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A review on data center monitoring system using smart sensor network

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ABSTRACT

A data center can be a single structure that contains computer systems or servers, as well as major elements including such storage and network communication systems, or a cluster of buildings that contain movable systems and related components (such as storage and telecommunications systems). All of the business area units' key operations are run on portable servers in the data center. Several environmental and security hazards can be addressed, and continuous services can be supplied to users, thanks to the data center's limitless observing conditions. Backup power, environmental management, and redundant data transfer connections are all included. The data center's security and privacy are critical in this instance. It is critical to avoid time periods in the data centre. Furthermore, as public awareness of environmental issues grows, data center energy consumption has risen to the top of the safety management priority list. Failures in the temperature and humidity functions will be significant. It is critical to pay strict attention to the data center's security at all times. Manual data center monitoring, on the other hand, is becoming increasingly time-consuming. Units in the technical field are currently emerging at a rapid pace. The data center is under the most strain in this instance. A good detector network, on the other hand, is critical to the advancement of Business 4.0 technology. As a result, we like to utilize a good network of detectors for data center observation protection and privacy. The Internet of Things is frequently utilized for data center observation, as well as a good wireless detector network. A wireless detector system is employed in this paper to track the effectiveness of adjustments in real time.

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INTRODUCTION

Preparedness and the ability to recognize and respond to important situations as quickly as possible to minimize are two ways to reduce risk in data centers. Multilevel security programs ensure that data centers are protected and managed in order to reduce period and intrusion threads. Servers in data centers must be available 24 hours a day, 365 days a year. As a result, the period bar is critical. Observation detector networking is the most popular in data centers. A good detector is a device that collects data from the physical environment and provides core figure resources to perform specified actions when specific input and output data are recognized before sending it on.
We may be able to alleviate the limitations of the existing observation system by utilizing victimization detector networking. Because of the increasing strain on employees' time, and despite the fact that records are unbroken, errors quickly creep in and reduce the data's responsible ness, manual data center observation tactics are nearly impossible to maintain. Due to the value and the rate of change at intervals the data center, wired data center surveillance systems are prized and elusive in tough physical situations.

Wireless detector network (WSN) on the other hand is a wireless network made up of distributed devices with various types of sensors that monitor physical or environmental conditions such as temperature, sound, vibration, pressure, motion, fire, or pollution at various locations. Unsurprisingly, a detector network is a wireless ad-hoc (mesh) network, which means that each detector follows a multi-hop routing algorithmic rule (data might locomote varied methods through the network to its desired destination). The network also makes use of wireless mesh routers to provide a strong network backbone and an entree to collect data and set up the network. Wireless sensors are frequently put in various locations in a typical data center observation application to monitor environmental elements such as temperature, humidity, and power consumption. Because of the mesh design's unique features, adding additional detector nodes or moving existing nodes is simple and does not require expert assistance to reconfigure the network. Monitoring our cabinet's power usage is a crucial part of data center management. We can verify how near we are to tripping a circuit breaker, assure data center uptime, and ensure that we are not overloading a cabinet's power supply by knowing our power usage (IOT Monitoring for Your Datacenter - AKCP Monitoring System, n.d.-a). Prevention, as well as the ability to identify and respond to severe incidents rapidly, are all important factors in reducing risk in data center facilities. Condition-based maintenance identifies the likelihood of asset failure before it occurs. The multilevel security program ensures that the data center site is protected and controlled in order to reduce downtime and intrusion concerns.

