A Decentralized Distribution of Wireless Sensor Network

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Abstract: Wireless sensor network (WSNs) has seen noteworthy progress in the field of energy efficiency of the node over the period of years. From hardware revolutions toprotocol optimization like ZigBee, APTEEN, TEEN and LEACHmany effective efforts have been made to extend the lifecycle of these network. Many techniques such as cycling, scheduling, data aggregation and energy harvesting have been actively infused to minimize the energy consumption of the node. Furthermore, some low power micro-controllers and energy efficient communication module makes sensor nodes more responsive. Additionally, improvement in low-power hardware component and communication protocols has more boosted efficiency. However, some challenges like balancing energy efficiency remains along with the short fall of scalability and performance of network. Thus, the research is continued to explore the novel solution for enabling their deployment in various field applications from industrial automation to environmental monitoring.

Keywords: *Energy efficiency, Cluster head, Wireless sensor network*

I.INTRODUCTION

The energy efficient WSN is a tale of continuous innovation that is driven by necessary need of sustainable solution for long lasting battery life. Earlier, it was the big deal to handle sensors and wireless nodes as nodes were often powered by small batteries with limited capacities. Consequently, lifespan of such types of networks was severely constrained and thus the widespread adoption is hindered. The first improvement in energy efficiency came with some advancement in hardware. Some low-power microcontrollers work to minimize the consumption of power in battery and enable nodes to operate in same environment. These microcontrollers came with new features like sleep mode that consumes minimal energy which prolong the battery life. Simultaneously, some other technologies like Bluetooth low energy and Zigbee is also developed to optimize the transmission by reducing the requirement of energy that is necessary for radio communication. These protocols included duty cycling where the nodes interchanged the position between active and sleep stages and maintaining the connectivity as well.

II.EVOLVING STANDARD

Wireless sensor networks changed dramatically over the last few years due to the prominent research in this field. Some key areas like IEEE 802.15.4 enhance its control in low-rate wireless personal area networks and becomes Zigbee. Zigbee is mainly used for home automation and controlling industrial process. Low PAN enables WSN to combine with the IoT. LEACH (Low-energy Adaptive clustering hierarchy) and DLP (Dynamic Power Management)both are become energy-efficient in the field of WSN by reducing energy consumption and simultaneously developed the techniques to adjust power usage based on activity and enhanced battery life-span. It improved accuracy and reduced data redundancy that processed by different types of data aggregation and Fusion. An improved security feature supported industrial application and enhances work performance by light weighted cryptographic protocols.
Now-a-days communication is also possible between WSN and IoT due to CoAP (Constrained Application protocol) which enables interoperability and integration. By reducing latency and bandwidth usage it enhances the real time decision-making capabilities and it is possible due to the integration of edge and fog computing.
The persistent development of WSN Standards focuses on improving security, efficiency, interoperability and integration among emerging technology like IoT, 6G, Edge computing.

III.LITERATURE REVIEW

Many techniques of deployment have been developed by the researchers in the field of WSN. Research is done for the equal distribution of notes, position; their connectivity within the region, coverage and fault tolerance etc. [1]. In Virtual force algorithm the node coverage theory and improved 3d space is proposed [2]. In deployment scheme of flow line based method [3] and scalability energy efficient deployment scheme in which the area is divided into hexagonlogically by based station and for optimal coverage instructed them to place at the center [4] are some schemes that have been suggested variety of deployment schemeto improve the performance of WSN on the basis of different criteria. The same problem in wireless multimedia is discussed Bai for high efficiency routing [5] some other researchers proposed the notes directly into targeted region by helicopter the simplifies the delivery in not reachable area further this scheme has many classifications on the basis of random or plant deployment schemes of notes [6] but some atmospheric condition andreal world deployment problems is not considered in simulation [7].

In mobile sensor network the notes are design with the quality of self-organizing possibilities in which sensor is able to recognize the position of nearest node [8] for small cluster region [9]. WSN based deployment scheme is proposed by Zou and Chakraborty. Coverage is gradually improved in many papers and algorithm. Aerial robot was introducing by corkeet [10] which follows shortest path during deployment of sensor notes but due to lack of scalability it can be used for small target region only.

