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Retraction

Retracted: Internet of Things System of Spatial Structure Sports Events Health Monitoring Based on Cloud Computing

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] R. Feng and N. Chang, "Internet of Things System of Spatial Structure Sports Events Health Monitoring Based on Cloud Computing," *Security and Communication Networks*, vol. 2022, Article ID 1354640, 13 pages, 2022.

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Research Article

Internet of Things System of Spatial Structure Sports Events Health Monitoring Based on Cloud Computing

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At present, the health monitoring system of world sports events uses the system's on-site information or periodic test information to evaluate the health of the system. In order to make the data more accurate, the application of cloud computing is necessary. This article is based on the cloud computing spatial structure sports event health monitoring Internet of Things system, aiming to analyze the data from the structure's resilience, surface load and other aspects, combined with cloud computing means to explore this monitoring system. This research uses literature retrieval methods, cloud computing particle swarm optimization and interpolation fitting methods to process data. Aiming at the data characteristics of spatial structure health monitoring, the overall framework of the Internet of Things system for spatial structure health monitoring is proposed. Taking advantage of cloud computing in processing computing-intensive tasks, an algorithm for data processing at the application layer is established, and the cloud data for spatial structure monitoring is completed. Management system design. Among them, the Internet of Things system, structural health monitoring system and other models are mainly combined with the various levels of the model to carry out targeted analysis; the factors involved are the arrangement of sensors and the installation of sensors at the junctions, for example, magnetoelectric acceleration sensors and optical fiber optical shed sensors for data recording of large stadiums with different structures. The experimental results show that when extreme temperatures exist, the stress of the rods as a whole will decrease to a certain extent. The maximum difference between the test data considering extreme weather and not considering extreme weather is 226.

1. Introduction

Space health monitoring research around the world is getting more and more attention, and the most important issue in health monitoring research is how to set up limited sensors to measure the dynamic behavior of a research project [1]. How to ensure the health and stability of the structure, the damage identification of the space structure, and the research on the health of the world space architecture system has also become the focus of human attention [2]. Due to its reasonable system layout, the spatial path of the structure can effectively transfer loads, suitable for use in various large-span spatial structures, and can adapt to the requirements of various building flat and facade shapes, so it is widely used in stadiums. Exhibition venues are the large-scale shopping malls, railway station rooms and public buildings in large spaces such as airports. Structural health monitoring research is a hot topic in recent years, and it is applied to related technical means in some fields such as computer acquisition systems, signal processing and structural analysis. The state evaluation of the structure is the evaluation of the structure performance, load response, bearing capacity, etc. during the service period of the structure, and it is the health indicator of the structure monitoring [3].This paper takes the spatial structure as the main line of research, and starts the whole process of monitoring information acquisition, transmission, fusion, storage and use, realizes the design of the Internet of Things system for spatial structure health monitoring, and improves the monitoring information performance. The current situation, and the development of spatial structure monitoring cloud information platform, successfully applied to large-scale spatial structure health monitoring project.

In recent years, sports events have been affected by many risk factors, and the cause and extent of their emergencies have surpassed the experience of traditional and cultural discrimination. It is urgent for the society to re-examine its risk characteristics and practical problems [4]. It is necessary to take measures to maintain the health of major high-rise buildings, skilled public buildings, etc., maintain the health of buildings in real time, and reduce institutional damage accidents caused by accumulation of damage [5]. Sports events can promote the construction of urban sports venues, facilities, exhibition halls and other cultural facilities, can promote sports knowledge, sports behavior and other spiritual culture, and promote the progress of sports practice, sports practice and other institutional culture; for the sustainability of the competition industry great contribution to development [6]. Sports events are typical sports events that can drive and enhance urban facilities and spiritual space [7].

Some major institutional engineering projects at home and abroad are under construction or have established health monitoring and monitoring systems, and their impact is becoming more and more obvious. Many scholars at home and abroad have actively participated in the research in this field and have achieved certain results. In Frimann S's research, the radiation transmission code RADMC-3D is used to create a synthetic continuum image and SED of the protostar system in a large-scale numerical simulation of molecular clouds. The synthetic continuum image and SED and observation will be calculated based on the large-scale numerical simulation. The research is compared, which helps to explain the fidelity of observation results and test simulation [8]. Khan I U's research confirms that the use of UAV-enabled IoT in sports has changed the dynamics of tracking and protecting player safety. WBAN can be combined with aircraft to collect health-related data and transmit it to the base station. In addition, the unbalanced energy use of flying objects will lead to early mission failure and rapid decline in network life [9]. Cloud computing can provide environmental assisted living systems with the ability to expand the limited processing capabilities of mobile devices, but its main function is to integrate all stakeholders through the storage and processing of health data and the orchestration of medical care business logic. On the other hand, the Internet of Things (loT) provides the ability to connect sensors and actuators, integrate and provide them through the Internet. Gomes B T P introduced Mobile-Hub/Scalable Data Distribution Layer, which is an AAL middleware based on cloud computing and the Internet of Things [10]. Mukherjee A proposed a mobile medical framework based on the edge-fog-cloud collaborative network. It uses edge devices and fog devices for parametric health monitoring, and uses the cloud for further health data analysis when abnormal health conditions occur. The user's continuous location change is a key issue. In an emergency, connection interruption and delayed delivery of health-related data can be fatal. In this direction, in the proposed framework, the user's mobility information is considered, and the user's mobility pattern detection is performed inside the cloud to provide users with suggestions about nearby health centers [11]. The Internet of Things (IoT) is a community of smart things, which is a combination of sensors and network technology, cloud computing and many data concepts [12, 13]. Mohamad A focuses on the recruitment of Internet of Things technology in the field of health applications. Its main goal is to provide patients with an ECG diagnostic system that uses the capabilities of the Things peak IoT platform and a reliable medical analysis system for healthcare professionals to use for patient monitoring [14]. Velrani proposed an automated intelligent health monitoring system (ASHMS) to study advanced home healthcare services, and based on cloud computing to provide security and privacy mechanisms for specific healthcare needs. In fact, the various sensors and security used in the experiment are realized by Arduino, which is realized by implementing a secure hash algorithm (Sha). Through smart phones, doctors and daycare staff can receive the measured temperature and pulse parameters [15]. Calyam P introduced the design of the "ElderCare-as-a-Smart Service" (ECaaS) system, which integrates applications for home health monitoring and remote physical therapy guidance. The focus is to transform the application into a cloud-based life laboratory, and then continue to develop/improve the application to achieve a real-world enhanced senior living environment with security, privacy protection, and social embedding. The system and network requirements for cloud-based ECaaS application delivery are introduced in detail. These applications have sensor data analysis and interactive interfaces across cities, suburbs and rural areas [16]. There are few researches in the field of health monitoring of IoT organizations, and the field of IoT is very extensive, but these studies have some similarities in services and business processes, and many technologies can be learned from them. These studies are analyzed from different modules, and the processing of edge technology, cloud computing, and Internet of Things technologies are combined to develop smart health systems. However, the research of these systems is too singular and relies on the characteristics of a certain aspect of a certain network technology. It is too simplistic and the structure is not perfect.

