International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 22 (2018) pp. 15983-15991

Adaptive Load-Aware Based Efficient Channel Reservation and Assignment Method for Mesh Router

Mrs. M. Sudha,
M.Sc., M.Phil
Assistant Professor, Department of Computer Science,
Muthayammal College of Arts & Science, Rasipuram, Namakkal DT., India.

M. Shanmugapriya
M.Phil Scholar, Department of Computer Science,
Muthayammal College of Arts & Science, Rasipuram, Namakkal DT., India.

Abstract:

Versatility administration is a Mobile Wireless Sensor Networks (MWSNs) it is a mind boggling issue that must be being used into account. In MWSN, hubs move all through the system haphazardly. Subsequently, a way framed between two inaccessible hubs is profoundly vulnerable to changes because of unusual hub development. Additionally, because of the restricted assets in WSN, the ways utilized for advice manual charge be approved for the affiliation affection and time devoured for advice sending. Keeping in apperception the end ambition to appreciate these issues, in this paper, an Ant based council assemblage with QoS acute advice acquisition basic is proposed. In this assemblage the affiliation affection and affiliation adjournment are adjourned for anniversary amalgamate of hubs. Affiliation affection is adjourned as far as Packet Reception Rate (PRR), Received Signal Strength Indicator (RSSI) and Link Affection Index (LQI). A solid way is looked over the antecedent to the ambition in appearance of the means navigated by forward ants and in reverse ants. All things considered, if the connection is observed to be inadequate amid information transmission, a connection fortification strategy is utilized to convey the information bundle at the goal effectively. The portable robots gather the abstracts with aerial advice utility. Furthermore every carriageable apprentice is furnished with assorted accepting affairs and Space Division Multiple Access (SDMA) strategy is then connected for successful information accumulation from numerous versatile robots. Reenactment results demonstrate that the proposed steering convention gives unwavering quality by retreating the bundle drop and end-to-end defer when contrast with existing convention.

I. INTRODUCTION

- A Wireless Sensor Network (WSN) comprises of a few moment sensor hubs which perform capacities like observing the system encompassing, taking care of the detected data, speaking with the goal hub remotely, and so forth. The sensor hubs in WSN have restricted assets and are fundamentally microelectronic gadgets.
- After the corruption of the sensors in WSN, these sensors assignment apart utilizing batteries with belted vitality. Henceforth, activities, for example, directing, obligation aeon planning and average admission authoritative charge be performed productively in WSN [5,10]. WSN can be activated in home, military, science,, transportation, human services, calamity help, fighting, security, modern and building mechanization, space revelation, and so forth. WSN is unfathomably utilized in wonders checking [8].
- As of late, portable remote sensor systems (MWSNs) are ascending as another pattern of WSN. They gangs every one of the things of static WSNs alongside hub versatility [15]. A trouble in versatile remote sensor systems (i.e. intended for information assembling to some degree than for distributed sharing) is survey the 'best' way the message must take possible conveyance to a base-station or leave point from the system. The portability example of hubs is to a great degree dynamic and basically variable, developmental the ideal way is unthinkable [3]

Hub versatility conveys a few difficulties to expansive scale sensor organizing.

- The preconstruction of message conveyance system may not be helpful since the topology may change too every now and again because of hub development.
- The visit area refreshes from a versatile hub can prompt an unreasonable deplete of restricted battery intensity of sensors and expanded impacts in remote transmissions.
- The circumstance can deteriorate when the quantity of portable hubs develops.
- **Self Configuration:** Once send in an obscure region portable sensor hubs must, build to cover the zone.
- Agility: The marvels of consideration shrivel, extend, or relocate to additionally puts. MSN must acclimate to the modify of the dynamic detecting condition to expand the detecting inclusion.
- **Network Connectivity:** MSNs must approach a base station to portrayal the present detecting readings. In the event that subset of hubs has guide network to the base station, whatever is left of hubs gathered have multi-bounce ways to those have that ability.
- **Energy Efficiency**: Energy effectiveness is not kidding to stretch the system span. In this way, the voyaging territory of versatile hubs and the correspondence overhead ought to be limited.
- **Noise Tolerance:** The detecting condition is liable to an abnormal state of spatial and fleeting clamor and also the sensor perusing mistake. In any case, the MSN ought to

have the capacity to locate the ideal area of organization [12].

Steering in MWSN is extremely testing because of its always changing topology and customary connection disappointments. Connection disappointment causes delay in parcel conveyance and may likewise prompt bundle misfortune. Subsequently, vitality use increments. The greater part of the specially appointed steering conventions, for example, Ad hoc On-Demand Distance Vector (AODV) Routing and On Demand Multi way Distance Vector Routing (AOMDV) perform viably in customary systems, anyway these conventions work ineffectively in WSN since the assets are restricted in the system hubs. Additionally, the recuperation strategies used to defeat the rehashed connect disappointments devour high vitality. The customary directing conventions of versatile specially appointed systems like AODV, DSR, OLSR, LAR, and so forth and vitality moderating conventions can be utilized for WSN. Be that as it may, the persistent portability isn't considered as a system trademark by these conventions for choosing the connections to forward the information bundles. So in this paper, we propose to build up a steering method which considers the hub development [6]. In this paper, insect based directing convention alongside QoS powerful information gathering is proposed utilizing Ant Colony Optimization (ACO) calculation is proposed.

