INTERNATIONAL JOURNAL OF

INNOVATIONS IN APPLIED SCIENCE

AND ENGINEERING

e-ISSN: 2454-9258; p-ISSN: 2454-809X

Developing an Integrated Model for Optimization of the Performance of Utilizing Green Information Technology for Energy Harvesting

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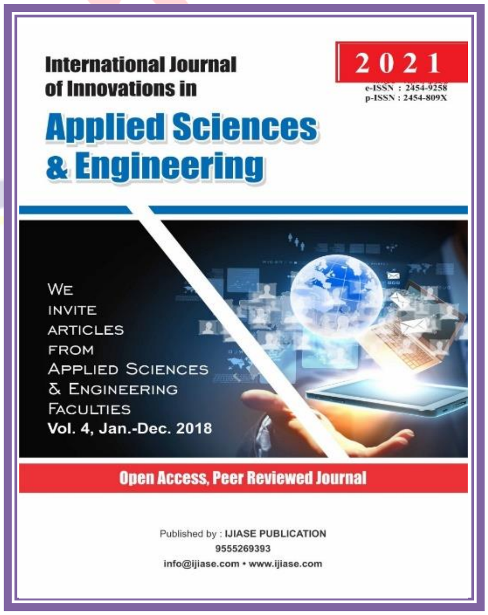
Paper Received: 08th May 2021; **Paper Accepted:** 25th June 2021;

Paper Published: 30th July 2021

How to cite the article:

Chandan Bansal, Developing an Integrated Model for Optimization of the Performance of Utilizing Green Information Technology for Energy Harvesting, IJIASE, January-December 2021, Vol 7; 196-210



ABSTRACT

Green information technology (IT) has the potential to revolutionize energy harvesting practices. Innovative approaches can be devised to capture energy from renewable sources like sunlight and wind, harnessing the capabilities of IT. This harvested energy can then be utilized to power households and perform various daily tasks. In this paper, we explore the opportunities presented by green IT for energy harvesting and discuss several applications. Among these, the utilization of intelligent grids stands out as a promising method for leveraging green IT in energy collection. Intelligent grids gather data from various components and transmit it to a central hub, aiming to optimize energy usage. By analyzing this data, the most cost-effective and efficient energy sources for a particular location can be identified, facilitating the integration of solar, wind, and other renewable energy sources into a more sustainable energy system. Additionally, green IT enables the development of efficient energy storage systems. By leveraging information technology, we can create energy storage solutions that are both effective and cost-efficient, utilizing batteries, solar energy systems, and other renewable resources. This ensures that energy remains readily available whenever and wherever needed, contributing to the establishment of a reliable energy storage infrastructure.

INTRODUCTION

In the contemporary world, the imperative to reduce energy consumption and carbon emissions is increasingly pressing. One innovative approach to addressing this challenge is the adoption of Green Information Technology (GIT) [1]. GIT encompasses a comprehensive array of methods, tools, and techniques aimed at enabling businesses to minimize energy usage, reduce their carbon footprint, and operate in a more environmentally sustainable manner [2]. Leveraging advanced technologies such as cloud computing, data centers, and interconnected devices, GIT empowers businesses to optimize their energy resources more efficiently [3]. By facilitating real-time monitoring of energy consumption, GIT provides organizations with valuable insights into their energy usage patterns, thereby identifying areas for improvement [4]. Moreover, GIT aids in reducing energy consumption by automating tasks such as scheduling power usage to coincide with off-peak times or maximizing the utilization of renewable energy sources [5]. Crucially, GIT plays a pivotal role in energy harvesting processes, enabling businesses to generate renewable energy to power their operations through technologies such as solar panels, wind turbines, and geothermal systems [6-7]. By harnessing GIT, businesses can enhance their energy harvesting endeavors, employing energy storage devices to store excess energy or deploying predictive analytics to optimize energy harvesting schedules [8–9].

