ENERGY EFFICIENT ROUTING USING SUPPORT VECTOR MACHINE IN WIRELESS SENSOR NETWORKS

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ABSTRACT

Cluster head selection and energy utilization are efficiently managed using a conventional routing mechanism employing Wireless Sensor Nodes (WSNs). The main objective of the paper is to enhance network lifetime with average greater energy utilization. The Support Vector Machine (SVM) is used to tackle routing problems in the mobile base station connected with the infrastructure network. The protocol is intended to avoid the control by a centralized router or mobile base station of the complete mobile sensor nodes. In comparison to traditional energy efficient algorithms, the validation of SVM methodology shows an effective routing efficacy. The results against typical routing techniques over WSNs have been found successful.

Keywords: *Energy Efficiency, SVM, Machine learning, Routing, Wireless Sensor*

1. INTRODUCTION

In order to supervise activity in surrounding regions, a network is deployed. There are various sensor nodes in the area that can be monitored to gather information of any importance. This network is called the network of wireless sensors (WSN). The sensor nodes are smaller and the tasks are performed with this limited energy. Vital information is collected, analysed and transmitted to consumers depending on the changes in the environment. This type of network does not have the capacity to perform and process. Motes, which are effectively miniature computers [1], are deployed on the network to collect information.

The two features of these networks are energy efficiency and multi-functioning. In numerous industrial applications, motes are employed. They assist in collecting information to fulfil certain application objectives. The motes connect to deliver the highest performance results, depending on the setups. Motes use transceivers to carry out communication. WSN contains about 100-000 sensor node numbers. There are fewer sensor nodes installed in ad hoc networks in which no infrastructure is included compared to the sensor networks. WSNs have been utilized to create new types of apps that enhance application monitoring capabilities [2].

It monitors the environment, processes the relevant information and sends and receives the processed data from sensing nodes via WSNs. For processing, the sensing unit, which is available in sensor nodes, transmits important parameters acquired from the surrounding field. The Analog to Digital Converter (ADC) is used to digitise analogue signals from sensors. A key aspect of the sensor node is the processing device. The processor helps to perform activities and to manage other component functionality [3].

Depending on the functionality of the nodes, the processor's energy use rate is varied. In WSNs, energy is the most critical aspect. Saving energy in hardware and software solutions is vital for improving network life. Compared to data collection and processing, the biggest share of energy is consumed in data communication [4].

Consequently, only short connections between the sensor nodes are used and long-range data transmissions are prevented since transmission power is limited. The occurrences in most WSNs are felt closer to, and farther away from, the region of interest. Short-range communication is used thereby to forward data packets utilizing intermediary nodes along the multipath. Routing in wireless sensor networks and in other networks is extremely different. In the event of node failures, the routing protocols establish rigorous energy saving requirements. Different researchers often employed different routing techniques [5].

Routing protocol categorization takes place in various categories. The routing takes place in the case of location-based protocols, depending on the position of the sensor nodes. The information relating to the sensor nodes is required to determine the distance between two specific nodes. The data-centering protocols are not like other protocols since they transport data to the base station from the source sensor nodes. Each sensor node uses a single source for the conveyance of data independently from the address-centered protocols to the base station. This hierarchy generates a number of clustered layers. After this cluster restriction, a cluster head is selected with the grouping of nodes. The use of CH permits the routing to other sinks or CHs from one cluster [6].

Data from one layer to another is hoped for over great distances, although the transfer from one node to another is carried out simply. The Support Vector Machine (SVM) is a clustering algorithm which is energy-efficient. That reduces energy spending to a minimum [7]. The SVM protocol is improvised in its version Power Efficient Collecting in Sensor Information Systems (PEGASIS). This protocol generates the sequence of sensor nodes from the neighboring node to broadcast and receive data. This protocol only selects one node from the sequence formed to forward data to the sink [8]. The sensor groups sensor nodes in cluster threshold Sensitive Energy Efficient Sensor Network Protocol (TEEN). Each cluster is led by a different person.The sensor node in the cluster report detected information to the head of the cluster.

