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A Novel EKH-LEACH Algorithm for Energy Optimization in IoT Wireless Sensor Networks

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Abstract

The Internet of Things (IoT) has revolutionized the electronic world by integrating numerous independent sensors capable of remote sensing and interaction. Wireless Sensor Networks (WSNs) form the backbone of IoT, providing extensive connectivity among resource-constrained nodes. However, energy efficiency remains a critical design challenge in WSNs due to the limited battery capacity of sensor nodes. This paper introduces a novel Enhanced Krill Herd-based LEACH (EKH-LEACH) algorithm for optimizing energy usage in IoT-driven WSNs. The EKH-LEACH protocol enhances the traditional LEACH algorithm by incorporating an improved Krill Herd (KH) optimization technique to select cluster heads (CHs) more effectively. By leveraging a suitability function that combines neighborhood distance with KH optimization, the proposed algorithm significantly improves energy efficiency and extends the network's lifetime. Experimental evaluations demonstrate that EKH-LEACH outperforms conventional methods in terms of average energy consumption, standard deviation of energy distribution, and overall network performance. This novel approach offers a robust solution for energy optimization in IoT-based WSNs, ensuring sustainable and efficient network operations.

Keywords — EKH, LEACH, IoT, WSN, energy efficiency, cluster head selection, optimization algorithm

1.Introduction:

The Internet of things (IoT) is a incorporeal grouping of technological capabilities that enable not only the interconnectivity of useful devices but also the environmental control of useful experiences. The IoT may be viewed as a multiplicity of connected environments in which a user can control and be controlled by experiences. Environments are populated by sensors, controllers, and other objects, which are principally powered by electricity. As a consequence, the growth of the IoT impacts the requirement for renewable energy and energy consumption efficiencies. In this paper we discuss optimizing energy consumption in the IoT smart environment of a home. Optimization by simple design is adopted as the best strategy for planning and regulating energy consumption.

Internet of Things (IoT) is an emerging technology and energy consumption is one of the important issues. It is crucial because the devices are energy constrained. The Sensors with actuators are operated by battery and every minutes these objects are connected to the internet. Substantial advancement has been made in this paradigm. This paper presents the issues and ways to minimize the energy consumption in IoT environment.

2.Related Work

[1] This mainly relates to further extension of wireless interrogation range and smarter control of power constraints, while also providing new applications. Once these requirements are improved, new applications in different user domains will emerge and further increase IoT market size. IoT could be implemented in many different environments. However, to better understand the scope of its applications

[2] This paper presents the issues and ways to minimize the energy consumption in IoT

Environment. This paper describes the overview of Energy efficiency of IoT devices on network.

[3] In this paper we discuss optimizing energy consumption in the IoT smart environment of a home. Optimization by simple design is adopted as the best strategy for planning and regulating energy consumption.

[4] An overview of the challenges involved in designing energy-efficient IoT edge devices and describe recent research that has proposed promising solutions to address these challenges First, we outline the challenges involved in

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efficiently supplying power to an IoT device. Next, we discuss the role of emerging memory technologies in making IoT devices energy-efficient

[5] In this paper propose a new common taxonomy that bring-all-together and covers the major energy-conservation techniques introduced in the reviewed categorization papers or proposed recently for IoT-based WSN. Finally, we briefly present each of the categories, according to the introduced classification view and identify their sub-divisions.

Keyur K Patel1 , Sunil M Patel2 (2016) this paper briefly discussed about what OT is, how IOT enables different technologies, about its architecture, characteristics & applications, IOT functional view & what are the future challenges for IOT.

Pallavi Sethi and Smruti R. Sarang 2017 this survey paper proposed a novel taxonomy for IoT technologies, highlights some of the most important technologies, and profiles some applications that have the potential to make a striking difference in human life, especially for the differently abled and the elderly. As compared to similar survey papers in the area, this paper is far more comprehensive in its coverage and exhaustively covers most major technologies spanning from sensors to applications.

M.U. Farooq Aer (2015) This paper aims to provide a comprehensive overview of the IoT scenario and reviews its enabling technologies and the sensor networks. Also, it describes a six-layered architecture of IoT and points out the related key challenges.

