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# With Insensitivity of Fuzzy C-Means improvising the SEP Routing Protocol

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**ABSTRACT**: With the rapid development of science and technology and the ever-increasing demand in all areas, wireless sensor networks become a necessary scientific achievement to meet human demand in modern society. The Wireless Sensor System (WSN) is designed to help us avoid losing too much energy and manpower, avoiding hazards and making work more efficient. Multiple routing protocols are used to increase the energy efficiency of the network with two different, homogeneous and heterogeneous protocols. In these two protocols, the stable election protocol (SEP) is one of the most efficient heterogeneous protocols to increase the stability of the network. In this article we propose an approach to the FCM algorithm that bundles the SEP protocol, making the WSN network more energy-efficient. The results of the simulation showed that the protocol proposed by SEP-EFCM was better than the conventional SEP protocol

**KEYWORDS**: **Fuzzy, WSN, SEP, SEP-EFCM**

## I. INTRODUCTION

The WSN is a network of interconnected sensor nodes. The sensor buttons are compact and inexpensive. Buttons are responsible for detecting environmental conditions such as temperature, noise, vibration, humidity, pressure, etc. The sensor nodes send their data to the aggregation node and transmit the data to the zinc (transceiver). As shown in FIG. 1, the sink is sent to the user via the internet or the satellite. In this process we see that CH (Cluster Head) not only listens to the signals from the nodes, but also synthesises the data and then sends the data to sink, to consume more energy, so that the routing, in the indication of the Path of this data stream is very important.

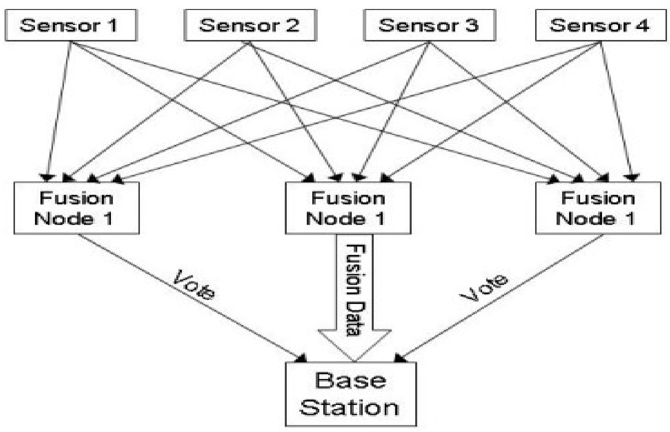


Fig:1. Basic Structure of WSN.

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Routing protocols are divided into two types, which are homogeneous and heterogeneous. Homogeneous routing protocols are nodes with the same energy level as the protocols: LEACH, TEEN, HEED, PEGASIS, APTEEN. The heterogeneous protocol is a protocol in which the nodes have different energy levels and are divided into two types of nodes: The Preference node and the Normal node. In this case, the Advance node has more energy and the chance of becoming a junction is greater than that of the remaining junction. Popular protocols in this protocol type are SEP [1-5], DEEC, EDEEC. The September protocol considers the energy levels in the CH selection process and improves the stability of the hierarchical classification process using the characteristic parameters of heterogeneity, with energy being added between the node and the normal peak node. In order to extend the stabilization period, SEP is obliged to limit energy consumption. Advanced nodes become CH more than normal nodes and are delivered more than normal nodes. However, the disadvantage of selecting the cluster header in the SEP protocol is that both the node types of Advance nodes and the normal nodes are not flexible, so the remote nodes will die first. To solve this problem, we conducted our research on MS and evaluated various known clustering algorithms such as K-Means, Fuzzy C agents, insensitive Fuzzy C resources WSN clusters. Based on the theory of learning, we propose a new approach that combines the insensitive C-resource algorithm with the SEP protocol, allowing the WSN network to become more energy-efficient. In addition, we used Matlab to simulate the new 140-node algorithm in a 500x500 grid with unequal energy between the nodes to show unequal influence between the network nodes. 10% of the nodes have an energy of 1 joule and 90% of the nodes have an energy of 0.5 joules. The position of the receiver is 250 x 250 and the length of each message is 500 bytes. The results of the simulation show that the proposed SEP-EFCFC protocol has performed better than the conventional SEP protocol. Our work consists of five parts: Part 1 is an introduction, part 2 shows related work, part 3 is proposed, part 4 simulation results and the final part is the conclusion.

