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Alleviation of Void and Energy hole in Mobile cloud offloading using hybrid behavioral intelligence

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ABSTRACT

In modern internet the usability of smart mobile devices is rapidly increased. It is not only used for commercial and communication purposes, it can be extended in the field like mobile health care, mobile learning, and mobile games. More access of smart mobile devices has a restriction due to resource constraint, this issue overwhelming via cloud computing. Heavy computations from mobile devices are offloaded to cloud and the application got executed. The problem occurs when the Electrogram data is entered into a mobile network in cloud environment which holds void and energy holes occurrences with heavy traffic and unbalanced load distribution.This paper aims to develop hybrid intelligence behavioural patterns for void and energy hole in mobile cloud offloading. The research work carried out in this paper extends its novelty in stage partitioning for concentric circles and sensor node distribution. The network area distribution of partitioning are uniformly distributed among void hole. The simulation results show the proposed approach produces high energy consumption in the mobile cloud paradigm.

1. Introduction

Mobile cloud computing paradigm gets the mobility from mobile computing and flexibility from cloud computing and the reliability from network providers which would be the excellent combination to have a best business solution. Mobile clouds computing highly increases the performance and optimize the energy [1]. Journey of several computational parts to a controlling cloud server to avoid the unsteady connectivity the solution provider is computation offloading which enables services like optimize carrying out time and energy efficiency [2].

In circumstance of complete mobile application offloading, problem of transmission time highly affects the performance of the application in cloud environment. Diverse wireless communication channels are accessible such as 2G, 3G, Wi-Fi, and 4G to offload the data between the mobile gadget and cloud server [3]. ECG biosensor, mobile device and healthcare center alerts about heart attack in the early hours [4].

Among several mobile applications this paper focuses on the mobile healthcare and monitors the patient's ECG signals and predicts if any cardiac abnormalities present. If any variations exist the information is passed as the data packets over mobile network to the healthcare centers and physicians for diagnosis and appropriate treatment has to be taken at right time.This mobile cloud offloading greatly helps to extract ECG signal of a patient by preprocessing and significant feature alone are transmitted as data packets over the mobile network.

During data transfer through Wireless Sensor Networks (WSNs) comprised of many sensor nodes which traverse the information from the sender (patient) to the base station (health care Centre or doctor) they also have resource constraint because they have limited energy and it is operated using batter power.

The data packets are forwarded to sink by multi-hop communication model. The nodes which are closer to sink ahead the aggregated data, so the energy utilization of these sensor nodes is comparatively high compared than additional nodes. Furthermore, deploying sensor nodes in a non-uniform random manner often leads to void holes in the network [5]. This may increase the uneven energy consumption arise energy holes. The network is then become a disconnected region when the void and energy hole occur.

Thus, these issues motivated to develop balanced energy consumption in the process of mobile cloud offloading of ECG signal transfer by alleviating not only energy holes but also increasing the lifetime of the entire network.

Following section converses about some of the earlier exertions in the field of energy consumption in mobile cloud offloading and in wireless sensor networks.

Sahoo and Liao [6] introduced a hole repair algorithm for WSN which uses the node mobility to decrease the power hole problem and to make best use of the coverage are by reducing the overlapping regions. Latif et al. [7], developed a sphere-shaped hole renovate technique which eliminates the exposure and energy holes issue in underwater sensor networks. It comprises three stages they are knowledge share, network operation and hole repair. It discovers that the nodes which highly overlap the region are responsible of occurrence of coverage and energy holes. Liu [8] in his work designed an optimal distance-based transmission strategy by adapting ant colony optimization. The energy balance is done by inferring the knowledge of ants global optimization.

Chen et al. [9], derived a model for under water sensor network to mitigate from energy hole issue. They developed a power saving mobicast direction-finding protocol to overwhelm the impact created by ocean current and consumption of sensor nodes in a non-uniform manner. A. K. Daniel et al. [10] have anticipate a new protocol in wireless mobile heterogeneous networks based on the use of pathway confirmation, traffic, steadiness judgment factor, and bandwidth information at each node for assign the way path and buffer.

