A REVIEW ON DIFFERENT TECHNIQUES FOR ROUTING IN IoT

Priyanka* [1], Er. Jashanpreet Kaur *[2]
M.Tech Scholar[1], Assistant Professor[2]
Department of Computer Science& engineering
Guru Kashi University Talwandi Sabo, Bathinda, India

Abstract: ***IoT, the internet of things is the most prevalent current future application of the internet. It makes the communication of small utility based network to connect to the remote network using internet. It provides cost efficient procedures for building networks. Various researches have been performed for identifying the paths or routes which are time efficient and cost efficient. Presently researchers have performed researches on fuzzy based path, neural network based identification. But optimization based on genetic based approach can be used for enhancing the work in line to enhance the route establishment success.***

Keywords: ***IoT, Genetic, Fuzzy, Neural network, Content centric routing.***

I. INTRODUCTION

Internet of Things (IoT) is a wireless network which comprises of substantial number of interconnected gadgets. These gadgets, for example, sensor hubs communicate with each other without need of human obstruction. All these smart gadgets sense information from the environment and aggregate this information to send significant data to the base station. From the base station, all the end clients who have access to this information will gather this data through the internet to use in a proficient way. The need of IoT is to make everything more astute for controlling the objects and gadgets in the environment. The Internet of Things includes numerous parts of our life from associated homes and urban areas to associated autos and streets, streets to gadgets that track individual behavior and utilize the information gathered to push administrations [1]. The Internet of things sooner rather than later will be utilized to allude to the general thought of things, particularly regular objects that are intelligible, unmistakable, locatable, addressable, controlled through Internet regardless of the correspondence implies. The various applications of IoT are as shown in fig.1.

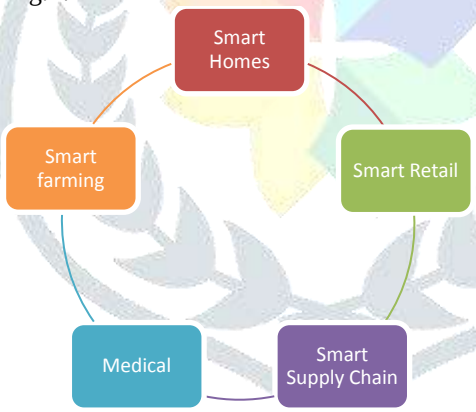

Fig. 1 IoT Applications

1.1 ROUTING IN IoT

Internet of things is a wireless network comprises of sensor nodes that are situated in brutal and unattended environment where human reach is outlandish. These sensor nodes have constrained battery control, so substitution of these batteries ends up close to unthinkable. The lifetime of network relies upon the life expectancy of its nodes. So routing algorithms have been intended to save the battery control however much as could be expected and to pick the less congested way to pass on data [2]. Two special routing metrics are used. The first one is the ETX metric which presents the connection quality between the nodes. Generally, probe packets are used to heuristically get the ETX value of a link [3]. Every node once in a while communicates or broadcasts the small-size probe packets to its one-hop neighboring nodes. The ETX metric is usually defined as:

$$\mathrm{ETX} = \frac{1}{pq}, \quad (1)$$

where p and q denote the forward packet delivery ratio and the reverse packet delivery ratio, respectively [3]. The parameters p and q are obtained heuristically. Assume that each node remembers the number of probe packets from the other nodes within w seconds. When each node at times broadcasts the probe packets in t cycles, the probe packet delivery ratio of one node at time t is defined as:

$$r(t) = \frac{\mathrm{count}(t-w, t)}{w/\tau}. \quad (2)$$

1.2 ROUTING TECHNIQUES

1.2.1 GENETIC BASED APPROACH

The Ant colony optimization is one of the genetic based approaches. It is a metaheuristic method in view of swarm intelligence for solving combinatorial enhancement issues to find out the shortest path. The ant colony algorithm is an approach for finding optimal paths that is based on the behavior of ants searching for food. To begin with, the ants walk arbitrarily. When an ant finds a source of food, it walks back to the colony leaving a chemical substance on the way called pheromone that show the path has food. The pheromones that are laid forward and backward the sustenance source is called as pheromone trail. It is extremely helpful to find out direction of food source. At the point, when different ants come across the pheromone trail, they are expected to follow the path with a certain probability. On the off chance that they do, at that point populate the way with their own pheromones. As more ants discover the path, it gets more stronger pheromone concentrations. Since the ants emitted pheromones each time they bring food. They pick the shortest path from numerous paths by utilizing pheromone trail. Shorter paths are more likely to be stronger, hence optimizing the solution [4].

