Webology, Volume 18, Number 5, 2021
ISSN: 1735-188X
DOI: 10.29121/WEB/V18I5/50

A short survey of wireless sensor networks

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ABSTRACT

In the last many years there is a quick development in the field of WSN. For affordable wireless communication, hundreds or thousands of sensor nodes and a base station (sink) have built a novel network that is termed a wireless sensor network. Nodes and Base station are located in vast area. This study gives a simple introduction to WSNs architecture, potential topologies and measurement of physical parameters with crossbow tool. Afterward, the study outlines the varieties of WSN and its applications.

Keywords: .

INTRODUCTION

Miniaturization, low-power circuit design, simple, low-power, moderately efficient wireless communication equipment, enhanced small-scale energy sup- plies, and falling manufacturing costs have all contributed to the realisation of a new technological vision in recent years. Sensor networks that don't rely on wires [1].

Low cost and wireless communication enable a new kind of network that may be deeply embedded in our physical world. This type of network combines basic wireless communication, minimum processing resources, and some sort of sensing of the physical environment. Temperature, light, vibration, sound, radiation, etc. are all possible sensing jobs for such a device. The desired form factor would be only a few cubic millimetres in volume, with a price tag of less than one US dollar [2]. This would include everything from the radio front end and microcontroller to the power supply and the sensor itself. A sensor node is a device that has all of these components in one convenient package.

Even while there are many ways in which sensor node networks are similar to traditional notions of ad hoc networks, there are also some significant ways in which they vary and provide their own unique issues.

Targeted to a Particular Use Many various application scenarios become possible as a result of the vast variety of possible combinations of sensing, computing, and communication technologies. Given the wide range of outcomes, it's doubtful that any one approach will work for everything [3]. Network densities in WSNs might range from very sparse to extremely dense, necessitating either completely new protocols or significant adaptations to existing ones.

Environmental Interaction Since these networks must respond to external conditions, we may anticipate that their traffic characteristics will be very distinct from those of purely human-driven networks. As a result, wireless sensor networks (WSNs) can display very low data rates over a relatively long period of time, but might experience very high bursts of traffic when something unexpected occurs (a phenomenon known from real-time systems as event showers or alarm storms). Potentially accommodating dozens or even hundreds of thousands of nodes, such WSNs will need to grow in a different way than today's ad hoc networks.

Energy Similar to ad hoc networks, when power is in short supply, this is a crucial factor in determining how a system should be designed. There are times when a sensor node's battery is not rechargeable, and this fact, together with the need to increase the node's lifespan, has significant implications for the underlying system and networking architecture.

Adaptability to new settings It is expected that WSNs, like ad hoc networks, will need to auto-configure into linked networks, however the differences in traffic, energy trade-offs, etc. may need novel approaches. For example, sensor nodes must acquire knowledge about their physical location. QoS and Reliability The ideas of reliability and quality of service in these networks will be vastly different; it is not even totally obvious how to accurately define the service provided by a wireless sensor network. In certain circumstances, simply infrequent delivery of a packet might be more than acceptable; in other cases, extremely high dependability requirements exist. For this reason, the packet delivery ratio is not a sufficient statistic; instead, what matters is the quantity and quality of information that can be recovered at specified information sinks about the observed objects or region. Furthermore, the effort necessary to acquire this knowledge has to be considered. Data centric First and foremost, in many application- situations, the cheap cost and low energy supply will necessitate the deployment of wireless sensor nodes in a redundant fashion. Because of this, unlike in classic networks, the significance of any one node is greatly diminished (where a user wants his laptop to communicate with that web server) [4]. More important is the data that these nodes can see. Because of this change in emphasis, networking paradigms are shifting away from node-centric systems and toward data-centric ones. Simplicity Because of their size and power constraints, sensor nodes need operating and networking software that is much less complex than what we use on our desktop computers today. Since abstractions are usually costly in terms of time and space, achieving this simplicity may also need departing from traditional layering conventions for networking software.

This is not meant to be a comprehensive survey of the relevant literature. Instead, it aims to provide a more in-depth look at the ways in which WSNs vary from other types of research, the types of solutions that are presently being considered, and the most pressing issues in this field of study.

