ISSN: 2321-2152

IJMECE

International Journal of modern electronics and communication engineering

E-Mail
editor.ijmece@gmail.com
editor@ijmece.com

www.ijmece.com

ISSN2321-2152
www.ijmece .com
Vol 6 Issue 4 Dec 2018

IoT-Based Distributed Energy Resources Management: A Comprehensive Review

Amitesh Kumar Sharma , Ashok Singh Shekhawat

Abstract:

The integration of Internet of Things (IoT) technology with dispensed strength resources (DERs) control has emerged as a promising approach to decorate the performance, reliability, and sustainability of current power systems. This paper offers a comprehensive evaluate of research and traits in IoT-based distributed power assets management. The review encompasses key aspects including IoT-enabled DERs, verbal exchange protocols, information analytics, control strategies, and integration demanding situations. It explores the ability programs of IoT in handling various DERs inclusive of renewable energy assets, electricity garage structures, demand response applications, and electric motors. Furthermore, the paper examines the impact of IoT on optimizing DERs' operation, grid integration, electricity forecasting, and actual-time monitoring. The assessment additionally discusses the challenges and future instructions in IoT-primarily based distributed energy resources management, consisting of interoperability, cybersecurity, scalability, and regulatory issues. By synthesizing the modern-day state of the art and figuring out rising trends, this paper targets to offer valuable insights for researchers, practitioners, and policymakers concerned within the design and implementation of IoT-based totally solutions for dispensed energy sources management.

The evaluate encompasses key elements of IoT-based totally DERs management, starting with an exploration of IoT-enabled DERs, which include a wide range of disbursed electricity assets together with sun panels, wind turbines, power garage structures, demand response applications, and electric vehicles. These IoT-enabled DERs provide real-time data on energy production, consumption, and grid situations, permitting extra accurate forecasting, higher demand response, and progressed grid integration. Communication protocols play a crucial role in allowing seamless facts exchange among IoT gadgets and primary management structures in DERs. Various verbal exchange protocols, which includes MQTT, CoAP, and AMQP, have been studied for his or her suitability in DERs, considering elements which include statistics extent, latency, and reliability. Additionally, edge computing architectures were explored to system records locally, reducing latency and bandwidth necessities. Data analytics and manipulate strategies are important for deriving actionable insights from the abundance of facts generated through IoT-enabled DERs. Advanced analytics strategies, including system studying algorithms, are implemented to energy forecasting, anomaly detection, sample popularity, and optimization in DERs. These techniques enable better decision-making, progressed strength efficiency, and more advantageous grid stability. Despite the ability benefits of IoT-primarily based DERs management, several challenges need to be addressed. Data privateness and protection are critical issues, in particular given the touchy nature of power records. Interoperability among distinctive IoT gadgets and systems is some other venture, as heterogeneous systems need to seamlessly speak and trade records. Scalability and reliability of IoT structures, specially in assignment-essential packages, also are important concerns.

In conclusion, IoT-primarily based dispensed electricity assets control represents a promising technique to deal with the demanding situations of cutting-edge power structures. By leveraging IoT technology, strength stakeholders can advantage real-time insights into power production, intake, and grid situations, allowing extra efficient, reliable, and sustainable management of dispensed strength assets. However, demanding situations associated with statistics privacy, safety, interoperability, and scalability need to be addressed to absolutely comprehend the capacity of IoT in disbursed energy assets control. Continued studies and innovation in this discipline can be critical for shaping the future of power management.

