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A Systematic Approach on Reducing the Energy Consumption in Green Computing

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Abstract- Green computing is focusing on reducing the energy consumption, resource usage, carbon dioxide emission. It was found that Last year, Google used about 12.4 terawatt-hours of electricity. Energy consumption in data centers is reduced by decreasing the resource utilization that is by switching off or shifting the computing nodes to sleep mode. But when the servers are being used the energy consumption is minimized by using energy efficient scheduling and optimization techniques.In WNS the sensor nodes are deployed in remote areas, these sensors are powered by battery that decreases the lifetime, therefore by using energy efficient techniques can increase the uptime of the battery-operated devices in WNS. This work studied various energy efficient techniques that minimize energy consumption usage in Data Centers (DC) and the algorithms that increase the uptime of the battery-operated device in (WNS) Wireless Network Sensors.

Keyword-Wireless Network Sensor (WNS), Data Centers (DC), Energy Efficient Algorithm (EEA).

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I. INTRODUCTION

The customer request for services increases in data centers day by day the computing resources in cloud data center also increases. The efficient usage of power consumption by these computing resources efficiently is very important issue. From past 45 years, the power consumption of the world has doubled, and it will further again double in next 10 years. One of the primary consumers of the energy is industries. The European union confirms the industry accounted for approximately 30% of energy consumption. The U.S estimated energy consumption of industrial fields is about 30.3%. The energy fields, production industries consumed nearly 1/3 of the global power consumption of the world [1]. In china the manufacturing sector occupied 56% of the total power consumption. The production industries play a key role as the living standards increases to satisfy the customers continuously with various products simultaneously, but it is necessary to reduce the demand of energy consumption in these manufacturing industries [2].

In this paper we have studied various the WNS energy efficient algorithms that increases the wireless sensor network lifetime and reduces the huge energy consumption problems,its related solutions and covering all the aspects of energy consumption by cloud data centers are analyzed and many energy saving research papers to minimize. The objective of the paper, we combine WNS and Data Centre (EEA) Energy Efficient Algorithm [32] that saves the power and helps us to achieve the goals towards green computing [4]. The average performance of different algorithms and comparing the energy saved is as illustrated in Table 3 and in Figure 3.

II. ENERGY EFFICIENT CONSUMPTION –

The implementation of energy efficient software, central processing units (CPUs), hardware and servers improves the energy efficiency [5]. Also, the energy efficient techniques reduce the resource usage, energy consumption and improve the usage of electronic waste.

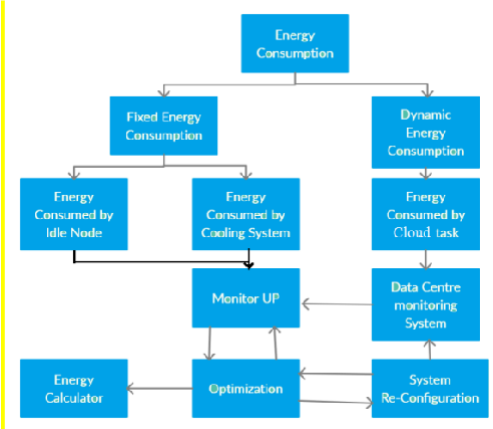

Figure 1: Energy Consumption and Saving Consumption

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In the energy saving software, energy saving scheduling for parallel system plays an important role to reduce power consumption and achieve better performance. Energy saving is part of green computing [4]. The energy consumption and saving architecture is illustrated as in Figure 1. The emission of carbon dioxide gas or Green House Gases are the main cause for climate changes thus there is a requirement to reduce them. If the size of a carbon footprint is known, then by implementing the policies can reduce it [8].

III. ANALYSIS OF EXISTING ENERGY EFFICIENT ALGORITHM

In this section, we have analyzed the existing WNS Algorithm and Data Centre Energy Efficient Algorithms [9]. The Figure 2 illustrates Green Energy Efficient Algorithms in Wireless Sensor Network and Cloud Data Centre. The Table 1 specifiesWNS Energy Efficient Techniques and Table 2 has algorithm of Cloud data center energy efficient algorithm [10][11].