### 1.2. Literature Survey

When LEACH was Malik M. et al. [6] provided the basic protocol for routing and rms for WSN networks Smaragdakis introduced a revolutionary SEP routing protocol. SEP is a heterogeneous routing protocol and has proven to be more efficient than the LEACH protocol. In the SEP protocol, the node sensors are divided into two types of nodes: the expected node and the normal nodes, with the extended node having a higher energy level, and the probability that the CH node is designed as a normal node. As shown in figure 2

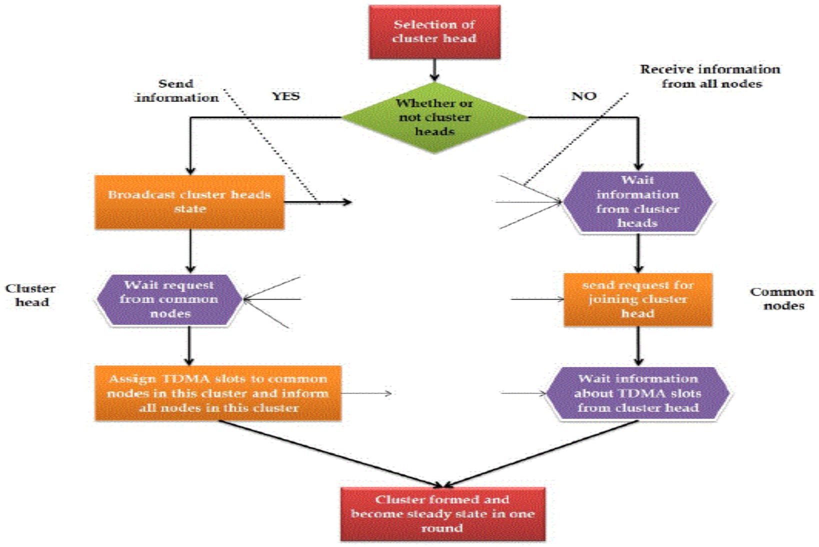


Fig:2. SEP Protocol – CH selection mode

If the K-Means algorithm [5] is a well-defined cluster algorithm, this means that a node belongs with only one cluster, which is only suitable for high-density detection and isolated detection, and the boundary must be defined as clusters. In practice, however, the boundary between clusters in WSN facilities may be blurred, clusters may overlap,

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which means that some nodes belong to different clusters. In this case, using the K-Means algorithm will limit the functionality of the wireless sensor network, so the Fuzzy C-Means algorithm (FCM) [7-9] has been developed to solve this problem. FCM is a fuzzy cluster algorithm developed by Dunn 1973 and then improved by Bezděk 1981. This technique divides a set of n-vector data objects X = {x1, ..., xn} ε. Fuzzy R groups Reduce the object function to measure the quality of the partition and find the cluster centres in each cluster, so that the costs of the non-equality are minimal.

Until 1998, Vapnick proposed using the ε parameter as a noise-sensitive parameter to solve overlapping clusters with high density, where a node is not only connected to a cluster, but can also be clustered. or many different groups. Since then, FCM [10-14] has always been the best choice for fuzzy clustering.
In this article, the simulated results show that selecting the CH node with the FCM algorithm reduces the power consumption of the WSN.

## II. PROPOSED ALGORITHM

The heterogeneous SEP protocol has been demonstrated by Smaragdakis to provide stability and longer duration compared to uniform protocols. However, they still contain several limitations, including restricted groups for high density tuber groups and a complex multidimensional implementation, where clustering leads to disparate groups. (Fewer node clusters and more node clusters) that lead to task division.

