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Wireless Sensor Networks Localization Algorithms: A Comprehensive Survey

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ABSTRACT

Wireless sensor networks (WSNs) have recently gained a lot of attention by scientific community. Small and inexpensive devices with low energy consumption and limited computing resources are increasingly being adopted in different application scenarios including environmental monitoring, target tracking and biomedical health monitoring. In many such applications, node localization is inherently one of the system parameters. Localization process is necessary to report the origin of events, routing and to answer questions on the network coverage ,assist group querying of sensors. In general, localization schemes are classified into two broad categories: range-based and range-free. However, it is difficult to classify hybrid solutions as range-based or range-free. In this paper we make this classification easy, where range-based schemes and range-free schemes are divided into two types: fully schemes and hybrid schemes. Moreover, we compare the most relevant localization algorithms and discuss the future research directions for wireless sensor networks localization schemes.

KEYWORDS

Localization, WSN, anchor node, range-based methods, range-free methods, hybrid-based methods.

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Towards Internet of Things (IOTS): Integration of Wireless Sensor Network to Cloud Services for Data Collection and Sharing

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ABSTRACT

Cloud computing provides great benefits for applications hosted on the Web that also have special computational and storage requirements. This paper proposes an extensible and flexible architecture for integrating Wireless Sensor Networks with the Cloud. We have used REST based Web services as an interoperable application layer that can be directly integrated into other application domains for remote monitoring such as e-health care services, smart homes, or even vehicular area networks (VAN). For proof of concept, we have implemented a REST based Web services on an IP based low power WSN test bed, which enables data access from anywhere. The alert feature has also been implemented to notify users via email or tweets for monitoring data when they exceed values and events of interest.

KEYWORDS

Internet of Things, Cloud computing, REST, Wireless Sensor Network, XBee

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A Reliable and Energy Efficient Transport Protocol for Wireless Sensor Networks

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ABSTRACT

In wireless sensor networks (WSN), an ideal transport layer needs to support reliable message delivery and provide congestion control in an efficient manner in order to extend the lifetime of a WSN. The main use of transport protocol in WSN is to overcome the congestion and the reliability with energy efficiency. In this paper, we develop a reliable and energy efficient transport protocol (REETP), which mainly focuses on the reliability and energy efficiency. Our proposed protocol consist of an Efficient Node Selection Algorithm to determine a set of efficient nodes called E-Nodes which form a near optimal coverage set with largest area and highest residual energy level. The key idea of REETP is to transfer encoded packets using LT codes from the source to the sink block by block and each block is forwarded to an E-node. After receiving encoded packets, the E-node tries to reconstruct the original data packets and it encodes the original data packets again and relays them to the next E-node until it reaches the sink. By simulation results, we show that our proposed protocol has more packet delivery ratio with reduced packet loss and energy consumption.

KEYWORDS

Wireless sensor networks, Congestion, Contention, Energy Efficient, Transmission rate, Data flow

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Concepts and Evolution of Research in the Field Of Wireless Sensor Networks

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ABSTRACT

The field of Wireless Sensor Networks (WSNs) is experiencing a resurgence of interest and a continuous evolution in the scientific and industrial community. The use of this particular type of ad hoc network is becoming increasingly important in many contexts, regardless of geographical position and so, according to a set of possible application. WSNs offer interesting low cost and easily deployable solutions to perform a remote real time monitoring, target tracking and recognition of physical phenomenon. The uses of these sensors organized into a network continue to reveal a set of research questions according to particularities target applications. Despite difficulties introduced by sensor resources constraints, research contributions in this field are growing day by day. In this paper, we present a comprehensive review of most recent literature of WSNs and outline open research issues in this field.

KEYWORDS

WSNs, protocols, sensor, applications, routing, services, survey, bio-inspired.

