International Journal of Computer Trends and Technology
ISSN: 2231 – 2803 / https://doi.org/10.14445/22312803/IJCTT-V69I8P104

Volume 69 Issue 8, 15-19, August 2021

Original Article

Design and Development of Robust and Secure Cluster Routing Algorithm for Manet Based IOT

Revathi B[1], Arulanandam K[2]

[1,2]*Department of Computer Applications, GTM College, Gudiyattam, Tamilnadu, India.*

Received Date: 08 July 2021
Revised Date: 12 August 2021
Accepted Date: 25 August 2021

Abstract *- Internet of Things (IoT) is the future of technology for intelligent communication between resources. IoT enables digital interaction between the physical stuff using communication and heterogeneous networks. IoT is the common platform for various sensor devices for emitting data. IoT is the most economical and successful technology for collecting and sharing physical devices in modern days. Mobile ad - hoc network (MANET) with IoT is the technological phenomenon for communicating worldwide frameworks through the internet. This advanced combination facilities communication with greater mobility and minimum costs.But achieving energy efficiency is still an open challenge in the networking environment. In this paper, we proposed MIOTCR (MANET-IOT Clustering Routing Algorithm) for achieving energy-efficient utilization. To prove the efficiency of the proposed system, comparison work is carried with MANET-WSN [11]. The obtained result shows the performance dominance of the proposed MIOTCR in terms of energy consumption and packet delivery ratio than the MANET-WSN.*

Keywords *- IOT, MANET, Cluster& Energy-efficient routing.*

I. INTRODUCTION

In the digital world, invention on the internet enables devices had rapid growth. Internet connectivity allows reliable interfaces between the devices. IoT plays a vital role in establishing an interconnection between the global network infrastructure. K.Ashton coined IoT in 1999 [1], which is defines as the future internet. The significant feature of IoT is connecting the number of electronic devices through Internet connectivity. IoT uses communication technologies for identifying and providing communication between the physical or virtual things within time [2].

The significant feature of IoT is incorporating the interconnection between small objects like sensors, etc. Wireless sensor network (WSN) plays a vital role in IoT system, especially in data sensing, data collection, data connectivity, and data processing. The advancement of WSN was put forth for the evolution of the Mobile ad-hoc network (MANET) [3]; MANET is a multi-hop network that is wireless and self-configuring. MANET connects the number of nodes through the router. The combination of MANET and IOT paves the way for intelligent and reliable technology

The main reason for the successful combination of the MANET-IoT systems is energy balancing. IoT travels through multiple wirelesssensors, which increases energy consumption. MANET protocols minimize energy consumption by choosing short and efficient routes in the network. There are several researchers involved in discovering energy-efficient routing protocols. The primary key for achieving minimum energy consumption is efficient routing protocols, maintaining the multi-hop wireless networkconnectivity for prolonging the network's lifetime. In MANET-IoT networks, the wireless network protocols cannot apply directly due to human interface with nodes, computational speed, and network node density.

In this paper, a cluster agent-based energy-efficient routing algorithm is proposed. Clustering is the concept of a grouping that enables routing energy-efficient and straightforward. The clustering mechanism with MANET-IoT increases the network lifetime than the other technologies. The main thing in our proposed MIOTCR is the selection of cluster agents. There are several nodes in the cluster, and each node is capable of selecting as a cluster agent. The only criteria for a cluster agent are the node with a higher energy level. Because the entire network communication is done under the supervision of a cluster agent, it decides if any nodes are limited to the transaction, which is the next node to continue the communication. MIOTCR performance is determined in NS-2. In coordination with the routing protocol for selecting the minimum path, the clustering agent increases the sensor's lifetime and overall energy consumptions.

This paper is organized as follows: Section 1 describes the introduction, section 2 describes the literature review, section 3 illustrates the structure and workflow of the proposed system, section describes the result and conclusion, and finally section describes the conclusion of this work.