3.The overview and architecture of IoT

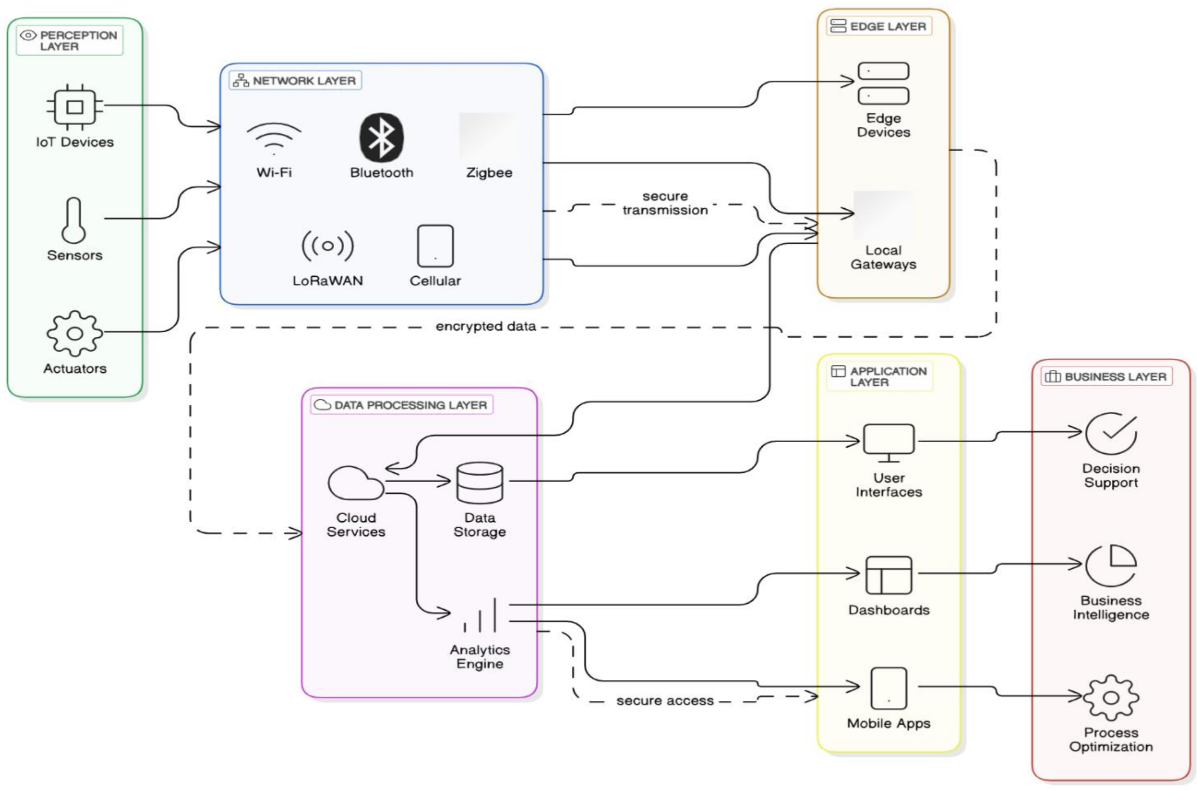

Fig 3.1 Architecture of IoT Based Sensor Nodes

Energy-aware routing in the IoT-based WSN plays a significant role in minimizing additional burdens on the intermediate nodes, it is one of the method to improving the energy in WSN of IoT, which lead to consuming higher amounts of energy during the data receiving, processing, and transmission, in both the single-hop and

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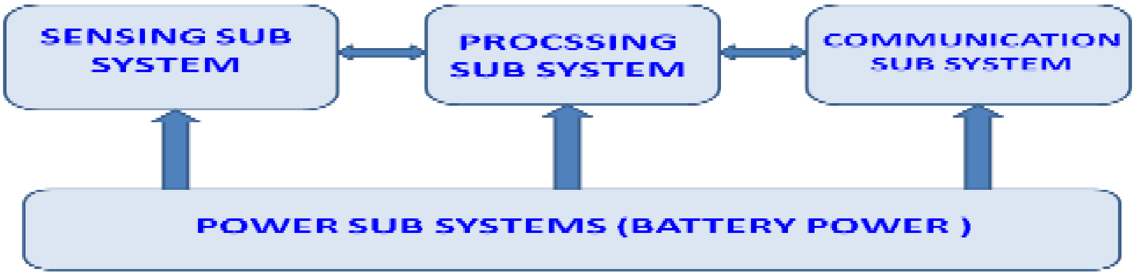

