International Journal of Advance Research in Science and Engineering
Vol. No.10, Issue No. 02, February 2021
www.ijarse.com
IJARSE
ISSN 2319 - 8354

A REVIEW OF RECENT ISSUSE AND CHALLENGES IN UNDERWATER SENSOR NETWORK

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Abstract

Underwater localization are an important part of wireless sensor network. In underwater sensor networks determining the location of every sensor is important and the process of estimating the location of each node in a sensor network. While various localization schemes have been proposed for terrestrial sensor networks, there are relatively few localization schemes for UWSNs. The characteristics of underwater sensor networks are fundamentally different from that of terrestrial networks. Underwater acoustic channels are characterized by harsh physical layer environments with stringent bandwidth limitations.

Keywords—UWSN-underwater wireless sensor network, nodes

I. INTRODUCTION

UWSN contain several sensors that are deployed in a specific acoustic area to perform collaborative monitoring and data collection tasks. A device that receives and respond to a signal or stimulus. Underwater sensor network has the potential to enable unexplored application and to enhance our ability to observe & predict the ocean. There networks are used interactively between different nodes and ground-based station. Unmanned or Autonomous Underwater vehicle's equipped with underwater sensors are also envisioned to find application in exploration of natural underwater resources and gathering of scientific date in monitoring mission. Underwater acoustic sensor networks provide In the authors present a localization technique for UASN in which them ability of the sensor odes consider and all the unknown sensor nodes are successfully placed at different positions. The positioning system is recursive and the localization method involves distinct sensor nodes. UASNs also increase the underwater warfare capabilities of the naval forces so that they can be used for the detection of a submarine, unmanned operation system, surveillance, and mine countermeasure algorithms. UASNs can also help such as rigs explosion in the Gulf of Mexico once occurred (2010). Similarly, UASN technology also helps in tsunami and earthquake forewarning. A unique system is called 3-DUL, which originally consisted of only three anchor sensor nodes, such as buoys on the water surface, which defuse their worldwide position data in all three directions and 3-DUL follows a 2-phase operation. An unknown place during the first stage. The anchor nodes are projected to their horizontal level in the second phase and form a virtual geometric shape using the depth information from these multivariate ranges. If the corresponding shape is robust, the sensor node will find itself and become an anchor sensor node through the dynamic trilateration method. In three-dimensional (3D) topology, this method iterates dynamically in all directions to locate as many sensors as possible. A 3Dlocalization method takes into account the attenuation of electromagnetic (EM) waves over the reliable elevation angle spectrum. They pick the radiation patterns of dipole antennas to determine the reliable elevation range. The feasibleness of this scheme is presented in distance estimation and 3D localization schemes by changing the elevation angle and distance. However, in ,the writers suggest a fresh model that utilizes the benefits of the features of EM waves in water. The sensor node cannot only evaluate the distance with low environmental noise but also ensure precise localization output with elevated sampling rates. Using the sets of RF sensors, a UWSN is built for this localization system at the target near-sea surveillance scheme that utilizes a tiny number of beacons for localization. Performance evaluations show that the worldwide localization of three surface anchor nodes is effectively spread by 3DUL. Its simple algorithm makes it possible for UASNs to adapt to the vibrant and its surrounding areas and provide this information via satellite communication to the ship or on-shore center or sometimes use underwater wires. These are replaced by less expensive and small underwater nodes that use this equipment in UASN to house various nodes on board, such as pressure, temperature, and salinity. Underwater sensor nodes are networked and can interact using acoustic signals. As we know, in underwater the radio signals can only travel to a short distance because the radio signal attenuates highly underwater and optical signals cannot travel in an inappropriate medium because of the dispersion of the optical signals. An acoustic signal scatters less as compared to radioandopticalsignals, resultinginanacousticsignal being more useful for underwater communication purposes as compared to radio and optical signals as shown in Table 1. However, the acoustic bandwidth in the underwater is smaller, resultinginreducedinformationrates. Multiple sensor nodes are needed to raise information rates and have