A. WNS Energy Efficient Algorithm

The main problem in WNS is in remote area the sensor nodes are deployed are powered by a battery, which decreases the service life of the sensor node [12][13].

Aggregation Technique - As discussed by D Vinodha (2017) [2], Rault et al. (2014), and Dhand and Tyagi (2016) [31], by utilizing aggregation technique the information is accumulated together in the sensor node and send it in a single payload is called as aggregation. Considering the scenario where for example a 25 Nodes are associated with the SINK in a simulation geographical region and send the information to the SINK node with an equivalent interval of time. So whenever suppose aggregation strategy is engaged with this procedure implies every sensor node in that network aggregates at least three data and send it to the sink node. So that procedure builds the energy effectiveness in WSN.

Zigbee transceiver protocol technique - As discussed by Mohammed (2017) [3], this ZigBee transceiver protocol Technique is executed in the physical layer in light of the fact that the majority of the power utilization happens in this actual layer. This strategy improves energy effectiveness, bit error rate and throughput of the WSN. This procedure is executed and tried in simulation software with Additive White Gaussian Noises (AWGN) and Rayleigh level blurring channels. This method is actualized in different fading channel conditions. Furthermore, concluding an end that this procedure will diminish the re-transmission brought about by error, and furthermore can be utilized to decrease the impact of the multipath fading channel.

Double warning thresholds for preemptive charging schedule - As discussed by Lin et al. (2019) [4], the sensor nodes are actualized with a twofold threshold value. Different remote charging vehicles are utilized in WSN to energize the sensor nodes by utilizing the wireless medium. The sensor hubs are having two threshold values to be specific one for typical threshold value that shows the predictive value when the sensor hub going to kick the bucket and the subsequent value is the last edge which Simulation is carried out taking Virtual

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Machine (VM) [19] [24] as the real computers.

SCORE tool as defined by Fernandez-Cerero, D [33], defines this tool is used to simulate single chip energy efficient and parallel programming techniques, as well as heterogeneous workloads. The SCORE test system developed thus depends on the model proposed by Robinson. The primary work process of that test system can be characterized as follows: a. Definition and initialization of the issue; b. Assurance of the displaying and general goals; c. Distinguishing proof of the model sources of info; d. ID of the model yields; and e. Assurance of the model substance and level of detail.

Efficient Energy Task Provisioning for Distributed Cloud Networks using Meta Heuristic Multidisciplinary Technique as described by Dr Anirban Basu (2016) [21]. The energy efficient techniques give more attention to reduce the energy consumption in task resources such as CPU and memory but in this paper not only considering CPU and memory resources, it focuses on the network transmission bandwidth and switching components is also considered and developed an optimized energy efficient task provisioning for cloud data centers.

Energy Consumption Model as stated by Xiao long Xu in [9] an energy utilization model is proposed to compute the energy utilization in the cloud climate. This model partitions the energy utilization into two significant classifications, for example the energy utilization for application execution, and the energy utilization for dynamic tasks.

Green Cloud Computing (GCC) technique as mentioned by Chen, F, [25] decreases the organization and operational expenses and consequently save energy and diminish unfavorable ecological effects. To accomplish this objective, an intensive comprehension of the energy utilization designs in complex Cloud conditions is required. The examination results coordinated into Cloud frameworks to screen energy utilization and backing static or dynamic framework level enhancement.

George et al. [30] proposed a brand-new model which is the mixture of resource allocation, scheduling and auto-scaling algorithms, designed for allotting the right assets and organized them.

