IJCSE International Journal of Computer Sciences and Engineering Open Access
Research Paper Vol.-6, Issue-6, Jun 2018 E-ISSN: 2347-2693

An Energy Efficient Hierarchical Routing Protocol in IoT

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Available online at: www.ijcseonline.org

Accepted: 15/Jun/2018, Published: 30/Jun/2018

***Abstract*—** Internet of Things (IoT) can possibly enhance the way we associate with things. IoT imagines the possibility of all-inclusive availability of everything which is characterized as the worldwide system of remarkably identifiable and addressable savvy things representing the capacity to interface and speak with other brilliant things. Each savvy protest comprises of a chip, handset module, sensors and power source. The greater part of the circumstances these frameworks need to manage low power and lossy systems (LLNs), where nodes have restricted memory, preparing capacity, and power. In any case, stringent Quality of Service (QoS) is required which is trying to give as the sensors are interconnected utilizing lossy connections. A routing protocol is required as these devices can be scattered in a spontaneous way. In this paper a novel hierarchal routing protocol has been proposed and compared with existing TEEN routing protocol. The proposed mechanism is implemented using MATLAB 2017 and compared with existing TEEN routing protocol.

***Keywords*—** IoT (Internet of Things), Energy, Routing, Cluster, Cluster head and TEEN (Threshold Sensitive Energy Efficient Sensor Network Protocol).

I. INTRODUCTION

The Internet of Things (IoT) is a worldview that has increased greater notoriety as of late. At a calculated level, IoT alludes to the interconnectivity among our regular devices, for example, PCs, workstations, tablets, advanced cells, PDAs, and other hand-held installed devices as appeared in fig.1. These devices currently convey sagaciously to each other. Besides, associated devices furnished with sensors or potentially actuators see their environment, comprehend what is happening, and perform likewise. These interconnected gadget systems can prompt an expansive number of clever and self-ruling applications and services that can bring critical individual, professional, and monetary advantages bringing about the rise of more information driven organizations[1][2]. IoT devices need to make their information available to invested individuals, which can be web services, advanced mobile phone, cloud asset, and so forth. Subsequently, IoT can't be viewed as individual frameworks, yet as a basic, incorporated foundation whereupon numerous applications and services can run. A few applications will be customized, for example, digitizing day by day life exercises, others will be citywide, for example, proficient, sans delay transportation, and others will be overall, for example, worldwide conveyance frameworks. The objective of the Internet of Things is to empower things to be associated whenever, wherever, with anything and anybody in a perfect world utilizing any way/arrange and any service. Internet of Things is another upset of the Internet. Items make themselves unmistakable and they acquire insight by settling on or empowering setting related choices because of the way that they can impart data about themselves and they can get to data that has-been collected by different things, or they can be parts of complex services[3].

Fig. 1 Internet of Things[3]

A. CHALLENGING ISSUES

With progress of internet innovation and improvement of informal community, it is sensible to expect that another age of Internet (likewise called future Internet) that will show up sooner rather than later. In, a few key specialized issues of IoT were brought up. These difficulties and open issues clear up that the issue of current Internet design requires incredible endeavors to change[4].

- Security: Security giving may be troublesome as the robotization of the devices has been expanded which made new security issues.

- Data management: As the correspondence between the devices is being done, each day between the devices part of information is being produced and there is parcel of data to be exchanged starting with one place then onto the next. Should check whether the correct information is being exchanged or not. Information administration assumes an essential part in IOT.

- Storage management: As there is huge measure of information produced. At the point when the devices are being associated there would be a lot of interactive media information which is being exchanged they possess a lot of information and the other kind is arbitrary records where the it contains information with respect to the devices these documents doesn't involve an immense measure of room yet they are substantial in number they should be available rapidly at whatever point essential.

- Server technologies: As the quantity of devices over the system region expands the demand and the quantity of reactions of the gadget additionally increments in the meantime it thoroughly relies upon the server where we are running the interface. Reaction of the server to the demand of the gadget ought to be done rapidly. There ought to be no deferral in the reaction to the customer.

- Insecure authentication/authorization: We give validation to give consent to the client, to get to the data and approval is utilized to alter or change the information for that specific application and authorization will be given by the head [5].

II. RELATED WORK

There exist numerous accessible protocols for IoT systems. In this area, three cases of such routing protocols are exhibited.

