APPLICATION OF IOT IN RENEWABLE ENERGY SYSTEM

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ABSTRACT

The growing interest in smart cities, the necessity of having a power supply that is both efficient and dependable has come more into the spotlight. The efficiency with which intelligent devices carry out their functions is directly correlated to the dependability of the power supply. Utilizing the potential contributions that may be made by diverse renewable energy sources is one of the most effective ways to meet the need for smart cities, which is a goal that can be achieved by integrating various kinds of renewable energy generation with the internet of things (IoT). The use of the internet of things to the production of renewable energy is predicated on the exploitation of intelligent sensors for the purpose of energy transmission and distribution. Businesses have the advantage of being able to monitor their equipment in real time when they employ remote control access. The utilization of intelligent sensors and remote-control access contributes to a reduction in the total cost of operations, while also helping to diminish the reliance on traditional sources of energy and fossil fuels, which are both limited resources.

INTRODUCTION

Renewable forms of energy are gaining ground despite the accelerating rate at which fuel reserves are being exhausted. This is due to the fact that the rate at which fuel reserves are being drained is speeding. Green resources refer to any form of energy that is useful to humans as well as the surrounding natural environment. The word "renewable energy" refers to power

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that is derived from resources that exist naturally, are capable of providing or renewing themselves, and do not deplete the natural resources of the earth.

This type of power is considered to be "green" energy. Examples of these ecologically beneficial resources include the sun, wind, rain, waves, and tides, as well as other naturally occurring phenomena. One may claim that the quantity of energy that comes from renewable sources is virtually limitless. Every type of energy, regardless of whether it comes from a renewable source or a nonrenewable source like fossil fuel, has some kind of impact on the surrounding ecosystem. The world's ongoing reliance on fossil fuels, which are the primary cause of the emission of greenhouse gases and produce dangerous particles as a byproduct of their combustion, continues to have a detrimental effect on the health of the world's population. When compared to the benefits of non-renewable energy, the benefits of renewable energy include a reduction in the utilization of land and water, a drop in air and water pollution, and either no emissions of greenhouse gases or a reduction in emissions of greenhouse gases. Other benefits include a reduction in the amount of pollution in the air and the reduction of greenhouse gas emissions.

The potential of the internet of things (IoT) to link commonplace devices to the internet will make this a reality. One strategy for achieving this objective is to design the network in such a manner that it incorporates sensors, actuators, and metering devices, and also provides support for a range of system automation and network functions. Developing technologies that are connected to the Internet of Things provide robust infrastructures that make it feasible for a range of smart grid applications to gather, process, send, and store data. The Internet of Things (IoT) technology has gained great attention across a broad number of application domains, including smart homes and buildings, healthcare, agriculture, and urban areas, amongst others.

REVIEW OF LITERATURE

Garima Sinha (2020) In recent years, there has been a rise in interest in smart cities, which has brought to the forefront the significance of having a power supply that is both efficient and dependable. This relevance has been brought to the forefront due to the fact that it has become more of a priority. This is due to the fact that smart cities are gaining more and more popularity. The efficiency with which intelligent devices carry out the responsibilities for which they were intended has a direct correlation with the dependability of the power supply. The Internet of

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Things (IoT) and the many different types of renewable energy generation can make it feasible for smart cities to more efficiently supply the demand for them. This is a goal that may be achieved by capitalizing on the potential contributions that may be offered by renewable energy sources. This is a target that can be attained. In order for the internet of things to be beneficial in the creation of renewable energy, it is important to deploy intelligent sensors for the purpose of energy transmission and distribution.

Sivagami Ponnalagarsamy (2015) The Internet of Things, often known as IoT, is the type of computer technology that consumers presently have access to that is the most cutting-edge and futuristic in its approach. The phrase "internet of things" (IoT) refers to the network of intelligence that links various electronic gadgets and computer systems that are located in various regions of the world by utilizing cloud portals to communicate with one another. This network of intelligence is referred to as the "internet of things." Several computer systems and electrical gadgets are connected to one another through this intelligence network. There might be millions or perhaps billions of linked gadgets in the world one day thanks to the Internet of Things. This is certainly not outside the bounds of the possible. As a result of the Internet of Things, the management of massive volumes of data, the analysis of those enormous amounts of data, and the execution of beneficial management activities are all made simpler and more secure. The Internet of things will eventually lead to the replacement of communication between persons and other people with communication between items. This will happen as a direct result of the IoT. Instead of the other way around, this change will take place. There is not a single sector that will not be affected in some kind by the Internet of Things and the applications that operate on it in the foreseeable future.