1.2.2 NEURAL NETWORK BASED APPROACH

Neural network is a computing framework which comprises of a large number of simple, well interconnected processing elements also called as neurons that will process the information by their dynamic state reaction to outside inputs. Due to their dynamic state reaction, neural networks can be used for path planning. Path planning is one of the important issues of mobile robots to avoid any obstacle in their path. The idea of the path planning is to identify the path from start position of a vehicle to the goal or destination of a vehicle. The main motive of the path planner is to identify the collision free path from source to destination. There are many algorithms for the path planning and one of them is ANN model for path planning of robots in harsh and bumpy grounds. This artificial neural network (ANN) model consists of three layers: Input layer, hidden layer and output layer. The input layer consists of basically two neurons designed to detect obstacles of any shape or size. The hidden layer consists of three neurons that read input data and multiply that data by weight (strength of a connection between two nodes) and then send the result to the next layer. The next layer is the output layer that consists of two neurons which are linked to the vehicle's motor that will control the vehicle's movements and its operations. This model works best on back propagation algorithm based on supervised learning approach that will allow the system to select the best path [5].

II. LITERATURE REVIEW

Agnihotri and Ramkumar (2017) have presented the various routing protocols based on swarm intelligence for Internet of things (IoT) which are presently used for wireless sensor networks (WSN) and Mobile Ad-hoc networks (MANETs). There are a few issues which are constraining the development of Internet of Things like security, reliability, privacy and scalability etc. Basically the swarm intelligence is applied to accomplish the optimality and effectiveness in understanding the complex and dynamic necessities of WSNs. It also provides the scope for the development of efficient protocols for routing in IoT. Though the existing protocols which have been intended for MANETs and WSNs are not sufficiently solid, there is the need of some proficient routing protocols for IoT [6].

Jeba and Kamala (2016) have surveyed different routing techniques for Internet of things (IoT). IoT is a wireless network of large number of interconnected devices. It's a worldview in which devices are installed with sensors that will influence them to connect with different gadgets and people too. These devices are fit for catching and changing the data they get from their surroundings. As IoT networks are decentralized so routing is necessary where the packets have to be send for the establishment of communication between the source and destination and to ensure the timely delivery of packets. The authors have described various routing techniques like DSR, DSDV, AODV, AOMDV, RPL, LEACH and SPIN etc. along with the various routing issues in IoT [7].

A. Dhumane et al. (2016) have reviewed the various routing issues in Internet of things (IoT). As IoT network comprises of large number of nodes, most of the nodes experiences constant movements which may come about into irregular interconnectivity between the devices that can cause numerous topology changes so routing has become a big challenge. The main goal is to focus on the existing routing algorithms and to analyze them so as to identify the major issues in routing the data in IoT. The authors have also made a comparison between different routing protocols on the basis of some parameters and shown the various possible open challenges for future research [8].

Kharkongor et al. (2016) have introduced an SDN controller in the IoT network which serves as a central manager and provides a protected network by refusing access to the selfish nodes in the network. As the main focus of Internet of things is to connect anything to anyone at anywhere so routing protocol is necessary to achieve this and to bring about the data transmission between heterogeneous nodes. The authors have reviewed different routing protocols to identify the main routing issues in IoT and introduced a new routing approach which is embedded with central manager called SDN controller. The comparison between the existing routing protocols like AODV, DSDV and DSR and the routing using SDN controller is also shown. The simulation results have proved that the proposed routing is better than the existing in terms of throughput, end to end delay and packet delivery ratio [9].

