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Wireless Sensor Network supplemented with MATLAB for improved environment condition and energy conservation

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ABSTRACT

A planned infrastructure or a communicative infrastructure revolves around the cellular network which has a pivotal role to play in the field of wireless communication. But despite these advantages which the wireless network possesses, they are not feasible in a drastic environment such as earthquake-hit areas, battlefield or any hostile zones simply because infrastructure remains a vague subject of concern [1]. Recent developments have enhanced the technology fabricating ad-hoc wireless system network which can respond to this type of versatile situation.

Keywords— *WSN, Wireless Sensor Network, MATLAB, Energy conversation, Condition monitoring*

1. INTRODUCTION

A planned infrastructure or a communicative infrastructure revolves around the cellular network which has a pivotal role to play in the field of wireless communication. But despite these advantages which the wireless network possesses, they are not feasible in a drastic environment such as earthquake-hit areas, battlefield or any hostile zones simply because infrastructure remains a vague subject of concern [1]. Recent developments have enhanced the technology fabricating ad-hoc wireless system network which can respond to this type of versatile situation. These networks can be automated by arranging the quanta autonomously and can be adapted in an independence fashion without any dependence on the infrastructure [2]. Further discovery has led to the invention of micro wireless devices which includes sensors, having the ability to sense and process the computing communication spontaneously [3]. WSNs comprises of hundreds of sensors agglomerated together [4] dispersed either randomly in an unfavourable environment or in a deteriorating area where no traces of infrastructure can be located. While they are being deployed, the sensors themselves would themselves to form a network in an ad hoc fashion through which they can operate in the Wireless Sensing Networks. [4, 5] The communication for this system is carried out by the single or multi-hop dissemination based on the coordinate points and the distance between the two sensors. Apart from this excellent use of this connectivity, these networks also help to extract the data from a proctored environment. This review deals with the objectives of how we can extract the data by this particular technique to enhance the network connectivity in a more diffused environment. Data collection is one of the main cellular operations in the WSNs through tree topology. Each of these sensors is capable of sensing the area under observation and retracing back the same data to the base known as the sink without any overflow or loss of memory [6,7]. Once the sink receives the data, it decides which data to be implemented for the particular type of operation that is instructed to be carried out. The sink is considered the most powerful station from which all the data are transmitted and thus is where from where the WSNs interact with the outside world [8, 9]. There are several paradigms which state the reporting of the data from the sink to the sensor networks. [10]

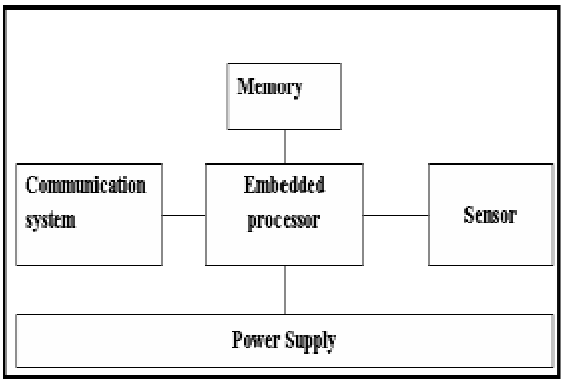


Fig. 1: Architecture of a Sensor Node

A remote sensor system comprises of spatially circulated self-sufficient sensors to helpfully screen physical or ecological conditions, for example, temperature, sound, vibration, weight, movement or toxins. The advancement of remote sensor systems was persuaded by military applications, for example, front line observation. They are presently utilized as a part of numerous modern and regular citizen application territories, including mechanical methodology checking and control, machine wellbeing observing, environment and living space observing, human services applications, home mechanization, and activity control [1-2]. A savvy sensor hub is a consolidation of sensing, transforming and correspondence advances. Figure 1 shows the essential design parts of a sensor hub. The sensing unit faculties the change of parameters, sign molding hardware readies the electrical signs to change over to the computerized area, the sensed simple sign is changed over and is utilized as the data to the application calculations or transforming unit, the memory helps to handle of assignments and the Transceiver is utilized for corresponding with different sensors or the base stations or sinks in WSN [3], see Figure 1. Sensors can screen temperature, weight, moistness, soil cosmetics, vehicular development, commotion levels, lighting conditions, the vicinity or nonappearance of specific sorts of articles or substances, mechanical anxiety levels on connected items, and different properties. Their system may be seismic, attractive, warm, visual, infrared, acoustic, or radar.

