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# Optimization Energy of WSN using DCH based Routing Protocol and Machine Learning

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**ABSTRACT:** Wireless Sensor Networks (WSNs) have gained significant attention in recent years due to their wide applications in areas such as environmental monitoring, healthcare, and smart cities. However, energy efficiency remains a critical challenge in WSNs, as sensor nodes typically rely on battery power, which limits the network's lifespan. This research proposes a novel energy optimization approach for WSNs by integrating a Dynamic Cluster Head (DCH) based routing protocol with machine learning algorithms. The DCH protocol dynamically selects the most energy-efficient nodes as cluster heads based on factors such as residual energy, node density, and network topology, thus ensuring optimal data aggregation and transmission. Machine learning techniques, including classification and regression models, are employed to predict and adaptively adjust routing strategies based on real-time network conditions and energy consumption patterns. The proposed framework aims to minimize energy consumption, prolong network lifetime, and enhance the overall performance of WSNs. Through simulations and performance evaluation, the results demonstrate significant improvements in energy efficiency, packet delivery ratio, and network stability compared to traditional routing protocols.

**KEYWORDS:** Wireless Sensor Network (WSN), Dynamic Cluster Head, Packet Delivery Ratio, Dead Node, Energy

## I. INTRODUCTION

WSNs are getting to be broad utilization of as a result of its boundless systems administration abilities. Different applications, for example, urban wellbeing, correspondences in misfortune, scholarly carriage frameworks, and public systems and so on are altogether bolstered by WMNs.

Contrasted with wired associations WMNs are the best arrangement as far as cost, arrangement and equipment. WMNs furnish wide scale availability with less expense when contrasted with wired broadband system get to on account of which it is named as best choices of the wired broadband system as far as expense [1]. As far as expense as well as WMNs can be effectively kept up and solid and offer predictable administrations [1]. As WMNs have preferences over its partner, it tends to be widely utilized in the few fields of sensor and specially appointed systems. WMN is an empowering innovation in the field of remote that can be utilized for a few fields [2], for instance, broadband access to web at home, collective and region systems, organizing at big business, robotization of structure, and so on.

As WMNs are equipped for self-sorted out and self-arranged, it tends to be sent utilizing one hub and the quantity of hubs can be augmented effectively when required for example they can undoubtedly be scaled up, it's forthright speculation is less thus drawing in the consideration of ISP, transporters and others.

Introducing a WMN isn't such a great amount of extreme, as all the fundamental constituents beforehand exist in the steering conventions of impromptu system, for example, WEP (wired proportional security security), MAC convention of IEEE 802.11 standard and so on. Numerous organizations have now comprehended the forthcoming of the WMNs innovation and arrangement numerous results of remote work systems.

Be that as it may, more investigation is peaceful required for making WMNs be all. The current MAC and steering convention in WMNs don't give the adequate adaptability and as the quantity of terminals builds a lot of throughput falls. In this way steering layer convention should be re-imagined. The standard gatherings existing in the business also work forcefully on new details in WMNs, for example, IEEE 802.11 [3], IEEE 802.15, and IEEE 802.16 [4] all have

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shaped sub-gatherings to accentuation on novel measures in WMNs. In the following area, we will begin by quickly characterizing the WSN demonstrating its advantages to the network, its sorts and applications.

## II. WIRELESS SENSOR NETWORK

Directly the primary issue in utilizing broadband system at home (even a little one) is the distinguishing proof of the site of the passageways, for which site review is to be done that is over the top expensive [5]. What's more, setting up of numerous passages at home is additionally not monetarily what's more, appropriate as a result of the Ethernet wiring required from the passage to the modem or center [6]. Moreover, if the terminal hubs go under two diverse passageways the interchanges between them need to sit back through the entrance center point producing blockage in the system.

Figure 1: WMNs for broadband home networking

Every one of these issues in utilizing broadband system at home can be understood utilizing remote work systems, as appeared in figure 1 in which all the passages are supplanted by remote work switches having network availability between them that give increasingly adaptable and more flaw tolerant.

Additionally by including progressively number of work hubs or just by altering its position or its capacity level, no man's lands can be killed. Here additionally the traffic with in the home systems need not to hang loose through the entrance center, the work hub does it, due to which the clog in the system is limited. Here remote work switches does not have any limitations on the power utilization and portability as it is fixed.

