Threshold Sensitive Energy Efficient Protocolin IoT

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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 an existingThreshold Sensitive Energy Efficient Sensor Network Protocol (TEEN) routing protocol. The proposed mechanism is implemented using MATLAB 2017 and compared withan existing TEEN routing protocol.

Keywords*— IoT, Energy, Routing, Cluster, Cluster head and TEEN.

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 devicesas appeared in fig.1. These devices currently convey sagaciously to each other. Besides, the associateddevices 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 not 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 [3]. The objective of the IoT is to empower things to be associated whenever, wherever, with anything and anybody in a perfect world utilizing anyway and any service [4]. IoT 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[5].

Fig. 1 Internet of Things[5]

A. Challenging Issues

With the progress of internet innovation and improvement of the informal community, it is sensible to expect that another age of the Internet (likewise called future Internet) that will show up sooner rather than later [6]. 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 [7].

- 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 the 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 [8].
- Storage management: As there is a 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 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 number of reactions of the gadget additionally increments in the meantime it thoroughly relies upon the server where we are running the interface. The reaction of the server to the demand for the gadget ought to be done rapidly. There ought to be no deferral in the reaction to the customer [9].

II. RELATED WORK

Wei et al.[10], Introduced and dissected the data innovation in building vitality sparing. In this paper, in view of remote sensor

systems, using Internet of Things innovation, a complete examination of building vitality utilization on smart building automation frameworks and hardware, make full utilization of the inherent focal points of sensor systems collecting environmental data on vitality utilization, proposed a design structure in light of incorporated administration of building energy utilization checking and investigation framework through Internet of Things, to improve the part of thoughts for the level of building vitality sparing technologies. For building vitality saving money on the demand for astute building vitality observing, creator proposed a framework structure of Building Energy Monitoring and Analysis System in view of the Internet of things, which has some edifying in Building vitality utilization advance to achieve ongoing observing and control, and enhance the energy-sparing of canny building.

Sun et al. [11], proposed a vitality proficient administration structure to give acceptable QoI involvement in IoT proposed conspire is straightforward and perfect to bring down protocols being used, and saved vitality effectiveness over the long haul without relinquishing any accomplished QoI levels. Specifically, first presented the new idea of QoI mindful "sensor-to-assignment importance" to expressly consider the detecting capacities offered by a sensor to the IoT sensory conditions, and QoI requirements required by an errand. Second, proposed a novel idea of the "basic covering set" of any given undertaking in choosing the sensors to service an assignment after some time. Third, vitality administration choice is made powerfully at runtime, as the ideal for long haul movement measurements under the imperative of the service delay. At last, a broad contextual analysis in view of using the sensor systems to perform water level checking is given to exhibit the thoughts and calculations. Proposed conspire didn't give any instrument that portrays how the framework learns and keeps up the assignment model and how delicate the relating calculations are to the exactness of the model. Proposed plot works just in incorporated system condition not in conveyed.

Yu and Penget al. [12], concentrated on RFID routing in the internet of things. In light of settings of ongoing insightful RFID node, evaluation of data and setting mindful registering make RFID routing has capacity of awareness. The characters of RFID and remote sensors are particularly fit for setting mindful registering. Setting delicate framework has a capacity of dynamic processing, to be specific currently acquiring settings and choosing acceptable behavior as indicated by the got data following stage. Setting touchy figuring consolidates the data of client and condition into the state space of RFID node, which influences RFID node to dispose of the customary mode and fabricates a scaffold amongst virtual and genuine world.

Chen et al.[13],chooses the setting attention to be the examination cornerstone as the intersection of the IoT thought and WSN innovation. The protocol CASCR (Context-Awareness in Sea Computing Routing Protocol) is presented in this paper on going for the existent issues in the current WSN routing protocol. Some advancing impact reference esteem and logical premise to some degree will be acquired the space of the IOT.Context data will turn out to be increasingly essential with the improvement of IOT, in light of the fact that we won't fulfill by social affair the information, however knowing the importance of the information.

In view of the Sea Computing model, they changed the customary routing thought into a positive unsurprising routing protocol with utilizing fluffy match hypothesis of man-made consciousness and Markov likelihood demonstrate, which contain some sending and order meaning.

Ali and Elkheir [14], discussed the lifecycle of IoT information that will shape the development of information administration arrangements and after that outline the current strategies that are utilized for vitality productive data management answers for IoT or IoT sub-systems. Here creator likewise plot a few issues that need top to bottom answers for vitality proficient IoT information administration arrangements. Creator just examined existing information administration procedures and issues didn't give any system that had prevalent highlights at that point existing methods.