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H-MAC : A Hybrid MAC Protocol for Wireless Sensor Networks

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ABSTRACT

In this paper, we propose a hybrid medium access control protocol (H-MAC) for wireless sensor networks. It is based on the IEEE 802.11's power saving mechanism (PSM) and slotted aloha, and utilizes multiple slots dynamically to improve performance. Existing MAC protocols for sensor networks reduce energy consumptions by introducing variation in an active/sleep mechanism. But they may not provide energy efficiency in varying traffic conditions as well as they did not address Quality of Service (QoS) issues. H-MAC, the propose MAC protocol maintains energy efficiency as well as QoS issues like latency, throughput, and channel utilization. Our numerical results show that H-MAC has significant improvements in QoS parameters than the existing MAC protocols for sensor networks while consuming comparable amount of energy.

KEYWORDS

Sensor networks, MAC protocol, energy efficiency.

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AOM : An Efficient Approach to Restore Actor-Actor Connectivity in Wireless Sensor and Actor Networks

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ABSTRACT

Wireless sensor and actor networks (WSANs) consist of powerful actors and resource constraint sensors that are linked together in wireless networks. They mostly rely on actors to make proper decisions and perform desired coordination to achieve the goals of the entire network. They are usually deployed in critical applications and actor-actor network connectivity is thus vital to their effective utilization. Since WSAN applications are mostly deployed in harsh environments, actor nodes may fail and so partition their network. We propose a comparatively more efficient distributed approach, nicknamed AOM, to restore actor-actor connectivity upon the failure of any actor. We identify critical actors by combining the result of determining critical actors using the Stojmenovich's method with the connectivity dominating set (CDS) of the network. This hybrid method of detecting critical actors helps in detecting critical nodes and candidate replacement actors more precisely while minimizing the total number of required messages for network restoration. The failure handling of actors is done in a proactive manner. Our proposed method minimizes both the restoration time of network and the total number of actor movements. When a failed actor is a critical node, actors in its neighborhood are relocated in a coordinated way to reconnect the actor network. The superiority of our approach compared to other works is shown by simulative experiments measuring two important parameters to WSANS, namely, the total number of transmitted messages and the total number of actor movements during actor-actor network reconnection process.

KEYWORDS

Wireless Sensor and Actor Network; Network Restoration; Actor Connectivity; Cut Vertex; Connectivity Dominating Set (CDS)

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Empirical Examination of Mobile Ad Hoc Routing Protocols on Wireless Sensor Networks

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ABSTRACT

Wireless sensor networks (WSNs) have great potential of being deployed in many places where traditional wired or wireless networks are not feasible. But they have also many new challenges more than other wireless networks. These challenges include the design of embedded intelligent sensors and wireless networking technology, ie. routing protocols and network security. WSNs also have some constraints such as sensor nodes failure which render WSN unavailable. The routing protocol in the sensor networks plays a critical role. They influence the performance of the WSNs and have significant impact on the security and the availability of WSNs. Wireless sensor networks (WSNs) have been regarded as an incarnation of Ad Hoc Networks for a specific application. Since a WSN consists of potentially hundreds of low cost, small size and battery powered sensor nodes, it has more potentials than a MANET to be deployed in many emerging areas. However, they also raised many new challenges, and these challenges include the design of embedded sensors and wireless networking technology, ie. routing protocols and network security. Many ad hoc routing protocols such as AODV, DSR, DSDR, TORA and OLSR, which have been developed particularly for the mobile wireless ad hoc networks (MANETs), performed satisfactorily on MANETs. Research has shown that these ad-hoc routing protocols work well for MANETs with different characteristics and requirements. In this paper, we investigate how well these ad-hoc routing protocols work on wireless sensor networks (WSNs). We focus on their performances in terms of average end-to end delay, packet delivery ratio and routing overheads.