To alleviate the issue of energy holes, an adaptive resistant based energy efficient gathering protocol is introduced in [11]. Though, the process proficiently consumes the energy reserve, persists the network life span with improved throughput, but the issue of energy hole continued because of unbalance load distribution. To evade the energy hole difficulty nearby the sink, a wireless sensor network energy hole alleviating (WSNEHA) algorithm was developed in [12].

However, the energy utilization is not satisfied in other regions because of uneven distribution of nodes. To stabilize the energy delay depending on different offloading decision criteria an energy-efficient offloading-decision algorithm based on Lyapunov optimization is developed in [13]. This approach determines at what time to run the submission locally, when to promote it directly for distant execution to a cloud infrastructure but fails to handle coverage and energy hole problem. The works still don’t have an accurate proof of handling void and energy hole in mobile cloud wireless sensor network.

2. Materials and methods

In this proposed work Electrocardiogram (ECG) signals from MIT-BIH database utilized. Using Meyer Wavelet (MVT) transformation method [14] features of ECG signals extracted.MVT is a continuous wavelet which precisely finding out R peaks.Selected data packets transferred to remote cloud network using mobile cloud offloading statergy.

To overwhelm these issues for transferring of ECG Signal details to detect the type of arrhythmia of concern patient’s in mobile cloud environment, this paper proposed a methodology which balances energy indulgence by portioning the network as concentric circles and the sensor nodes are organized in a standardized random manner around the sink. Thus, the base station is made free of force depletion. Next a proficient ahead node selection is performed to alleviate coverage and energy holes by applying swarm intelligence. Thus, the energy saved using mobile cloud offloading transfer the patient details to health centres or physicians at a right time.

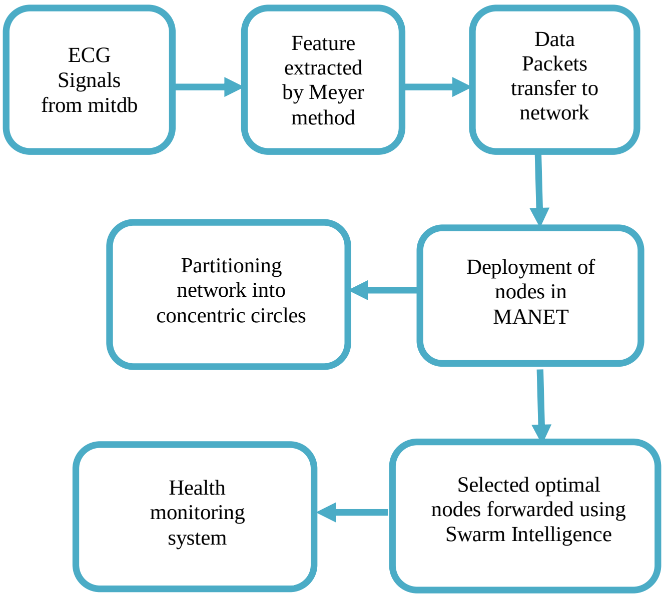

Figure 1: Framework of AVEH-SIMCO

3. Theory/calculation

It is assumed that the Mobile Adhoc Network consist of n sensor nodes with homogenous energy is deployed in circular region around a sink likewise each node senses the data periodically [15]. Once it receives data, then it is either transferred to the sink directly or to next neighbor hop. Further the network is divided into M concentric Logical Circles which are signified as C1, C2,…,CM. The radius of the network is denoted as $\dot{R}$ and the transmission radius is represented as $\dot{r}$ [16] as shown in Figure 2. The thickness of each concentric circle is calculated as $\dot{t} = \frac{\dot{R}}{M}$