In this way conventions required for WMNs are must be improved one contrasted with those conventions for portable impromptu systems [7]and remote sensor systems [8].So, WMNs are well suitable for broadband system utilizes at home. In a network, the web is gotten to through a DSL modem having web association and is associated with a remote switch. In such a system regardless of whether the traffic needs to be shared inside the system it needs to course through the web which essentially diminishes the asset usage. Numerous territories in the middle of houses in the general public may not be secured by remote administrations and furthermore remote administrations must be set up in individual homes which is again costlier. There might be a solitary course accessible for individual home access the Internet.

While WMNs ease the above disadvantages with the assistance of adaptable work associate between homes, as appeared in figure 2 and WMNs likewise license different uses for instance scattered document stockpiling, scattered record access, and gushing on the off chance that video and sound.

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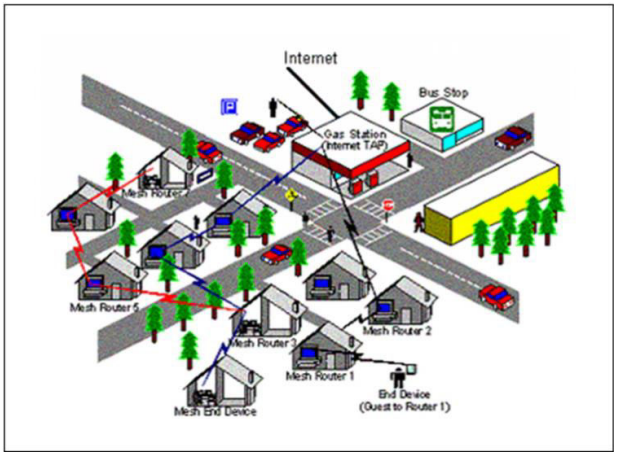


Figure 2: WMNs for Civic and Locality

At present, in a few workplaces standard IEEE 802.11 remote systems are normally utilized, which are again associated through wired Ethernet associations thus the expense of undertaking system is high. Be that as it may, if the passageways in IEEE 802.11 are substituted by the work switch as appeared in figure 3, increment the strength and usage of the asset of undertaking systems.

As we realize that WMNs is effectively versatile if the undertaking become the size of the system can be effectively grow. A few parameters, for example, control level of correspondence, traffic design, design of the system, thickness of the terminal in the system, organize topology, portability of the hubs and number of channels utilized by every hub influences the ability of the WMNs. So as to build up the convention, structural plan, setting up and activities of the system there must be an emphatically comprehension of the relationship between limit of the system and the above factor is required.

Investigation of WMNs At present much research has been done so as to think about the limit in the event of remote impromptu systems which can be actualized to investigate the limit of WMNs. If there should be an occurrence of a stationary multi-jump arrange, [3] talked about, the ideal transmission power level of a hub is accomplished if there are six hubs around it go about as neighbor hubs. An ideal trade off between number of hubs from source to the objective and the recurrence spatial-reuse productivity has accomplished utilizing the estimation of [4]. This is productive for the situation in WMNs where the portability is negligible. In any case, if as in half and half WMNs, the versatility is the concern, no speculative results are expressed till date. In [6] certain investigational considers have been done, where the reenactment consequences of point portable system confirm the speculative consequences of [8].

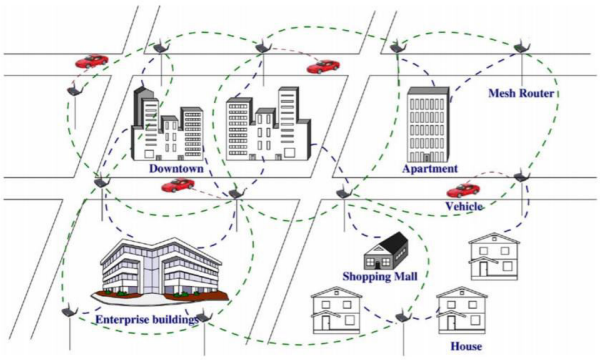


Figure 3: WMNs for Metropolitan Area Network

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## III. MACHINE LEARNING

Uproarious information is available in the heap of substance that will be identified through the anomaly strategies. The information can be spatial or can be a transient method spatial connected with the geological conditions and worldly connected with the time perspectives [8]. The principle point of exception identification is to deal with the loud information that is introduced in the heap of text. Different methods for recognizing abnormalities in Text are specified in below:

**Learning**

The main property of an ML is its capability to learn. Learning or preparing is a procedure by methods for which a neural system adjusts to a boost by making legitimate parameter modifications, bringing about the generation of wanted reaction. Learning in an ML is chiefly ordered into two classes as [9].

