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Ant-Fuzzy Meta Heuristic Genetic Sensor Network System for Multi Sink Aggregated Data Transmission

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***Abstract*—** Wireless sensor network with the hierarchical organization of sensors aggregate the tasks into groups. The sensor nodes broadcast the aggregated data directly to the distant base station. Existing Mixed Integer Programming (MIP) formulation obtain the good solutions for multi-action processes but not effectual in developing the hybrid genetic algorithms with the Tabu search meta-heuristics ant colony optimization. Another existing work developed for security purpose named as Dynamic secure end-to-end Data Aggregation with Privacy function (DyDAP) decrease the network load but topological configurations with multiple sinks are not addressed. To develop the hybrid genetic algorithm on ant-fuzzy system, Hybrid (i.e.,) ant-fuzzy Meta-heuristic Genetic method (HMG) based on the Tabu search is proposed in this paper. Ant-fuzzy Meta heuristic Genetic method carries out the classification process on the aggregated data. The classification based on the genetic method uses the Tabu search based mathematical operation to attain the feasible solution on multiple sinks. Initially, Ant-fuzzy Meta-heuristic Genetic method classifies the data record based on the weighted meta-heuristic distance. The classified records perform the Tabu search operation to transmit the aggregated data to the multiple sink nodes. HMG method achieves approximately 19 % improved transmitted message rate. Experiment is conducted in the network simulator on the factor such as classification time and transmission rate.

Keywords- *Weighted Meta heuristic, Tabu Search, Ant-Fuzzy Genetic method,*

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I. Introduction

A wireless sensor network consists of an enormous number of minute, low-priced, self-powered sensor devices. The communication device for the purpose of gathering local information makes use of the global decision operation on the sensor network environment. The storage space capabilities and energy resources are also measured in the wireless sensor network. The data aggregation of the network has established the considerable attention over the previous numerous years by the research population. The design of energy aware data aggregation protocols and algorithm helps us to save the energy and consequently extend the network transmission power.

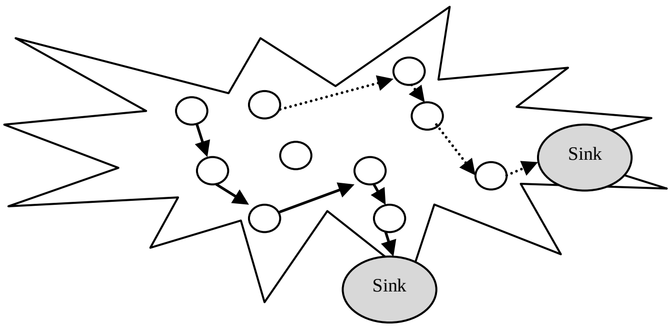

Figure1. WSN with Sink nodes

Figure 1 describes the sensor nodes for addressing result to the queries through the sink nodes. The query result is addressed to all sink nodes based on several conditions in sensor network. All though many researchers have discussed about a variety of transmission, still sensible solutions are not offered for the multiple sink node transmission in sensor network.

Location-Based Pair wise Key Pre-distribution (LPKP) as described in [3] generates the random key but fails to provide security with private key values in sensor network. Redundancy administration of heterogeneous wireless sensor networks (HWSN) as expressed in [7] makes use of multipath routing for responding different user queries but tolerance protocol is not developed for security.

Sleep wake scheduling (SS) method in [4] forward a packet to the adjoining node primarily and then wakes up in the middle of several candidate nodes in WSN. Sleep wake scheduling protocol and any cast packet-forwarding protocol capitalize on the network lifetime, and subject to a restraint on the expected end to end packet-delivery delay. SS fail to generalize the energy resources on wake-up processes of sensor network. Generic Algorithm is presented in [6] to determine the k-connectivity but fails to develop secured distributed versions. MIP formulation as described in [1] discovers the dissimilarities surrounded by business and developed processes. MIP is not effectual in addressing the hybrid genetic algorithms with the Tabu search meta-heuristics ant colony optimization.