2. LITERATURE REVIEW

Liu, Zhang [8][9] has detailed in a complex system, condition monitoring (CM) can collect the system working status. The condition is mainly sensed by the pre-deployed sensors in/on the system. Most existing works study how to utilize the condition information to predict the upcoming anomalies, faults, or failures. There is also some research which focuses on the faults or anomalies of the sensing element (i.e., sensor) to enhance the system reliability.

Hayes, M.A. [12] Performing predictive modelling, such as anomaly detection, in Big Data is a difficult task. This problem is compounded as more and more sources of Big Data are generated from environmental sensors, logging applications, and the Internet of Things. Further, most current techniques for anomaly detection only consider the content of the data source, i.e. the data itself, without concern for the context of the data. As data becomes more complex it is increasingly important to bias anomaly detection techniques for the context, whether it is spatial, temporal, or semantic. The work proposed in this paper outlines a contextual anomaly detection technique for use in streaming sensor networks. The technique uses a well-defined content anomaly detection algorithm for real-time point anomaly detection. Additionally, we present a post-processing context-aware anomaly detection algorithm based on sensor profiles, which are groups of contextually similar sensors generated by a multivariate clustering algorithm The interworking of physical devices is essentially what is The Internet of Things, these connected devices or “smart devices” with network connectivity enables objects to collect and exchange data. IoT is about making data come together in new ways to help modernize businesses. Smart devices allow objects to be sensed and or controlled remotely across different networks, having this ability results in improved efficiency, accuracy, economic benefits. The Internet of Things is expected to advance connected devices, systems, and services which will bring automation to almost every industry. Currently in its infancy and we are seeing IoT being integrated into industrial, commercial, residential and personal use cases to aggregate, store display, and process data on smartphones, dashboards, and other display devices.

Varga, A [23] wireless sensor network consists of spatially distributed autonomous sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance. They are now used in many industrial and civilian application areas, including industrial process monitoring and control, machine health monitoring, environment and habitat monitoring, healthcare applications, home automation, and traffic control.

Sergey Alatartsev, Marcus Augustine, and Frank Ortmeier [25] have outlined the sequence optimization is an important problem in many production automation scenarios involving industrial robots. Mostly, this is done by reducing it to Traveling Salesman Problem (TSP). However, in many industrial scenarios optimization potential is not only hidden in optimizing a sequence of operations but also in optimizing the individual operations themselves. From a formal point of view, this leads to the Traveling Salesman Problem with Neighborhoods (TSPN). TSPN is a generalization of TSP where areas should be visited instead of points. In this paper, we propose a new method for solving TSPN efficiently. We compare the new method to the related approaches using existing test benchmarks from the literature. According to the evaluation of instances with known optimal values, our method is able to obtain a solution close to the optimum.

Jean-Claude Bermond [28] states the problem of gathering information from the nodes of a multi-hop radio network into a pre-defined destination node under the interference constraints. In such a network, a message can only be properly received if there is no interference from another message being simultaneously transmitted. The network is modelled as a graph, where the vertices represent the nodes and the edges, the possible communications. The interference constraint is modelled by a fixed integer.

Yanzhong Bi, Limin Sun, [30] mobility has attracted much research interest in recent years because it can improve network performance such as energy efficiency and throughput. An energy-unconscious moving strategy is potentially harmful to the balance of the energy consumption among sensor nodes so as to aggravate the hotspot problem of sensor networks. In this paper, we propose an autonomous moving strategy for the mobile sinks in data-gathering applications.