Energy harvesting strategies must inherently integrate GIT [10]. By harnessing cutting-edge technologies, organizations can gain insights into their energy usage patterns, thus enabling the development of more effective energy harvesting methods [11]. This not only leads to cost savings but also contributes to reducing carbon emissions, thereby fostering a greener and healthier future [12]. Energy harvesting through green information technology (GIT) has emerged as a critical component in ensuring a sustainable future [13]. GIT confers several advantages to energy harvesting systems, enhancing their reliability and efficiency while minimizing their environmental impact [14]. Moreover, GIT facilitates the utilization of renewable energy sources, such as solar, wind, and hydroelectric power, thereby promoting sustainability [15]. By leveraging advanced algorithms, GIT aids in optimizing the utilization of various renewable energy sources and identifying optimal locations for deploying solar panels and wind turbines [16]. Additionally, GIT facilitates the development of efficient energy storage systems, enabling the storage of energy for extended periods with minimal loss, thereby enhancing the effective utilization of renewable energy sources [17-18]. Other GIT applications, such as smart grids, further contribute to enhancing energy efficiency [21]. By reducing energy wastage, GIT enhances the effectiveness of energy harvesting systems [22]. Furthermore, GIT can play a pivotal role in detecting and preventing energy theft and losses [23]. By minimizing the adverse environmental impacts of energy harvesting devices, GIT helps design and develop energy harvesting systems with a reduced carbon footprint [24-26]. Consequently, GIT emerges as a crucial tool for enhancing energy harvesting systems and ensuring a sustainable future [30].

RELATED WORKS

In the contemporary landscape, Green Information Technology (GIT) has emerged as a cutting-edge approach to energy harvesting, gaining increasing significance [31]. GIT encompasses a system comprising hardware, software, and services aimed at gathering, analyzing, and sharing data related to energy consumption, production, and conservation. By providing real-time data on energy production and consumption, GIT equips organizations with the necessary resources and insights to efficiently manage energy usage [32]. Moreover, GIT aids in identifying the most effective energy sources and areas for energy savings, thereby facilitating resource allocation decisions to meet energy efficiency objectives [33]. Furthermore, GIT holds the potential to drive the development of new renewable energy sources, such as solar, wind, and hydropower, by leveraging data analytics to optimize their utilization [34]. By monitoring energy usage and identifying opportunities for energy efficiency, GIT contributes to cost savings in energy expenditures [35]. Additionally, GIT enables the identification of potential sites for renewable energy development, further lowering overall energy costs [35]. Importantly, GIT holds the promise of creating a more sustainable energy future by enabling organizations to make informed decisions regarding energy consumption and renewable energy production [36]. Hence, the significance of GIT in energy harvesting cannot be overstated [37].

Given the global imperative to mitigate climate change and explore alternative energy sources, leveraging green information technology (GIT) for energy harvesting presents a compelling solution. This technology has the potential to revolutionize the generation, storage, and utilization of renewable energy, encompassing a broad range of technological solutions aimed at reducing energy consumption and increasing energy efficiency [38]. Key components of GIT include smart meters, energy management systems, and renewable energy systems, which enable organizations to monitor energy usage and identify opportunities for reduction [38]. By harnessing energy from renewable sources such as solar, wind, and wave power, energy harvesting through GIT offers a sustainable alternative to conventional energy sources [38]. The advantages of using GIT for energy harvesting include reduced reliance on fossil fuels, elimination of the need for costly infrastructure, and provision of a reliable energy source in remote or unstable locations [38]. While challenges remain, such as technological and regulatory barriers, the potential benefits of GIT for energy harvesting warrant further exploration [38].

PROPOSED MODEL

An innovative approach to energy conservation and sustainability involves leveraging green information technology (GIT) for energy harvesting. This technology, which has gained prominence in recent years, offers a practical solution for generating energy from renewable sources such as water, wind, and solar energy [39]. By capturing and converting energy from these renewable sources into electricity, GIT facilitates the transition towards a more sustainable energy future [39]. Although the process may seem straightforward, extensive research and development efforts have been devoted to optimizing energy harvesting techniques [39]. Energy harvesters play a crucial role in this process, as they capture and convert energy from renewable sources into electricity [39]. The architectural design of the green cloud, as depicted in Figure 1, illustrates this concept [39]. Additionally, GIT enables the monitoring and management of energy consumption in enterprises and buildings, thereby ensuring efficient energy utilization and cost savings [39]. By improving the efficiency of existing energy sources, such as solar panels, GIT contributes to a more sustainable future [39]. Energy harvesting through GIT reduces dependence on non-renewable sources and promotes the growth of renewable energy sources, thereby reducing carbon emissions and mitigating climate change [39]. Figure 2 illustrates the three-tier architecture of GIT, highlighting its role in enabling sustainable energy harvesting practices [39].