short-range communication, resulting in excellent coverage. The acoustic channel also has a low quality of connection owing to the time variability of the propagation of the medium and multipath. The underwater sound speed is approximately 1500m/s, resulting in very elevated delay propagation. The UASNs are also energy-limited as WSN work proposes a semidefinite programming- (SDP-) based localization procedure that is achieved by measurements obtained via onboard pressure sensors. SDP enhances the point localization precision and provides quicker convergence for monitoring under the same system setup and environmental circumstances, particularly at low signal to noise ratio (SNR). On condition that geomagnetic anomaly can be reversed as a magnetic dipole target, the localization of an underwater vessel relative to the target is calculated by the magnitude of the magnetic field and target gradients. The magnetic field is calculated by the device mounted on a car comprised of ten magnetometers of one axis. Applications that are not presently feasible or expensive to implement, including oceanographic information collection, ecological applications, government security, UWSNs mounted on the bottom of the ocean with underwater sensor nodes can detect earthquakes and tsunami formations before entering residential areas. A rough drawing of underwater node operation is shown in Figure 1. Mobile USNs can track polluted waters for water pollution detection devices as they propagate to clean water from their source and warn authorities to take action. USNs could be used to monitor coastal creatures and coral reefs, wherethereislimited data about human activity. The Gaussian noise injection detector (GNID) is proposed, to improve the probability of detection based on the noise enhanced signal detection using a PR whitening filter, time frequency denoising technique with S-transform, in inverse whitening filter results in improving underwater signal.

Environmental monitoring’s main purpose is sampling soil, water, and atmospheric but they also need to take the air samples inside buildings to guarantee releasement. Thegroupofpeopleworkinginenvironmental monitoring needs to looking for many things which are important in fact. The key objectives of this paper are to outlines a comprehensive review of underwater localization techniques and their algorithms. The main objective of this review is to provide a detailed knowledge of underwater localization techniques, localization algorithms, architecture, etc. We also highlight the weaknesses and strengths of the existing underwater localization techniques that can help the researchers to identify more efficient and accurate solutions for the existing challenges.

The paper is organized as follows. Section 2 presents the procedure and basics of localization. Next, Section 3 presents the architecture of UASN, Section 4 presents the related works, and Section 5 presents the techniques used for UASN localizations. Furthermore, Section 6 and Section 7 present range-based and range-free algorithms for localization, respectively. Section 8 presents the performance evaluation of underwater localization schemes

Assumptions for the localization operation need to take care of is that all antenna nodes have an ideal understanding of their position and should share clock information with the other sensor nodes worldwide synchronization. All nodes should meet to share data at any time, i.e., every individual sensor node can retrieve all readings and execute the process of localization before carrying all data back to the active or reference nodes. Each sensor node in the corresponding destination frame can communicate completely with other nodes and has no accident or interference problems [18]. At time t0, the active sensor node emits a single message requesting location through all of the listening nodes and each node gets message at the time tenon. On the given message, each node conducts a Doppler speed estimate. After gathering all data from sensors, a master node gets all estimates and performs the operation of localization and transmits the complete estimate back to the active node. Alternatively, it is possible to collect and relay the data to the active node where localization is done after that. The updates of the active node or master node estimate tracking and navigation algorithms as estimates of points are acquired. Localization is another difficult work; the use of Global Positioning System (GPS) is limited to surface nodes because in underwater, GPS signal does not propagate [19]. Alternative GPS fewer positioning approaches for terrestrial sensor networks have been provided, but they must be amended owing to the description of the acoustic channel. The acoustic channel has low bandwidth, high delay in propagation, and high error rate. Localization protocols, therefore, need to operate with the minimal feasible exchange of messages between nodes and exchange of messages such as two-way data exchange.

