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Retraction

Retracted: Design and Implementation of Human Motion Monitoring System on Account of Intelligent Computing of Internet of Things

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Journal of Electrical and Computer Engineering has retracted the article titled "Design and Implementation of Human Motion Monitoring System on Account of Intelligent Computing of Internet of Things" [1] due to concerns that the peer review process has been compromised.

Following an investigation conducted by the Hindawi Research Integrity team [2], significant concerns were identified with the peer reviewers assigned to this article; the investigation has concluded that the peer review process was compromised. We therefore can no longer trust the peer review process, and the article is being retracted with the agreement of the editorial board.

The authors do not agree to the retraction.

References

[1] Y. Liu and L. Zhao, "Design and Implementation of Human Motion Monitoring System on Account of Intelligent Computing of Internet of Things," *Journal of Electrical and Computer Engineering*, vol. 2022, Article ID 3316433, 13 pages, 2022.

[2] L. Ferguson, "Advancing Research Integrity Collaboratively and with Vigour," 2022, https://www.hindawi.com/post/advancing-research-integrity-collaboratively-and-vigour/.

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Research Article

Design and Implementation of Human Motion Monitoring System on Account of Intelligent Computing of Internet of Things

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The era of big data network represented mainly by the Internet of Things is limited by various factors such as various environments, volumes, and calculations. This paper proposes and studies a human motion detection system based on the intelligent computing of the Internet of Things, which can effectively detect the daily motion of the human body. In the era of the Internet of Things, this paper designs and develops a human motion detection system based on the Internet of Things technology and intelligent computing and explores the law of normal human motion. This paper also analyzes the design ideas and technical advantages of the human motion detection system from many aspects. This research is a human motion detection system designed and developed under the comprehensive use of Internet of Things technology and intelligent computing technology, which can effectively detect the actual situation of the human body in the state of motion. Experimental results show that the overall accuracy of the system for monitoring and recognizing human walking is 96.91%, and the overall accuracy of monitoring and recognizing human jogging is 97.18%. It monitors and recognizes human jogging with an overall accuracy rate of 97.96%. It has great practical significance.

1. Introduction

The Internet of Things has been an innovative discovery since entering the 21st century. Based on the original Internet, it interconnects different items to form a brand-new network model. The ultimate goal of the Internet of Things technology is to realize the interconnection of everything. It can gather different objects through monitoring, connection, and other means. And through various online methods to collect corresponding information, it can finally achieve the purpose of interconnection of all things. It may realize the all-pervasive connection between things and things, as well as the process of intelligent perception, recognition, and management between things and people. The Internet of Things is based on the Internet, which interconnects different information collection equipment and devices. And through the computer's large amount of data calculation, it combines all the components to obtain a huge information network. What is different from the traditional Internet is that it has different information carriers. In real life, it can interconnect furniture, vehicles, mobile devices, and so on. The monitoring and tracking of human motion has always been an important content of research scholars at home and abroad for the analysis of human motion, and it is also one of the most popular research directions in recent years. It belongs to a branch in the field of computer vision. Nowadays, research in this field still has great research value, which can save a lot of manpower and material resources. It not only has very broad research prospects but also produces great economic benefits to society.

The detection and tracking problems related to the human body in daily life have always been a problem that many scholars are discussing, and it is also an important part of human body motion analysis. Since the beginning of the 21st century, it has been focused on in computer-related fields. From the most basic detection of relevant motion regions in image sequences to the recognition, tracking, and identification of human motions and to advanced research and understanding of human behavior, its direction has great application value. There are many aspects of applying IoT technology in real life. However, there are relatively few researches on human motion monitoring that connect people and things to achieve corresponding tracking systems. It has very important research significance and practical value. Research on human motion detection, tracking, analysis, and so on has broad prospects and application value in human-computer interaction and motion function analysis. It is of great significance to integrate the Internet of Things technology with human motion monitoring.

Human motion monitoring system is the direction that many scholars at home and abroad have been studying since the beginning of the 21st century. It can well grasp the movement laws of the human body so that people can understand their own real movement and can also help people with defects to a certain extent. The use of Internet of Things technology for related research and development is very much in line with the development of this era. In order to identify several types of standard human movement, Vu developed an intelligent processing model embedded in muscle activity pants based on the Adaptive Neurofuzzy Inference System (ANFIS). The processing circuit digitizes the movement data of the fabric stretch sensor developed in the previous research. The results show that the developed adaptive neurofuzzy expert system can be used as one of the intelligent simulators to recognize human motion with robustness and high-precision classification rate. Based on test statistics, the ANFIS model has been proven to be superior to ANN and FIS in terms of classification rate [1]. The real-time health monitoring system is a promising body area network application that can improve the safety of firefighters when working in harsh and dangerous environments. Geng Y considers using features obtained from body radio frequency (RF) channels for motion classification. He has identified various relevant RF features and has implemented a support vector machine (SVM) to facilitate human motion classification. He initially discussed the anisotropy of electrical resistance of conductive fabrics, the resistance-strain relationship, and the relationship between resistance and human knee and elbow motion [2]. Movement is a key indicator of human existence and activity. The latest developments in the field of indoor motion detection reveal their potential to enhance life experience through applications such as intrusion detection and sleep monitoring [3]. Yu G designed a deviceless motion detection system (MoSense) based on radio frequency (RF). It uses the ubiquitous WiFi signal attenuation caused by motion to provide reliable and transparent detection services in real time. Considering that MoSense is compatible with existing WiFi infrastructure, it constitutes a low-cost but promising motion detection solution [4]. In almost any medical procedure, breathing motion is a problem and can cause image quality degradation. Odenbach R evaluated an interactive breath-hold control system, which helps to breathe smoothly. He then reduced respiratory motion during signal acquisition or procedural therapy, providing an easy-to-use and relatively inexpensive solution to imaging problems related to respiratory motion [5]. Gait rehabilitation requires a quantitative analysis of gait stages. Chen W researches the potential use of support vector machine technology and force-sensitive resistors and acceleration values to detect the phase of the human body's dynamic gait cyclic movement. The experimental results verify the effectiveness of the proposed method, and the accuracy rate is as high as 94.08% [6]. Data is the cornerstone of the Internet of Things (IoT) application of digital sensors and has been widely used in various fields from social development to human life. Liu G X proposed an online trusted data integrity monitoring (DIM) method for digital sensors. This method can significantly improve data quality and is expected to be applied to digital sensor systems for other IoT applications [7]. The mentioned related studies have all monitored human movement, but they have not formed a certain system but only monitored human movement from a single or multiple aspects. Moreover, the theoretical methods they use are all similar, lacking a certain degree of innovation.

This paper mainly builds a human motion monitoring system based on the Internet of Things technology and develops the corresponding system by using the Internet of Things technology for intelligent computing. The main function of the system is to be able to detect the human body in motion from the unchanging scene, recognize, detect, and track the related motion of the human body, and finally save the relevant data in the database for subsequent research. In the actual background, the foreground detection method is used to detect, and the performance of the algorithm is tested in the space. In the aspect of tracking, a combined method is used to suppress the divergence caused by different reasons, and good results have been achieved in practical applications. The application of the intelligent computing of the Internet of Things can well solve the problems existing in human motion detection, and it has very good practical application and research value.