2. RELATED WORKS

The authors in [9] studied and investigated a new multi-cluster head-based clustering routing technique. The major objective was to equalize the energy utilized by various WSN sensor nodes. The aim of this paper was also to improve the stability and lengthen the network's service life. The fundamental component of this project was the cluster and the WSN was divided into numerous clusters. Details on the WSN energy consumption model (ECM) were provided by this publication. In addition, the recommended routing algorithm was simulated and examined. The test results showed that the method provided was capable of balancing the energy required by multiple nodes in the WSN. It effectively prolonged the life span and enhanced the stability of WSN. The algorithm recommended for different reasons, the indicated algorithm could be employed.

The new WSN energy efficiency model has been presented in [10]. This model was termed the Energy Consumption Model in advanced first order. The results showed the effectiveness of the model advocated in real time. However, only Energy Consumption Cost modelling on the network layer has been examined. The future study would therefore focus on extending the spectrum of this study to two proposals. These concepts include the Energy Consumption Cost second order modelling of the network layer and Medium Access Control layer.

The main objective of a WSN is the collection of environmental data utilizing several sensor nodes. The authors in stated Sensor node energy consumption [5,6,9,10] was an important factor in this network. The duration of WSN's lifetimes was greatly impacted by Energy Consumption. Changing the already defined WSN designs was a challenging task. A representative node had an embedded sensor system and depended entirely on various applications. The focus of this work was on energy spent by sensor nodes using a specific class and SVM methods.

The novel strategy of lowering power usage was introduced in [12]. LEFD was the new method. Initially, this work used the knowledge about the time correlation of sensor devices to detect defective LEFD devices. This technique then implemented information about spatial correlations to discover remaining defective devices. Furthermore, information in the recognition method did not need to be shared with the nearby nodes as LEFD took data sensed by a node to detect certain types of faults. This lowered the energy consumed by the nodes efficiently. Finally, LEFD also considered nodes that may have transitory problems. The results of the simulation confirmed the efficiency of the strategy indicated with regard to better data transfer and lower power consumption.

The authors in [13] advocated the energy-efficient cross-application RBF technique for WSNs to decrease sensor node power consumption. This work utilized the radial base function of the Neural Network to estimate a clustering algorithm based

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on itself. This study then employed the LMS algorithm to modify and adapt the weight matrix of the cluster hub to understand the synthesis of the data. The simulation results showed that after various phases, the recommended strategy lowered the energy use to a significant level.

WSNs have encountered an important problem in energy usage [16-23], where the authors in [14] said. During the course of time, many researchers devised diverse ways of energy reduction used by such networks. In this measurement of the energy spent in the past by such networks, a selection of a low energy consumption and economic circuit has been performed. The left side of the deployed batteries was also measured. This study used panStamp for multiple tests with the wireless node. More empirical testing would be done to calculate the left over power of deployed network nodes.

The authors in [15] indicated that energy usage has a significant impact on the efficiency of WSN. At the same time, testing using real-time tools and networks could be costly and complicated. An option to simplify the inquiry scenario might therefore be used with a simulation program. These works have been simulated by the Cooja tool. Five distinct tests with four measurement metrics were conducted to measure the power consumption of different sensor devices without changing the location of the base station. The result produced shows that the minimal number of nodes is not primarily associated with the medium energy spent by each node.

3. PROPOSED METHOD

The evolutionary method for trajectory setting from source to destination is used with the SVM in this work. This protocol mainly consists of three phases for cluster routing. To transmit data to the dish, each cluster head communicates directly. The application of clusters extends the WSN service volume with the clusters. For the transmission of only important information to the individual sensors, the SVM protocol compresses original data. The aggregate is referred to and used by the SVM protocol. It is a protocol that is self-organized. This protocol uses a random CH rotation to evenly distribute the energy charge between sensor nodes in the network.