Benjie, Kyle, Hari [35] had introduced the concept of *Span*, a power saving technique for multihop ad hoc wireless networks that reduce energy consumption without significantly diminishing the capacity or connectivity of the network. Span builds on the observation that when a region of a shared-channel wireless network has a sufficient density of nodes, only a small number of them need be on at any time to forward traffic for active connections.

Vensi [40] has been focused on creating a unique end-to-end solution for IoT, this is one of a complete solution on the market for your IoT needs, incorporating hardware and software.

3. OBJECTIVES

- To evaluate application areas of Wireless Sensor Networks in data propagation mechanism via multi-hop relay to reach the respective base station (BS). Thus, sensors will send their packets through other intermediate sensors.
- To reduce energy consumption without significantly diminishing the capacity or connectivity of the network.
- To address this issue, a new scheme which includes sensor selection strategy and data anomaly detection by utilizing information theory and Gaussian Process Regression (GPR)

4. PROBLEM STATEMENTS

Keeping all the advantages of the WSNs aside, a major flaw that arises in these systems are the captive energy resources which the sensors can store which in turn is the biggest disadvantage to the entire processing model [11]. Specifically, when these sensing networks are implemented to the harsh conditions and severe environment, battery replacement is an obscure phenomenon. It is very unlikely to replace the batteries especially when they are put into places to detritus conditions. Hence there energy must be used judiciously so as they can serve the purpose throughout their entire life span [12].

Another secondary challenge for the system is the changed topology. The topology today made differ from that of tomorrows and the sensors must adapt to it without delay and without consuming much energy [13]. Thus reconstructing the topology should be energy efficient. Manufacturing an energy efficient static sensor still remains a challenge for the forthcoming years. Along with the efficiency, the conservative memory also plays as a drawback for the WSNs. The sensor nodes are a small device having the capacity to store a limited amount of memory. The mechanism of the data transfer should be as high as possible to bypass the problem of surplousity or overflow [14].

Sensors are by nature a packed source of information having a small memory. Thus any additional incorporation of any data may lead to overflow and the network failure. This is why they are supplemented with batteries which should be replenished time to time to increase the efficacy of the sensors [15]. But the situation, where human interaction cannot be transuded, magnifies the above problem of replenishing the batteries. Thus the lifetime of the sensors drastically decreases because of the unaltered battery source. To combat the problem, there are several algorithm techniques that are being proposed every day so as to improve the life span as much as possible.

4.1 Environmental Setup with Solution

The above drawback of the WSNs can be overcome by the two basic theories of networking and sensing. The first one being the idle listening state and other being the sink mobility.

(a) Usually, a power management cascade system is used to achieve energy saving in WSNs. The transceivers are the prime energy consuming source of the circuit. The theory states that an algorithm is designed in such a way that these sensor circuits when do not take part in the communication system are automatically shut down or put into a sleep/idle mode to conserve energy [16]. Thus a load of energy can be conserved by taking the transceivers into a hibernating mode when not needed and back again to active ode when required. As a follow-up strategy similar to this, another way where energy gets overflowed is by idle listening. Idle listening takes place when a certain part of the circuit, the node is waiting to receive the data from the sending node, but there is a high probability that the sending node is blank without any data to fetch it to the waiting or the listening node [17, 18].

(b) The second approach to save the energy consummation is by achieving an energy saving WSNs supplemented by sink mobility with a single hop communication. Static networks, precisely cause's issues, for instance, the several ones to one scheme is a very mundane way of fabricating a network web and collecting data from the sensors. In this context, the nodes that are very close to the base station turns out to be burgeoning for others to move their information forward to the sink, and by the time they reach the sink; more than half of their energy drains out [19,20]. As a result, the entire structure becomes static and paralyzed and although the nodes which are far away from the sink may transduce data, they can't because of this momentarily static effect. Moreover, the disconnected parts which are un-functionalized lose the capability to communicate with the other global parts [21].