Luo and Li (2012) have proposed the Ant colony system based routing algorithm for WSN (Wireless sensor networks) as routing is one of the major problems of WSN. Ant Colony algorithm offers a great advantage in solving complex optimization problems. The authors have improved the Ant colony optimization by considering nodes energy, packet loss rate, network latency and other quality of service (QoS) requirements. Also, they first introduce the ACO (Ant colony optimization) algorithm and MMAS (Max-Min Ant System) and then propose the improvement in parameters of MMAS while taking into account the Quality of service parameters of WSN and then introducing the search angle concept to progress the convergence speed. The future goal is to improve the efficiency and performance of Ant colony algorithm and to make it adaptable to the large-scale network like IoT [10].

Chen and Chiu (2015) have presented an optimal path planning scheme based on neural networks that builds map and plan optimal paths for mobile robots. The system first locates the origin and the stationary obstacles. And then calculates the optimized trajectory by utilizing neural network model and consequently plan the movement of mobile robots. The path transfer algorithm will transfer the path into commands so that robot can understand it. The mobile robot can also sense the environment to avoid the obstacles which are not stationary (i.e. mobile obstacles).This system can be utilized in our daily lives. The practical experiments have shown that this system is more efficient and effective than the existing ones [11].

Yichao Jin et al. (2016) have proposed content centric routing (CCR) technique in which routing paths are decided by the content. Such type of technology is required as collecting huge amount of data like images, videos from different networks can cause traffic congestion in a primary network area. CCR routes interrelated data to the intermediary relay nodes for processing that will increase data aggregation ratio and thus reducing the traffic congestion in the network. Moreover, it will eliminate the redundant data transmissions that reduce the amount of energy spent on a wireless communication thus preserving limited battery. It is confirmed from the implementation results that CCR reduces the network latency, extends the network lifetime and improves the communication reliability. In future, the hardware atoms utilizing CCR technology can be deployed for collecting more and more data [12].

F.K Purian et al. (2013) have proposed a path planning mechanism by using fuzzy logic for mobile robots in an unknown environment. The main purpose of this method is to find a least distance path in obscure, dynamic situations with different complexities. This method is based on fuzzy logic and is picked by two important criteria 1) difference of angle to the target and the distance to the closest obstacle. 2) The target selection of the next node depends upon the coefficient procured for each node on a route to reach their destination. This method makes use of fuzzy logic to select the nodes and the angle difference between the node and the target is very less and the node will be of great distance from the closest obstacle and the top-priority coefficient achieves relative to other nodes. Simulation results have shown that this method finds the shortest possible path for mobile robots which is collision -free and the length of this path has the least cost [13].

V.J Kotagi et al. (2017) have proposed an adaptive and load balancing routing method to improve the throughput of the IoT networks. Earlier parallel opportunistic routing (POR) was proposed which utilizes many wireless technologies for the parallel transmission of data. As the data in POR always follow the same route from source gateway to the Internet, this causes congestion at the source gateways which will degrade the performance of the network. In order to resolve this problem, a new technique called Adaptive routing using multi-technology and Load balancer (ARMY-Lancer) is used. The ARMY-Lancer makes sure the balanced use of gateways that is; it provides load balancing at gateways in the network. This method also provides the parallel data transmission. Simulation results have shown that ARMY-Lancer performs better than POR and LBR (Load balanced routing using single technology) in terms of throughput as it upgrades the network's throughput up to 11-32% [14].

Amgoth and Jana (2014) have stated the energy aware routing algorithm for WSNs (wireless sensor networks) as it is very difficult to replace the power batteries of sensing nodes in WSN. So it is necessary to have an energy saving routing algorithm. The proposed algorithm is based on smart strategy for selection of cluster head (CH), remaining energy of cluster heads (CHs) and intra-cluster distance for the formation of cluster. An implicit backbone of cluster heads which is fixed at the base station is constructed to assist the data routing. This algorithm also balances the energy consumed by cluster heads during the process of data routing. Simulation results have shown that the proposed algorithm is better than the prevailing algorithms in terms of energy consumption, network lifetime, and power imbalance factor [15].