2. Internet of Things Technology and Human Motion Monitoring Methods

2.1. Internet of Things Technology. The Internet of Things (IoT) refers to any object or collection of objects. It collects basic information such as sound, light, heat, electricity, biology, engineering, and biology [8]. The method is accomplished through various data sensors, positioning systems, identification systems, induction systems, and other real-time monitoring, connection, and interactive radio frequency identification technologies and through various processing equipment and technologies such as infrared sensors, positioning devices, and laser scanners [9, 10]. Through the possible access of various networks, the all-pervasive connection between things and people and things can be realized [11–13]. A new network model is established by intelligent perception, recognition, and proper management of objects and processes [14]. The Internet of Things technology is a new generation of information service providers developed on the basis of the traditional Internet and using new technologies. It is a new type of network mode that can interconnect and modify physical objects. In real applications, different items will be identified accordingly, and then they will be connected to the gateway device. Then, all the information is integrated, processed, and connected to the high-data network, and finally, all the information is connected to the Internet. It can realize the interconnection of everything in a true sense. The specific theoretical model of the Internet of Things is shown in Figure 1.

Nowadays, what many IoT experts see is distributed and user-friendly computing. In the Internet of Things and integrated systems, the solution to sending massive amounts of data to server devices is to build a large database and store the obtained data in the database [15–17]. In the case of factory automation, there may be hundreds of built-in sensors, which send 3 data points every 1 second. Most sensor data is completely useless after 5 seconds, and many systems with multiple gateways and multiple processes need to process this information almost immediately [18]. Most supporters of data processing support the cloud model. This means that something must always be sent to the cloud, which is the first computing basis of the Internet of Things [19, 20]. The four computing foundations of IoT technology are cloud computing, fog computing, edge computing, and MIST computing. Cloud computing is similar to a data lake, while fog computing can process units and corresponding calculations locally. Edge computing is used to capture tiny interactions. MIST calculation can be used for data processing and intelligence of the Internet of Things, and it can provide corresponding calculations for other services of the Internet of Things [21, 22]. The specific calculation mode diagram is shown in Figure 2.

The Internet of Things includes a perception layer, a network layer, and an application layer. The main components of the Internet of Things technology are composed of three, and their functions and roles are different. Coupled with a platform layer, it constitutes all the constituent layers of the Internet of Things. The function of the perception layer is to digitize object information in the real world or information that can be automatically processed in real time in various ways in the virtual world. Level-related technologies include RFID technology, detection and control technology, and short-range wireless communication technology [23]. The main role of the network layer includes communication and transmission. The communication layer means the information collected from the perception layer, combined through various network technologies, and combined with a large amount of data for processing [24]. The main meaning of the transport layer is to seamlessly transmit sensing data using the Internet, mobile networks, sensor networks, and fusion technologies. The main role of the application layer includes technical support and application interface, completing the expression and processing of data to achieve its purpose [25]. Technical support includes semantic collaboration and data sharing. The application interface layer refers to the interface between the Internet of Things and users (including people, organizations, and other systems). It combines the needs of the industry to realize the intelligent implementation and integrated services of the Internet of Things. The specific three-tier structure of the Internet of Things is shown in Figure 3.

2.2. Intelligent Computing. Intelligent computing is one of the branches of artificial intelligence. It is a program that can calculate based on experience, and it can help people deal with problems and think independently. As the intelligence of the current system continues to grow and the complexity of tasks automatically completed and defined by the computer continues to increase, the use of intelligent computing is gradually increasing. For example, intelligent computing technologies are widely used in industries such as finance, medical care, and national defense and security. Intelligent computers have invested a lot of money in industrial production and lives and can also be called computational intelligence. It includes genetic algorithms, smelting simulation algorithms, forbidden search algorithms, evolutionary algorithms, heuristic algorithms, ant colony algorithms, deep learning algorithms, biological computing, DNA computing, quantum computing, intelligent computing, optimization fuzzy, and other specific logic mode algorithms [26]. Traditional computers have lost innovation in the continuity and sublimation of scientific development and actual calculations, while intelligent computing is a new computing model that conforms to the trend of artificial intelligence. It can adapt well to the changes of the current era, but it requires a large amount of computing power to support the algorithm model. Intelligent computers developed by intelligent computing must have the following key characteristics: continuous evolution, intelligent management, and upgrade capabilities; eco-friendly: growth, seamless geographic connectivity, and efficient collaboration; open ecosystem: multiple upstream and downstream can participate in the creation and distribution of artificial intelligence dividends [27]. On the basis of the realization of intelligent computing in the Internet of Things, the first is to use advanced IT and CT technologies, such as B-ultrasound and scanners, for corresponding scan input. The second is to use chips, architecture, artificial intelligence, and so on to intelligently upgrade IT infrastructure. And intelligent loading of business, optimization of computing resources, optimization of IT infrastructure, and so on are now very important methods. Optimizing today's business TCO computing power can grow and develop anytime, anywhere. Using and cooperating can reduce the restrictions on the use of artificial intelligence and make artificial intelligence a comprehensive and general computing resource. Finally, the open architecture and ecology can provide more participation opportunities for participants from all over the world [28]. Figure 4 shows the relationship between the Internet of Things and intelligent computing.

In the actual intelligent computing process of the Internet of Things, the matrix operation is performed cyclically on the DLP first, and the result after the operation is copied back to the ARM. Finally, the space between the two is released. The released space can meet the storage of the next

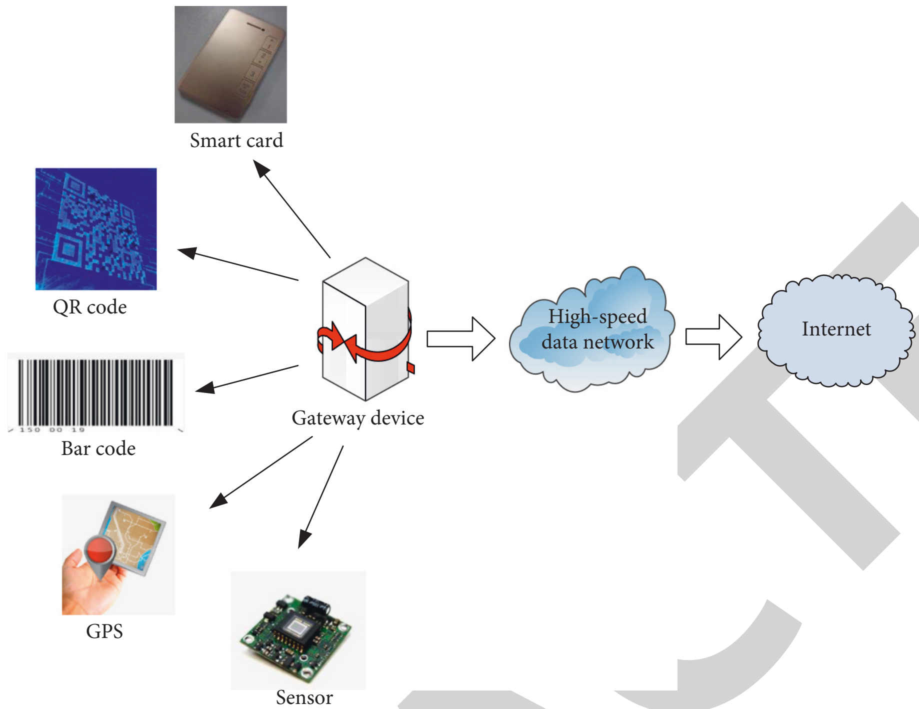

FIGURE 1: Basic theoretical model of IoT.

