

A
Dissertation
On
Clustering in WSN Using Firefly Algorithm

Submitted in partial fulfillment of the Requirement

For the Award of the Degree of

Master of Technology
in
Computer Science and Engineering
by

Priti Singh

University Roll No. 2K13/CSE/17

Under the Esteemed Guidance of

Mr. Vinod Kumar

Associate Professor, Computer Engineering Department, DTU



2013-2015

COMPUTER ENGINEERING DEPARTMENT

DELHI TECHNOLOGICAL UNIVERSITY

DELHI-110042, INDIA

ABSTRACT

Wireless Sensor Networks consists of hundreds to thousands of limited energy battery powered sensor nodes. The use and applicability of WSNs has increased in many areas like vehicular movement, weather monitoring, security and surveillance, industry applications etc. The nodes in WSNs sense the environment and send the desired information to a processing centre (base station) either directly or via other nodes. The sensor nodes are inaccessible to the user once they are deployed. Replacing the battery is not possible every time. Hence in order to improve the lifetime of the network, energy efficiency of the network needs to be maximized by decreasing the energy consumption of all the sensor nodes and balancing energy consumption of every node.

In this dissertation we developed an algorithm (Firefly-DCH) for clustering in wireless sensor network. This is a centralized approach in which base station performs clustering on the basis of data sent by the nodes. Clustering involves selecting the cluster head and allocating the nodes to cluster head using some objective function. In this algorithm two cluster heads are selected called primary and secondary cluster head. An objective function is defined to minimize the intra cluster distance to optimize the energy consumption of the network. The clusters formed by this algorithm are compact in size and number of nodes allocated to different clusters is almost uniform. The proposed algorithm is fault tolerant as if one of the two cluster head dies another one can serve as single cluster head within network without any interruption in communication. Thus it saves the time for re-clustering. Our proposed algorithm is observed to perform better than the conventional clustering protocols like LEACH, standard firefly algorithm in terms of network lifetime.

Keywords: Wireless Sensor Network, Clustering methods, Firefly algorithm, Firefly-DCH, network lifetime, energy efficient clustering.

ACKNOWLEDGEMENT

I would like to express my deep sense of gratitude to my project supervisor Mr. Vinod Kumar for providing the opportunity of carrying out this project and being the guiding force behind this work. I am deeply indebted to him for the support, advice and encouragement he provided without which the project could not have been a success.

I am grateful to Dr. O.P. Verma, HOD, Computer Engineering Department, DTU for his immense support. I would also like to acknowledge Delhi Technology University library and staff for providing the right academic resources and environment for this work to be carried out.

Last but not the least I would like to express my sincere gratitude to my parents and friends for constantly encouraging me during the completion of this work.

Priti Singh

University Roll No.: 2K13/CSE/17

M.Tech (Computer Science and Engineering)

Department of Computer Engineering

Delhi Technological University

Delhi-110042



CERTIFICATE

This is to certify that the dissertation titled “**Clustering in WSN Using Firefly Algorithm**” is bonafide record of work done by **Priti Singh, Roll No. 2K13/CSE/17** at **Delhi Technological University** for the partial fulfillment of the requirement for the degree of Master of Technology in Computer Science and Engineering. This project is carried out under my supervision and has not been submitted elsewhere, either in part or full, for the award of any other degree or diploma to the best of my knowledge and belief.

Date:_____

(Mr. Vinod Kumar)

Associate Professor and Project Guide

Department of Computer Engineering

Delhi Technological University

TABLE OF CONTENTS

Abstract	ii
Acknowledgement	iii
Certificate	iv
List of Figures	vii
List of abbreviations	viii
Chapter 1	
Introduction	1
1.1 Basic Architecture of Sensor Node	2
1.2 Sensor Network Protocol Stack	3
1.3 Characteristics of WSN	5
1.4 Motivation	5
1.5 Objective	6
1.6 Thesis organization	6
Chapter 2	
Literature Review	7
2.1 Classification of WSN	7
2.2 System Evaluation Metrics	10
2.3 Application areas of WSN	11
2.4 Clustering in WSN	14
Chapter 3	
Nature Inspired Protocols	21
3.1 Clustering using GA	22
3.2 T-ANT Protocol for Clustering	23
3.3 Clustering using PSO	24

Chapter 4	
Proposed Work	27
4.1 Structure of Firefly algorithm	28
4.2 System Model	30
4.3 Clustering using Firefly Algorithm	31
Chapter 5	
Simulation Results and Analysis	35
5.1 Simulation Setup	35
5.2 Performance Evaluation	36
Chapter 6	
Conclusion and Future work	40
References	41

List of Figures

Figure 1.1: Wireless Sensor Network

Figure 1.2: Sensor Node Components

Figure 1.3: Sensor Network Protocol Stack

Figure 2.1: Single hop and multi hop network

Figure 2.2: Flat architecture network

Figure 2.3: Hierarchical architecture network

Figure 2.4: Sensor Network Applications

Figure 2.5: Clustering in WSN

Figure 4.1: First order radio energy model

Figure 5.1: Clusters formed by Firefly algorithm

Figure 5.2: Clusters formed by Firefly-DCH

Figure 5.3: Network Lifetime (Firefly vs Firefly-DCH) with BS (250,250)

Figure 5.4: Network Lifetime (LEACH vs Firefly-DCH) with BS (250,250)

Figure 5.5: Network Lifetime (Firefly vs Firefly-DCH) with BS (250,575)

Figure 5.6: Network Lifetime (LEACH vs Firefly-DCH) with BS (250,575)

List of Abbreviation

WSNs	: Wireless Sensor Networks
BS	: Base Station
MMP	: Mobile Management Plane
PMP	: Power Management Plane
TMP	: Task Management Plane
CH	: Cluster Head
TDMA	: Time Division Multiple Access
RSS	: Received Signal Strength
LEACH	: Low energy Adaptive Clustering Hierarchy
HEED	: Hybrid Energy Efficient Distributed Clustering
BFS	: Breadth First Search
GA	: Genetic Algorithm
ACO	: Ant Colony Optimization
PSO	: Particle Swarm Optimization
MST	: Minimum Spanning Tree
SNR	: Signal to Noise Ratio
DCH	: Double Cluster Head