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TABU Search Based Cluster Head Selection in Stable Election Protocol

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Abstract— The clustering in the Wireless Sensor Networks (WSN) is one of the most important investigation areas. There are many cluster head selection algorithms which were developed before today. Tabu search based algorithms is developed to reduce the energy consumption and enhance the WSN life-time. The comparison is done among the SEP ,D-SEP,M-SEP and TABU based SEP in the wireless sensor network. The planned technique has the flexibility to beat the constraints of the SEP routing protocol by pattern clump and TABU search. The comparison square measure drawn among the current and planned techniques. The comparisons has clearly shown that the planned technique outperforms over the on the market techniques.

Keywords— *Wireless sensor network (WSN), SEP,D-SEP,M-SEP,TABU SEARCH.*

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I. INTRODUCTION

A wireless sensor network (WSN) comprises of hundreds to several thousand low-power multi-functional sensor nodes, doing work in an unattended environment [1,5], and having sensing, computation and communication capabilities. The fundamental aspects of a node certainly are a sensor unit, an ADC (Analog to Digital Converter), a CPU (Central processing unit), an energy unit along with a communication unit. Sensor nodes are micro-electro-mechanical systems (MEMS) that create calculable reaction to a modification of some physical condition like temperature and pressure. Sensor sense or measure the physical data with the area to become monitored. The repetitive analog signal sensed through the sensors is digitized by an analog-to-digital converter and delivered to controllers for further processing. Sensor nodes are of smaller size, use extremely low energy, are operated in high volumetric densities, which enable it to be independent and adaptive towards environment.The spatial density of sensor nodes within the field might be as much as 20 nodes/ m^3. As wireless sensor nodes are generally smaller electronic gadgets they could only be well prepared having a limited power source. Each sensor node carries a certain part of exposure for the purpose it may and properly report the specific quantity that it must be observing. Some reasons for power consumption in sensors are: (a) signal sampling and conversion of physical signals to electrical ones; (b) signal conditioning, and (c) analog-to-digital conversion.

II. SEP (STABLE ELECTION PROTOCOL)

GeorgiosSmaagdakis, Ibrahim Matta and AzerBestavros [6,7,8] proposed SEP (Stable Election Protocol) in which there two types of nodes called normal nodes and advance nodes with advance nodes having (1+a) more energy than the normal nodes. Every sensor node in a heterogeneous two-level hierarchical network independently elects itself as a cluster head based on its initial energy relative to that of other nodes. The probabilities for nodes to be cluster head [13] is given by equation (1):

$$p=\begin{cases}\frac{p_{opt}}{1+am} & \text{for normal nodes;}\\ \frac{p_{opt}\,(1+a)}{1+am} & \text{for advance nodes;}\end{cases} \quad (1)$$

Unlike [2], SEP does not require any global knowledge of energy at every election round. Unlike [3], [4], SEP is dynamic in that it does not assume any prior distribution of the different levels of energy in the sensor nodes. Furthermore, the analysis of SEP is not only asymptotic, i.e. the analysis applies equally well to small sized networks. Finally SEP is scalable as it does not require any knowledge of the exact position of each node in the field.

III. D-SEP (DETERMINISTIC-SEP)

In this paper, authors have proposed a new SEP protocol called as Deterministic-SEP (D-SEP) [11,13], for electing cluster heads in a distributed fashion in two-, three-, and multi-level hierarchical wireless sensor networks. There has been significant improvement has been shown by using D-SEP in comparing it with SEP in terms of network lifetime, energy consumption and data transmission to BS.

The results of D-SEP reveal that there is 323% & 207% improvement in the overall lifetime of the network by using D-SEP after comparing two-level (m=0.3, a=1.5) & three-level (m=0.5, m0=0.4, a=1.5, b=3) respectively.

IV. M-SEP (MODIFIED SEP)

The authors represent three cluster based routing protocols; Low Energy Adaptive Clustering Hierarchy(LEACH), Deterministic Cluster Head Selection in LEACH(DCHSLEACH) in single energy level nodes, Stable Election Protocol(SEP) in two energy level nodes. They proposed a two energy level based Modified Stable Election Protocol (M-SEP) [9,10]. Then they adopted a new approach to define the lifetime of sensor network using four new matrices FND (First Node Dies), SND(Some Node Dies),HND(Half Node Dies) and LND(Last Node Dies). After simulating in MATLAB it reveals that M-SEP protocol performs 55%, 22.5%, and 40% respectively longer than LEACH,DCHS-LEACH, SEP. It also shows that M-

SEP increases the stability period and packet transmission rate as compare with other routing protocol.