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Table 1: WNS Energy Efficient Techniques

Reference	Algorithm policy Improvement/Achievement or strategy	Problem Addressed Weakness/Limitations		
Reviewed papers on Data Reduction Technique				
(i) Data compression technique [5]	Error-Control Truncated Singular Value Decomposition (ETSVD)	Online outliner detection and adaptive data compression	ETSVD in terms of error and accuracy compared to the performance of conventional SVD are 85.26% and 33.49%	ETSVD doesn't behave the same way with larger data set.
[6]	Zoom-In Zoom-Out (ZIZO) mechanism a to minimize data transmission in WSN	Battery life improvement in WSN	reduced energy consumption by up to 90% in some cases	improve the compression ratio of IBE (Index-Bit-Encoding)
[16]	It is a combination of Delta and	handling high amounts of data	good compression ratio of 52.67% for 12bit ADC,	Only works for specific sensor data and

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	RLE compression techniques	with low bandwidth	without compromising on the quality of the data	cannot be generalized.
[23]	Run Length Encoding (RLE) algorithm	power consumption since it directly influences the lifetime of micro-sensors	performed 90% and 79% better in term of compression ratio for Temperature and Relative Humidity	The raw data output from the ADC (Analog to Digital Converter) in the sensor node is to be considered
[25]	Lightweight data compression with zero-cost encryption.	CS-based watermark cryptosystem for WSNs	cryptosystem can resist ciphertext-only attack and known-plaintext attack and detect denial of service attack	Encryption and decryption adds overhead on power consumption as the required energy for transmission is more

(ii) *Hybrid data reduction techniques*

[26]	Two-hierarchy Communication &Computation Hybrid Optimization (TCCHO) protocol	Energy consumed in data computation	Reduction of energy consumption	Generality of the protocol is not achieved

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(iii) Data aggregation technique [12]	Mixed integer linear programming disaggregation model	Energy efficiency of composable data centre (DC)	Reduction of energy consumption	Generality of the protocol is not achieved
B. Sleep/Wakeup Mechanism				
[3]	Coverage, routing, sleep/wakeup and retransmission	Optimize the lifetime of WSN	Reduced energy consumption	Homogeneous nodes are considered
[10]	Gradient based multi-path routing protocol (GMRP)	Delivery latency as well as high energy efficiency	Reduced latency and high performance	Single gradient is considered as performance metric.
[11]	Cross-layer duty cycle MAC protocol (P- MAC)	Saving energy and reducing end-to-end delivery latency	Improve performance	Pipelining adds overhead on load in WSN

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C. Energy efficient routing mechanism

[7]	Fuzzy logic-based clustering protocol	Load balancing, energy consumption minimization, and network lifetime prolongation	Reduced Energy Consumption compared to TTDFP Tier-1, EAMMH, EAUCF, and LEACH clustering algorithms	Implementation using interval type-2 fuzzy logic theory
[8]	Ant Colony optimization (CAVC)	network lifetime, QoS, and security	Prolonged network lifetime, reducing delay, and forwarding data through trusted nodes.	Weight vectors may be nontrivial.

Table 2: Cloud data center energy efficient algorithm

Reference	Algorithm policy or strategy	Problem Addressed	Improvement/Achievement	Weakness/Limitations
Energy management technique				
[15]	A stochastic process of disk state transitions	Optimal file placement for power management	Energy consumption can be reduced by 31.8%	Procedure fail in mixed storage architectures
[16]	Renewable resources and energy storages	energy management	Reduced power consumption	renewable resources management
[17]	Cooling-aware VM consolidation	Energy consumption	Reduced energy consumption	Heterogeneous physical machines.
Energy efficient resource provisioning				

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[18]	Energy Efficient Genetic Algorithm (EEGA).	Energy consumption	Reduced energy consumption	Heterogeneous physical machines
[21]	Heuristic algorithm	virtual machine placement and migration	minimize the energy consumption	Performanc degradation and SLA violation
[20]	VM Selection Policy (MCSSD)	Energy consumption	Reduced energy consumption and SLA violations	Practical situation implementation
Energy efficient scheduling algorithm				
[27]	Data-driven machine learning methods	Cooling cost and reliability, computational complexity	Reduces the peak temperature by 6.5®C and consumes 34.5 percent less energy	Implemented on homogenous nodes.
[28]	Voltage scaling approach Markov model, stochastic algorithm	Minimizing the electrical cost	Reduced costs	Integrating multiple factors
[29]	Genetic Simulated annealing-based Particle swarm optimization (GSP)	Optimized usage of limited resources	GSP achieves joint optimization of computation offloading between a cloud data center and the edge	Scalable memory of servers have huge impact on algorithm

