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Computer application

NOVEL ROUTING STRUCTURE WITH NEW LOCAL MONITORING, ROUTE SCHEDULING, AND PLANNING MANAGER IN ECOLOGICAL WIRELESS SENSOR NETWORK

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Abstract. Ecological Wireless Sensor Networks (WSNs) have recently been established, and large WSNs are deployed to monitor environments of various scales. As ecological WSNs are used more, new opportunities and problems emerge, such as better software and hardware design, new questions, new phenomena, and new sensors. This work focused on OWS (Orchard wireless sensor) network with new local monitoring, route scheduling, planning manager (LMRSPM) mechanism, and the proposed mechanism based on the routing structure which consists of three modules such as network model, Local monitoring (LM) model and route scheduler planner model. The LM is a static node that will not take part in communication. It only involves monitoring the node's activities. The principle is sensor node details are collected by local monitors such as sensor nodes energy; distance, buffer size, location, and link quality are sent to the scheduler planning manager. The route scheduler and planning manager analyses the node efficiency based on the above factors and form a routing path according to the node's energy level. To measure our proposed method proficiency, an experimental observation is carried out between Dynamic path planning design for mobile sink with burst traffic (DPPMSBT), expecting lowest-residue-energy maximisation opportunistic routing (ELMOR) with our system. The obtained observation by each algorithm is plotted on the graph. From the observation, it is proved LMRSPM is more efficient than the existing methodologies.

Keywords: communication, orchard management, protocols, routing and scheduling, ecological wireless environment.

AIMS AND BACKGROUND

In a heterogeneous network environment, factors involved in packet losses and delays are low energy level, poor link quality, and buffer unavailability. These packet losses need high energy consumption for re-transmission.WSN is a special

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kind of wireless network consisting of several self-directed, minute, circulating, low-powered devices known as sensor nodes, in which nodes are small devices which group each other to form a network. These networks are structured less which follows the OSI architecture Model. The OSI model consists of five layers such as application, transport, network, and data link with the physical layer and three cross planes such as task management, mobility management, and power management. The application layer is responsible for converting the data into possible information. Some of the general characteristics of WSN are cross-layer design, node mobility and heterogeneity, easy implementation, handling of node failures, and scalability to a large scale of distribution[1–4]. In WSN, sensor nodes monitor several environmental factors like pressure, temperature, humidity, and vibration. These sensor nodes sense the information and are transported wirelessly through multiple nodes and gateways. For network formation, routing and transmission follow efficient network topologies along with routing protocols. In WSN coverage optimisation is important which helps balance the energy distribution among the network. Orchard wireless sensor network has features like low bandwidth, large network scale, low cost, low energy, and complex environment[5,6], in which the existing issue is the inefficiency of data collection from a targeted area. Another important issue is a time delay. This is because of the lack of decision-making in routing and task execution. In a dynamic environment, nodes are deployed dynamically[7]. In this dynamic environment, there is a possibility of packet drop due to the unstable link quality and unavailability of a free buffer. It is believed that these issues can be overcome by efficient routing protocol by balancing the link quality, node energy, and buffer availability. Most of the previous works prove link-quality degradation leads to several network performance problems[8]. Another commonly known problem in WSN is the flooding problem it is caused due to the packet re-routing to multiple nodes because of improper routing path[9]. While ecological WSN's are a welcome breakthrough, they are not sufficient to quickly solve some complex scientific issues in nature. Biology, ecology, electrical engineering, information technology, and statistics all need to work together more. Only successful integration of various research areas can help investigations looking into previous non-observable and unforeseen happenings.

Sai Krishna Mothku and Rashmiranjan Rout[9] have solved the energy efficiency challenges in the heterogeneous sensor network by introducing a fuzzy logic system in taking the routing decision. The proximity node is calculated using distance, link quality, availability of buffer size, and residual energy. Efficient energy saving sink selection Scheme for IoTis proposed using tree-based self-organising protocol with best base station placement strategy[10]. In this efficient sink, the selection scheme applied two node types such as network node and non-network node. The network node is responsible for packet transmission and non-network node select the proper sink node for receiving the broadcasted packets. The novel optimises the power consumption approach for orchard wireless sensor networks using Efficient Opportunistic Routing and opportunistic routing path selection employing efficient/reliable topology management[11]. As a result of this method, the overall network performance is significantly improved. It was proposed[12] a dynamic path planning design for mobile sink with burst traffic in WSN. This mechanism has prior-trail creation in planning the routing path. Besides grid network partitions, estimation, burst-traffic awareness.