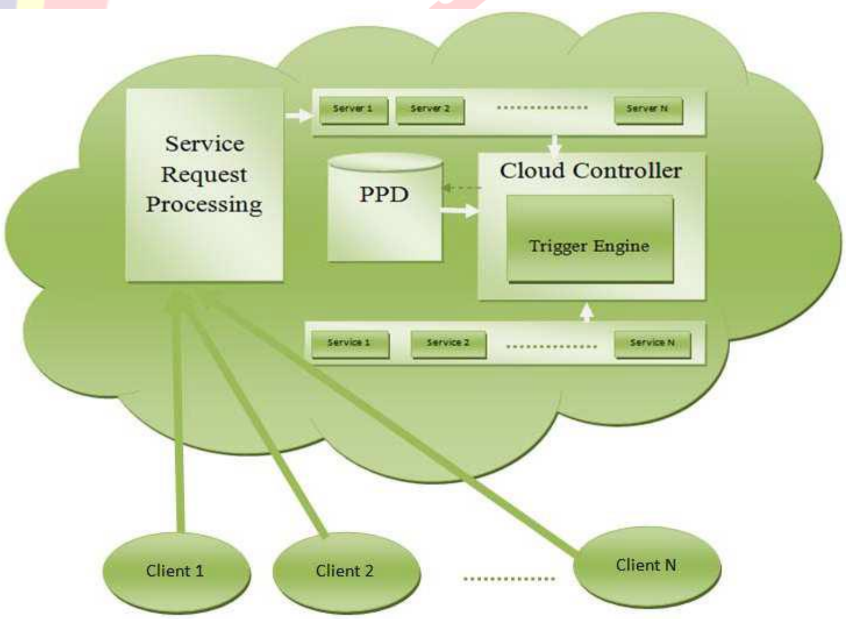


Fig. 1. Green cloud architecture

Utilizing Green Information Technology (GIT) for energy harvesting presents a creative solution to the challenge of maintaining a sustainable global energy supply. By harnessing renewable sources such as sunlight, wind, and hydropower, GIT enables power generation even in remote areas lacking access to conventional energy sources. While cost, efficiency, and environmental impact are key considerations in evaluating GIT's effectiveness for energy harvesting, the long-term benefits outweigh the initial investment. Despite being initially more expensive than conventional sources, GIT proves to be highly efficient, generating energy at a lower cost over time.