LITERATURE REVIEW

Without a sensor network, people are having a lot of trouble monitoring data centers. Without sensors, temperature monitoring is extremely difficult. Changing from previous methods of monitoring these temperatures is costly, complicated, and inconvenient once implemented (*Data Center Heat Monitoring Using Wireless Sensor Networks | Proceedings of the 2014 ACM Southeast Regional Conference*, n.d.) . Wireless sensors could be a natural fit for data center monitoring (*Data_center_white_paper_best-Practices-for-Data-Center*, n.d.) applications that are performed remotely. It may be easily installed in any position. Today's IT equipment has a high-power density, causing hot spots to form in every server rack. The amount of heat generated has a significant impact on the apparatus's operating time. It may even cause harm to essential and expensive components. Temperature, humidity, power consumption, dust, and power, as well as data connectivity on specific racks, must all be monitored continuously. To begin with, the data center environment is often dynamic, and floor layout with alteration often provides additional potential as an edge. The climbable architecture of Wireless Sensors not only allows for easy repositioning of monitoring sites, but also for easy integration of additional monitoring points (Richards, 2012). As a result of the rapid rise of data storing technology through cloud systems (Pandey & Singh Yadav, 2020), the power consumption of data centers has gained worldwide attention. A wireless detector network for data center environmental monitoring is built as part of this study. As a result of the rapid rise of data soring technology through cloud systems (*Entrance Systems for Data Centers | ASSA ABLOY Entrance Systems*, n.d.), the power consumption of data centers has received worldwide attention. The goal of this study is to construct a wireless detector network for data center environmental monitoring in order to improve energy efficiency and data center performance. Aside from that, temperature, humidity, and hot spot detection will save operating costs, allow for remote monitoring, and provide real-time awareness of proper air flow, which is critical and should be monitored to ensure proper air exchange. Flooding or a low status in a data center might be disastrous. In data centers, problems included over-cooling, humidifying, and dehumidifying at the same time, different perforated floor tiles, different panel blanks missing, and ineffective airflows. A smart wireless detector network may be easily established in data centers to provide important environmental information and alarms while lowering costs and ensuring server uptime (al Azam et al., 2019). As a result, the purpose of this article is to show how a detector network makes monitoring crucial data about the environment of a data center easier and more cost effective. Now a days we are surrounded by IoT device. In every sphere of life from ICU management to energy management, Security monitoring or other various parameters monitoring purpose IoTs are used widely (Sharif, Al-Mamun, & Kabir, 2021).

Data center power consumption has received global interest due to the rapid growth of the information technology (IT) industry. Data centers in the United States utilize 61 billion kilowatt hours (kWh), or 1.5 percent of overall electricity consumption, according to a report by the US Environmental Protection Agency (EPA). In the United States, power usage in 2006 may quadruple by 2011. According to the prediction, the federal government's yearly electricity expenses for servers and data centers might reach $740 million by 2011 unless energy efficiency improves above current levels. Due to a lack of environmental information and over-compensation of the cooling system, over 60% of the energy consumed by the data center is wasted for cooling. The significant growth in the heat density of computer systems is another trend in data centers. This rise in thermal density is related to a rise in computer resource density, which results in a rise in computing power usage. According to the EPA, by 2014, computer server equipment would consume more than 6 kilowatts per square foot, and communication equipment will consume more than 10 kilowatts per square foot. Data center cooling is a problem that traditional air conditioning solutions can't tackle.

The number of electricity clients in the United States has increased from 47 percent to 90 percent in the last nine years. It is predicted that by 2040, the electricity demand will have grown to 63600 MW, with an annual increase of 8%. According to a June 2006 report, Bangladesh agricultural and industrial demand accounted for nearly 48 percent of total demand in 2004-2005, with domestic purposes accounting for nearly 42.4 percent, commercial purposes accounting for nearly 7.63 percent, and other miscellaneous activities accounting for the remainder. As a result, energy conservation and efficiency improvements may be the cheapest and quickest way to meet all of the energy demands. To improve energy potency and maximize data center performance, energy savings involves reducing energy consumption due to low energy and low energy efficiency. Aside from that, temperature, humidity, and hot spot detection will save operating costs, allow for remote monitoring, and provide real-time awareness of proper air flow, which is critical and should be monitored to ensure proper air exchange. Flooding or a low status in a data center might be disastrous. In data centers, problems included over-cooling, humidifying, and dehumidifying at the same time, different perforated floor tiles, different panel blanks missing, and ineffective airflows. A smart wireless detector network may be easily established in data centers to provide important environmental information and alarms while lowering costs and ensuring server uptime. As a result, the purpose of this article is to show how a detector network makes monitoring crucial data about the environment of a data center easier and more cost effective (Nayak et al., 2014).