V. TABU SEARCH

Tabu Search [12] is a meta-heuristic that guides a local heuristic search procedure to explore the solution space beyond local optimality. One of the main components of Tabu Search is its use of adaptive memory, which creates a more flexible search behavior. Memory-based strategies are therefore the hallmark of tabu search approaches, founded on a quest for "integrating principles," by which alternative forms of memory are appropriately combined with effective strategies for exploiting them. A novel finding is that such principles are sometimes sufficiently potent to yield effective problem solving behavior in their own right, with negligible reliance on memory. Over a wide range of problem settings, however, strategic use of memory can make dramatic differences in the ability to solve problems. Pure and hybrid Tabu Search approaches have set new records in finding better solutions to problems in production planning and scheduling, resource allocation, network design, routing, financial analysis, telecommunications, portfolio planning, supply chain management, agent-based modeling, business process design, forecasting, machine learning, data mining, biocomputation, molecular design, forest management and resource planning, among many other areas.

The TS technique is rapidly becoming the method of choice for designing solution procedures for hard combinatorial optimization problems. A comprehensive examination of this methodology can be found in the book by Glover and Laguna (1997). Widespread successes in practical applications of optimization have spurred a rapid growth of the method as a means of identifying extremely high quality solutions efficiently. TS methods have also been used to create hybrid procedures with other heuristic and algorithmic methods, to provide improved solutions to problems

A. *Solving the problem by local search*

One of the most successful methods of attacking large scale hard combinatorial optimization problems is local search (Ahuja et al. 2002; Michiels et al. 2007). Every local search technique is based on the concept of a neighborhood function, that is a mapping N, which for each solution X assigns a subset of solutions N(X) that can be reached in one move starting from X. The set N(X) is called a neighbourhood of X. A local search algorithm starts from a feasible solution X0 and performs a sequence of moves, which consist of choosing a solution

$$Xi+1 \in N(Xi).$$

By specifying method of choosing a solution from the neighbourhood and a stopping criterion we obtain a particular type of the local search algorithms such as: iterative improvement,simulated annealing, threshold acceptance or tabu search.

B. TABU SEARCH ALGORITHM .

ENSURE: THE NEIGHBORHOOD N(T).
1: N(T)←∅
2: FOR ALL {I, J} ∈ E \ T DO
3: DETERMINE THE SET OF EDGES {F1, . . . FK
} THAT ARE ON THE PATH FROM I TO J IN T
4: FOR ALL F ∈ {F1, . . . , FK
} DO
5: ADD T ∪ {I, J} \ F TO N(T)
6: END FOR
7: END FOR
8: RETURN N(T)

our main goal is to construct a fast tabu search algorithm for computing solutions of good quality for large instances of the minmax regret minimum spanning tree problem. The standard works on the tabu search technique and some of its applications to hard combinatorial optimization problems can be found in Glover (1989, 1990), Glover and Laguna (1997).

VI. PROPOSED METHODOLOGY

In this flow chart Step by step Procedure is defined on how to select cluster head and How the data is forwarded to cluster head by all the cluster members.

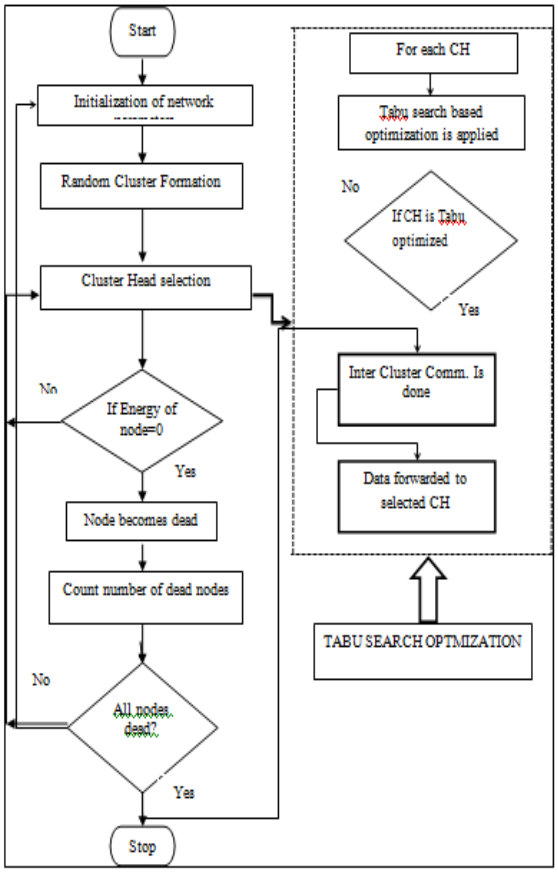


Figure 1: Flow Chart Of Proposed Methodology

VII. RESULTS AND DISCUSSION

To study the SEP ,D-SEP,M-SEP AND TABU based SEP routing protocol in wireless sensor network .To proposed

and implement TABU SEARCH based SEP ROUTING PROTOCOL for selection of cluster head. To comparative analysis of proposed TBSEP(TABU SEARCH based stable election protocol) with stable election protocol and D-SEP and M-SEP by using parameters Network Remaining Energy, Dead Nodes, Alive Nodes.