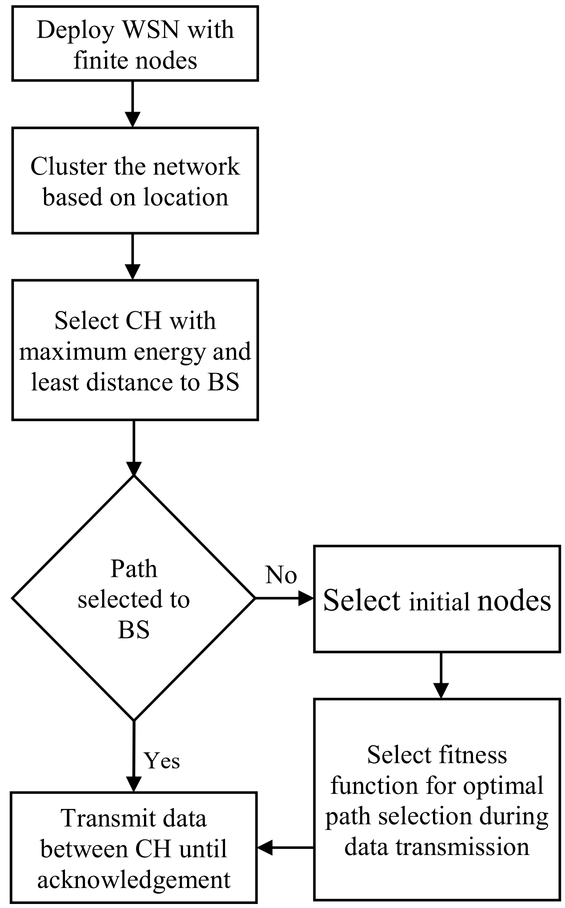

Figure 1: Proposed SVM Model

By monitoring the volume selected to pass to the base station, this protocol enhances the scalability and robustness for routing and data distribution. The high-energy CH position is rotational frequently in SVM, rather than the static selection of the CHs, to offer all the sensor nodes the same chance to be picked as CHs. The use of this approach can avoid energy depletion at smaller times. Two different steps of this technique. The first phase is called the stage setup. In this step, the network is arranged in clusters and base station is considered the second stage. In this phase, information is compressed and relayed to the base station to aggregate data.

The SVM is one of the well-performing classification machine learning algorithms. It is one of the learning models to regress or classify unknown data. In this technique, the data is plotted in an n-dimensional area, and the data is the point for plotting. The data collected as a group in the graph is drawn on the basis of their class. The SVM method consists of two phases: training and testing. The training step takes place through the creation of

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a model based on the data set or knowledge from the experiment. The test phase classifies unknown data based on the model of training. Then find the appropriate class depending on the coordinate range during the testing phase.

This describes the general process of the SVM protocol. In the cluster set-up phase, the sensor nodes randomly generate a number between 0 and 1. You may calculate the threshold by the following formula:

$$T(n)=\begin{cases}\dfrac{p}{1-p\left[r \bmod\left(\dfrac{1}{p}\right)\right]} & N\in G\\ 0 & Otherwise\end{cases} \quad (1)$$

The variable r shows the number of rounds or periods that already exist. N refers to the overall sensor node number. G is the set of nodes that are not cluster heads in the 1/p round. The evolutionary algorithm is used to establish the path for data transmission from the category head to the cluster head.

Distance to Base Station: It is the sum of the direct distance between all sensor nodes. The huge WSN is quite energy-consuming. DDBS is also useful for networks of small size. The number of narrow nodes is not important in these networks.

$$DDBS=\sum_{i=1}^{m} d_i \quad (2)$$

Cluster Distance: The distance between cluster heads and base stations and the sum of the distance between the members' nodes and their CHs shall be established. The solution is suitable for networks with many remote nodes.

$$CD=\sum_{i=1}^{n}\left(\sum_{j=1}^{m} d_{ij}\right)+D_{is} \quad (3)$$

Transfer Energy (*E*): It refers to the energy consumption level necessary to convey to the base station all the data gathered.

$$E=\sum_{i=1}^{n}\left(\sum_{j=1}^{m} e_{ij}+mE_R+e_i\right) \quad (4)$$

4. RESULTS AND DISCUSSIONS

In implementing and evaluating the proposed strategy, the Matlab simulator calculates a few performance measures and compares the results to the findings from earlier approaches.