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The information gathered by the sensors, as well as knowledge of how external variables affect room conditions, can be utilized to create control systems that alter cooling resources (such as fans and outlet temperatures) to keep the room running. Distance. The Microsoft Research Group, for example, has altered the wireless sensor network in the data center by employing sensor chains as workers rather than transmitters. All workers are connected to the main station, which polls the many sensors beneath it and sends the results to the base station. In many applications, including data-environmental monitoring centers, wireless sensor networks provide the best integrated solutions for the gathering, transport, and analysis of distributed data. Wireless sensor nodes must be distributed in preset locations for data center applications, such as computer racks and structural parts of the entire room (for example, walls, tables, or other fixed positions), as well as air conditioners. Input and output are both important. Furthermore, mobile nodes can be deployed in inconvenient locations to capture relevant data. These data collection locations gather data depending on information particular to your location. Temperature and humidity data will be collected for cooling reasons, resulting in high-resolution, real-time heat maps of the rack environment that can be used for data center dynamic control. The purpose of this study is to create a wireless sensor network for data center environmental monitoring (Rodriguez et al., 2011) in order to improve the Argonne National Laboratory's energy efficiency and data center performance. This networked, real-time environmental monitoring system should be simple to install and maintain in your existing IT infrastructure, as well as provide a better understanding of the data center's heat and power consumption curves.

Proposed model

Several challenges have been encountered in the data center monitoring (*Data_center_white_paper_best-Practices-for-Data-Center*, n.d.) system, such as the fact that the building's age ranges from several decades old to brand new today. When converting a space into a data center, it is difficult to obtain appropriate electricity, cooling, and other security measurement systems. It is possible to use a variety of short-range wireless communication protocols for data center environmental monitoring (Rodriguez et al., 2011), such as Bluetooth or LoRaWAN.

6loWPAN and Zigbee are also options. Unwired detector networks are made up of detector nodes, interface circuits, a power module, and an RF radio module, among other things. Aside from the entire area, there are two more areas of interest: the temperature and humidity of the rack server. Figure-1 depicts two completely distinct wireless detector network architectures that are intended to be used in the wireless detector network environment. In order to monitor the large space environmental profile throughout the entire data center, a multichip multipoint-to-point network design is used, while a multichip cluster specification is used to collect temperature and humidity data movement within the rack (Zhang et al., 2021) .

