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The Internet of things technology in the rehabilitation for the disabled in China: A survey

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Abstract

According to the WORLD Disabled Persons federation (WPF), there are a large number of disabled people in the world, accounting for over 400 million in the Asia-Pacific region alone. This paper discusses the application of the Internet of Things technology in the rehabilitation of special populations, aiming at achieving high allocation of resources without changing personnel allocation, realizing innovation to improve economic benefits without changing personnel allocation, and rationally optimizing resource allocation to achieve maximum. Firstly, we give an overview of the Internet of Things technology and its application, and introduce the sensor, RFID, embedded system and other technologies. Then, we discuss the application of Internet of Things technology in the rehabilitation of disabled people, from the rehabilitation needs of disabled people and the application of Internet of Things technology in the field of rehabilitation. Then, from the statistical analysis of the application of Internet of Things technology in the rehabilitation field in the past 10 years, we obtained the shortcomings of the application of Internet of Things technology in the rehabilitation field and some space for further exploration. Finally, we believe that the application of Internet of Things technology to the rehabilitation management of persons with disabilities will be a breakthrough in the rehabilitation management of persons with disabilities, and have important reference value for the rehabilitation management of persons with disabilities worldwide. We also hope that understanding, respecting, caring and helping people with disabilities will increasingly become a global consensus and action.

Keywords: Rehabilitation for the disabled; The Internet of things; Intelligent management; RFID sensor.

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1. Introduction

According to statistics released by the China Disabled Persons' Federation, the total number of disabled people in China is 85.02 million. The number of persons with disabilities was 12.63 million with visual disabilities, 20.54 million with hearing disabilities, 1.3 million with speech disabilities, 24.72 million with physical disabilities, 5.68 million with intellectual disabilities, 6.29 million with mental disabilities, and 13.86 million with multiple disabilities. 25.18 million were severely disabled and 59.84 million were moderately and mildly disabled[1]. It involves 260 million families, more than 50 percent of whom are poor due to disability[2]. This is a very large group. From 2008 to 2012, a number of key rehabilitation projects were carried out, helping 12.192 million people with disabilities to recover to varying degrees. The work of "rehabilitation in the community and service in the family" to be carried out by 2015 is an important basis for the realization of "everyone can enjoy rehabilitation services". In addition to the comprehensive types of disability rehabilitation services, we should also ensure that everyone with disabilities in urban areas can enjoy quality services at the regional level[3]. With the rapid development of China's economy, the progress of medical science and technology, the improvement of people's life quality and the influence of the family planning policy, the aging trend of China's population is increasingly aggravated[4]. Therefore, the miniaturization of IoT medical equipment facilitates the tracking and guidance of the medical staff at home, reduces the medical expenses of the elderly[5], and facilitates the long-term tracking and maintenance of medical staff. However, in the face of the increasing needs of rehabilitation groups, clinical practitioners and rehabilitation resources are still particularly lacking. Therefore, it is an urgent problem to improve the rehabilitation management level of the disabled as soon as possible and enhance the quality of rehabilitation services for special groups. Based on this Internet of things emerged in the field of rehabilitation of the disabled.

Internet of Things, originating in the media field, is the third revolution in the information technology industry. The Internet of Things refers to connecting any object to the network through information sensing equipment according to the agreed protocol. The object can exchange and communicate information through the information transmission media,to realize intelligent identification, positioning, tracking, supervision and other functions[6]. The Internet of Things is an extreme extension of Internet technology, and the development process of the Internet of Things has also absorbed a large number of new technologies and new ideas. To put it simply, the Internet of Things is the transmission and control of information between things and people. In recent years, the rapid popularity and development of cloud computing and big data in China has accelerated the development of the Internet of Things. During the recent COVID-19(also known as coronavirus) pandemic, researchers also used the Internet of Things to investigate whether fusing chest CT with chest X-ray could help improve the diagnostic performance of AI[7]. Cerebral microhemorrhage (CMB) is a biomarker associated with cerebrovascular diseases. A new computer aided diagnosis method for CMB detection is proposed. Because the CMB is so small, there is very little efficiency and repeatability. Therefore, it is necessary to develop a computer aided diagnosis (CD) system to assist doctors in diagnosis[8]. In recent years, the CPC Central Committee and The State Council have given special care to the disabled and attached great importance to the cause of the disabled, especially to the rehabilitation of the disabled. In December 2018, the central government pointed out that it would increase investment to promote reform and innovation in the manufacturing sector, improve manufacturing infrastructure and vigorously promote the development of 5G. The compound growth rate of the Internet of Things is as high as 22.12 percent, according to the Iot Branch of the China Communications Industry Association and MWC[9].

