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Reputation and Quality of Service for Wireless Sensor Networks Using Ant Colony Optimization

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Abstract: In wireless sensor network, security is a major concern. The protection of integrity and confidentiality of information can be protected from unauthorized access is an important one. In open wireless medium and small size of sensor nodes, the implementation of security can be challenged one. In existing, they can be used QDV for securing WSN. Two parameters are used such as QOS and reputation. It takes more simulation time. In proposed, Ant colony optimization concept can be used for more securable between the two neighbour nodes and it can be providing the trusted nodes and more reliable data for communication purposes. Additionally, it can provide the scalability and computation power.

Keywords: Quality of Service, Ant colony optimization, Reputation and Scalability.

I. INTRODUCTION

Wireless Sensor Network consists of spatially distributed self-configurable sensors, and meets the requirements. The sensors provide the ability to monitor the environmental conditions such as temperature, humidity, vibration, pressure, sounds, heat, motions with low energy consumption. In the WSNs using more amount of sensor nodes, each node communicate with each other using their components: a radio transceiver, processor, sensing units and battery. The sensor nodes send the sensing data to base station and the base station are disseminates the sensing data to the end users, and the modern WSNs are using 'Bi-directional' (i.e. enabling the two way communications). Each sensor node is a low-cost, low-power, multi-functional, small embedded system. WSNs using different type of network topologies are star, peer –to –peer, tree, and mesh. The main task of wireless sensors node is sense and collects data from particular domain and sends it to the sink (information gather point). The direct communication between a sensor and the sink may force nodes to emit their messages with such a high power that their resources could be quickly depleted.

The main characteristics of WSNs are low energy use, dynamic and self-organizing operations, mobility of nodes, dynamic network topology, communication loss, heterogeneity of a nodes and scalability to large scale of deployment, ease of use. Wireless sensor networks can be used for many critical applications such as target tracking in battlefields and emergency response. The main goal of WSNs is to make longer the life time of network [8], tolerate sensor damage, and battery power. In WSNs energy is mainly consumed for following purpose: data processing, signal processing and hardware operation. The main challenges in WSNs are decreasing the sensor size and cost.

QOS: QOS provide the predictable results in the WSNs [9]. The elements of QOS are uptime (availability), bandwidth (throughput), latency (delay), and error rate. The goal of QOS is to provide better delivery service for the applications that need it by to make sure sufficient bandwidth, controlling latency, and reducing data loss. In this paper the QOS provide the service of finding the neighbour node secure or not.

ACO: This paper focuses on ACO technique. The ACO is probabilistic [10] or metaphor technique used for finding the optimal path and energy efficiency in routing .This algorithm is a member of ant colony algorithms. There are number of reasons for using ACO algorithm in WSNs routing, it is based on the behaviour of real ants and decentralized.

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WSNs are more dynamic that a wired network. Nodes can break, run out of energy, and radio propagation characteristics change. ACO mainly focus on routing in wireless sensor network and give an overview of how AntNet is implemented on NS2 simulator using 802.15.4.and compare ACO to AODV routings, standard WSN algorithms. Finally, wind up the paper with a discussion of our results and describe our future work with the project.

II. ROUTING PROTOCOLS FOR SENSOR NETWORK

A routing protocol is based on set of rules used by routers. A routers has mainly used for finding the optimal path from source to destination and routing protocols allows to change the network dynamically. In WSNs there are many no. of routing has been used. The routing is differs from various network. Routing is a challenging task in WSNs because of their unique characteristics which makes it different from other wired and wireless sensor networks like cellular or mobile ad-hoc networks [6]. Sensor network nodes are limited in respect to energy supply, computational capability, communication bandwidth, provide prolong the lifetime of the sensor nodes, and designing a efficient routing protocol is very critical. The important two issues should be taken into designing a routing protocol for WSNs,

- At each stage the power consumption level should be maintained.
- Different type of failure should be tolerated.

WSNs can be classified into flat, hierarchical and location-based routings. The location based routing depending on the network structure, in flat-based routing; all nodes are assigning equal roles or functionality, and the WSNs divided into two types: structured and unstructured. Structured- at fixed location all the nodes are deployed on pre-planned manner. Unstructured-less or small devices can be deployed with lower network maintenance and manage the cost.