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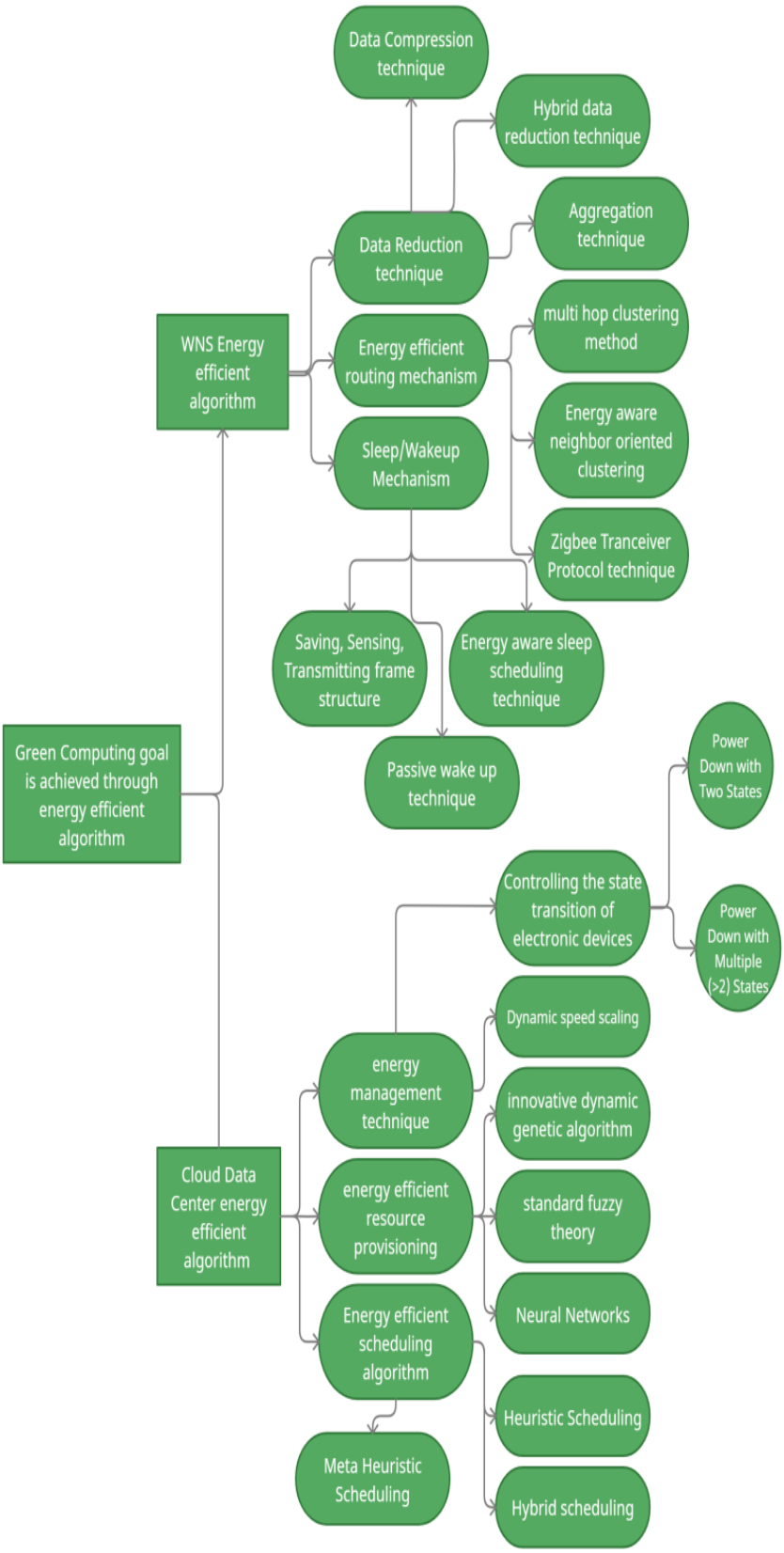