The Internet of Things is complex in detail, but ultimately the typical architecture is divided into three layers, as shown in Figure 1, with the perception layer, network layer and application layer from bottom to top[10]. The system mainly consists of an operation support system, sensor network system, business application system and wireless communication network system. Iot core key technologies include RFID technology, sensor technology, wireless network technology, artificial intelligence technology, cloud computing technology, its advantage is that under the condition of without changing staffing, achieve efficient distribution of resources, realize the innovation on the function, not only promoted economic efficiency, good is also reasonable optimization on the allocation of resources, Maximum use. The process of the integration of Internet of Things technology and medical device management system, according to its business requirements,can be divided into four parts: intelligent medical layer, system application layer, network layer and user layer[11], as shown in Figure 2.

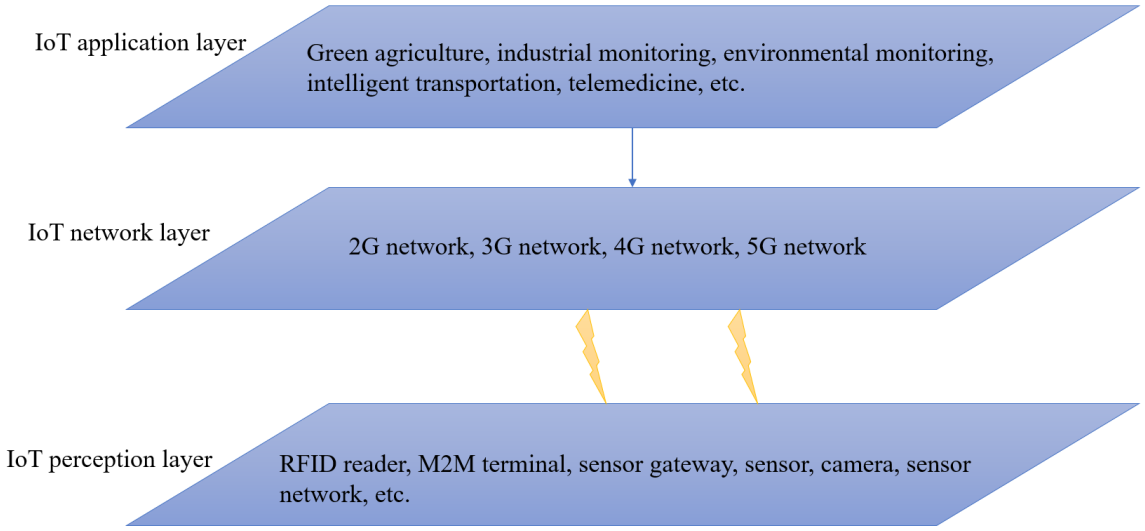

Figure 1. A three-tier conceptual model of the Internet of Things

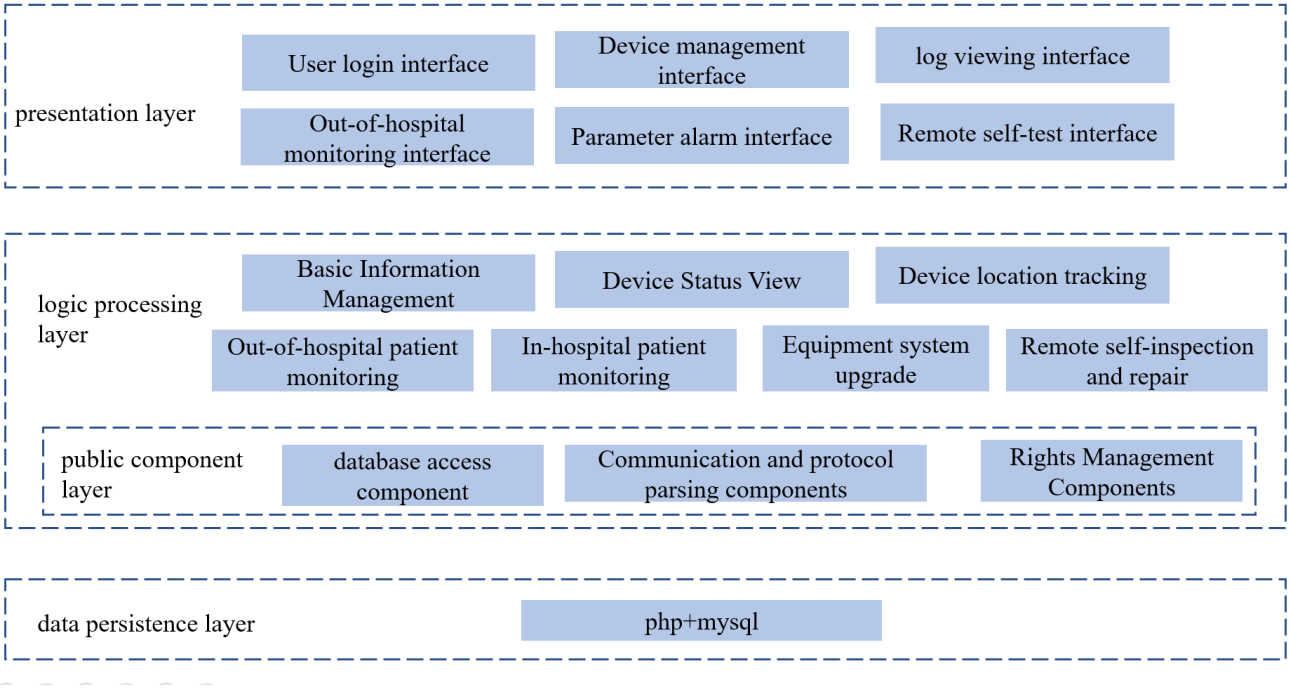

Figure 2. System internal hierarchy diagram

2. The major technologies of IoT

2.1 Sensor technology

Sensor technology mainly refers to the combination of various information sensing devices and the Internet to form a huge network, and is sensitive to the information being measured, an emerging technology for technological output[12]. It is a kind of conversion of the simulation signal in the transmission line into the digital signal that can be processed, the key technology in the computer application that is finally handed over to the computer for processing. It is another influential new technology after the two major technologies of communication technology and computer technology[13]. Currently, traffic patterns in wireless sensor networks (WSNs) generally follow a many-to-one model, a sensor node close to a static receiver will use up its limited energy faster than other sensors[14]. The application of sensor technology is widely involved in environmental monitoring, traffic management, manufacturing and medical health.

2.2 RFID technology

RFID is also known as radio frequency identification technology. It is a kind of automatic identification technology, which uses radiofrequency for non-contact two-way communication to achieve the purpose of identification[15]. The basic RFID system consists of three parts: transponder (tag), reader and application management system[16], its working principle is shown in the figure below, the technology mainly uses radio signals to identify specific targets, with the advantages of single identification, wireless communication and low cost of tags. RFID technology is entering various fields, becoming more and more important in people's lives, pathways are created for new applications and complement known applications[17]. The main function of RFID technology is to identify objects, and it is widely used in logistics management, health care, identity verification, etc.