II. LITERATURE REVIEW

Getsy S Sara et al [1] have built up a half and half multipath directing calculation with a productive bunching component. A hub with higher measure of vitality, great correspondence range and least versatility is picked as the bunch head. The vitality utilization amid directing is taken care of productively by including the Energy Aware (EA) choice plan and the Maximal Nodal Surplus Energy assurance conspire in this paper. This proposed system incorporates the grouping and steering convention which performs well in exceedingly powerful condition and furthermore in vitality lacking system conditions.

Karim and Nasser [2] have displayed an area mindful and blame tolerant bunching convention for portable WSN (LFCP-MWSN). At the season of bunch development and development of hubs between two groups, the hubs are restricted by the LFCP-MWSN procedure by including a range free system. The vitality devoured by this convention is around 30% lesser when contrasted and the regular conventions. The conclusion to end transmission defer included with this convention is additionally low.

Samer Awwad et al [3] have proposed a system in which the group head acknowledges the information bundle from every one of the hubs in the system amid the schedule opening doled out by TDMA. In light of the movement and additionally portability highlights of the system, the TDMA planning is changed in like manner by the CBR Mobile WSN. The convention transmits the information towards the bunch head based on the got flag quality.

Peng Li et al [4] have proposed a group based information gathering calculation ECDGA for versatile remote sensor systems. This system is comprised of both versatile hubs and additionally static hubs. The versatile hubs shape a group independent from anyone else systemizing process which modifies its situation as per the separation between the static hubs. The bunch head is chosen by the static hubs based on the leftover vitality and versatile hub position, which is critical in exchanging the information parcel inside the group. Information assembling and additionally information combination is the undertaking of bunch head. This calculation improves the system lifetime and the system unwavering quality.

Daddy Dame et al [5] have proposed a portable access goals based on the X-MAC convention. This convention takes after a few strategies which helps in limiting the vitality use. The lifetime of the settled hubs are evaluated based on the MoX MAC convention and the decrease of the static hubs in the system because of the nearness of the versatile hubs is additionally taken care of.

Duc Van Le et al [6] have proposed an impromptu steering and handing-off design called as Robots' Controllable Mobility Aided Routing (RoCoMAR). After the errand is accomplished or if there is no more use from the transfer, at that point the mechanical hub quits working for the hand-off. At the point when the transfer position is resolved, the mechanical hub places itself at a situation by changing in accordance with the portability of the system hubs to keep up the connection.

Yongping Xiong et al. [11] have proposed an information reaping plan for irregularly associating versatile sensor organize. Their methodology took full preferred standpoint of capacity asset and versatility design information to enhance the conveyance proportion while limiting the transmission overhead. Besides, their powerful methodology could be versatile to the dynamic topology of system. An effective sending component and keen support administration technique were exhibited by them to course the information from versatile sensors towards various settled or portable sinks. In their plan, each sensor was related with a parameter conveyance utility which meant the probability that it could convey a message to a sink. Additionally a message was sent in their plan as per irregular or utility-construct technique depending with respect to whether the versatility example could be anticipated to a specific degree.

Farshid Hassani Bijarbooneh et al [13] have introduced a novel nature of-data (QoI) mindful information gathering convention (QoIACP) for remote sensor systems with portable clients. The convention is intended to advance information utility, which measures the standardized QoI estimation of gathered information per transmission. A half and half philosophy is utilized in our QoIACP convention with an appropriated neighborhood revelation convention, however unified bunching and information gathering booking for coordination among different portable clients. The calculation can essentially enhance information utility at low correspondence overhead. Anyway the sensors in QoIACP may have marginally higher correspondence overhead.

Yosef Alayev et al [14] accept proposed to accede a aberration of TMP affair with able manual ability and amount control. They accept abundant the affair for collective booking with either ascendancy or amount ascendancy or both. The advice things are to be transmitted to carriageable barter by agency of the anchored advice passages (APs). The scheduler devotes arrange of alternating timeslots of an AP to downloading an advice affair to a customer. The APs controlled manual accommodation to tune its manual extend ensuring that no impedance happens with adjoining APs' transmissions. In any case if two apparatus may meddle with anniversary added the ability levels and their manual ante may change.

Andrey Koucheryavy and Ahmed Salim [15] accept presented a anticipation based absorption algorithm for MWSNs. It applies all-important bearings for cluster-head acclamation beside with heuristic predictors to accomplish abiding and counterbalanced clusters.

ANT BASED ROUTING AND QoS

EFFECTIVE DATA COLLECTION MECHANISM

A. Ant Colony Optimization

Subterranean insect Colony Optimization (ACO) is a class of calculations whose first part is called Ant System. At the point when the creepy crawlies like ants, honey bees and so on., going about as a network, even with extremely constrained individual capacity can agreeably perform numerous intricate undertakings fundamental for their survival. This new heuristic is active and adjustable in ambidextrous with an all-encompassing array of combinatorial accessory issues. Here, the Forward Ant specialist (FA) builds up the pheromone clue to the antecedent hub while the Backward Ant abettor (BA) sets up the pheromone clue to the ambition hub.