Fig.3.2 Sensor Power System Architecture

multi-hop paths. Three major objectives are identified for routing protocols, which are: balancing the energy-load between all the sensor nodes, coordinating interaction between them, and optimizing data transmission energy. This category includes three major techniques for energy-efficient data routing, as we depict in the following figure

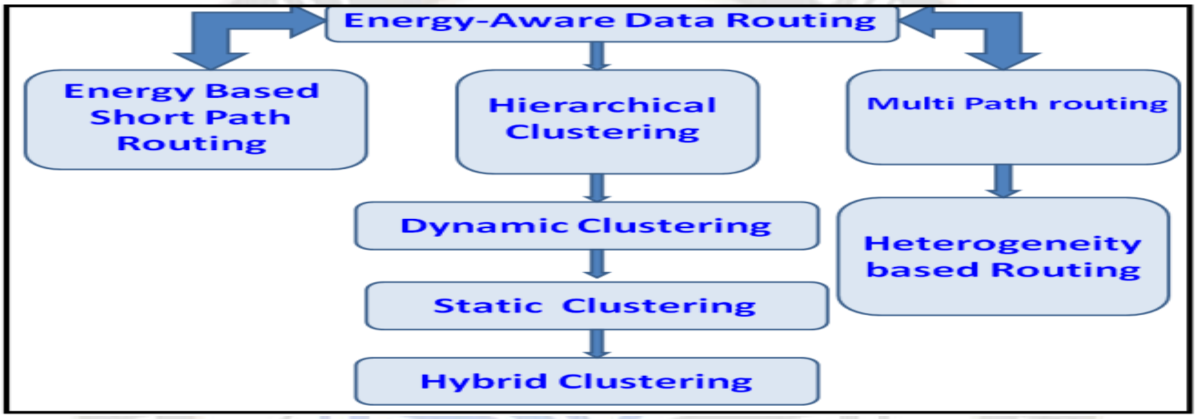

Fig.3.3 : Energy-Aware Data Routing

Energy-Efficient Data Acquisition Even though the energy consumption of the sensing unit is the least compared to that of communication and processing units, nevertheless, it can be the greatest energy dissipated in the sensor node due to various factors. However, energy-aware data acquisition techniques can be used to minimize energy dissipated in the sensing unit as well as in the communication unit. This is achieved by reducing the number of data samples and hence the number of transmitted samples, which in turns reduces the transmission energy. Three energy-efficient data-acquisition techniques have been identified in [19], which are shown in Figure.1.4