This is also assessed by the sensor node's restricted battery energy and the underwater sensor node battery recharge or replacement problem. To execute localization in a better way, it requires several objects with known locations, i.e., anchors and distance or angle measurement between anchors and the object to be located underwater, i.e., unknown sensor node. The anchors can be placed in a fixed position and their coordinates may have been configured in the beginning, or they may have distinctive hardware to learn from the location server such as GPS. Using angle or distance measurement between the anchor and the unknown node to estimate the location of an unknown sensor node and also combining measurements occur. Sensors presently used for oceanographic studies are either located with long or short baseline (LBL/SBL) devices. With a set of receivers based on acoustic wave communication, sensor positions are described in both instances. The eff ects of multiple error sources on the LBL based scheme's localization accuracy have been investigated and evaluated in detail. It shows that the more severe variables that may aff ect general accuracy are the calibration of the transmitters and the amounts of data about the sound speed in the operating area. A vessel follows the sensors in the SBL scheme and utilizes a short-range emitter to allow the process of localization. UWSN is characteristically composed of various nodes that are anchored to the lowermost of the ocean wirelessly linked with underwater gateways. The information from these sensors is transmitted within this network from thelowermostoftheseatothewatersurfacestationbyapplying multichip links. The gateways in underwater are furnished with definite nodes with both upright and straight transceivers. The first gateway is utilized to transfer instructions and constellation information to the nodes and receive.

2. Architecture of UWSN:

It is well known that energy consumption is more important in UWSN, which may limit long life cycles. Also, the reliability and capacity of the network depend on the network topology. Therefore, how to organize such a network topology is a challenging task, and researchers need to pay more attention to network topology. Here, the architecture of UASN is classified according to two metrics: one is the motion capability of the sensor nodes, i.e., stationary, mobile, or hybrid of UASN, i.e., 2D or 3D UASNs as shown in Figure 3. The nodes float freely under the water in the portable UASNs with unpropelled and untethered sensor nodes and drift with the water current. In UASN with powered sensor nodes, the node motion can be controlled by inertial navigation systems. Autonomous Underwater Vehicles (AUVs) and Unmanned Underwater Vehicles (UUV) are floats, drifters, gliders, and profiling float, along with examples of unpropelled portable machinery. Most of these instruments are used in oceanography to gather data and measurements from the various layers of the ocean environment. Drifters operate mostly on the ground and drift with winds and surface waves as floats move with the current of the water. They are used to acquire measurements from the surface of the ocean and send the information to the on-shore center via satellite or GPS. Gliders are devices driven by buoyancy, as they can travel vertically comparable to floats for profiling. Besides that, with the assistance of their body and wing design structure, they can move horizontally. Sensor nodes arelinkedtosurfacebuoysorocean floorunitshavinga fixed position in the stationary UASNs.

to the EM and optic speed in air. Due to the unique challenges of the acoustic channel, it is highly variant, for example, high propagation delay, variable sound speed, narrow bandwidth, reflection, and refraction. Because of these unique properties, it creates more issues regarding MAC protocols. MAC protocols have two main groups such as content-based and scheduled based protocols. Content-based nodes complete each other for the exchange of signals, while scheduled-based avoid collision among the transmission nodes. Content-based are not suitable for the underwater environment, while scheduled based such as TDMA and FDMA are not efficient due to the high propagation delay and narrow bandwidth, respectively; however, CDMA is appropriate for UANs [33, 34]. A localization scheme for UWSN is presented for localization issues in large-scale UWSNs. Unlike in TWSN, GPS cannot work properly in underwater or attenuate highly [35]. Due to the costly equipment of underwater, limited bandwidth and harshly impaired channel all make the process of localization very challenging. Currently, most of the localization techniques are not well appropriate for the deep underwater field. The researchers presented a new scheme that mainly consists of four types of sensor nodes, such as DETs, surface buoys, ordinary nodes, and anchor nodes. DET is connected to the surface buoys and can dive and rise to the water surface for the broadcasting of its location. Surface buoys are supposed to connect with the GPS. Anchor node can estimate their locations based on location.