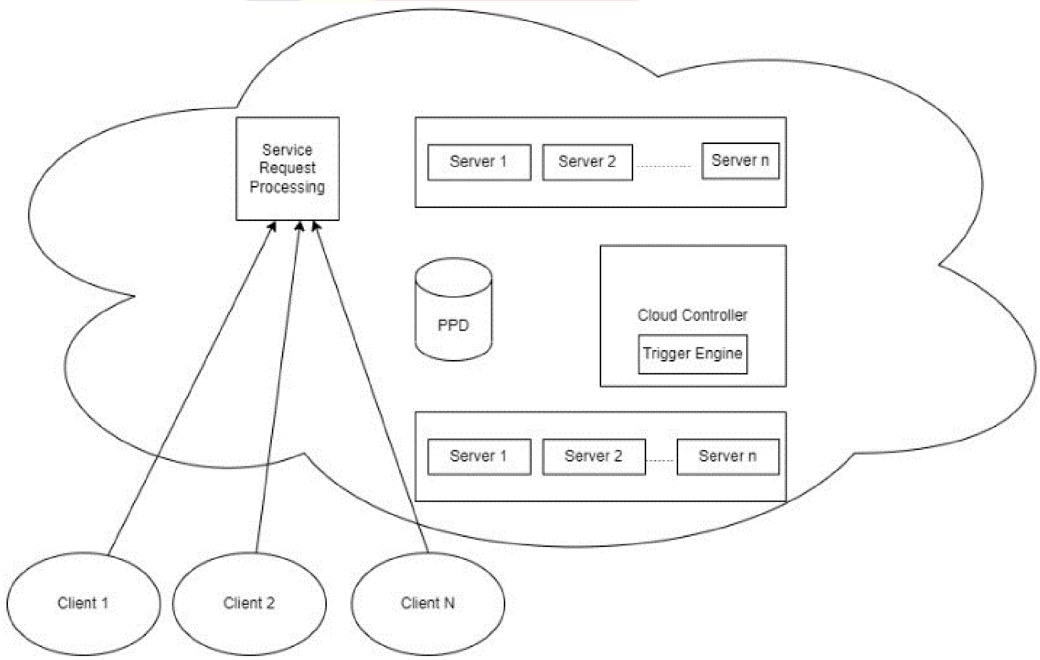


Fig. 2. Three tire architecture

Furthermore, GIT boasts a significantly smaller environmental footprint compared to conventional energy sources, making it a practical and efficient solution for global energy sustainability. Although still in its early stages, GIT shows promise as a viable alternative to traditional energy sources, but further research and development are needed for widespread adoption. It's crucial to remember that GIT works best when integrated with other energy sources such as wind or solar power. Hence, continued research and development efforts are essential to make GIT a practical substitute for conventional energy sources.

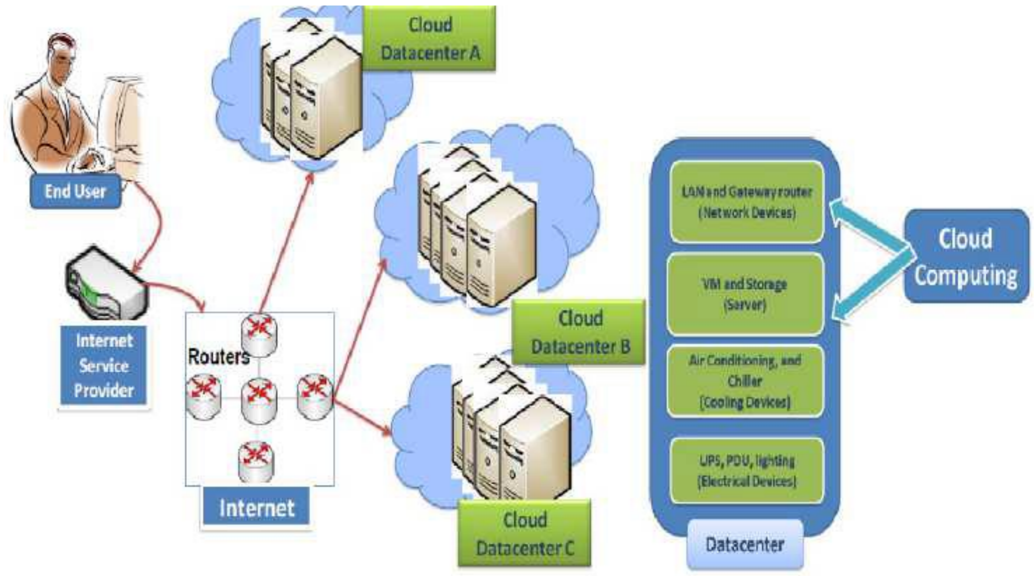


Fig. 3. Functions of green cloud

RESULTS AND DISCUSSION

Green Information Technology (GIT) has revolutionized energy consumption practices, allowing businesses to operate more efficiently and sustainably. By capturing energy from both conventional and renewable sources like coal, natural gas, solar, and wind power, GIT enables organizations to reduce energy costs and minimize their environmental impact. However, a critical challenge lies in optimizing GIT for energy harvesting, as illustrated in Fig. 4, which compares voltage vs. time.

