JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

"Review paper on wireless sensors-based system"

[1] **Vijay Nalvaya,** [2] **Namrata Sahayam**
[1]MTech Scholar, [2]Assistatnt Professor
[1]Deapartment of Electronics & Telecommunication Engineering
[1]Jabalpur Engineering College, Jabalpur

Abstract: Wireless Sensor Networks (WSNs) are critical for applications like Structural Health Monitoring (SHM) and military surveillance. However, energy depletion in sensor nodes, especially in harsh environments where batteries cannot be easily replaced, remains a primary challenge. This work focuses on two optimization fronts: location optimization to reduce the number of sensors while maintaining high information quality, and energy optimization through efficient routing. A new algorithm, Higher Information Oriented Genetic Algorithm (HIOGA), is proposed to optimize sensor placement based on the Fisher Information Matrix (FIM).

Index Terms -

I. INTRODUCTION

Wireless sensor networks (**WSNs**) refer to networks of spatially dispersed and dedicated sensors that monitor and record the physical conditions of the environment and forward the collected data to a central location. WSNs can measure environmental conditions such as temperature, sound, pollution levels, humidity and wind

These are similar to wireless ad hoc networks in the sense that they rely on wireless connectivity and spontaneous formation of networks so that sensor data can be transported wirelessly. WSNs monitor physical conditions, such as temperature, sound, and pressure. Modern networks are bi-directional, both collecting data and enabling control of sensor activity The development of these networks was motivated by military applications such as battlefield surveillance Such networks are used in industrial and consumer applications, such as industrial process monitoring and control and machine health monitoring and agriculture

A WSN is built of "nodes" – from a few to hundreds or thousands, where each node is connected to other sensors. Each such node typically has several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting. A sensor node might vary in size from a shoebox to (theoretically) a grain of dust, although microscopic dimensions have yet to be realized. Sensor node cost is similarly variable, ranging from a few to hundreds of dollars, depending on node sophistication. Size and cost constraints constrain resources such as energy, memory, computational speed and communications bandwidth. The topology of a WSN can vary from a simple star network to an advanced multi-hop wireless mesh network.

Applications- Area monitoring

Area monitoring is a common application of WSNs. In area monitoring, the WSN is deployed over a region where some Phenomenon is to be monitored. A military example is the use of sensors to detect enemy intrusion; a civilian example is the geo-fencing of gas or oil pipelines

Health care monitoring

There are several types of sensor networks for medical applications: implanted, wearable, and environment-embedded. Implantable medical devices are those that are inserted inside the human body. Wearable devices are used on the body surface of a human or just at close proximity of the user. Environment-embedded systems employ sensors contained in the environment. Possible applications include body position measurement, location of persons, overall monitoring of ill patients in hospitals and at home. Devices embedded in the environment track the physical state of a person for continuous health diagnosis, using as input the data from a network of depth cameras, a sensing floor, or other similar devices. Body-area networks can collect information about an individual's health, fitness, and energy expenditure.[9][10] In health care applications the privacy and authenticity of user data has prime importance. Especially due to the integration of sensor networks, with IoT, the user authentication becomes more challenging; however, a solution is presented in recent work.

Habitat monitoring

Wireless sensor networks have been used to monitor various species and habitats, beginning with the Great Duck Island Deployment, including marmots, cane toads in Australia and zebras in Kenya.

Environmental/Earth sensing

There are many applications in monitoring environmental parameters, examples of which are given below. They share the extra challenges of harsh environments and reduced power supply.

Air quality monitoring

Experiments have shown that personal exposure to air pollution in cities can vary a lot.[14] Therefore, it is of interest to have higher temporal and spatial resolution of pollutants and particulates. For research purposes, wireless sensor networks have been deployed to monitor the concentration of dangerous gases for citizens (e.g., in London).[15] However, sensors for gases and particulate matter suffer from high unit-to-unit variability, cross-sensitivities, and (concept) drift.[16] Moreover, the quality of data is currently insufficient for trustworthy decision-making, as field calibration leads to unreliable measurement results, and frequent recalibration might be required. A possible solution could be blind calibration or the usage of mobile references.

Forest fire detection

A network of Sensor Nodes can be installed in a forest to detect when a fire has started. The nodes can be equipped with sensors to measure temperature, humidity and gases which are produced by fire in the trees or vegetation. The early detection is crucial for a successful action of the firefighters; thanks to Wireless Sensor Networks, the fire brigade will be able to know when a fire is started and how it is spreading.