In this article, we propose to use the εFCM algorithm to select the node for the September CH protocol, and this node selection is the first priority to use the node node this additional power source, as the CH node. to create the most stable network time, then the improved energy of the nodes and the remaining energy equal to the normal node is consumed, the EFCM go-CH nodes over the entire selection network prefer the node to have more energy in the CH node has been converted. The objective function of the FCM algorithm is defined as follows:

$$J_{m\varepsilon}(U,V) = \sum_{k=1}^{n}\sum_{i=1}^{c}(u_{ik})^m \|x_k, v_i\|_\varepsilon \quad (1)$$

Where $\|x_k, v_i\|_\varepsilon = \sum_{l=1}^{p}\|x_{kl} - v_p\|_\varepsilon$, $\varepsilon$is non-sensitive to noise are Vapnick proposed in 1998 as follows::

$$\|t\|_\varepsilon = \begin{cases} 0, & \|t\| \le \varepsilon \\ \|t\| - \varepsilon & \|t\| > \varepsilon \end{cases}$$

$$u_{ik} = \begin{cases} \dfrac{1}{\sum_{j=1}^{c}\left(\dfrac{d_{ik}}{d_{jk}}\right)^{\frac{2}{m-1}};\quad 1 \le i \le c, 1 \le k \le n} \quad ; \quad I_k = \emptyset \\ \begin{cases} 0; \quad i \ne I_k \\ \displaystyle\sum_{i \in I_k} u_{ik} = 1 \; ; \quad i \ne I_k, I_k \ne \emptyset \end{cases} \end{cases} \quad (2)$$

$$\forall_{1\le i\le c}\forall_{1\le l\le p} v_{il} = \frac{1}{card(A_i^+ \cup) A_i^-}\left[\sum_{\{k|\lambda_k^+ \in A_i^+\}}(x_{kl} + \varepsilon) + \sum_{\{k|\lambda_k^- \in A_i^-\}}(x_{kl} - \varepsilon)\right] \quad (3)$$

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**The steps of the εFCM algorithm:**

**Input:** The number of clusters c and the parameter m, ε for the objective function J;
**Output:** The cluster data so that the objective function (1) reaches the minimum value;

**Begin**

1. Input parameter c ($1 < c < n$), m ($1 < m < +\infty$) and $\varepsilon \geq 0$;
   Initialize the matrix $V=[v_{ij}]$, $V^{(0)} \epsilon R^{sxc}$, set j = 0;
2. Repeat
   **2.1** J:=j+1;
   **2.2** Calculate fuzzy partition matrix $U^{(j)}$ according to the formula (2);
   **2.3** Update center clusters $V^{(j)} = [v_1^{(j)}, v_2^{(j)}, \dots \dots, v_c^{(j)}]$ according to the formula (3) and $U^{(j)}$
3. Until $\left(\left\|U^{(j+1)} - U^j\right\|_F \leq \varepsilon\right)$;
4. Demonstrate result of clusters;

**End**

The SEP protocol [10-12] considers the energy level in the selection process of the main node. SEP improves the stability of the hierarchical classification process by using the nodes usually have more power than the normal node. The total energy of the system varies. Assuming that Eo is the initial energy of the normal node, the energy of the advanced node is set to Eo * (1 + α). The total energy needed to (re) define is: n * (1-m) * Eo + n * m * Eo (1 + α) = n * Eo (1 + αm). The total energy of the system (1 + am) is thus increased. We can increase the stability of the sensor network (1 + αm).
The probability that the normal node becomes CH is 1 and the extended node becomes CH is 1 + a. When the threshold value T (n) is set to normal and the extended node is different, the normal node of G becomes the first cluster once and the extended node of G becomes the first cluster 1 + a times. Pnrm is defined as the probability of selecting weights for normal nodes and the probability of selecting weights for advanced nodes. The weightings for normal nodes and advanced nodes are therefore:

$$\text{Pnrm} = \frac{Popt}{1 + \alpha m}$$

$$\text{Padv} = \frac{Popt}{1 + \alpha m} x(1+\alpha)$$

The function T (n) is replaced by Popt with the weighted probability that the selection threshold CH is obtained in each revolution.

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- The threshold for normal node:

$$T(Snrm) = \begin{cases} \frac{Pnrm}{1-Pnrm(r*mod\frac{1}{Pnrm})} & \text{if } Snrm \in G' \\ 0 & \text{another case} \end{cases}$$

Where:

- r: current loop
- G': Normal node does not become CH with 1 / Pnrm last cycle per phase.
- T (Snrm) is the threshold applied to n (1 - m) normal node. This ensures that each normal node becomes CH once time in $\frac{1}{Popt}$ (1+αm) per phase and that is the average of the normal nodes becoming CH each round is n (1-m) * Pnrm
- The Threshold for advanced node

$$T(Sadv) = \begin{cases} \frac{Padv}{1-Padv(r*mod\frac{1}{Padv})} & \text{if } Snrm \in G'' \\ 0 & \textit{another case} \end{cases}$$

Where

- G": advanced node does not become CH CH in $\frac{1}{Padv}$ last cycle per phase.
- T(Sadv) is the threshold applied to n*m advanced node.