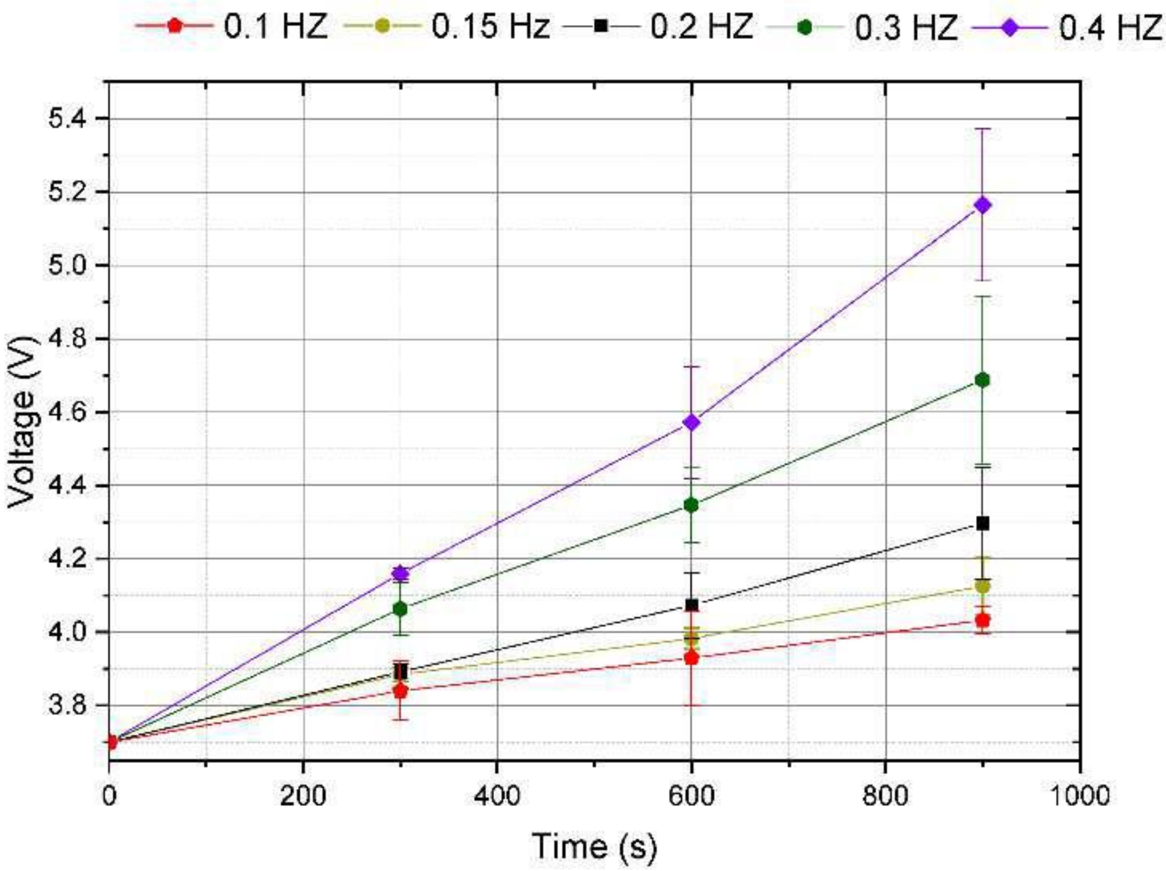


Fig. 4. Comparison of voltage vs time

Several factors must be considered to efficiently optimize GIT for energy harvesting. First, the type of energy source and the corresponding energy harvesting device must be carefully chosen to maximize performance while minimizing costs, as shown in Fig. 5, comparing open circuit voltage. Additionally, the environmental impact of the energy harvesting system must be evaluated to mitigate adverse effects, as depicted in Fig. 6, comparing power density.