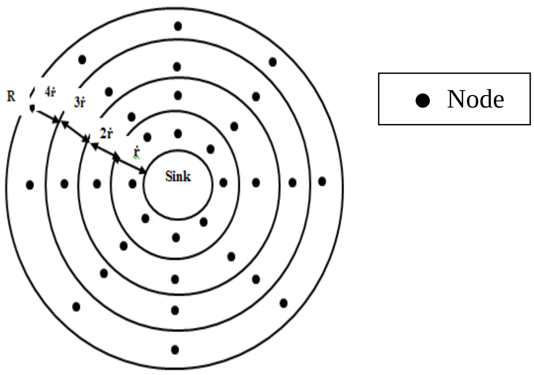

Figure 2: Mobile Network region divided into Concentric circles

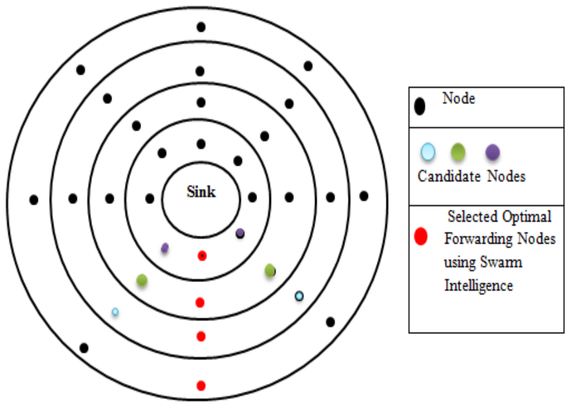

Figure 3: Selection of optimal forwarding nodes using swarm intelligence.

Energy hole alleviation using swarm intelligence

Energy hole often occurs in MANET due to the overloading of data transmission on some specific sensor nodes particularly those which are very closer to the sink node. This paper aims to overwhelm this problem in mobile cloud offloading and transmitting the ECG data packets of a particular patient in the network. Sensor nodes density (τ) are regularly deployed around the sink or base station in the network. Here the base station is free of energy limitation, whilst the sensor nodes are working with the power of battery which has limited constraint. During transmission of ECG details as data packets over the network the energy is majorly consumed so that this resource is considered as a most precious.

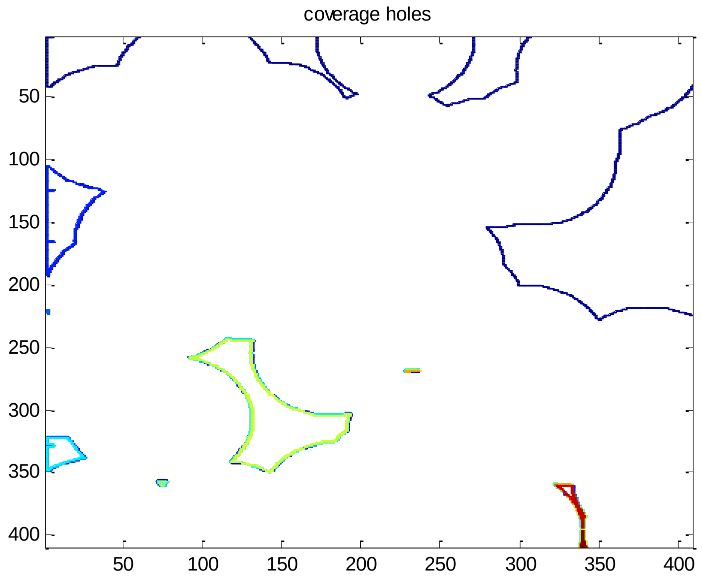

Figure 4: Network with void holes

After portioning the network area into concentric circles void hole is alleviated considerably as shown in the figures 3 and 4.