This article discusses in depth key technologies such as data transmission and communication technology, intelligent terminal management technology, low-power transmission technology and cloud computing services in the intelligent terminal data collection and operation system. The role of structural health monitoring depends on the quality and quantity of measurement data, which is collected according to the number and location of sensors. The research arrangement of this study does not consider the energy factor, and uses the modal kinetic energy method and the modal strain energy method to arrange the measuring points as far as possible in the position with greater kinetic energy or strain energy. Determine the best position of the pressure sensor and acceleration sensor in the spatial structure health monitoring system, and apply the system to the health monitoring project of large-scale sports events. Taking into account the support of cloud computing to the system, a comparative analysis of the performance of accelerated signal processing in structural health monitoring is carried out. For structural health monitoring, calculation and storage in cloud computing are ideal in terms of using analysis results. The system development of the spatial structure monitoring cloud is completed through the resources of the public cloud, and a complete Internet of Things system for spatial structure health monitoring is realized. Expand real-time display, intelligent processing and comprehensive control. Ye design ideas have good user behavior data.

2. Spatial Structure Health Monitoring

2.1. Sports Venues. With the continuous progress and development of modern building technology and the continuous improvement of people's requirements for large-span space, more and more large-span structures are emerging, and they are showing trends such as large spans and complex shapes [17]. The service life of large stadiums is very long. If safety problems occur during normal operation, it will cause huge loss of life and property, and in dangerous situations, it will cause catastrophic consequences. A large number of on-site maintenance and monitoring of the health of the system are carried out to ensure the safety functions of the system during construction and normal use [18]. The service life of major stadium structures is decades or even hundreds of years. The combined effect of multiple negative effects and catastrophic factors will inevitably lead to the accumulation of structural and system damage and the reduction of resistance, resulting in a decline in the ability to resist natural disasters and even normal environmental impacts. As shown in Figure 1.

2.2. Cloud Computing and Internet of Things System. Cloud computing is a network-based shared computing resource pool service model with on-demand access and on-demand expansion [19]. It is one of the solutions for massive data storage and processing, large-scale concurrent operations and other services [20]. Big data cloud computing is a product of Internet information technology [21]. It has become the focus of attention of many companies and poses severe challenges to the current data system, storage, and operation technology transfer in many industries. With the rapid development of the Internet and the Internet of Things and their popularity in many places, the total amount of global information is increasing every day, and people are entering the era of big data [22]. Cloud computing integrates many distributed resources in the network, creating a collection of shared resources for users to use. The integration of structural health monitoring and the Internet of Things is an impossible problem in the construction of digital cities, but it can promote the development of institutional monitoring and have a huge impact. Cloud computing technology is an important supporting technology to develop and understand the hugely attractive data of Internet of Things materials. Cloud computing technology is an important research direction in the field of structural health monitoring. The Internet of Things is essentially an integration of various disciplines and various types of technologies. The technologies involved are complex, not only various types of Internet technologies, but also various types of communication technologies, sensor technologies, network technologies, and so on. Through the Internet of Things, many manufacturing indicators can be understood and controlled, so as to achieve the goal of reducing many safety incidents and increasing productivity. The Internet of Things, big data, and cloud computing have become the only way for traditional industries to upgrade, increase value-added services, and improve product competitiveness. Cloud platforms provide technical support for traditional industries to enter the field of Internet of Things. The complexity, integration and transformation of big data, as well as the popularization and in-depth application of information technologies such as cloud technology and the Internet of Things, have completely changed the system monitoring system, and cloud space monitoring has emerged as the times require. It is the culture of the future development of life monitoring systems. Use Internet of Things technology to monitor institutional health, establish a monitoring network distributed across multiple terminals, and improve the existing monitoring level [23]. Through the reasonable distribution of multiple sensors, the change data of the research project in different periods is recorded and analyzed, and the changes on the time line are connected together, and a series of changes represent the dynamic behavior changes of the spatial structure. Cloud computing technology has changed the chimney-like information construction architecture of the traditional data center, allowing multiple virtual servers to run simultaneously on one physical server, and the virtual servers are completely isolated and do not affect each other. Operating system and business software, these virtual servers are not perceptible to users, as if they are still running on physical servers [24]. As shown in Figure 2. Moreover, cloud computing environments are often equipped with corresponding management software, so that operation and maintenance managers can manage the entire cloud computing environment more conveniently, and clearly see the use of resources, shortcomings and trends of the entire environment. Cloud computing technology isolates users from hardware. Users do not have to worry about which physical hardware the application is running on. They only need to care about whether the existing resources are sufficient and whether they can support the operation of the business system.

The Internet of Things itself does not have powerful computers and storage services, so it needs a "brain" with strong computing and storage capabilities, intelligent, efficient, low-cost, and compact to support large databases, calculations and management, and cloud computing can meet this calculation [25]. For specific data collection tasks, multi-angle, multi-type, multi-dimensional information management is completed through consolidation, and source interaction and sharing with other network segment

Figure 1: Collapse accident diagram of the stadium.