III. RELATED WORK AND BACKGROUND

Routing algorithms can be divided in two classes, Reactive (on demand) routing and proactive (table driven) routing. Reactive protocols establish a path between the source and destination only when there are packets to be transmitted and the reactive protocol not having the neighbour's information. The reactive protocol classified in two common types in WSNs such as [4] Ad-hoc on-demand Distance Vector (AODV) routing and Dynamic Source Routing (DSR). The reactive protocol taking only less amount of time for data transmission and the packet delivery is more efficient compare to proactive protocol and Proactive protocols maintains the routing table and all the nodes maintain the information about the next node, and it's taking the more time for routing, but the reactive protocol taking fewer amounts of time .Reactive protocols suitable for dynamic network. Reactive protocol create their routes just before data is about to be sent. This ensures the nodes have the most up to date routing information but there is a start up cost as the route is being acquired and Reactive protocols have lower overhead than the proactive protocols and work better for intermittently links.

DSDV is a proactive routing protocol it's based on ad-hoc network, and DSDV provide the loop free path. The loop free path is an inter-neighbour synchronization mechanism, and it does eliminate the temporary loops based on the loop free algorithm. The main goal of DSDV is finding the shortest path. In DSDV each entry in the routing table contains a sequence number. A route is considered more favourable if it has a higher sequence number. If two routes have the same sequence number, one with the lower cost metric is chosen. When a node decides a route is broken, it advertises that route with an infinite metric and a sequence number one greater than before. It can be shown that this routing algorithm is loop free.

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DSR is a reactive protocol that is similar to AODV, and it is designed for mobile ad-hoc network (MANET).The DSR does not based on any infrastructure. In this routing each node caches the routing information. The difference from AODV is DSR uses source routing instead of hop-by-hop routing, and each packet routed by DSR contains the complete ordered list of nodes that the packet travels through. The protocol consists of two phases that are route discovery and route maintenance, Route discovery is used to get a path from a source to a destination, and Route maintenance is used to detect if the network topology has changed.

AODV is a reactive protocol it's the combination of DSR and DSDV. AODV maintaining active routing and sequence number, the sequence number used for loop prevention (i.e., a node already looped then again it's not looped). AODV provide the unicast and multicast communication, and Route discovery and maintenance is similar to DSR, and using the hop by hop routing of DSDV. It also uses sequence numbers for loop prevention, with the goals of quick adjustment under changing link conditions, lower transmission latency of other protocols and less bandwidth consumption.

IV. PROPOSED FRAMEWORK

Swarm Intelligence (SI) [3] is the local interaction of many simple agents to attain a global target and SI is based on social insect metaphor for solving many types of problems. Insects like bees, ants and termites live in colony. Every single insect in a social insect colony seems to have its own agenda or plan. The combination of all individual activities does not have any supervisor. In a social insect colony, a worker does not perform all tasks ,but rather specializes in a set of tasks and this division of labour based on specialization is believed to be more efficient than if tasks were performed sequentially by non-specialized individuals. SI is emerged with collective intelligence of groups of simple agents. This approach emphasizes on distributedness, flexibility, robustness and direct or indirect communication among relatively simple agents the agents are autonomous entities, both proactive and reactive and have capability to adapting, co-operate and move intelligently from one location to the other in the communication network. The basic idea of the ant colony optimization (ACO) meta-heuristic is taken from the food searching behaviour of real ants. Ant agents can be divided into two sections:

- FANT (Forward Ants)
- BANT (Backward Ants)

The main purpose of this of these agents is to allow the BANTs to utilize the useful information gathered by FANTs on their trip time from source to destination based on these principle, no node routing information updates are performed by FANT and whose only purpose in life is to report network delay conditions to BANT. The various steps how these agents are passing routing information to each other are as follows:

1. Each network node starts FANT to all destinations at regular time intervals.

2. Ants find a path to destination one way or another way based on current routing tables.

3. The FANT creates a stack, pushing in trip times for every node as that node has reached.

4. When destination is reached, the BANT inherit the stack.

5. The BANT pop the stack entries and follows the path in reverse.

6. The routing table of each visited node are updated based on trip times

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Various fields of FANT:

1. Source Address
2. Sequence
3. Destination Address
4. Stack
5. Stack Pointer
6. Fwd

1. Source Address: The 4 bytes field, which contains address of source node discovered by route discovery phase.

2. Sequence Number: The 2 bytes field or local counter maintained by each node and incremented each time when FANT generated by source.