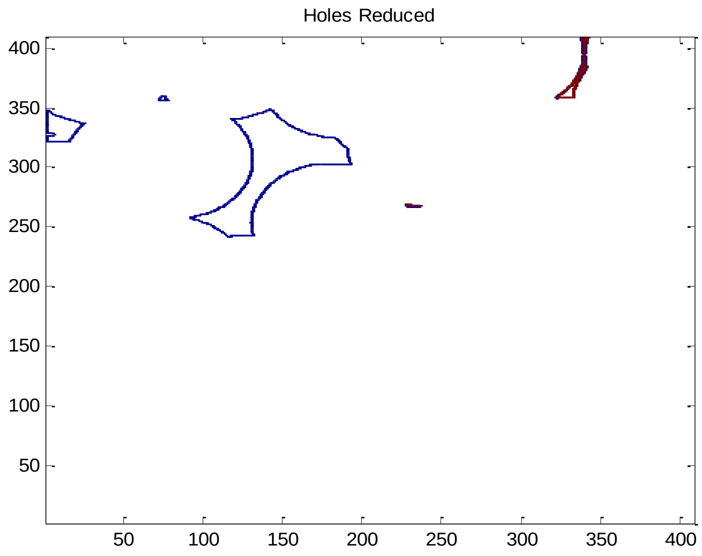

Figure 5: Reduced void holes

Considering these factors, the proposed methodology, Alleviation of Void and Energy Hole using Swarm Intelligence in Mobile cloud offloading (AVEH-SIMCO) introduces a two-stage process for efficient energy consumption in the following ways:

- Selecting optimal forwarding nodes to transfer the data packets using Swarm Intelligence
- Selection of shortest and optimal path from the source to end station using Fuzzy Inference System

In this paper first stage implementation works carried out and the second stage process will be carried out as future work.

Contribution of the proposed methodology

1. It well-handles the void hole alleviation in mobile cloud offloading paradigm by portioning the network area into concentric circles and distributing the sensor nodes uniformly

2. The energy hole which occurs due to depletion of energy especially nodes near the base station are significantly solved by following strategy

The Optimal forwarding nodes are selected by the swarm intelligence using fitness function without considering the candidate possible forwarding nodes.

4. Results

Simulation results

The performance of the AVEH-SIMCO is evaluated using NS2 simulation. The ECG Signal is preprocessed using Wavelet toolbox of MATLAB. To simulate the mobile cloud networking the following simulation setup is used.

Table 1: Simulation results

Parameter	***Value***
Network Area	1000x1000
Sensor nodes	100
Sink	100m away
Channel capacity of mobile nodes	2mbps
Simulated Traffic	CBR
E_0	0.5J
size(pkt)	500 bytes
msg	25 bytes

Performance metrics

The performance of the AVEH-SIMCO method is compared with the existing Lagrange Relaxation based Aggregated Cost (LRAC) [13] and WSNEHA [12].

The performance is evaluated using different metrics as follows:

Packet Dropped:

It is a measure taken while transmission of ECG data packets over the network the number of packets Dropped is considered

Pkt-Dropped = Number of packets send – Number of packets received

Throughput

It is calculated by dividing the number of packets successfully received to the total number of packets generated

Throughput = no. of packets successfully received/ no. of packets generated.

End to End delay:

It indicated as average time taken while data packets left out from the sender node and received successfully by the base station.

Energy:

It is a measure of Average energy consumed by overall forwarding nodes for data transmission.

