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Routing protocols for mobile wireless sensor networks- A survey

K. Vijayasathana[1], Vishnu kumar. Kaliappan[2]

Department of Computer Science and Engineering,
KPR Institute of Engineering and Technology, Coimbatore-641407, Tamil Nadu, India
vijikubendran@gmail.com[1], vishnudms@gmail.com[2]

Abstract

This study is investigating about the mobile wireless sensor networks (MWSN) routing protocols which are utilized to node mobility reduction and route discovery improvement. Various MWSN routing protocols are studied which are proposed for data transmission effectively and evaluated in terms of their merits and demerits to illustrate location aware based routing protocol has better performance efficiency compared to other routing protocols. The consequence of this study demonstrates that the location aware based routing protocol provides better performance than other MWSN routing techniques.

Keywords: Location-aware routing protocol, MWSN, Latency, Routing protocol, Route discovery.

1. Introduction

One of the types of wireless sensor network (WSN) is Mobile Wireless Sensor Networks (MWSN) [1] where the mobiles are utilized as the sensor nodes. Here, the nodes includes radio transceiver and microcontroller which is powered by battery as well as sensor to detect light, heat, temperature, humidity and etc. Though, the challenges are occurred in MWSN in terms of hardware requirements and location information. The cost and battery power requirements are the limitations in hardware. The shared medium and varying topology are the main environmental characteristics.

For data transmission, the major significant for path selection is network topology. The routing protocols are provided for the transmission path selection process in order to transmit the data packets to the destination properly. However, all network topologies are not used for transmitting the data packets on sensor node's mobility in reliable data communication. Therefore, for reliable data communication different routing protocols [2] are developed depending upon the wireless sensor networks (WSN) [3,4] and mobile ad-hoc networks (MANET) [5] protocols. Nevertheless, in mobile wireless sensor networks (MWSN), various challenges are raised since the network topology is dynamically changed for routing the source information to the destination. Such routing protocols are not useful for handling the high frequency of topology changes and mobility of the nodes.

In [6], geographically opportunistic routing protocol (GOR) for mobile wireless sensor networks was presented. The bounded sensor region was separated as unchangeable grids in which according to the distance to the sink. The generation of forwarding path table was achieved by the source after embedding the constant grid information into the all sensor. This process was performed based on the distance which is equivalent to the maximum one-hop transmission distance and forwarded the highest priority packets.

In [7], the mobility-based clustering (MBC) protocol was investigated which is proposed for MWSN. In the proposed protocol, cluster head was selected among different sensor nodes based on their residual energy and mobility. In addition, the non-cluster head node was also selected by estimating the time. Based on TDMA, each non-cluster head node was allowed into the time slots for data packet transmission. The new cluster was connected by broadcasting the joint request message packets and thus the packet loss was removed.

In [8], multi-objective evolutionary routing protocol was investigated for the purpose of coverage improvement. The optimization issue in coverage was considered in which the number of identified mobile sensor nodes locations were required being re-decided. Hence, the sensed information from the identified targets was more effectively routed to the sink. The multi-objective optimization (MOO) problem was obtained for NP-complete problem. Here, the MOO problem was eliminated by the non-Dominated Sorting Genetic Algorithm-II (NSGA-II).

In [9], zone-based energy efficient routing protocol was presented based on Ad-hoc On-demand Distance Vector Routing (AODV) protocol. This method was utilized for deriving the cost of routing information in terms of factor which makes use of residual energy and mobility of the nodes. The prediction about the availability of the route was provided by this factor. Thus, this least cost path was utilized for routing the information towards the base station.

In [10], the multiple path routing algorithms were investigated in MWSN. The novel Data Centric Braided Multipath (DCBM) algorithm was introduced for achieving and sustaining the path resiliency via multiple interleaving routing paths. This DCBM was reserve path based forwarding algorithm suited for conventional MWSN. Moreover, the different properties of DCBM algorithm were described.

In [11], the mobility adaptive cross-layer routing (MACRO) protocol was introduced based on the top-down cross-layer interaction among application layers. The design of interaction among application layers were exploited in single protocol. The major objective of this protocol was to determine the most reliable path and maintain the path reliability, energy efficient and delay aware. The new route request forwarding method was utilized to avoid congestion and accumulate energy in terms of decreasing the network traffic load.

