HIERARCHICAL CLUSTER BASED UNDER WATER COMMUNICATION

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ABSTRACT

Water Pipeline Monitoring Systems have emerged as a reliable solution to maintain the integrity of the water distribution infrastructure. Various emerging technologies such as the Internet of Things, Physical Cyber Systems, and machineto-machine networks are efficiently deployed to build a Structural Health Monitoring of pipeline and invoke the deployment of the Industrial Wireless Sensor Networks (IWSN) technology. Efficient energy consumption is imperatively required to maintain the continuity of the network and to allow an adequate interconnection between sensor nodes deployed in the harsh environment. In this context, to maximize the Lifetime of the WSN underwater Distribution system domain is a primordial objective to ensure its permanently working and to enable a promising solution for hydraulic damage detection according to diverse performance metrics In this context, the data aggregation techniques are well-designed and various smart algorithms are developed to reduce the quantity of transmitted data and to minimize the energy consumption. In this paper, we combine between data aggregation and clustering algorithm in order to improve the WSN Lifetime.

INTRODUCTION

Recently, advancements in Wireless sensor networks(WSNs) domain make possible to deploy them efficiently inmany real-life applications, such as environment, health and
water pipeline monitoring. The main problem in WSNs is howto efficiently collect and deliver the sensed data. Wirelesssensor nodes are generally small in size with limited
communication range that depends on the transmission power.In addition, sensor nodes normally operate while relying on asmall capacity battery. Considering the difficulty of replacingthe battery after deploying the sensor nodes, it is necessary tomanage their energy consumption to achieve the maximum
operation time for WSNs. In this paper, we focus on WSNsthat are used to monitor water pipelines. In fact, we study thelinear sensor placement problem. Many studies in literatureaddressed the linear sensor

deployment problem and proposeseveral solutions that could be applied to many domainapplications In this paper, we focus on WSNsthat are used to monitor water pipelines. In fact, we study thelinear sensor placement problem. Many studies in literatureaddressed the linear sensor deployment problem and proposeseveral solutions that could be applied to many domainapplications

II. RELATED WORK

The damage of water pipeline is very critical and hasmalicious effects in the life of human being. Nevertheless,installing, upgrading, and replacing infrastructure of water pipeline requires large investments of money and time.Therefore, developing a real time system to monitor leak inwater pipelines and transfer the measurements collected from different distributed sensors is very important [1]. Sensornodes must have the ability to detect events and transmit theinformation. Therefore, the deployment of nodes mostly affects the function of WSNs and in consequence theperformance of WSNs. Thus, the development of a sensor deployment scheme has become an important research issue inrecent years. There are several works proposed to solve the problem of sensor deployment in many application domains.The original locations of deployed sensors can be changed due to many conditions such as new nodes join the networks orprevious nodes leave the networks in case of die out.Therefore, perfect node deployment is a very challengingproblem that has been proven as NP-Hard for the majority ofsensor deployment approaches. The first objective of applyinga deployment algorithm is to minimize the number of sensorsneeded while respecting the constraint of having a maximumcoverage and connectivity throughout the region. As firstsolution, there is some works in literature that studied theproblem of sensor deployment as an (art gallery) difficulty [3].A randomized algorithm is proposed in [4] to solve the art gallery problem by finding places for sensor nodes.Nevertheless, the assumptions in the art gallery problem, doesnot hold for WSNs in which sensor nodes have limited sensing ranges [5].

THE ALSN MODEL

Our proposed model helps reduce the impact of energylosses by minimizing its use. The overall framework relieson short range communication and autonomous underwater vehicles (AUVs) that travel across the LSN to collect data.As a result, no multihop communication is needed and nodes need only transmit data within a very short distance. Fig. 1and Fig. 2 show the ALSN model and data exchange process respectively. As shown in Fig. 1, the model contains threetypes of nodes:

Sensor Node (SN): SNs perform the sensing operations.The type of sensing data that is collected depends onthe application, content of the pipeline, and objectivesof the monitoring and control process.

AUV: The AUV is responsible for collecting data from theSNs and delivering it to the surface sink. It is a more capablenode. More specifically, compared to the SN node, it

has more processing power, more memory and storage capacity,more energy, and a longer communication range*Surface Sink*: Surface sinks are placed at both ends of
the ALSN network. As indicated earlier, the AUV movesalong the ALSN and delivers its data to the surface sink.Then, the surface sink uploads the collected SN data tothe network control center (NCC) using the networkingprotocols that are available in the local geographicarea.

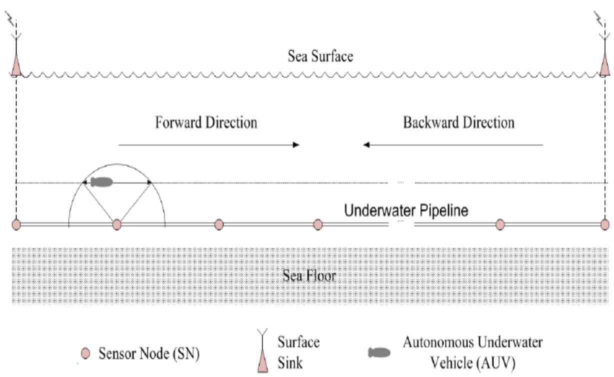

Fig. 1: The ALSN model.