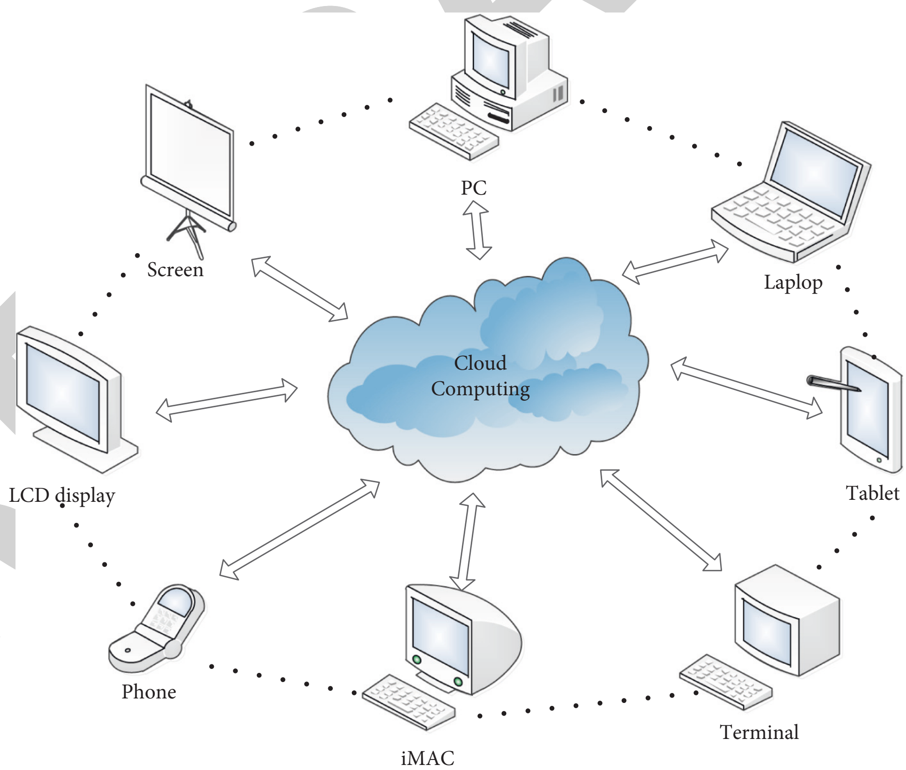

FIGURE 2: Four computing modes of the Internet of Things.

data input, and it can also make the entire system not stall after a certain period of use, as shown in (1):

$$ops = 2W * W * \ln * e\ln * dp * C * N * H. \quad (1)$$

Next, use the NeuWare library function to count the time that may be consumed by the corresponding matrix calculation completed on the DLP and calculate the peak computing power OPS. Assuming that the total amount of

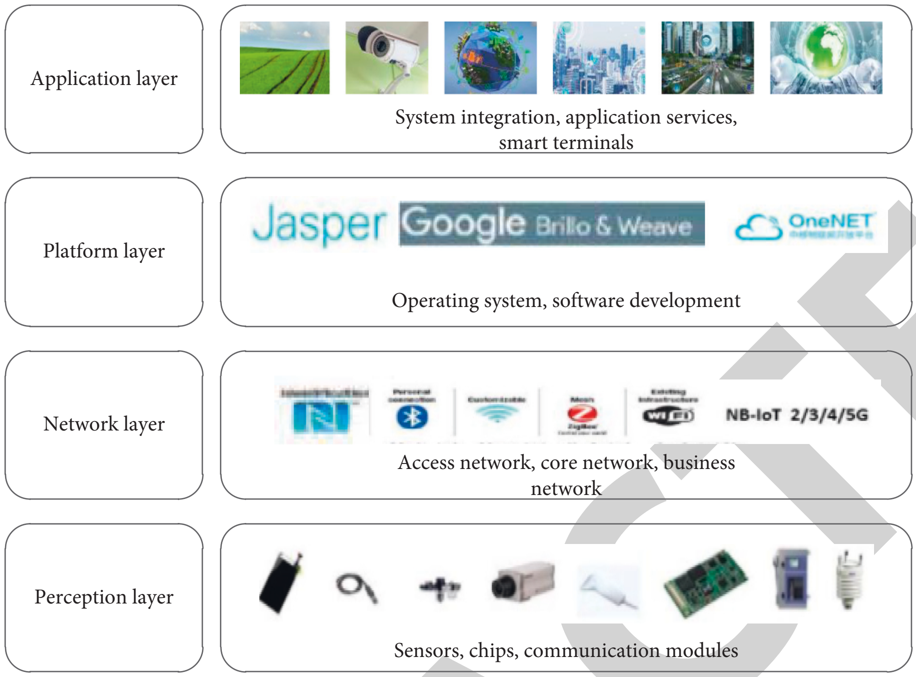

FIGURE 3: Schematic diagram of the three-tier structure of the Internet of Things.

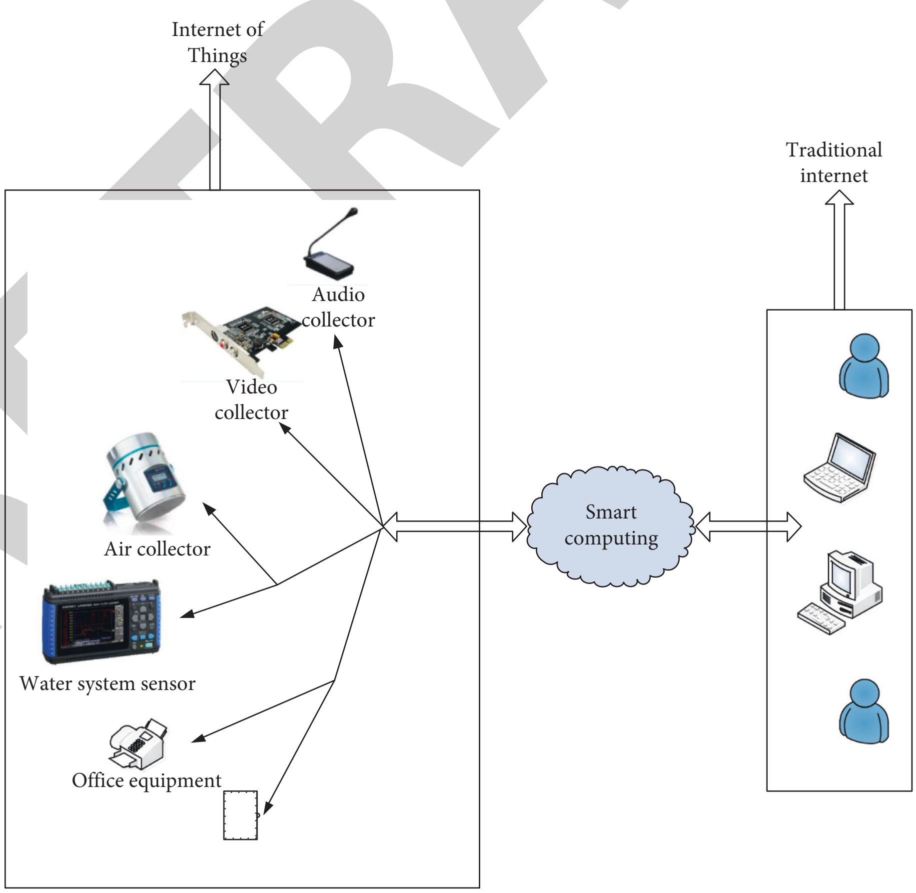

FIGURE 4: Schematic diagram of the Internet of Things and intelligent computing.