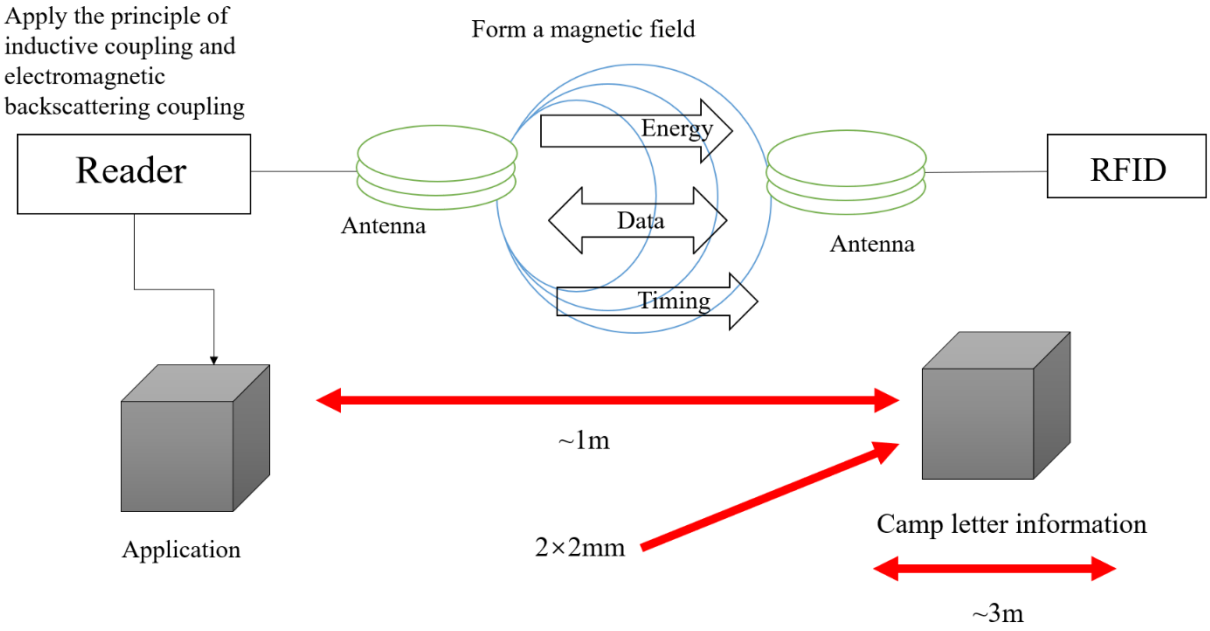

Figure 3. How RFID works

2.3 Embedded system technology

Embedded system is a special computer system with application-centric, computer technology-based, software and hardware tailorable, function, visibility, cost, size, and power consumption strict requirements[18]. It is a complex technology that integrates computer software and hardware, sensors, integrated circuits, and electronic application technology. It is currently mostly used in integrated wiring technology in smart homes, digital products in consumer electronics, and engine control systems in automotive electronics. Nowadays, with the development of computing technology, there is a push for low-power processors for embedded AI systems, which have less resource usage, called intellino, the protocol specified for intellino enables embedded systems to work efficiently through the system kernel[19].

2.4 Intelligent technology

"Intelligent technology" is a general term for technologies that use machines to simulate people's external cognition and ideological behavior[20]. Therefore, artificial intelligence can also be used to express intelligent technology. From the perspective of the application areas of artificial intelligence, there are four main application areas of artificial intelligence: visual processing, speech recognition, natural language processing and intelligent robots[21]. The technology employs some form of artificial intelligence device to help people with tasks such as intelligent transportation, home robotics, intelligence augmentation, and more. What these applications have in common is their mobility and real-time operation and requirement to interact with the real world, whether active or passive[22].

2.5 Nanotechnology

Nanotechnology can be defined as the study of the properties and interactions of matter (including the manipulation of atoms and molecules) at the nanoscale (between 1 nm and 100 nm), as well as the interdisciplinary science and technology that exploits

these properties[23]. Regarding the application of nanotechnology, there are theories and methods of using nanotechnology, the emerging borderline interdisciplinary fields of medical research and clinical treatment[24], the observation of biomolecules with nano size, and the use of nanotechnology to manufacture military weapons.

2.6 Other

In addition, there are distributed information processing systems, which are composed of multiple interconnected terminal systems, and any of these systems may communicate with another system[25]. At the same time, it has a higher degree of security in terms of database operation;and has unity and integrity in terms of logic. And in distributed processing technology, there is no geographical connection between different data nodes, and they can be distributed in any country, city,or region[26]. Its typical application is a distributed splicing processor, a distributed node computer image processing system that adopts a network distributed architecture and can realize interconnection, interaction, synchronization, etc.

3. Application of IoT technology in rehabilitation for the disabled

3.1 Demand statistics in the rehabilitation for the disabled

Through investigation and research, it is found that different types of disabilities have different -rehabilitation needs. In terms of physical disabilities, children with disabilities have different rehabilitation needs from adults with disabilities. The main causes of disability in children with disabilities are congenital and genetic factors, while those in adults with physical disabilities are mainly caused by trauma and disease. Therefore, the demand for medical rehabilitation for children with disabilities is greater than that for adults with disabilities. Children with physical disabilities and adults with physical disabilities are more consistent in terms of factors affecting the effect of family rehabilitation, the main reasons are lack of professional guidance (57.1%), lack of understanding of rehabilitation methods (42.0%) and inability to persist in training for a long time (37.5%)[27]. Among adults with disabilities, young people with disabilities are the main body of adults with disabilities. The main needs of young people with physical disabilities for rehabilitation are reflected in medical rehabilitation needs, functional training needs, assistive device needs, and barrier-free environment needs. Among them, rehabilitation medical needs include disability assessment and diagnosis, surgery and drug treatment, physical therapy, and rehabilitation care. Functional training needs include motor function training, self-care ability training, and language communication training. Assistive device needs include living aids, mobility aids, learning and communication aids, prosthetics or orthoses[28]. Overall, the physically handicapped have the greatest need for assistive devices in rehabilitation, followed by nursing care and drugs, and functional training[29].