III. ROUTING PROTOCOLS

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 [15] is intended to stretch out IPv6 systems to IoT systems. The benefits of this approach are the likelihood of re-utilizing existing IPv6 innovations frameworks. Be that as it may, this sort of system is initially intended for figuring devices with higher handling capacity and memory assets which aren't appropriate for IoT organize substances.
- RPL - IPv6 Routing protocols for Low Power and Lossy Network [16] This protocol writes are intended forarrangingto contain 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) [17] 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 bolsters multicast with minimal overhead.
- LEACH

  The Low Energy Adaptive Clustering Hierarchy (LEACH) [18] is a clustering based hierarchical routing protocol. A few of the sensor nodes in the LEACH protocol are randomly selected as cluster leaders. The main purpose of this selection is to ensure that the energy of the sensor nodes is used equally. Another task of sensor nodes that are cluster leaders is to collect information from nodes in the environment and transmit them to the base station. The LEACH protocol assumes that all sensor nodes have equal energy at each step and nodes consume equal energy. The LEACH protocol consists of two phases, the establishment phase of the network topology and the persistent state phase. In the first stage, clusters are created, the cluster leader is determined, while in the second stage, data transmission takes place. Due to the design of the LEACH protocol, there are many disadvantages [19]. These are listed below. LEACH assumes that each sensor node will pass directly to the base station or cluster head with a single hopper. Hence, it cannot be used in applications where sensor nodes are deployed in large areas. The idea of dynamic clustering in the LEACH protocol, which should be the main aim of reducing energy consumption, places an additional burden on cluster leaders. Since Cluster Leaders are randomly selected, several cluster leaders may be found in the same area, while in some areas cluster leaders may be few[20]. This prevents network communication. LEACH assumes that every sensor node consumes the same energy in each selection cycle. But it also includes cluster leaders. They acknowledge that each cluster leader is consuming equal energy [21].

- PEGASIS
  Power-Efficient Gathering in Sensor Information Systems (PEGASIS) [22] is a chain-based hierarchical routing protocol in sensor information systems. It presents an approach based on accepting the closest neighbors of sensor nodes as base stations and communicating with these nodes [23]. If the sensor node can not reach its nearest neighbors, it changes its frame and identifies another nearby neighbor and accepts it as a base station. The PEGASIS protocol aims to increase the total energy of the network as a result of cooperation in the network, and to prevent unnecessary traffic in the network due to the proximity of the neighbor. The nearest neighbors determined by the signal power form a chain-like path. Thus, a chain-like path occurs up to the base station, from which the closest sensor nodes are formed. Due to the design of the PEGASIS protocol, there are some disadvantages [24]. These are listed below. PEGASIS assumes that each sensor node is in communication with the base station, but in practice, the sensor nodes may need to jump more than once to reach the base station. PEGASIS assumes that all sensor nodes have the same level of energy and that their energy will be consumed at the same time. Because of the chain logic in PEGASIS, remote nodes can send their data with too much delay [25]. Also, if the base station is seen by the sensor nodes, this causes the nodes in the network to waste energy and use the network unnecessarily [26].
- TEEN
  Threshold-sensitive Energy Efficient Sensor Network Protocol (TEEN) [27-29] is a threshold-based hierarchical routing protocol. It is recommended for applications where time is important. In the TEEN protocol, the sensor nodes are functioning in the network according to their energy levels. A sensor node in a high energy state can both sense and route, while sensor nodes in a lower state are only detecting. Some disadvantages of the TEEN protocol are given below. A node can wait for its time slot for data transmission. If the node does not have the data, the repetitive time slot can be wasted. Transceivers are always open because cluster leaders always expect data from nodes [30].
- APTEEN
  Adaptive Periodic Threshold-sensitive Energy Efficient Sensor Network Protocol (APTEEN) [31] is a threshold-based hierarchical routing protocol such as the TEEN protocol. The energy level is made dynamic in the APTEEN protocol[32]. Therefore, the energy level can be determined according to the application requirements. APTEEN is suitable for time-critical applications such as environmental monitoring. Some disadvantages of the APTEEN protocol are given below. Creating clusters at multiple levels causes additional complexity 33]. At the same time, the overhead is also increasing as the threshold based functions are increased [34].

