Journal of Advances in Science and Technology
Vol. 14, Issue No. 1, June-2017, ISSN 2230-9659

Energy Efficient Routing Protocol for Wireless Sensor Nodes in Internet of Things

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Abstract – The Wireless Sensor Network (WSN) is mostly used to obtain the information. The main important problem is energy efficiency which is vital factor for deciding the long running operations of WSNs. The Wireless sensor network (WSN) is nothing but group of large number of low power and tiny sensor devices those are deployed manually or randomly over the network. WSNs are widely used in the real life applications such as disaster monitoring systems, health care systems, security systems; environment monitoring systems etc. But the main limitation of WSNs is limited energy resources of sensor nodes. The energy efficiency becomes challenging research problem for achieving the longer operation of sensor networks. There are different solutions have been presented for energy efficiency based on hardware and software. The existing clustering methods having drawbacks like cluster heads suffered from excessive energy consumption due to all loads on it, therefore this can be later overcome by placing the gateways in WSNs which can acts cluster head with more energy sources in it. To overcome these problems, we attempt to present novel scalable and energy efficient routing protocol for WSN in IoT applications. We are presenting the novel energy efficient and QoS efficient routing method for WSNs based on gateway based clustering approach and improved particle swarm optimization (PSO) methods. The Particle swarm optimization (PSO) based clustering method is proposed to achieve both energy efficiency and load balancing in WSNs. The proposed IPSO based clustering routing protocol is work with efficient method of particle encoding and fitness function.

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1. INTRODUCTION

The Wireless sensor network (WSN) has emerged as a technology of choice for several applications due to the significant advancement in micro electro mechanical system (MEMS) based low-cost, small sized intelligent sensors, low power and highly integrated digital electronics and wireless communication technology. WSN consists of large number of autonomous battery-powered multi-functional sensor nodes, also known as motes (Ray & De, 2016). A WSN node typically consists of a sensor, processor which could be a microcontroller, digital signal processor (DSP), field programmable gate array (FPGA) or application specific integrated circuit (ASIC), transceiver, power source and radio. The focus is on three important subsystems used for sensing, processing, and communicating. These motes are densely deployed to measure a given physical environment. Different mechanical, thermal, biological, chemical, optical and magnetic sensors may be attached to the mote to measure properties of the environment (Siavoshi, et. al., 2016). Due to the limited capability and accessibility of motes, a radio is implemented for wireless communication to transfer the sensed data to a base station usually located in a remote site for further processing.

A large number of applications have been proposed for WSN. These applications are mostly related to tracking and monitoring of some physical phenomenon. Monitoring applications include environment monitoring, health monitoring, pipeline monitoring of water, oil and gas, seismic and civil structure (buildings, bridges etc.) monitoring. Tracking applications include tracking vehicles, animals, humans and other objects. For WSN, energy efficient is very important to work longer for such remote monitoring applications (Xiang, 2016).

A wireless Sensor Networks (WSN) consists of different sensor enable nodes which are distributed in an environment and use batteries as energy resource. These tiny sensor nodes, which consist of sensing, data processing, and communicating components, result in the idea of sensor networks based on collaborative effort of a large number of nodes. Figure 1 showing the general working of WSN in IoT applications. As showing in figure 1, the centralized gateway connect all the nodes in the network, its establish connection between network

nodes wirelessly (Ray & De, 2016). We can establish long distance and reliable connection with help of routers. This functional diagram in figure 2 is shows modular design approach which provides the flexible and versatile platform for the addressing the variety of IoT based applications needs. For the deploying the sensors in the network field the signal conditioning block can be reprogrammed or replaced. Wireless sensing node uses the different of sensor (Siavoshi, et. al., 2016). As per the given application the requirement of radio links may be swapped. For the bidirectional communication these application needs wireless range (Xiang, 2016).