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www.ijarse.com
IJARSE
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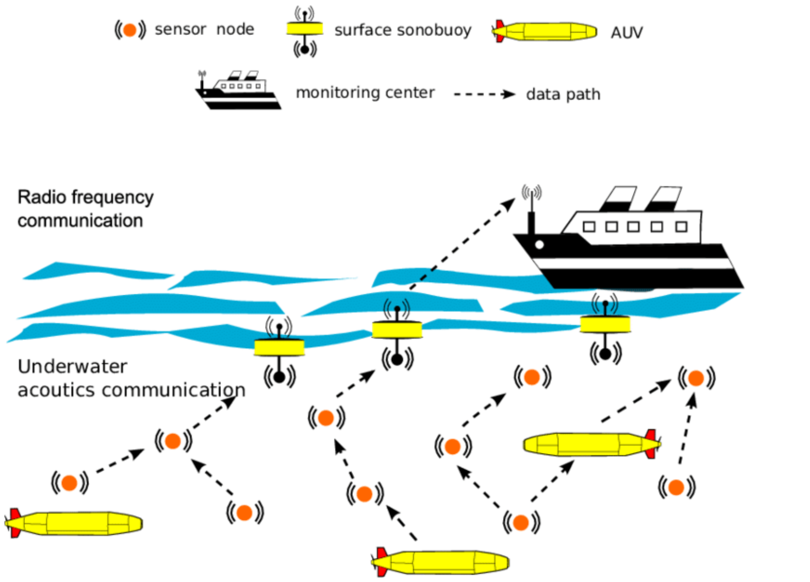
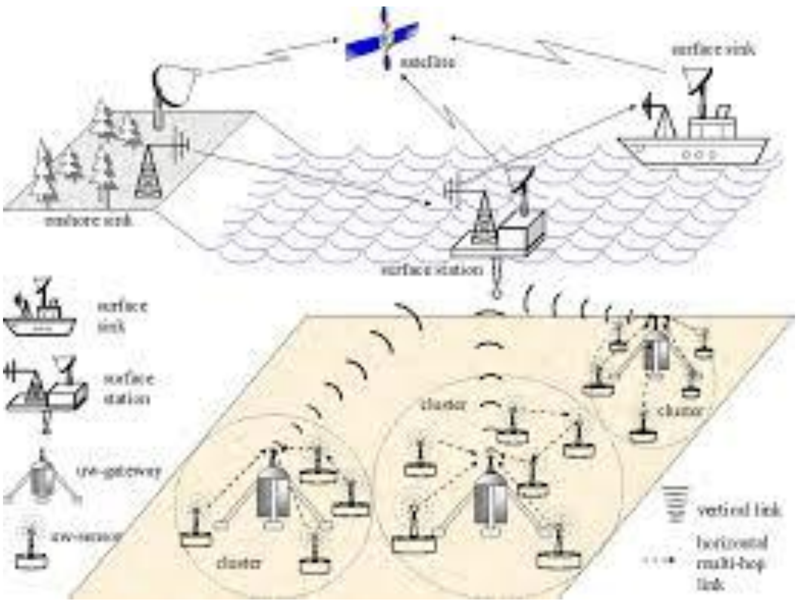
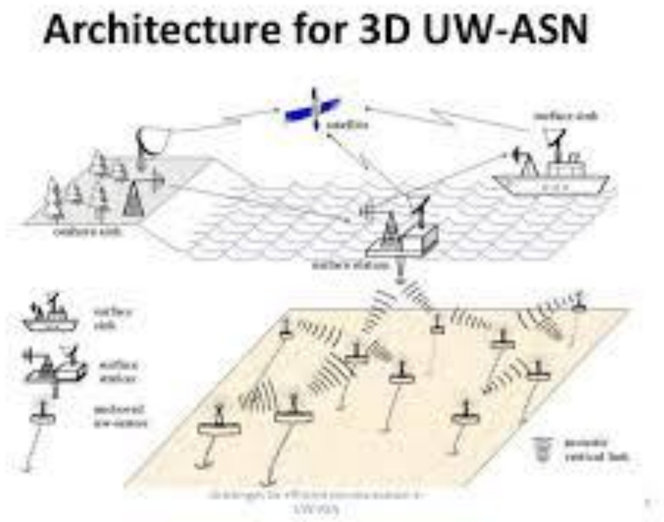
Limited bandwidth, capacity, and variable delays are characteristics of acoustic technology. There fore, new data communication techniques and efscient protocols are required, for underwater acoustic networks. Designing the network topology requires significant devotion from designer, because underwater network performance is generally depending upon topology design. Network reliability should increase with efficient network topology and network reliability should also decrease with less efficient topology. Energy consumption of efficient network topology is highly less as compared to incorrect and less efficient topology design of underwater network. Design of topology for underwater sensor network is an open area for research