EXPERIMENTAL

PROPOSED METHOD

As WSN is structure-less, hence the energy consumption taken for communication is not stable; it may vary as per the circumstances. These challenges of energy efficiency in WSN motivated to development of a novel mechanism. In this way, the key concept is gathered from the fuzzy logic system using a fuzzy-based delay and an energy-aware intelligent routing mechanism[13]. In fuzzy logic, the authors implement multiple nodes based on efficiency parameters like higher buffer availability, quality link, near-by hop node, and maximum residual energy for communication. The novel routing structure such as new local monitoring and route scheduling and planning manager mechanism (LMRSPM) consists of three modules such as network model, local monitoring model, and route scheduler along with planner model.

Network model. In the proposed work orchard wireless sensor network is implemented. In which N is the sensor nodes deployed arbitrarily in a two-dimensional rectangular region of $X \times Y$. The essential characteristics of a WSN are stated below:

(i) Static network with higher density and the sensor nodes remain unchanged.

(ii) The node density calculates the monitoring area coverage and network connectivity.

(iii) In the network, which node is highest in the network that node act as local monitoring node (LM) but monitor the network performance and report to the route scheduling and planning manager.

(iv) A sink node is a static node with unlimited energy contributions. The sink nodes transmitting power is controllable.

(v) The initial energy of the node is assigned as S (n) which is isomorphic and non-rechargeable.

(vi) Heterogeneity of network energy; this is because energy consumption by individual sensor nodes varies.

(vii) Nodes are self-energy perceptions.

In this work, a network is formed with the number of sensor nodes, and the heterogeneity characteristics such as sensor nodes energy, distance, link quality, and location are taken for evaluation. The node which has the highest energy acts as a local monitoring node (LM). This node is idle and monitors network behaviours and it was done by collecting the node's information from the network communication and the performance reports are sent for route scheduling and planning manager. They decide which path is available, busy, and full.

Local monitoring. In the network, sensor nodes are deployed with the sensing capability, gathering and processing the information and then communicating with one another. In a network, the heterogeneous node characters are buffering capacity, battery capacity, link quality, and distance. Based on the evaluation of these parameters node's energy level is measured. The proposed method of broadcasting messages among the neighbourhood nodes is performed. The node with near distance along with battery capacity, quality link, and buffer receives the messages and transfers. In this, the node with higher energy is elected as local monitoring. In fuzzy model nodes are dynamic but the proposed model as local monitoring nodes are static with a unique characteristic. The observed details are transformed into route scheduler and planner for further processing.

$$S_{\mathrm{n}}(e) = [S_{\mathrm{n}}(x, y) \rightarrow (N_{\mathrm{e}})] \tag{1}$$

$$S_{\mathrm{n}}(d) = ((x_i - x_j)^2 + (y_i - y_j)^2)^{1/2} \tag{2}$$

$$S_{\mathrm{n}}(l) = |P(i)\, p(r)/p(n)| \tag{3}$$

$$S_{\mathrm{n}}(b) = \mathrm{data}_{\mathrm{bits}}/\mathrm{sec}. \tag{4}$$

Expression (1) states the energy calculation from the network nodes S_{n} and energy are calculated in J and then the distance is evaluated by expression (2) with $S_{\mathrm{n}}(d)$. It is the evaluation of the distance between two neighbouring nodes by which the nearest node is selected. Another important quality for the reliable network is link quality measured by expression (3). It is calculated by link stable for entire communication that is nodes initial transmission and reception time/overall communication time. The final parameter is buffer, it is temporary storage that stores and transmits the data as per the network availability.

Route scheduling and planning manager. In the proposed system, the sink node is applied as a base station where the collected details from the local monitor node are transformed to the sink node. The route scheduler and planning manager analysed the collected details from LM and determined the node's energy level. Based on that hierarchy of node, connectivity is enabled for routing the path. In this way, the node with a nearby distance along with other properties is the next-hop node in the routing path. The node which meets these criteria will take part in the communication.