computing is ops and the computing time is t, the peak computing power can be expressed as

$$\mathrm{OPS} = \frac{\mathrm{ops}}{\mathrm{t}}. \tag{2}$$

In the intelligent computing system of the Internet of Things, the optical image is used as the raw data to be tested, and the actual target classification network model is transplanted and operated. According to the actual power consumption when the model is running, the specific energy efficiency ratio is calculated [29], and the number of operations of the convolution kernel *ck* is

$$\mathrm{MAdd}_{ck} = 2HW\left(C_{\mathrm{in}}K^2 + 1\right)C_{\mathrm{out}}. \tag{3}$$

Among them, H and W are the height and width of the input feature map, K is the width of the convolution kernel, and the number of multiplication-addition operations of the fully connected layer fcl is

$$MAdd_{\mathrm{fel}} = (2I - 1)O. \tag{4}$$

Among them, I is the input dimension, and O is the output dimension [30].

In the IoT intelligent computing system, the specific multiplication-addition operation includes multiple floating-point operations. Then, in the actual calculation process,

$$\mathrm{Gflops} = 8 * \mathrm{MAdd} * 10^{-9}. \tag{5}$$

If the frame rate fps of the target classification can be calculated experimentally, the corresponding AI computing power requirement can be derived, and the calculation formula is as follows:

$$\mathrm{TFLOPS} = G\mathrm{flops} * \mathrm{fps} * 10^{-3}. \tag{6}$$

Assuming that the current system power consumption is P, then the energy efficiency ratio is

$$\mathrm{EER} = \frac{\mathrm{Gflops} * \mathrm{fps} * 10^{-3}}{P}. \tag{7}$$

2.3. Human Motion Detection Method. In recent years, the hot topic of people's discussion has always been health. Now everyone is in a subhealth state. There are many factors that affect physical health from internal and external factors. External factors refer to external environmental factors, such as air, light, and daily diet. The internal factors include physical, psychological, and other internal factors of the human body, among which internal factors such as mood and work-rest combination are closely related to people's psychological conditions. With the continuous acceleration of life, most people are generally busy with work and do not work according to intermittent and rest periods. Less exercise in daily life brings more physical problems, the body will gradually appear various minor problems, and it will be in a subhealthy state for a long time [31]. Physical health is the foundation of everything. Without good physical support, other work activities will be quite difficult. It is very important to find a way to maintain a good body. In addition to improving eating habits and work and rest habits, proper daily exercise is also essential. One of the important components of human behavior is human physical activity. In real life, it is closely connected with health. Therefore, the physical condition of a person can be evaluated according to the amount of physical activity of the person. It can realize the mastery of human health to a certain extent. Daily exercise includes walking, running, jumping, and up and down exercises. According to the physical activity statistics of these daily activities, it can indirectly reflect people's physical trends. There are basically two ways to obtain information about human behavior: one uses vision, and the other uses sensors [32]. Vision-based human behavior recognition technology was recently launched, and the theoretical research is relatively complete. Both the recognition success rate and the algorithm complexity are quite reasonable. However, the method of visually recognizing human behavior has its shortcomings. It is easily affected by the external environment and requires adequate lighting and background conditions to judge the movement of the human body. In addition, vision-based methods may violate user privacy [33]. However, the vision-based observation method must be completed under the camera device. On the contrary, another method of recognizing human behavior based on the speed sensor has obvious advantages. It can independently receive data on human daily behavior and is convenient for users to carry. Normal human behavior does not infringe user privacy; as long as the user holds the device's acceleration sensor, the human body motion data can be obtained through the sensor, and the corresponding algorithm can calculate the number of walking steps [34]. After a long period of training, these algorithms can be fully applied to the Internet of Things and human motion detection. But its essence is still closely related to the collected data. It is embodied in the authenticity and reliability of the data, as well as in the final realization. The details are shown in Figure 5.

The division of the area around the human body is based on the human body coordinate system, and the pitch angle and roll angle are mainly used to judge the human body posture. In the calculation process of the human body posture angle [35], the corresponding calculation is carried out by the following formula:

$$\begin{aligned}
\theta &= -\arcsin\left(\frac{G_Y}{g}\right), \\
\gamma &= \arcsin\left(\frac{G_X}{g\cos\theta}\right), G_Z < 0, \\
\gamma &= \pi - \arcsin\left(\frac{G_X}{g\cos\theta}\right), G_Z > 0 \,\&\, G_X > 0, \\
\gamma &= -\arcsin\left(\frac{G_X}{g\cos\theta}\right) - \pi, G_Z > 0 \,\&\, G_X > 0.
\end{aligned} \tag{8}$$

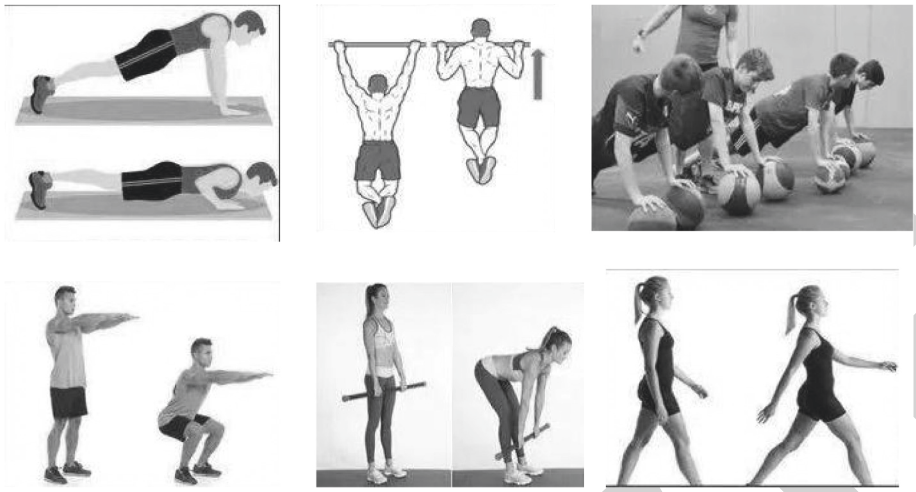

Figure 5: Entity diagram of normal human motion detection.