3. Destination Address: The 4 bytes field, which contains address of node where to send the information from source.

4. Stack: The memory area in which data gathered by FANTs is stored.

5. Stack Pointer: It is 2 bytes field, which keep track of number of visited nodes.

6. Fwd: The 1 bit field set to 1 when ant agent is FANT and set to 0 when ant agent is BANT.

When ants are on the way to search for food and start from their nest and walk unto the food. When an ant reaches a crossway, it has to decide which portion to take next. Then the walking ants deposit pheromone, which marks the route taken. The focusing of pheromone on a certain path is an indication of its usage, with the timing concentration of pheromone decreases due to dissemination effects.

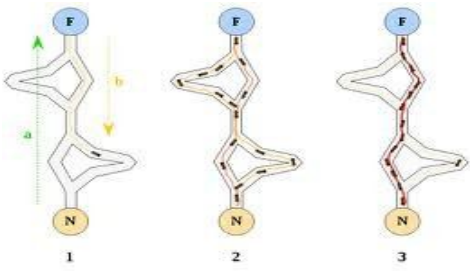

Fig. 1: All ants take the shortest path after an initial searching time.

V. ROUTING IN WSN USING ANT-LIKE AGENTS

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5.1 AntNet

Ant Net uses ant agents for routing in the network. Using Ant Net nodes in the network again and again send ant agents to randomly selected destinations in that network. After reaching the destination, the ant agent travels the same path and going back to the ordinal source node and on the way back to the Source node, the ant agents update the routing table of the nodes and launching ant-agents frequently increases the control overhead more In a dynamic network such as WSNs, by the time, the ant agent reaches the source node; the routing information may have changed [12].

5.2 The Three Phases of Ant Based Algorithm

- Route discovery phase
- Route maintenance phase
- Route failure handling

The detailed explanation of various phases of algorithm is as

Follows,

1. Route Discovery Phase

Route discovery phase used for obtain the path between source to destination and uses control packet to discover route from source to destination. The control packets are mobile agents which walk through the network to establish routes between nodes. Route discovery uses two ant agents called Forward Ants (FA) and Backward Ants (BA) and these two ants are same in structure but differ in the type of work they performed. The FA is an agent, which establishes the pheromone track to the source node, and BA establishes pheromone track to the destination. A forward ant is broadcast by the sender and relayed by the intermediate nodes till it reaches the destinations and a node receiving a FA for the first time creates a record in its routing table. The records having the next hop, destination address and pheromone values. The node clarify the source address of the FA as the destination address and the address of the previous node as the next hop and computes the pheromone value depending on the number of hops the FA needed to reach the node. Then the node forwards the FA to its neighbours and FA packets have unique sequence number and the duplicate FA is detected through sequence number. Once the duplicate ants are detected or eliminated, the nodes drop them. When the FA reaches the destination, its information is extracted and it is destroyed. The BA is created with same sequence number and sent unto the source and BA reserves the resources at along the nodes upto source. BA establishes path to destination node.

2. Route Maintenance Phase

Route Maintenance phase used for control the network changes and plays a very important role in WSN's as the network keeps dynamically changing and routes found great during discovery may turn to be bad due to congestion, signal strength, etc. Hence when a node starts sending packets to the destination using the Probabilistic Route Finding algorithm explained above, it is essential to find the benefits of a route regularly and update the pheromone counts for the different routes at the source nodes and to attain this, when a destination node receives a packet and probabilistically sends a Congestion update message to the source which informs the source of the REM value for that route. This Congestion Update message also serves an ACK to the source.