II. LITERATURE REVIEW

A. MANET

MANET is a structureless network, and there is no fixed topology. Nodes in the network perform a dual role as a host and router. The nodes in the network are free to move anywhere and can join and leave; there is no condition. In the network, nodes are linked to each within a range and can transfer the data between them. MANET is a fully distributed network that interacts with other nodes in a wireless medium. It does not require any base stations or access points.

Multiple ad-hoc networks are two kinds, such as MANET and mobile ad-hoc sensor networks. The mobile ad-hoc sensor network needs minimum complicated setup methods comparing to typical sensor networks. The ad-hoc sensor network contains a large structure of operations, and it does not require any centralized controller; it communicates directly [4]. MANET [5] has 6 major characteristics: lightweight terminals,shared physical medium, dynamic topology, multi-hop routing, distributed operation, and autonomous terminal. Routing protocols for MANET are described below;

B. Topology - based routing

Topology based routing protocols are;

- Proactive routing protocols
- Reactive routing protocols
- Hybrid routing protocols

C. Location - based routing

Location-based routing uses the node's actual position for making routing decisions. They are;

- Global positioning system (GPS)
- Location - aided routing (LAR) protocol

D. Internet of Things (IoT)

IoT connects electronic devices using the internet for digital communication [6]. The linked objects and things process information exchange, management, and communication. “Internet of Things” is a global infrastructure medium for information exchange through the internet [7].

E. The Interaction between Internet of Thing and MANET

The sensor revolution increases remote monitoring usage in various domains such as medical, industries, etc. Wireless sensor networks (WSN) are significant sources of remote monitoring as they do not require any wireless medium. In WSN, several sensors are connected for acquiring the node's sensed data and transmission. WSN is a centralized network [8], enabling communication to a wide range through IoT systems. IoT performance is depends on high power consumption and scalability [9]. For improving the efficiency of WSN, routing protocol plays an important role. But still, challenges like path elimination, dead sensor are existing in MANET, which had a greater influence on the Quality of Service (QoS) [10].

F. Cluster-based Routing Protocols

Alamerie et al. [11] proposed combined MANET protocols and WSN routing principles for data transmission. The proposed system includes dynamical monitoring with a predefined threshold value. The vital component of the proposed approach is the cluster head, and the cluster head selection is based on obtaining comparative results on the node's threshold value.

Yalda Akbari &Shayesteh Tabatabaei et al. [12] proposed a novel fuzzy logic and reinforcement learning for achieving high reliable routing system. The proposed system working procedure is based on the node's available bandwidth, node's energy in routes, and distance to the sink nodes.

The proposed system shows better performance in network lifetime and power consumption.

Li, G., Zhang et al. [13] proposed a multicast routing algorithm for achieving quality of service. Routing links are estimated based on the collected aggregation information

The deterministic algorithms for finding a multi-thread tree are not required.

Shah, J., & Mishra, B et al. [14] proposed a content-aware method for clustering sensor nodes. The proposed system is based on the Ant Clustering algorithm. The clustering sensor nodes are created as semantic sensor networks (SSON). Next, the proposed ANTCLUST is applied for building the cluster based on the content of the nodes. This approach minimizes the node searching process and improves network performance.

Qiu et al. [15] proposed the delay iterative method (DIM) to achieve real-time IoT response. The proposed system applies Delay Estimates for avoiding the neglecting of valid routes. This new routing method decision based on the information has enhanced the security level on transmission. Additionally, for load balancing in the network REPC method is implemented.

III. PROPOSED SYSTEM

A. MIOTCR (MANET-IoT clustering routing algorithm)

MIOTCR is a cluster-based routing algorithm, and cluster formation is very effective in identifying the shortest path in the network. The proposed system and its working mechanism is described below;