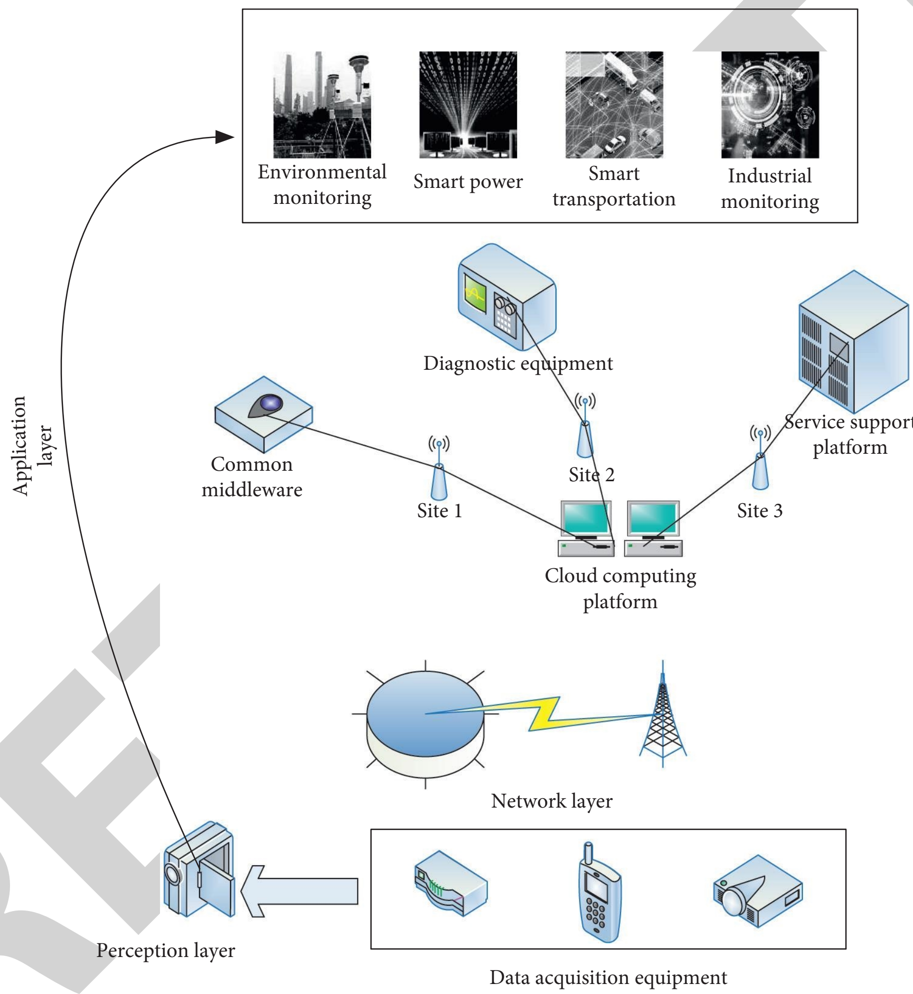

Figure 2: The architecture of the Internet of Things system.

information through the access network. Due to complex factors such as monitoring technology and methods, the previous identification and damage mainly on simulation inspection, but this method is only effective when the system and components are visible damage, and cannot provide health monitoring. The particle swarm algorithm based on cloud computing first randomly initializes a group of particles, and allows these random particles to perform an optimal search within a given range, and iteratively searches for the global optimal solution within the solution range [26]. Initially defined as:

$$g(i) = \sum_{(i,j)\in R}^{m} \frac{g(i)}{M_i},$$
$$g_i = (i_{l1}, i_{l2}, \ldots i_{\ln}), \quad i = 1, 2, \ldots, m. \tag{1}$$

g_i is a particle swarm in a D-dimensional space, and also represents a certain performance index of this particle swarm. The individual optimal value is reached through the optimization criterion g(i). Using iterative function to illustrate can be expressed as:

$$d_{ij}(a+1) = \varphi d_{ij}(a) + t_i v_i\left(e_{ij}(a)\right),$$
$$d_{ij}(a) = -a_{ij}(a) + t_2 v_2(a)\left(d_{ij}(a) - i - j\right), \quad (2)$$
$$\delta = \delta_{\max} - \frac{a}{\delta_{\max}}\left(\delta_{\max} - \delta_{\min}\right).$$

δ is the inertia weight, and its change conforms to a linear relationship. t is time, v is speed. i and j are local search and global search. The number of iterations e increases and decreases gradually. $\delta_{\max}$ is the maximum number of changes. When particles of similar size are used to optimize the comparison, the formula can be expressed as:

$$R = \sum_{i=1}^{n} i \cos[(i+1)u + i], u = \sum_{j=1}^{r} j \cos\sqrt{[(j+1)v + j]}. \quad (3)$$

R is the three-dimensional calculation of the multimodal function. u is the frequency and v is the order. The strain energy of each mode corresponds to the overall strain energy j of the structure. Application sensor optimization can be calculated as:

$$K = \frac{1}{2}\sum_{i=1}^{i} p_i^2 \lambda_i^t z \lambda_i, k = \frac{1}{2}\sqrt{\sum_{i=1}^{i-1} p\lambda_i^2 * \mu_2 - p_i^2}. \quad (4)$$

Z is the particle metric matrix, λ and μ are the independence of the two vectors, and the space intersection angle is the orthogonal vector on the node. To optimize the layout, the following formula is established:

$$\mu = \left[\beta_t^v\left(\chi_0^2\right)^{-1} \otimes \beta\right]^2 - 1. \quad (5)$$

β is the deviation covariance.

2.3. Spatial Structure Health Monitoring. Internet of Things research focuses on sensors, technical standards, system application solutions, etc. Global Internet of Things materials are not an authoritative and unified management unit, and they meet complete technical standards. At the same time, industry-leading Internet of Things material technologies are also being explored layer by layer. The area involved is small and not in-depth. Only when the Internet of Things technology is frequently applied to specific industry applications, can it provide extended incentives for the exploration of the Internet of Things [27]. The scope of the Internet of Things is far from deep in all aspects of human life, and the Internet of Things research on structural health monitoring in the field of civil engineering is even rarer [28]. With the progress of science and technology, the development of modern industry and the future needs of mankind, the modern space system is evolving in the direction of scale and complexity. The construction of the space system is an important measure of national architecture and technology, as well as an important part of modern civilization. It is widely used in large buildings such as stadiums, airport terminals, conferences and exhibition centers. On the other hand, due to the aging of materials, uneven distribution of foundations, strong earthquakes, hurricanes and other external forces, these structures will inevitably produce certain damage and decay, which will cause major property losses. The structural health monitoring system essentially collects data through a sensor system, analyzes the collected data, determines whether damage has occurred, the degree of damage, and evaluates the health of the system. The structural health monitoring system collects relevant data representing changes in structural details in real time, and uses a specific damage recognition algorithm to determine the specific degree and extent of the damage to ensure the safe operation of the computing system. However, structural health requires sensor systems to collect and analyze information. Under normal circumstances, there are often several independent parameters in the system, but the sensor cannot be configured for each degree of independence, so some important influencing conditions must be configured. With the continuous development of sensor technology and intelligent information technology, the integration of the Internet of Things and institutional health monitoring is the development trend of world sports event monitoring, which will significantly improve the level of institutional health monitoring [29]. By modeling user behavior data, the effectiveness of this method for CTR prediction model is proved. Using the input of different candidates to capture the different interests of users, long-term user behavior data is valuable, and modeling users' long-term interests can bring users more diverse recommendation results.