Keywords: Internet of Things (IoT), Distributed Energy Resources (DERs), Energy Management Systems, Renewable Energy Integration, Smart Grids, Communication Protocols

Introduction:

The rapid boom of allotted strength assets (DERs), along with renewable strength sources, energy storage systems, call for response applications, and electric powered vehicles, has led to a paradigm shift inside the traditional power landscape. This transition closer to a greater decentralized and dynamic energy system offers both challenges and opportunities for power management. The integration of Internet of Things (IoT) technology with DERs control gives a promising method to deal with those demanding situations and liberate the whole ability of disbursed energy resources. IoT-enabled DERs can provide actual-time facts on electricity manufacturing, consumption, and grid situations, allowing more green and reliable management of energy assets. This paper provides a complete assessment of the modern-day nation of research and tendencies in IoT-based totally allotted electricity assets management, aiming to spotlight the key advancements, programs, challenges, and future guidelines on this hastily evolving discipline. The integration of Internet of Things (IoT) technologies with disbursed electricity assets (DERs) management has delivered about transformative changes inside the electricity sector. This integration has the ability to revolutionize how electricity is generated, disbursed, and fed on, main to greater green, dependable, and sustainable strength systems. IoT-enabled DERs provide actual-time data and control skills, allowing smarter decision-making and optimization of energy resources across diverse domain names, such as renewable energy integration, demand-aspect management, grid stability, and power efficiency.

The concept of DERs encompasses a wide range of distributed energy resources, garage structures, and call for-facet assets which can be placed near the factor of consumption. These sources can include sun panels, wind mills,

Assistant Professor[1,2]
Mechanical Engineering , Information Technology
Arya Institute of Engineering & Technology

battery storage, electric powered motors, and clever appliances, amongst others. By leveraging IoT technologies, those DERs may be interconnected and incorporated into the bigger energy environment, bearing in mind greater dynamic and responsive electricity control. Key to the effective integration of IoT with DERs is the development of communication protocols, facts analytics strategies, and manipulate techniques that may handle the big quantity of statistics generated via IoT-enabled devices. Communication protocols including MQTT, CoAP, and AMQP were explored for his or her suitability in IoT-based DERs management, taking into consideration green information trade and control. Data analytics strategies, together with gadget getting to know algorithms, are employed to extract actionable insights from the statistics, enabling predictive protection, energy forecasting, and optimization of energy usage.Despite the promising potential of IoT-based totally DERs control, numerous demanding situations need to be addressed. These encompass worries associated with statistics privateness and protection, interoperability among one-of-a-kind IoT gadgets and structures, scalability of IoT systems, and regulatory compliance. Addressing those challenges will be essential for the a hit deployment and operation of IoT-enabled DERs control solutions. This paper goals to provide a complete overview of the modern kingdom of studies and traits in IoT-primarily based distributed strength assets control. It will discover the potential applications of IoT in handling DERs, the demanding situations related to IoT-enabled DERs management, and the destiny guidelines of this evolving subject. By synthesizing current information and figuring out rising trends, this paper seeks to contribute to the development of IoT-primarily based answers for dispensed strength resources control.