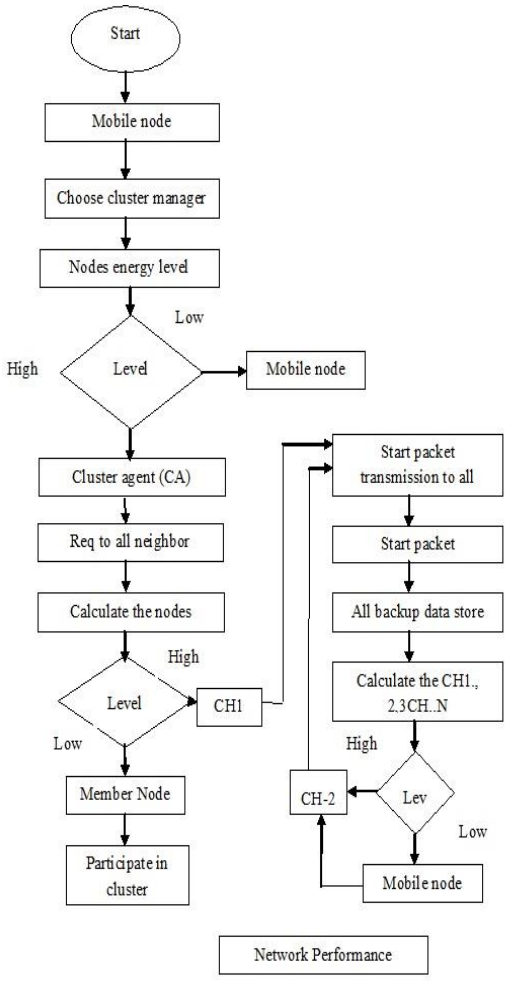

Fig. 1 MIOTCR Architecture

The proposed mechanism begins with node deployment. The node deployment model is comprising of implementing nodes within a range. The deployed nodes have different energy levels, such as low and high. Initially, the network is done among the deployed nodes. For this message, the broadcast is done, by which each node broadcasts a "Hello" message to its neighbor nodes. The replying nodes are considered active nodes, and only the active nodes take part in transmission. Based on the active nodes, cluster formation is done, and next is the cluster agent selection process. The node within the cluster network with a high energy level is selected as the cluster agent (CA).

CA is the central core of the proposed system, and hence the entire network transmission is done under its supervision. Next, CA does another message broadcast to all its neighbor nodes. Based on the reply, each node's distance and its energy levels are noted. The nodes with the high energy level is selected as Cluster Head (CH) CH1, and the node with the next energy level is the CH2. Based on the energy level and its distance, a routing path is discovered. CA is monitoring the CH1 and other participating nodes in the transmission. CH 1 decides the next node to take part in the path. If the CH1 energy level is drained, then CH2 becomes the next CH, and this process cycle through the transmission until it completes.

Steps for implementing the proposed system is stated below:

Step 1:Implementing network model (Node Deployment)
Step 2: Executing CAMIOTCR for selecting Cluster Agent (CA)
Step 3:Nodes in the network are analyzed, and finally, the node with a high energy level is selected as CA.
Step 4:CA progression begins
Step 5: CA broadcast the "Hello" message to all the neighbor nodes and track its energy level.
Step 6: Next, CA executes the CH selection process. The node with a high energy level is selected as CH.
Step 7: The Selected CH begins its transmission process with its neighboring nodes in the network.
Step 8: The entire network transmission is under the supervision of CA. It looks at the responsibility of monitoring the CH energy level.
Step 9: If the current CH energy level drains, CA allocate the next node with a higher energy level as CH. This process continues till transmission completes.
Step 10: Network Performance Evaluation

IV. RESULT & DISCUSSION

In this research, the performance of the proposed work is executed in the simulation environment NS-2. Network simulator – 2 is the best-known platform for research execution. The experimental setup consists of 50 nodes between the range of 1000 x 1000. The performance comparison is made between the proposed MIOTCR and MANET-WSN [11]. The performance metrics taken for comparison are energy consumption and packet delivery ratio. The execution time is calculated in sec. The observation obtains from both algorithms is plotted in graphical representation for deciding the performances. The other parameters used in the experimental setup are described in below table 1.