In [12], cluster based routing (CBR) protocol was investigated in which, an adaptive time division multiple access (TDMA) scheduling and round free cluster head protocol were proposed. The data packets from cluster members were received by the cluster head during TDMA time slot. Each cluster head was required turn to become free cluster head in network when the sensor node has free time slots. The TDMA scheduling was changed adaptively based on the traffic and mobility characteristics by using clustering based routing protocol.

In [13] investigated about the multi-objective mobile agent based routing protocol by using MOEA/D. The problem-specific operators for Multi-Objective Evolutionary Algorithm based on Decomposition (MOEA/D) were developed for multiple objective mobile agents routing problem. The mating limitations and selection of tournament were combined by the M-tournament selection. The parameters were controlled dynamically by using the window crossover and instant requirements. An adaptive mutation operator along different mutation strategies was also utilized based on the sub-problems objective preferences.

In [14] investigated about trust opportunistic routing protocol in multiple hop wireless networks. The new routing metric such as E2TX instead of classic metric ETX of opportunistic routing was developed. This new method was specifically mixing trust among neighbor nodes including link quality metric ETX which utilized E2TX for selecting candidate relay groups. This new opportunistic routing algorithm was called as TOR and described in brief.

In [15], localized geographic routing protocol with security algorithm was developed for mobile sink nodes. In this paper, the localized Integrated Location Service and Routing (ILSR) protocol was proposed for broadcasting the sensors data to the mobile sink nodes in WSN. For maintaining the slow-varying routing with prior knowledge about quick-varying sink location, the proposed approach was utilized. Here, the routing failure was prevented by updating the sink location information to the neighbor nodes. The message cost was reduced based on the dynamically controlling the level of location update.

In [16] investigated about the reliable location aware routing protocol in MWSN. In order to improve the energy efficiency and reliability, fault tolerance and location aware clustering protocol were developed. The proposed protocol was also suited for supporting the mobility of sensor nodes and sensor localization. In this protocol, the sensor localization was considered as one of the most significant characteristics for WSN applications. This protocol utilized particular packets which are transmitted by member nodes of cluster to cluster head. These particular packets were allowed for detecting the mobility and failure of member nodes of the cluster.

In [17], the location aware sensor routing protocol (LASeR) in mobile wireless sensor networks was investigated to achieve high reliability and low latency. The location information was utilized by this protocol for sustaining the gradient field when the routing overhead was reduced. The blind forwarding technique was utilized by this protocol for transmitting packets to the sink. This protocol utilized multiple paths simultaneously for constructing the route diversity and improving its robustness.

The comparison of different routing protocol in MWSN is shown in Table 1.

Table 1. Comparison of different routing protocols

Ref. No.	Merits	Demerits
ώ6ϐ	Less overhead and latency	Transmission rate was not controlled
ώ7ϐ	Minimized control overhead and energy utilization	The packet delivery rate was reduced as increased number of nodes
ώ8ϐ	Improved network lifetime and coverage	No uncertainty and detection accuracy was not analyzed
ώ9ϐ	Less routing overhead	The zone size was predetermined.
ώ10ϐ	Packet delivery ratio was increased and overhead was reduced	The significant improvement was not observed
ώ11ϐ	Packet loss and connection error were reduced	Reduction of energy consumption was not improved
ώ12ϐ	Data delivery rate was increased	The average delay was not reduced
ώ13ϐ	Path loss was reduced and data accuracy was improved	The latency was not reduced
ώ14ϐ	High throughput and security	High routing overhead
ώ15ϐ	Reduced message cost	The QoS was less
ώ16ϐ	Reduced energy utilization	High end-to-end delay
ώ17ϐ	Energy consumption was reduced	The packet loss was high due to priority

3. Summary and Conclusion

In this paper, the comprehensive study for routing protocols is presented. There were several routing protocols developed for reliable data communication in mobile wireless sensor networks (MWSN).The provided routing protocols are having the capability for improving the data transmission routing with minimum energy consumption, end-to-end delay and also maximum data delivery ratio. However, the further improvement of data transmission routing is improved by using the location-aware routing protocol in mobile sensor nodes.

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