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A Neighbor Trust-Based Mechanism to Protect Mobile Networks

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ABSTRACT: Lifetime enhancement has constantly been a crucial concern as most of the wireless sensor networks (WSNs) function in unattended environment where human access and monitoring are basically infeasible. Clustering is one of the mainly powerful techniques that can organize the system operation in associated behavior to attend the network scalability, decrease energy consumption, and complete prolonged network lifetime. To conquer this problem, current researchers have triggered the scheme of many various clustering algorithms. However, most of the proposed algorithms overburden the cluster head (CH) during cluster development. To overcome this problem, many researchers have come up with the scheme of fuzzy logic (FL), which is applied in WSN for judgment making. These algorithms focus on the competence of CH, which could be adoptive, flexible, and intelligent enough to allocate the load among the sensor nodes that can increase the network lifetime. But regrettably, most of the algorithms use type-1 FL (T1FL) model. In this paper, we proposition a clustering algorithm on the basis of interval type-2 FL model, expecting to handle doubtful level decision better than T1FL model. Mobile nodes in a mobile ad hoc network (MANET) form a temporal link between a sender and receiver due to their continuous movement in a limited area. This network can be easily attacked because there is no organized identity. This article discusses the MANET, its various associated challenges, and selected solutions.

KEYWORDS: WSN, type 2 fuzzy logic, Mamdani's method

I. INTRODUCTION

The huge applications of WSNs bring many challenges even if these tiny sensor nodes are battery controlled and deployed randomly or deterministically in hazardous places where traditional infrastructure based network is practically infeasible. There are many typical issues like limited energy resources, limited computing capacity, open environment and wireless connectivity makes the sensor network failure most of the time. Once sensor nodes are deployed, nodes with finite battery power should sustain for months or years at a stretch without any intervention. An important design issue in WSNs is to reduce the energy consumption by the use of energy conserving hardware, operating system and communication protocols. Further, among the communication protocols, the design of routing schemes is even more complex and must be able to exchange, process the information effectively and efficiently. It is noteworthy that transmission energy that dominates overall energy consumption is proportional to the distance between the transmitter and receiver. In order to design a suitable protocol, it is important to understand the parameters that are relevant to the applications.

II. METHODOLOGY

2.1 HIERARCHICAL ROUTING PROTOCOLS BASED ON CLUSTERING

LEACH is a famous hierarchical routing protocol where CH is elected on rotation basis based on a probabilistic model and each sensor node gets equal chance to be a CH. LEACH protocol considers two phases; set up phase and steady state phase. In Set up phase, cluster formation is done and actual data is transmitted in the steady state phase. Each node chooses a random number between 0 and 1 to be the CH. If the number is less than the threshold value $T(n)$, the node gets the chance to be the CH for the current round. The threshold value $T(n)$ is defined in equation 1. Is the round which already ended, p is the probability of the nodes to be the CH, G is a set of nodes which have never been cluster head in the last $1/p$ rounds. Although LEACH distributes the load equally on each CH, still there are some disadvantages that are discussed in and . In LEACH-C uses a centralized approach to elect the CH. BS uses the centralized approach to know the position information and energy of individual node. Better clusters are formed by BS by distributing CH nodes throughout the network. The main drawback of LEACH-C is discussed in



PEGASIS is the modified version of LEACH discussed in where the nodes communicate with their closest neighbors and form a chain to deliver the message to BS. A new round starts only when a round of nodes communicating with the BS ends.

2.2 FL BASED CLUSTERING PROTOCOL

Many researches discuss about Fuzzy Logic (FL) how it can be applied on clustering so that the energy consumption will be minimized. CHEF considers two fuzzy parameters such as proximity distance and energy to elect the CH. Abhijeet Alkesh et al. and Taheri et al. has considered three fuzzy parameters such as energy, concentration, and centrality to calculate the chance to be the CH and extends the network life time. In F-MCHEL, CH is elected by utilizing fuzzy rules based on energy and proximity of distance. The node is having maximum residual energy among the CHs is elected as a Master Cluster Head (MCH) and sends the aggregated data to the base station. F-MCHEL is an improvement of CHEF. The advantages and disadvantages of these protocols are discussed in many protocols have been discussed based on fuzzy techniques.

2.3 PROBLEM FORMULATION

A routing chain in WSN is an ordered sequence of all the nodes in the network forming a chain like structure to deliver the message to the BS. As discussed in beginning, Clustering approach can greatly contribute to overall system scalability, energy efficiency and network lifetime. It improves the power control and helps to reuse the bandwidth for better resource allocation. On the other hand, single hop communication overburdens the gateway with the increase in sensor density. The aim of this algorithm is to minimize the energy consumption at the cluster level by forming an optimal data gathering chain. In a protocol is proposed based on three fuzzy parameters such as remaining battery power, mobility, and distance to base station to elect a super cluster head (SCH) among the CHs. But the major drawback of this protocol is that the lifetime of the network remains constant irrespective of the mobility of BS. Shyan-Lee et al. has improved the algorithm.

