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ACO Based Routing in Internet of Things

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Abstract: The internet of things (IOT) which are belongs to the internet and interconnected all things and connected all with remotely. It is important technology and ambiguous term. It has unique identifier and collects data from network to network without interaction of human beings. Many techniques are used in IOT which collect data without any loss. But the technique ACO which gives better results than other techniques. This paper research on internet of things in which from source to the destination are cover many route but ant colony optimization (ACO) technique which gives shortest path between transmitter and receiver then optimize the route.

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I. INTRODUCTION

The Internet of Things (IoT) is an important which are used in technology industry, policy, and engineering circles. It has become headline news in both the specialty press and the media. This technology are wide spectrum in whole world & networked products, systems, and sensors, which take advantage of advancements in computing power, electronics miniaturization, and network interconnections to offer new capabilities not previously possible. The internet has unique identity whole connected objects which devices are connected for communication. The internet of things which are based on smart objects. It has ability to communications between to objects which has ability to discovered and incoming messages and reply them. The basic idea about IoT is the around us of a variety of things or objects – such as Radio-Frequency Identification (RFID) tags, smart sensors, mobile phones, etc. – which are for data communication & able to interact with each other and cooperate with their neighbors, control and automation. In global network infrastructure in which are connected no. of objects by internet with self configuration. Transparent and seamless connection of a large number of different and heterogeneous end systems in IoT. IN the various forms of objects like as Building critical architecture for the present IoT is a very difficult task. Because large variety of devices, security and other services are involved in it. The Internet of Things (IoT) is a latest communication paradigm, where number of objects used in daily life & will be able to communicate or interact with each then equipping another and with the users by with transceivers equipping & routing strategies also part of the Internet [1].. The coordination of everyday objects which see, hear, and perform various tasks sharing information when interact each other The aims of IoT concept connect everyday objects by internet and these objects are transforming from traditional to smart using embedded devices, technologies of communication , ubiquitous computing, networks of sensors etc. Internet of things are provide many opportunities for companies and users. Many productive sectors which including e.g. health care , environmental monitoring and mgmt. workplace ,home support and security and surveillance etc, are find the applicability by IoT technologies.RFIID tags, home appliances, surveillance cameras, monitoring sensors, displays, vehicles, are easy acess and ranging variety of devices. Many number of applications will support services to citizens, companies, and public administrations. This standard finds application in various areas, like as home automation, industrial automation, medical aids, mobile healthcare, elderly assistance, intelligent energy management and smart grids, automotive, traffic management, and many others [2].

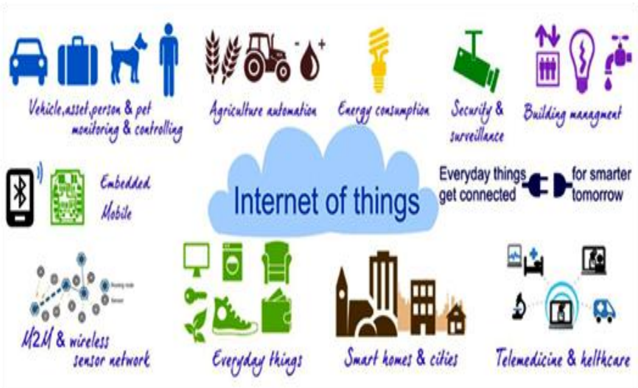

Fig. 1.1: The Internet of Things (IoT)

In Internet of things are major problem entire network performance and find the best route between sorce and destination node. In the whole network find the problem of best route and loss the packets and quality of service parameters. In the multihop counting in which only hops count and they transfer data continually not consider the best route between the node and exchange the data directly and indirectly. [5, 6]. In the network structure in which ruting mechanism are easily and quickly detect changes and for communication QoS parameters are maintain. The IoT networksare dynamic effect by varying networks. IoT which provide optimize network resource which fulfill the QoS parameters [7-8].

II. REVIEW OF LITERATURE

In the IoT in which connections anywhere, anyhow, anytime and computing to "anything, anyone, any service."

[1] Miorandi et al which presents a exchange the paradigms where everyday objects are communicate with each other microcontroller, transceivers for digital communication A number of research challenges has identified and given overview of key issues which are related to IoT technologies.