In the proposed work, Hybrid Meta-heuristic Genetic method is used to initially classify the ant-fuzzy rule based on aggregated data. The aggregated data is confidential through the genetic chromosome concepts and through the weighted meta-heuristic distance. The classified data are transmitted through Tabu search based data path selection and transmission of information. The data packets are transmitted on the multiple sink (i.e.,) base station in the wireless sensor network.

The structure of this paper is as follows. In Section 1, describes the basic problems in classification of aggregated data. In Section 2, present a method named HMG based on the Tabu search. Section 3 outline the parameters and the ns2 simulator set up range. Section 4 presents the experiment

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results. Section 5 demonstrates the related work and Section 6 concludes the work.

II. HYBRID META- HEURISTIC GENETIC METHOD ON WIRELESS SENSOR NETWORK

The main objective of the proposed work is to classify the aggregated data and performs the path searching process for the effective transmission of data packets on the multiple sink nodes. In the first step, the classification operation is carried out with the hybrid (i.e.,) ant-fuzzy rule aggregated data information. The aggregated information is classified with the meta-heuristic genetic algorithm. After the classification, the searching process is carried out using the Tabu search for the effective transmission of the data packets on the sensor network. Architecture Diagram of the Hybrid Meta-heuristic Genetic (HMG) method is illustrated in Figure 2.

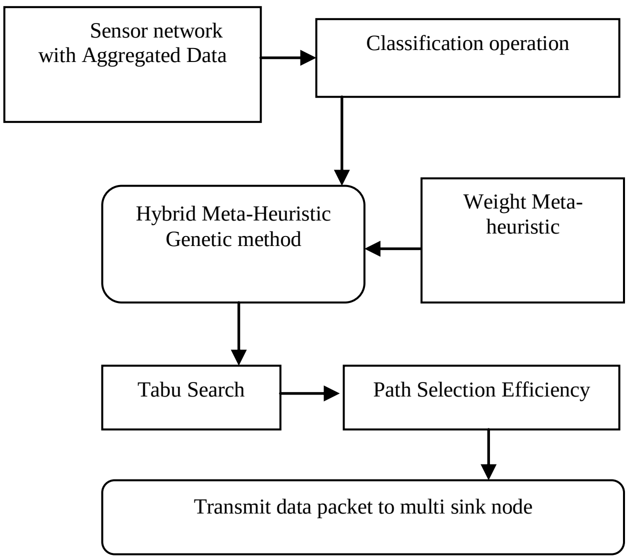

Figure 2. Architecture Diagram of HMG method

As illustrated in Fig 2, HMG method overall process is briefly explained through the diagram. The energy effective data aggregation is performed on the sensor network using the fuzzy ant colony optimized clustering rule. The aggregated data through the ant-fuzzy rule is used to perform the classification using the Hybrid Meta-Heuristic Genetic system. The classification process using the weighted meta-heuristic form helps to improve the classification accuracy rate. The classification data are searched using the Tabu search in HMG method to increase the path selection efficiency. The selection of path helps to transmit the data packet to the multi-sink nodes.

A. *Weighted Meta-Heuristic Distance for Classification*

Hybrid Meta-Heuristic Genetic system uses the ant-fuzzy aggregated data rule to classify the data packets. The hybrid genetic concept in HMG provides the appropriate classification using the meta-heuristic chromosome weight distance computation in wireless sensor network. Meta-heuristic in HMG method denotes the high level procedure which is used to classify, search and transmit the data packets to the destination sink nodes. Chromosome Weighted meta-heuristic is written as,

$Data\ Aggregated\ Fuzzy\ Rule$

$f_i(x) = f_1(x), f_2(x), \ldots . f_n(x)$ ….. Eqn (1)

Ant-Fuzzy rule are demonstrated in Eqn (1) with $f_i(x)$. $f_1(x)$ and $f_2(x)$ are the fuzzy set rule of 1,2…up to n where the the classification through weighted procedure. The weighted procedure in HMG method is computed as,

$g_i(x) \geq 0\ (i = 1,2,3..n)$. Eqn (2)

$h_i(x) \leq 0\ (i = -1, -2, -3..n)$. Eqn (3)