In terms of visually impaired persons, the rehabilitation needs of visually impaired persons are mainly concentrated in three aspects: visual aids, drugs and nursing. Rehabilitation services received were structured by their reported rehabilitation needs. Improving the ability of visually impaired persons to obtain information or providing information accessibility support is also a very important rehabilitation service[30].

In terms of hearing disabilities, very severe hearing disabilities reported rehabilitation needs, mainly focusing on assistive device needs, followed by nursing needs, medication needs, functional training,and surgical needs. Among them, functional training needs and surgical needs of 0-6 years old are higher than other age groups, 7-18 years old have the highest demand for assistive devices, and drug needs of ⩾60 years old are higher than other age groups; the surgical needs, functional training needs, and assistive device needs of non-agricultural households are higher than those of agricultural households; the nursing needs of hearing and other disabilities are higher than those of other disability categories[31].

In terms of speech-impaired persons with disabilities, there are dilemmas such as separation of education and rehabilitation, delayed intervention in rehabilitation, lack of rehabilitation resources, lack of qualified teachers, and lack of family rehabilitation support[32]. Therefore, it is not difficult to find that the rehabilitation needs of disabled people with speech impairments include a "combination of medicine and education" and easy-to-obtain rehabilitation resources.

In terms of persons with intellectual disabilities, the rehabilitation needs from high to low are nursing, drugs, assistive devices, functional training and surgery. The rehabilitation needs of very severe and severe adults with intellectual disabilities are mainly concentrated in nursing, and the rehabilitation services they have received are also mainly nursing services[33].

The rehabilitation of the disabled requires a lot of time, money and energy. Due to many objective reasons, many disabled people cannot receive good rehabilitation treatment, and the rehabilitation needs of the disabled are still huge.

Table 1. Rehabilitation needs of various special groups

	Hearing impairment	Mental retardation	Physical disabilities	Others
Assistive device	65.50%	20.90%	55.90%	22.40%

Drug	22.70%	36.90%	26.30%	14.30%
Care	19.10%	52.50%	27.00%	10.80%
Function ai training	16.20%	19.70%	23.90%	9.70%
Operation	2.20%	0.80%	2.30%	0.30%