[2] L. Atzori, A. Iera, and G. Morabito, In this paper presents that vision concepts and technologies , various challenges some innovations and various applications such as home automation, industrial automation, medical aids, mobile healthcare, elderly assistance, of the internet of things.

[3] P. Bellavista, G. Cardone, A. Corradi, and L. Foschini, In the paper which gives the solution of the for exploit and data harvesting in Internet of Things (IoT).In this everything locatable, addressable, and readable an known as virtual. These virtual entities which produce collaborate toward a common goal and consume services. It can act on his behalf when user's phone knows about his physical and mental state through a network of devices that surround his body.

[4] A. Laya, V. I. Bratu, and J. Markendahl,touting In this paper processes that communication between two devices utilize protocols[8]. And this routing protocol which has the intrinsic power of any heterogeneous, dynamic, and complex network that changing topology and traffic flow by multiple dynamic factors.

[5] A. M. Alberti D. Singh, In this paper which can find the optimal path Efficient and scalable routing protocols are required that can adapt to different scenarios and variations in network size and can find optimal routes. In this intelligent routing which utilize and achieve data forwarding to multiuser environment. In IoT environment in which D2D communication with complex.

[6] D. Giusto, A. Iera, G. Morabito, L. Atzori (Eds.) In this paper describe the optimization of real time and priori which are basic methods of the optimization technique. In real-time optimization, in which available information created dynamically by routes and criteria of interest is revealed as data flow from device to device. And priori optimization in which routes are created by the probabilistic

[7] J. Gubbi, R. Buyya, S. Marusi, M. Palaniswamia In This paper in which given the vision & architectural elements and future elements. And this cloud which are centric vision between the IoT things. The interaction of private and public cloud is presented is used by *Aneka* cloud.

[8] Oladayo Bello and SheraliZeadally, In this paper many routing algorithms are used for dynamic wireless networks. In a network in which these algorithms are taken operational constraint & according to conditions routes formulate.

[9] M. Farooq and G. Di Caro In this discuss the properties and routing algorithms used. These algorithms are bio-inspired. So used ant colony optimization technique and bee insects are used shortest path are driven by pheromone.

In this paper in which are used bio logical system and this are inspired by nature. For the networking and communication algorithms & dynamics for biological system. For these algorithms prove it that is swarm intelligence-based algorithms such as the ant colony optimization(ACO). Ant colony in which ant finds meals between source & destination node and gives the optimal path, & Swarm intelligence is based on the observation of the collective behavior of decentralized. For the examples of these self-organized systems such as ant colonies, flocks of fishes, or swarms of bees or birds.

[10] D. Papadimitriou, "Stochastic Routing In this in which Given the multiple and optimal paths and difference with single run and comparison with various EA's . In Pareto optimal solutions which are are superior to these when all competing objectives are considered & the solutions that are optimal in wider sense i.e. in the search space.

[11] A. Liotta and G. Exarchakos, "A peek into the future in which explain about the some research directions and discuss about small world , scale free, autonomic , context -aware network.

.[12] F. Dressler and O. Akan, "A survey on bio-inspired networking," In this paper in which current status of the research to address and these are captured bio inspired efforts & are common in networking challenges.

[13] X Yao, Y Liu and G. Lin in this Evolutionary programming (EP) are used for simulating and utilize the Darwinian evolution which changing the static and dynamic environment .[22] it is as a computational technique was first proposed while working in the field of artificial intelligence.

[14] A. Konak, DW. Coit, A E. which given Smith Genetic algorithms. These algorithms are machine learning techniques. And Their behavior is derived evolutionary biology metaphor. These algorithms explains the origin of species[23].In terminology of GA, a chromosome or an individual is a solution vector & made up discrete units called genes.

[15] K.E Kinnear and L Altenberg in this used Genetic programming, which is an extension to the conventional genetic algorithm. In GP, each individual in the population is a computer program. The GP which attempts to construct a computer program by using terminal set or function set as input and to solve the problem.

[16] D Simon in this Biogeography based optimization algorithms. these are inspired by concepts of biogeography in optimization problems [25-26]. Bio-geography is the study of geographical distribution of biological organisms it is based mathematical models which describe how new species arise, migration of species from one island to another, and extinction of species takes place.