5. Discussion

Results based on throughput

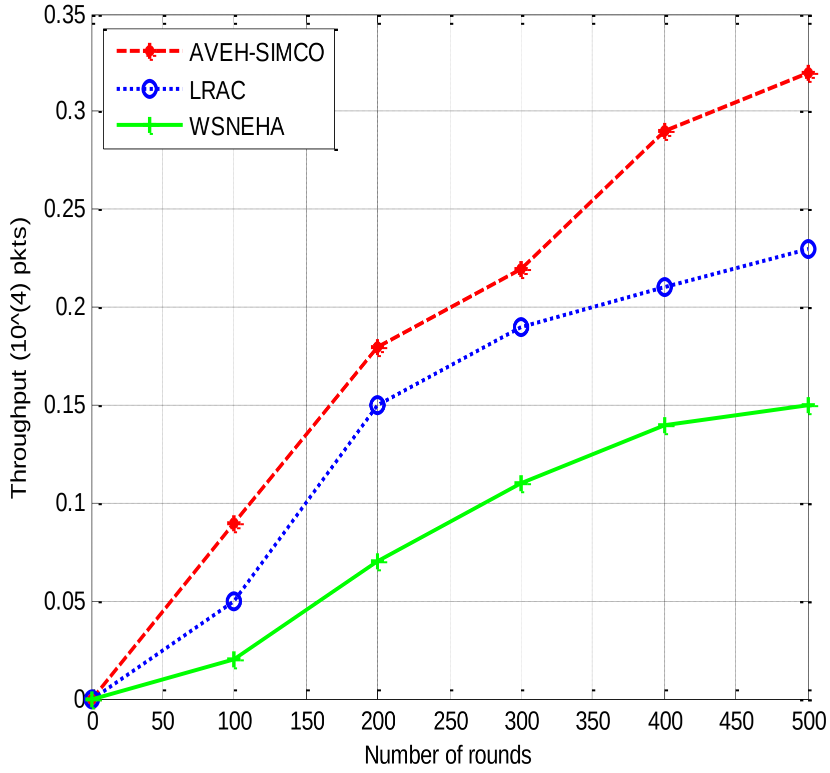

Figure 6: Average number of data packets delivered to sink.

From the figure it is analyzed that during the initial periods all the three algorithms, packet delivery ration (throughput) is equal. The differences arise after 50 rounds over. This is because the AVEH-SIMCO selects forwarding nodes with the intelligence of swarm behavior in this the highest fitness value node are considered as optimal forwarding nodes. In addition, the data packets are traversed each time with the knowledge of fuzzy inference engine which helps to choose the nodes with the status strong or if no strong forwarding nodes are found then it discovers the node with normal status. As a result more, data is transported to the base station using AVEH-SIMCO by alleviating the void and energy holes in an intelligent way. On the other side the two existing schemes LRAC and WSNEHA has low throughput because they did not handle the problem of energy hole hence, they failed to forward more data to sink