Subterranean insect calculations archetype the conduct of 18-carat insect with a specific cardinal of basic all-overs developing arrange on a development diagram. Each bend in the development diagram is allocated an basal admeasurement of pheromone in the pheromone framework.After the development, every arrangement is assessed. This demonstrates the ants pick these edges in the following emphasis of the calculation.

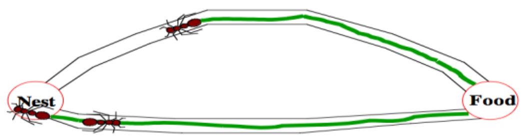

Figure 1. Foraging Behavior of Ants

- When all ants have registered their visit, Ant System refreshes the pheromone trail utilizing every one of the arrangements created by the subterranean insect settlement. Each edge having a place with one of the figured arrangements is adjusted by a measure of pheromone relative to its answer esteem. Toward the finish of this stage, the pheromone of the whole framework vanishes and the procedure of development and refresh is iterated.
- The elements of an ACO calculation can be condensed as takes after:
- set of computational simultaneous and offbeat operators (a settlement of ants) travels through conditions of the issue comparing to fractional arrangements of the issue to illuminate.
- They move by applying a stochastic neighborhood choice strategy in light of two parameters, called trails and appeal.By moving, each ant incrementally constructs a solution to the problem.
- When an ant completes a solution, or during the construction phase, the ant evaluates the solution and modifies the trail value on the components used in its solution.
- This pheromone information will direct the search of the future ants.

The algorithm is summarized as follows:

1. {Initialization}

Initialize $\tau\psi$ and $\eta\psi$, $K(\iota\psi)$.

2. {creation}

For each ant k (currently in state ι) do

repeat

choose in prospect state to travel into

Append the chosen move to the k-th ant's set tabu k.

until ant k has completed its solution.

end for

3. {track update}

For each ant move $\iota\psi$ do

compute $\Delta\tau\iota\psi$

Update the trail matrix.

end for

4. {Terminating state}

If not end test go to step 2

B. Proposed Contributions

In this paper, we propose to outline Ant based versatility supported directing convention for WSN. In this convention, the connection quality is evaluated regarding Packet Reception Rate (PRR), Received Signal Strength Indicator (RSSI) and Link Quality Index (LQI) [7]. Notwithstanding the connection quality, the connection deferral can likewise be included the connection support process [6]. In this convention, for course foundation, the Ant based directing of Ant Colony Optimization (ACO) is utilized. Here the forward ants (FANT) and back ward ants (BANT) can be utilized for course demand and course answer process, individually. Figure 2 demonstrates the square graph of the proposed directing convention.

The versatile robots gather the data with high information utility [16] .what's more we furnish every portable robot with numerous recieving wires and apply SDMA (Space Division Multiple Access) system to information gathering [17] from various versatile robots. SDMA plans information transmissions successfully with the goal that we can limit the aggregate information gathering time by investigating the tradeoff between most limited moving voyage through versatile robots and full usage of SDMA.

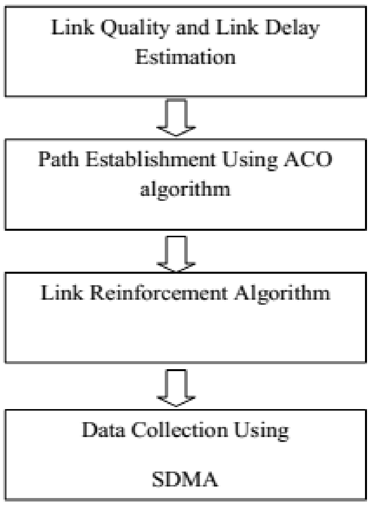

Figure 2: Block Diagram

C. Link Quality and Link Delay Estimation

The link quality is estimated in terms of Packet Reception Rate (PRR), Received Signal Strength Indicator (RSSI) and Link Quality Index (LQI) [7]. The LQI is estimated according to the equation (1) given below:

$$LQI = PRR \times normalized(RSSI_{mean}) \quad (1)$$

where $normalized(RSSI_{mean}) = \frac{RSSI_{mean}}{60} + \frac{100}{60}$ (2)

$$RSSI_{mean} \in [-100, -40] dbm$$

$$normalized(RSSI_{mean}) \in [0,1]$$

$$PRR \in [0,1]$$

The link delay, D_{link} is calculated according to equation (3) given below:

$$D_{link} = D_{proc} + D_{prop} \quad (3)$$

where D_{proc} is the processing delay involved with the forward ant/ backward ant

D_{prop} is the propagation delay between two nodes

D. Path Establishment for Mobile Robots using ACO algorithm

The path to transmit the data between the source and the destination is determined using the ACO algorithm. When there is need to transmit data, the ant colony is used to discover all the possible paths towards the destination using forward ants and backward ants. The format of the forward ant and backward ant is described in figure (2) and (3).

Table 1. Format of Forward Ant

Source Address	Destination Address	Intermediate Nodes	LQI value	Link Delay

Table 2: Format of Backward Ant

Source Address	Destination Address	Intermediate Nodes	LQI value	Link Delay

These ants use pheromone to identify the path travelled. The forward ants distribute pheromone as it travels towards the destination. The pheromone aids the forward node to select links with lower delay and connect to nodes with good LQI. After the forward ants reach the destination, backward ant is created which traverse back to the source. The backward ants use the information recorded and pheromone distributed by the forward node to reach the source. The pheromone, φ redistributed by backward node is given according to the equation (4) depicted below:

$$\varphi = \varphi + LQI - D_{link}(\text{ms}) \quad (4)$$

Based on the LQI value and time used, the path is selected. The ACO technique is described in algorithm 1.