As illustrated in Fig.2, the SVM protocol for data transmission to the base station is performed on the network. In each cluster, energy and distance to the base station are used to determine the head. For additional processing, the cluster head transmits data to the base station. The SVM technique for tracking is used for the SVM. The numbers of dead nodes in the network are reduced compared with the simple SVM protocol when a SVM is employed.

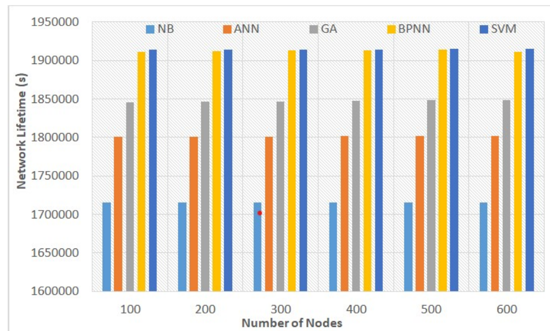

Figure 2: Network Lifetime

The SVM is employed for the path establishment using the SMV protocol, as illustrated in Figure 3. The number of living nodes in the network increases compared to the simple SVM protocol when the SVM is applied.

As illustrated in Figure 3, SVM and SVMs are compared to the number of packets transmitted by the basic SVM. In comparison with the SVM protocol with SVM, the protocol for SVM has a high number of dead nodes. If there are fewer dead nodes in the SVM protocol with a SVM, the number of packets transferred in the network increases directly.

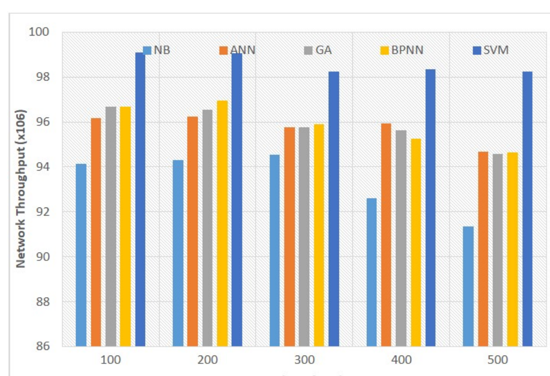

Figure 3. Network Throughput

The SVM is compared to the cluster heads of the conventional SVM procedure. Compared to the existing models, the SVM protocol has a high number of cluster heads. SVM methods have a high number of selected cluster heads on the net.

As demonstrated in Fig.4, latency and energy consumption is compared with conventional protocol. In comparison to the SVM procedure, energy usage with SVM is low.

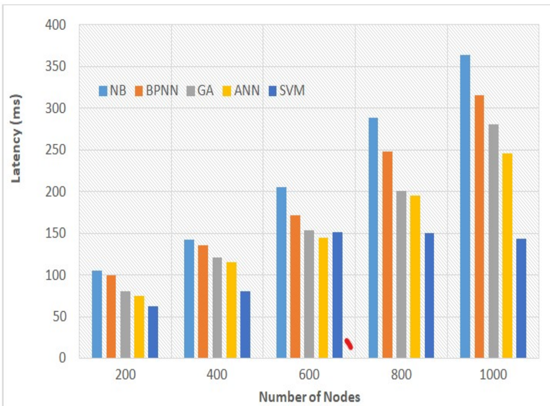

Figure 4: Latency

5. CONCLUSIONS

The entire network is separated into specific classes in order to improve the lifetime of the WSN. Valid information is transferred to a base station by cluster heads. The network uses an evolutionary algorithm to define the shortest trajectory from cluster head to base station. The genetic algorithm co-ordinates the initial sensor node population. The optimization function is used to identify the shortest route between the source and target. WSN performance is examined using a SVM algorithm and the results analyzed shows that the proposed model achieves higher level of energy consumption than other methods.

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