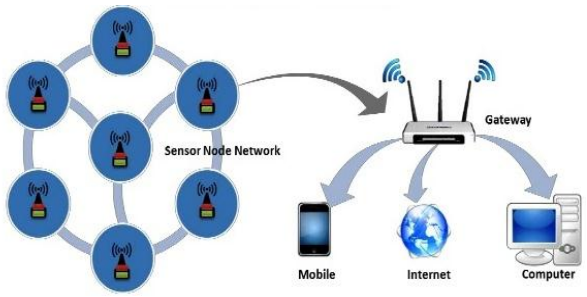

Figure 1: General Architecture of Wireless Sensor Network Communication in IoT

WSN has emerged as a technology of choice for IoT applications due to the significant advancement in micro electro mechanical system (MEMS) based low-cost, small sized intelligent sensors, low power and highly integrated digital electronics and wireless communication technology. WSN consists of large number of autonomous battery-powered multi-functional sensor nodes, also known as motes. A WSN node typically consists of a sensor, processor which could be a microcontroller, digital signal processor (DSP), field programmable gate array (FPGA) or application specific integrated circuit (ASIC) (Hu & Liu, 2017), transceiver, power source and radio. The focus is on three important subsystems used for sensing, processing, and communicating. These motes are densely deployed to measure a given physical environment. Different mechanical, thermal, biological, chemical, optical and magnetic sensors may be attached to the mote to measure properties of the environment (Helal & ElMougy, 2015) (Shen, et. al., 2017). Due to the limited capability and accessibility of motes, a radio is implemented for wireless communication to transfer the sensed data to a base station usually located in a remote site for further processing. There is large number of applications of WSN. These applications are mostly related to tracking and monitoring of some physical phenomenon (Farhan, et. al., 2017, John & Babu, 2017, Vikram, et. al., 2017, John, et. al., 2017). Monitoring applications include environment monitoring, health monitoring, pipeline monitoring of water, oil and gas, seismic and civil structure (buildings, bridges etc.) monitoring. Tracking applications include tracking vehicles, animals, humans and other objects.

For WSN, energy efficient is very important to work longer for such remote monitoring applications (Krishna, et. al., 2017). The fundamental goal of a sensor network is to produce, over an extended period of time, globally meaningful information from raw local data obtained by individual sensor nodes. Importantly, this goal must be achieved in the context of prolonging as much as possible the useful lifetime of the network and ensuring that the network remains highly available operating environment (anonymity of personage sensors, limited power resources and a possibly hostile environment), pose unique challenges to the designers of protocols. Therefore, in this research work we are presenting the novel energy efficient routing protocol for WSNs in IoT applications.

2. LITERATURE SURVEY

Anindita Ray, et al. (2016) introduced the vitality profitable gathering tradition in perspective of K-infers estimation named EECPK-suggests has been proposed for WSN where midpoint figuring is used to upgrade beginning centroid decision procedure. The proposed approach produces balanced packs to finally alter the stack of gathering heads (CHs) and draw out the system lifetime. It considers extra essentialness as the parameter despite Euclidean partition used as a piece of fundamental K-infers computation for legitimate CH assurance. Multi-bounce correspondence from CH centers to BS happens dependent upon their partitions from BS. Re-authorization result exhibits that the proposed approach beats Drain B, balanced parallel K-suggests (BPK infers), Stop's approach and Mk-infers with respect to organize lifetime and essentialness proficiency.

Saman Siavoshi, et al. (2016) spoke to an imaginative grouping convention of load adjusting which parts in the whole network to the variable sweeps of the viable circle. The author examines the convention; these are utilized for explore design in intra bunch communication. In that convention clarify the range of circle and size of every single bunch are ascending with the rising the separation from the base station that implies the measure of group of circle is particular from the bunch of another circle. In every single group, the parent hub is subject for coordinating and minimized information from their conventional adjoining hubs and sending to parent bunch.

Wei Xiang et.al (2016) enhances a vitality productive directing calculation for SDWSNs. In this advancement system, to make the network to work, control hub is distributed different works progressively. The choice of control hub develops the

NP-difficult Issue these are winning into examination of the remaining vitality of the hubs and the transference remove. To types of gear the NP-difficult issue, a successful PSO (molecule swarm enhancement) calculation is developed. The reproduction yield is show that the advancement calculation working better over the relative calculations of various plan.