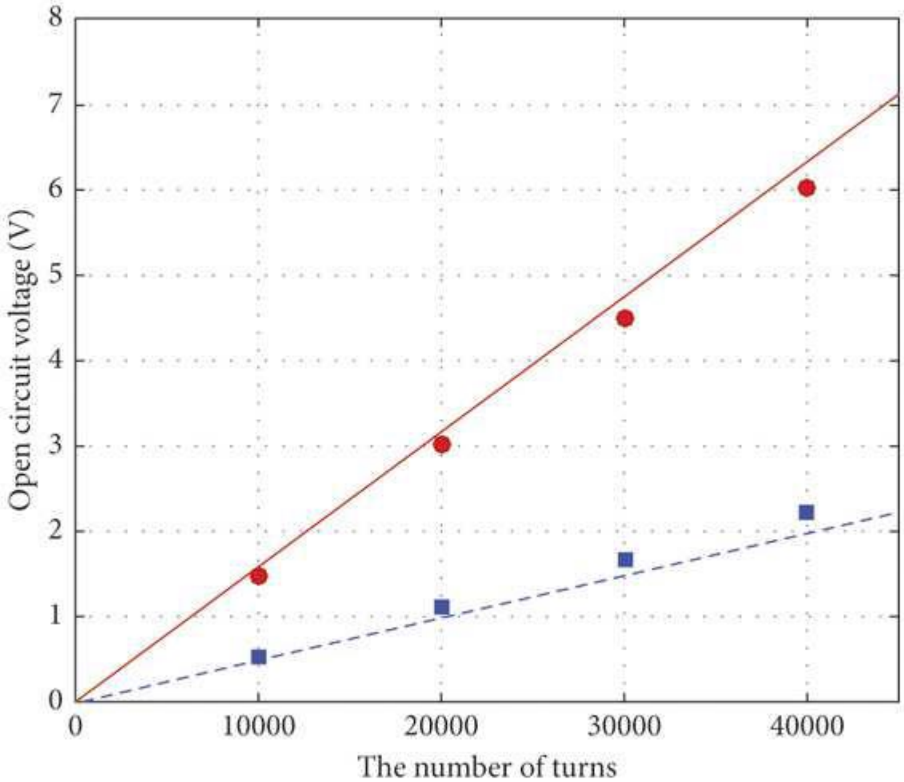


Fig. 5. Comparison of open circuit voltage

Moreover, scalability is crucial in determining the maximum energy obtainable from a given source and ensuring the energy harvesting system meets organizational needs. By carefully considering these factors, businesses can successfully optimize GIT for energy harvesting, reducing energy costs and environmental impact. The comparison of copper resistance in Fig. 7 highlights the importance of addressing performance optimization in GIT for energy harvesting.