Structural health monitoring is to regularly monitor the monitoring points set on the system, and to understand the health of the system by estimating the amount of change in the monitoring points [30]. The system health monitoring system is always composed of five components: subsystem sensors; data assets and partition transmission; data processing and analysis; data management and damage identification, model correction; safety assessment and early warning system. Existing health monitoring systems have certain limitations. Most health monitoring systems monitor a single set of technologies, and it is difficult to identify the local cluster monitoring network. The spatial structure is a synthesis of many technologies. With the development of this theory and the progress of its application, structural health monitoring has developed into a new technology with diverse usage, wide range and high degree of automation. To evaluate the damage of the space structure, the application of cloud computing technology is regarded as the signal H(i), and the risk estimation uses wavelet decomposition, and uses the interpolation fitting to find the minimum mean square error criterion. When evaluating, the element energy method and the modal strain energy method, the minimum mean square error of the fitted modal matrix is also relatively small, and its optimization effect is better. Then there is:

$$H(i) = (\mathrm{sort}(|i|))^2 / \sqrt{f(h(i) \bullet \alpha_i},$$
$$\mathrm{risk}(i) = \frac{\left[n - 2i + \sum_{i=1}^{h} f(i) + (n-i)(n-h)\right]}{n}. \quad (6)$$

sor(|i|)) is the threshold, h is the high-frequency coefficient; if the wavelet coefficients smaller than the threshold are reset to zero, there is:

$$F_i(h) = [\sin(F_i(h)\bullet F_i(h) - q\, F_i(h) > q0\, F_i(h) < q]. \quad (7)$$

This is a function of the high frequency double measurement. q is the given threshold. F_i is the detail component. The relationship between the two is:

$$\chi(a) = \sqrt{2}\sum_h f_{0h}\chi(2a-h), \chi(a) = \sqrt{2}\sum_h f_{1h}\chi(2a-h). \quad (8)$$

f_{0h}, f_{1h} is the multi-resolution coefficient. Use two-scale resolution to define:

$$\varphi_{2i}(a) = \sqrt{2}\sum_{h\in U} f_{0k}\varphi_i(2a-h), \varphi_{2i+1}(a) = \sqrt{2}\sum_{h\in U} f_{1h}\varphi_i(2a-h). \quad (9)$$

The establishment condition of the above relationship is $\varphi_0(a) = \chi(a)$, the scaling function $\varphi_0(a)$ and the wavelet mother function $\varphi_i(a)$ together form a set of related functions. Refactoring this collection, there are:

$$P_h^{b+1,2i} = \sum_i f_0(2i-h)p_i^{b,i}, p_h^{b+1,2i+1} = \sum_I f_{1(2I-h)}p_I^{b,i}. \quad (10)$$

There are two types of outliers that can be identified in the model, additive outliers and innovative outliers, which are usually abbreviated as P and h, respectively. Additive outliers are the time series that are interfered with an impulse response at time f, that is, in addition to It is not affected outside the moment f, and the formula is written as:

$$p_I^{b,i} = \sum_h \left[f_{0(i-2h)}p_h^{b+1,2i} + f_{1(I-2h)}p_h^{b+1,2i+1}\right]. \quad (11)$$

p is the cost of the information function, p_i^b is the wave number characteristics of the reconstructed signal of each layer after wavelet coefficient transformation.

3. Experimental System and Data Processing

3.1. Spatial Structure Monitoring IoT System. In the cloud computing platform, distributed computing can be used to realize the migration of computing to storage, and the application of computing and storage-intensive structural health monitoring system in the cloud has high computing efficiency, powerful functions, and low communication burden for structural health monitoring. It shows the number of sensors used for calibration and improve the recognition of advanced agents in multiple systems. Through the comparison of recognition models, the recognition accuracy of multi-path optimization progress is determined. Then, when all sensors are disturbed by noise and each sensor is disturbed by noise, two stress detection methods are used for stress identification, including the number of calculated sensors and the number of calibrated sensors, and the detection efficiency of the two methods is compared to determine After calculating the number of sensors, the anti-noise ability of the stress detection method is reasonable.

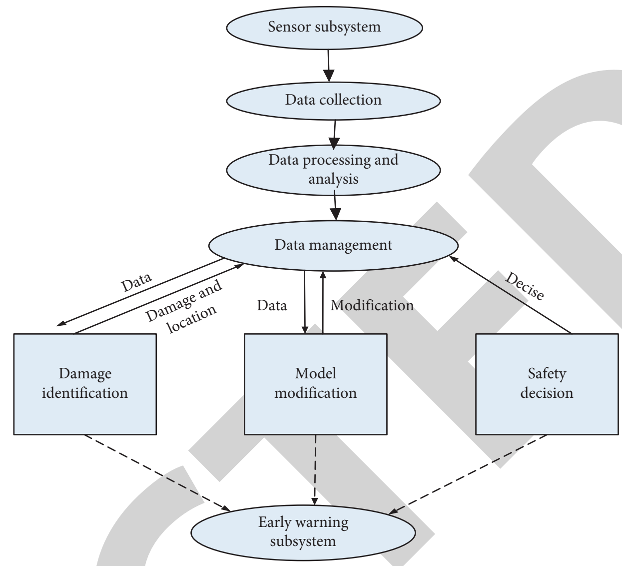

Figure 3: Structural health monitoring system.

Based on the measurement data of the sports industry, the performance of the crisis identification method after the introduction of the number of sensors for analysis is determined by comparing the identification accuracy. The system presents the characteristics of low power consumption, small size and low cost in the selection of components. The system is self-contained, it does not rely on the community, which is installed and used. The system is convenient and fast, and uses wireless transmission technology for short-distance wireless data transmission. The system adopts redundant design, and the whole system is divided into three parts: data acquisition module, wireless transceiver module, and information terminal control module. The construction of the monitoring system model is shown in Figure 3.

The field monitoring center needs to send the gathered data to the server of the data center through the remote communication network for analysis, processing and storage. The data center will also have related control commands issued to each terminal device to meet the requirements of related tasks. The monitoring data management module also manages the negligence of the monitoring data, and judges the operation status of the monitoring system by setting the landscape value. If the safety design value exceeds the set safety limit, other modules will trigger (structural damage identification module, safety assessment early warning module, etc.) to call the historical data of the server for structural damage analysis and safety assessment. The monitoring data management module adopts a standard interface design to ensure the normal calling of other application service modules.

Due to the complexity of the optical position of the sensor, the sensor transmission method of the sensor will affect the extraction amount of the analysis result. The sensor optimization system is very important for setting the number of sensors at a given optimal position in order to obtain as much response data and dynamic characteristic

Table 1: Structure monitoring sensor system statistics of large domestic stadiums

Name	Environment and Nuclear Load	Strain	Displacement	Vibration	Total
Beijing National Swimming Center	212	44	13	5	274
Shanghai Oriental Sports Center	127	113	25	73	338
Beijing Workers Stadium	21	48	19	27	115
Shenzhen Universiade Sports Center	33	57	25	39	154
Taipei Arena	16	78	16	64	174

information as possible. Make statistics on the structure monitoring sensor system of large domestic stadiums, as shown in Table 1.

Data transmission emphasizes the extraction, management and use of general information in the open field. This setting will best contribute to the timely improvement of data object applications. And even if scientists and engineers are not in the monitoring field, they can always know the status of the field monitoring system and the real-time changes of the system settings through the network, and can also send out to the control system running on the client computer monitoring the site server computer through the network according to the specific location and instructions to adjust the operating status of the site management system in time to achieve the goal. Among all field sensors, sensors with different signal types have different field data transmission methods. The relevant arrangements are shown in Table 2.