Xiangdong Hu, et al. (2017) introducing vitality proficient multi-mode groups support (M2CM) strategy are proposed for limited and occasion driven technique. In this paper examine on the ordinary bunches support show with dependably occasionally re-grouped among the entire network style in light of time-trigger for various leveled WSNs. M2CM satisfy the all requests of bunches upkeep as versatile nearby support for the harmed groups as per its adjustments in time and space field. The triggers of M2CM incorporate such occasions as hubs lingering vitality being under the edge, the heap irregularity of bunch head, participate or leaving from any group for new hub or impair one, and so on**.**

Xuan Liu, et al. (2017) proposed a novel joint outline of sensor hubs bunching and information recuperation. Where the WSNs is sorted out in a two-layer way with their created bunching calculations and after that the missing information is recouped utilizing this two-layer structure system. The proposed grouping calculations are take both the vitality productivity and information guaging precision into thought and examine the exchange off between them. It depends on the key perception that the high vitality productivity of the networks which is accomplished by diminishing the separations among the hubs in a bunch and whiles the exactness of the estimating comes about is enhanced by expanding the relationship of the information stream among the hubs in a group.

Jian Shen, et al. (2017) showing Wireless sensor networks (WSNs) disperse hundreds to thousands of reasonable smaller scale sensor hubs in their districts, and these hubs are essential parts of Internet of Things (IOT). In WSN-helped IOT, the hubs are asset compelled from numerous points of view, for example, stockpiling assets, figuring assets, vitality assets, et cetera. Vigorous directing conventions are required to keep up a long network lifetime and accomplish higher vitality use. In this paper, we propose another vitality effective centroid-based steering convention (EECRP) for WSN-helped IOT to enhance the execution of the network. The proposed EECRP incorporates three key parts: another disseminated group arrangement procedure that empowers the self-association of neighborhood hubs, another arrangement of calculations for adjusting bunches and pivoting the bunch head in light of the centroid position to equally appropriate the vitality stack among all sensor hubs, and another component to diminish the vitality utilization for long-remove interchanges**.**

Rana Helal, et al (2015) displaying Internet of Things, it is required to encourage billions of heterogeneous sensors and actuators that help an extensive variety of uses. Expanding the use of these sensors is pivoted upon the capacity to find their abilities (ex: estimated qualities, area, precision, and so on.). This procedure is known as Administration Revelation (SD), and can have a nearby extension (SD inside a limited region), or a worldwide degree. Generally, SD is performed utilizing a devoted passage that is constantly dynamic and associated with the Internet. This entryway stores the properties of sensors inside its zone. In any case, this approach might be excessively costly within the sight of billions of sensors. In this paper, a novel convention for nearby SD is recommended that dispenses with the requirement for a committed portal. The convention uses a multi-level network design with a specific end goal to accomplish two principle targets: vitality productivity and high achievement rate in fulfilling administration demands**.**

Laith Farhan, et al. (2017) portray Internet of Things (IOT) is winding up increasingly unavoidable in regular daily existence and associating a variety of various physical items. It is quickly developing and accepting a colossal measure of research center. Billions of items convey each other with or without human intercession to accomplish brilliant applications. The majority of the associated gadgets are compelled hubs to its ecosystem which have constrained recollections, CPU capacities and power sources. In this way, to implement independent brilliant systems, proficient vitality utilization is basic. This paper presents a novel planning calculation called Long Jump (LH) first to enhance vitality utilization on a Wireless Sensor Network (WSN) that empowers IOT system. LH calculation plans high need for bundles accompanying more jumps and longer separations to be served first at the bunch head (CH) hubs of the WSN. Since these parcels require more connections and hubs (in this way expanded vitality and transfer speed utilization) to achieve a definitive goal if not organized, the proposed calculation diminishes the general vitality use and limits the aggregate number of bundles re-transmission and the viable information transmission separations. This enhances the general system execution and stretches the network lifetime.