We regard this phase as the secondary phase. Each step has a subtext 1 + a and the extended node becomes CH exactly 1 + a times in phase. The average value of the extended node becomes CH for one cycle with n * Padv.

The average number of CHs per round is therefore: n * (1-m) * Pnrm + n * m * Padv = n * Popt. This is the desired number of CH in phase.

## III. SIMULATION AND EVALUATION

In this work we use the Matlab software (R2016a) to perform simulations with fixed coordinates for 140 nodes in a 500x500 network with inhomogeneous energy between the nodes to show unequal influence between the nodes of the network. 10% of the nodes has an energy of 1 joule (a = 1, Popt = 0.1), 90% of the nodes has an energy of 0.5 joules. The position of the sink is set at 250.250, the length of each message is 500 bytes, the reinforcement coefficient efs = 10 pJ / bit / m² and = 0.0013pJ / bit / m4, the maximum number of loops is 6000. The input parameters are correct, the author in turn adds these parameters in the SEP log in progress and in the proposed protocol SEP_ £ CFM. Then we compare the protocol that uses the SEP protocol and SEP_ε. FCM according to the following measures: the number of active nodes, the number of dead nodes and the remaining energy of the nodes.

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| PARAMETERS | VALUE |
|---|---|
| Network size | 500x500 |
| BS | (250,250) |
| Rounds | 6000 |
| Iteration | 200 |
| □fs | $10pJ/bit/m^2$ |
| □mp | $0.0013pJ/bit/m^4$ |
| EDA | 5 nJ/bit/packet |
| $E_0$ | 0.5J |
| N | 140 |
| A | 1 |
| K | 15 |
| Popt | 0.1 |

### 3.1 RESULTS AFTER THE FIRST ROUND OF 1200

In Figure 3 we see on the SEP protocol that after 1200 cycles the dead node appeared in the association SEP_ε. FCM shows the result after 1200 cycles in 4 no death node.

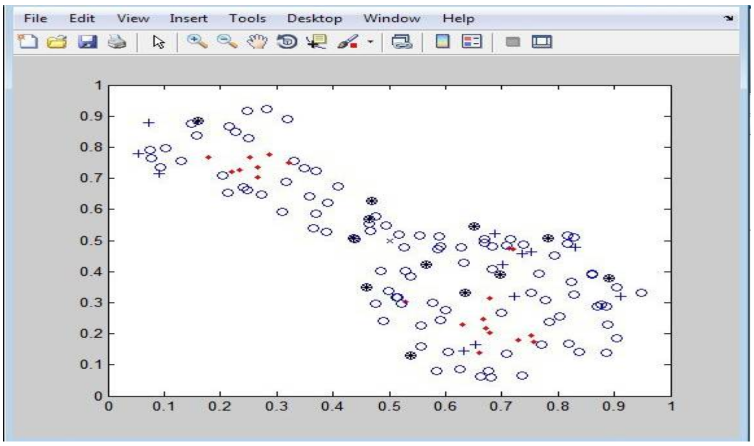


Figure 3: SEP protocol after 1200 rpm

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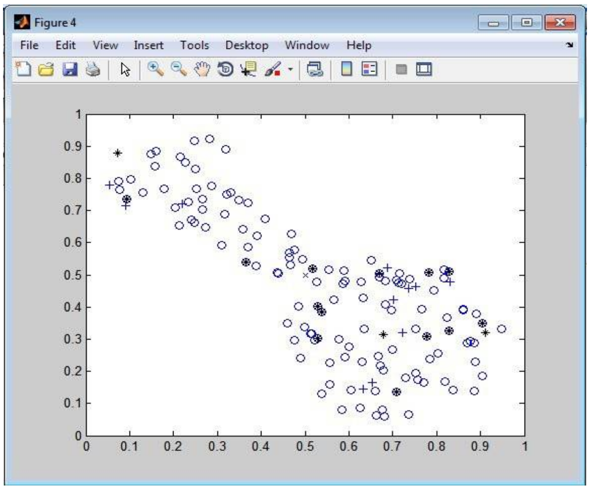