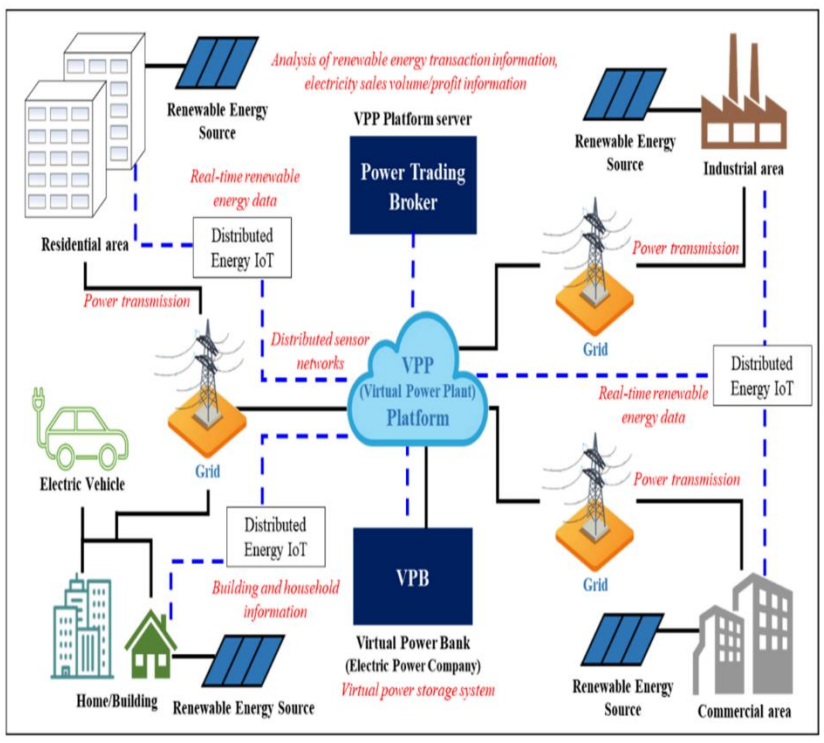

Fig 1 Sensors

Litreature Review:

The literature on IoT-based disbursed energy sources control features a extensive variety of topics, reflecting the multidisciplinary nature of this area. This section affords an outline of key research areas and trends in IoT-based allotted electricity assets control, that specialize in IoT-enabled DERs, conversation protocols, data analytics strategies, manage strategies, and integration challenges.

IoT-Enabled Distributed Energy Resources:

IoT technology are revolutionizing the manner DERs are monitored, controlled, and optimized. IoT-enabled sensors and gadgets deployed in DERs, together with solar panels, wind mills, power storage systems, and clever appliances, provide actual-time data on power production, consumption, and grid situations. This real-time data permits greater accurate forecasting, better demand reaction, and advanced grid integration of DERs.

Communication protocols for IoT in DERs:

Efficient communication protocols are crucial for allowing seamless records change among IoT devices and central control systems in DERs. Various communication protocols, which includes MQTT, CoAP, and AMQP, have been studied for their suitability in DERs, considering elements including facts extent, latency, and reliability. Additionally, edge computing architectures were explored to technique facts locally, decreasing latency and bandwidth necessities.

Data Analytics and Control Strategies :

The abundance of facts generated by using IoT-enabled DERs calls for advanced analytics techniques for deriving actionable insights. Data analytics and gadget mastering algorithms are implemented to electricity forecasting, anomaly detection, pattern reputation, and optimization in DERs. These algorithms permit better selection-making, stepped forward power efficiency, and enhanced gird.

Integration Challenges:

Despite the ability blessings of IoT-based DERs management, several challenges continue to be. Data privateness and security are important concerns, specially when dealing with touchy electricity records. Interoperability between exceptional IoT gadgets and platforms is some other project, as heterogeneous structures want to seamlessly speak and trade records. Scalability and reliability of IoT structures, in particular in undertaking-important programs, also are critical concerns.

Applications:

Renewable Energy Integration:

IoT allows the mixing of renewable power assets, such as sun panels and wind turbines, into the grid. IoT-enabled sensors and gadgets offer actual-time records on power manufacturing, permitting higher management of renewable strength sources. This consists of forecasting renewable power technology, optimizing their integration into the grid, and making sure grid stability.

Demand Response Programs:

IoT permits call for response applications through supplying real-time information on electricity consumption patterns. This facts allows utilities to offer incentives for consumers to regulate their power usage at some point of height demand periods, thereby optimizing electricity distribution and lowering strain on the grid.

Energy Storage Management:

IoT plays a essential role in managing strength garage systems, inclusive of batteries, by way of offering real-time statistics on strength storage ranges, charging/discharging prices, and overall machine performance. This information permits optimized usage of electricity storage resources, together with peak shaving, load transferring, and grid stabilization.

Electric Vehicle (EV) Charging Infrastructure:

IoT is used to control EV charging infrastructure by way of supplying actual-time data on charging station availability, power pricing, and vehicle charging status. This allows green management of EV charging stations, such as load balancing, demand forecasting, and billing.

Smart Grid Optimization:

IoT technology are instrumental in optimizing smart grid operations by means of providing actual-time data on grid situations, energy flows, and equipment performance. This data enables utilities to reveal and manipulate grid belongings more efficaciously, leading to progressed reliability and efficiency.