III. ENERGY MODEL ANALYSIS

The sensor network is divided into number of levels. The sensor, nodes from sensor network form the

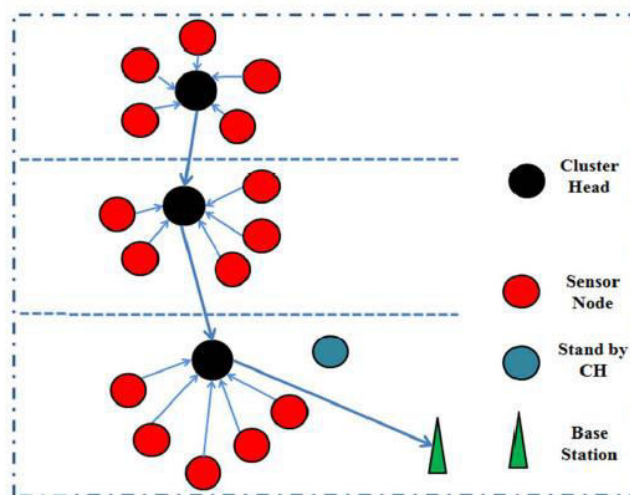


Figure: Energy Model Analysis

Cluster of different size at different levels. Each cluster has a CH. The information sensed by each node is transmitted to CH. Each CH gathers the data from its cluster members, compresses it and sends the compressed data to the base station. Since most of the energy is dissipated during the transmission, the energy optimization technique has been used. The energy model considered in our work is referred from. The transmitter dissipates energy to run the radio electronics and power amplifier whereas the receiver dissipates energy to radio electronics. The amount of energy consumption required for l bits to travel to a distance d (from the transmitter to the receiver) during transmission.

IV. FUZZY LOGIC MODEL

The result conveys that T2FL produces smooth performances and always outperforms T1FL model. The inference techniques and the fuzzy system used for our Membership function plots, (a) Remaining battery power, (b) Distance to BS, (c) Concentration, Proposed model three fuzzy input variables are considered to elect the tentative CH. All the three input variables have three membership functions each. The fuzzy set that represents the three input variables i.e. remaining battery power, distance to BS, and concentration is depicted in respectively. The linguistic variables for the fuzzy set is less, medium and high. Triangular membership function has been considered for less, medium and high. The linguistic variables for distance to BS are taken as close, adequate and far. The third fuzzy input variable is the concentration that means how many sensor nodes are available in that particular locality. The linguistic variables for concentration are considered as low, medium and high. Table I shows the Membership functions of all the input variables. The degree of the membership function is shown by a numerical after each membership function.

4.1 RULE BASE AND INFERENCE ENGINE: IN OUR SYSTEM

We have used 27 rules in Fuzzy Inference technique. The form of the rules is if X, Y, Z then C. Here X represents remaining battery power, Y represents distance to BS, Z represents the concentration, and C represents the confidence factor (CF). The output CF is composed of 7 membership functions i.e. Very poor, Poor, Below Average, Average, Above Average, Strong, and Very Strong. The fuzzy set for confidence factor is depicted in the Membership functions for the output variable CF. The CF value to be the CH is calculated considering three input parameters such as remaining battery power, distance to BS, and concentration by using Mamdani's Fuzzy rule. The fuzzy rules and value of confidence factor is depicted in T1FL model consists of four modules: a fuzzifier, fuzzy inference engine, fuzzy rules and a defuzzifier. The block diagram of Fuzzy Inference System. There are four steps required to complete the process. T1FL is used to handle the uncertainty level to some extent not completely. On the other hand, Type-2 Fuzzy Logic (T2FL) model is useful in circumstances where it is difficult to determine an exact numeric membership function and there are measurement uncertainties the idea is to apply T2FL on WSN which can help to elect an efficient CH so that it can distribute the load evenly among the sensor nodes. In T2FL is characterized by a superior membership function and an inferior membership function. These two functions can be represented (each one) by a Type-1 fuzzy set membership function. The interval between these two functions represents the footprint of uncertainty (FOU) which is used to characterize a T2FL set. Let the FOU is expressed as f . If $f \in [0, 1]$, and $f \rightarrow 0$, then Member Function is considered as T1FL. If $f \rightarrow 0$ to 1, then T2FL have a wide range of FOU between 0 to 1. But the rules formation is same as T1FL.

V. CONCLUSION

The basic LEACH protocol is a promising protocol and provides an opportunity to improve in various parts of the communication protocol so that the applicability of the protocol can be widely extended. In this work, the whole sensor network is divided into number of levels and at each level, efficient Cluster Head is elected based on T2FL Model. Three fuzzy descriptors such as remaining battery power, distance to base station, and concentration have been considered. Each Cluster Head sends the data to the next level (starting from the first level to the last level) till it reaches at the base station. The novelty of the protocol utilizes the concept of Type 2 Fuzzy Logic justifying that fuzzy logic model handles real time problems more accurately than any other probabilistic model. Again, Type 2 Fuzzy Logic Model handles the measured level of uncertainties more accurately than Type 1 Fuzzy logic model. Further, multi-hop communication protocol provides a wider scope for larger application. It is concluded from simulation results that T2FL model provides better scalability, better lifetime compared to T1FL, LEACH single hop and LEACH multi-hop protocol. We present an algorithm to prevent probing, DoS, vampire, and U2R attacks. The security scheme identifies attacker nodes through their malicious behavior and minimizes packet dropping and routing overhead. The security scheme first considers nodes in the suspicious range. Nodes that demonstrate malicious functions are defined as attackers these attacker nodes are blocked after confirmation in the network. For future research, this work will be tested in different network sizes to check scalability. We will also look at preventing multiple attacks in the network simultaneously.



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