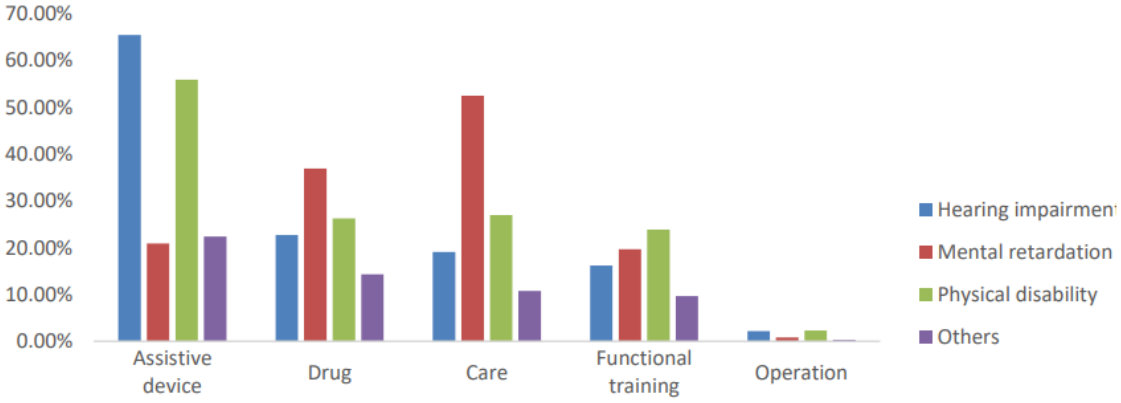

Figure 4. Rehabilitation needs of various special groups

3.2 IoT technology in the field of medical rehabilitation

3.2.1 IoT platform and its additional services

After the Internet, the Internet of Things will be a major development trend. The release of various intelligent hardware and the continuous updating of network technology also promote the rapid arrival of the era of "The Internet of everything". With the outbreak of COVID-19 (also known as coronavirus) in 2020, a new multi-input Deep Convolutional Attention Network (MIDCAN) model for COVID-19 diagnosis has been proposed, fusing chest CT with chest X-ray to improve the diagnostic performance of AI[7]. Rehabilitation medical treatment is an important project for people's livelihood, and social rehabilitation medical service institutions are an important part of the rehabilitation medical resource system. The number of rehabilitation hospitals is increasing year by year, while the proportion of public rehabilitation hospitals is decreasing year by year. The "Internet + rehabilitation" model has become the mainstream trend of the development of rehabilitation hospitals.

In shui-Hua Wang's article proposes a novel VGG-inspired network as the mainstay and combines the attention mechanism with VIN to produce a new ADVIAN deep-learning model to detect AD. The 18-way DA is harnessed to prevent overfitting in the training set. The experiments revealed the usefulness and superiority of this proposed. But deploying ADVIAN to hospitals is hard for human experts to understand. The following studies could be carried out in the future[34].

The promotion and application of rehabilitation therapy technology and equipment based on the Internet of Things platform in clinics, communities, and families, as well as the development of medical devices and health aids based on Internet of Things protocol standards, are effective measures to alleviate the current situation of insufficient clinical rehabilitation practitioners. Hand function rehabilitation based on the IoT platform, including wearable devices and portable devices for assessment and treatment, will be the focus of future research. Research and develop various auxiliary devices to improve the activities of daily living of people with hand dysfunction, including auxiliary sports orthoses, hand and upper limb functional braces, to build an Internet of Things rehabilitation information platform to assist in improving the efficacy and rehabilitation management of hand function rehabilitation. The new model of hand function rehabilitation under the data-sharing combined with the Internet of Things technology will help to monitor the status of hand function rehabilitation from multiple dimensions and improve the rehabilitation effect. The remote guidance of hand function rehabilitation based on the Internet of Things, community rehabilitation as an important turning point from the hospital to the family, the service model of the community medical network can be piloted.