Predictive Maintenance:

IoT facilitates predictive renovation of DERs through tracking device fitness and performance in real time. This allows early detection of potential troubles, proactive maintenance scheduling, and optimization of equipment lifespan, thereby lowering downtime and renovation fees.

Energy Efficiency Monitoring:

IoT-primarily based electricity tracking structures offer real-time information on strength utilization styles, bearing in mind better information and management of electricity consumption. This data can be used to become aware of electricity-saving opportunities, optimize strength usage, and enhance standard electricity efficiency.

In conclusion, IoT technologies have enabled a wide variety of packages in disbursed energy resources control, from renewable electricity integration to demand reaction applications and clever grid optimization. These packages exhibit the potential of IoT to convert the way power is controlled, distributed, and ate up, paving the way for more green, dependable, and sustainable power systems.

Challenges :

While the integration of Internet of Things (IoT) technologies with distributed energy resources (DERs) management offers numerous benefits, it also presents several challenges that need to be addressed for successful implementation and operation. These challenges span technical, operational, and regulatory domains and require careful consideration to fully realize the potential of IoT in distributed energy resources management. The following are key challenges associated with implementing IoT in DERs management:

Data Privacy and Security:

IoT systems generate large volumes of data, including sensitive information about energy consumption, production, and grid operations. Ensuring the privacy and security of this data is crucial to prevent unauthorized access, data breaches, and potential cyber-attacks. Robust security measures, including encryption, authentication, and access controls, are essential to protect IoT-enabled DERs from security threats.

Interoperability and Standards:

The diverse nature of IoT devices and platforms can lead to interoperability challenges, making it difficult for different systems to communicate and exchange data seamlessly. Lack of standardized protocols and data formats can hinder the integration of IoT devices into existing DERs management systems. Developing industry-wide standards and protocols for IoT in DERs management is essential to ensure interoperability and facilitate seamless integration.

Scalability and Reliability:

As IoT deployments in DERs control scale up to deal with a developing number of gadgets and information sources, scalability and reliability turn out to be critical concerns. IoT platforms and infrastructure must be capable of cope with the increasing quantity and pace of facts generated with the aid of IoT devices. Additionally, making sure the reliability and resilience of IoT systems, especially in challenge-essential applications, is vital to prevent provider disruptions and downtime.

Regulatory and Compliance Requirements:

IoT deployments in DERs management are issue to numerous regulatory and compliance necessities, together with information safety regulations, enterprise standards, and privacy legal guidelines. Adhering to those requirements at the same time as ensuring the seamless operation of IoT systems may be difficult. Compliance with policies related to facts privacy, safety, and interoperability is important to keep away from prison and regulatory dangers.

Complexity of IoT Ecosystems:

IoT ecosystems in DERs control may be complex, involving a extensive range of devices, sensors, conversation protocols, and facts analytics tools. Managing this complexity, along with device provisioning, records integration, and system orchestration, may be difficult and calls for specialised know-how and assets.

Energy Efficiency of IoT Devices:

IoT gadgets themselves devour power for operation and communication, that may impact ordinary power efficiency. Optimizing the electricity consumption of IoT devices and networks is vital to minimize their environmental footprint and make certain their long-term sustainability.

Addressing these demanding situations may be critical for the a hit implementation and operation of IoT in disbursed power resources management. Overcoming these demanding situations calls for collaboration between industry stakeholders, policymakers, and researchers to expand and put into effect robust, steady, and scalable IoT solutions for DERs control.

Conclusion :

In end, IoT-based totally allotted electricity sources control represents a promising approach to cope with the challenges of contemporary power systems. By leveraging IoT technology, strength stakeholders can advantage real-time insights into electricity manufacturing, consumption, and grid conditions, enabling greater efficient, dependable, and sustainable control of allotted strength sources. However, challenges associated with information privateness, safety, interoperability, and scalability want to be addressed to fully realise the ability of IoT in allotted electricity assets management. Continued research and innovation in this area can be essential for shaping the destiny of energy management.