Aniji John, et al. (2017) describe the Wireless sensor networks (WSN) is the key resource of perception and is widely used in the systems based on Internet of Things (IOT). The smart sensor nodes are used in applications like infrastructure monitoring, medical health care systems, etc. But these nodes are energy constraint devices. Efficient clustering and proper cluster head (CH) selection schemes are required, in order to improve energy saving of sensor nodes. In this paper, dynamic CH selection method (DCHSM) is used where CHs are selected in two

phases. This algorithm improves energy saving on large scale thus can be used for IOT applications. Initially, Voronoi diagram is used to divide the monitoring area in polygonal shaped clusters. Then, CH election is performed in two phases. First class of CH is elected based on perceived probability and the second class is elected on the basis of survival time estimation. Simulation analysis show that DCHSM outperforms the conventional methods in terms of network lifetime**.**

G. Raja Vikram, et al. (2017) displaying Multicast Correspondence assumes a critical part in a large portion of the asset obliged networking conditions, for example, Wireless Sensor Networks (WSN), Internet of Things (IOT). Correspondence in WSN is confined by vitality, calculation and memory capacities of sensor hubs. Planning an effective directing calculation to accomplish correspondence between Stationary Base station (BS) and a group of sensor hubs in a particular area requires the base station to send singular messages to all sensor hubs. This approach devours a lot of vitality and data transmission. An assortment of calculations exist to address this issue by isolating the sensor hubs into groups. Each group is observed by a Bunch Head (CH), in charge of social affair and accumulating information to send the same to the BS. In this paper, we checked on existing grouping strategies and propose an unequal bunching based plan. This enables the BS to convey a multicast message to bunch individuals and in addition a group make a beeline for speak with other group individuals. The outcomes demonstrate that our approach enhances network lifetime.

Aniji John, et al. (2017) concentrating on Internet of things (IOT) associates the innovations which incorporates detecting, correspondence, networking and distributed computing in wide achieving detecting an area. The most appropriate foundation for IOT applications so as to screen the network is wireless sensor networks (WSN). With the point of expanding the lifetime of sensor hubs conveyed for detecting, vitality proficient bunch head (CH) determination plans are produced. Vitality sparing of these sensor hubs are unavoidable to stay away from brisk battery deplete. Along these lines, a vitality sparing CH choice (ESCHS) strategy is advanced to enhance the network lifetime of the systems created for IOT applications. This technique makes utilization of uniform bunching for group development. CH is picked in light of leftover vitality of individual sensor hubs. The hub which has lingering vitality higher than the normal remaining vitality of the separate group is qualified as CH The results show that the proposed strategy performs better than the current techniques regarding vitality sparing and network lifetime.

P. Venkata Krishna, et al. (2017) introducing Internet of Things (IOT) is a rising stage which connects this present reality and digital world however correspondence. Any question or thing in reality are associated and spoken with the client through the IOT. The significant research issue associated with the IOT is vitality utilization. Numerous wireless sensor network calculations are proposed to streamline vitality and those are not reasonable for the IOT. The design of IOT is not the same as the customary WSNs. To accomplish the vitality productive instrument, this paper proposed a progressive system for IOT correspondences. A vitality display is produced for every hub and related parts are relegated in view of the administrations.

Megumi Kaneko, et al. (2017) portray outline of vitality and frightfully effective Wireless Sensor Networks (WSN) is pivotal to help the up and coming development of Internet-of-Things (IOT) versatile information movement. In this work, we consider a vitality collecting WSN where sensor information are intermittently answered to a Combination Center (FC) by an inadequate arrangement of dynamic sensors. Dissimilar to most existing works, the transmit control levels of every sensor are thought to be obscure at the FC in this circulated setting. We address the opposite issue of joint flag/control reclamation at the FC-a testing under-decided detachment issue. To regularize the poorly postured issue, we accept both a chart flag smoothness earlier (flag is smooth concerning a diagram displaying spatial relationships among sensors) and a sparsity control earlier for the two obscure factors.