When the acceleration sensor is stationary, it does not mean that the output of the acceleration sensor is at this time. Because of the existence of gravity, the static acceleration is produced when gravity acts on the mass. At this time, the output of the acceleration sensor is the projection component of the gravitational acceleration on the supporting axis of the mass [36].

$$\overrightarrow{a} = \overrightarrow{g} \cos\theta. \tag{9}$$

Using this characteristic of the acceleration sensor, the output of the acceleration sensor in a static state can be used to obtain the inclination angle of the acceleration sensor in the gravitational field; namely,

$$\theta = \arccos \overrightarrow{a} . \tag{10}$$

The basic working principle of capacitive sensors is based on the relationship between the capacitance between objects and their structural parameters. For plate capacitors, the relationship between capacitance value and structural parameters is shown in (11). Among them, ε is the dielectric constant of the medium, A is the area of the two opposite plates, and D is the distance between the opposite plates.

$$C = \frac{\varepsilon A}{D}. \tag{11}$$

The output a_u of the acceleration sensor on this axis can be regarded as the projection value of the combined acceleration $\overrightarrow{a_{res}}$ on this output axis, as shown in the formula, where $\overrightarrow{u}$ is the unit vector on the output shaft of the acceleration sensor.

$$a_u(t) = \overrightarrow{a_{res}}(t) * \overrightarrow{u}(t). \tag{12}$$

Because the total acceleration is composed of two parts of acceleration. One part is the gravitational acceleration $\overrightarrow{u}$ that always exists in the gravitational field, and the other part is the acceleration $\overrightarrow{a}$ generated by body motion, as shown in the following formula:

$$\overrightarrow{a_{res}}(t) = \overrightarrow{a_B}(t) - \overrightarrow{g} . \tag{13}$$

The output signal of the acceleration sensor on this axis can be expressed as

$$\begin{aligned} a_u(t) &= \left(\overrightarrow{a_B}(t) - \overrightarrow{g} \right) * \overrightarrow{u}(t), \\ a_u(t) &= a_B(t)\cos(\vartheta(t)) - g\cos(\delta(t)). \end{aligned} \tag{14}$$

According to the output of the acceleration sensor, the angle between the output shaft and the acceleration of gravity can be obtained, that is, the position information of the acceleration sensor in the gravity field, as shown in the following formula:

$$a_u = -g\cos\delta. \tag{15}$$

In order to monitor the fall of the human body, the SVM feature quantity is introduced:

$$\mathrm{SVM} = \sqrt{x_i^2 + y_i^2 + z_i^2}. \tag{16}$$

3. Human Motion Detection System Design

3.1. Hardware Design. The hardware system includes MPU6050 three-axis acceleration sensor, MicroSD card, DS18820 temperature sensor, OLED display, organic light-emitting diode, and accelerometer for human motion monitoring. The MSP430 data processing microprocessor and the Bluetooth HC05 module are composed, and the system framework and data flow direction are shown in Figure 6. The microprocessor can use the temperature sensor to receive human body temperature information and the three-axis acceleration sensor to receive different information about the human body, such as the three-axis acceleration and human body environmental temperature in

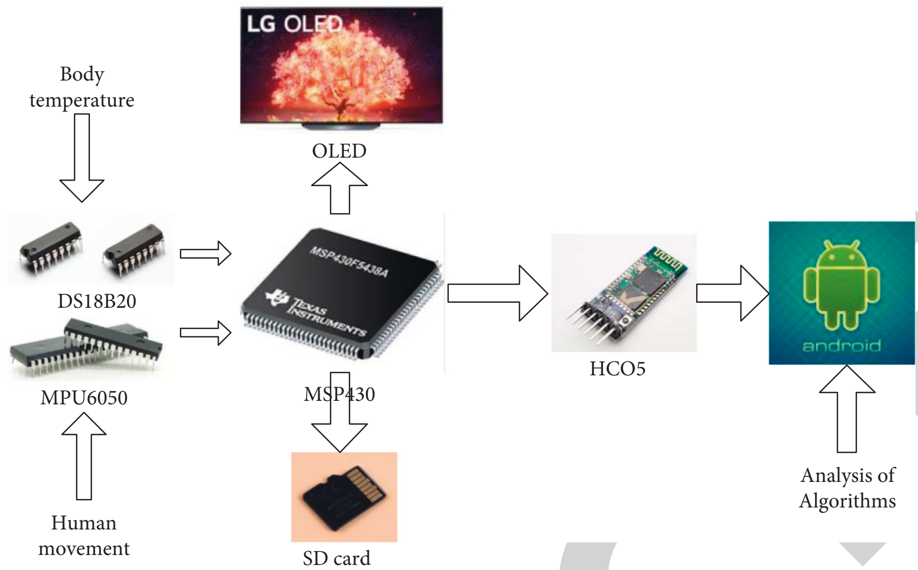

Figure 6: System framework and information flow.

different motion states. Temperature detection, heartbeat detection, blood pressure detection, and so on are processed by the microprocessor. The microprocessor displays these data on the screen on the one hand and stores the data on the SD card on the other hand for offline analysis of the received data. The Rock Bluetooth module is sent to the Android platform of the mobile phone and analyzed through algorithms. Finally, it combines three-axis acceleration and Android portable programming to calculate speed, distance, and calorie consumption, as well as the body's movement posture in various motion states, and finally, all the information appears on the mobile phone for users to observe.

Nowadays, smart devices can be seen everywhere. Most electronic products, including mobile phones, computers, and tablets, have become part of most people's lives. According to relevant statistics, some people will install relevant health detection software on their mobile phones in order to detect the normal movement of the human body. As shown in Figure 7, the user status of health application installers is mainly middle-aged, relatively few users install mobile health applications, and the largest proportion of users who download point applications are games and entertainment. There are relatively few users of health-related applications such as social networking and life. This system is for research on human movement. The application it designs and develops is between the life category and the health category, but it also includes social communication sharing.

Many applications now provide users with a single menu option. It does not make corresponding recommendations based on the type of exercise selected by the user and the actual situation of the user. Different users calculate exercise distance and exercise energy consumption differently because the user's exercise type is constantly changing. So it should be changed according to the different situations of different users. This fixed training type setting has more differences in the final result, and the user experience is terrible. Most health apps do not calculate body movement data based on weight, height, pace, stride length, and other data. Different users' weight, height, pace, and exercise behavior (such as walking and running) will affect the results. Some health and fitness applications use GPS to track the user's exercise trajectory, but from the opinions of users who have used it, there is a big difference between the location result and the actual trajectory. After measuring related applications for a period of time, it is found that the download status of some health applications in the Android mobile phone application market and the download status of some other applications in the other mobile phone application market are shown in Figure 8.

3.2. Software Design. The Android software system flowchart uses the Struts2+Hibernate framework on the server side and uses the MySQL database to store data. In the server-side architecture, all servers adopt a multilevel architecture. From top to bottom, it is the controller layer, the model layer, and the persistence layer. Among them, the Struts2 database level is used as the control level and the Hi version level. This paper is based on the integrated intelligent computing system of the Internet of Things technology, tracking the calculation of the relevant aspects of human motion detection. Although it is not the best in the industry in terms of net computing power, it has the advantage that it is mainly used in simulated training scenarios and can well implement system functions. And it has strong portability, mainly used for model inference, and its energy efficiency ratio far exceeds other AI accelerator platforms. It can well complete the development of this system, as shown in Figure 9.