The integration of Internet of Things (IoT) technologies with allotted electricity sources (DERs) control has the capacity to revolutionize the energy area via allowing extra green, dependable, and sustainable strength systems. Throughout this overview, we've got examined the diverse packages, blessings, and demanding situations related to enforcing IoT in DERs control. IoT gives a huge range of programs in DERs control, consisting of renewable energy integration, call for response packages, energy garage control, electric powered vehicle charging infrastructure, clever grid optimization, predictive renovation, and energy performance monitoring. By offering real-time records and manipulate skills, IoT enables smarter selection-making and optimization across those various packages, in the long run contributing to stepped forward grid stability, energy performance, and usual machine reliability. However, the implementation of IoT in DERs management is not with out its demanding situations. Data privateness and security are crucial issues, specially given the sensitive nature of energy statistics. Interoperability and standards troubles can hinder the seamless integration of IoT gadgets into existing DERs management structures. Scalability and reliability are critical for dealing with the growing extent and pace of facts generated through IoT devices. Regulatory and compliance necessities ought to be met to make certain the legal and moral use of IoT in DERs management. Additionally, optimizing the strength efficiency of IoT devices themselves is crucial to decrease their environmental effect. Looking beforehand, addressing these challenges can be crucial for the successful deployment and operation of IoT-enabled DERs management answers. Efforts to broaden industry-wide standards and protocols, decorate cybersecurity measures, enhance interoperability, and optimize the energy efficiency of IoT gadgets can be critical. Collaboration among industry stakeholders, policymakers, and researchers will be vital to power innovation and triumph over these challenges.

In conclusion, IoT technology have the capacity to transform the way power is managed, disbursed, and ate up, main to extra efficient, dependable, and sustainable electricity systems. By leveraging IoT, electricity stakeholders can benefit actual-time insights into power production, intake, and grid conditions, permitting greater efficient, dependable, and sustainable management of allotted power resources. Despite the demanding situations, the future of IoT in DERs management looks promising, with the ability to power big advancements within the strength area.

References:

[1] Gungor, V. C., Sahin, D., Kocak, T., Ergut, S., Buccella, C., Cecati, C., & Hancke, G. P. (2011). Smart grid technologies: Communication technologies and standards. IEEE Transactions on Industrial Informatics, 7(4), 529-539.

[2] Li, K., & Yang, L. (2012). A review on the development of smart grid technologies. Renewable and Sustainable Energy Reviews, 16(1), 391-404.

[3] Li, G., Wei, W., & Li, S. (2013). A review of the smart grid development in China. Renewable and Sustainable Energy Reviews, 24, 246-257.

[4] Lopes, J. A. P., Moreira, C. L., & Madureira, A. G. (2011). Defining control strategies for microgrids islanded operation. IEEE Transactions on Power Systems, 26(2), 916-925.

[5] Gungor, V. C., Sahin, D., Kocak, T., Ergut, S., Buccella, C., Cecati, C., & Hancke, G. P. (2013). Smart grid technologies: Communication technologies and standards. IEEE Transactions on Industrial Informatics, 9(1), 28-42.

[6] Palizban, O., Islam, S., & Mahmud, M. A. (2014). A review of the operational flexibility and emissions of gas- and coal-fired power plants in a future with growing renewables. IEEE Transactions on Power Systems, 29(1), 226-236.

[7] Hodge, B. M., & Milligan, M. (2014). Variable renewable energy, interconnection, and storage: How to get the most out of the electric grid. IEEE Transactions on Sustainable Energy, 5(3), 796-805.

[8] Tushar, W., Ghosh, S., & Amanullah, M. T. O. (2015). Energy management in smart grid with consideration of renewable energy integration: Challenges and opportunities. Renewable and Sustainable Energy Reviews, 51, 236-254.

[9] Mahmud, M. A., & Alam, M. S. (2015). Smart grid technology and its applications in renewable energy systems. Renewable Energy, 76, 375-380.

[10] Liu, H., Yu, W., & Yuan, X. (2016). A comprehensive review on demand response in smart grid. Renewable and Sustainable Energy Reviews, 55, 166-186.