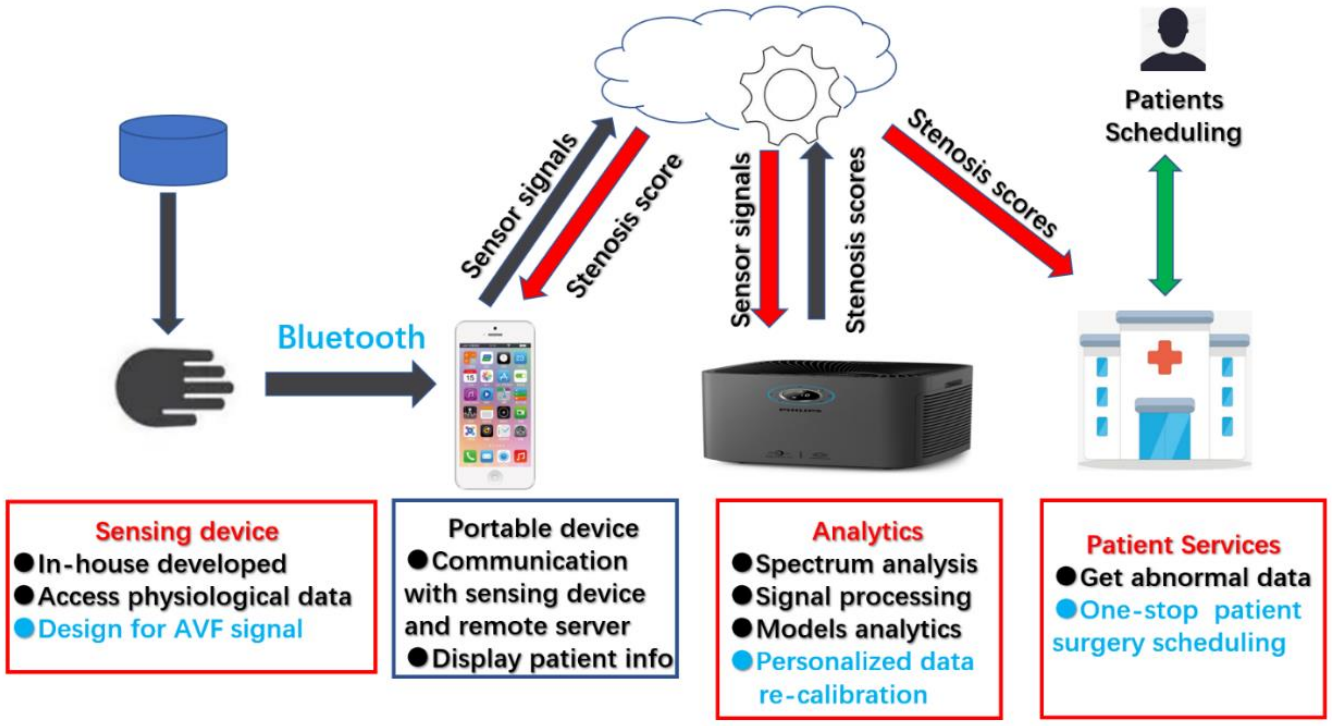

Figure 5. Hand Function Rehabilitation Mode

For example, in October 2021, the IoT medical ecological platform featuring severe rehabilitation will also be launched at Shanghai Yongci Rehabilitation Hospital. Yongci Hospital will cooperate with Fourier Intelligence in early 2021 to land in China's largest intelligent IoT rehabilitation port. In the Rehabilitation IoT Port, a rehabilitation specialist can manage 20 patients and perform physical therapy at the same time, changing the traditional rehabilitation from labor-intensive to technology-intensive, and subverting the traditional "one-to-one" rehabilitation model, addressing the dual pain points between patients and therapists. It is understood that the program can set a different time, items and goals according to the patient's gender, interest, condition, etc., thus avoiding the negative effects caused by boring, greatly improving the patient's recovery experience, and improving the recovery efficiency, it has realized the service concept of "liberating people, serving people, adding value, and trusting people" of the Internet of Things. Using artificial intelligence, sensing equipment, Internet of Things, mobile Internet, smart terminals and other technologies, Yongci Hospital has achieved achievements such as smart nursing, smart ward, smart diagnosis and treatment APP, smart management, and smart cockpit, apply the thinking of the Internet of Things to traditional medical services, change the "patients chasing the doctors" into "the doctors and nurses turn around the patients", and create a warm smart hospital, from paying attention to the quality of life of users to caring for the healthy life of users, Yingkang Lifespan, an IoT medical ecological brand represented by Yongci, is building a "user experience-centered", an ever-evolving, open and shared IoT medical and health ecosystem with many resource parties, and embraces the infinite beauty of the IoT era with the vision of "everyone in the world is healthy for a lifetime".

In addition, at present, rehabilitation hospitals in various regions of my country will provide rehabilitation guidance and rehabilitation evaluation for discharged patients. Taking Peking University Sixth Hospital as an example, based on understanding the patient's medical history and treatment, the patient's social and psychological factors were also evaluated, proposing individualized and systematic rehabilitation planning. Rehabilitation guidance can help patients and their families to clarify the direction of rehabilitation, and has important practical significance for patients to better adapt to life outside the hospital, maintain and restore social functions, and prevent a recurrence.

3.2.2 Medical devices, rehabilitation aids and management solutions based on IoT protocol standards

With the rapid development of the Internet of Things in the medical industry, the medical industry is undergoing a change that we have never seen before. This change is sweeping the entire medical industry centered on the Internet of Things medical devices. New opportunities in markets such as the Internet of Things (IoT) and smart mobile devices are also bringing many benefits to users, accelerating the development of wearables, health aids.

Wearable medical devices based on IoT technology

Wearable medical equipment is integrated with daily clothing such as wristbands, glasses and hats through technologies such as sensors, wireless communication and intelligent control, and realizes real-time monitoring of

human health signs data on network platforms and system terminals, a new type of medical device that provides the basis for disease diagnosis and treatment, rehabilitation management and health monitoring[35]. Due to its intelligence and convenience, this kind of equipment has become the first choice for monitoring human body signs. The types of equipment are becoming more and more abundant, and the proportion in the market is gradually increasing[36]. In addition to the common types of sports bracelet devices, there are also intelligent bracelets specially designed for patients with epilepsy, which can help patients to prevent the onset of epilepsy, and can send an alarm at the first time when the disease occurs[37].For example, in 2014, Empatica, an American start-up technology company, developed a smart early warning wristband specially designed for epilepsy patients - Embrace Watch[38]. Women's smart underwear, daily detection of cancer through temperature sensors; back treatment instrument; pain relief instrument, etc[39].

