section are the average

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of network lifetime, SSIM and VQM. The network lifetime has been measured as the time until 10% of the nodes run out of energy.

Parameter	Scenario 1	Scenario 2
Field size	100X100	125x125
Location of base station	(50,100)	(75,125)
Transmission Power for MEMVI	-15dbm	-25 dbm
Transmission Power for multi-hop	-10 dbm	-15 dbm
Total number of nodes	200	
Multimedia-aware powerful nodes	65	
Initial Energy (E O)	10 J	
Temperature Threshold	50 C	
Frame Structure size (n)	18	
Duration of each Slot (T slot)	1 Seg	
Round Duration (R)	25 Seg	
Idleness of a time-slot(y)	5	
Number of LQI values to compute the LQI average (X)	5	
Maximum HOP Count	9	
Video sequence	Container	
Video Encoding	MPEG-4	
Format	SCIF (256X192)	

Table 2: Simulation parameter

Figures 4 show the number of nodes per round that are still alive. The number of nodes alive per round is same for MEMVI in both versions, due to the fact that the main difference between them is that the MEMVI version includes inner and outer cluster formation scheme entirely different way because it uses solar and battery powered so energy problem not occurred. Network life time increased 95% better quality multimedia transmission important are energy and distance increase a CH numbers decrease a distance and improve high resolution video transmission. According to the above simulation parameter based on life time increasing the method already used and then currently implemented MEMVI it is evaluated and tabulated based on the life time increasing percentage based comparing previous methods.

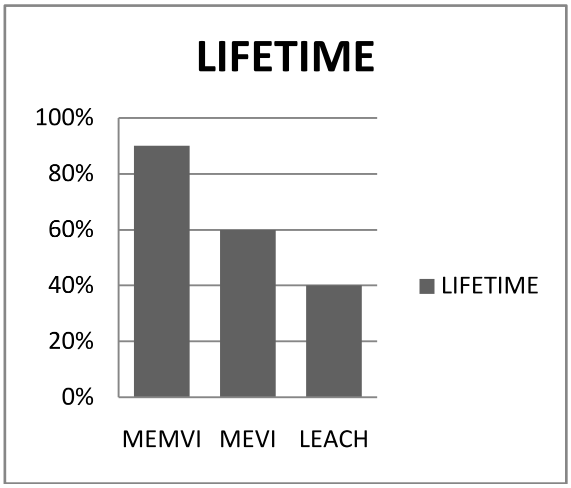

Figure 4. node life time

Distances are a important one in WSN, we reduce the distance to fix a cluster head and increase quality transfer 36m decrease 30m than increased quality we use SCIF format so get better quality because pixel value is higher than comparable previous one. It is SCIF (256 x 192) good quality will be given. Since the transmitting nodes use the same transmission power at the same distance. However, MEMVI multi-hop increases the video quality by 40%for SSIM and 60% for VQM. This is due to the fact that the proposed path selection, reliable solution based transmission.

CONCLUSION

This research uses the MEMVI routing protocol to provide high resolution and efficient multimedia transmission. MEMVI combines an opportunistic scheme to create clusters with event oriented and inner, outer clusters and a multi-hop communication between the CH and BS. For route a navel one selection process is entirely innovative because it is using the path selection solution. Based on only event oriented conditions energy efficient, so dry conditions rarely occur. Additionally, the nodes sensed, capture and send video in according to the environmental information that has been collected. Simulations were carried out to show the benefits of MEMVI. It was found that the proposal increases the network lifetime by at least 90% for short and longer network field size. High resolution multimedia contents transmitted both short and longer networks. MEMVI deliver the contents is smart way comparing the MEVI and LEACH.

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