Sabri investigated the method of realizing energy consumption in WSN and also measured the power consumption of node that is degrading while sending and receiving the information and also analyzed the model which consumed the power even in the idle mode [11].

Hussein [12] in their paper explored the technical aspect and models of chain based routing protocols and investigated how to upgrade the network life time on the basis of notes when they have expired. The main problem of WSN is energy efficiency that can be improved by variety of approaches including clustering Jang,Seongsoo Ho-Yeon Kim [13] a new approach EECCH was proposed to overcome the different flaws of LEACH. Ibrahim [14] published the survey on various domain of WSN explaining the solution of problem with their solution this study helps a lot to strengthen the WSN technology. Authors in [15], investigated a launcher based model called precise placement model [PLM] that launch the nodes uses air pressure to lunch a node in specific region by helicopter. He also worked on velocity and time to calculate the exact timing on the basis of many variables like velocity and altitude.

IV.RESEARCH GAP

In the above mentioned paper the researcher has suggested many schemes for deployment of sensor nodes there are various scheme suited for various region considering the natural phenomenon as well in the present study we have studied the constrains of existing models and proposed a deployment of cluster head and sensor node in predefined manner by using a novel scheme of deployment in which we have used two funnels to deploy nodes. One is deploying cluster head (CH) and other is deploying sensor nodes (SN) in a ratio of 1:6. In existing model sensor node acts like a cluster head but in this model we proposed a new deployment scheme which consists of two funnels one is for sensor node and other is for cluster head. We separated cluster head in form of buffer memory. Cluster head stores the data while in sleep and pop out information when memory is full which is more reliable and robust in comparison to other scheme in case of failure we can easily detect and replace the cluster head and node will remain the same position.

V.LIFE SPAN EXTENSION METHOD

In this method, we develop a novel scheme in which a buffer memory concept is introduced. Due to which CH will not remain active all the time, it stores all the messages and remain in sleep mode till memory is not full. As it filled CH will become active and pop out all the messages and send them to the desired destination. In between the receiver remain active and keeps receiving messages from the sender. This situation is remaining same for the low priority tasks but in case of high priority task it will not wait for memory to be full. It will pass the data as soon as received. This schedule will work on the mode of sleep and wake cycle.

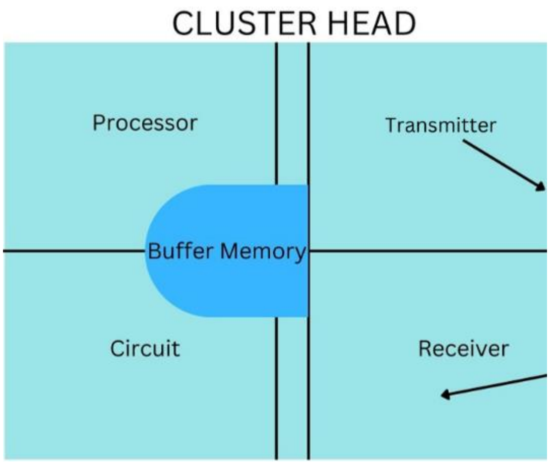

Fig 1: Internal Layout of Cluster Head

7532

In Fig 1.Internal layout of Cluster Head has been designed and clearly mentioned the position of processor, circuit, transmitter and receiver along with the buffer memory concept. Further in Fig 2. working and concept of buffer memory has been clearly explained as memory is working in form of Stack. Instruction pushed and accumulated in stack and popped out all messages through transmitter to all other nodes. Till the time cluster head remain in sleep mode. In case of emergency, when SOS generated, memory popped out the message as shown in Fig 3 and Fig 4.