Table 1. Experimental parameter values

Parameter	Value
Number of nodes	50
Simulation environment	1000*1000
Radio transfer range	250 m
Packet size	1024 bit
Send type	Constant
Simulation time	200 s
Mac layer	IEEE 802.15.4
Primary energy value	200-450 Jul

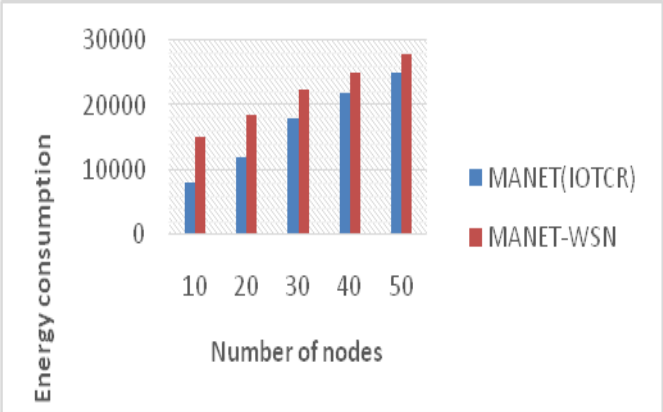

Fig 2. Energy consumption VS number of nodes

Above fig 2 illustrates the energy consumption achieved by each algorithm. The energy consumption is calculated initially with 10 nodes at each stage; the input nodes are increased in the count of 10 and the observations are noted. The X-axis describes the number of nodes inputted in the experiments, and Y-axis represents the energy consumed by each set of nodes, respectively. The proposed MIOTCRenergy consumed for 10 nodes is 7500 sec, 20 nodes are 13000 sec, 30 nodes is 16000 sec, 40 nodes are 22000 sec, and 50 nodes is 25000 sec. Whereas MANET-WSN energy consumed for 10 nodes is 15000 sec, 20 nodes are 18000 sec, 30 nodes are 23000 sec, 40 nodes is 25000 sec, and 50 nodes is 26000 sec. This graphical representation clearly shows energy consumed by the proposed MIOTCR is minimum than the MANET-WSN. Thus proves the proposed system performance efficiency in the term of energy consumptions

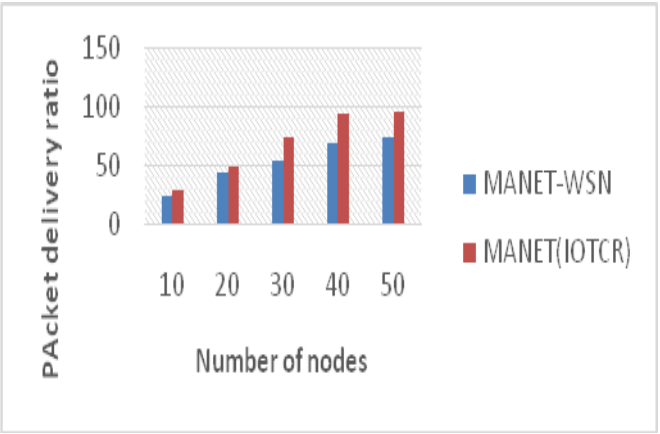

Fig 3. Packet delivery ratio (PDR) VS number of nodes

Above fig 3 illustrates the Packet delivery ratio (PDR) achieved by each algorithm. PDR determines the ratio of successful packet delivery in comparison to the total packets transmitted within the time. The PDR is calculated initially with 10 nodes at each stage; the input nodes are increased in the count of 10, and the observations are noted. The X-axis describes the number of nodes inputted in the experiments, and the Y-axis describes the PDR achieved by each set of nodes. The proposed MIOTCRachieved PDR for 10 nodes is 25%, 20 nodes are 18%, 30 nodes are 75%, 40 nodes are 90%, and 50 nodes are 94%. Whereas MANET-WSN PDR for 10 nodes is 22%, 20 nodes are 42%, 30 nodes are 56%, 40 nodes are 70% and 50 nodes is 68%. This graphical representation clearly shows that PDR achieved by the proposed MIOTCR is far better than the MANET-WSN.