VIII. EXPERIMENTAL SET-UP

In order to implement the proposed design and implementation has been done. Table 1 has shown a variety of constants and variables required to simulate this work. These parameters are standard values used as benchmark for WSNs.

IX. EXPERIMENT RESULTS

TABLE 1: Parameters and their values

Parameter	Value
Area	(100,100)m
BS location	(50,175)m,
Initial energy (Quantity)	In Joules
	0.1
E_{elc}	50nJ/bit
E_{efs}	10pJ/bit/m^2
E_{mp}	0.0013pJ/bit/m^4
d_0	87m
E_{DA}	5nJ/bit/signal
Data packet size	4000bits

Figure 2: represents the graphical representation of TABU search based SEP routing protocol in MATLAB is following way. Firstly, the graph represents the initial performance of TABU search based SEP routing protocol. Here, we have the green colour nodes which represents the normal node, and one diamond shape node which represents the base station in the network. Pink dots line are representing how data communicate to the base station.

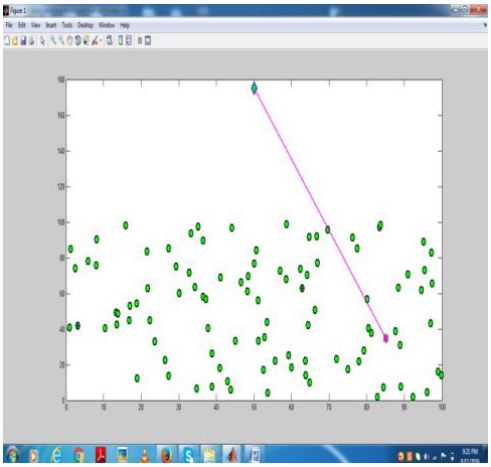
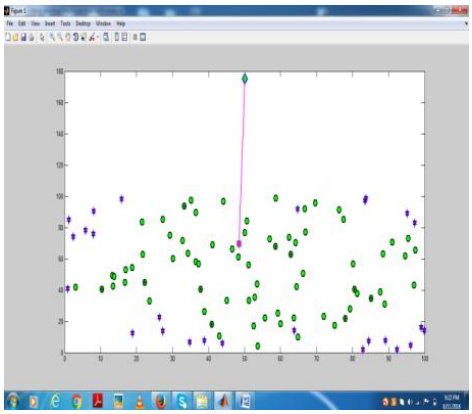


Figure 2:Initial Performance Of Tabusep

Figure 3: is showing the environment of TABU based SEP in which half nodes are dead. Dead nodes are represented by node having boundary of blue colour and filling of pink colour. The Green colour nodes represents the normal node, and one diamond shape node which represents the base station in the network. Pink dots line is representing how data communicate to the base station.



Figue 3: Half Performance Of Tabusep

Figure 4: is showing the environment of TABU based SEP in which all nodes are dead. Dead nodes are represented by node having boundary of blue colour and filling of pink colour.

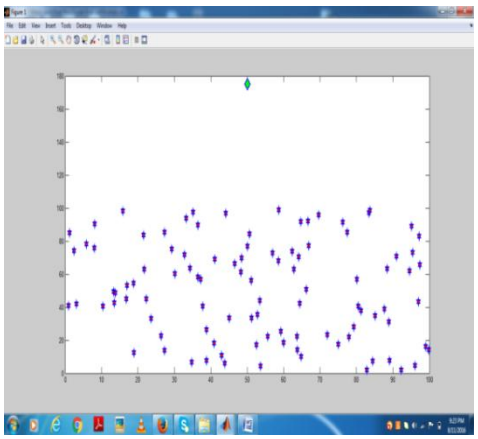
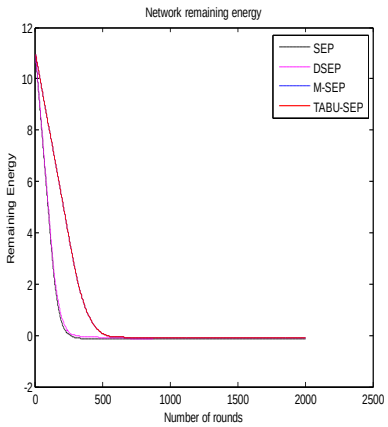