Algorithm 1

Notations:

1. S : Source
2. D : Destination
3. LQI : Link Quality Index
4. D_{link} : Link Delay
5. F_{ant} : Forward Ant
6. B_{ant} : Backward Ant

1. When S wants to transmit data to D, it launches the F_{ant}towards the D.
2. The F_{ant} move towards D through intermediate 1hop nodes.
3. The F_{ant}calculate the LQI value for every path towards all the 1 hop nodes according to equation (1).

4. The 1hop nodes with path having higher LQI value are selected and as it passes a node, it distributes pheromone at the node.
5. As the F_{ant} passes each link, the link delay is estimated according to equation (3).
6. The intermediate node details, link delay and the LQI value of every node traversed by the F_{ant} are recorded by it.backward travel, the B_{ant} distribute the pheromone at all the traversed node and records the link delay.
7. When the B_{ant} reach S, the S considers the path with best LQI value and lower link delay to transmit the data packet.

Thus, the path from the source to the destination node is determined based on the ACO algorithm which considers the quality of every link used for data transmission. Also, the selected path ensures lower delay in forwarding packets.

E. Link Quality Reinforcement algorithm

Link Quality reinforcement is performed to reinforce the link defects. This is necessary even though the path is determined efficiently using ACO due to the error prone nature of the wireless sensor network. Due to the dynamic network topology, there are possibilities of link compromise. So, link quality reinforcement is used.

Every node maintains a routing table. In the node's routing table, information about its neighboring nodes and surrounding robotic nodes are recorded. The path from the source to destination is selected based on the ACO algorithm and the LQI at every route is estimated. In case of lower LQI, the link quality reinforcement algorithm is used. The link quality reinforcement algorithm is described in algorithm 2.

Algorithm 2

Notations:

1.	S	:	Source node
2.	D	:	Destination node
3.	ACO	:	Ant Colony Optimization
4.	LQI	:	Link Quality Index
5.	LQI_{ETE}	:	End To End LQI
6.	LQI_{req}	:	required LQI
7.	$REI_{Request}$	:	Reinforcement Request
8.	REI_{node}	:	Reinforcement Node
9.	REI_{reply}	:	Reinforcement Reply
10.	RN_{node}	:	Robotic Node
11.	M_{Req}	:	Move Request
12.	PRE_{node}	:	Predecessor node
13.	$next\_hop_{change}$	:	Next Hop Change

1. When the F_{ant} reach D, B_{ant} are created by D.
2. The B_{ant} move towards the source by traversing the path selected by the F_{ant}.
3. During the After the path is determined using the ACO algorithm, source transmits the data to the first intermediate node in the path.
4. When the intermediate node receives the data packet, it estimates the LQI and appends it at the packet header along with the LQI values of the previous nodes across the path.
5. On receiving the data packet, D retrieves the LQI value at every link and estimates the LQI_{ETE}.
6. D compares the estimated LQI_{ETE} with the predefined LQI_{req}.
7. If $LQI_{ETE} > LQI_{req}$ then, link quality is good.
8. If $LQI_{ETE} < LQI_{req}$ then, link quality is poor.
9. When the link quality is poor, D sends a $REI_{Request}$ to the node with lower LQI and it is considered as REI_{node}.
10. On receiving a $REI_{Request}$, the REI_{node} responds by sending an ACK to D to confirm the request reception.
11. If D receives the ACK, then it waits for REI_{reply}.
12. If D doesn't receive ACK within a predefined time interval, then it retransmits the $REI_{Request}$.
13. After sending an ACK to D, the REI_{node} searches for a RN_{node} in its neighborhood and sends a M_{Req} to the closest RN_{node}.
14. On receiving the M_{Req} which consists of the address of the PRE_{node}, the RN_{node} sends an ACK to the REI_{node}.
15. Then the RN_{node} moves towards the assigned location and locates itself at the midpoint between the REI_{node} and PRE_{node}.
16. RN_{node} updates its routing table with its predecessor node as PRE_{node} and its successor node as REI_{node}.
17. RN_{node} then sends a $next\_hop_{change}$ message to the PRE_{node}, to update its routing table with its successor node as RN_{node}.
18. Now the data packet is forwarded by the PRE_{node} to the RN_{node}, which in turn forwards the data packet to the REI_{node}.
19. On receiving the data packet from the RN_{node}, the REI_{node} sends a REI_{reply} to D to confirm the successful formation of a relay.

Thus, the robotic nodes are included in all the links with poor quality until the data is delivered at the destination. This increases the LQI value and thus stabilizes the path used for data transmission. So, data is delivered at the destination reliably.

F. Estimating Data Utility (D_u)

When a mobile robot enters a sensing field, it performs the function of collecting the data. But, for improved network operation, the data collected need to be of good quality, which is possible only if the data present at each node is of good quality.

Data Utility [16] is a metric estimating the sum of qualities of information from the sensed data divided by communication overhead occurring the network in during data collection. Moreover, it maximizes gathered information without any increase in energy consumption.