Landslide detection

A landslide detection system makes use of a wireless sensor network to detect the slight movements of soil and changes in various parameters that may occur before or during a landslide. Through the data gathered it may be possible to know the impending occurrence of landslides long before it actually happens.

Water quality monitoring

Water quality monitoring involves analyzing water properties in dams, rivers, lakes and oceans, as well as underground water reserves. The use of many wireless distributed sensors enables the creation of a more accurate map of the water status, and allows the permanent deployment of monitoring stations in locations of difficult access, without the need of manual data retrieval.

Industrial monitoring

Machine health monitoring

Wireless sensor networks have been developed for machinery condition-based maintenance (CBM) as they offer significant cost savings and enable new functionality

Wireless sensors can be placed in locations difficult or impossible to reach with a wired system, such as rotating machinery and untethered vehicles.

II. CHARACTERISTICS

The main characteristics of a WSN include

- Power consumption constraints for nodes using batteries or energy harvesting. Examples of suppliers are ReVibe Energy and Perpetuum
- Ability to cope with node failures (resilience)
- Some mobility of nodes (for highly mobile nodes see MWSNs)
- Heterogeneity of nodes
- Homogeneity of nodes
- Scalability to large scale of deployment
- Ability to withstand harsh environmental conditions
- Ease of use
- Cross-layer optimization

Cross-layer is becoming an important studying area for wireless communications.[34] In addition, the traditional layered approach presents three main problems:

1. Traditional layered approach cannot share different information among different layers, which leads to each layer not having complete information. The traditional layered approach cannot guarantee the optimization of the entire network.
2. The traditional layered approach does not have the ability to adapt to the environmental change.
3. Because of the interference between the different users, access conflicts, fading, and the change of environment in the wireless sensor networks, traditional layered approach for wired networks is not applicable to wireless networks.

III. HARDWARE REQUIRED

One major challenge in a WSN is to produce *low cost* and *tiny* sensor nodes. There are an increasing number of small companies producing WSN hardware and the commercial situation can be compared to home computing in the 1970s. Many of the nodes are still in the research and development stage, particularly their software. Also inherent to sensor network adoption is the use of very low power methods for radio communication and data acquisition.

Wireless

There are several wireless standards and solutions for sensor node connectivity. Thread and Zigbee can connect sensors operating at 2.4 GHz with a data rate of 250 kbit/s. Many use a lower frequency to increase radio range (typically 1 km), for example Z-wave operates at 915 MHz (in North America) and in the EU 868 MHz has been widely used but these have a lower data rate (typically 50 kbit/s)

Software

Energy is the scarcest resource of WSN nodes, and it determines the lifetime of WSNs. WSNs may be deployed in large numbers in various environments, including remote and hostile regions, where ad hoc communications are a key component. For this reason, algorithms and protocols need to address the following issues:

- Increased lifespan
- Robustness and fault tolerance
- Self-configuration

Lifetime maximization: Energy/Power Consumption of the sensing device should be minimized and sensor nodes should be energy efficient since their limited energy resource determines their lifetime. To conserve power, wireless sensor nodes normally power off both the radio transmitter and the radio receiver when not in use.

Routing protocols

Wireless sensor networks are composed of low-energy, small-size, and low-range unattended sensor nodes. Recently, it has been observed that by periodically turning on and off the sensing and communication capabilities of sensor nodes, we can significantly reduce the active time and thus prolong network lifetime. However, this duty cycling may result in high network latency, routing overhead, and neighbor discovery delays due to asynchronous sleep and wake-up scheduling.

Operating systems

Operating systems for wireless sensor network nodes are typically less complex than general-purpose operating systems. They more strongly resemble embedded systems, for two reasons. First, wireless sensor networks are typically deployed with a particular application in mind, rather than as a general platform. Second, a need for low costs and low power leads most wireless sensor nodes to have low-power microcontrollers ensuring that mechanisms such as virtual memory are either unnecessary or too expensive to implement.

IV. SIMULATION

At present, agent-based modeling and simulation is the only paradigm which allows the simulation of complex behavior in the environments of wireless sensors (such as flocking).[50] Agent-based simulation of wireless sensor and ad hoc networks is a relatively new paradigm. Agent-based modelling was originally based on social simulation.

Network simulators like Opnet, Tetcos Net Sim and NS can be used to simulate a wireless sensor network.