- Supervised learning
- Unsupervised learning

**Supervised Learning**

Regulated learning is two stage forms, in the initial step: a model is fabricated depicting a foreordained arrangement of information classes or ideas. The model developed by investigating database tuples portrayed by traits. Each tuple is expected to have a place with a predefined class, as dictated by one of the qualities, called to have a place with a reclassified class, as controlled by one of the traits called the class name characteristic. The information tuple are dissected to fabricate the model all things considered from the preparation dataset.

**Unsupervised learning**

It is the kind of learning in which the class mark of each preparation test isn't knows, and the number or set of classes to be scholarly may not be known ahead of time. The prerequisite for having a named reaction variable in preparing information from the administered learning system may not be fulfilled in a few circumstances.

Data mining field is a highly efficient techniques like association rule learning. Data mining performs the interesting machine-learning algorithms like inductive-rule learning with the construction of decision trees to development of large databases process. Data mining techniques are employed in large interesting organizations and data investigations. Many data mining approaches use classification related methods for identification of useful information from continuous data streams.

**Nearest Neighbors Algorithm**

The Nearest Neighbor (NN) rule differentiates the classification of unknown data point because of closest neighbor whose class is known. The nearest neighbor is calculated based on estimation of k that represents how many nearest neighbors are taken to characterize the data point class. It utilizes more than one closest neighbor to find out the class where the given data point belong termed as KNN. The data samples are required in memory at run time called as memory-based technique. The training points are allocated weights based on their distances from the sample data point. However, the computational complexity and memory requirements remained key issue. For addressing the memory utilization problem, size of data gets minimized. The repeated patterns without additional data are removed from the training data set [10].

**Naive Bayes Classifier**

Naive Bayes Classifier technique is functioned based on Bayesian theorem. The designed technique is used when dimensionality of input is high. Bayesian Classifier is used for computing the possible output depending on the input. It is feasible to add new raw data at runtime. A Naive Bayes classifier represents presence (or absence) of a feature (attribute) of class that is unrelated to presence (or absence) of any other feature when class variable is known. Naïve Bayesian Classification Algorithm was introduced by Shinde S.B and Amrit Priyadarshi (2015) that denotes statistical method and supervised learning method for classification. Naive Bayesian Algorithm is used to predict the heart disease. Raw hospital dataset is employed. After that, the data gets preprocessed and transformed. Finally by using the designed data mining algorithm, heart disease was predicted and accuracy was computed.

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**Support Vector Machine**

SVM are used in many applications like medical, military for classification purpose. SVM are employed for classification, regression or ranking function. SVM depends on statistical learning theory and structural risk minimization principal. SVM determines the location of decision boundaries called hyper plane for optimal separation of classes as described in figure 3. Margin maximization through creating largest distance between separating hyper plane and instances on either side are employed to minimize upper bound on expected generalization error. Classification accuracy of SVM not depends on dimension of classified entities. The data analysis in SVM is based on convex quadratic programming. It is expensive as quadratic programming methods need large matrix operations and time consuming numerical computations.

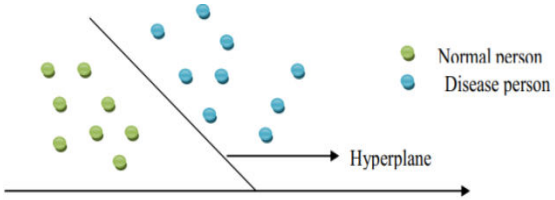
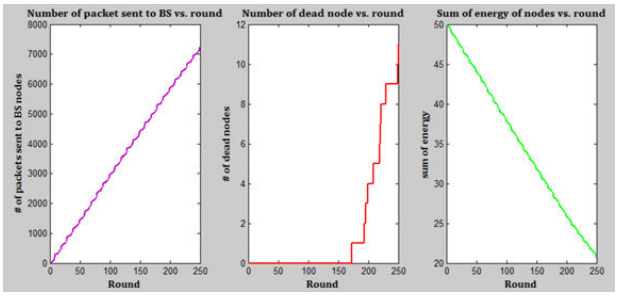