In Algorithm 3, the process of collecting the data with high data utility is described.

Algorithm 3

Notations:

1. S_i : Sensor node
2. m : mobile robot
3. i : integer value
4. $U(S_i, m)$: data utility for communication between S_i and m
5. $D(S_i)$: Data size that is buffered at S_i
6. $Q(S_i)$: Data quality at node S_i
7. $B(S_i, m)$: Boolean Variable
8. $H(S_i, m)$: number of hops between S_i and m

1. Every sensor node maintains two neighbor node sets; one its immediate neighbor nodes which is considered as the candidate sink nodes and the second node set is the immediate neighbor of its previous node.
2. When in the sensing field, if the candidate sink node in the node set of the sensor node differs from the candidate sink node of the previous sensor node set, then the current sensor node requests its candidate sink node for a neighborhood discovery process
3. In the neighborhood discovery process, the sink node broadcasts a message to the immediate neighbors.
4. The broadcasts message includes information such as node address, data size in the buffer, and data quality.
5. The sensor nodes receiving the broadcast message responds by providing its information to the requesting node.
6. Based on the received information, the candidate node ananlyzes the surrounding sensor node's locations.
7. Then a cluster of sensor nodes is formed by considering the nodes with high data utility value.
8. The data utiliy value is estimated by the mobile robot according to (5) :
$$U(S_i, m) = \frac{D(S_i).Q(S_i).B((S_i, m)}{H((S_i, m)} \qquad (5)$$
9. The sensor with higher data utility value is selected as the data collecting point by the mobile robots.
10. In this way, a cluster of sensor nodes are formed with high data quality.

Thus, all the sensor nodes with higher data quality are selected by the mobile robots for better network performance.

G. Data Collection using Space Division Multiple Access (SDMA)

Algorithm-4

Notations:

1. P : set of subsets of polling points
2. P_i' : subset of polling points
3. S_i' : sensor nodes
4. i : integer value

1. The polling points in the network are selected and grouped according to its current region, into a set of subsets of P denoted by P_1', P_2',….., P_n', such that
$$P_1' \cap P_2' \cap \dots \dots \cap P_n' = \emptyset$$
$$P_1' \cup P_2' \cup \dots \dots \cup P_n' = P' \epsilon P_i$$
2. The sensor nodes in the network are grouped according to its current location and represented by S_1', S_2',….., S_n', such that
$$S_1' \cap S_2' \cap \dots \dots \cap S_n' = \emptyset$$
$$S_1' \cup S_2' \cup \dots \dots \cup S_n' = S' \epsilon S_i$$
3. The mobile robots visit the polling points in the sequence P_i' where i=1, 2 ….., n, such that maximum data gathering time among n regions is minimized.
4. Thus, the overall latency involved in data collection from the sensor nodes is minimized.
5. Then the compatible pair among sensors are determined by connecting two sensors which lie within the coverage area of a single selected polling point.
6. The polling point ensures that the compatible pair of sensors are in a short moving tour.
7. If the sensor pair does not lie within the short moving tour path, then this pair is ignored.
8. This guarantees the latency involved in data uploading to be maintained at a minimum level.
9. By connecting all the polling points, a minimum spanning tree is created and values are allocated to each point of the tree.
10. Then the spanning tree is divided into smaller trees, since the network range is usually too large to be considered a single tree.
11. After the tree size is optimized, the mobile robots traverse through the tree.
12. The mobile robots hop from one polling point to the next polling point, along the tree path.
13. At each polling point, the mobile robot collects data from every compatible sensor pair within the coverage area of the polling point.
14. After gathering data from one polling point, the mobile robot hops to the next polling point and so on.

III. SIMULATION RESULTS

A. Simulation Parameters

We utilize NS-2 [16] to reproduce our proposed Ant based Routing and QoS Effective Data Collection (ARQEDE) convention. We utilize the IEEE 802.11 for Mobile Sensor organize as the MAC layer convention. The sensor hubs are arbitrarily sent over a zone of size 500 meter x 500 meter. It has the usefulness to educate the system layer in regards to connect breakage. In the reproduced topology, there are 5 versatile mechanical hubs and 95 portable sensors with one static sink or base station, situated at the upper right corner. The portable sensors are moving at a normal speed of 2m/s and the versatile robots are moving at the speed of 5m/s.

The execution of AMAR is contrasted and RoCoMAR [6] and MoXMAC conventions and the execution is assessed regarding normal bundle drop, parcel conveyance proportion, end-to-end delay, normal lingering vitality and directing overhead.

The simulation settings and parameters are summarized in table 1

Table 1: Simulation parameters

Total number of Nodes	101
Number of Robotic nodes	5
Speed of mobile sensors	2 m/s

B. Results & Analysis

In this section, the performance evaluation of AMAR and RoCoMAR protocols are presented by changing the data distribution rate and number of traffic flows.

1. Varying Data Sending Rate

The data sending rate of CBR traffic is varied from 50 to 250Kb for 10 traffic flows and the performance is evaluated.

