Revised: 24 July 2017

Accepted: 31 October 2017

DOI: 10.1002/dac.3485

RESEARCH ARTICLE

A novel fault detection and recovery technique for clusterbased underwater wireless sensor networks consumption. Over the decade, many theories have discussed the fault detection of either CH or CM. However, there

hese sensor nodes are subjected to different types of failures in harsh underwater environm

YBJHW peration of the network. This may be due to energy depletion or breakdown sor nodes $^{14.17}$ In a cluster based environment, there may be a failure of cluster

both, which would result in the loss of the connectivity of CMs within the

Nitin Goyal¹ | Mayank Dave¹ | Anil Kumar Verma² failed.21 In the event of a node failure or data packet losses, other nodes

¹ Department of Computer Engineering, National Institute of Technology, Kurukshetra 136119, Haryana, India

rebroadcast the same data packets

²Department of Computer Science and Engineering, Thapar University, Patiala, Punjab, India

Correspondence

Nitin Goyal, Department of Computer Engineering, National Institute of Technology, Kurukshetra-136119, Haryana, India. Email: er.nitin29@gmail.com

ompared with existing technique,

network lifetime.25-32 To deal with identify CH failure in cluster-based to reduce the energy consumption

1 | INTRODUCTION

Underwater wireless sensor network (UWSN) consists of multiple underwater sinks (UW-sinks) situated in the middle of areas under surveillance. Also, there are sensor nodes that surround UW-sink and a surface station linked to control center located on-shore.¹⁻⁴ Out of many characteristics of UWSN, narrow bandwidth, time-consuming propagation, and stringent geographical environment of acoustic medium are some characteristics that give challenges for propagation under UWSN.^{5,6} These all lead to some serious issues like high bit error rates, temporary losses of connectivity, and limited energy, which in turn make UWSN a difficult medium for data transmission.^{7,8} UWSN typically consists of homogprimary CH. Both schemes have discussed the alternative of failed enous and quasi-stationary nodes.9-13

wileyonlinelibrary.com/journal/dac

Int J Commun Syst. 2017;e3485. https://doi.org/10.1002/dac.3485

Summary goloveb of at high a this pay of the pay of the pay of the second secon

The performance of underwater wireless sensor network gets affected by the working of a cluster in the network. The cluster head (CH) or cluster member (CM) fails because of energy depletion or hardware errors that increase delay and message overhead of the network. To recover the affected cluster, a technique is required to identify the failed CH or CM. We propose a fault detection and recovery technique (FDRT) for a cluster-based network in this paper. Primarily, while selecting the CH, a backup cluster head (BCH) is selected using fuzzy logic technique based on parameters such as node density, residual energy, load, distance to sink, and link quality. Then, failure of CH, BCH, and CM is detected. If fault is detected at CH, then the BCH will start performing the task of failed CH. Simultaneously, when BCH failed, any other CM will be elected as BCH. If any of the CM appears to be nonperforming, then CH will detect the communication failure and request BCH to transfer the data from the failed CM to CH. The comparison of proposed FDRT is performed with existing FDRTs EDETA, RCH, and SDMCGC on the basis of packet drop, end-to-end delay, energy consumption, and delivery ratio of data packets. By simulation results, it is shown that FDRT for cluster-based underwater wireless sensor network results in quicker detection of failures and recovery of the network along with the reduction in energy consumption, thereby increasing the lifespan of the network. In the most effective method for improving the energy of showing CH or CM faults, some of the work has been focusing on fault detech-

KEYWORDS reliesed this based insertings its basedord even. ""Is to traw

backup cluster head, cluster head, cluster member, fault detection, fault recovery, UWSN nique is designed in a way that it detects the CHI failure accerticly and fact

that is caused by false detection. Although it effectively detects a CH faults.

death rate of sensor nodes. But it fails to consider the network and link

Copyright 19 2017 John Wiley & Sons, Ltd.

NE

1 of 14