[17] S.Sharma, S. Kumar and B .Singh in this paper A habitat suitability index (HSI) are used for geographical areas. It is well suited as residents for biological species. Factors such as rainfall, temperature, land area, and diversity of topological features which sare correlated with HIS.

[18]X.S.YangSwarm in this given intelligence based algorithms which are concerned with designing multi-agent systems. For examples which are inspired by bio inspired & the social insect's collective behavior such as ants, bees, termites, bats and wasps, also from animal societies such as schools of fish or flocks of birds.

III. ANT COLONY OPTIMIZATION

The ACO is based on optimization technique and which solve the problems of optimization. ACO based routing in IoT in which link cost between the distance of the node and compute the most desirable route in given time. It is applied & discover the shortest routing direction in the IoT.Ant Colony Optimization is the meta-heuristic technique because ants travel from source to destination many times for shortest and best path. To solve the problem of optimization solution in given time ants findest the meals and perform the random walk. After it is returned to the nest and findest many routes. Other ants guided to to the meals and amount of pheromone deposited on other various paths. Pheromone allows and discover the food supply and their nest. Routing algorithm is based on the IoT which stimulated by the ants searching the meals. So finding the shortest path between transmitter and receiver node in a IoT network is as :

A topology graph *G (N, L)* having *N* nodes and *L* links in between nodes.

d_{ij} = positive weight (cost)

N_i^k =neighborhood of an ant *k* at node *I*

L^k =the length of ant *k*'s path.

So the constant amount of pheromone τ_{ij} between i^{th} and j^{th} node which are assigned to all arcs of the graph. The pheromone trails τ_{ij} and a node *i*, the probability of selecting node *j* as next node & ant *k* is computed as

$$p_{ij}^k = \begin{cases} \dfrac{\tau_{ij}^{\alpha}}{\sum_{l \in N_i^k} \tau_{il}^{\alpha}}, & if \;\; j \in N_i^k \\ 0, & if \;\; j \notin N_i^k \end{cases}$$

Where α is a constant variable. Loops are avoided by the previous node which not selected. Neighborhood ants checks by ant k at node i. When until receiver node are not received then till hops from one node to another node taking the stochastic decision. When receiver node is received then forward ant is converted in backward ant to to repeat the travelled path. The aim of this path to remove the loops and re-travelling is to update the routing records at every node. When new routing information is updated regulated by α While returning from receiver node to to the source node, the ant *k* updates the pheromone value of arc (*i*, *j*) as

$$\tau_{ij} \leftarrow \tau_{ij} + \Delta\tau^k$$

Where

$\Delta\tau^k$ = increment in pheromone quantity.

When ants re-travelled more pheromone is deposited. The deposited pheromone trails at each arc evaporates similarly to normal evaporation of real pheromone in nature. The objective of the pheromone diffusion process is to avoid quick convergence to a sub optimal route. At arc (*i*, *j*) pheromone trails are updated as

$$\tau_{ij} \leftarrow (1-\rho)\tau_{ij} \;, \rho \in (0, 1] \quad (3.3)$$

Where

ρ = evaporation constant.

The routing tables obtained are updated at regular interval or at detection of a change in network configuration.

The finding the optimal path by routing algorithm as given below:

Step 1: ACO parameters are initialized. For all 'n' given nodes the adjacency matrix is updated.

Step 2: Pheromone levels are initialized by assigning equal values to all links And the nodes which are in IoT scenario LC between all adjacent node.

Step 3: Then Link Cost based distance between the adjacent nodes is computed. And on based it the matrix is constructed.

Step 4: N paths are generate or Using the adjacency matrix,

Step 5: Move all ants from current node (starting from source node) to adjacent node till these reach destination node.

Step 6: Record the paths.

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Step 7: Update the pheromone trail based on the recorded paths.

Step 8: Repeat the algorithm from step 5 until the stopping condition has been accomplished.

Step 9: For next iteration the routing tables are updated.

