Mobile Agent Data Aggregation Technique for Wireless Sensor Networks

[1]Dr.Srinivas Dava

[1]Associate Professor, Dept. Of Computer Science & Engineering

[1]Jyothishmathi Institute of Technology & Science, Karimnagar,India

Abstract:

The efficient energy would always have animportanceat the time of schemingnetworks of wireless sensor. Introducingthetechnology of mobile agent in the networks of the wireless sensor for the sake of collaborativesignal and processing information has been delivered the new choiceto processefficientand data aggregation. Mobile agent based scatteredfiguring paradigm which would offerplentifuladvantages over the prevailing and they are normally utilized client/server calculating paradigm inthe networks of wireless sensor. Recently the mobile agent (MA) wasrecommended to offer a solution which is substitutefor the data which is traditional that gather in Wireless Sensor Networks (WSNs). Mobile agent achieves the data processing task and aggregation of the dataat the level of node rather than at the sink, hence, rejecting the terminated networkoverhead. The most vitalchallenges in paradigm which is mobile agent-based is anitinerary scheduling for an agent traversal. We initiated a fuzzy with agent of dynamic mobile which is basedon the data aggregation approach(FuMADA) that would be consideringefficientenergy, lifetime of network,end to end postponement and ration of aggregation at the time ofa taking a decision of the movement of data agent inthe multi-hop network of sensor. As our methodthat consider 3 parameters: energy that is remaining, distance, and the number of neighbours.The experiments of simulation would be shown that FuMADA systemenhances the successful MA round-trip rate and the lifetime of network.Additionally, aninitiated FuMADA methodoutperforms the algorithms that are compared in the energy distribution terms utilization among nodes.

Keywords: Wireless Sensor Networks, Routing algorithms, Mobile agent-based data aggregation, Mobile agent, Dynamic itinerary, Energy consumption, Network lifetime, FuMADA.

I. Introduction

The currentdevelopments and advances in the micro-electrosystem of field mechanical and communications that are wireless have paved a path for Wireless Sensor Networks (WSN). WSN are beenhere to be known as one of the importantzonesof studyas of their capabilities foraltering the way of interactionamidstthe world of physical and human. In the past several years,WSN would have been twisted to be an immense interestmatter. WSN is a modest network with a tiny infrastructure, that consist of a numerous tiny node of sensorwith an energy that is computational and limited ability. Sensor nodes in WSN are deployed densely in variedconditions of environment also used tonotice theaspectssuch aspressure, temperature, humidityetc. [1, 2].

The distributed as well as dense systems have capacityto perform toughinferences and tasks which wouldreplace the traditional centralized architectures at a rate of prodigious. A DistributedSensor Network (DSN) is a pooling of numerous homogenous or heterogeneous nodes of sensor that are logically distributed, spatially or geographically over a location of interest and linkedby a network [3]. The sensors which collect the data repeatedly from their environments, processesit and then communicate it by the network. The gathered information from the network's severalparts is then attachedto each other to get the final inferences [4].

The nodes of sensor are been powered by battery devices that havecomputational constrained abilityand limitedrange of sensing, so, collaboration (i.e. correlation between located spatially nodesto decrease the overalltransmission of thedata to the centre of processing), is also needed so the nodes could be made for the shortcomings of one another's for controlling the data'sredundant flow in the network,hence, making it efficient of energy. Forenabling theapplicationprocessing of collaborativeinformation in WSN, spread computing paradigms are needed [5, 6].Although, it faces fewdifficultieslike single point of failure, huge network traffic,consumption of high bandwidth, andnetwork lifetime reduction.

The paradigm of Mobile Agent (MA) [7, 8] has beeninitiated forWSN to overcome these challenges.Here, MAs travelsince node to nodeutilizing the nodes' resourcesto perform the allotted task. MA based model has many advantages like network loadreducing, network latencychallengeovercoming,tolerating androbustness of the faults.At that point of time,fewproblemssuch as the network overhead, issues of energy inthe networks of low-densitycase are available [9]. The migrated MAselectively amongstthe nodesof sensoraffecting the code of processing among the nodes that are targeted, also would perform the processing local byutilizing efficientresources that haveavailability at the local nodes than the entirely transmissionof redundant data to a central processor (sink), and that fuses localincrementally information oneach node of sensor for reaching a progressively accurate global consensus [10].