- 6LoWPAN - IPv6 more than 802.15.4 [6] is intended to stretch out IPv6 systems to IoT systems. The benefits of this approach is the likelihood of re-utilizing existing IPv6 innovations a frameworks. Be that as it may, this sort of system is initially intended for figuring devices with higher handling capacity and memory assets which isn't appropriate for IoT organize substances.
- RPL - IPv6 Routing protocols for Low Power and Lossy Network [7] This protocol writes are intended for arrange containing limitation devices in control, calculation capacity and memory. Along these lines the information transmission in this kind of systems are questionable and have low information rate yet high misfortune rate.
- Compelled Application Protocol(CoAP) [8] The most noticeable component in this sort of routing protocols is the capacity of meaning HTTP message in order to coordinate with web services. The protocol additionally bolster multicast with minimal overhead.

III. PROPOSED WORK

Hierarchical routing is an effective method to bring down vitality utilization inside a cluster, performing information collection and combination with a specific end goal to diminish the quantity of transmitted messages to the Base Station. In a hierarchical engineering, higher-vitality nodes can be utilized to process and send the data, while low-vitality nodes can be utilized to play out the detecting in the vicinity of the objective. The making of clusters and relegating uncommon errands to cluster heads can enormously add to general framework adaptability, lifetime, and vitality productivity. Hierarchical routing is primarily two-layer routing where one layer is utilized to choose cluster heads and the other for routing. Be that as it may, most strategies in this class are not tied in with routing, yet rather "who and when to send or process/total" the data, channel portion, et cetera, which can be orthogonal to the multihop routing capacity.

Existing routing protocol:
TEEN (Threshold Sensitive Energy Efficient Sensor Network Protocol) is appropriate for time basic applications and is additionally very effective as far as vitality utilization and reaction time. Teenager is a hierarchical clustering protocol, which bunches sensors into clusters with each drove by a CH. The sensors inside a cluster report their detected information to their CH. The CH sends collected information to more elevated amount CH until the point when the information achieves the sink. Accordingly, the sensor organize engineering in TEEN depends on a hierarchical gathering where nearer nodes shape clusters and this procedure goes on the second level until the BS (sink) is

come to. Adolescent uses an information driven technique with hierarchical approach[9].

Proposed Algorithm

Step1: Path construction- :

There are 4 chains in our proposition so chain development happens in following way.

1. BS sends hello parcel to every one of the nodes to get data from the all considerable number of nodes.
2. BS finds the most far away remote node by looking after the distance comparison from itself.
3. The chain development begins from the farthest remote node that is otherwise called as end nodes. The end node finds the closest node from itself.
4. Therefore, every node finds the separation amongst itself and the closest node that is not associated in chain and after that link with it by following the similar approach.
5. In the chain, every node receiving end is known as parent node while sending nodes is called as child node. A similar procedure of chain development rehashes in each of the 4 areas and in this way, 4 chains are made.

Step2: Region head selection- :

1. Each active node on the network will have to calculate the basic prestige factorδ.
2. Each node calculates δ by dividing leftover energy with its distance from BS.

$$\delta = \frac{L_e}{D_{bs}}$$

3. Prestige factor of each node has been observed by the network.
4. With having the highest prestige factor δ value among those nodes is considered as winning region head.

Step3: Sub-sink trajectory- :

1. In this proposed work it has been assumed that sink or BS is the main station which is capable enough with all resources like power, internet connectivity etc.
2. For the purpose of mobility in the network presence of sub-sink has been assumed which also have enough resources with internet connectivity and capabilities.
3. For each region sub-sink will collect all the data from the respective region head nodes and immediately send it to the main cloud of the network which is handled by the BS, the one round process will be completed when BS has all four regions data.
4. We consider that sink has enough power and its portability to boost the system lifetime.
5. Sink moves in a settled direction over pre-calculated trajectory. It has to stay in each region for limited time, Total time for one iteration of all regions is knows as Stay-Alive time S_t . Where r is number of regions and $\theta_r$is the TTL time for one region

$$S_t = \sum_{r=1}^{4} (\theta_r)$$

6. Sub-sink trajectory will be calculated according to the nodes placement locations here we are assuming the even node placement in the region. Calculated trajectory coordinates will be like (x_{r1} , y_{r1}), (x_{r2} , y_{r2}), (x_{r3} , y_{r3}), (x_{r4} , y_{r4}) because assumed regions are four.

$$C_{Traj} = \{2 * N_r\} + S_p$$

Where $C_{Traj}$is the current position of the sub-sink ,S_p is considered as initial position of the sub-sink and N_r is considered as Length of network. For each round sub-sink trajectory can be calculate by the above equations.

