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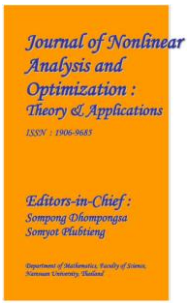

UNDERWATER WIRELESS SENSOR NETWORKS: RESEARCH ISSUES, CHALLENGES AND APPLICATIONS

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Abstract- Underwater wireless sensor networks (UWSNs) have been attracted many researchers in recent years and have eventually contributed to a wide use of diverse applications for underwater environment. The significant advances in UWSNs and the benefits provided by UWSNs have been allowed the rapid creation of UASNs. In this paper UASNs are addressed various research issues and open research challenges for the future research opportunities. Furthermore, this paper addresses major problems in various areas of UWSN and offers guidance for research study, including communication protocols and architectures. In this paper, we present an empirical approach of various issues, challenges and applications which are employed in underwater wireless sensor networks and generally focus on localization algorithms.

Keywords: *Underwater sensor networks, Wireless sensor network, Underwater localization, LEACH*, K-means

I. INTRODUCTION

Recently, underwater wireless sensor networks (UWSNs) have attracted much attention and provided sufficient technical support to many application fields, such as ocean environment monitoring, natural disaster prevention and military defense [1-2]. Localization technology is one of the key technologies of UWSNs [3-6]. However, due to the complex underwater environment, the ground node location method cannot be directly applied to UWSNs [7], UWSNs should use different underwater localization methods. We work and live the way such systems revolutionized. At present, wireless sensor networks are beginning to be sent at an enlivened advance and thoughtless to anticipate that in ten-fifteen a long time to encourage the world will remain enclosed with WSN with getting to over World Wide Web. The web can be measured as carrying a physical network. Ordinarily, the small-sized sensor hubs due to pulverization are caused by the disappointments in WSN by the battery control fatigue, inertia periods, and powerlessness. Wireless systems primarily have low-power, and untrustworthy joins with reduced transmission capacity, and their interface quality can be intensely affected by natural variables. In a general sense, the investigation resists in Wireless sensor systems are boundless. The confined organize life span is the foremost common issue in Wireless sensor systems. The WSN must abuse the nature of the map-reading conventions and are related to different topics, counting the reality that most information is as it was substantial for a brief time. The steering conventions considered for a WSN must subsequently adjust real-time execution and vitality. Radio waves can travel longer distances but because of the salt water characteristics, it operates at very low frequencies, and those low frequencies also require large antennas and high communication skills. Experiments include made at Southern California University, shows that, communication range of only 120 cm has possible at the 433 MHz high frequencies [8]. Additionally, optical waves don't have that high problem attenuation, but suffering from the dispersion, and need high often aiming beam accuracy.

The rest of the paper is organized as follows: Section 2 discusses background of Wireless sensor network and architecture of underwater wireless sensor networks. Section 3 presents literature review. Section 4

covers research issues in UWSN. Section 5 discusses about major challenges. Section 6 presents core applications of UWSN. Section 7 concludes the paper while references are mentioned in the last.

II. UWSNs - BACKGROUND

A. Wireless Sensor Network

The wireless sensor network gathering of nodes controlled into a two-route network. All hub comprises of handling capability for DSP chips, CPUs or one or more microcontrollers, and may contain different sorts of memory of program, data and flash recollections and have a control source like batteries and sun based cells and have an RF handset (routinely with a solitary Omni-directional getting wire), and oblige different sensors and actuators. The ad-hoc design frequently self-organizes after being conveyed in a wireless hub. Even systems of thousands or ten thousands nodes are projected. WSN transmission by any other multi hop technique to create a method called a WSN. The development of wireless sensor network system which recognizes medium access control (MAC) and a physical (PHY) layer performed at a moderate rate and relies upon the IEEE802.15.4 standard and wireless personal area arrangement (LR-WPAN). The vicinity to an occurrence to amass the specified particulars almost the physical world, including transferring those to this sink hub (base station of WSN) and a WSN, may consolidate an enormous number of wireless sensor hubs put in near. A wireless sensor system to screen from a separate and permits a client to productively sense. Miniaturized WSN hubs have taken a toll and measure limitations. In including up the computational speed, memory, vitality, and transmission capacity are an impediment that boosts the WSN complexity.