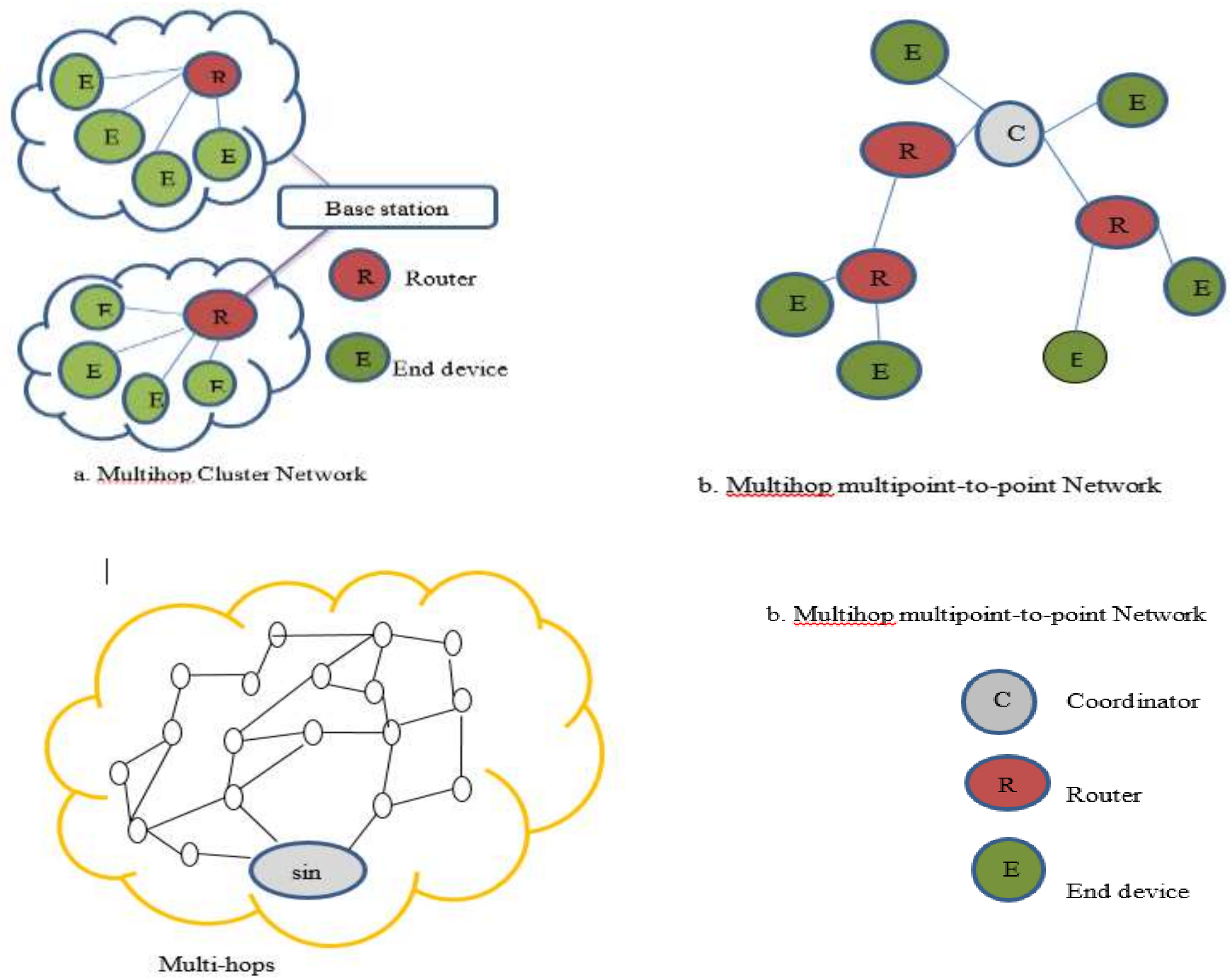

Figure 1. Architecture Diagram of Proposed Wireless Network

There are several detector nodes in every network that detect movement in environmental data, a router node that relies on the perceived information, and an arranger node that initiates the network, receives the knowledge, and processes the data. In order to manage the Arduino detector interface or Internet of Things devices, Zigbee wireless connection and information management, a software package has been designed. A WSN node can be made up of a number of basic sensing components, as well as a sensing element interface circuit, a power supply, and a radio communication module. The paradigm wireless sensing element network is used as a sensing unit to detect environmental knowledge relevant to data center (*Smart Sensors Mind Data Center Health | FierceElectronics*, n.d.) cooling procedures. Temperature and humidity sensors have been designated for this function. Several sensors are used in this sensing element. Because it is low power, the sensing unit's total power consumption is modest. The wireless sensing element network was built with ZigBee a pair of.5RF modules, which were designed to work within the IEEE 802.15.4/ZigBee protocol and due to the demand for low-cost, low-power wireless sensing element networks. The arranger is responsible for putting a complete network's channel and private space network (PAN) into action. Once installed, the system will enable network connectivity by allowing routers and end-of-life monitoring devices to connect to it. The router keeps track of network data flow to determine the shortest path for a knowledge packet. To receive or transfer data, the top devices are constantly in contact with the parent nodes. The kid node will be able to communicate data to end nodes after the router sends messages. This means that it improves packet routing capabilities. A 2000 mAh, 3.7V Li compound battery is used to supercharge the paradigm sensing element node. Because of its long lifespan, this battery was chosen. The Lithium-Ion battery pack was chosen so that the complete module could be thick enough for data center use. Data from the sensing element is sent to the monitoring station. The ASCII text file on the Arduino module/IoT(*Telia International Carrier Uses IoT Smart Sensor Monitoring* |, n.d.) device receives temperature and humidity strings from the sensors, converts them to numerical values with relevant data, manages sensing element ID, and creates a knowledge packet to send to the RF module. The module is then programmed using an FTDI USB cable and the Arduino Integrated Development Environment. The Arduino open-source computer code allows you to program sensing element interfaces to make application development easier. Three knowledge management programs are designed utilizing the MATLAB programming language for data management system computer code style. The main disadvantage extracts period knowledge strings from coordinate notes, translates them to numerical values, finds types of data (temperature or humidity), assigns a time stamp to each received sensing element data, and saves the data into the data. The second application separates the data into temperature and humidity files. The sense data is visualized in the third program. This is an easy-to-use graphic interface with a computer menu for selecting sensing element nodes and temperature or humidity files, as well as a button to refresh the screen to show all the data on the same screen.