The route and scheduling manager implementation is expressed as follows:

$$R_{\mathrm{mgr}} \rightarrow P_{\mathrm{th}}, \tag{5}$$

where R_{mgr} is the routing planning manager and R_{th} – the routing path.

Working principle. The nodes $S_n(x, y)$ are deployed randomly to form a network. Next, the nodes broadcast the message to all neighbouring nodes. In Fig. 1, the orange node is determined as a local monitoring node that broadcasted messages and receives messages faster thus implying with higher energy level. Based on that local monitoring node S_{Lm} is initialised. Then the resource parameters such as energy level, distance, quality link, and buffer availability $S_n(e)$, $S_n(d)$, $S_n(l)$, $S_n(b)$ are examined respectively using the above-mentioned expressions (1), (2), (3) and (4). Based on this evaluation the node with overall resources at a higher level is elected by $S_{Lm} = S_n(e), S_n(d), S_n(l)$. Thus, the S_{Lm} holds the nodes with higher overall resources. All these details are extracted and sent to the route and schedule planner. The route and schedule planner is nothing but a sink node which is initialised by R_{mgr}, based on the collected information the route and schedule planner execute the routing path ($P_{th} = 0; p_{th} > n; p_{th}$ ++). In this way, the route and schedule planner execute several paths such as $P_{th} \rightarrow 1$, $P_{th} \rightarrow 2$ and $P_{th} \rightarrow n$ that is if path 1 fails alternatively path 2 will take part. Here the efficient routing path is determined by the three factors such as current path, busy path, and filled path. Which current path is the path ready for communication and it is created by routing and planning manager. The busy path indicates that the path is an ongoing transmission and the filled path is not fit for transmission. Figure 1 describes the proposed routing structure clearly. From the figure the red line indicates current data transmission still going on (S7, S12, S15, S6), the green line indicates the path is full (S1, S2, S13, S14 S5, S6) and blue lines indicate busy (S7, S8, S9, S10, S11, S6). Other sensor nodes are idle which are not qualifying for efficient communication.

Proposed algorithm

(i) Begin ()

(ii) Nodes are randomly generated $S_n(x, y)$

(iii) Initialise local monitoring node S_{Lm}

(iv) Calculate the network resources

(v) Nodes energy $S_n(e) = [S_n(x, y) \rightarrow (N_e)]$ // joules/bits

(vi) Nodes distance $S_n(d) = ((x_i - x_j)^2 + (y_i - y_j)^2)^{1/2}$ //sensor nodes distance between neighbouring nodes

(vii) Nodes link complete transmission $S_n(l) = |P(i)\, p(r)/p(n)|$ // nodes initial transmission and reception time /overall communication time

(viii) Buffer size $S_n(b) = \text{data}_{bits}/\text{sec}$, calculate bits per second.

(ix) Over network resources $S_{Lm} = S_n(e), S_n(d), S_n(l)$. Route planning manager initialisation while $R_{mgr} \rightarrow P_{th}$ //

(x) For ($P_{th} = 0; p_{th} > n; p_{th}$++); If ($P_{th} \rightarrow 1$) // the first path is available

(xi) Else if ($P_{th} \rightarrow 0$) // choose the alternate path according to the Route planning manager

(xii) If ($P_{th} \rightarrow 2$) // the second path is available

(xiii) Else if ($P_{th} \rightarrow 0$) // choose the alternate path according to the Route planning manager

(xiv) If ($P_{th} \rightarrow 3$) // the third path is available

(xv) Else if ($P_{th} \rightarrow 0$) // choose the alternate path according to the Route planning manager