Figure 2: Green Energy Efficient Algorithms in Wireless Network Sensor and Cloud Data Centre

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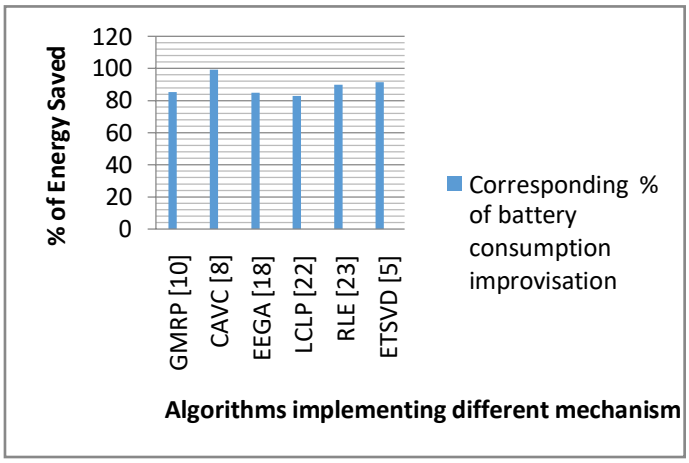

Figure 3: Energy saved using Energy Efficient Algorithms

From figure 3, we compare energy saved in terms of percentages against the various algorithm for implementing different mechanism.

From table 3, tabulated the various algorithm in terms of percentage of improvisation of various Energy Consumption.

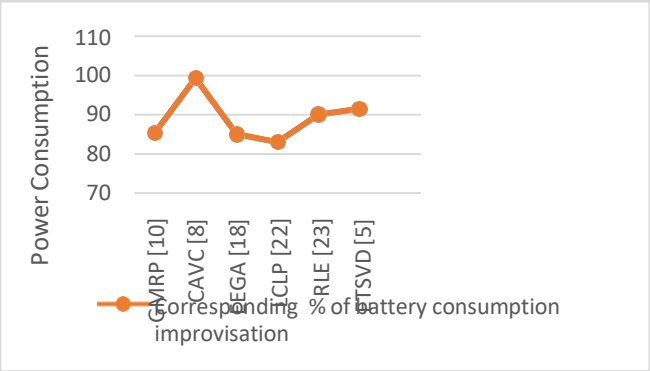

Figure 4: Power Consumption using Energy Efficient Algorithms

From figure 4, we plot the graph of power consumption against the battery consumption

V CONCLUSION

IV RESULTS AND DISCUSSION

The Objective of this paper is analyzing the different WNS energy efficient and Data Centre energy efficient algorithms [14][15]. The average performance of different algorithms and comparing the energy saved is as illustrated in Table 3.

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Table 3: Average performance of different algorithms

Algorithm	% Of energy consumption for improvisation
LCLP [22]	83
EEGA [18]	85
GMRP [10]	85.26
RLE [23]	90
ETSVD [5]	91.49
CAVC [8]	99.3

Our proposed work presents a Systematic Review on Energy Efficient Algorithm in Green Computing. Objective The Green computing is focusing on reducing the energy. We have investigated various state-of-arts energy efficient algorithms and categorized them as WNS energy efficient algorithms and Data Centre energy efficient algorithms but most of the articles have been screen out after the study and unfulfilled mentioned criteria, finally we have identified various research papers for our work. We have discussed fundamentals concepts and advantages of existing WNS energy efficient algorithms and Data Centre energy efficient algorithms. Further several notable scheduling algorithms are studied that are based upon heuristic, meta-heuristic and hybrid techniques. All the mentioned algorithms are discussed based upon QoS parameters, nature of tasks, techniques used to solve problem, We have observed that most of the algorithms have not considered some important QoS parameters, constraint and SLA violation. Maximum algorithms have some limitations that degrade the performance of the algorithm. Therefore, improvement is needed to enhance the performance of the algorithm.The Objective of this paper is analyzing the different WNS energy efficient and Data Centre energy efficient algorithms, comparing the energy saved and identifying maximum energy saving algorithm. This is further helpful for users as well as researchers to develop a new algorithm.

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