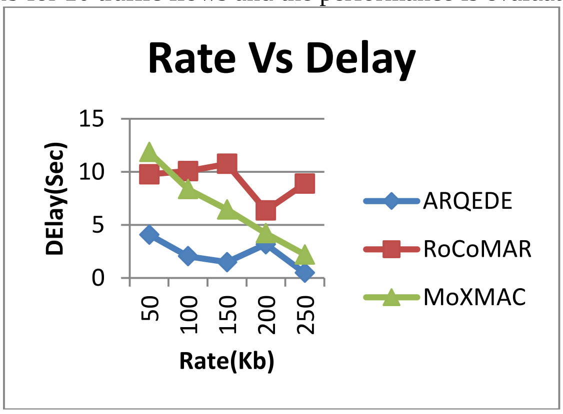

Fig 4: Rate Vs Delay

Figure 4 shows the resutls of delay for ARQEDE,MoXMAC and RoCoMAR protocols, when the rate is varied. Since ARQEDE includes the link delay metric also in path establishment, the associated delay of ARQEDE is 73% lesser when compared to RoCoMAR and ARQEDE is 64% leser when compared to MoXMAC.

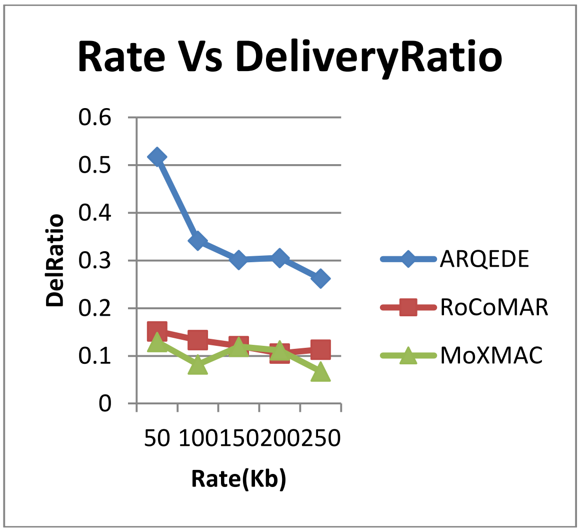

Fig 5: Rate Vs Delivery Ratio

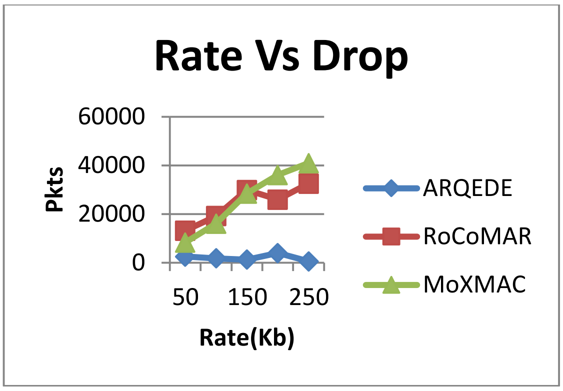

Fig 6: Rate Vs Drop

Figure 5 and 6 show the resutls of packet delivery ratio and packet drop for ARQEDE ,MoXMAC and RoCoMAR protocols, when the rate is varied. As the volume of data traffic increases, there will be more packet drops. As depicted in figure 5 and 6, the packet drop linearly increases for RoCoMAR at higher data rates whereas ARQEDE shows a steady packet drop and delivery ratio. Accurate estimation of link quality in ARQEDE yields 63% higher delivery ratio and 90% lesser packet drops, when compared to RoCoMAR and ARQEDE is 70% is higher delivery ratio than MoXMAC and ARQEDE is 88% lesser packet drops.

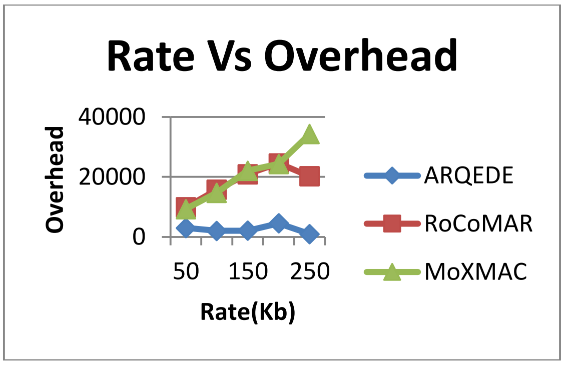

Fig 7: Rate Vs Overhead

Figure 7 shows the results of overhead occurred for ARQEDE,MoXMAC and RoCoMAR protocols, when the data sending rate is varied. The use of ACO technique in ARQEDE reduces the huge packet exchange involved in route discovery. Hence the overhead of ARQEDE is 84% less, when compared to RoCoMAR and 85% less,when compared to MoXMAC.

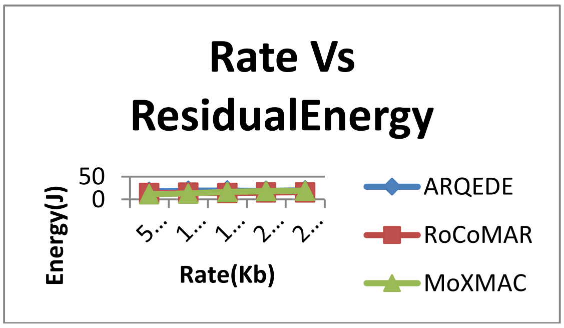

Fig 8: Rate Vs Residual Energy

Figure 8 show the results of residual energy for ARQEDE and RoCoMAR protocols, when the rate is varied. When compare the performance of two protocols, we infer that ARQEDE has 21% higher residual energy, than RoCoMAR, since the number of route disconnections is minimized in ARQEDE there by reducing the energy involved in retransmission and 18% higher residual energy then MoXMAC.