KEYWORDS

Wireless technology, Sensor nodes, Dynamic routing, Throughput, Wireless Network, End-to-End delay

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A Cross-Layer Approach for Minimizing Interference and Latency of Medium Access in Wireless Sensor Networks

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ABSTRACT

In low power wireless sensor networks, MAC protocols usually employ periodic sleep/wake schedule to reduce idle listening time. Even though this mechanism is simple and efficient, it results in high end-to end latency and low throughput. On the other hand, the previously proposed CSMA/CA based MAC protocols have tried to reduce inter-node interference at the cost of increased latency and lower network capacity. In this paper we propose IAMAC, a CSMA/CA sleep/wake MAC protocol that minimizes internode interference, while also reduces per-hop delay through cross-layer interactions with the network layer. Furthermore, we show that IAMAC can be integrated into the SP architecture to perform its interlayer interactions. Through simulation, we have extensively evaluated the performance of IAMAC in terms of different performance metrics. Simulation results confirm that IAMAC reduces energy consumption per node and leads to higher network lifetime compared to S-MAC and Adaptive S-MAC, while it also provides lower latency than S-MAC. Throughout our evaluations we have considered IAMAC in conjunction with two error recovery methods, i.e., ARQ and Seda. It is shown that using Seda as the error recovery mechanism of IAMAC results in higher throughput and lifetime compared to ARQ.

KEYWORDS

Wireless Sensor Networks, MAC, IAMAC, Tree-Based Routing, Cross-Layer Optimization, Interference.

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Performance Analysis of an Improved Graded Precision Localization Algorithm for Wireless Sensor Networks

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ABSTRACT

In this paper an improved version of the graded precision localization algorithm GRADELOC, called IGRADELOC is proposed. The performance of GRADELOC is dependent on the regions formed by the overlapping radio ranges of the nodes of the underlying sensor network. A different region pattern could significantly alter the nature and precision of localization. In IGRADELOC, two improvements are suggested. Firstly, modifications are proposed in the radio range of the fixed-grid nodes, keeping in mind the actual radio range of commonly available nodes, to allow for routing through them. Routing is not addressed by GRADELOC, but is of prime importance to the deployment of any adhoc network, especially sensor networks. A theoretical model expressing the radio range in terms of the cell dimensions of the grid infrastructure is proposed, to help in carrying out a deployment plan which achieves the desirable precision of coarse-grained localization. Secondly, in GRADELOC it is observed that fine-grained localization does not achieve significant performance benefits over coarse-grained localization. In IGRADELOC, this factor is addressed with the introduction of a parameter that could be used to improve and fine-tune the precision of fine-grained localization.

KEYWORDS

Wireless sensor networks, Localization, Centroid, TDOA, Fixed-grid

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Determination of Optimal Number of Clusters in Wireless Sensor Networks

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ABSTRACT

Prolonged network lifetime, scalability and efficient load balancing are essential for optimal performance of a wireless sensor network. Clustering provides an effective way of extending the lifetime of a sensor network. Clustering is the process that divides sensor networks into smaller localized group (called clusters) of members with a cluster head. Clustering protocols need to elect optimal number of clusters in hierarchically structured wireless sensor networks. Any clustering scheme that elects clusters uniformly (irrespective of the distance from Base Station) incurs excessive energy usage on clusters proximal and distant to Base Station. In single hop networks a gradual increment in the energy depletion rate is observed as the distance from the cluster head increases[17]. This work focuses on the analysis of wasteful energy consumption within a uniform cluster head election model (EPEM) and provides an analytical solution to reduce the overall consumption of energy usage amongst the clusters elected in a wireless sensor network. A circular model of sensor network is considered, where the sensor nodes are deployed around a centrally located Base Station. The sensor network is divided into several concentric rings centred at the Base Station. A model, Unequal Probability Election Model (UEPEM), which elects cluster heads non-uniformly is proposed. The probability of cluster head election depends on the distance from the Base Station. UEPEM reduces the overall energy usage by about 21% over EPEM. The performance of UEPEM improves as the number of rings is increased.

KEYWORDS

Wireless sensor networks, Ad-hoc networks, clustering.

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