B. Underwater Wireless Sensor Network

The underwater wireless sensor network (UWSN) has materialized as a compelling method for many applications, including monitoring, measuring, surveillance, and control [23]. UWSN's are composed of the base station and sensor nodes, data processing, and data collection. These nodes are capable of communication. Here, we invent security services for the data transmission, and the localization algorithm is applied to the network clustering to avoid the uneven clustering that happened in k-Means. Underwater wireless sensor networks (UWSNs) have proven strength in various underwater applications of ocean monitoring, resource exploration, surveillance and military use in harsh underwater environments [9,10]. The basic architecture of underwater wireless sensor network (UWSN) is shown in fig.1.

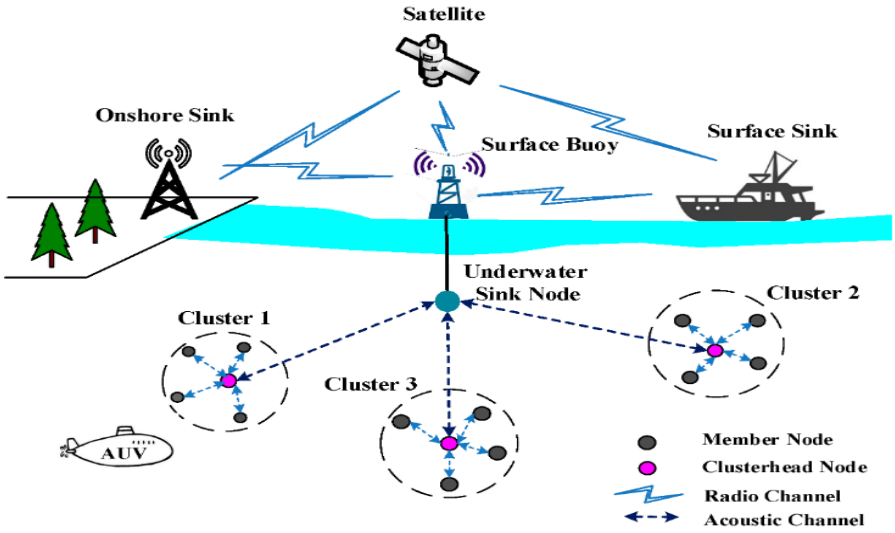

Fig.1 Basic Architecture of UWSN [11]

UWSNs are composed of several components: onshore sink, surface buoy, underwater sink node, and underwater sensor nodes. Moreover, satellite, vessel, and autonomous underwater vehicles (AUVs) can be used to expand the sense and communication range.

III. LITERATURE REVIEW

Several researchers conduct various researches in UWSN surroundings using different algorithms, but some attributes related to UWSN were explored. Such lookup papers are useful in examining completed work and identifying lacunas that remain unresolved in modern day work. Others are summarized as under-

In[12] authors have proposed a system of LEACH protocol (LEACH-TLCH) which is intended to balance the energy consumption of the entire network and extend the life of the network. The algorithm is emulated by Matlab simulation platform the simulation results indicate that both energy efficiency and the lifetime of the network are better than that of LEACH Protocol.

In[13] authors proposes the clustered directing convention for three dimensional UWSN (underwater wireless sensor networks). The K-means calculation can effectively adjust the vitality utilization, expand the life expectancy of arrange, and increment the sum of parcels transmission assess with Filter and LEACH-L calculations.

Algorithms for location have been worked out for WSN to achieve the fine grained location[14], [15], [16] is usually dependent on the spectrum of methods most popularly received signal strength indicator (RSSI), angle of arrival (AoA) and time-based techniques(ToA, TDoA). RSSI is vulnerable to multipath and breakup, though AoA systems are expensive and inefficient precise estimates are often difficult to obtain. Therefore, UWASN due to the heavy attenuation of TDoA cannot be used RF signals. Moreover, the low speed of sound allows precise signal timing. The 5 meter range resolution has recorded in [17].

In [18], a complex hydrological system used the Scalable Localization with Mobility Prediction (SLMP) algorithm. Both the anchor node and the unacknowledged node estimate their location according to their own motion pattern and previous co-ordinates [19], but localization time and motion prediction model are influenced by the performance of the algorithm. The range-free localization algorithms are lower than the range-based localization algorithms.