The application of Internet of Things technology in structural health monitoring is mainly to expand the limitations of the existing system in terms of sensor data collection, network communication and intelligent processing of data. Under the premise of unifying relevant norms and standards, establish an Internet of Things monitoring platform and develop areas. Cluster monitoring, incorporating more types of structural monitoring into the cluster platform monitoring system, reduces overall monitoring costs, and provides managers with timely real-time safety and health status of major projects in the region. Structural health monitoring research includes a wide range of research procedures, such as testing technology, vibration technology, diagnostic technology, cognitive technology, etc. It is a large-scale project monitoring plan project. The front panel sensor part of the main technical system that monitors the Internet of Things technology system will be more integrated and intelligent. Data collection and processing can be improved and changed at the front end, and transmitted to the control center through a comprehensive wireless network, which greatly improves the quality of data. Evaluate the different characteristics of these data, as shown in Figure 4.

Combining with the construction of digital network cities, improve the information management level of urban infrastructure. As an important part of the digital city, urban infrastructure safety monitoring can control the operation status of major projects in a timely manner, effectively improve the information level of operation and management, and realize its real-time or near-real-time, dynamic, spatial, digital, and networked, Intelligent and visualized management. The sensor arrangement of the centralized structural health monitoring is distributed, and the data processing function is centralized. This brings about problems such as low system reliability and low computing efficiency. For example, the relevant parameters of the magnetoelectric acceleration sensor are shown in Table 3.

Table 2: Sensor layout of this study

Sensor type	Quantity	Sensor type	Quantity
Fiber grating strain	77	Fiber optic shed temperature	22
Accelerometer	53	GPS	11
Hygrometer	2	Thermometer	2
Barometer	1	Ultrasonic anemometer	4
Displacement meter	5	Magnetometer	12

3.2. Stadium Monitoring Data. The existing large-scale stadium structure types include beam structure, truss structure, bent structure, portal frame structure, arch structure, thin-walled space structure, grid structure, grid structure, and reticulated shell Structure form, suspension cable structure form, etc. Figure 5 shows the appearance of some large stadiums.

The roof of the entire structure of the large gymnasium adopts steel structure and membrane structure. The steel structure provides the skeleton covered by the membrane material, and the membrane structure forms the protection of the indoor space of the structure. A simplified diagram of the installation of the strain monitoring sensor of the rod is shown in Figure 6. Although there are very few members with excessive stress ratio in the results, it will not cause structural safety problems, but this phenomenon should be considered in the structural design. Structural pressure is the most direct indicator to judge the safety of the system. The health level of the system will always lead to over-allocation or negligence in allocating other monitoring results, such as location, alarms, vulnerabilities, etc. This will determine whether the state of the structure is within a safe and controllable range.

In a very large system, there are many sensors and many types, and the sensor information is scattered, distributed, and of different types. In order to efficiently integrate and manage a large-scale distribution monitoring network, a multi-agent collaboration system has been established. Structural health monitoring technology adopts the new concept of intelligent application system, and uses the advanced knowledge/driving elements integrated in the system to obtain online and real-time information related to system health, such as strength, strain, temperature, vibration mode,

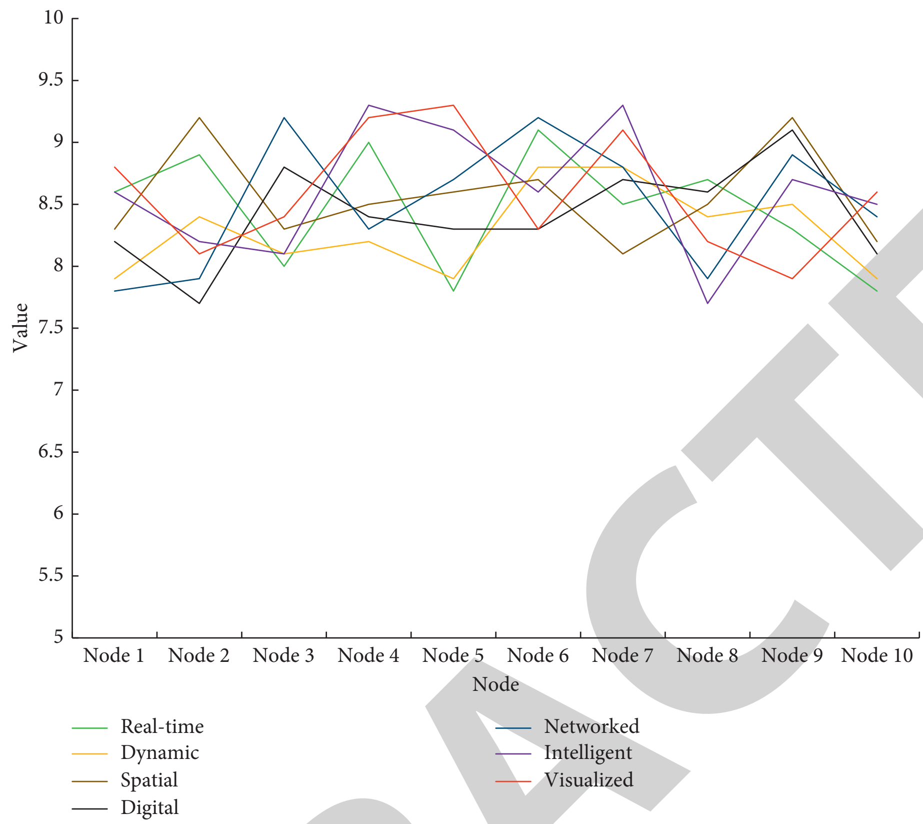

Figure 4: Characteristics of sensor monitoring data.

Table 3: Magnetic acceleration sensor performance

project type	parameter
Measuring range	±2.1g
Dynamic Range	>110dB
Sensitivity	±2.3V/g
Transverse sensitivity ratio	<1%
Linearity	>1%
Zero drift	<0.5
Ambient temperature	-28°-75°

wave propagation characteristics, etc. Test and record data from four aspects of stress, strength, pre-tension recognition accuracy, and surface load reliability test. The first is to continue the statistics of the test results considering extreme temperature and not considering extreme temperature for the stress ratio of the rod, as shown in Figure 7.

When the extreme temperature exists, the stress of the bar will decrease to a certain extent. The difference between the data when considering extreme weather and not considering extreme weather is 226. Perform statistics on the intensity measurement data before and after the use of the magnetic acceleration sensor, as shown in Figure 8.

Because wireless sensor network components have local signal processing functions, most of the processing of signal information can be done locally near the sensor components, which will reduce the information that needs to be transmitted, and transform the serial operation and central decision-making system originally guaranteed by the central operating system. It is a relatively decentralized information processing system, which will improve the operating speed of the monitoring system and the reliability of decision-making. Select the reliability index and failure probability of some bars in this study to display, as shown in Table 4.

Record the data before and after adjusting the position of the sensor for the accuracy of the tension recognition, as shown in Figure 9.