Rangaswamy and Krishnareddy (2015) have presented a system to manage the packet level congestion for distributed networks by adapting a metric called as stochastic rate control as there are only few techniques for controlling the traffic congestion in distributed networks. The proposed system will ensure the balanced data flow rate in well distributed networks. The proposed metric which is termed as RCM (rate control metric) will support the congestion-free traffic in upcoming Internet architectures. The association of the RCM in the networks will improve the quality of transmission. This can be accomplished as there is no need to evaluate the transmission rate and to trace the flow state at each queue. From the simulation results it is clear that the existing TCP based technique cannot be used for future Internet, therefore in future the more efficient techniques can be evolved for future Internet architectures [16].

M. Frey et al. (2014) have proposed energy aware ant routing algorithm (EARA) which is based on search behavior of ant colonies. This algorithm is an extension of the ant routing algorithm (ARA). This algorithm provides a new way to estimate the fitness of path and energy information distribution unlike the other energy efficient ant based algorithms that only taking into account the energy values of next hops. Simulation results have shown that EARA outperforms ARA in terms of network lifetime as it improves the average network lifetime by 30 seconds [17].

III. COMPARATIVE ANALYSIS

Author	Year	Technique	Constraints/future work
Agnihotri and Ramkumar [6]	2017	This paper has presented swarm intelligence based numerous routing protocols for IoT which were conventionally used for MANETs and WSNs. By using swarm intelligence principles, protocol's efficiency can be improved.	Although the proposed protocols improve the route selection procedure yet there are some reliability and other issues which need to be resolved. In future content based routing can be used to achieve more effectiveness.
Y. Jin et al. [12]	2016	This paper has presented the Content centric routing (CCR) technology where the route is determined by the content. CCR eliminates the unnecessary data transmissions thus conserving limited battery.	CCR improves the network latency, reliability and network lifetime. In future, various technologies like Data mining and fuzzy logic can be considered to support network processing.
Luo and Li [10]	2012	This paper has presented Ant system (genetic approach) based routing algorithm for wireless sensor networks. Ant colony algorithm is very helpful in solving complex optimization problems.	Ant colony optimization can be improved by considering nodes energy, packet loss rate and QoS requirements. The future goal is to enhance the performance and efficiency of the proposed algorithm and to make it malleable with large scale network.
F.K Purian et al. [13]	2013	This paper has presented a path planning system for mobile robots by utilizing fuzzy logic in obscure, dynamic environments.	Although this fuzzy logic based method is useful for finding the shortest path yet it is not as much efficient as the genetic approach is for finding shortest possible path.
Chen and Chiu [11]	2015	This paper has proposed optimal path planning system for mobile robots by using neural network based approach. The proposed algorithm finds the optimal path and then transfers it to the commands that robot can understand.	The proposed system avoids collision with both stationary and mobile obstacles. In future, this system can be used to build an automatic system for transferring stocks from carts to shelves.
Amgoth and Jana [15]	2014	This paper has presented an energy aware routing algorithm for wireless sensor networks as power sources of sensor nodes are usually irreplaceable.	The proposed algorithm balances the energy consumed by cluster heads during data routing process but did not consider the dynamic scenario and fault tolerant feature of wireless sensor network.
V.J Kotagi et al. [14]	2017	This paper has presented an adaptive routing using Multi-technology and Load Balancer (ARMY-Lancer) for IoT networks. This technique is used for the parallel transmission of data and load balancing at gateways in the network.	The proposed technique improves the network throughput by 11-32% when compared with POR and LBR. This work can be enhanced by maximizing energy preservation by using load balanced routing.

IV. CONCLUSION

From the above study it is clear that route establishment for IoT is an important activity that needs research as there is large amount of data which is being transferred through internet. There are various types of security and congestion issues in the network. If the delay rate reduction and efficient techniques are used for transferring the data from source machine to the destination machine, the traffic in the network will reduce substantially. For meeting the requirements, Genetic based technique is the most efficient solution for identifying the least cost and least distance path.

V. FUTURE WORK

Presently researchers have been using Genetic based technique for path identification with fewer parameters. These parameters are the basic criteria for selection and crossover. We can further enhance this work by considering more efficient parameters that will influence routing efficiency.

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