7. For each region sub-sink will be considered as main collector point which collect each nodes data in the form of chain where parent node collect data from the child and finally deliver at the sub-sink.

IV. RESULTS

MATLAB 2017 is used to analyze the performance of proposed mechanism with different performance parameters such as dead nodes, packet count rate and compared with existing routing such as TEEN routing protocol.

Table 1 Simulation parameters table

Sr. No.	Parameters	Value
1.	Network size	100m*100m
2.	Number of nodes	100
3.	Packet size	2000 bits
4.	Iterations	5000
5.	Initial energy of nodes	0.5 J
6.	Range	25 m
7.	E_{elec}	50nJ/bit
8.	E_{fs}	10pJ/bit / m 2
9.	E_{mp}	0 .0013pJ/bit / m 4
10.	E_{DA}	5nJ/bit

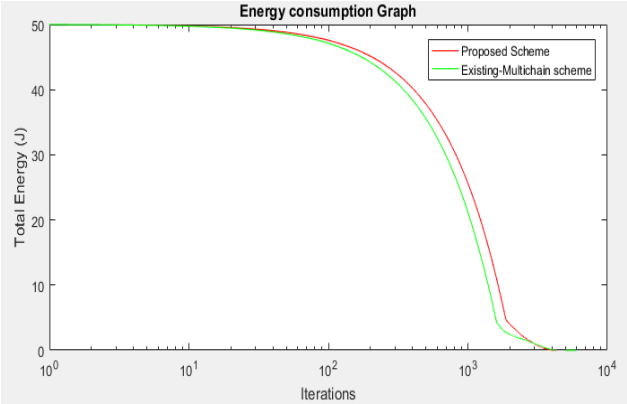

Fig.2 Energy consumption graph

Fig.2 depicts energy consumption graph, it shows the optimized energy consumption of the proposed scheme. In the figure it's clearly shown that the proposed scheme utilizes network energy in very optimized way.

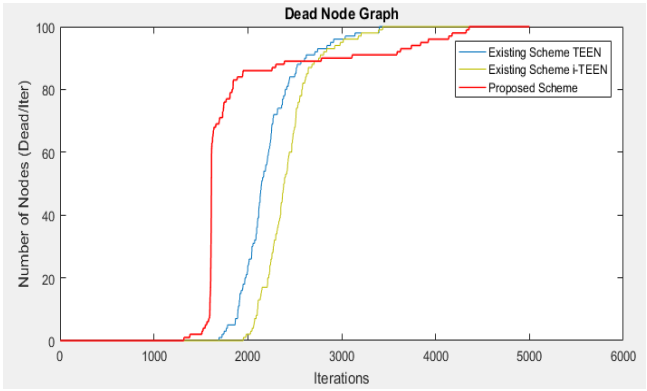

Fig 3 Dead node Graph

Fig. 3 illustrates the dead node graph of the proposed schemes and compares its performance with various existing schemes. Figure shows that initially proposed scheme performs in very stable manner till 1500 rounds. With the proposed scheme network works for 4300 lifetime. From the graph it has been illustrated that proposed scheme works around 1200 iterations more as compared to the various proposed schemes that shows its efficiency.

V. CONCLUSION AND FUTURE SCOPE

In this paper an energy efficient Hierarchical routing protocol has been presented to reduce number of dead nodes and increase packet count rate during data transmission in IoT. In proposed mechanism number of dead nodes are less as compare to existing technique, packet count rate is high as compare to other techniques where as energy consumption is optimized as compare to existing technique.In future it is intended to exploit the advantages of heterogeneity and we will likewise propose upgrades of end to end delay, information pressure systems, parcel conveyance proportions and throughput parameters, to accomplish a more effective condition in IoT.

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Mr. Naresh Kumar currently working as assistant professor in UIET, kurukshetra university from past 12 years and specializes in computer engineering.

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