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Utilization Examples of Sensor Networks

From this technical utopia, brand-new uses may be conceived. Surveillance tasks, such as intruder surveillance in premises, deeply embedding sensing into ma- chinery where wiring would not be feasible (e.g., because wiring would be too expensive, could not reach the deeply embedded points, limits flexibility, represents a major obstacle), and environmental control (e.g., fire fighting, preventing marine ground floor erosion, understanding earthquake vibration patterns). Among the many categories of applications is inter- and intra-vehicle communication. When the fundamental size and cost constraints are resolved, sensor networks may become a game-changing technology.

Architecture

The design of such WSNs, both on the level of individual nodes and the network as a whole, will be radically different due to the fundamental changes in application situations and underlying communication technology. Architecture with a single node

Embedded microcontrollers with a low level of complexity, such the Atmel or the MSP 430 from Texas Instruments. The ability to place these microcontrollers into different operating and sleep modes, the number of sleep modes available, the time and energy required to transition between these modes, and so on are all crucial characteristics beyond the obviously critical power consumption. Important factors include the necessary chip size, processing power, and on-chip memory.

Radio transceivers like the RFM TR1001 or devices from Infineon or Chipcon are in use today, and several companies provide radio modems with comparable functionality. While most devices rely on ASK or FSK modulation, Berkeley PicoNodes employ OOK.

The effects of proposed improvements to radio technology, such as ultra-wide band, remain unclear. Important progress might be made with the introduction of a somewhat functional wake-up radio concept that could wake up all nodes in the neighbourhood of a sender or even just certain explicitly targeted nodes. With the use of a wake-up radio and a simple detecting circuit, a node may go to sleep and be roused by appropriate signals from other nodes while conserving energy. It is not unheard of to think of alternatives to radio transmission, such as optical or ultrasonic for use in submerged environments. This depends much on the intended use; in this article, we'll be mostly concerned with radio transmission. Batteries, which provide the necessary power. Battery management and the feasibility of energy scavenging for in-field battery recharging are key issues to consider. Depending on the use case, battery self-discharge, self-recharge, and lifespan might also be problematic. The literature is similarly split on the best choice of operating system or, more accurately, run-time environment for such systems [5]. The memory footprint and execution overhead must be kept to a minimum. However, adaptable ways to combine protocol building blocks are required since a straightforward layered design is not likely to be optimum and because meta information is likely to be utilised in a wide variety of locations throughout a protocol stack (e.g., information about location, received signal strength, etc. has an influence on many different protocol functions). Accordingly, we think that blackboards, publish/subscribe, and tuple spaces are all promising foundations for the run-time environments of such nodes. Organizational structure of a network. Multiple factors must be considered while designing a network's infrastructure.

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Both an application- and an energy-driven perspective must be taken into account in the design of the protocol architecture. Things like QoS, uptime, redundancy, and the inevitable degree of error in sensor readings must be taken into account. Addressing in WSNs is likely to look quite different: An "address-free structure" [1] may be necessary due to scalability and energy concerns [6]. Even if these addresses are only unique in a two-hop neighbourhood, distributed assignment of addresses may be a useful method. Additionally, data- and location-based addressing schemes are essential. When it comes to establishing characteristics, the need and capability to do in-network processing will be paramount. This includes distributed signal processing, the use of temporal and spatial correlation structures in the sensor readings, and data aggregation when numerous sensor readings are converge-casted to a single or multiple sinks. Another benefit of data aggegation is a decrease in the total number of packets that must be sent across a network connection. What kind of service a WSN provides at the scale of the whole network on the basis of this kind of in-network processing is still something of a grey area. It's not the sending and receiving of digital data, but neither will a broad description of a WSN service ("provides readings of envi- ronmental values upon request" etc.) cover every use case. Due to the inevitable and eventuality, these services are called by nodes outside the system, gateway concepts are necessary. Unanswered questions include how to best organise WSNs into bigger networks, and where to best bridge the various communication protocols (from the physical layer on up). Non-traditional networking architectures are another possibility; for instance, agents might "travel" over a specific network to investigate its topology and tomography. Occasionally, it may be essential to re-task a WSN, which means giving each node a fresh assignment and a copy of the network's operating software.

Communication protocols

When discussing "classical" radio transmission, the primary concern is how to maximise transmission efficiency while minimising all associated expenses (overhead, possible retransmissions etc.). There is a dearth of literature on protocols well suited to WSN requirements. One of the most active study topics for WSNs (as it is for ad hoc networks) is medium access, making a comprehensive description difficult here. Most research focuses on figuring out how to make sensor nodes sleep without disrupting the network for as long as feasible. Consequently, TDMA may be seen in many of the concepts.