Gaurav P. Dave, et al. (2017) proposes Advances in I/W/EoT (Internet, Web, and Everything of Things) based brilliant conditions have made colossal request in wireless sensor networks (WSNs). These keen conditions require vitality productive equipment and software because of nature of wireless correspondence and imperatives of sensors fused in the system. "IEEE 802.15.4" standard is utilized for wireless medium access and information transmission at physical layer (PHY) and Medium Access Control (Macintosh) layer. It gives Macintosh sublayer which may work in reference point empowered or non-guide empowered modes. The contextual investigation based centered approach furnishes better comprehension of IOT applications with valuable experiences of equipment and software advancements.

Fang Junli, et al. (2017) proposes Wireless Sensor Network (WSN) is generally utilized as a part of IOT, military and natural application. Be that as it may, WSN is vitality obliged and the network hubs set in unfriendly condition are difficult to supplant. Thusly, planning a vitality productive steering calculation is noteworthy. Numerous arrangements have been

proposed to streamline vitality utilization in regular wireless sensor network, however they don't function admirably. Software Characterized Wireless Sensor Network (SDWSN) which isolates the control plane and sending plane of network layer is proposed as of late to work out this trouble. In this paper, we outline a productive vitality directing calculation in view of SDWSN. This novel steering calculation which is worked in the controller builds up separate line in view of the data gathering from the hubs and registers the nearest hub to transmit information for every hub.

3. PROPOSED METHODOLOGY

In the WSN Analysis and energy management is important objective is to present the energy efficient routing protocol for WSN. This section presents the design of proposed routing protocol,

In this paper, we present novel scalable and energy efficient routing protocol for WSN in IoT applications. The Wireless sensor network (WSN) is nothing but group of large number of low power and tiny sensor devices those are deployed manually or randomly over the network. WSNs are widely used in the real life applications such as disaster monitoring systems, health care systems, security systems; environment monitoring systems etc. But the main limitation of WSNs is limited energy resources of sensor nodes. Therefore energy efficiency becomes challenging research problem for achieving the longer operation of sensor networks. Clustering based routing protocols and optimization methods gained significant attentions of researchers, as these methods delivering the best WSNs performances. We are presenting the novel energy efficient and QoS efficient routing method for WSNs based on gateway based clustering approach and improved particle swarm optimization (PSO) methods. This method is composed of linear programming (LP) and non-linear programming (NLP) formulations for problems of routing and clustering. The improved PSO method is used to achieve the trade-off among number of data forwards and transmission distance. The proposed IPSO based clustering routing protocol proposed in this research work with efficient method of particle encoding and fitness function.

4. MATHAMATICAL MODULE

A. Avg. Throughput

Throughput = (seq number * segment size * 8) / active duration

B. End to End Delay (Processing Time)

Delay = N[dtrans+dprop+dproc+dqueue]

Where,

dend-end= end-to-end delay

dtrans= transmission delay

dprop= propagation delay

dproc= processing delay

dqueue= Queuing delay

N= number of links (Number of routers - 1)

C. Energy Consumption:

Energy_Consumed = (InitialEnergy − FinalEnergy)

Average_Energy_Consumed (Joules) = Sum_of_Energy_Consumed_by_All_Nodes / Number_of_Nodes

D. Battery Lifetime:

Lifetime (Rounds) = Total Remaining Energy/10

■ PSO Algorithm

for each particle i = 1, ..., S do

Initialize the particle's position with a uniformly - distributed random vector: xi ~ U(blo, bup)

Initialize the particle's best known position to its - initial position: pi ← xi

if f(pi) < f(g) then

update the swarm's best known position: g ← pi

Initialize the particle's velocity: vi ~ U(-|bup-blo|, -|bup-blo|)

while a termination criterion is not met do:

for each particle i = 1, ..., S do

for each dimension d = 1, ..., n do

Pick random numbers: rp, rg ~ U(0,1)