Maria G. Ioannides (2021) The Internet of Things (IoT) is a system that was developed with the goal of overseeing, regulating, and administering a broad variety of enterprises, marketplaces, and other sorts of organizations of all shapes and sizes. These industries and sectors include the maritime industry, healthcare, education, energy, and smart cities, in addition to the environment, transportation, manufacturing, and industrial automation. Other industries and sectors include industrial automation, manufacturing, and manufacturing automation. The Internet of Things (IoT) came into being when a number of different devices were networked together via the internet. In recent years, new markets have emerged in a variety of fields, including industrial motion motors, renewable energy systems, sensors, and actuators, amongst others. These new markets have been driven by technological advancements. The advent of new technologies has been the impetus behind these emerging markets. In this article, we use examples from the real world to illustrate how specific apps for the Internet of Things may be conceived of and built for wind energy producing devices and electric motors. These applications can be used to collect data, monitor and control the equipment. The incorporation of technologies based on the Internet of Things into the control systems of electric machines, most commonly in the context of applications involving motor drives and systems that generate wind energy, contributes to improved performance monitoring and management in addition to the possibility of reduced energy consumption. These applications are most commonly found in the context of applications involving motor drives and systems that generate wind energy. The contexts in which these applications are most commonly seen are those involving motor drives and systems that generate wind energy. Experimental settings, which also increase the infrastructure of the laboratory, may be beneficial to engineering education because they provide new teaching and research perspectives that can be utilized in the classroom. This is because experimental settings improve the infrastructure of the laboratory. In addition, the infrastructure of the laboratory is enhanced as a direct result of the experimental setups being carried out there.

John et al. (1984) provided more information about the particulars of this pattern of change, which occurred in the power distribution system between the years 1960 and 1980. These alterations were substantial in nature. Their investigations investigated a variety of demand management strategies that were utilized often throughout that era of time. This book also includes a discussion on the utilization of renewable energy sources such as solar, wind, tidal, and hydro, which may be found in the appendix. The process of incorporating renewable energy sources into the electrical grid has been in the planning stages for the past three decades, and it is only now getting off the ground.

RESEARCH METHODOLOGY

In the year 1999, Kevin Ashton offered the first idea for what would later be known as the Internet of Things (IoT). Since that time, it has found applications in a wide range of industries, including as the medical industry, agriculture, the transportation industry, and power grids. The Internet of Things (IoT) is an ambitious initiative that aims to break down barriers caused by both time and distance by bringing previously disconnected objects together via the use of various networking technologies. The Industrial Internet of Things (IoT) has been applied in a variety of production environments, some of which are quite unique from one another.

The ideal way to conceive of the Industrial Internet of Things (IoT) is as an embedded system that optimizes the performance of production processes by utilizing a real-time network. This network is connected to the devices that are being manufactured. When used in this context, the term "real-time system" refers to "the system in which the correctness of the system does not depend only on the logical results of computation but also on the time at which the results are produced." In other words, the correctness of the system is dependent not only on the logical results of computation but also on the time at which the results are produced. In other words, the correctness of the system is reliant not only on the logical results of computing but also on the time at which the results are created.

IOT-BASED MONITORING SYSTEM FRAMEWORK

The Internet of Things (IoT) must be able to manage and analyze data in real time while experiencing extremely low latency if it is to stand out from other technologies. This is one of the characteristics that distinguishes IoT from other technologies. One of the differentiating characteristics that sets IoT apart from previous technologies is the presence of this functionality. Real-time monitoring systems are able to provide information to system operators about the general status of the monitoring objects they are keeping an eye on when they are placed in power substations. These systems are keeping an eye on. As a consequence of this, there is a chance that not only the dependability of the system, but also the efficiency with which it is operated, will be enhanced. During the course of this inquiry, we will make use of a Field-Programmable Gate Array (FPGA) integrated controller that is built in accordance with a particular industry standard.

The controller has been pre-programmed to use Linux as its operating system (OS), and it has been given the instruction to collect data in real time using a range of sampling rates concerning the voltage, actual power, and reactive power as well as the state of the circuit breaker and the temperature of the transformer. Additionally, the controller has been instructed to monitor the temperature of the transformer. In addition to that, the controller now has the capability to keep an eye on the temperature of the transformer. Field programmable gate arrays (FPGAs) are produced using reprogrammable silicon chips, which gives them a bigger processing capacity

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in addition to a faster reaction time than digital signal processors (DSPs), which are made using non-reprogrammable silicon chips. DSPs are referred to by its acronym in full, which stands for digital signal processors. Digital signal processors are composed of silicon. At current moment, a wide range of research projects have shown a variety of uses for the FPGA technology, which may be employed in a variety of contexts. These applications can be utilized to improve the efficiency of various processes.

DATA ANALYSIS

Wind power, which is widely recognized as one of the most promising kinds of renewable energy, has been the focus of a substantial amount of research and development work since the 1990s. By the end of the year 2017, the capacity has expanded all around the world by more than 51.2 GW. Nevertheless, the widespread implementation of wind power brought with it a significant increase in the likelihood of encountering challenges and issues with the operation and maintenance of the system. Failure rates for wind turbines tend to be rather high due to both the increasing size of wind turbines and the difficult operating environment. As a direct consequence of this, the unplanned operation and maintenance (O&M) expenses account for more than thirty percent of the total cost of wind energy. Condition monitoring is something that has been developed to provide system operators with the needed information in order to cut down on unexpected downtime and expenditures connected with maintenance. This may be accomplished by reducing the amount of unplanned downtime that occurs. A system that uses acquired data in conjunction with an automated system to analyze the condition of the monitored item in order to prevent failures is referred to as state monitoring.