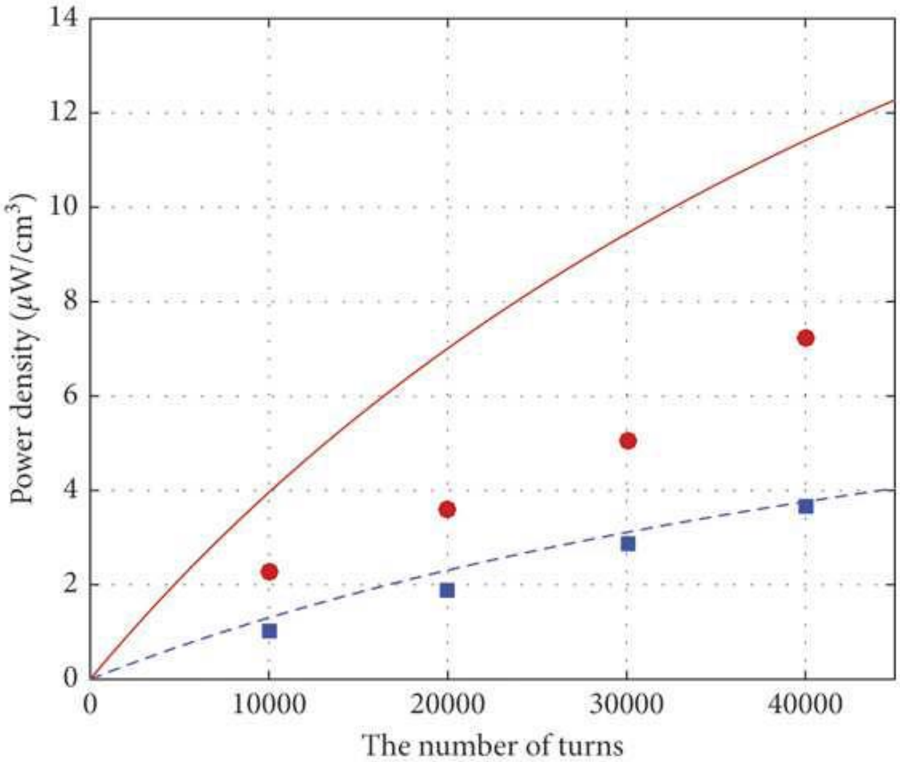


Fig. 6. Comparison of power density

Furthermore, the concept of "green information technology" (GIT) is pivotal for organizations aiming to reduce energy usage and promote sustainability. By leveraging technologies like cloud computing and communication networks, GIT enables businesses to become more energy-efficient and environmentally responsible, as shown in Table 1, displaying a comparison of overall performance. By harnessing renewable resources and tracking energy consumption, GIT facilitates energy efficiency improvements and informed decision-making, thus helping organizations lower energy bills and reduce their environmental footprint.

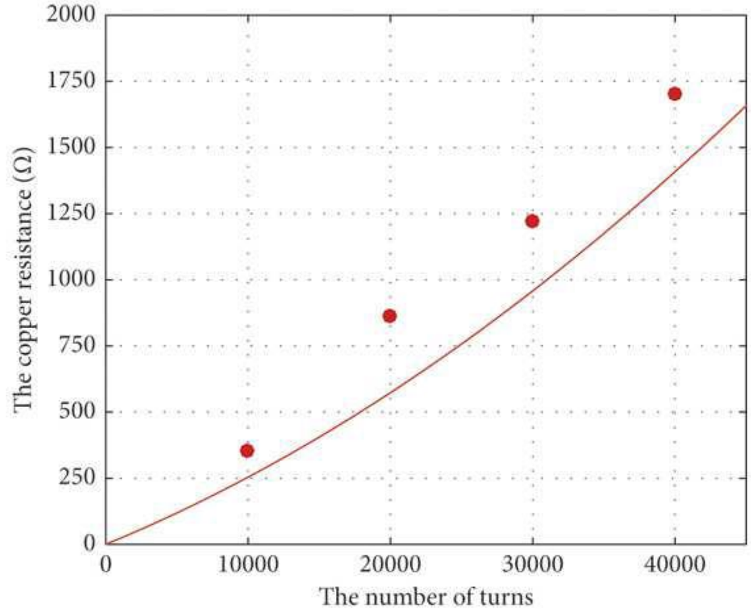


Fig. 7. Comparison of copper resistance

TABLE I. OVERALL PERFORMANCE COMPARISON

Input	[5]	[8]	[12]	[15]	Proposed
100	44.23	49.27	51.06	80.57	93.06
200	44.34	49.25	51.23	80.84	93.56
300	44.36	48.37	50.50	80.54	93.44
400	41.26	45.54	47.16	77.03	90.21
500	40.06	44.22	46.43	75.71	89.83
600	39.45	43.39	45.54	75.17	89.26
700	39.04	42.99	45.46	74.87	89.56

CONCLUSION

In conclusion, organizations should consider adopting GIT for energy harvesting to achieve energy savings, increase efficiency, and minimize environmental impact. Effective utilization of GIT requires investment in appropriate technologies such as communication networks and cloud computing, ultimately contributing to a more sustainable energy future.

In conclusion, the integration of smart meters with green IT offers a powerful tool for energy collection and storage. Smart meters enable the tracking of energy consumption at specific locations, facilitating the development of energy conservation strategies and incentives for reduced consumption. Furthermore, leveraging this data for predictive modeling allows for accurate forecasts of future energy requirements.

Green IT has the potential to revolutionize energy collection by enabling innovative approaches to harness renewable sources such as sunlight and wind. Additionally, it facilitates the development of more cost-effective and efficient energy storage solutions. Ultimately, these advancements contribute to the creation of a more environmentally friendly energy system, reducing our reliance on fossil fuels and promoting environmental sustainability.

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