Figure 4: Association protocol SEP_ εFCM after 1200 cycles

**3.2 Number of live nodes**

Figure 5 shows the number of live during the life of the network. After 800 cycles SEP appears as the first dead node after 2790 cycles of SEP_ & epsi; FCM were displayed. The proposed protocol is more than 21% SEP of the number of revolutions that the last node dies. Therefore, the active nodes in the SEP_ & epsi; FCM combination protocol more active nodes than the SEP protocol. After some initial rounds are unstable, but the number of active nodes starts to rise, this indicates that the SEP_ & epsi; FCM combination protocol consumed more efficiently Energy compared to the SEP protocol. The results of the combination protocol SEP_ & epsi; FCM improved several active nodes compared to the SEP protocol.

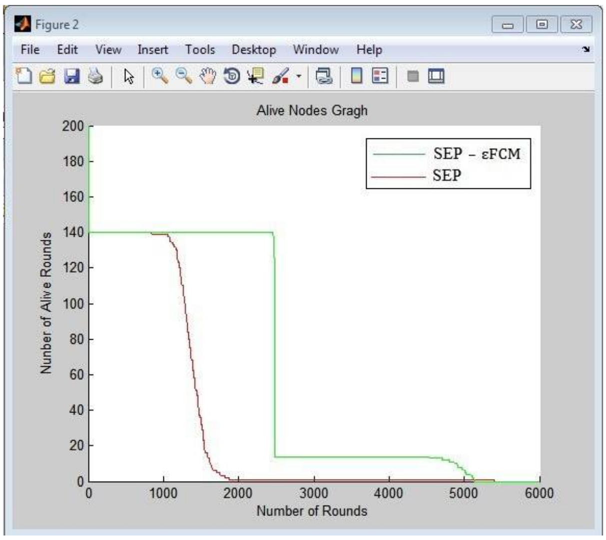


Figure 5: Comparison of the living node between the SEP protocol and the εFCM SEP_ protocol

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### 3.3 REMAINING ENERGY

In Figure 6 we see that after 4985 curves the node in SEP is out and 5150 nodes SEP_ ε CFM. The proposed protocol is greater than 3.3% MS. The result shows that the remaining energy of the correspondence protocol SEP_ εFCM is greater than that of the SEP protocol. The results of SEP_ & epsi; FCM combination protocols improved the residual energy of the SEP protocol.

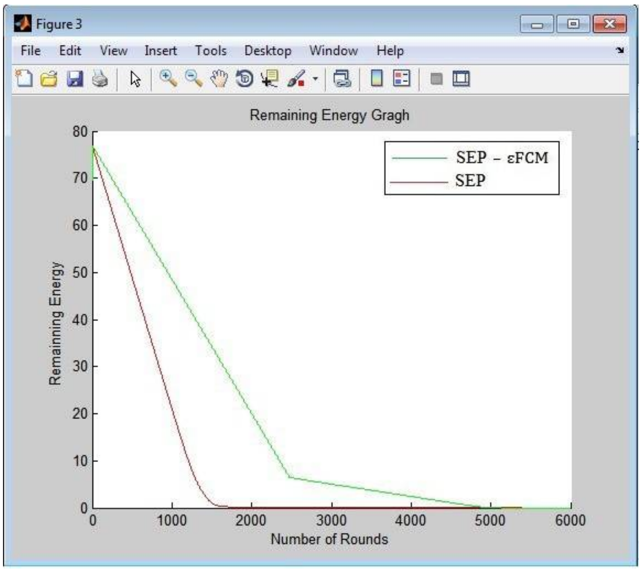


Figure 6: Comparison of the remaining energy between the SEP protocol and the SEP_ εFCM protocol

## IV. CONCLUSION

The design of the WSN with a functional operating system that is flexible and easy to implement for real applications presents many problems, the greatest difficulty being that the performance of the node is limited and difficult to recharge. Therefore, the use of available power sources on the nodes effectively reduces power consumption, extending the lifetime of the entire network and extending the network time. We have investigated the routing protocols to propose the new algorithm using the fFCM fuzzy algorithm in the CH node selection in the SEP protocol. The results of the simulation suggest that our improvement has a lower power consumption and a longer network life than the SEP3.3 protocol. This helps the network to extend life.

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