V. CONCLUSION

In this paper, MIOTCR (MANET-IoT Clustering Routing Algorithm) is proposed for attaining a better data routing path. The main motto of this paper is to enhance the energy performance of IoT with MANET. For this cluster-based network model is introduced, which makes the network transmission free from the complex process. The combined approach of CA with CH makes the transmission more effective and stable than the earlier mechanisms. The hierarchical sub-ordinate in heading the transmission attains a more successful rate than the other algorithms. To prove the performance of the proposed work, a comparison is made between the proposed MIOTCR with MANET-WSN in terms of energy consumption and packet delivery ratio. From the observation, it is clearly shown that the proposed MIOTCR is far better than the MANET-WSN. The hieratical and chain selection process in CH achieves quick transmission with a highly successful packet delivery rate

REFERENCES

[1] (IOT): A vision, architectural elements, and future directions, Future Generation Computer Systems, 29(7) (2013) 1645–1660.

[2] ITU-T/Recommendation Y.2060, Overview of the Internet of Things, available at: https://www.itu.int/rec/T-REC-Y.2060-201206-I, 2013

[3] M. B. M. Kamel, I. Alameri, A. N. Onaizah, STAODV: A Secure and Trust based Approach to Mitigate Blackhole Attack on AODV based MANET, IEEE 2nd Advanced Information Technology, Electronic and Automation Control Conference, (2017) 1278-1282.

[4] Z. Hussain, R. Balakrishna, A survey on Manets-Types, Characteristics, Applications and Protocols used, National Conference on Frontiers and Advances in Information Science and Technology, (2013).

[5] Kumar, S. Kumar, Study of MANET: Characteristics, Challenges, Application and Security Attacks, International Journal of Advanced Research in Computer Science and Software Engineering, 3(5) (2013) 252-257.

[6] S. Agrawal, M. Lal Das, Internet of Things — A Paradigm Shift of Future Internet Applications, Nirma University International Conference on Engineering; (2011) 1–7.

[7] P. Suresh, J. Vijay Daniel, V. Parthasarathy, R. H. Aswathy, A State of the Art Review on the Internet of Things (IoT) History, Technology and Fields of Deployment, International Conference on Science Engineering and Management Research, (2014) 1–8.

[8] P. Bellavista, G. Cardone, A. Corradi, L. Foschini, Convergence of MANET and WSN in IoT Urban Scenarios, IEEE Sensors Journal, 13(10) (2013) 3558-3567.

[9] G. S. Yovanof, G. N. Hazapis, An Architectural Framework and Enabling Wireless Technologies for Digital Cities & Intelligent Urban Environments, Wireless Personal Communications, 49(3m) (2009) 445-463.

[10] N. Bessis, F. Xhafa, D. Varvarigou, R. Hill, M. Li, (eds), Internet of Things and Intercooperative Computational Technologies for Collective Intelligence, Springer-Verlag, (2013).

[11] S I. A. Alameri, MANETS and Internet of Things: The Development of a Data Routing Algorithm, Engineering, Technology & Applied Science Research, 8(1) (2018) 2604-2608

[12] Yalda Akbari &Shayesteh Tabatabaei, A New Method to Find a High Reliable Route in IoT by Using Reinforcement Learning and Fuzzy Logic, Springer Science +Business Media, LLC, part of Springer Nature 2020,https://doi.org/10.1007/s11277-020-07086-8

[13] Li, G., Zhang, D., Zheng, K., Ming, X., Pan, Z., & Jiang, K. A kind of new multicast routing algorithm for application of Internet of Things. Journal of Applied Research and Technology, 11 (2013) 578–585.

[1]

[14] Qiu, T., Lv, Y., Xia, F., Chen, N., Wan, J., &Tolba, A. ERGID: An efficient routing protocol for emergency response Internet of Things. Journal of Network and Computer Applications, 72 (2016) 104–112

[15] Surendiran,R., Similarity Matrix Approach in Web Clustering. Journal of Applied Science and Computations (JASC),5(1) (2018) 267-272.
DOI:16.10089.JASC.2018.V5I1.140146.22858

[16] Surendiran, R., Rajan, K.P. and Sathish Kumar, M., Study on the Customer targeting using Association Rule Mining. International Journal on Computer Science and Engineering, 2(7) (2010) 2483-2484.