IV. UWSN RESEARCH ISSUES

We review the different characteristics of each of these below.

A) More Expensive Devices: Submarine sensor systems are more expensive. And no supplier offers such devices any more, since these devices are part of research-oriented activities. Sensor devices underwater are not readily available on the market[9].

B) Hardware Security Requirement: the cost of underwater equipment is higher. Software security or hardware security against water is therefore needed [9].

C) High Communication Power Required: in underwater sensor communication more power will be needed, because data transfer will take place in the water medium. Further energy is required for data exchange in water. UWSN contact is probably the greatest challenge UWSNs face.

D) Propagation Delay: Underwater Wireless Sensor Network's delay of propagation is a major problem. The transmission of acoustic channels underwater in the terrestrial sensor network is of an order of magnitude greater than radio-frequency[10].

E) Location: Localization means that the Underwater Wireless Sensor Network sensor location has been found. Localization is therefore another major problem still to be resolved. Localization is the challenging factor for data labeling, and data is required immediately for some critical applications[10].

F) Limited Battery Power: the lifespan of the UWSN is a broad area of study. UWSNs suffer from corrosion and fouling of a sensor. The elements of electronics like the battery begin to degrade at extremely low temperatures more easily Like the one found deep underwater. As a result, the lifespan of the USWN is significantly shorter than that of a comparable TWSN. There is limited power in the underwater sensor battery. The cost of replacement is increased by shorter life, as the underwater sensor battery cannot be charged[10].

G) Latency Limit: Another major problem is the bandwidth of the underwater Wireless Sensor Network. Because there is limited bandwidth capacity [11].

H) Reliability: One of the main design issues for the accurate delivery of sensed data on the sea sink or water surface is a problem compared with the provision of the collected data to the control center or on-shore station[24].

I) Temporary Losses: Temporary losses mean packet losses when sending time of connection and packets.

V. UWSN CHALLENGES

Given the fact that UWSN is a welcoming new area with various applications, such as the monitoring of the ocean environment, disaster management, assisted navigation and tracking, offshore exploration, oceanographic data collection and several other miscellaneous applications, underwater communications still face some serious problems that need to be tackled, namely efficient communication, low rates of communication. The key challenges in the architecture of acoustic underwater networks [27] are as under:

- Battery power is limited and batteries cannot usually be charged as solar power cannot be exploited;
- The bandwidth available is severely limited;
- The channel has long and variable propagation delays, multipath problems and decay problems;
- Error rates are usually very high;
- Underwater sensors tend to fail frequently due to fouling, corrosion, etc.

In addition to its challenges, the man-made/artificial UAN is a hybrid of natural acoustic systems, suffering from many practical challenges, such as in underwater environment:

1. Usage of Sensor Node in 3D space
2. Passive Mobile Nodes
3. Synchronizing Time
4. Multipath and Fading Signal Reflection
5. Environment propens to failure

In acoustic underwater channel

1. Variable speed of sound
2. Bit rate and low bandwidth
3. Propagation Variable Overdue
4. High chance of mistake

VI. UWSN APPLICATIONS

Systems underwater are used for monitoring scientific applications (live aquarium), industrial applications (fish farms and pipeline control), military and home protection applications (harbor safety). This is also used for offshore oil and gas production, oil spills, military surveillance, mine deduction, emissions control, natural calamities such as earthquake and hurricane prediction, coral reef, repetitive marine life control, and fish farming. A flexible UWSN offers a safe way to explore effectively and studying the different aqueous conditions. Major applications of UWSN are shown is fig.2 below.