The itinerary of an MA could be prearrangedin MA-based data pooling by utilizing 2 approaches: SIP (Single Itinerary Planning) and (MIP) Multi Itinerary Planning). In SIP, a sole MA has beentransmitted from sink and would also be travelling to the nodes of source to completethe gathering of data [11]–[14].Various MAs are spread to network and concurrently work in MIP [15]– [17] by contrast.

The MA application has been determined by which strategy itinerary has to be assumed. Anactive itinerary is applicable to track the targetingapplications which are given areal-time MA adaptation itinerarythat is neededfor providing progressive accuracy [13], [18].A static itinerary by contrast is more appropriate for the monitoring of data applications where these physical quantities measurements (liketemperature and humidity) are periodically gathered at the sink. Also, we would befocusing on the static itinerary in thestudy.

We recommendlogic of fuzzy with MA based aggregation of data methodfor mitigating the issues in this paper. The FuMADA methodregulates an appropriate itinerary for an MA by taking into the consideration of3constraints: distance, energy that is remaining, and number of neighbors. The proposed FuMADA methodthat would be increasing the successful rate of MA's round-trip. Besides, the FuMADA algorithm would be improving the lifetime of networkthroughpicking the node with a higher residual energy as the next hop for migration of MA. Hence, the approach is also capable for balancing the consumption of energy amongst the nodes that would increase the overall sensor networklife time.

II. Literature survey

Determiningitinerary as thebest for traversal of MA is an issue of chiefstudy for theactual and effectualgroupof the data from many sensor nodes in the sensor network of mobile agent-based[19]. The nodes sequence in an itinerary would have a vital impact on the accuracy and qualityof data fusion which influences ultimatelythe main purpose of WSN, inapplications like target tracking or environment controlling. Itineraries could be categorized in2 ways: first one, whether they are static or dynamic; second one, whether they utilize a singleagent or multiple agents. Itineraries could be either statically or dynamically planned [19].

In [20], the authors have been shown two methods which are namely: Local Closest First (LCF) whereMA appearances up for the next node that have the least distance from the current node;and Global Closest First (GCF), where the MA searches for the next node that have theleast distance from the PE. A quiet alikeapproach to LCF has been recommended in [21]called Mobile Agent-based Directed Diffusion (MADD). MADD would differ from LCF only inthe choice of the first source node; rather than selecting the nearest node from the PE itstarts by choosing the farthest node as the initial one. However, all these methods thatby takinginto the consideration of only the spatial nodeslocations and hence they are not energy efficient.

A Genetic Algorithm (GA) [22] based methodensures not need anyutteringnode finding for the algorithm to implement; instead it selects any of the active node as the initial node. As,each node mustdescribe its status to maintain theinformation globally at the PE, so GAsustains a lot of overheadcommunication. Two energy efficient approaches Itinerary EnergyMinimum for First-source-selection (IEMF) and Itinerary Energy Minimum Algorithm(IEMA) having been presented in [23]. IEMF chooses the first source node as the one whose subsequentitinerary has lowermost energy cost which was estimated amongst other itineraries, and then ituses LCF tactic to strategy the itinerary that is remaining. IEMA would iterate IEMF k times to furtherdevelop the efficiency of the energy.

An MA-based Directed Diffusion (MADD) was recommended in [12]. MADD is alike to LCF yetvaries in the same sense that an MA chooses the farthest node from the sink as the first source node. Though the LCF, GCF, and MADD approaches are very easy to be implemented, they are also not accessibleas the MA itinerary that is resolute according to the distance among source nodes.

In [24], two algorithms, namely, the selection of IEMF and IEMA, which have beenpresented to attain energy-efficient itineraries. IEMF adopts the round robin method, where every node is been tentatively selected as the first source node. Then, the LCF algorithm is applied to the remaining source nodes. Such procedurewould be generating different candidate itineraries, where every itinerary is corresponded toan energy cost. Subsequently, an itinerary with the lowest energy cost is chosen by IEMF. By contrast, IEMA is the iterative form of IEMF, such that IEMA controls the outstanding source nodes visiting order along the first source node. Despite the returns of the IEMF and IEMA algorithms in terms of energy efficiency, these algorithms are still evidently based on the LCF algorithm which is associated with LCF and GCF. LCF looks for the next MA's hop depending on the current location of the MA despitelooking for global network information. Furthermore, the LCF, GCF, IEMF, and IEMA techniques were developed with a single MA itinerary (SIP), which displayslesspresentation in a large-scale network.