Test the maximum processing capacity of the built-in intelligent processor in the IoT intelligent computing system. First read each group of data, perform corresponding classification, and then use the library function to read the

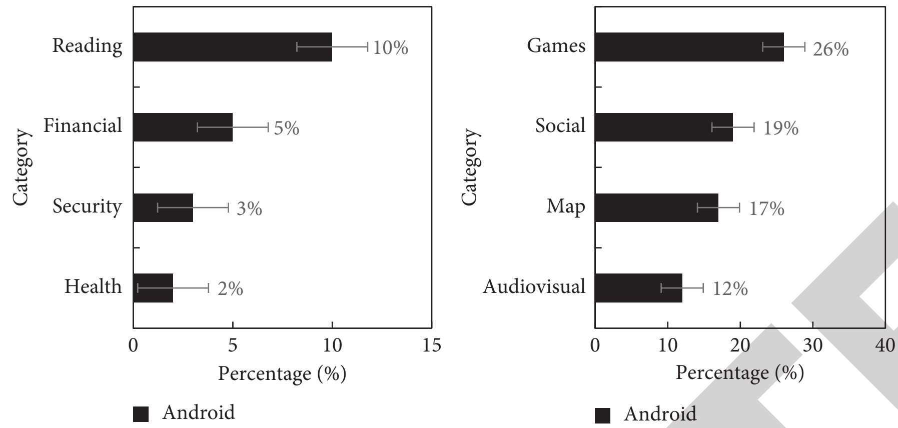

Figure 7: Application download details on the Android platform.

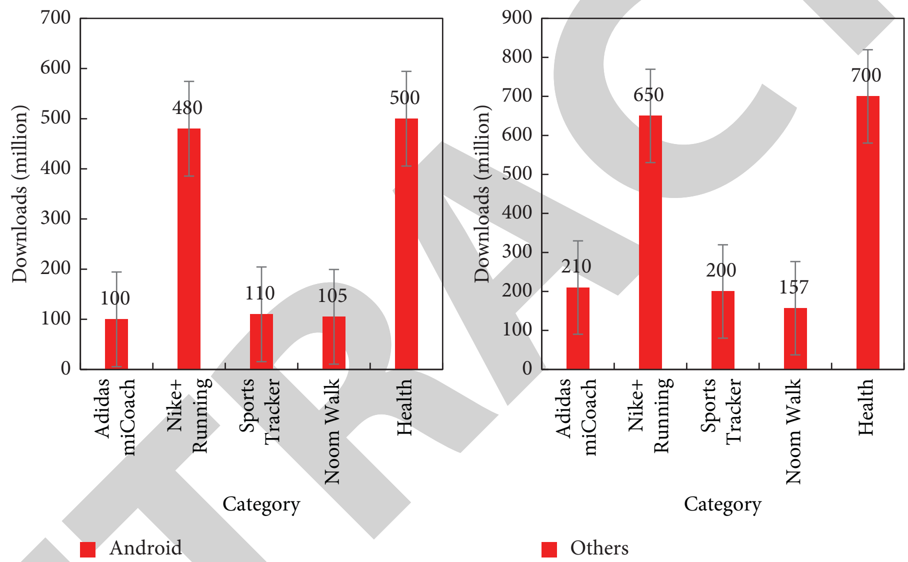

Figure 8: Health app downloads in different mobile app stores.

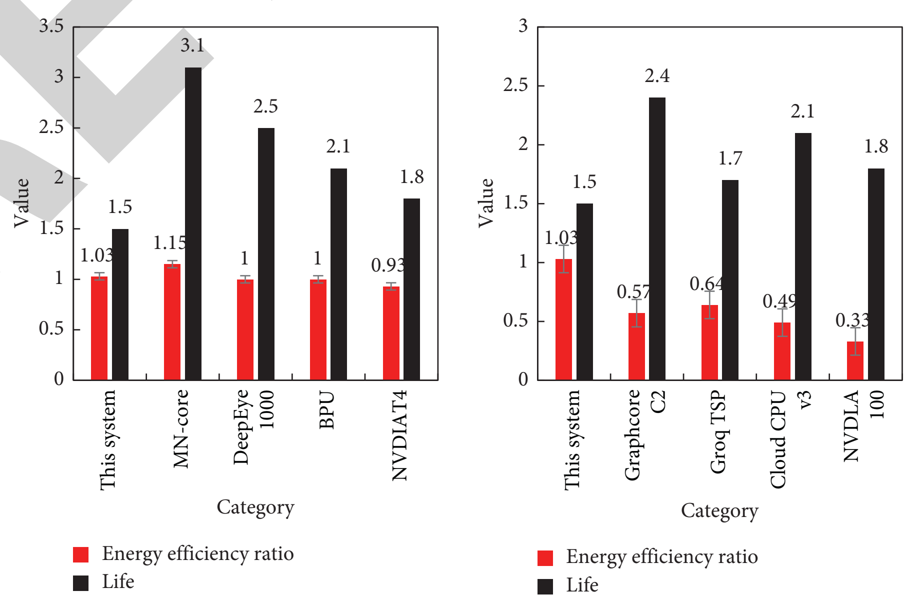

Figure 9: Comparison of energy efficiency between IoT intelligent computing system and other systems.

Table 1: Evaluation results in peak calculation.

Test sequence	Computation (ops)	Computing time (ms)	Peak computing power
1	323.157×10^{12}	2989.221478	114.91×10^{12}
2		2989.201523	114.91×10^{12}
3		2989.198742	114.91×10^{12}
4		2989.221472	114.909×10^{12}
5		2989.175349	114.904×10^{12}
6		2989.232471	114.905×10^{12}
7		2989.245712	114.911×10^{12}
8		2989.204716	114.914×10^{12}
9		2989.221478	114.907×10^{12}
10		2989.214751	114.91×10^{12}

calculation time of each array multiplication performed by the system. Then calculate the average value of the maximum processing capacity of the system. In this way, the computing power of the computing system can be fully used, and the system will not be idle or piled up. Check that the entire program flow function test was carried out 10 times; the test results are shown in Table 1. The calculation time in the table refers to the inference time in the DLP, excluding the data replication time. It seems that the result of the built-in intelligence of the average maximum processing power computer system has met expectations. During the test, the operator type material configuration, test method, and so on all meet the requirements. The maximum processing capacity test result only shows the processing efficiency. The highest level of system performance cannot be displayed in a dedicated test environment, so the test results in the table are only a reference for the system's AI processing capabilities.

When performing integrated implantation and common target detection/classification network evaluation experiments, the size of the test image, the number of image groups, and the number of model calculations should be recorded before the test. In addition, it is necessary to measure the processing capacity requirements of each model, record the actual power consumption during the test, and calculate the corresponding power efficiency ratio and results afterward. Table 2 shows the average power efficiency ratio of the integrated intelligent computing system.

3.3. Overall Design. This system completes the calculation of calorie consumption by measuring acceleration in different directions. The system uses GPS positioning technology to realize the tracking and recognition of human motion and finally uses the Internet of Things intelligent calculation to complete the calculation to track the human motion state. According to the final system design, it is found that the detection function of the human body can be well realized through the Internet of Things and intelligent calculation in this system. It can also observe the specific changes in the user's body after exercise to a certain extent so that it can recommend the user to make corresponding supplements, as shown in Figure 10.

This system uses Internet of Things technology and intelligent calculation methods to design and develop human motion detection systems. In the actual experiment, the dynamic monitoring system is designed using human body measurement and Android technology. In the experiment, the human body's normal walking, jogging, and falling, three different movements, are studied, and the instantaneous acceleration experimental data are collected. The energy consumption in this process is used as an experimental variable for comparison with energy consumption data measured from a typical corridor. Then, it can analyze the validity of the system test results.