In a distributed monitoring network, there are many types of sensor networks and a large number of sensors. The information received by each sensor is not complete. The comprehensive use of multiple sensors and test methods will ensure the stability and reliability of the measurement information. The comprehensive utilization of multiple sensors and testing methods will effectively ensure the integrity and reliability of the measurement information. For surface load reliability, fiber optic sheds and magnetic acceleration sensors are used for analysis. The data is shown in Figure 10.

It can be seen that the deformation measurement points are mainly distributed on the second ring, the fourth ring, the sixth ring and the seventh ring (support), so the comparative analysis is carried out according to the above four rings. We will find that in the Ansys simulation analysis, the settlement at the central node is the largest, the settlement is 40.96 mm, the direction is downward, and the simulated value of the settlement at the support is zero, because the support is hinged. The measured settlement of the central measuring point is -52 mm, and the simulated settlement is -40.96 mm. The difference between the two is 11.04 mm,

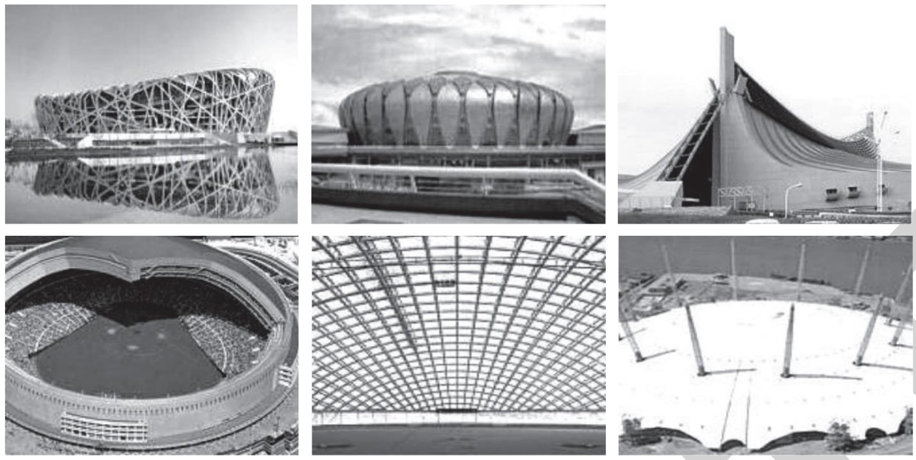

Figure 5: The structural appearance of some large stadiums.

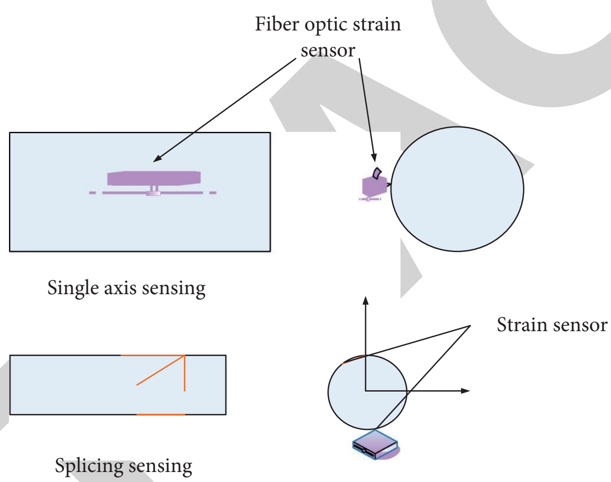

Figure 6: Simplified installation of rod sensor.

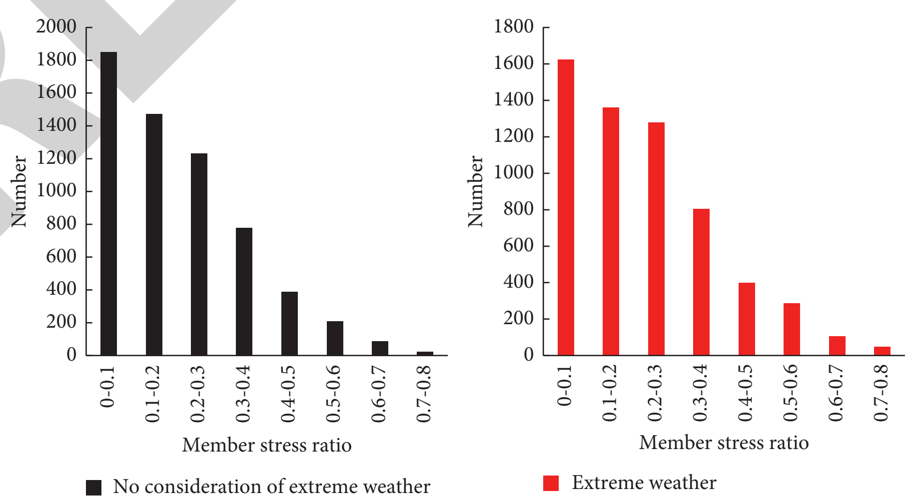

Figure 7: Member stress.

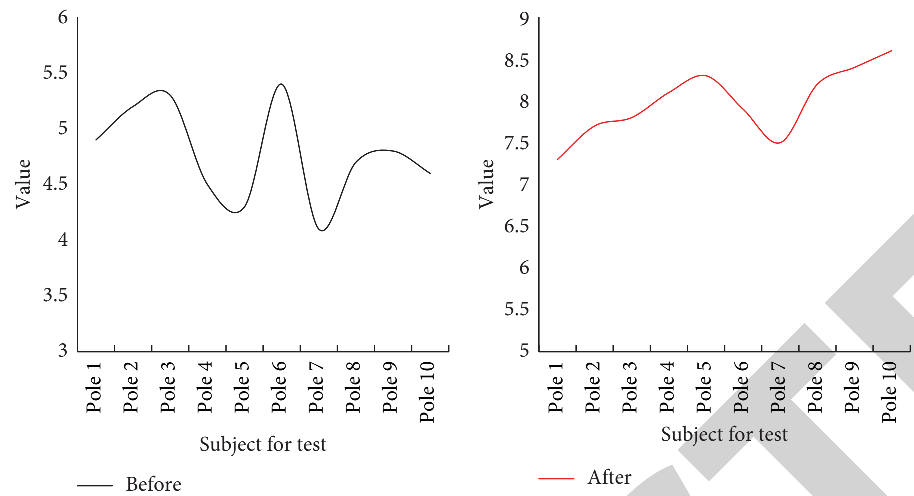

FIGURE 8: Intensity measurement data.