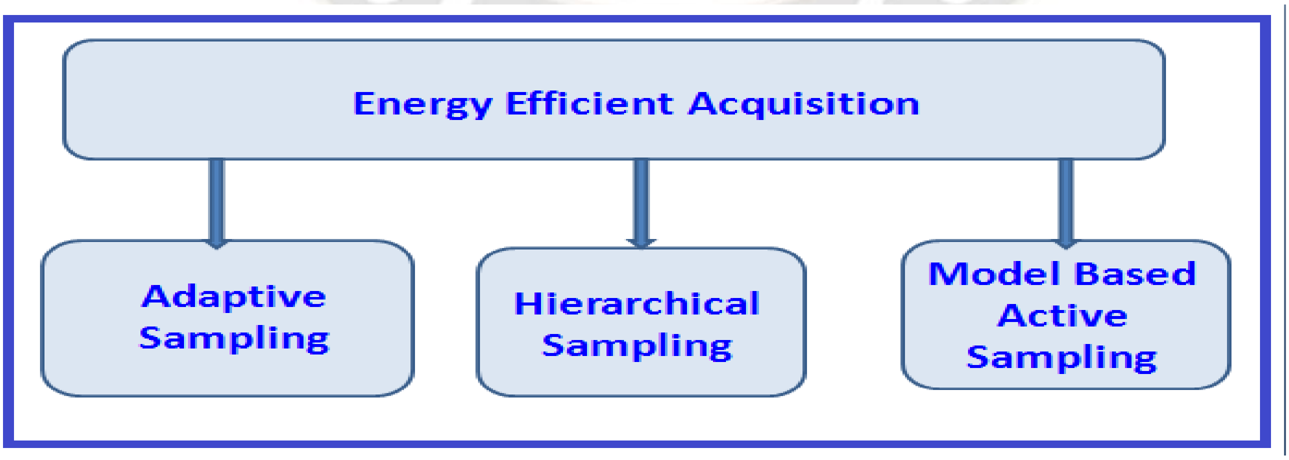

Fig :3.4 Energy-Efficient Data Acquisition

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4 THE PROPOSED ADVANCED (ENHANCED KRILL HEADS)-LEACH PROTOCOL

The LEACH technique is a usual hierarchical routing protocols method which is a generally utilized clustering routing protocols; thus, LEACH is obtained as the study objects provided higher representation. Consider precondition of the LEACH protocol is given by:

a) In the Wireless Sensor Network every sensor node is similar, and radio signal produced by the Node consumes similar energy; a primary energy of every node is equivalent, the energy is constrained,
b) Each node could distinguish its RE. The node contains power controlling module for changing the transmission power and controls the transmission distance, and every node have adequate calculating power;
c) Every node could interact straightaway with one another that employs to node and Base Station;
d) Base Station is stationary and farther from the whole WSNs. Energy utilization of sink node isn't deliberated in this research, as it is expected to contain adequate energy
e) supply; and all Sensors are fixed static.

The WSN is given by

$$S = \{ S_1, S_2, S \ldots Sv\}$$

The LEACH protocol cycles via cluster reconstruction procedure where every phase of the cycle is defined by round [16]. Every round is separated into 2 stages: development stage of the cluster (setup stage) and stable stage of the transferred data (ready stage).

To improve the CH selection process of the LEACH protocol, the Enhanced KH algorithm is implemented. The KH is a new metaheuristic optimization method working for resolving an optimization procedure which is based on swarm of krill about certain biological and environmental procedures.. The time based location of an individual krill in 2D space is specific with three main performances:

a) The movement biased by other separate krill
b) Forage action performed,
c) Arbitrary distribution of nodes.

5.EVALUATION OF PERFORMANCE

A analysis of experimental value has been identified in the proposed EKH-LEACH method with existing techniques takes place in Table 1.
Its examines the TEC analysis of the EKH-LEACH technique under diverse node count. The experimental results stated that the EIKH-LEACH technique has gained minimum TEC over the other techniques.

Table 5.1 Energy Consumption Level

Energy Consumption Level				
Number of Nodes	**PSO-C**	**GWO-C**	**KH-C**	**EKH-LEACH**
100	6.28	5.5	4.1	3.01
200	9.39	6.24	4.48	4.01
300	12.63	10.82	7.58	6.25
400	15.48	14.45	10.81	7.21
500	16.82	15.11	11.38	10.19

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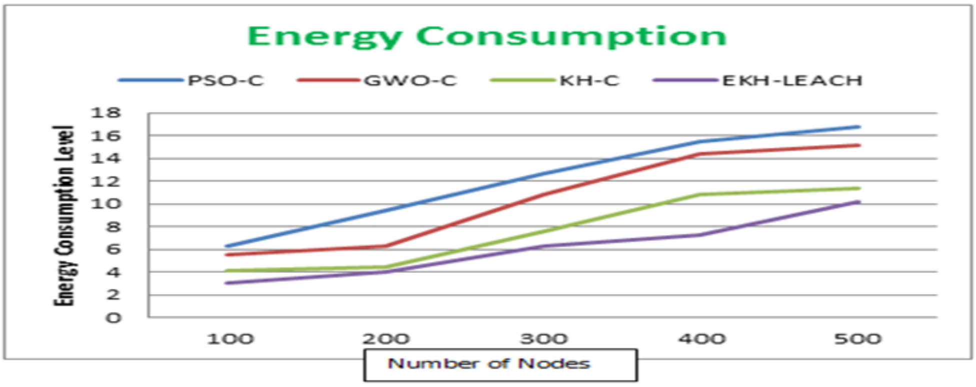

Fig 5.1 Energy Consumption Level

For the instance, in 100 nodes, a lowest TEC of 3.01J has been consumed by the EKH-LEACH technique whereas the PSO-C, GWO-C, and KH-C techniques have established somewhat increased TEC of 6.28J, 5.5J, and 4.1J respectively.