Results based on energy consumption

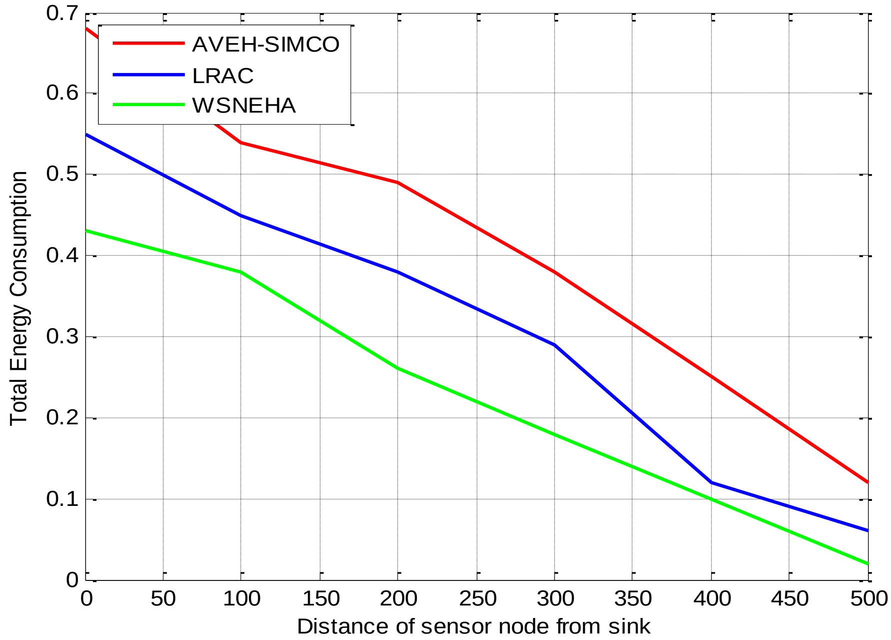

Figure 7: Total Energy Consumption

The figure reveals that the sensor nodes at smaller distance will participate more in the data broadcast and their energy depletes soon because they lie nearer to base station. The energy depletion of sensor nodes which are nearer to base station may leads to energy hole. Considering this factor, AVEH-SIMCO during the network setup it partitions the network are into concentric circles and deploys the sensor nodes uniformly random. Thus it avoids the early depletion of sensor nodes near to the base station. Using route recovery warning message it can able to alleviate occurrence of void and energy hole in network. The other two existing system LRAC and WSNEHA fails to handle the efficient energy consumption because of giving more loads to the sensor nodes near base station.

Results based on end to end delay

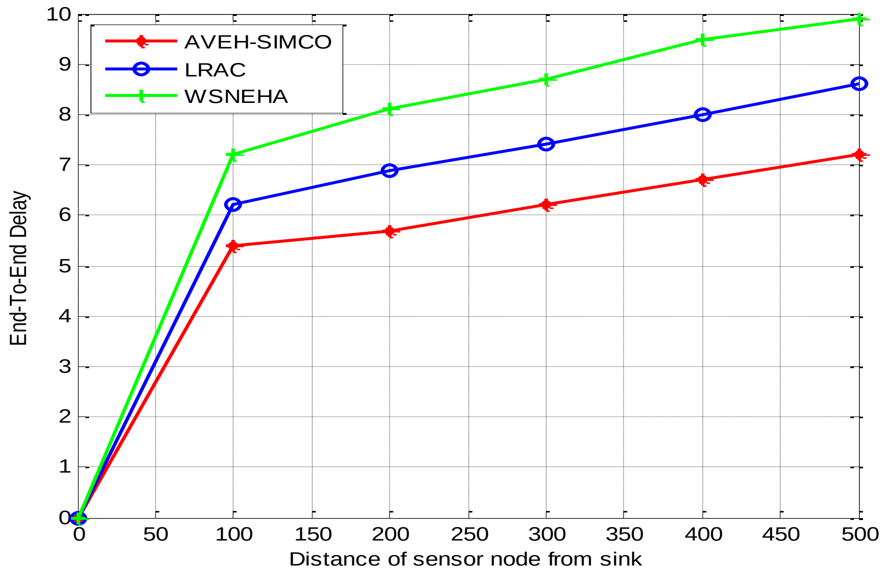

Figure 8: Results on End to End delay

The figure shows the relative analysis of AVEH-SIMCO, LRAC and WSNEHA algorithms based on end to end delay. WSNEHA takes more time mainly due to more number of error surviving and data retransmission. The time taken to select forwarding node selection is also high. Next, LRAC have high delay compared to AVEH-SIMCO because its selection strategy and computation complexity takes more time. Whereas AVEH-SIMCO takes less delay even it takes time for deciding the optimal forwarding nodes the network is partitioned into concentric circles and the sensor nodes are distributed uniformly and the node status is managed and updated each time the mobility of nodes takes place. Furthermore, it is also clear from the outline that the broadcast delay is low when the distance among the sensor nodes and base station is less.

6. Conclusions

Mobile cloud offloading transfers profound working outs from smart mobile device to distant cloud storage. It is an auspicious method to alleviate the great effort among resource-constrained mobile devices and resource-hungry mobile requests especially while transferring ECG signals in emergency situation where time is an important factor to promptly deliver such complex data packets over the mobile wireless sensor networks. The AVEH-SIMCO alleviates such issues by overwhelming random deployment of sensor nodes by diving them into concentric circles and it reduces the void hole problem. Thus it alleviates both coverage and energy hole in the mobile wireless network environment, with appropriate simulation result the optimized usage of mobile cloud offloading is achieved in the field of health monitoring system more efficiently while comparing other state of art. In future work selection of optimal path using Fuzzy inference work will be carried out and finally it will send to health care monitoring system for further treatment.

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