TABLE 4: Reliability index and failure probability of some members

Lever	Reliability index	Probability of failure
1	0.557	0.143
2	0.297	0.374
3	0.265	0.327
4	0.673	0.357
5	0.438	0.213
6	0.173	0.374

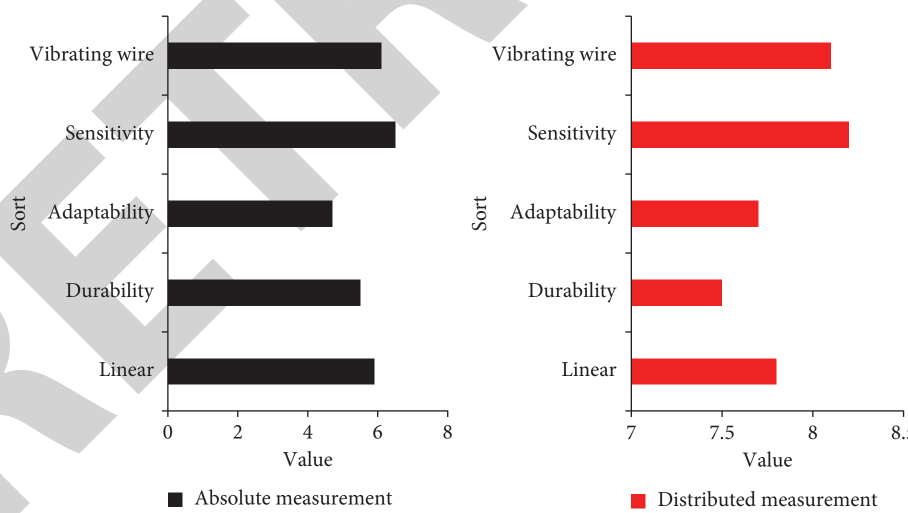

FIGURE 9: Accuracy of pulling force recognition.

which is the point with the largest difference among the measuring points.

At present, the design of venues for competitions has changed from only providing venues at the beginning to the direction of many activities now. However, if multiple venues are a simple combination of many activities, such a multi-functional advantage is actually not obvious. Research on the different arrangement modes of fiber optic shed sensor and magnetic acceleration sensor, the difference between the two is not big.

4. Discussion

Because the infrastructure in most regions has not been updated in a timely manner, the premise of the populari-zation of big data requires the interaction of hardware and

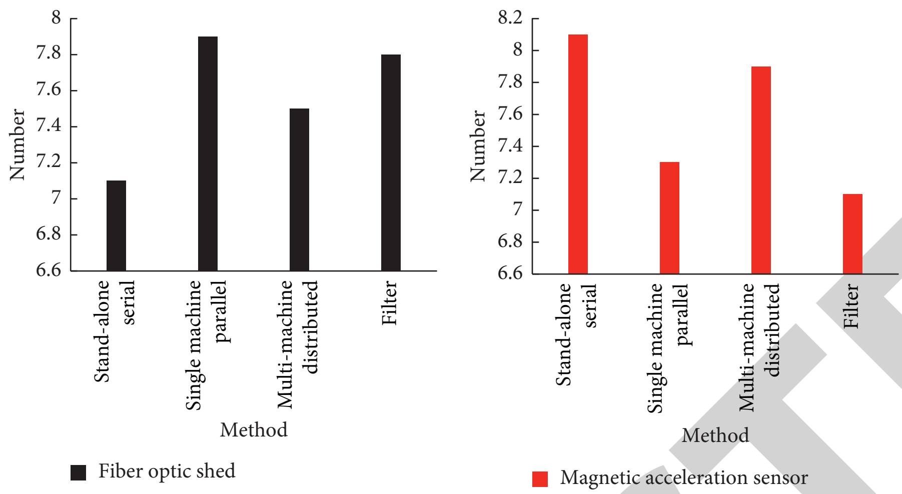

FIGURE 10: Fiber optic shed and magnetic acceleration sensor.

software, so big data has not been rapidly popularized in the medical field. Analyze the characteristics of the Internet of Things and institutional health monitoring, and compare it from three levels, highlighting the three common characteristics of the working environment of the plan designer and the venues: comprehensive views, building trust and understanding. And the specific application of the Internet of Things in the field of equipment monitoring is the subnet of the Internet of Things. Identify the health system through the results of diagnostic tests, determine whether the safety and capacity of the system meet the requirements, evaluate its reliability and technicality of the remaining life, provide a solid foundation for subsequent processing and stability, and improve the safety of the technical system, to extend its service life, thereby creating greater economic and social benefits. The overall structure is operating normally under normal load conditions. When encountering rare extreme load conditions, it is necessary to pay more attention to monitoring data changes, timely observation of various data, timely warning, and timely corresponding remedial measures to avoid overall damage to the structure and further harm. When deploying strain sensors and acceleration sensors, limited to economic conditions and environmental factors, most of them optimize the position under a given number of sensors. The layout results are not necessarily the optimal layout, but how to determine the optimal sensor. The number has not been well resolved, and further research is needed.

5. Conclusion

With the continuous development of China's national economy, science, technology and culture, the national capacity is also improving. The recent changes in the safety performance of cities and infrastructure have attracted the attention of the government. More and more funds are invested in its construction and maintenance, which has promoted the overall development of institutional health monitoring. The corresponding diagnostic methods, technologies, equipment and materials have also been further developed. The idea of promoting urban development and renewal with major sports events has become a tradition, and the construction of large-scale sports venues has set off an upsurge in the country. The multi-function of the competition venue is to meet the requirements of various sports, including sports competition, sports training, sports fitness and so on, through the change of space, such as setting technical measures such as raised floor, lifting curtain and movable partition. The venue can meet the different requirements of different sports events such as basketball, volleyball, badminton and sports, It can switch between the same venues, and can also meet the requirements of daily training and physical exercise. Mass sports events focus on participation. Mass participation in large-scale mass events is quite high, and large-scale competition areas and multiple venues have become necessary conditions. Explore the key technologies and operation problems of creating a dynamic world, and learn the on-site design of dynamic theater and a variety of internal and external interfaces. The application of conceptual framework to structural health monitoring and the development of understanding and practical practice has become an important guide for the development of structural monitoring technology in the future. Taking the distribution of research stations in monitoring sensor networks and wireless monitoring sensor networks as the object, the key contents of realizing this technology are studied. Two kinds of strain sensing bodies are used in the system, including strain sensing body and optical fiber sensing body. In the field of structural health monitoring, the construction of multi-agent system can solve many problems effectively, and achieve the coordination of different sensor information, simultaneous interpreting of different diagnostic methods and coordination among different monitoring sub regions. The aim is to make efficient and effective health monitoring for the whole large-scale actual structure by using the system resources reasonably and effectively.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

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References

[1] S. Song, K. S. Schmidt, P. Pilewskie et al., "The spectral signature of cloud spatial structure in shortwave irradiance," *Atmospheric Chemistry and Physics*, vol. 16, no. 21, pp. 13791–13806, 2016.

[2] R. Bratu, P. Musialik, and M. Prochaska, "Development of LiDAR data classification algorithms based on parallel computing using nVidia CUDA technology," *Running algorithm of simulator of wireless distributed measurement-control system with rule based processing*, vol. 62, no. 11, pp. 387–393, 2016.

[3] Q. Li, "Empirical study on the transformation and development of internet financial system based on spatial econometric model," *Boletin Tecnico/Technical Bulletin*, vol. 55, no. 18, pp. 100–107, 2017.