3. Route Failure Handling Phase

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Routing failure handling phase is responsible for generating alternative routes in case the existing route fails. Every packet is associated with acknowledgement; hence if a node does not receive an acknowledgement and it indicates that the link is failed and detecting a link failure. The nodes send a route error messages to the prior node and deactivates this path by setting the pheromone value to zero. Then prior node tries to find an alternate path to the destination. While the alternate path exists, the packet is forwarded on to that path else the node informs its neighbours to relay the packet towards source. This continues until the source is reached. After reaching the source the source node indicate a new route discovery phase. Hence ant algorithm does not resolve on failure of optimal path. That is, if the optimal path is loaded heavily, and the data packets can follow the next best paths.

Applications of ACO algorithms

Since their introduction in the early 1990s, ACO algorithms have been applied to many optimization problems. First, classical problems such as scheduling problems, assignment problems, graph colouring, the maximum clique problem, or vehicle routing problems were solved and more recent applications includes, for example, cell placement problems arising in circuit design, the design of communication networks, bioinformatics problems, or problems arising in continuous optimization. In recent years some researchers have also focused on the application of ACO algorithms to multi-objective problems and to non static problems.

VI. EXPERIMENTAL RESULTS

To increase the lifetime for wireless sensor networks, a new ACO routing protocol is used. The data are selected and transferred from the source to the destination via the router. In this result we implemented the simulation of AODV protocol and calculated its performance such as throughput and energy level

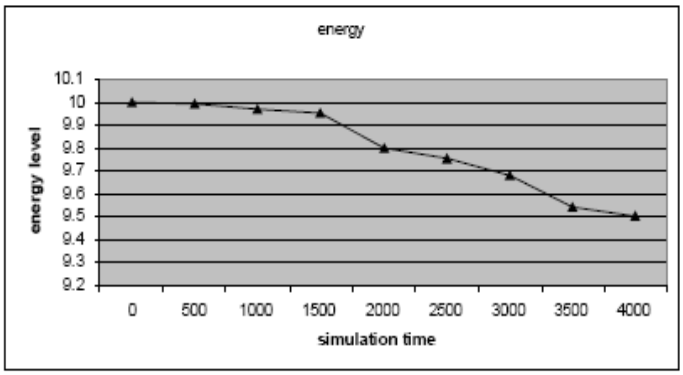

Fig2. AODV Energy Level

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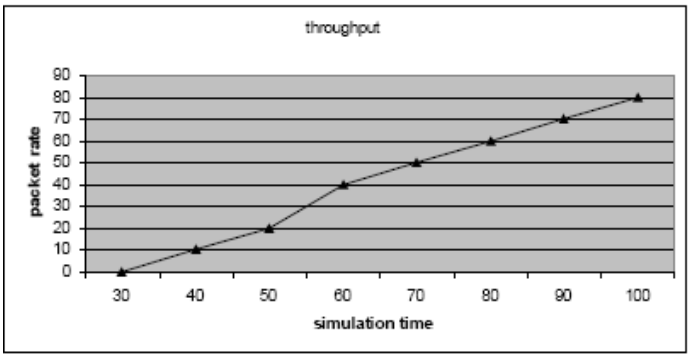

Fig3.AODV Throughput Level

VI. CONCLUSION AND FUTURE WORK

In this paper, we presented a new protocol for WSN routing Operations. The protocol is achieved by using ACO algorithm to finding the optimal paths and providing a effective multi-path data transmission to obtain reliable communications in the case of node faults. We aimed to maintain network life time in maximum, while data transmission is achieved efficiently. Our study was concluded to evaluate the performance of ant based algorithm and AODV routing protocol in terms of Ratio of packet delivery, average end-to end delay and Routing Load to be normalized. From the comparison it is concluded that overall performance of ant based algorithm is better than AODV in terms of throughput. Our proposed algorithm can control the overhead generated by ants, while achieving faster end-to-end delay and improved ratio of packet delivery. The future work could be to examine different methods to more limits the traffic or load and compare the ant based algorithm for other proactive and reactive routing protocols.

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