Figure 4: Last Performance Of Tabusep



Figue 5: Network Remaining Energy Vs. Rounds

Figure 5: REMAINING ENERGY (RESIDUAL ENERGY) The comparison among SEP, D-SEP AND M-SEP and TBSEP with respect to average remaining energy i.e. residual energy. It has been clearly shown that the residual energy in case of the TBSEP are quite more than the SEP, D-SEP AND M-SEP. It has clearly confirmed that TSEP is comparatively better than the existing protocol.

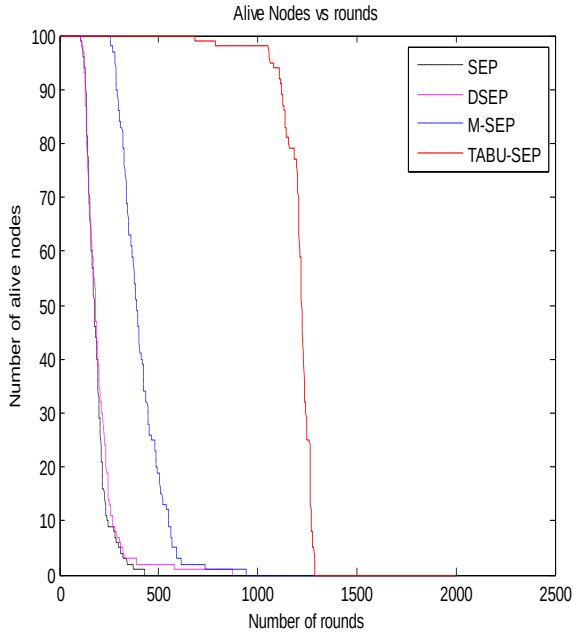


Figure 6: Networks live Nodes vs. rounds

Figure 6: represents the comparison among SEP, D-SEP AND M-SEP and TBSEP with respect alive nodes. It has been clearly shown that the number of rounds for alive nodes in case of the proposed are quite more than the SEP, D-SEP and M-SEP. It has clearly verified that the TBSEP is comparatively better than the other protocols.

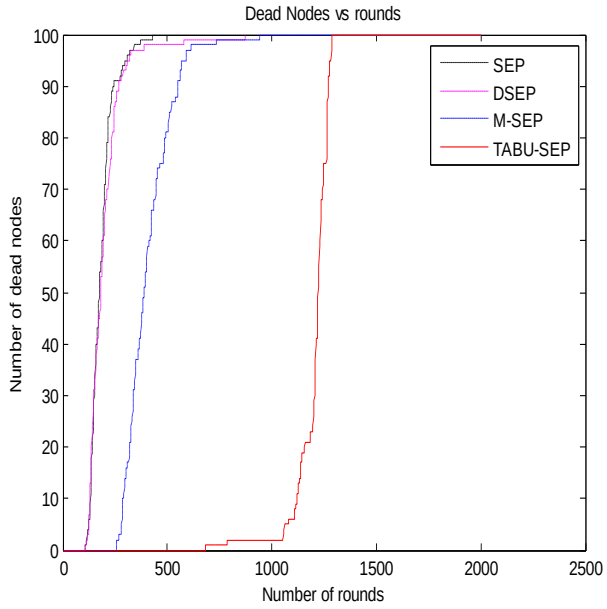


Figure 7: Network Dead nodes vs. Rounds

Figure 7: represents the comparison among SEP, D-SEP AND M-SEP and TBSEP with respect all dead node time. It has been clearly shown that the number of rounds for all dead node in case of the TBSEP are quite more than the SEP, D-SEP AND M-SEP. It has clearly verified that the TBSEP is comparatively better than the available protocols.

X. COCLUSION AND FUTURE SCOPE

Many protocols has been planned thus far to enhance the energy potency more however still abundant sweetening may be done. SEP has shown quite vital results over the on the market WSNs protocols. however it's neglected several problems. so as to beat the constraints of the sooner work a brand new improved technique is planned during this analysis work. The planned technique has the flexibility to beat the restrictions of the SEP routing protocol by exploitation agglomeration and TABU search. The planned technique is intended and enforced within the MATLAB tool with the assistance of knowledge analysis tool case. Experiments has clearly shown that the planned technique outperforms over the on the market strategies. but this work has not take into account the utilization of 3D WSNs, thus in future work we have a tendency to willl extend the planned technique for 3D WSNs surroundings

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