A. Factor Affecting Routing

- Node deployment:Unlink traditional systems where organize topologies are resolved at the start of system development. Node arrangement in WSNs is either deterministic or randomized. In deterministic application, organize topologies are chosen ahead of time and remain about the same amid their lifetime and subsequently information can be steered through pre-decided ways [35]. Nonetheless, in the randomized organization, sensor nodes are arbitrarily scattered making an obscure and precarious system topology. Information routing in this sort of node organization intrinsically have no earlier learning of system and accordingly requires handling all the more routing information [36].
- Energy Consumption without losing precision: Energy utilization is a major worry in WSNs because of sensor nodes constrained the supply of vitality [37]. Subsequently, the routing protocols are requiring amplifying the vitality moderating type of interchanges and calculations to draw out the battery lifetime. Anyway, these kinds of correspondences calculations still give the required precision of routing protocols. The second part of vitality worry in WSNs is to keep up the precision of routing protocols in the nearness of low power sensor nodes [38]. As sensor nodes can go about as senders, beneficiaries or switches. A breaking down of some sensor nodes because of intensity disappointments can cause topology changes or miscommunication or erroneous conclusion in building routing ways. Along these lines routing protocol ought to know about and get ready to deal with this conceivable issue [39].
- Network Dynamic: Like are traditional systems, the vast majority of WSNs comprising stationary sensors nodes. Nonetheless, there existsa dynamic system in WSNs, for example, WSNs target identification or following applications. Routing messages in this sort of unique systems are more difficulties due to rapidly changing routing way[40]. In powerful systems methodology for routing protocols is to just produce routing way on request. Because of the precariousness of the system, pre-computing routing way isn't of significance as the pre-ascertained way might be of no utilization when they are required [41].
- Fault Tolerance: WSNs are characteristically inclined to disappointment due to for instance absence of intensity, physical harm or ecological obstruction. Notwithstanding of the various measures of sensor nodes in a few applications, the disappointment of a certain number of sensor nodes can extraordinarily diminish and influence the execution of the entire system. For instance, parcels should have been directed through a long way; an entire system is isolated into two sections. In this way, routing protocols should contemplate some adaptation to internal failure system if there should arise an occurrence of unforeseen disappointment. For instance, giving greater need to routing way with all the more residual vitality or rapidly recognizing the disappointment of specific nodes to suggested options routing ways[42].
- Scalability: WSNs are probably going to be extended now and again. For instance, an organization may convey a system of around a hundred sensor nodes in the first place and afterward extend the system to the number of thousands of sensor modes a short time later. Subsequently routing protocols ought to be intended to work not just in connect with a modest number of sensor nodes yet additionally in coordinate with a bigger measure of sensor nodes [43].

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 number 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 multi-hop 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. A 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 a 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

Stage 1: Path construction- :

There are 4 chains in our proposition so chain development happens in the 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 the 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 asa child node. A similar procedure of chain development rehashes in each of the 4 areas and in this way, 4 chains are made.

Stage2: 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.

Stage3: 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 the 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 a limited time, Total time for one iteration of all regions is known 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. The 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 posititheon of the sub-sink and N_r is considered as Length of network. For each the the the roundsub,-sin,k trajectory can be calculate by the above equations.

7. For each region, sub-sink will be considered as main collector point whichcollectseach node's data in the form of the chain where parent node collects data from the child and finally deliver at the sub-sink.

IV RESULTS

MATLAB 2017 is used to analyze the performance of the 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	Initial Values
1.	Network size	100m*100m
2.	Number of nodes	100
3.	Packet size	2000 bits
4.	Iterations	5000
5.	The 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

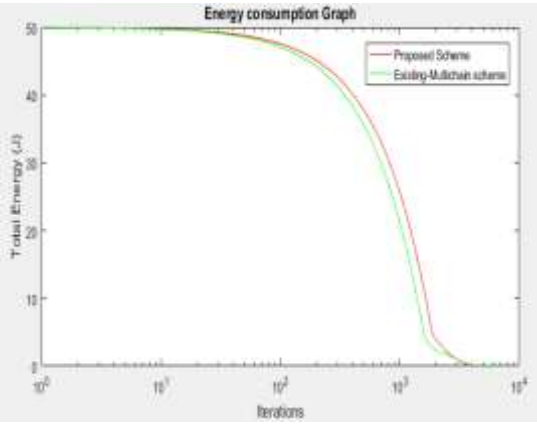

Fig.2 Energy consumption graph

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 a very optimized way.

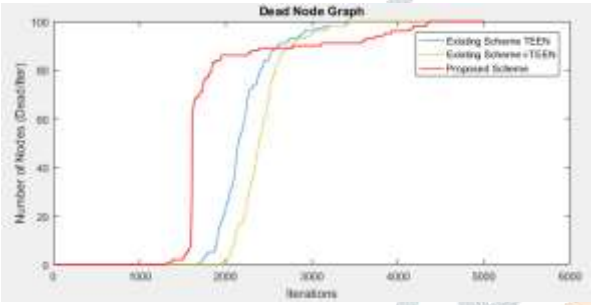

Fig 3 Dead node Graph

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

V. CONCLUSION AND FUTURE WORK

In this paper, energy efficient Hierarchical routing protocol has been presented to reduce the number of dead nodes and increase packet count rate during data transmission in IoT. The proposed mechanism in which contact of IoT objects aremeasured on the bases of their contact, next forwarded object may be selected to increase delivery ratio. In theproposedmechanism,a number of dead nodes are less as compare to existing technique; packet count rate is high as compare to other techniques whereasthe proposed scheme utilized energy in an optimized way.In future, it is intended to exploit the advantages of heterogeneity and will likewise propose upgrades of an 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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