Localization

Network localization refers to the problem of estimating the location of wireless sensor nodes during deployments and in dynamic settings. For ultra-low power sensors, size, cost and environment precludes the use of Global Positioning System receivers on sensors. In 2000, Nirupama Bulusu, John Heidemann and Deborah Estrin first motivated and proposed a radio connectivity based system for localization of wireless sensor networks.[51] Subsequently, such localization systems have been referred to as range free localization systems, and many localization systems for wireless sensor networks have been subsequently proposed including AHLoS, APS, and Stardust.

Sensor data calibration and fault tolerance

Sensors and devices used in wireless sensor networks are state-of-the-art technology with the lowest possible price. The sensor measurements we get from these devices are therefore often noisy, incomplete and inaccurate. Researchers studying wireless sensor networks hypothesize that much more information can be extracted from hundreds of unreliable measurements spread across a field of interest than from a smaller number of high-quality, high-reliability instruments with the same total cost.

Macro programming

Macro-programming is a term coined by Matt Welsh. It refers to programming the entire sensor network as an ensemble, rather than individual sensor nodes. Another way to macro-program a network is to view the sensor network as a database, which was popularized by the TinyDB system developed by Sam Madden.

REFERENCES

1. *Ullo, Silvia Liberata; Sinha, G. R. (2020-05-31). "Advances in Smart Environment Monitoring Systems Using IoT and Sensors". Sensors.* ***20*** *(11):3113. Bibcode:2020Senso..20.3113U. doi:10.3390/s20113113. ISSN 1424-220. PMC 7309034. PMID 32486411.*

2. *FrancescoMario, Di; K, DasSajal; AnastasiGiuseppe (2011-08-01). "Data Collection in Wireless Sensor Networks with Mobile Elements". ACM Transactions on Sensor Networks.* ***8****: 1–31. doi:10.1145/1993042.1993049. S2CID 15576441.*

3. *Xia, Feng; Tian, Yu-Chu; Li, Yanjun; Sun, Youxian (2007-10-09). "Wireless Sensor/Actuator Network Design for Mobile Control Applications". Sensors.* ***7*** *(10): 2157–2173. Bibcode:2007Senso...7.2157X. doi:10.3390/s7102157. ISSN 1424-8220. PMC 3864515. PMID 28903220.*

4. *"Wireless sensor networks for battlefield surveillance" (PDF). 2006.*

5. *Global, I. G. I. "Wireless sensor networks have potential in health care and agriculture, says study". techxplore.com. Retrieved 2023-02-09.*

6. *Dargie, W.; Poellabauer, C. (2010). Fundamentals of wireless sensor networks: theory and practice. John Wiley and Sons. pp. 168–183, 191–192. ISBN 978-0-470-99765-9.*

7. *Sohraby, K.; Minoli, D.; Znati, T. (2007). Wireless sensor networks: technology, protocols, and applications. John Wiley and Sons. pp. 203–209. ISBN 978-0-471-74300-2.*

8. *Oliveira, João; Goes, João (2012). Parametric Analog Signal Amplification Applied to Nanoscale CMOS Technologies. Springer Science & Business Media. p. 7. ISBN 978-1-4614-1670-8.*

9. *Peiris, V. (2013). "Highly integrated wireless sensing for body area network applications". SPIE Newsroom. doi:10.1117/2.1201312.005120.*

10. *Tony O'Donovan; John O'Donoghue; Cormac Sreenan; David Sammon; Philip O'Reilly; Kieran A. O'Connor (2009). A Context Aware Wireless Body Area Network (BAN) (PDF). Pervasive Computing Technologies for Healthcare, 2009. doi:10.4108/ICST.PERVASIVEHEALTH2009.5987. Archived (PDF) from the original on 2016-10-09.*

11. *Bilal, Muhammad; et al. (2017). "An Authentication Protocol for Future Sensor Networks". Sensors.* ***17*** *(5): 979. arXiv:1705.00764. Bibcode:2017Senso..17..979B. doi:10.3390/s17050979. PMC 5464775. PMID 28452937.*

12. *Oppermann, Felix Jonathan; Boano, Carlo Alberto; Römer, Kay (2014). "A Decade of Wireless Sensing Applications: Survey and Taxonomy". The Art of Wireless Sensor Networks: Volume 1: Fundamentals. Springer. pp. 11–50. doi:10.1007/978-3-642-40009-4_2. ISBN 978-3-642-40009-4.*