RESULTS AND DISCUSSION

Wireless sensing element network provides a strong, extremely reliable platform to observe essential knowledge in data centers (Anand & Jeevan, 2021). Wireless sensing element system measured temperature, pressure below the raised floor, current, humidity. Ancient monitoring systems usually need the pricey method of actuation wire through the power. Wireless sensing element design eliminates the requirement for this. Sensing element network breakthrough technology permits for fast and simple installation. Sensible sensors is situated nearly anyplace, permitting is to observe locations which will are too pricey to observe within the past. Sensible sensors may also be simply reconfigured and settled as monitoring wants within the atmosphere amendment. Key options of the developed wireless sensing element network: high performance up to a hundred m/indoor and one.6 km/outdoor and RF knowledge rate: 250 kbps. Low power: TX current: 295 mA at three.3 V, Rx current: forty-five mA at three.3 V, power down current (idle mode) :< one µA at25 ºC. Advanced networking capability: sixteen channels, 65,000 distinctive network address, self-routing, self-healing, fault-tolerant mesh network, sixteen-bit distinctive physical address for every sensing element node. Sleep mode: each pin sleep and cyclic sleep, permitting the RF module to enter states of low power consumption once not in use.

The performance of the wireless sensing element network paradigm within a rack throughout the twenty-four-hour run from a knowledge assortment purpose of read was shown to be effective. No knowledge packets were lost throughout transmission. Sensing element networks integrates with several in-place computer code and/or HMI systems through the utilization of ModBus, TCP, OPC, ODBC, net services or FTP/HTTP post and integrate several internet-based monitoring and horrifying system. Sensible sensing element line of monitoring sensors provides data center operates AN correct image of environments at the rack, facility level and of potential risks. The sensors monitor will monitor a cabinet’s temperature, humidity, air flow, air pressure; find water leaks, vibrations, and unauthorized openings of cabinets’ doors. Data gathered by the sensors is monitored and analyzed by Data Centre Infrastructure Management (DCIM) computer code for chase trends and gathering response. As an example, a dashboard compares the data from sensors to the environmental envelope of a psychology chart to confirm that adequate cooling is wherever it must be. By mistreatment sensing element networking in data center, we will close supernumerary cooling systems.

OUTCOMES

This study shows that wireless sensing element networks are an effective tool for monitoring the atmosphere in a data center. Because there is no need for wiring for power and data transmission, such a network has the advantage of being simple to set up throughout the server racks. Because the sensing element modules are deployed in locations where wired sensors would be impracticable for technical or safety (*Safety and Security in Data Centers | Honeywell Building Technologies*, n.d.) Reasons, this network also provides flexibility in preparation. For data center environmental monitoring (Rodriguez et al., 2011), a paradigm wireless sensor element network has been designed. A 24-hour test run at a data center has proven that the wireless networked environmental monitoring solution is simple to integrate and maintain with existing IT infrastructure while providing greater visibility into datacenter temperature and humidity distribution. The current sensor network includes any analog or digital sensing devices. The use of data aggregation to understand temperature and humidity distribution is a first step in increasing a data center's energy efficiency. This paper's ultimate goal is to close the loop between large-scale sensing and dispersed effort in order to dynamically alter environmental conditions and energy resource allocation in data centers. The created wireless sensing element network might also be utilized as a diagnostic tool to quickly identify existing data-center energy efficiency concerns and help minimize the data center's cooling challenges.

CONCLUSION AND RECOMMENDATION

In data centers, the wireless sensor element network is useful for monitoring temperature, humidity, power usage, flow, and overall health. With a combination of sensible wireless sensors, mesh routers, and gateways, the wireless sensing element network has the potential to be an exceptionally dependable and incredibly secure (*Building a Smarter, Brighter, and More Secure Data Center*, n.d.) monitoring system that is simple to setup. Because of their wireless architecture, wireless sensors provide a number of advantages over older monitoring systems, including quick readiness, cost savings, and adaptability. It is possible for the United States and other countries in North America to swiftly and effectively monitor critical information, ensuring that data centers do not go to sleep and remain operational 24 hours a day, 365 days a year.

LIMITATIONS OF THE STUDY

In this paper the main challenges are to manufacture the accurate sensors and utilize all the sensors properly. Fault tolerance is an important issue. Also maintaining constant power supply is also a challenge. Many third world country like India, Sri-Lanka, Pakistan has load shedding issue. It will seriously interrupt proper monitoring. More over due to irresponsibility of monitoring personnel serious damage can be occurred.

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