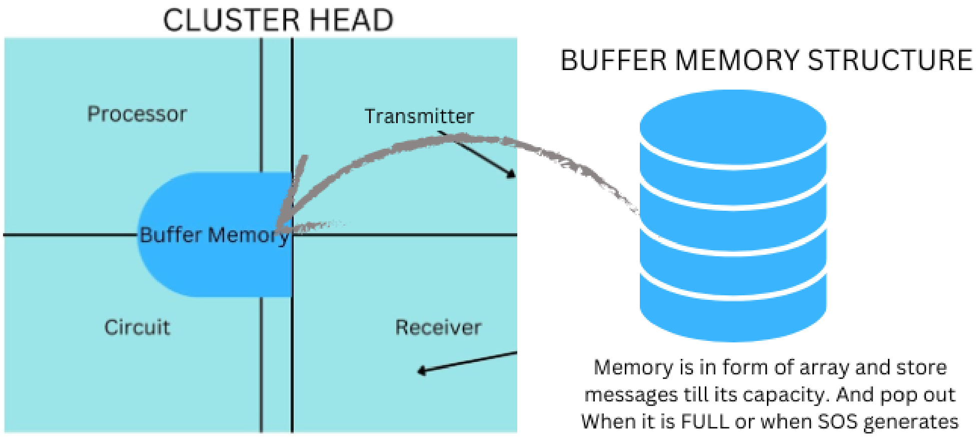

Fig 2: Explaining Memory Structure of Cluster Head and its working

In Fig 3.the graph shows the list of task in stack piled up continuously and with this stack continuously filled out to its capacity. Capacity can be as per requirement.

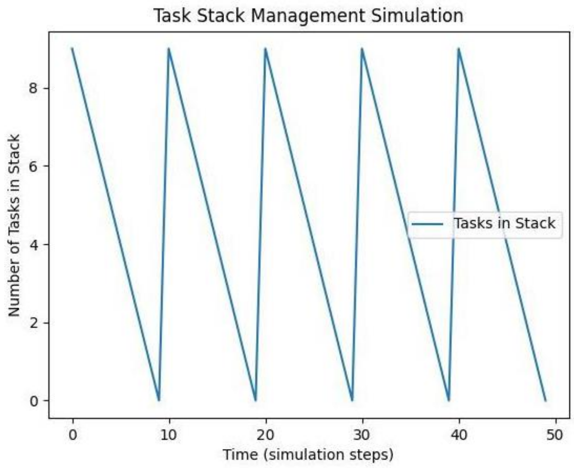

Fig 3: Task Stack Management when there is no SOS

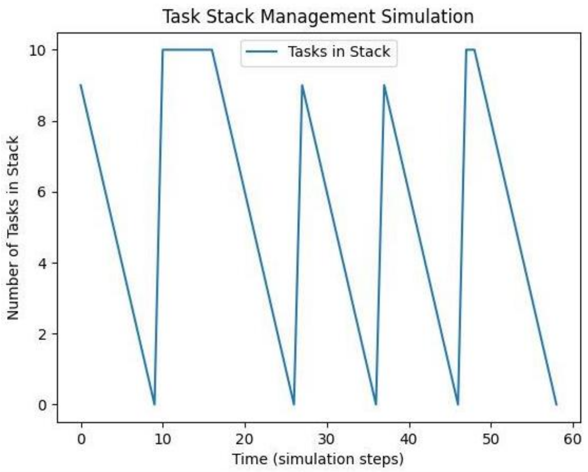

Fig 4: Task Stack Management When SOS Generated

Fig 3. Is drawn on the basis of no of task in stack and time. It shows continous pattern as only messages received by receiver of cluster head and stored in memory. Pattern deflects from regular mode when receive any SOS as shown in Fig 4. Pattern is broader if two or more than two SOS received at the same time as shown in time duration between 10-20 and pattern is narrow if only one SOS is received by receiver.

VI.MODEL /ALGORITHM/FLOWCHART

Description:

- *Start*
- *Monitor Battery Level of Cluster Head*

(consume during Communication, Data Processing and Sensing)

- *Introducing Cluster head with Buffer memory*
- *Essential Tasks (SOS high priority)*
- *Non-Essential Tasks (low priority) Stores in memory and transmitter transmits all the messages when*

7533

FULL

- *Optimize Energy Usage:*
- *Low Power Mode for non-essential tasks*
- *Adaptive Sampling to reduce sensing frequency*
- *Schedule Sleep/Wake Cycles (based on cluster head workload)*
- *Reevaluate Energy Levels Periodically*
- *End (loop continuously)*