(c) The wireless ad hoc sensing mechanism is considered one of the superior technologies to connect any sensing process with its subsequent user interface. One of the prime advantages for which we use ad hoc sense is to realize the network of a superfluous number of tiny nodes whose battery capacity is limited. To overcome this, a network routing protocol should be simulated and systemized according to the xerophytic conditions. As the power is limited we require a network of neural chains which can diverge the information from one node to several others.

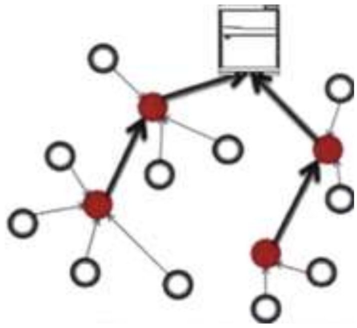


Fig. 2: Neural Network with a multi-hop networking system

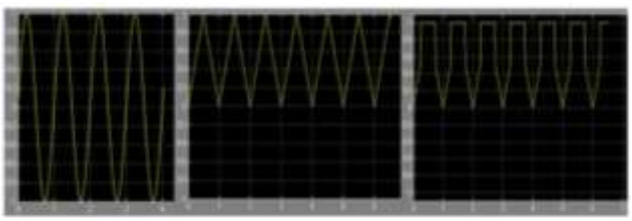
As per Figure 2, if any of the battery becomes inaccessible, the remaining nodes can fully function independently of the break down rally. There are several routing algorithms which are used to transmit the data using this neural network strategy. Dividing the sensor nodes into clusters and drawing neurons from each of these clusters are of great efficacy. Each data pool has a cluster head and there several neural routes through which the data can be transmitted to the sink. To optimize the energy efficiency and maximize the lifetime of the wireless sensor networks, distributed and autonomous methods should be suitable because the wireless sensor networks always include a huge number of sensor nodes

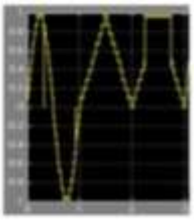
4.2 Reducing idle listening in Wireless Sensor Networks

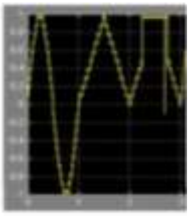
During data collection with a tree topology, as we have discussed earlier, a surplus amount of energy is lost. The collision is the primary concern which causes the loss in the data as provided in the literature [22-26]. When the packets collide with each other, the destination node is unable to receive the data being transmitted correctly. As a result, retransmission is needed which results in the loss of loss of energy. Both the primary and the secondary phases of collision must be avoided to achieve full conversion of the energy. Primary conflicts occur when a single node transmits data and receives data at the same time or if several nodes send packets of data simultaneously to a single node. Secondary conflicts occur when the receiver is receiving the data but the data in being interpenetrated by other data sent from different nodes [27-28]. The interfering data consumes the energy which could have been used to send more than a hundred packets. The third case is, of course, the idle listening. Few of the resisting methods aligning to the idle listening are discussed below.

5. RESULTS AND ANALYSIS

This chapter tabulates the performance of every approach. Results on each technique have been discussed individually. Relative performance comparison of all approaches on the basis of various parameters has been discussed.







6. FUTURE SCOPE

The primary goal of this review was to propose the various methods to conserve energies for WSNs data collection. We had focused on several approaches along with a basic algorithmic layout to show how efficient the process can be or how applicable the process is in context to pragmatic view. However, as technology evolves every day, there are several scopes of metamorphisms in the near future with reference to Wireless Sensing Networks. Some of which are enumerated below:

1. Modifications can be made for the successive slot schedule in the field of the cycle time or any process that can increase the speed of the succession.
2. Extra bit Technique needs a distributed contextual algorithm in near future.
3. Amalgamating the hop transmissions along with the sink is one of the most fascinating areas to improve on.
4. For the k ary method, there are various scopes of the number of iterations can be increased which can both increase the speed and as well as conserve the energy.
5. Another potential direction that could be taken into consideration is that choosing a subset of nodes which can cover the target area, namely, deactivation of redundant nodes that cover the same area.

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