Connation Layer

The link layer has seen far less development than the MAC layer. Energy use per bit of data is studied, who look at the effects of FEC and transmission power change. Recent, ongoing research (conducted by one of the author's groups) is aimed at considering the link-layer redundancy that an aggregated message conveys[7]. Unique to the context of wireless sensor networks. Yet, there have been no findings from this method that have been made public.

Conceptual Issues

Some of the challenges that arise when addressing inquiries in WSNs are also seen in more conventional ad hoc networks. For instance, the dispersed address assignment issue is similar to the ad hoc network problem, but with certain WSN-specific nuances . Additionally, geographic addresses are essential in WSN since they are used in many applications (such as environmental

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monitoring) and have shown to be highly useful in networking activities like routing.

Time synchronisation algorithms are obviously necessary in WSNs, given the centrality of time in these networks (to guarantee that observations are labelled with the right time, to synchronise sleeping cycles, etc.).

Localization
Computing a sensor network co-ordinate system, or localising sensor nodes using the network itself, is a rapidly growing field of study. Mechanisms such using received signal intensity indications, arrival time, time disparity, and angle of arrival are being looked into. In addition, there are a lot of well-known and critically important issues, such as how to best include beacons or anchor nodes that provide accurate data, or how to best raise the accuracy of distributed algorithms via iteration.

Managed Topologies
Performing a broadcast via simple flooding in a densely distributed network incurs a substantial overhead of redundant information since many nodes in the neighbourhood will repeat the message despite the fact that many other nodes have already done [8]. One of the reasons to use topology control in a WSN is to attempt to modify the mix of node types that make up a network's graph.

Clustering, the effort (roughly speaking) to approximate maximal independent sets, and transmission power control are the two most used strategies. There is a great deal of publishing activity in each of these fields of study.

The LEACH study work, and the passive clustering work are all highly pertinent to the topic of clustering. It is important to highlight while discussing the management of electricity. Stacking the Network's Baseband, or the Network

The network layer, together with the media access control and topology control layers, is unquestionably the most active field of study today. While it has some similarities to ad hoc networking, it requires different approaches due to more strict criteria for scalability, energy efficiency, and data-centricity. However, WSN still faces the age-old challenges of unicast, multicast, anycast, and convergecast routing for a variety of uses, as well as the less common geographic routing and the more recent and defining data-centric routing. The standard realm of unicast ad hoc routing protocols is already fully covered elsewhere. Energy efficiency, or how a protocol handles energy in general, is a crucial statistic for WSNs due to the nature of the technology (the most energy-efficient path is not necessarily the best path if it leads across nodes that are already low in battery power, etc.).

LEACH , which mixes clustering with routing, is one example of a good routing protocol for this purpose; other recent references in this extensive field include. However, caution is required since non-power-aware routing protocols may outperform power-optimized protocols in certain situations .

Various methods also take into account the issue of sensing quality while making routing choices. In addition to the unicast scenario, multicast is another feature that will be necessary in some WSN implementations. To reiterate, energy efficiency is a crucial quality indicator. Recent publications provide energy-efficient multicast protocol solutions.

The request of a multicast can specify that only a certain percentage of the nodes is supposed to answer the request (with the intuition that the individual nodes that answer this request can rotate over multiple requests), for example, to support rotating sleeping patterns of nodes, leading to stochastically constrained multicast. In this way, application needs and lower-layer behaviour may be brought into harmony. There is active research in this area (including by the authors' teams), but there are no conclusive publications on the issue as of yet.

To send a message to a specific object while there are several instances of that item in the network is an example of anycast (typically, the closest instantiation is preferred). In the context of locating new services, this feature is often seen important. There is no believable source, however, since the idea of service discovery is still in its infancy for WSNs [9].

Transportation by means of a geographically defined path: If a packet is directed to a region rather than a specific node, then any node within that region is a valid recipient and may handle the message. Obviously, in the context of sensor networks, such geographical routing is crucial in order to request sensor data from some place ("Request temperature in living room"). It will also commonly be linked with some concept of multicast, in particular stochastically limited multicast.

A data-driven approach to routing: WSNs may have their abstract foundation in data-centric routing. It has the potential to unite a natural framework for in-network processing with the applications' need to access data (instead of individual nodes). Popular abstractions in this setting include the publish/subscribe model a node with known or updated sensor readings broadcasts them, and other nodes that are interested in receiving them may sign up to receive them. A node, for instance, may say, "Give me any occurrences in which the temperature is higher than 50 degrees Celsius," and get notifications if such a situation arose.