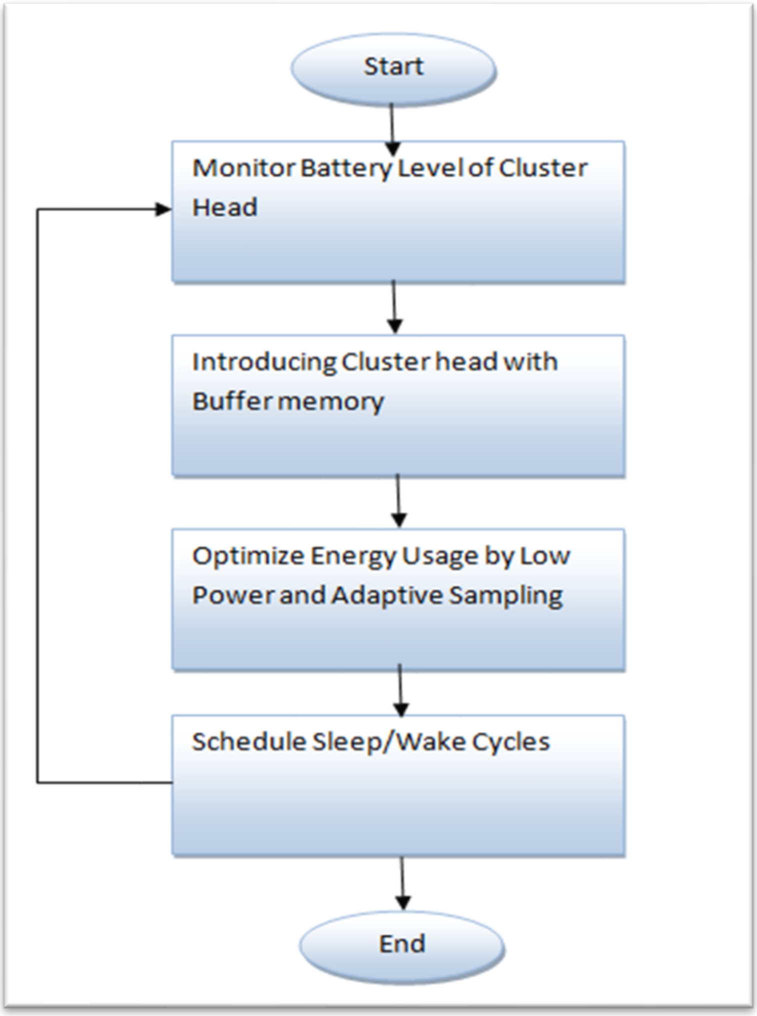

Fig 5: Flow chart of working of Decentralized Distribution of Wireless Sensor Network

Fig 5. Shows the flow control of working model, where cluster head is introduced with buffer memory concept and optimize energy usage by low power and adaptive sampling. Sleep and wake cycle scheduled according to the high or low priority of messages. In this way, re-evaluation of energy levels has done periodically and at the same time the battery level of cluster head is also monitored. Cluster heads and sensor nodes are different in property as only cluster head contains buffer memory and sensor nodes are the normal nodes that governs by cluster heads.

7534

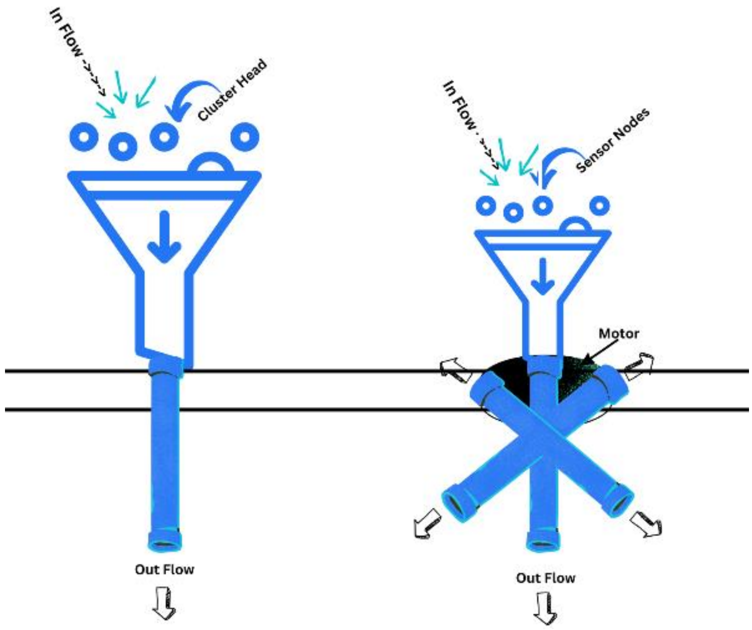

Fig 6: Deployment of Cluster Head and Sensor node in predefined manner

Fig 6 shows the deployment of cluster head and sensor nodes in predefined manner, as CH has property different from SN so here, introduced a model with two funnels in which one has to deploy CH with only one exit point and has inbuilt buffer memory and another funnel has three exit point for normal sensor nodes SN. There is some definite ratio exits between CH and SN as it can vary as per requirement. There is a motor attached with funnel which keeps the exit points rotating for even distribution of SNs.