The results of normal human walking are shown in Table 3. The relevant personnel in this test of normal walking human body detection are all people of normal form, and the experimental results are universal. The system's recognition rate of walking reached 96.91%, and the relevant personnel agreed during the experiment. This experiment will not have a negative impact on the human body.

The results of normal human jogging are shown in Table 4. The relevant personnel in this normal jogging human detection experiment are all people of normal form, and the experimental results are universal. The system's recognition rate for jogging reached 97.18%, and the relevant personnel agreed during the experiment. This experiment will not have a negative impact on the human body.

Table 5 shows the results of a fall in a normal human body. The relevant personnel in this normal fall human detection experiment are all people of normal form, and the results of the experiment are universal. The system's recognition rate for falls reached 97.96%, and the experiment was conducted with the consent of relevant personnel. This experiment will not have a negative impact on the human body.

4. Discussion

In order to make a qualitative and quantitative assessment of the human motion monitoring system based on the Internet of Things technology plus intelligent computing, this paper designs a set of experiments to verify the feasibility of the human motion monitoring system based on the Internet of Things technology. The principle of experimental organization is to first ensure that all motion categories in the human motion classifier designed for system software and hardware are considered. In addition, the experiment also needs to consider the influence of some other uncertain motions on the preset motion types of the system in the actual monitoring system operation process. Therefore, a

Table 2: Average power ratio of intelligent computing system.

Model	Size of picture	Number of pictures	Computation	Floating-point operations
YOLOv3	416*416	1000	20.29	162.32
VGG-19	1024*1024	500	11.3	156.8
ResNet-34	1280*1280	1000	19.6	28.8
ResNet-50	224*224	1000	3.6	30.4
ResNet-152	224*224	500	3.8	90.4

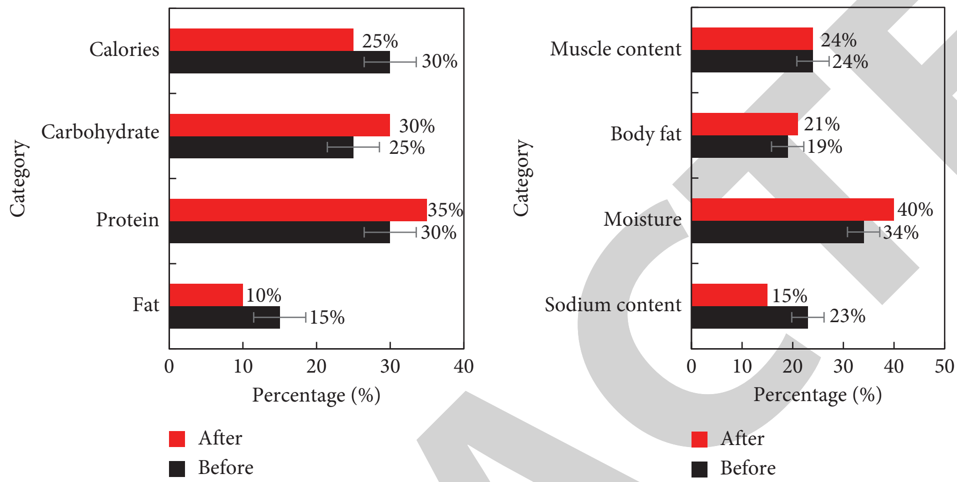

Figure 10: Changes in the body after a period of time.

Table 3: Experimental test results of normal walking.

Motion state	t (s)	a	S (m)	T	Calories burned
Walk normally	1	2.3	2.62	23.1	396.57
	2	3.1	3.51	23	513.46
	3	2.5	2.81	23.2	442.67
	4	2.7	3.01	23.1	492.54

Table 4: Experimental test results of jogging.

Motion state	t (s)	a	S (m)	T	Calories burned
Jogging	1	4.6	17.8	23.3	868.26
	2	5.1	24.91	23	1110.45
	3	5.3	31.47	23.1	1015.12
	4	4.5	35.28	23.1	1062.42

Table 5: Experimental test results of falling.

Motion state	t (s)	a	S (m)	T	Calories burned
Falling	1	3.3	44.34	23.3	1064.41
	2	1.5	43.26	23.2	923.26
	3	4.2	47.26	23.1	1076.14
	4	2.6	51.24	23	1120.26

group of experiments were designed to obtain relevant data. The final data result is also close to what was envisaged before the start of the experiment. Many dynamic activities will be classified into static poses by the classifier. If it is slightly smaller than this value, much static small body shaking may also be regarded as dynamic activities. Therefore, it greatly improves the error rate of the human motion monitoring system. Corresponding experiments are designed to verify the performance and feasibility of the human motion classifier algorithm and the human posture monitoring system. Experiments prove that the system has a good accuracy rate. Then, the two important thresholds in the system are verified. Experiments show that the parameter values adopted by the system are needed to ensure the performance of the system. The experimental results finally show that the human body motion posture monitoring system based on the Internet of Things technology and intelligent computing is completely feasible.

5. Conclusion

At present, in the mobile application market, game-type mobile application software accounts for the majority, and health-type mobile application software accounts for the minority. It implies that health-related mobile applications still have great market prospects. At present, sports mobile health application software uses exercise steps, exercise energy consumption, and exercise distance as basic functions. Some will add network sharing as a means of social communication, and some applications will have an independent server platform for data storage and processing. In addition to monitoring the user's motion based on the acceleration sensor, this paper also monitors the user's motion trajectory. This paper adds a function that does not have GPS motion tracking in other applications. This function records the user's outdoor exercise track and saves the daily exercise track. At the same time, users can share their trajectories with other communication or processing platforms via the Internet. A human motion detection system is designed and developed based on the intelligent computing of the Internet of Things. In the field of intelligent computing, its actual application value is greatly improved compared to traditional software. It has great use value in daily life.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this paper.

References

[1] C. Vu and J. Kim, "Human motion recognition using E-textile sensor and adaptive neuro-fuzzy inference system," *Fibers and Polymers*, vol. 19, no. 12, pp. 2657–2666, 2018.

[2] Y. Geng, J. Chen, R. Fu, G. Bao, and K. Pahlavan, "Enlighten wearable physiological monitoring systems: on-body RF characteristics based human motion classification using a support vector machine," *IEEE Transactions on Mobile Computing*, vol. 15, no. 3, pp. 656–671, 2016.

[3] H. Jiyong, Z. Xiaofeng, L. Guohao, Y. Xudong, and D. Xin, "Electrical properties of PPy-coated conductive fabrics for human joint motion monitoring," *Autex Research Journal*, vol. 16, no. 1, pp. 7–12, 2016.

[4] G. Yu, J. Zhan, Y. Ji, L. Jie, and S. Gao, "MoSense: a RF-based motion detection system via off-the-shelf WiFi devices," *IEEE Internet of Things Journal*, vol. 4, no. 99, pp. 2326–2341, 2017.

[5] R. Odenbach, A. Boese, and M. Friebe, "Interactive monitoring system for visual respiratory biofeedback," *Current Directions in Biomedical Engineering*, vol. 2, no. 1, pp. 723–726, 2016.

[6] W. Chen, Y. Xu, J. Wang, and J. Zhang, "Kinematic analysis of human gait based on wearable sensor system for gait rehabilitation," *Journal of Medical and Biological Engineering*, vol. 36, no. 6, pp. 843–856, 2016.