IV. RESULTS AND DISCUSSION

We verify & simulation the performance for various iterations in MATLAB and optimize the performance of the proposed algorithm for IoT. For our simulation experiments we considered 9 nodes IoT network was considered with 50, 100, 200 and 500 iterations for each network configuration. These nodes were placed to form a connected grid within a 500m ×500 m area. For this network the transmission range of the nodes was 200 meters. In the network data transmission is through multiple hops via various adjacent node in which multiple routes/paths are available. The current value of the Link Cost (LC) between the two adjacent nodes and Selection of path or route depends upon on it. For all IoT scenarios 20 trials were conducted. The proposed algorithm performance is evaluated in terms of computed ILC within the given time.For every constraint of a time set of a specific scenario minimum, average and maximum value of ILC is enumerated.

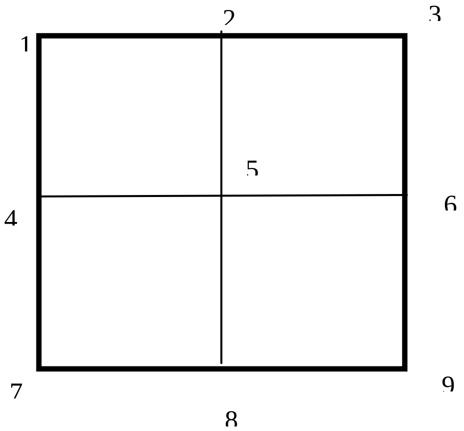

Figure 5.1: Architecture of 9 nodes IoT

Table 4.1: Results of ACO based routing for Static IoT nodes for 50 iterations

No. of Trial	Link Cost for Number of Iterations	
	50	
1.	2.1341	**Maximum LC = 3.2348 Average LC = 2.09024 Minimum LC = 1.4783**
2.	1.8242	
3.	2.2299	
4.	3.2348	
5.	2.1390	
6.	1.5527	
7.	1.4783	
8.	2.8857	
9.	2.1341	
10.	1.4783	
11.	2.3953	
12.	2.2359	
13.	2.0709	
14.	1.5527	
15.	1.8242	
16.	2.2299	
17.	3.2348	
18.	1.5527	
19.	1.4783	
20.	2.1390	

Table 5.1-5.4 presents the LC values of 9 node static IoT. Fig. 5.2-5.5 shows the enumerated LCs for 50, 100, 200 and 500 iterations for 9 node static IoT. These results indicate that ACO based routing approach to find the shortest path for IoT networks improves with increasing number of iterations.

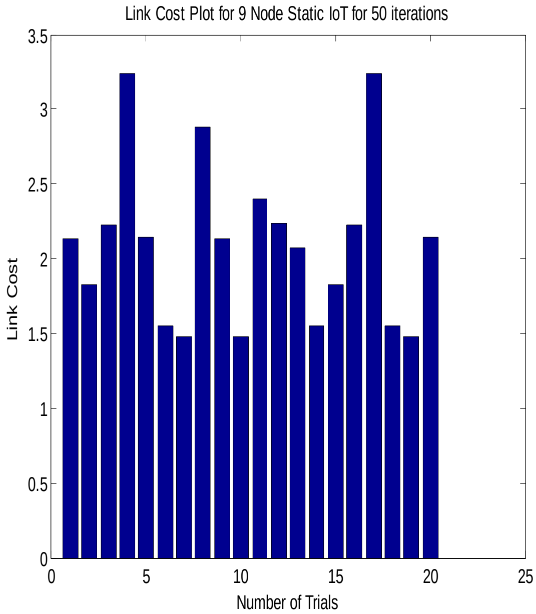

Figure 5.2: Number of trial Vs. ILCs for a 9 node IoT for 50 iterations

Table 4.2: Results of ACO based routing for Static IoT nodes for 100 iterations

No. of Trial	Link Cost for Number of Iterations	
	100	
1.	1.4783	**Maximum LC = 3.2348 Average LC = 2.046085 Minimum LC = 1.4783**
2.	2.0709	
3.	1.5527	
4.	2.1390	
5.	2.1341	
6.	1.4783	
7.	2.4832	

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8.	1.5527	
9.	1.5527	
10.	2.3953	
11.	3.2348	
12.	1.4783	
13.	2.8857	
14.	2.1341	
15.	1.5527	
16.	2.0709	
17.	2.8857	
18.	2.2299	
19.	2.1341	
20.	1.4783	