Although not all of its performance and functional properties are fully understood or described, "directed diffusion" is the most popular and often-cited technique in this area. Content-addressed, peer-to-peer systems over the Internet (such distributed hash tables) provide a natural analogy as well. While minimal stretch peer-to-peer networks have been studied in theory, in practise this relationship has not been substantially explored. Transport

Surprisingly little attention has been paid to the subject of what transport protocols might work best for WSNs. It's directly related to the dilemma of deciding how much power to use in exchange for how much reliability and quality of service to provide in wireless sensor networks.

High-level application support

The protocol functions outlined in Section 4 are present in conventional wired, cellular, and ad hoc networks, but in a somewhat altered form. On the other hand, it seems that a greater degree of abstraction is helpful for applications that collaborate with WSNs. Some of the studies that have

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been conducted in this field are described below. A Conceptualization of

Abstraction in Databases

One intriguing strategy is to treat the sensor network as a massive database and query it like any other system. In passing, this method resolves the whole issue. The challenges here are designing appropriate query languages that can represent the entire depth of WSNs and finding energy-efficient techniques to execute such searches. Probably the most prominent organisation in this area is the TinyDB project at the University of California, Berkeley. The references are some of the best available. Files are stored in several locations.

Like peer-to-peer systems and distributed hash tables, WSNs are a type of distributed data storage. There are some similarities because of the emphasis placed on data in both approaches. Disseminating information effectively and at the right time is also an important consideration. WSNs may be thought of as peer-to-peer systems, where the topological proximity of nodes should reflect and correlate to the informational proximity of nodes.

With the addition of actuators like valves, the subject of distributed algorithms becomes necessary in wireless sensor networks, which were previously just concerned with perceiving the environment. One example is the distributed consensus problem, in which several actuators need to reach an agreement (a functionality which is also required for distributed software update, for example). While this issue has been studied to some extent for ad hoc networks, it has not been thoroughly explored in the context of WSNs, where new scalability and reliability issues emerge and the integration in the underlying, possibly data-centric routing architecture has not yet been investigated (although there is currently some work in progress in one of the author's groups). Among the many sources on ad hoc networks Centralized processing vs distributed processing

One of the key enabling technologies for WSNs is in-network processing, the ability to alter data as it passes through the network. This has the potential to greatly improve the network's energy efficiency. A fundamental principle is that temporal and spatial correlations in the data may be used to one's advantage. Compression or aggregation, which is one of the most active study fields in WSNs, are two examples of possible in-network processing. Since computing often requires less energy to do than transmission, this is a significant incentive for aggregation and in-network processing.

Security

Protecting wireless sensor networks is an emerging research area. As much as feasible seems to be immediately transferred from the ad hoc scenario, the main dangers and prospective assaults to the proper. There hasn't been a comprehensive study of how WSNs work yet (albeit they will most certainly be largely application-dependent). This means that researchers have a lot of room to explore.

Methods for Implementing 5 WSNs

Some additional support functionality beyond what has been detailed so far regarding data transfer is required for WSNs to be deployed in a realistic setting. Additionally, the network as a whole must

ISSN: 1735-188X
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be taken into account. Two major considerations are: Management The identification of malfunctioning nodes, for purposes such as replacement, is a common challenge in the administration of WSNs. Some other administration issues include software updates or providing quality of service.

Conclusions

There is more to ad hoc networks than merely wireless sensor networks. Due to the high demands for downsizing and low cost, the efficient utilisation of energy and processing capacity is a much larger problem than in traditional ad hoc networks. In addition, there are cases when the standard ways in which communication protocols are developed need to be reconsidered.

Since wireless sensor networks are a relatively new area of study, efforts are currently being made to address numerous outstanding questions. At the time of this writing, wireless sensor networks are not yet ready for actual deployment since certain of the underlying hardware difficulties, particularly with regard to the energy supply and downsizing, have not yet been entirely addressed. Nonetheless, these issues may be fixed in the not-too-distant future.

The treatment of movement is perhaps the most significant conceptual issue. Three distinct forms of mobility exist in a sensor network: the sensor nodes themselves, the observed phenomenon (such as an intruder in a surveillance application), and the requester of information. Current sensor network protocols do not adequately support any of these mobility kinds, therefore the findings presented here are only the beginning of an ongoing investigation into this problem.

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