(xvi) End if & End process

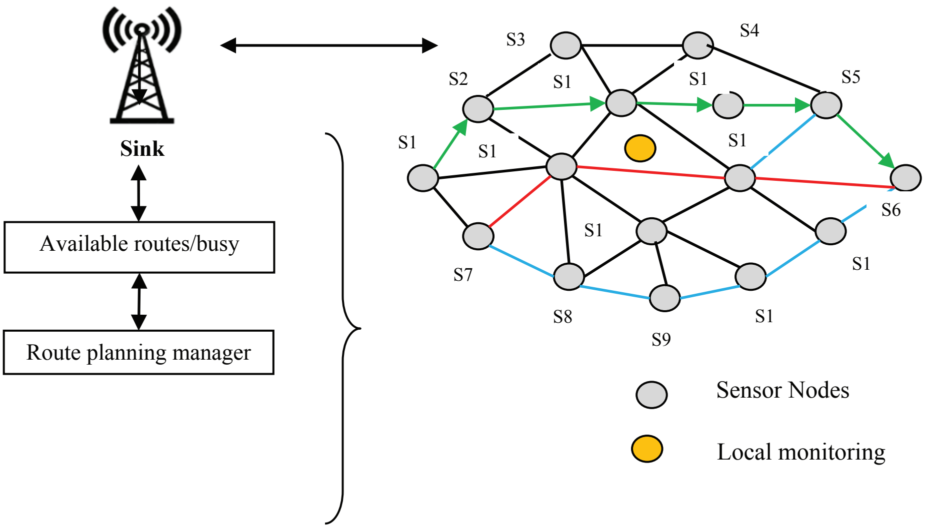

Fig. 1. Proposed route structure

RESULTS AND DISCUSSION

The graph shown in Fig. 2 states the examination of successful retransmission performed by the algorithms. From this graph, blue lines indicate LMRSPM, while orange indicates DPPMSBT performance and remaining states ELMOR performance. Thus, LMRSPM achieves successful retransmission for better than others.

The examination of a maximum round of network by three methods is shown in Fig. 3. From this graph, blue lines indicate LMRSPM, while orange indicates DPPMSBT performance and remaining states ELMOR performance. It is clear that compared to the other two our proposed LMRSPM achieves maximum round of network on every increase of nodes periodically.

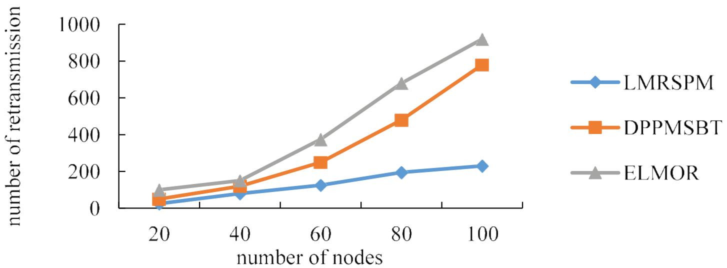

Fig. 2. Number of retransmission versus numbers of nodes

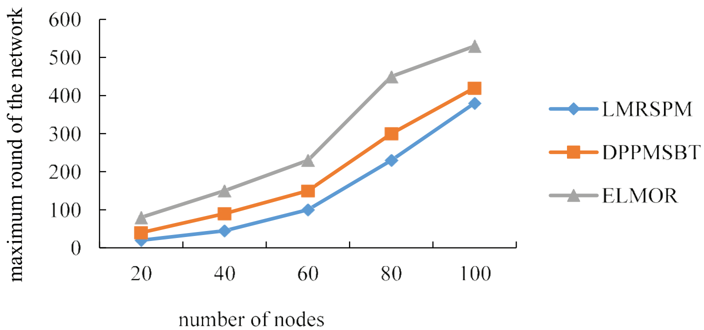

Fig. 3. Maximum round of network versus number of nodes

CONCLUSIONS

Sensor problems have been identified using anomaly detection methods. Consequently, effective technology has benefited ecological WSNs. The proper routing protocol with a quality link is more essential for a successful network. Most of the existing methods suffer from improper routing path, network traffic, and packet loss. This mechanism section has two sections that are local monitoring and route scheduler with planning manner. Local monitoring is the node with higher energy that monitors the network but does not take part in communication. It absorbed the node's parameters and transfer to the route schedule as well as the planning manager. Based on the obtained details they schedule an availability efficient routing path. A comparison work is carried out between DPPMSBT and ELMOR with LMRSPM on energy consumption, several retransmission, and network efficiency. Achieved results prove that the proposed LMRSPM is far better than the other two methods especially in energy efficiency, stable network, minimum delay with no packet loss, and increase in network lifetime.

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