[7] G.-X. Liu, L.-F. Shi, and D.-J. Xin, "Data integrity monitoring method of digital sensors for internet-of-things applications," *IEEE Internet of Things Journal*, vol. 7, no. 5, pp. 4575–4584, 2020.

[8] L. Pang and J. Zang, "Design and implementation of an intelligent tourism system based on cloud computing," *Clinica Chimica Acta*, vol. 42, no. 3, pp. 1038–1042, 2017.

[9] I. Cvitić, D. Peraković, M. Periša, and M. D. Stojanović, "Novel classification of IoT devices based on traffic flow features," *Journal of Organizational and End User Computing*, vol. 33, no. 6, pp. 1–20, 2021.

[10] B. Zhang, K. Wen, J. Lu, and M. Zhong, "A top-K QoS-optimal service composition approach based on service dependency graph," *Journal of Organizational and End User Computing*, vol. 33, no. 3, pp. 50–68, 2021.

[11] O. I. Khalaf and G. M. Abdulsahib, "Optimized dynamic storage of data (ODSD) in IoT based on blockchain for wireless sensor networks," *Peer-to-Peer Networking and Applications*, vol. 14, no. 5, pp. 2858–2873, 2021.

[12] S. Bharany, S. Sharma, S. Badotra et al., "Energy-efficient clustering scheme for flying ad-hoc networks using an optimized LEACH protocol," *Energies*, vol. 14, no. 19, p. 6016, 2021.

[13] C. A. Tavera Romero, J. H. Ortiz, O. I. Khalaf, and A. Ríos Prado, "Business intelligence: business evolution after industry 4.0," *Sustainability*, vol. 13, no. 18, p. 10026, 2021.

[14] D. Xiaojuan and Z. Yuan, "Application and implementation of intelligent community system based on the Internet of things technology," *Agro Food Industry Hi-Tech*, vol. 28, no. 1, pp. 1558–1562, 2017.

[15] M. Adil, M. A. Jan, S. Mastorakis et al., "Hash-MAC-DSDV: mutual authentication for intelligent IoT-based cyber-physical systems," *IEEE Internet of Things Journal*, p. 1, 2022.

[16] M. Adil, H. Song, J. Ali et al., "EnhancedAODV: a robust three phase priority-based traffic load balancing scheme for internet of things," *IEEE Internet of Things Journal*, p. 1, 2022.

[17] Y. Sun, H. Song, A. J. Jara, and R. Bie, "Internet of things and big data analytics for smart and connected communities," *IEEE Access*, vol. 4, pp. 766–773, 2016.

[18] M. S. Mustafa, Z. Husin, W. K. Tan, M. F. Mavi, and R. S. M. Farook, "Development of automated hybrid intelligent system for herbs plant classification and early herbs plant disease detection," *Neural Computing & Applications*, vol. 32, no. 15, pp. 11419–11441, 2020.

[19] W. Li, J. Zhu, Y. Zhang, and S. Zhang, "Design and implementation of intelligent traffic and big data mining system based on internet of things," *Journal of Intelligent and Fuzzy Systems*, vol. 38, no. 2, pp. 1967–1975, 2020.

[20] T. Hong, W. Zhao, R. Liu, and M. Kadoch, "Space-air-ground IoT network and related key technologies," *IEEE Wireless Communications*, vol. 27, no. 2, pp. 96–104, 2020.

[21] Y. Li, Y. Zuo, H. Song, and Z. Lv, "Deep learning in security of internet of things," *IEEE Internet of Things Journal*, no. 99, p. 1, 2021.

[22] D. Guido, H. Song, and A. Schmeink, *Big Data Analytics for Cyber-Physical Systems: Machine Learning for the Internet of Things*, pp. 1–360, Elsevier, 2019.

[23] A. I. Abdulla, A. S. Abdulraheem, A. A. Salih et al., “Internet of things and smart home security,” *Technol. Rep. Kansai Univ*, vol. 62, no. 5, pp. 2465–2476, 2020.

[24] T. Mettler and R. Winter, “Are business users social? A design experiment exploring information sharing in enterprise social systems,” *Journal of Information Technology*, vol. 31, no. 2, pp. 101–114, 2016.

[25] M. A. Hoque and C. Davidson, “Design and implementation of an IoT-based smart home security system,” *International Journal of Networked and Distributed Computing*, vol. 7, no. 2, p. 85, 2019.

[26] R. Mukherjee, S. K. Ghorai, B. Gupta, and T. Chakravarty, “Development of a wearable remote cardiac health monitoring with alerting system,” *Instruments and Experimental Techniques*, vol. 63, no. 2, pp. 273–283, 2020.

[27] Q. Xu, Z. Safar, Y. Han, B. Wang, and K. J. R. Liu, “Statistical learning over time-reversal space for indoor monitoring system,” *IEEE Internet of Things Journal*, vol. 5, no. 2, pp. 970–983, 2018.

[28] F. J. Badesa, R. Morales, N. M. Garcia-Aracil et al., “Dynamic adaptive system for robot-assisted motion rehabilitation,” *IEEE Systems Journal*, vol. 10, no. 3, pp. 1–8, 2017.

[29] M. Forouzanfar, M. Mabrouk, S. Rajan, M. Bolic, H. R. Dajani, and V. Z. Groza, “Event recognition for contactless activity monitoring using phase-modulated continuous wave radar,” *IEEE Transactions on Biomedical Engineering*, vol. 64, no. 2, pp. 479–491, 2017.

[30] L. Stirling and J. Maclean, “Roadmap for the development of at-home telemonitoring systems to augment occupational therapy,” *IEEE Transactions on Human-Machine Systems*, vol. 46, no. 4, pp. 569–580, 2016.

[31] S. Youm, Y. Jeon, S.-H. Park, and W Zhu, “RFID-based automatic scoring system for physical fitness testing,” *IEEE Systems Journal*, vol. 9, no. 2, pp. 326–334, 2015.

[32] E. Villeneuve, W. Harwin, W. Holderbaum, R. S. Sherratt, and R. White, “Signal quality and compactness of a dual-accelerometer system for gyro-free human motion analysis,” *IEEE Sensors Journal*, vol. 16, no. 16, pp. 6261–6269, 2016.

[33] S. S. Balpande, J. P. Kalambe, and R. S. Pande, “Development of strain energy harvester as an alternative power source for the wearable biomedical diagnostic system,” *Micro & Nano Letters*, vol. 14, no. 7, pp. 777–781, 2019.

[34] F. S. Ayachi, H. P. Nguyen, C. Lavigne-Pelletier, E. Goubault, P. Boissy, and C. Duval, “Wavelet-based algorithm for auto-detection of daily living activities of older adults captured by multiple inertial measurement units (IMUs),” *Physiological Measurement*, vol. 37, no. 3, pp. 442–461, 2016.

[35] D.-X. Xia, S.-Z. Su, L.-C. Geng, G.-X. Wu, and S.-Z. Li, “Learning rich features from objectness estimation for human lying-pose detection,” *Multimedia Systems*, vol. 23, no. 4, pp. 515–526, 2016.

[36] R. B. Woodward, S. J. Shefelbine, and R. Vaidyanathan, “Pervasive monitoring of motion and muscle activation: inertial and mechanomyography fusion,” *IEEE*, vol. 22, no. 5, pp. 2022–2033, 2017.