III. Proposed framework

This unitwould present the planned FuMADA approach. The FuMADA techniquethat is based on DMAS (Decision making for mobile agent selection) with help of FLS (fuzzy logic set), computational intelligent system (CLS). DMAS is taking a decision which is based on mobile agent choice algorithm that has been utilized to the network performance enhancement. DMAS offers advantages to design a WSN routing protocol in terms of media characteristics transmission and performance of protocol, thereby making fuzzy representation easy and realistic. A method that is being provided the elasticity in terms of the impact deciding of an individualconstraintwhich include in the function of cost. Hence, depending on the application's requirement one can adjust the weight factors accordingly giving the higher or lower priority tothe parameters based on the scenario. And, if needed we could be adjusted the weight aspects ofthe cost function for changing environments to offer more elasticity in terms of impact ofindividual parameters in deciding the route of MA migration.

When the determinationof an itinerary for an MA in WSNs, numerous constraints, like remaining energy, number of neighbors, and distanceshould be measuredconcurrently when choosing the next MA's migration hop. Hence, choosing the appropriate node for the next MA's hop under these multi-parameters exerts a considerable influence on overall network performance. Here, DMAScould be offered an appropriate solution for this type of multi-constraintassessmenttricky. That is, DMAScould be integratedvarious node selection constraints.

In the suggested FuMADAmethod, DMAS is utilized to compute the MA's hop sequences amidst each two source nodes (intermediate nodes) by calculating the possibility of each candidate node based on their input restrictions. Before the sink dispatches MAs to the network for data pooling, the maintenance of the global information of all the nodes to partition the network and regulateeach MA visiting order for both source and intermediate nodes. The source nodes visiting order has been obtained by using the LCF algorithm, whereas the visiting order of intermediate nodes is computed by using DMAS.

For each MA's hop between the intermediate nodes, three constraints are been utilized as the inputs to DMAS for every candidate node. These constraints include remaining energy, distance to the source node, and number of neighbors of the candidate node. After DMAS controls the next node for an MA, the chosen node will be added to the MA's visiting order. The same process will be recurring for the next hop of migration of MA till all the MAs' itineraries for all partitions are regulated. Figure 1shows the flowchart of the FuMADA approach.

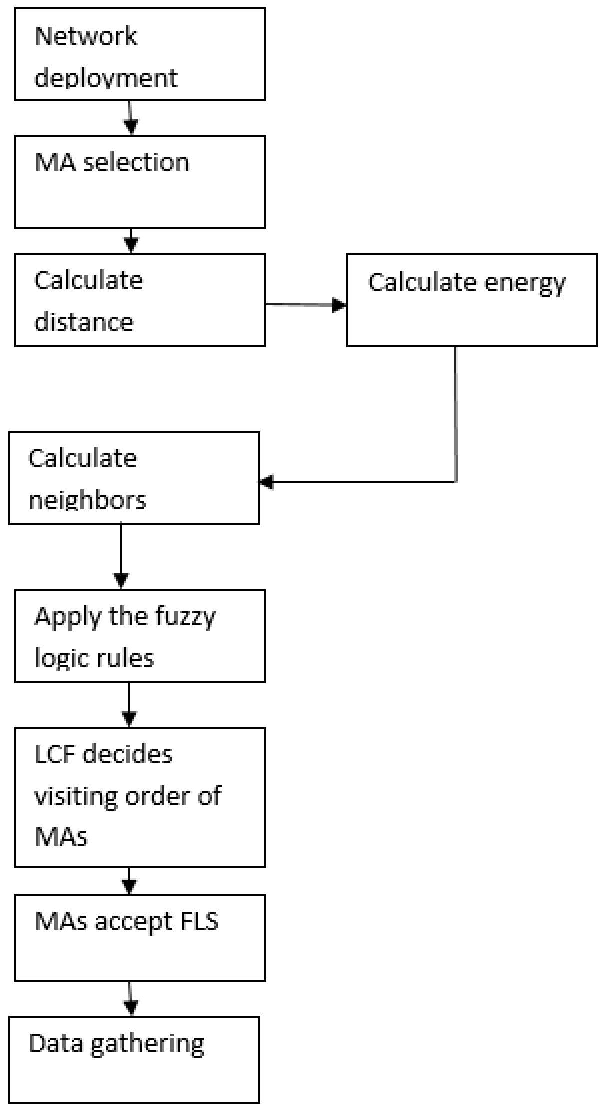

Fig1: FuMADA approach

DMAS input parameters:

As mentioned earlier, three parameters were utilized as inputs to FLS in our proposed FuMADAmethods. In this work, we limited the input constraints to three inputs to circumvent the problem of fuzzy rule explosion. Increasing the number of input parameters in FLS will rise the difficulty of the rule base in the plannedmethod. Whereas, a method, such as the hierarchical fuzzy system (HFS), is planned to lessen the size of the rule base while maintaining adequate accuracy. The three constraintsthat are been used in this research are described as follows:

1) Node's remaining energy: This parameter designates the node's energy which is remaining. All nodes at the outset have an initial energy. The nodes begin to lose

energy because of the MA migration process after starting the first data gathering task.

2) Distance to the source node: This parameter mentions to the distance of a candidate node to the next source node. The geographical information of all the organized nodes in the network is expected to be known to the sink; hence, the distance between each two nodes could be computed easily.

3) Number of node's neighbors:This constraintsignifies the number of nodes that lies within the radius of each candidate node within the location of the current MA. The number of candidate's neighbors is used in this research to make surewhere the MA always has a adequate number of candidates for the subsequent hop decisions because of the multi-hop migration model for MA-based data gathering.

Table1: Fuzzy rules in FuMADA approach

Remaining Energy	Dis to source node	No.of neighbors	Decision making
Low	Far	Small	V-Low
Low	Close	Small	V-Low
Medium	Medium	Small	V-medium
High	Far	Small	V-Low
High	Close	Large	V-High

IV. Result and discussion

In the simulation of our proposed scheme we have considered all ways of energy consumptionincluding both communication and computational costs. Most of the proposed MIP (multi-agent itinerary planning) approaches adopt the proposed SIP (Single Agent Itinerary Planning) algorithms for the itinerary of each individual MA. In this segment, the FuMADA method has been evaluated relative to previous fuzzy based mobile networks. For the approaches that are compared, the LCF algorithm is been adopted to regulate an MA's itinerary. Simulations are achieved using NETWORK SIMULATOR-2.35. The itineraries of MA's are programmedstatically at the sink node before the MAs are dispatched to the network. In FuMADA, the LCF algorithm is adopted to govern the order of the visited source nodes, whereas the intermediate nodes visiting order between each two source nodes is controlled by DMAS. The node of sink has been positioned at the network center and is the starting and ending points of each MA's itinerary.

Parameter	Value
Application Traffic	CBR
Transmission rate	1024 bytes/0.5ms
Radio range	250m
Packet size	1024 bytes
Maximum speed	30m/s
Simulation time	10000msec
Number of nodes	40
Area	1000x500
Routing protocol	AODV
Mobile agent	1,2,3,4
Routing method	FuMADA, EEDAMA, LTAWSN

Table1: Simulation table

We assume that 40 sensor nodes are distributed randomly in this paper over a 1000x500m^2 field by taking into considerationof the Radio range as 250m.In the Table1, shows that the parameters of system that are utilized in our simulations. We make use of Application Traffic here as CBR (Constant Bit Rate) it could be supportedto control the traffic in network, Routing Protocol as AODV and it is used for routing level in network, Routing Methods are FuMADA, EEDAMA, andLTAWSN in our simulation, and this routing approached are used efficiently to perform the outcomes of network. Then, the rate of transmission is 1024 bytes/0.5msby taking into the consideration of the Packet size as 1024 bytes and with a Maximum speed 30m/s and the total Simulation time is 10 sec.

Evaluation results:

In this section, we utilize the mobile agent based data aggregation method. According to the delay, energy, and throughput, we present experimental results of the algorithm which are introduced below.