$g_i(x)$ and $h_i(x)$ denotes the classified part in HMG method using the meta-heuristic chromosome weighted distance. The positive and negative value of chromosome weighted in HMG method varies based on the axes distance in sensor network. Chromosome Weighted Meta-heuristics is formularized as,

$$CWM = \sum_{i=1}^{n} \begin{cases} g_i(x), h_i(x), if\ c_n = i \\ 0, \quad if\ c_n \neq i \end{cases} \quad …….. \text{Eqn (4)}$$

Where $g_i(x), h_i(x)$ is the classified part, if they are Equal to 'i', then the result have accurate result on classification. Otherwise, the result is set to zero in Chromosome Weighted Meta-heuristics (CWM) form.

B. *Hybrid Genetic Algorithm*

Chromosomes are vectors of real-valued weights from the hybrid (i.e.,) ant-fuzzy rule. Each chromosome is a vector with the weight count of decimal numbers and vector value of the chromosome is associated with each classification attribute in HMG method. Hybrid genetic Algorithm based classification is demonstrated in Figure 3.

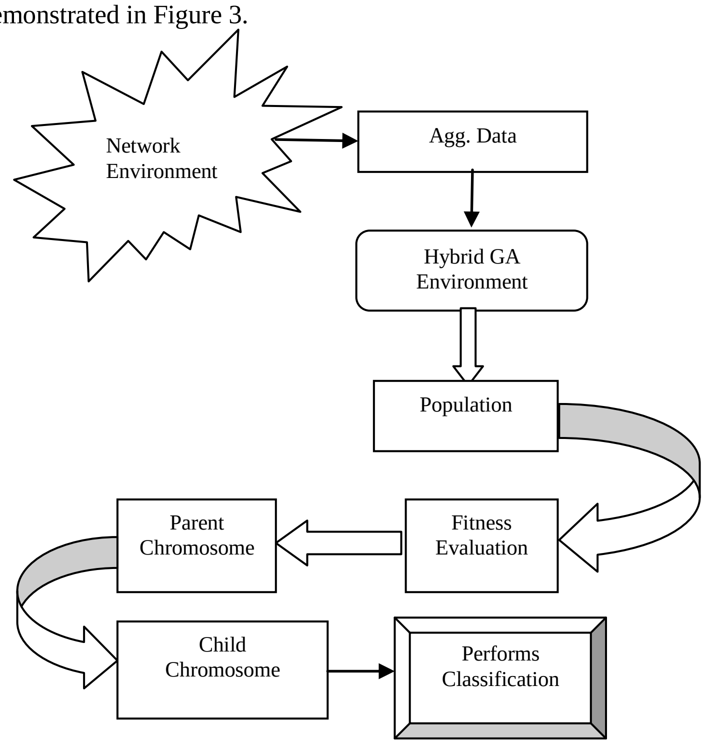

Figure 3. Hybrid Genetic Algorithm based Classification

Figure 3. describes the classification of aggregated data using the hybrid genetic algorithm. The initial population is measured in hybrid genetic method to easily measure the classification time. The populated chromosome measures the weight using the fitness function. The fitness function is measured for the parent chromosome selection. The selected parent chromosome perform the weighted meta-heuristic measure to classify the child chromosome (i.e.,) offspring in

sensor network. The goal of the hybrid genetic algorithm is to have an attribute fitness vector from the ant-fuzzy weights and to improve the classification accuracy. These computations are used in a number of ways to evaluate the functions and demonstrated through the algorithmic step.

//Sensor Network Environment

Step 1: Aggregated Data 'D1', 'D2', 'D3'…'Dn'
Step 2: Initialize a population 'P' of 'n' data packets from sensor network
Step 3: For every population 'P'
Step 4: Fitness function on 'n' data packets
Step 5: If data packet passes the weighted criteria test,
Step 6: Then the classification process is preceded, until the specified termination condition
Step 7: End if
Step 8: Parent Chromosome classified based on the Eqn (2) and (3) result
Step 9: Child Chromosome classified based on parent attribute vector value
Step 10: End For

The classified attribute is associated with initial population of chromosome to generate the effective data aggregated process. The parent and offspring chromosome are effectively selected using the hybrid genetic algorithm for the ant-fuzzy rule based data packet classification.