2. Varying the Data Flows

The number of sources sending data to the sink are varied from 2 to 10 with a data sending rate of 50Kb and the performance is evaluated.

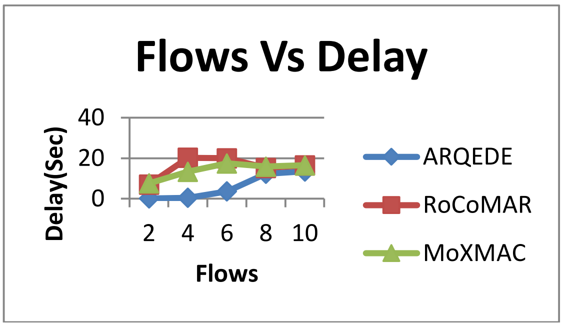

Fig 9: Flows Vs Delay

Figure 4 shows the resutls of delay for ARQEDE,MoXMAC and RoCoMAR protocols, when the rate is varied. Since ARQEDE includes the link delay metric also in path establishment, the associated delay of ARQEDE is 63% lesser when compared to RoCoMAR and ARQEDE is 64% leser when compared to MoXMAC.

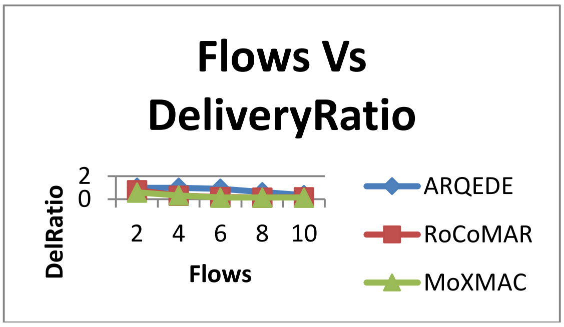

Fig 10: Flows Vs Delivery Ratio

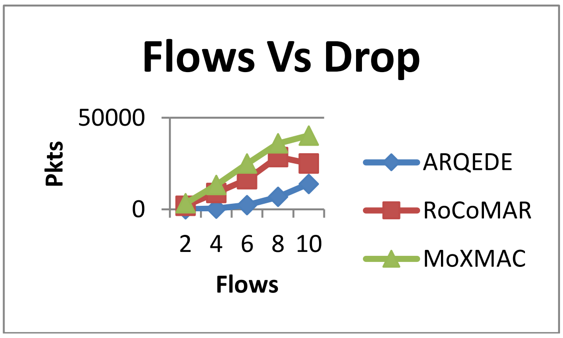

Fig 11: Flows Vs Drop

Figure 10 and 11 demonstrate the resutls of parcel conveyance proportion and bundle drop for AMAR and RoCoMAR conventions, when the information streams are changed. As the volume of information movement increments, there will be more parcel drops. As delineated in figure 5, the bundle drop directly increments for RoCoMAR and AMAR when the information streams are expanded. Precise estimation of connection quality in AMAR yields 60% higher conveyance proportion and 67% lesser bundle drops, when contrasted with RoCoMAR.

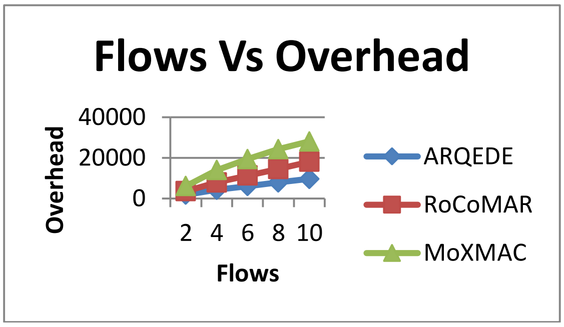

Fig 12: Flows Vs Overhead

Figure 12 shows the results of overhead occurred for ARQEDE,MoXMAC and RoCoMAR protocols, when the data sending rate is varied. The use of ACO technique in ARQEDE reduces the huge packet exchange involved in route discovery. Hence the overhead of ARQEDE is 46% less, when compared to RoCoMAR and 68% less,when compared to MoXMAC.

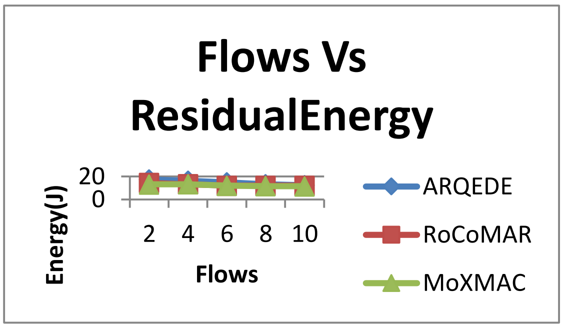

Fig 13: Flows Vs Residual Energy

Figure 13 show the results of residual energy for ARQEDE and RoCoMAR protocols, when the rate is varied. When comparing the performance of the two protocols, we infer that ARQEDE has 14% higher residual energy, than RoCoMAR, since the number of route disconnections is minimized in ARQEDE there by reducing the energy involved in retransmission and 17% higher residual energy then MoXMAC.