Update the particle's velocity: vi,d ← ω vi,d + φp -rp (pi,d-xi,d) + φg rg (gd-xi,d)

Update the particle's position: xi ← xi + vi

if f(xi) < f(pi) then

Update the particle's best known position: pi ← xi

if f(pi) < f(g) then

Update the swarm's best known position: g ← pi

- **Hardware and Software Used**

Hardware Configuration

- Processor : Intel Core I3
- RAM : 4GB
- Disk : 320 GB

Software Configuration

- Operating System : -Windows 7, Linux
- Development Languages: - Java, C
- IDE :- Net Beans

5. RESULT

1. Average Energy Consumption – 90 Gateways

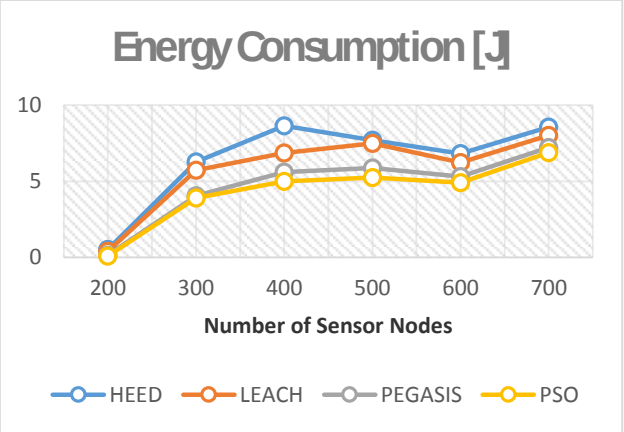

Figure 3 Energy Consumption Result

In this evaluation we compare the four techniques HEED, LEACH, PEGASIS and Proposed PSO. The X-axis has Number of Sensor Nodes. The first technique is HEED, its use more energy for processing as compare to other techniques. Same as LEACH and PEGASIS. The proposed technique is use energy less than compared other techniques.

2. Network Lifetime (Rounds)

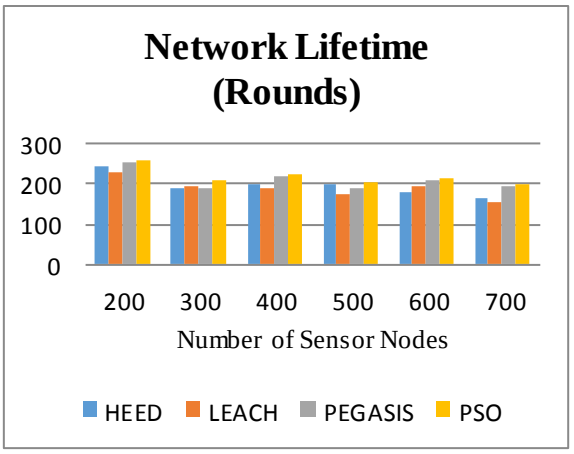

Fig 4: Network Lifetime Result

In this result we compare the four techniques Lifetime HEED, LEACH, PEGASIS and Proposed PSO. The X- axis contain the Number of Sensor Nodes and Y axis contain the lifetime round count. The all techniques are compare with each other using the lifetime round count. The proposed technique is better than the others technique. It has a maximum lifetime round count in processing.

6. CONCLUSION AND FUTURE WORK

In this result paper we discuss and address the challenges and problems of WSN methods under single Network and PSO under Multiple node network methods, the novel PSO algorithm along with the QoS improvement approach is designed. These protocols updates the routing information in the routing table dynamically and selects the disjoint paths and then equally distribute the traffic among them in order to prevent the congestion and control overhead. The simulation work was carried using the well know simulator tool called NS2. The comparative study among HEED, LEACH, PEGASIS and proposed PSO protocol is conducted in this research work extensively. From the investigations we observed that the existing protocols showing the worst performance with using energy and IOT Methods. The PSO protocols shows the better performance as compared to existing protocols. The proposed protocol improves all the QoS performance metrics significantly.

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