C. Tabu Search in HMG Method

The classified Ant-fuzzy rule data aggregation in HMG method performs the searching process through Tabu mathematical operation. The Tabu search in HMG method refers to the set of classification rules to formulate the binary programming. The delay time minimized in HMG method by judging the result of the individual users and formularized as,

$$Tabu\ Search\ Time = Min \sum_{g=1}^{n} \sum_{h=1}^{n} [\sum_{i=1}^{n} e_{ig}, e_{ih} \quad]$$

…..Eqn (5)

Tabu search time minimize the delay count by computing the Eqn (5) for the each users. $\sum_{g=1}^{n}, \sum_{h=1}^{n} are$ weight result of the meta-heuristics.The classified records perform the Tabu search operation to transmit the aggregated data to the multiple sink nodes without any strategic delay. The meta-heuristic weight guides to search the optimal result and explore the solution space. Initially, Tabu search assume i*=i and k=0, where k=0 at the root node. Tabu search in HMG method is described as,

Step 1: Choose a data packet 'i' from the population set 'P'
Step 2: K=k+1, when travelled with the data packets
Step 3: Binary programming choose best path
Step 4: If $f_i(x)<f_i * (x)$, then i* = i.
Step 5: Update Tabu and goal conditions
Step 6: User request satisfied, then stop, else go to Step 2
Step 7: End If

Tabu search in HMG method offers the bilinear path to transmit the ant-fuzzy rule based data packets for the multiple sink nodes. The program specifies the sink nodes and connected though objective function. The first denotes parent (i.e.,) root attribute values and the second term denotes the (i.e.,) offspring attribute values. The Tabu search based data packet transmission in HMG is demonstrated in Figure 4.

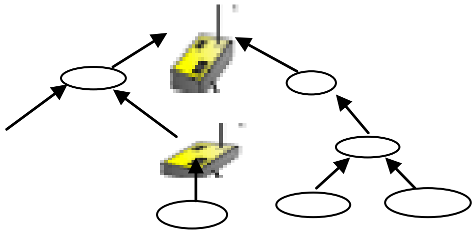

Figure. 4 Multi Sink Data Packet Transmission

Tabu search used to transmit the ant-fuzzy data packets to the multiple sink nodes with the feasible solution. In the first stage of data packet transmission in HMG method, a quality solution produced with the root path selection. After the root path selection, the offspring (i.e.,) forwarding nodes are judged to improve the diversity of result. Finally, a diversification strategy is used in HMG method to generate a new initial solution to reinitialize the procedure and perform the data aggregation for the other set of features.

III. HMG EXPERMENTAL WORK EVALUATION

Hybrid (i.e.,) ant-fuzzy Meta-heuristic Genetic method (HMG) based on Tabu search is experimented on ns-2 simulator.. The network range taken for the experimental work is about 1000*1000 m. HMG takes the 25 milliseconds on each simulation and averagely 80 sensor nodes are taken for the experimental evaluation. The minimum moving speed of the sensor node is about 4.0 m/s of each sensed node. The random movement of sensor nodes uses the Dynamic Source Routing (DSR) Protocol while performing the experimental evaluation in the HMG method. Transmission message rate is defined as the amount of efficiency in transferring the data packets to the multiple sink nodes.

$$Transmission\ Message\ Rate = \frac{Message\ Size}{Network\ Throughput}$$

Message varied on each request and the network throughput is maintained as '90' in experimental work. Classification time is defined as the amount of time taken to classify the aggregated data and it is evaluated as,

$$Classification\ Time = Start\ Time\ for\ classification - End\ Time\ of\ classification$$

IV. RESULT ANALSIS ON HMG METHOD

HMG method performs the experimental work and compares the result percentage on the existing MIP and DyDAP function.