[4] B. Miziński and T. Niedzielski, "Fully-automated estimation of snow depth in near real time with the use of unmanned aerial vehicles without utilizing ground control points," *Cold Regions Science and Technology*, vol. 138, pp. 63–72, 2017.

[5] B. T. Russell, D. S. Cooley, W. C. Porter, B. J. Reich, and C. L. Heald, "Data mining to investigate the meteorological drivers for extreme ground level ozone events," *Annals of Applied Statistics*, vol. 10, no. 3, pp. 1673–1698, 2016.

[6] A. K. Singh, A. Anand, Z. Lv, H. Ko, and A. Mohan, "A survey on healthcare data: a security perspective," *ACM Transactions on Multimedia Computing, Communications, and Applications*, vol. 17, no. 2, pp. 1–26, 2021.

[7] S. Hioki, J. Riedi, and M. S. Djellali, "A study of polarimetric error induced by satellite motion: application to the 3MI and similar sensors," *Atmospheric Measurement Techniques*, vol. 14, no. 3, pp. 1801–1816, 2021.

[8] S. Frimann, J. K. Jørgensen, and T. Haugbølle, "Large-scale numerical simulations of star formation put to the test," *Astronomy & Astrophysics*, vol. 587, no. 39, pp. A59–A32727, 2016.

[9] I. U. Khan, M. A. Hassan, M. D. Alshehri et al., "Monitoring system-based flying IoT in public health and sports using ant-enabled energy-aware routing," *Journal of Healthcare Engineering*, vol. 2021, no. 1, 11 pages, Article ID 1686946, 2021.

[10] B. D. T. P. Gomes, L. C. M. Muniz, F. J. da Silva e Silva, L. E. T. Ríos, and M. Endler, "A comprehensive and scalable middleware for Ambient Assisted Living based on cloud computing and Internet of Things," *Concurrency and Computation: Practice and Experience*, vol. 29, no. 11, Article ID e4043, 2017.

[11] A. Mukherjee, S. Ghosh, A. Behere, S. K. Ghosh, and R. Buyya, "Internet of Health Things (IoHT) for personalized health care using integrated edge-fog-cloud network," *Journal of Ambient Intelligence and Humanized Computing*, vol. 12, no. 1, pp. 943–959, 2021.

[12] G. M. Abdulsahib and O. Ibrahim Khalaf, "An improved algorithm to fire detection in forest by using wireless sensor networks," *International Journal of Civil Engineering and Technology (IJCIET) - Scope Database Indexed.*vol. 9, no. 11, pp. 369–377, 2018.

[13] I. Osamah, O. I. Khalaf, and G. M. Abdulsahib, "Energy efficient routing and reliable data transmission protocol in WSN," *International Journal of Advances in Soft Computing and Its Applications*, vol. 12, no. 3, pp. 45–53, 2020.

[14] A. Mohamad, N. K. Jumaa, and S. H. Majeed, "Thingspeak cloud computing platform based ECG diagnose system," *IJCDS Journal*, vol. 8, no. 1, pp. 2210–2142, 2019.

[15] K. S. Velrani and G. Geetha, "Cloud based smart health monitoring system Arduino-implementation result," *Journal of Computational and Theoretical Nanoscience*, vol. 14, no. 9, pp. 4434–4439, 2017.

[16] P. Calyam, I. Jahnke, A. Mishra, R. B. Antequera, D. Chemodanov, and M. Skubic, "Toward an ElderCare living lab for sensor-based health assessment and physical therapy," *IEEE Cloud Computing*, vol. 4, no. 3, pp. 30–39, 2017.

[17] D. F. García-Molin, R. González-Merino, J. Rodero-Pérez, and B. C. Hurtado, "3D documentation for the conservation of historical heritage: the Castle of Priego de Córdoba (Spain)," *Virtual Archaeology Review*, vol. 12, no. 24, pp. 115–130, 2021.

[18] M. Manunta, C. De Luca, I. Zinno et al., "The parallel SBAS approach for sentinel-1 interferometric wide swath deformation time-series generation: algorithm description and products quality assessment," *IEEE Transactions on Geoscience and Remote Sensing*, vol. 57, no. 9, pp. 6259–6281, 2019.

[19] L. Ogiela, M. R. Ogiela, and H. Ko, "Intelligent data management and security in cloud computing," *Sensors*, vol. 20, no. 12, p. 3458, 2020.

[20] F. Hu, C. Yang, J. L. Schnase et al., "ClimateSpark: an in-memory distributed computing framework for big climate data analytics," *Computers & Geosciences*, vol. 115, pp. 154–166, 2018.

[21] S. Rajendran, O. I. Khalaf, Y. Alotaibi, and S. Alghamdi, "MapReduce-based big data classification model using feature subset selection and hyperparameter tuned deep belief network," *Scientific Reports*, vol. 11, no. 1, Article ID 24138, 2021.

[22] A. Afsharinejad, A. Davy, and B. Jennings, "Dynamic channel allocation in electromagnetic nanonetworks for high resolution monitoring of plants," *Nano Communication Networks*, vol. 7, pp. 2–16, 2016.

[23] M. Sathya, S. Madhan, and K. Jayanthi, "Internet of things (IoT) based health monitoring system and challenges," *International Journal of Engineering & Technology*, vol. 7, no. 1.7, pp. 175–178, 2018.

[24] M. Anekar, A. Khetarpal, and S. S. Sambare, "Survey on real-time health monitoring system based on IOT," *International Journal of Computer Application*, vol. 181, no. 28, pp. 19–23, 2018.

[25] C. Gadekar and V. M. Vaze, "Context aware computing: IOT for neonatal health monitoring," *Advances in Computational Sciences and Technology*, vol. 10, no. 1, pp. 53–62, 2017.

[26] L. Ma and C. Xiu, "Spatial structure of urban residents' leisure activities: a case study of shenyang, China," *Chinese Geographical Science*, vol. 31, no. 4, pp. 671–683, 2021.

[27] P. Guo and Q. Shang, "An optimization framework of coupling effects between sports events and urban economic development," *Boletin Tecnico/Technical Bulletin*, vol. 55, no. 8, pp. 218–224, 2017.

[28] Y. Lai and R. Kuang, "Spatial Structure model analysis of urban public sports," *Boletin Tecnico/Technical Bulletin*, vol. 55, no. 11, pp. 379–385, 2017.

[29] S. V. Bakurskiy, N. V. Klenov, M. Y. Kupriyanov, I. I. Soloviev, and M. M. Khapaev, "Extraction of inductances and spatial distributions of currents in a model of superconducting neuron," *Computational Mathematics and Mathematical Physics*, vol. 61, no. 5, pp. 854–863, 2021.

[30] J. H. Abawajy and M. M. Hassan, "Federated internet of things and cloud computing pervasive patient health monitoring system," *IEEE Communications Magazine*, vol. 55, no. 1, pp. 48–53, 2017.