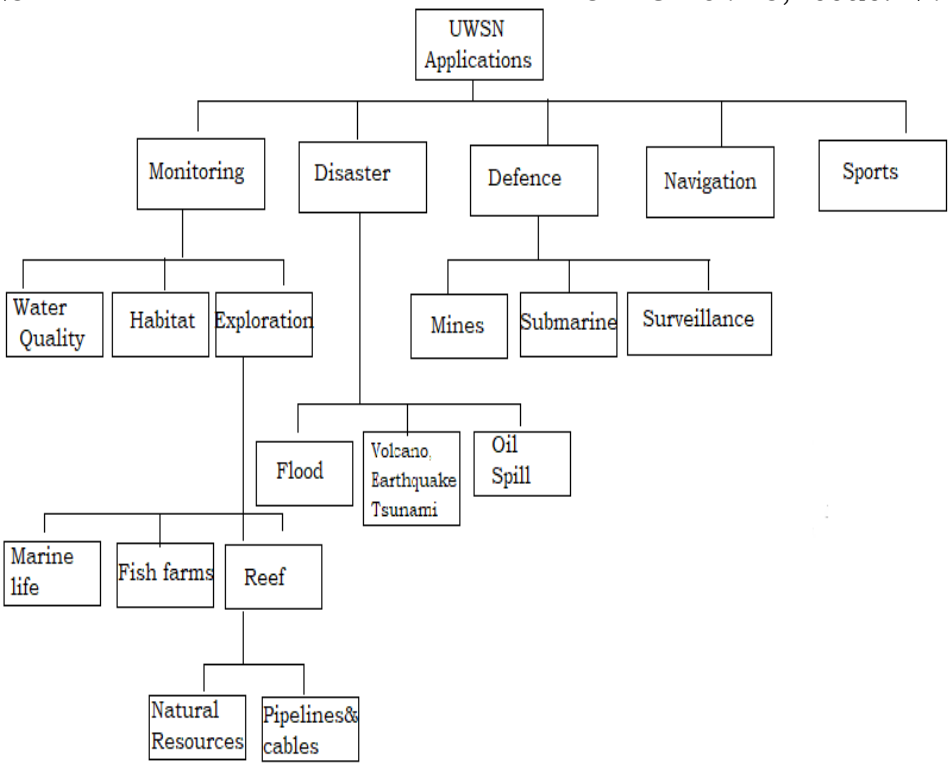

Fig.2: UWSN Applications

For a variety of different applications, as stated earlier, underwater wireless sensor networks (UWSN) can be used, as can radio frequency air networks [20-22]. Some of the main core application areas are as follows:

- *Environmental Surveillance:* Pollution is now one of the biggest problems, oil spills from boats or broken tubes could damage marine biodiversity, industry and tourist areas. Monitoring habitats may help to understand and forecast the impact of humans and nature or the environment.
- *Submarine Control:* The sensor used to route and to classify risks in shallow water on the seabed, rocks or shoals[26].
- *Navigation Helped:* Sensors may be positioned in low water for the detection of hazards on the sea bed, the positioning of hazardous rocks or shoals, mooring positions and drawing the area's bathymetry profile.
- *Submarine Discovery:* Underwater wireless sensor networks can be used to find petroleum fields and reservoirs and to identify routes for intercontinental cable connections. It can be used to even search for shipwrecks, archeology or abandoned sink cities.
- *Natural Disaster Mitigation:* The sensors can alert coastal areas by measuring the seismic activity from different remote locations by detecting tsunami or warnings by underwater earthquakes.
- *Boundaries:* These environments on the one hand are not practicable human presence as accidental underwater activity, high Water pressure and vast areas of water are the main reasons for unmanaged activities exploring [25]. At the same time there is localized exploration despite the more precise results, better than remote sensing, as Remote sensing technology might not find suitable Knowledge of occurrences in unstable underwater umbrella.
- *Autonomous Underwater Vehicles (UAVs):* The distributed movement sensors can help tracking, identification and recognition areas for intrusion.
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VII. CONCLUSION

This paper used research knowledge about underwater sensor networks (UWSN's) residual energy and direction of transmission and suggested a new scheme to increase the network's lifespan based on localization algorithms. It contains main design approaches, challenges, applications and implementation of wireless sensor networks underwater. A variety of technology issues related to design are also addressed. Underwater sensor network analysis, implementation and testing opens a new window to the researchers. The scope of the research work is to provide secured and efficient data transmission to overcome the various clustering issues occurred in low-energy adaptive clustering hierarchy (LEACH) protocol and K-means algorithm. As a future work, we propose the localization algorithm for secure data transmission in dynamic underwater wireless sensor networks (UWSNs).

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