Fig. 4: Support Vector Classification

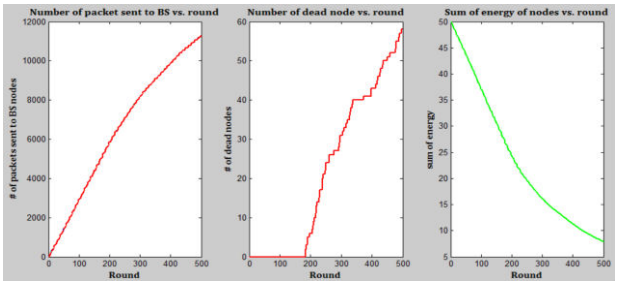
## IV. SIMULATION RESULT

Packet delivery ratio (PDR): The proportion of successful data packets delivered to the destination compared to the total generated data packets.

Round = 250




Round = 500



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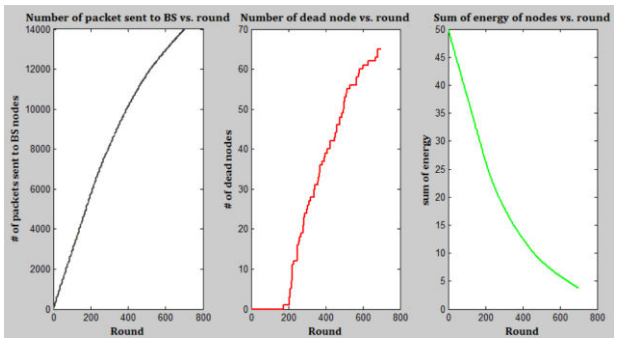
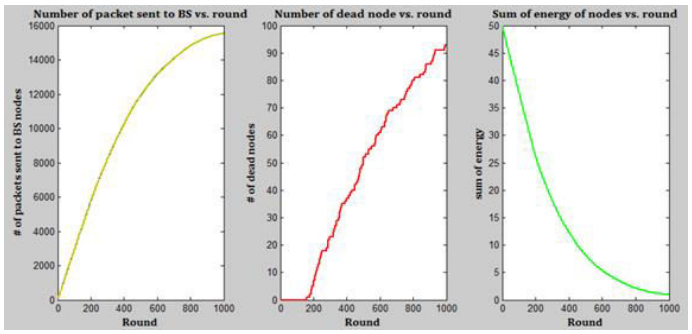
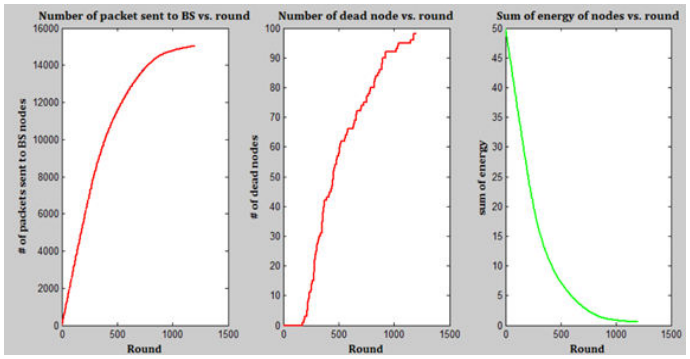
Round = 700




Round = 1000




Round = 1200




## V. CONCLUSION

In conclusion, the integration of the DCH-based routing protocol with machine learning offers a promising solution for optimizing energy consumption in Wireless Sensor Networks. By dynamically selecting cluster heads based on energy efficiency and adapting routing strategies using machine learning models, the proposed approach ensures longer network lifespans and improved overall performance. The results from simulation studies indicate that the combination of adaptive decision-making and energy-efficient routing can significantly enhance the sustainability of WSNs in diverse application scenarios. Future work can focus on further refining machine learning algorithms for real-time adaptation, addressing scalability challenges, and implementing security measures to ensure robust and reliable network operations.

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