Table 4.2: Results of ACO based routing for Static IoT nodes for 100 iterations

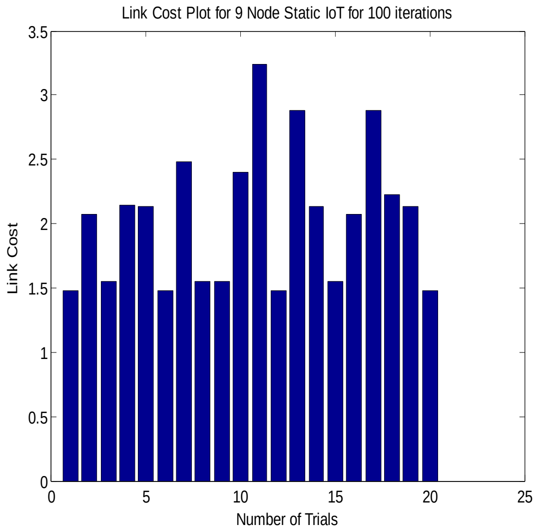

Figure 5.3: Number of trial Vs. ILCs for a 9 node IoT for 100 iterations

No. of Trial	Link Cost for Number of Iterations	
	500	
1.	1.4783	**Maximum LC = 2.0709 Average LC = 1.52653 Minimum LC = 1.4783**
2.	1.4783	
3.	1.4783	
4.	1.5527	
5.	2.0709	
6.	1.4783	
7.	1.4783	
8.	1.4783	
9.	1.5527	
10.	1.5527	
11.	1.4783	
12.	1.4783	
13.	1.4783	
14.	1.5527	
15.	1.5527	
16.	1.4783	
17.	1.4783	
18.	1.4783	
19.	1.4783	
20.	1.4783	

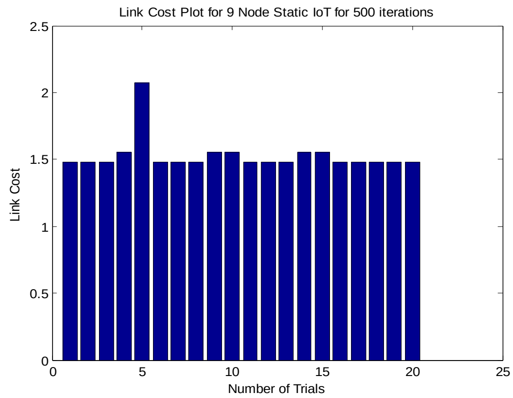

Figure 5.5: Number of trial Vs. ILCs for a 9 node IoT for 500 iterations

For 9 nodes IoT 20 trials were conducted for each set of iterations of 50, 100, 200 and 500. From Table 5.1-5.4 and Fig. 5.2-5.5 we observed that the average LC for all the trials conducted tends to approach the LC of best path. However in the given number of iterations this approach selects a near shortest path for routing.

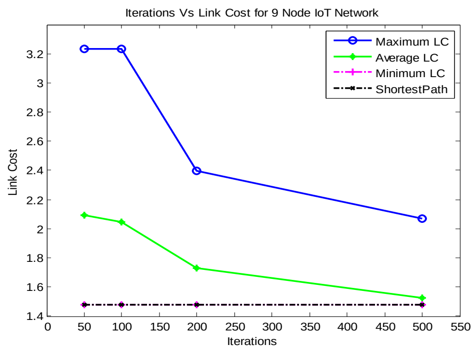

Figure 5.6: Number of Iterations VsLCs for a 9 node IoT for Maximum, Average and Minimum Link Cost

In this results are indicate the number of iterations or computing time is relaxed then this approach achieve the best path LC successfully.

IV. CONCLUSION

In this paper Routing approach a new ACO in IoT network. This routing approach are bio-inspired.In this the algo are perform on 9 node network .In this find the shortest path between the source and destination node.ACO based routing approach apply and simulated for for 50, 100, 150 and 200 iterations in network scenario. In network nodes link cost and and simulations are recorded by 20 trails. After many trails find the ACO based approach for routing in IoT was able to converge to the best path. So it is concluded that ACO based approach is a suitable solution to find the shortest path between source and destination nodes in IoT networks.

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