VII.SIMULATED RESULTS

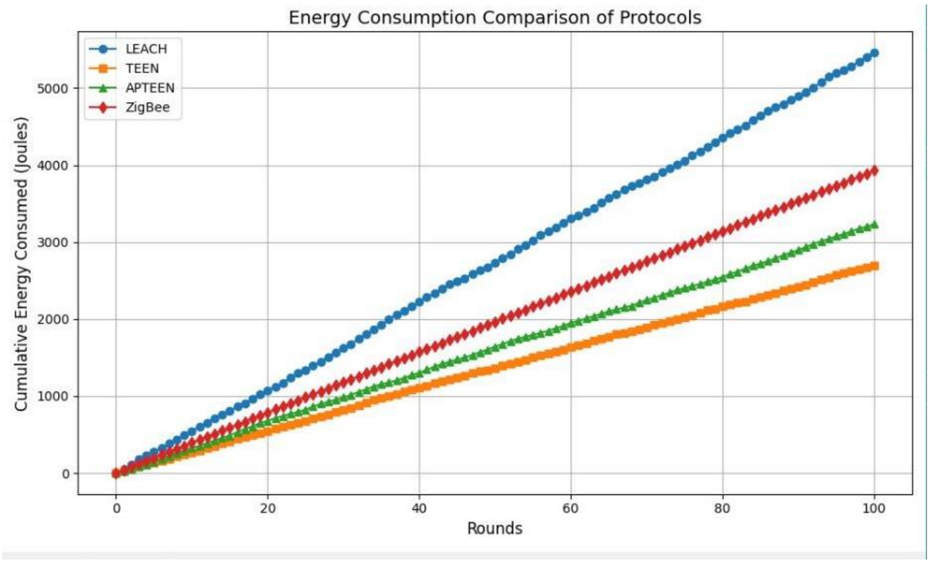

Fig 7: A comparative study of Energy Consumption of various protocols

Fig 7. shows the comparative analysis of energy consumption of various protocols on the basis of cumulative energy consumed in joule and rounds of nodes for LEACH, TEEN, APTEEN and ZigBee Protocols.

7535

Table 1: A Comparative analysis of LEACH, TEEN, APTEEN and ZigBee algorithm on the basis of Lifetime, average throughput, average end-to-end delay and packet delivery Ratio.

Rounds (For 100 nodes)	Lifetime (in secs)	Average throughput (KBPS)	Average end-to-end delay (in secs)	Packet delivery Ratio
500	443.21	141	0.3837	0.946
750	471	138	0.4131	0.951
1000	621	140	0.4432	0.949