Eventually, under 500 nodes, a lowest TEC of 10.19J has been consumed by the EKH-LEACH technique whereas the PSO-C, GWO-C, and KH-C techniques have established somewhat increased TEC of 16.82J, 15.11J, and 13.38J respectively. Meanwhile, under 500 nodes, a lowest TEC of 6.35J has been consumed by the EEIKH-LEACH

The Values are tabulated in the table 1 and corresponding graph have pictured.A analysis of experimental value has been identified in the proposed EKH-LEACH

Table 5.2 Life Time of Networks Nodes

Life Time of Networks Nodes				
Number of Nodes	**PSO-C**	**GWO-C**	**KH-C**	**EKH-LEACH**
100	19905	20945	22873	23793
200	17368	19090	21247	22258
300	15218	16727	19003	19822
400	12996	15044	18573	19056
500	12419	14781	17675	18257

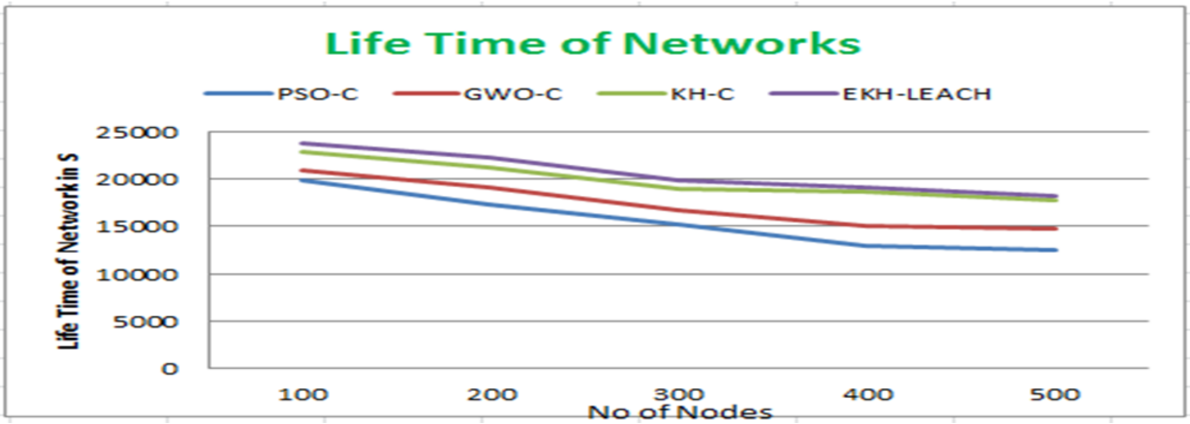

Fig. 5.2Life Time of Networks

method with existing techniques takes place in Table 1. and 2 examines the lifetime analysis of the EKH-LEACH technique under diverse node count. The EKH-LEACH method / technique has consummate improved lifetime over the other techniques.

For instance, under 100 nodes, a maximum lifetime of 23793 rounds has been offered by the EKH-LEACH technique whereas the PSO-C, GWO-C, and KH-C techniques have demonstrated slightly degraded lifetime of 19905, 20945, and 25873 rounds respectively.

Likewise, under 500 nodes, a maximal lifetime of 18257 rounds has been offered by the EKH-LEACH approach whereas the PSO-C, GWO-C, and KH-C techniques have demonstrated slightly lesser lifetime of 12419, 14781, and 17675 rounds correspondingly.

6.Conclusion:

In this analysis it is concluded that the various Energy efficiency techniques and methods have been studied and analyzed. The Energy-Aware Data Routing and Energy-Efficient Data Acquisition technique have been discussed and advantages of these technique gives a solution for the efficiency of energy for sensor devices on Internet of things. We have discussed IoT based sensor nodes and introduced an existing technique for energy we have explored this issue in the IoT-based multifarious Wireless Sensor Networks and introduced a new various energy-saving schemes. In this paper an analysis about the state of the art technologies both in sensing and data transmission is described, while stating and discussing most important challenges that IoT devices should meet We first analyzed and reviewed some of the major research works that provide various method of energy conservation challenges and schemes in the literature survey , discussing their major focuses and pointing-out their main categories as well as some key parameters, which mainly depends on some related parameters and issues which over comes the problems being finest in that sense would increase the battery lifetime and Enhance the quality of service.

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