IV. CONCLUSION

In this paper, the remote sensor organize is subterranean insect based portability supported steering framework. At first, the insect settlement enhancement procedure is utilized to decide a solid way. The forward ants and the regressive ants utilize pheromone to abstain from returning to any hub which may drag out the way. The connection quality and defer included are the critical variables utilized for way choice by the subterranean insect state. After the determination of a way, information bundles are transmitted by the source towards the goal hub. Amid information transmission, the connection quality is again tried and contrast through an incentive with a predefined esteem. In the event that the connection quality is resolved to be poor then mechanical hubs are set in the poor connection in the middle of the two back to back halfway hubs. This upgrades the connection quality and makes the connection solid. The information is then conveyed at the goal by embeddings automated hubs at whatever point any connection quality is resolved to be poor. For QoS powerful information gathering, every versatile robot is furnished with various radio wires to apply SDMA system to gather information with high adequacy. Entertainment results demonstrate that the proposed steering conventions give steadfastness by lessening the parcel drop and end-to-end defer when contrasted with existing conventions.

REFERENCES

[1]. Getsy Sara, Kalaiarasi, Neelavathy Pari and Sridharan, "Energy Efficient Clustering And Routing in Mobile Wireless Sensor Network," International Journal of Wireless & Mobile Networks, Vol.2, No.4, 2010

[2]. L. Karim and N. Nasser, "Reliable location-aware routing protocol for mobile wireless sensor network," The Institution of Engineering and Technology, 2012

[3]. Samer A. B. Awwad, Chee K. Ng, Nor K. Noordin, and Mohd. Fadlee A. Rasid, "Cluster Based Routing Protocol for Mobile Nodes in Wireless Sensor Network," IEEE, 2009

[4]. Peng Li and Xu Jian-bo, "ECDGA: An energy-efficient cluster-based data gathering algorithm for Mobile Wireless Sensor Networks," IEEE International Conference of Computational Intelligence and Software Engineering, 2009.

[5]. Papa Dame Ba, Ibrahima Niang and Bamba Gueye, "An optimized and power savings protocol for mobility energy-aware in wireless sensor networks," Springer, Telecommunication System, 2013

[6]. Duc Van Le, Hoon Oh and Seokhoon Yoon, "RoCoMAR: Robots' Controllable Mobility Aided Routing and Relay Architecture for Mobile Sensor Networks," Sensors, 2013

[7]. Michele Rondinone, Junaid Ansari, Janne Riihij arvi and Petri Mahonen, "Designing a Reliable and Stable Link Quality Metric for Wireless Sensor Networks, "Proceedings of the workshop on Real-world wireless sensor networks, ACM, 2008

[8]. Xing Zhang, Jingsha He and Qian Wei, "Energy-Efficient Routing for Mobility Scenarios in Wireless Sensor Networks," In Proceedings of the Third International Symposium on Electronic Commerce and Security Workshops, 2010

[9]. Shahzad Ali and Sajjad Madani, "Distributed Efficient Multi Hop Clustering Protocol for Mobile Sensor Networks,"The International Arab Journal of Information Technology, Vol. 8, No. 3, 2011

[10]. Kai Li and Kien A. Hua, "Mobility-assisted Distributed Sensor Clustering for Energy efficient Wireless Sensor Networks," Ad Hoc and Sensor Networking Symposium, 2013.

[11]. Yongping Xiong, Jianwei Niu, Jian Ma and Limin Sun, "Efficient Data Delivery in Mobile Sensor Networks", Journal of Communication and Computer, ISSN 1548-7709, Volume 7, No.5 (Serial No.66), USA, May 2010.

[12]. Seokhoon Yoon, Onur Soysal, Murat Demirbas, and Chunming Qiao, "Coordinated Locomotion of Mobile Sensor Networks", 5th Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks, SECON '08, San Francisco, CA, 16-20 June,2008.

[13]. Farshid Hassani Bijarbooneh, Pierre Flener, Edith Ngai, and Justin Pearson, "Optimizing Quality of Information in Data Collection for Mobile Sensor Networks", Quality of Service (IWQoS), 2013 IEEE/ACM 21st International Symposium on IEEE 2013.

[14]. Yosef Alayev, Fangfei Chen, Yun Hou, Matthew P. Johnson, Amotz Bar-Noy, "Throughput Maximization in Mobile WSN Scheduling With Power Control and Rate Selection", IEEE Transactions on Wireless Communications, Vol. 13, No. 7, Pages: 4066-4079, July 2014.

[15]. Andrey Koucheryavy and Ahmed Salim, "Prediction-based Clustering Algorithm for Mobile Wireless Sensor Networks",

[16]. Farshid Hassani Bijarbooneh, Pierre Flener, Edith Ngai, and Justin Pearson, "Optimising Quality of Information in Data Collection for Mobile Sensor Networks", Quality of Service (IWQoS), 2013 IEEE/ACM 21st International Symposium on IEEE 2013.

[17]. Miao Zhao, Ming Ma and Yuanyuan Yang, "Efficient Data Gathering with Mobile Collectors and Space-Division Multiple Access Technique in Wireless Sensor Networks", IEEE TRANSACTIONS ON COMPUTERS, VOL. 60, NO. 3, MARCH 2011

[18]. Network Simulator: http:///www.isi.edu/nsnam/ns