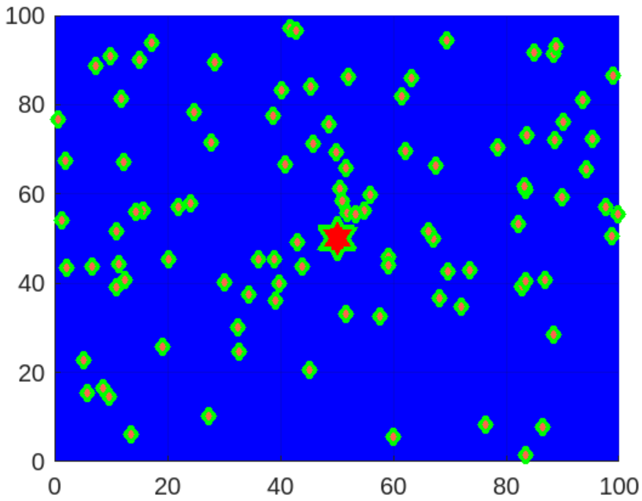

Fig 8.1: Cluster head created

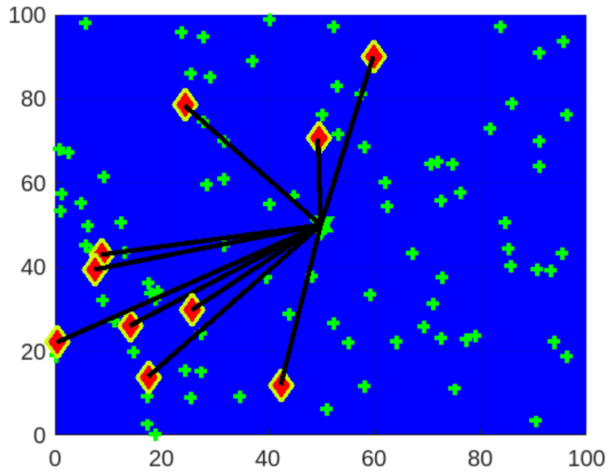

Fig 8.2: Cluster Head connected to other sensor network

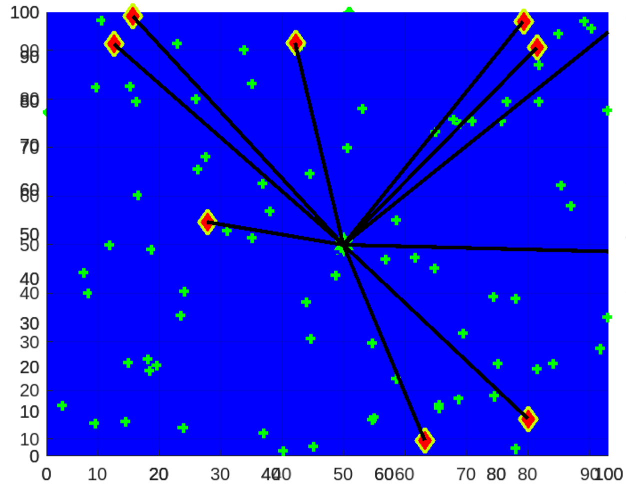

Fig 8.3: Cluster Head connected to other sensor network

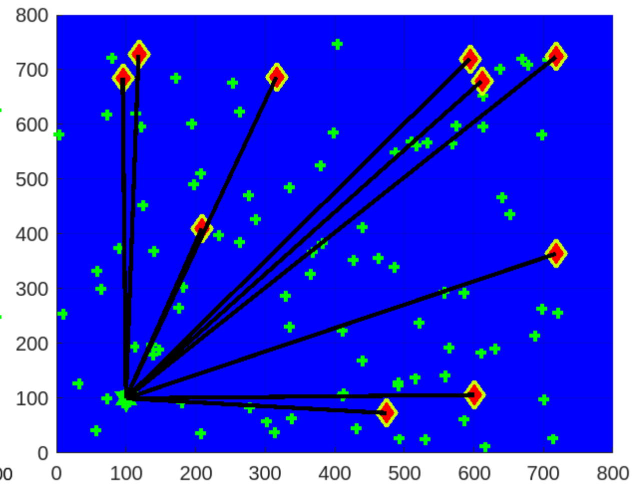

Fig 8.4 Load Balancing in Decentralized distribution mode

In above set of Fig, 8.1 shows the creation of cluster head in simulated environment and in 8.2 cluster head deployed and created. Thus the head is connected to other nodes and created a network. In Fig 8.3 and in 8.4 load balancing of nodes is shown in decentralized distribution mode. Cluster head keep balancing the nodes and thus in this way, extend the battery life.

VIII.CONCLUSION AND FUTURE WORK

In this paper we deal with autonomous deployment of sensor nodes as well as cluster heads in large scale area and will deploy the nodes in recursive method under the scheme of decentralized distribution. This method is used to expend the battery life of cluster head. In future we plan to extend the life of node by embedding the solar panels in cluster heads that will boost the green energy concept and help to extend the life cycle of sensor network. It is marked that it will not perform smoothly in Frigid Zone. By reducing communication and connection all time also reduces the battery consumption. Some AI based smart

7536

algorithms also helpful in improvement of energy consumption and while integrating with 6G and IoT devices we can achieve scalable solution in real time environment.

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7538