Several studies have been conducted to investigate the many different condition monitoring systems for wind turbines and the components of these machines. As part of the project, a data collecting platform that will be utilized for the development of a wind turbine condition monitoring system will be constructed. For the purpose of predicting future issues with the wind turbine, data are obtained on a number of features using a variety of sample frequencies. This is done in order to collect as much information as possible. The authors of the study made use of wavelets so that they could conduct an analysis of the output power of wind turbines for an off-line condition monitoring system. By doing an examination of the frequency components, one is able to determine the characteristics of the mechanical and electrical states of wind turbines. A high-resolution diagnostic method in addition to a real-time condition monitoring system for wind turbine blades are going to be developed as part of the research project's scope of work. The real-time conditioning monitoring and defect detection system was developed in China by the authors of the study, and it was utilized in their investigation. Deep neural networks are utilized in this study as a condition monitoring technique to propose a way for determining whether a failure has occurred in the gearbox of a wind turbine. The transmission of critical real-time data to the control center is yet another obstacle that needs to be conquered before the monitoring system can be put into use. There is a problem with this independent of the design of the monitoring system.

THE MONITORING SYSTEM'S STRUCTURE

An FPGA-CPU hybrid controller, a host computer, an uninterruptable power supply (UPS), a Network-Attached-Storage (NAS), and a hardware firewall are the components that make up this Internet of Things-based monitoring system. A hardware firewall protects each and every one of these components at all times. Reprogrammable hardware, such as an FPGA, which is built of silicon chips that can be rewritten, offers a better degree of dependability than the majority of systems that are based on CPUs. Reprogrammable hardware is comprised of silicon chips that can be rewritten. Because FPGAs make use of parallel processing, it is now feasible to do several tasks simultaneously utilizing the same quantity of resources without having to engage in a struggle for those resources. FPGAs are able to carry out predictable processing thanks to this characteristic of parallel processing, which is particularly significant for a real-time system that processes numerous inputs at the same time.

CONCLUSION

Applications of internet of things technology in power systems are presented in this article-based dissertation. Six articles that were originally published in academic research journals served as primary sources for this dissertation. These applications are related with a number of research issues, some of which include arc flash avoidance in electric power systems, demand-side management for both residential and commercial customers, and monitoring systems in power grids.

In the first three research projects, monitoring systems are designed for power substations at petrochemical sites, power substations for large power grids, and holistic wind turbine monitoring, respectively. These monitoring systems are based on the Internet of Things (IoT).

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A monitoring system may be able to take advantage of the real-time and remote monitoring capabilities offered by a platform that is powered by the Internet of Things (IoT). When it comes to monitoring the power supply, having abilities like these is of the biggest importance. When developing these monitoring systems, hybrid FPGA-CPU controllers were incorporated into the architecture wherever it was feasible to do so. The deterministic and parallel processing capabilities of the FPGA have helped to increase the overall performance of the monitoring system.

This has contributed to an improvement in the overall performance. The speed as well as the accuracy of the system's measurements have significantly improved as a result of this change. On the other hand, the Field-Programmable Gate Array (FPGA) is a device that can be written in hardware. As a consequence, it gives developers the option to personalize and update monitoring objects without forcing them to acquire additional hardware. As a direct result of this, the answer that this innovation offers to the problem of monitoring in the power industry is one that is one that is both practical and cost-effective. In petrochemical facilities, there is a monitoring system that has the possibility of being programmed with a diverse selection of detection procedures. This system is able to detect a broad variety of substances. The identification of SSOs is one of these methods. In order to enhance the usefulness of the second monitoring system for power substations as a whole, discussions have taken place on the distribution of responsibilities and the usage of a variety of communication channels. These discussions are being held with the intention of improving the system's functionality as a whole. In Chapter 4, the holistic monitoring system for wind turbines presents a one-of-a-kind solution to the problem of SSCI detection while concurrently monitoring the state of wind turbines. This method allows for simultaneous monitoring of both wind turbines and their condition. This system's primary function is to keep track of the wind turbines' general states of health. It is quite likely that this will prevent the wind turbines from suffering a catastrophic failure. Additionally, it is likely that this will decrease the amount of downtime that is experienced.

THE DIRECTION OF FUTURE RESEARCH

Internet of Things (IoT) applications are investigated in this article-based dissertation in the context of power system monitoring, power system demand-side management, and power system protection. This dissertation is made up of a total of six pieces that have been published in various academic publications throughout the world. The Internet of Things (IoT), which offers a platform that enables the conveyance of data without being constrained by either time or place, is the most significant component in the development of smart grids. This is due to the fact that it provides a platform that enables the conveyance of data.

In the first part of this research, it is shown that the use of a monitoring system that is based on the Internet of Things may be expanded to embrace a number of monitoring and control systems that have a variety of intended objectives. This finding was made possible by the fact that the researchers were able to demonstrate that this expansion is possible. It may be possible to capture more relevant data, such as weather, sun radiation, and electricity use, using this cutting-edge invention, and then combine them in further study in order to enhance overall monitoring. As a direct result of this, there is potential for improvements to be made to the effectiveness, dependability, and robustness of the electrical networks.

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