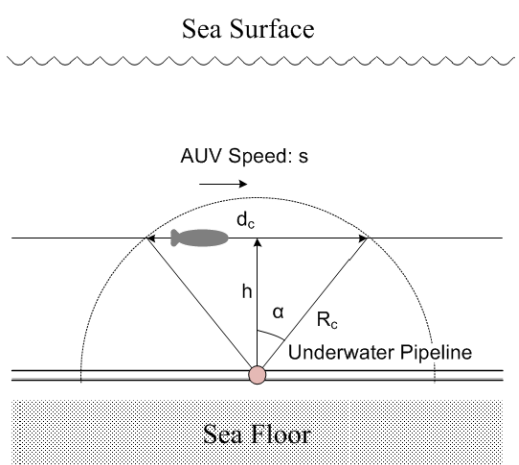

Fig. 2: Exchange of data when the AUV is within range of
the SN.

Considering the energy constraints in wireless sensor networks the proposed DA is designed to provide energy-efficient data aggregation together with secure data communication.DA protocol consists of a number of algorithms and processes. Sensor nodes implement the following processes. Sensing data from the environment. Defining intervals from threshold values set for the environment parameters. Assigning critical values for intervals using pattern seed from cluster-head. Generating the lookup table. Generating pattem codes using pattern generation algorithm. , Sending pattern codes to cluster-heads. Receiving send-requestslACK from the cluster-head Sending actual data to cluster-heads.

Cluster-head performs the following processes.

Broadcasting the pattern seed for each time interval.

Receiving pattern codes from sensor nodes.

Forming the selected-set of pattern codes using the pattern comparison algorithm.

Requesting selected sensor nodes to send actual data.

The pattern generation and comparison algorithms as well as an example for pattern generation are presented in the sequel.

Pattern Generation Sensor nodes receive the secret pattern seed from the cluster head. The interval values for the data are defined, based on the given threshold values set for each environment parameter. The number of threshold values and the variation of intervals may depend on the user requirement and the precision defined for the given environment in which the network is deployed. The algorithm then computes the critical values for each interval using the pattem seed to generate the lookup table, where the' pattem seed is a random number generated and broadcasted by the cluster-head. This pattern seed is changed at regular time intervals. In ESPDA, the pattern generation algorithm (PG) which is executed on all sensoc nodes uses the pattern seed to generate pattern codes. Before sending the actual data, the sensor nodes send the pattem codes to the cluster-head. These patterns are analyzed by the pattern comparison algorithm at the cluster-head to prevent redundant data being transmitted Sensor nodes sends the set of unique data (without redundancy) to the cluster-head which is transmitted to the base station.

Pattern Comparison The cluster-head also has equal responsibility as the sensor nodes in data aggregation. It sends the pattern seed periodically to all active sensor nodes to maintain the confidentiality of the pattem codes. After receiving pattern codes from the sensor nodes for a time period T, the entire set of codes is classified based on redundancy. Unique patterns are then moved to the 'selected-set' of codes. The time period T varies based on the environment where the sensor network is deployed. The sensors nodes that correspond to the unique panem set ('selected-set') are then requested to transmit the actual data

NS2 IMPLEMENTATION

The proposed protocol has been simulated using Network Simulation 2 (NS-2) in version 3.5. The performance of the proposed protocol has been evaluated through comparing its QoS metrics with some other existing methods such in terms of packet delivery ratio, packet delivery delay and control overhead.

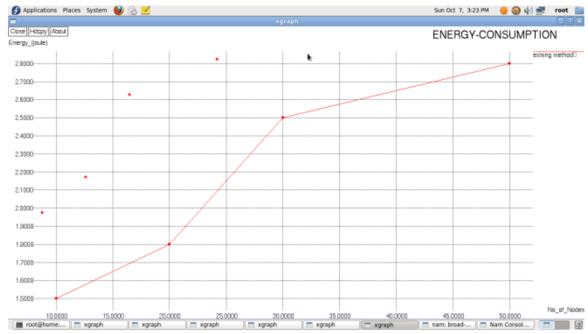

Fig Energy analysis

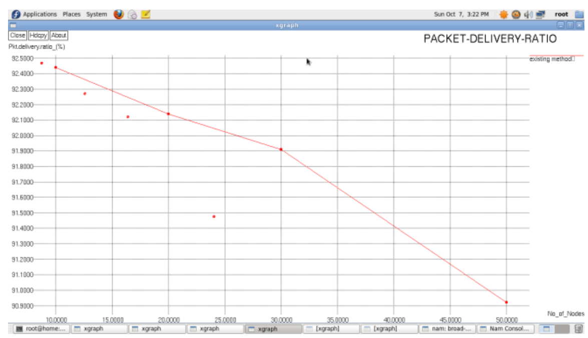

Fig packet delivery ratio

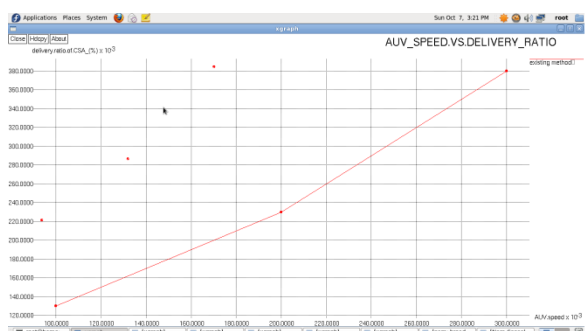

Fig speed versus delivery ratio

CONCLUSION

A data aggregation clustering algorithm combined with DataElimination Redundancy technique was detailed and implemented.The algorithm is based on two main phases. Firstly,the divide the WSN into anumber of clusters and the define the best data aggregation that ensures the minimum of Energy consumption andthe shortest distance between sensor members and CH. Efficient dataaggregation allowing the redundancy elimination at the clusterand sensor node level improves more the results and reducesthe energy consumption.

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