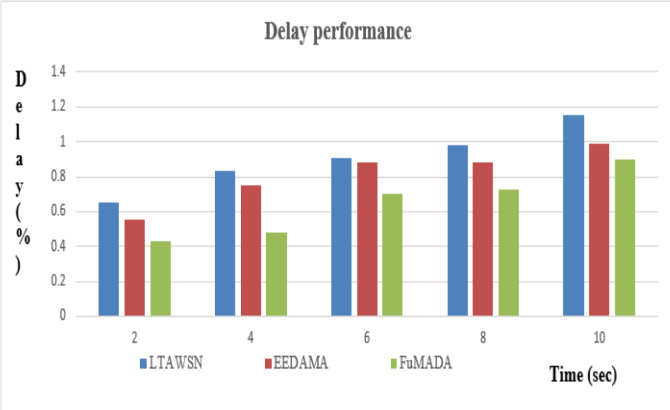

Fig2: Delay performance

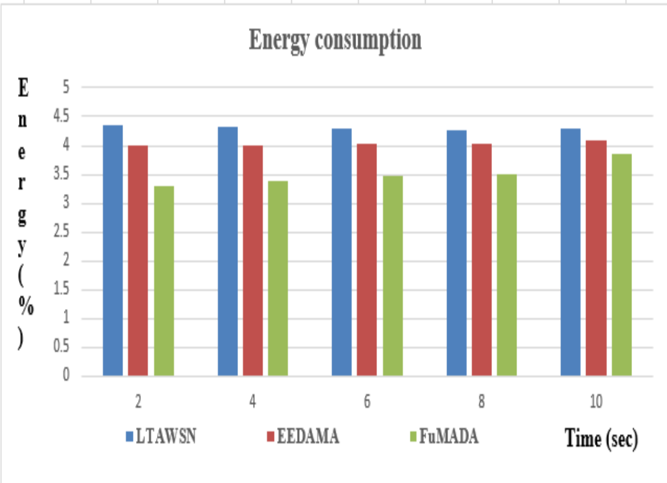

Fig3: Energy consumption

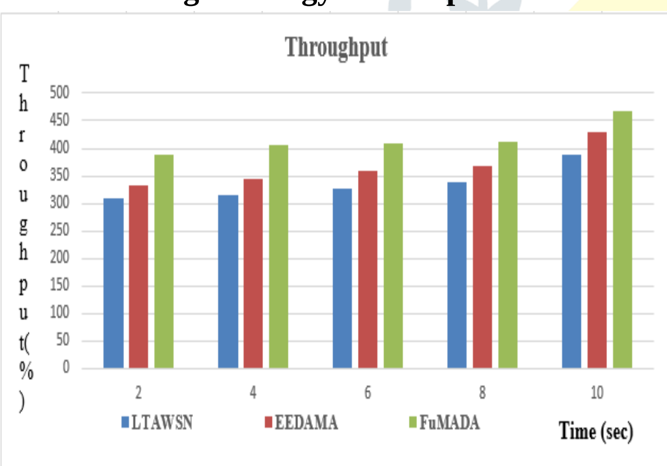

Fig4: Network performance

In fig 2, this graph would be showing and representing end2end delay.It shows a simulation time versus delay. The fuzzy logic performance with mobile agent data aggregation methodprogresses delay time whichis meant tolessen the delay between communication nodes when compared to energy efficient mobile agent aggregation of data method and life time aware routing algorithm for WSN. Fig 3 graph would show and represent consumption of energy. The performance of fuzzy logic with mobile agent data aggregation approach enhancesconsumption of energy compare with energy efficient mobile agent data aggregation method and life time aware routing algorithm for WSN. Fig 4 is showing and representing thenetwork throughput. The performance of fuzzy logic with mobile agent data aggregation approach improves network performance compare with energy efficient mobile agent data aggregation method and life time aware routing algorithm for WSN.

Conclusion

In earlierapproaches, the authors have presented an efficient energy aggregation of data method byusing MA for WSN. They didn't focus on decision making with few conditions where there is a possibility here. In our work, the FuMADA approach is proposed to regulate an appropriate MA itinerary. Extensive simulation experiments have been conducted to compute the performance of FuMADA. The simulation outcomeswould show that FuMADA outperforms the compared with previous methods in terms of distance, residual energy, FLS, and number of neighbours. This method of proposalcould be enhancedby balancing energy among nodes for each calculated itinerary.

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