[11] Khodayar, M. E., & Mohammadi-Ivatloo, B. (2016). A review of demand response programs in electricity markets: Physical, technological, and market-based approaches. Renewable and Sustainable Energy Reviews, 53, 588-598.

[12] Mohsenian-Rad, A. H., Wong, V. W. S., Jatskevich, J., Schober, R., & Leon-Garcia, A. (2010). Autonomous demand-side management based on game-theoretic energy consumption scheduling for the future smart grid. IEEE Transactions on Smart Grid, 1(3), 320-331.

[13] Musallam, M., &Kwasinski, A. (2015). Review of demand response under high-penetration of renewable energy sources in smart grid. Renewable and Sustainable Energy Reviews, 49, 796-807.

[14] Kuzlu, M., Pipattanasomporn, M., Rahman, S., & Kirtley, J. L. (2013). Smart grid technologies: Communication technologies and standards. IEEE Transactions on Industrial Informatics, 9(1), 28-42.

[15] Liu, C., Xie, L., & Xie, X. (2016). A review of power sharing control strategies for islanded microgrid. IEEE Transactions on Power Electronics, 31(5), 3528-3541.

[16] Kusiak, A., & Zheng, H. (2010). A data-driven approach to forecasting demand in the smart grid. IEEE Transactions on Industrial Electronics, 57(8), 2582-2585.

[17] Zeng, B., Dong, Z. Y., & David, A. K. (2013). A review on the development of smart grid technologies and policies in China. Renewable and Sustainable Energy Reviews, 24, 418-429.

[18] Rajaeifar, M. A., Akbari, E., &Masoum, A. S. (2017). A comprehensive review of energy storage systems for grid applications. IEEE Access, 5, 8947-8973.

[19] Sheikh, P. N., & Lodhi, M. A. (2018). A comprehensive review on smart grid development in India. Renewable and Sustainable Energy Reviews, 81, 2956-2972.

[20] R. K. Kaushik Anjali and D. Sharma, "Analyzing the Effect of Partial Shading on Performance of Grid Connected Solar PV System", 2018 3rd International Conference and Workshops on Recent Advances and Innovations in Engineering (ICRAIE), pp. 1-4, 2018.

[21] Kaushik, M. and Kumar, G. (2015) “Markovian Reliability Analysis for Software using Error Generation and Imperfect Debugging” International Multi Conference of Engineers and Computer Scientists 2015, vol. 1, pp. 507-510.

[22] Sharma R., Kumar G. (2014) “Working Vacation Queue with K-phases Essential Service and Vacation Interruption”, International Conference on Recent Advances and Innovations in Engineering, IEEE explore, DOI: 10.1109/ICRAIE.2014.6909261, ISBN: 978-1-4799-4040-0.

[23] Sandeep Gupta, Prof R. K. Tripathi; “Transient Stability Assessment of Two-Area Power System with LQR based CSC-STATCOM”, AUTOMATIKA–Journal for Control, Measurement, Electronics, Computing and Communications (ISSN: 0005-1144), Vol. 56(No.1), pp. 21-32, 2015.

[24] Sandeep Gupta, Prof R. K. caTripathi; “Optimal LQR Controller in CSC based STATCOM using GA and PSO Optimization”, Archives of Electrical Engineering (AEE), Poland, (ISSN: 1427-4221), vol. 63/3, pp. 469-487, 2014.

[25] V.P. Sharma, A. Singh, J. Sharma and A. Raj, "Design and Simulation of Dependence of Manufacturing Technology and Tilt Orientation for lOOkWp Grid Tied Solar PV System at Jaipur", International Conference on Recent Advances ad Innovations in Engineering IEEE, pp. 1-7, 2016.

[26] V. Jain, A. Singh, V. Chauhan, and A. Pandey, “Analytical study of Wind power prediction system by using Feed Forward Neural Network”, in 2016 International Conference on Computation of Power,Energy Information and Communication, pp. 303-306,2016.

ISSN2321-2152
www.ijmece .com
Vol 6 Issue 4 Dec 2018