Connectivity and Mobility Awake Efficient Routing In MWSN

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Abstract. Mobile Wireless Sensor Networks (MWSNs) have established their applications in various streams, particularly in agriculture, forest fire detection, and military applications. However, insufficient bandwidth, communication faults, energetic topography, energy restraints, and stability of connection variations guide to node movement. However, the major problem is to link failures between sensor nodes. As a result, make the rerouting process create an additional delay. To solve the connectivity and Mobility Awake Efficient Routing in MWSNs introduced. We design this paper is mainly for monitoring crop agriculture also produce the supervise information to base stations. In this strategy, the dynamic connectivity is used to measure the node connectivity among nodes. Average encounter rate and the route encounter rate is applied to evaluate the node mobility. These three parameters are used to choose the best forwarder node in MWSN. Simulation results illustrate that improve the network performance equate to the baseline approach.

Keywords: Mobile Wireless Sensor Networks, dynamic connectivity, Connectivity, Average encounter rate, Route Encounter Rate

1. Introduction
MWSNs permit the sensor nodes to move anywhere and transmit with other nodes lack in necessitate of any preset infrastructure. A sensor node contains three basic elements: a sensing device, a processing device, and an antenna [1]. Introducing movement in WSN is painstaking to benefit. MWSNs better static WSNs in different factors containing energy expenditure, relocation, the channel's capacity, dynamic topology, better targeting, lifetime, data fidelity, etc. The most important application in agriculture in which the mobile sensors can monitor crop cultivation. [2]. Figure 1 explains the MWSN formation in the crop field.
In MWSN, the sensor nodes are disseminated arbitrarily in the network. Path failure frequently occurs in MWSNs due to node failure, channel fading, intrusion, node mobility, and shadowing. The mobile node updates its positions regularly that can guide the extreme drain of the sensor node’s battery delivery besides enhancing collisions. The major components to be regarded in MWSNs comprise limited resources, bandwidth limitations, and mobility [3].

Research on Coverage and connectivity (RCC) for WSN approach is used to compute the coverage calculation also compute the single connectivity in WSN. This approach improves the WSN performance. However, this approach can’t perform well during sensor node mobility [14]—this paper, proposed Connectivity and Mobility Awake Efficient Routing in MWSN.

2. Related Works
Localization approach is performing better by connectivity information. It can integrate distance among neighboring nodes, whereas it is accessible [4]. Community detection-based routing approach is an expansion of the Routing Label Propagation. It is a distributed probabilistic procedure which enhances the network connectivity inside the communities [5]. Vicinity-based Dynamic Connectivity approach is capable of energetically searching the network’s status through a connectivity metric [6]. Dynamic random geometric graph framework is used for highly dynamic networks [8]. Mobility, energy, and traffic congestion are the major causes of a reducing route function [9]. Mobility, Energy and Congestion Aware Routing approach that increases the route function. It also discovers the stable as well as congestion-free route [7]. Link availability evaluation based consistent routing protocol conceives the unheralded network topology update difficulty to enhance the network function. The link accessibility represents the possibility of a connection in scantly presented for a specified time [13].

A terrain awakens-based mobility is used to emulate the influence that terrain components have on mobile nodes’ active distinctiveness [15]. A linear time-invariant method is used to creates a colored noise with first-order Markov property [12]. It facilitates the nodes to distinguish as well as bypass the area. This approach simulates the response of nodes while the nodes countenance large-scale terrain factors [10]. An Innovative Node Encounter Rate Metric is used to enhance the quality of service by minimizing the packet loss and average delay. In this approach, the Node Encounter Rate is introduced throughout the network function [11].

3. Proposed Method
An MWSN is constituted through a diagram $G(V, L)$, where, $V$ represents the established nodes going an area A and L denote the established connection among pairs of nodes. A link $\{i, j\}$ since node seems while node j is upcoming into the node i communication range. A preset communication range $R$ prepares every node. Analysis of node mobility is shown in Figure 2.

Figure 2. Analysis of Node mobility

- **Encounter (eij):** The two nodes meeting every other while the space among them turns lesser than the R. The $e_{ij}$ among i as well as node j is defined as:

  $$e_{ij} = \{i, j, t, \Delta t\}$$

  Here, $t$ denotes the occurrence period of the encounter also $\Delta t$ denotes the encounter lifespan.

- **Average Encounter Rate (AER):** It is defined as the tolerable amount of fresh encounters received through every node in a period $T$. Take $En$ indicates established fresh encounters experiential through node $i$, the $i^{th}$ node AER($I_{AER}$) is computed as follows.

  $$I_{AER} = \frac{I_{En}}{T}$$  \hspace{1cm} (1)

  Here, $I_{En}$ denotes the cardinality set $En(i)$. The main benefit of applying AER is to notice the comparative node mobility regarding its neighbors. Additionally, this metric is applied to exactly decide the greatest stable path.

- **Route Encounter Rate (RER):** It is represented as the sum of square AER evaluates entire nodes beside the route. Here, $n$ denotes the number of nodes along with the routing.

  $$RER = \sum_{k=1}^{n} AER_k^2$$  \hspace{1cm} (2)

  In this approach, we introduce dynamic connectivity (DC) to eliminate the essential for global density. The DC measures the connectivity ratio of a contributed node established on its neighborhood details., DC is defined as the relationship between the average amount of neighbors and the total amount of nodes.

  $$DC = \frac{\text{average amount of neighbours}}{\text{Total amount of nodes}}$$  \hspace{1cm} (3)

  The DC reveals the present node placed in a thin region, otherwise a dense area through computing the ratio of the average number of neighbors to the number of present neighbors of a contributed node. To compute the average amount of neighbors at a contributed node can utilize the following formula.

  $$AN = (T_n - 1) h \lambda$$  \hspace{1cm} (4)

  Here, representing the average number of neighbors, $T_n$ represents the total amount of nodes, $h$ denotes the constant $\lambda$ part of the whole network area enclosed via mobile sensor nodes computed as in formula.
\[ \lambda = \frac{(\prod I R)}{\text{Area}} \quad (5) \]

Where \( R \) denotes the communication range, \( DC \) is used to minimize the redundant route request packets. In MWSN, the source desires to communicate the data to the destination; the sender selects the forwarder node based on the highest connectivity, AER, and RER.

4. Simulation Results

Here, applying the network simulator-2.35 for measuring the simulation results. Here, we arbitrarily situated 50 sensor nodes within an agriculture field of 500m×600m. Packet received rate signifies the volume of information packets communicated since sender towards a destination in MWSN. Figure 3 explains that the CMER approach better packet received compare to the existing approach RCC. Here, the node mobility increases in the existing approach highly minimized than the CMER mechanism.
The delay is decided as the period distinction among data transmits period and data, received period. Figure 4 shows the delay of CMER and RCC approach. It exposes CMER has the lesser delay for a node while equated to the RCC mechanism.

Throughput refers to the packets effectively disseminated throughout the network. Figure 5 indicates the throughput analysis for CMER and RCC mechanisms. Figure 5 explains that the CMER approach better throughput compares to the existing approach RCC.

5. Conclusion
In this paper, Connectivity and Mobility Awake Efficient Routing in Mobile Wireless Sensor Network (CMER) is proposed. In this strategy, the dynamic connectivity is used to measure the node connectivity among nodes. Average encounter rate and the route encounter rate is applied to evaluate the node mobility. These three parameters are used to choose the best forwarder node in MWSN. The main aim of this paper is monitoring crop agriculture also supervise the information to base stations. Simulation results illustrate improving the throughput and minimizing the network delay during high mobility compared to the baseline protocol.

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