2.1. Underwater Sensor Networks in Two-Dimensions: Deep ocean anchors are utilized for collection of sensors. Anchored underwater nodes use acoustic links to communicate with each other or underwater sinks. Underwater provide it to offshore command stations, using surface stations. For this purpose, underwater sinks are provided in Purpose of horizontal transceivers is to communicate with sensor node, to collect data or provide them commands, as have been received by offshore command station, although vertical transceiver isusedtosenddatatocommandstation. Because ocean can be as deep as 10km, vertical transceiver should contain enough range. Surface sink that is equipped with acoustic transceivers has the capability to manage parallel communication, sinks. Surface sink is also equipped through extensive range radio frequency transmitters, to communicate with offshore sinks.



2.2Underwater Sensor Networks in Three Dimensions: Activity required to present three-dimensional environments new architecture which is known as underwater threedimensionalnetworksisused. Sensornodesfloatatdifferent depth to monitor a specific activity in three-dimensional underwater networks. Traditional solution regarding underwater three-dimension sensor is the use of surface buoys. Depth of the nodes is controlled using wires which are attached with these anchors. Major challenge regarding such network influenced by the current properties of the ocean.



3. Issues and Challenges in Underwater Sensor Network:

Research and implementation of UWSNs have been growing and widely applied in research and industry. However, after reviewing the current trends and studies, several challenges remain to be addressed for further development.

3.1 Limited Bandwidth: According to factors such as noise, multiple path, path loss, and Doppler spread can affect UWSN communication based on simulation analysis and real time experiment, there are many more challenges, and concern that need to be resolved in future.

3.2 Path Loss: When sound propagates from underwater environment then some of its strength converts into heat. Sound wave propagation energy loss.

3.3 Attenuation: Attenuation is defined as "wave energy converted into some other form of energy", such as heat energy, absorbed by the medium used. Within acoustic communication, this phenomenon is compassionated as acoustic energy is converted into heat. The converted heat is absorbed by underwater environment.

3.4 Scattering Loss: Deviation regarding the line of sight of a signal or change in angle is generally a physical property. Underwater channel also contains this property that effects acoustic channel data transmission during communication. Surface roughness increases due to increase in the wind speed.

3.5 Noise: Noise can be defined as a quality of communication system that degrades signal strength of any communication system. In case of underwater acoustic channel there exist different kinds of noises.

3.6 Multipath: Sound propagation in shallow water is influenced by surface reflections while deep water propagation is affected by bottom refection that becomes cause of large and variable communication delay in acoustic communication. A major cause that makes acoustic signal weak is called multipath effect that becomes cause of intermoult interference which also makes acoustic data transmission difficult and erroneous. Vertical acoustic channel is less affected by multipath effect as compared to horizontal acoustic channel.

3.7 Doppler Spread: Because of channel flaws, wireless signals practice a diversity of degradations. For example, electromagnetic signal affects by interference, reflections, and attenuation; acoustic signals regarding underwater are also affected by same kind of factors. Underwater acoustic channel is complex channel due to time variation and space variation. the relative motion of transmitter and receiver that causes the mean frequency shift is called Doppler ship. Although the fluctuation of frequency in the region of this Doppler shift is called Doppler spread , two types of influences are observed on acoustic channel because of Doppler Effect: first is pulse width that will be compressed or stretched and second is frequency offset as a result of frequency offset compressing or expending of signal time.

4. CONCLUSION:

In this paper we have discussed several techniques of underwater sensor networks. The objective of the reviewed technologies about architecture of underwater wireless sensor network and to give direction of future researchers. Also, we present a dimensional of architecture of underwater sensor network by providing a base for a better solution. In this perspective, we have presented future direction which are still not yet explored in the research area. A better communication technique can be proposed by considering environmental effect during communication. Thus, we intend to target in future the variable packet size selection to improve the utilization of acoustic channel.

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