TABLE 1 TRANSMITTED MESSAGE RATE

Message Size (KB)	Overall Transmitted Message Rate (m/s)		
	MIP method	DyDAP	HMG method
5120	48.29	50.22	56.88
10240	90.75	101.45	113.77
15360	140.69	155.76	170.66
20480	189.17	200.65	227.55
25600	250.91	265.19	284.44
30720	280.43	300.78	341.33
35840	350.19	369.72	398.22

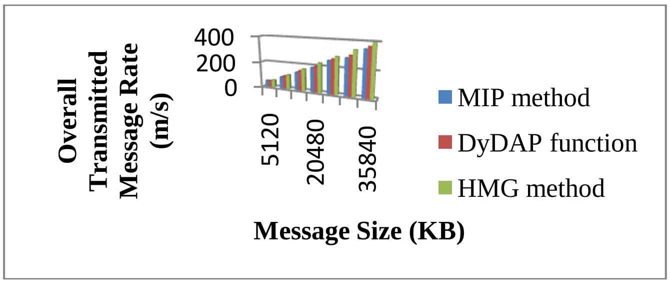

Figure 5 Transmitted Message Rate

Figure 5 describes the transmitted message rate. The hybrid genetic concept in HMG provides the transmission using the meta-heuristic chromosome weight distance computation in wireless sensor network. Meta-heuristic in HMG method improves the transmission rate by 13 – 25 % when compared with the MIP method [1]. HMG method transmits the data packets from 7 – 13 % improved when compared with the DyDAP function [2].

TABLE 2 CLASSIFICATION TIME

Data Record Size (KB)	Classification Time (sec)		
	MIP method	DyDAP	HMG method
50	440	420	400
100	585	528	500
150	910	880	850
200	1530	1495	1462
250	1925	1885	1724
300	2199	2176	2125
350	2452	2398	2256

Figure 6 Performance of Classification Time

Figure 6 presented the classification time based on the data record size. In HMG method, $g_i(x)$ and $h_i(x)$ denotes the classified part using the using the meta-heuristic chromosome, so that the classification rate is reduced up to 3 – 14 % when compared with the MIP method [1]. The positive and negative value of chromosome weighted improves the axes distance measure, so that the HMG method is 2 – 8 % lesser time taken to classify when compared with the DyDAP function [2].

Finally, Hybrid Meta-heuristic Genetic method is used to classify the ant-fuzzy rule based data aggregation set. The classified data are transmitted through Tabu search based data path selection and transmission of information.

V. RELATED WORK

User-Customizable Urban Traffic Information Collection (CUTIC) Method as presented in [7] provides different routing paths to meet diverse user. CUTIC scheme achieve the good balance between the energy consumption but the time get delayed on different set of attribute aggregation. Beaconless Geo Routing (BGR) algorithms decide accurate edges on [5] define a beaconless recovery algorithm but efficiency on packet delivery is not enhanced when routing overheard occurs in sensor network. Maximum Weighted Matching (MWM) scheduling policy as demonstrated in [9] offer the effective throughput scheduling but the distributed routing algorithms is not designed.

The optimization model as illustrated in [11] with mathematical formulation is still needs to be developed with the fast heuristic algorithm for privacy maintenance. Dynamic secure end-to-end Data Aggregation with Privacy function (DyDAP) as illustrated in [2] decreases the network load but topological configurations with multiple sinks are not addressed.

VI. CONCLUSION

Hybrid Meta-heuristic Genetic method classifies the aggregated data and produces the optimized search result to the sensor network system. The path search in sensor network is carried out effectively using the Tabu search. The Tabu search mproves the path efficiency rate to 11.34 % when compared with the DyDAP function. Hybrid genetic algorithm result offers a minimal absolute error rate and achieves improved classification performance in a realistic time. HMG method is adapted to different contexts of sensor network for transmitting the data packet to the different sink nodes. Network simulator provides averagely 5.172 % lesser delay time and 7.95 % improves the buffer level memory rate by effectively managing the memory through Tabu search. Tabu search in HMG method is used for the effective transmission of the ant-fuzzy data packets in sensor network.

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