A variety of instruments are used in hospital operations, but sometimes lax sterilization can lead to cross-infection. Using advanced Internet of Things technology, each surgical package is equipped with a barcode or RF radio frequency tag to collect and store the attribute information of the surgical package process, mainly including the type and number of surgical instruments, quantity, packaging personnel number, packaging date, disinfection date, surgical package type, etc[40]. The system uses this information to record the recycling, cleaning, classification and packaging, disinfection, distribution and other links of the instrument kit, and to monitor the storage and use of the instrument kit, so as to control and eliminate the potential safety hazards of the instrument kit to the greatest extent, it also clarifies the responsibilities of staff in each link and records relevant information, to facilitate the traceability of relevant infection accidents[41].

Rehabilitation aids based on IoT technology

The rehabilitation assistive device industry will be one of the landmark industries in which the fifth industrial revolution occurs or deepens in my country[42]. The technological level of rehabilitation facilities has become increasingly modern and intelligent since the 1960s. As Zhang Haidi, chairman of the China Disabled Persons' Federation, said in an interview with the media, intelligence is becoming a new trend in the development of rehabilitation equipment for the disabled. "Many assistive devices for the disabled have achieved very good results in intelligence, such as the intelligence of artificial limbs and the intelligence of wheelchairs, and some wheelchairs can even stand up automatically. What's more, many products have used the principle of bionics to develop new intelligent high-end products.[43] "

According to Japanese media reports, the number of Alzheimer's patients in Japan increases significantly every year, and the daily care of Alzheimer's patients is gradually being valued by Japanese society. Japan has begun to implement a five-year plan for dementia (senile dementia). The main content of the plan is, first of all, to require the grass-roots administrative organizations of cities, towns and villages to formulate their plans for the elderly dementia care insurance business, early detection and early diagnosis and treatment of elderly people with dementia symptoms, and the establishment of a sound community medical service system, nurturing more professionals engaged in medical care services. In terms of research on rehabilitation aids policy, the government has called for vigorous research into robotic aids that can help delay Alzheimer's and monitor Alzheimer's patients. At present, there are a variety of assistive devices in this area applied in the field of elderly care. Since the implementation of the Nursing Care Insurance Law in Japan[44], the country has advocated vigorous research on rehabilitation aids, and provided a large number of research funds to support the development of rehabilitation aids research, all kinds of practical rehabilitation aids have fully covered various scenes of life care, and the research cases of rehabilitation aids for patients with dementia, which are difficult in rehabilitation aids, have also increased year by year in recent years, robotic assistive devices have also been announced successfully.

Internet of Things technology in the management scheme of medical devices

To ensure the safety and effectiveness of medical devices, protect human health and life safety, promote the development of the medical device industry, and severely crackdown on the use of fake drugs and inferior medical devices by lawbreakers and informal hospitals to cause tragedies, in recent years, the state has incorporated medical device innovation into its development priorities, and has also formulated the Regulations on the Supervision and Administration of Medical Devices for this purpose, which has had a positive impact on the safety management of medical devices[45]. The application of Internet of Things technology to the management of drugs and medical devices has a good effect on combating counterfeit and shoddy drugs. At the same time, modern scientific information technology is used to change the supervision mode, effectively alleviate the lack of law enforcement power, and improve the quality and efficiency of supervision[46]. For example, the uniqueness and non-replicability of RFID electronic tags can manage and monitor the production, transportation, sales, and use of drugs and medical devices, and have obvious advantages in the field of anti-counterfeiting[47]. At the same time, for the rehabilitation management of the disabled, Chen Shengsheng proposed a four-level intelligent rehabilitation management service model for the disabled, which is "individual, family, community, and hospital", continuous and secure through hardware frameworks and software services[3].

The medical equipment management system based on the Internet of Things model realizes the intelligent identification, positioning, tracking, backtracking and monitoring of medical equipment, making equipment management more convenient and intelligent.

3.3. Information and intelligent perspective of rehabilitation management of disabled persons

The application of the Medical Internet of Things in the medical industry is more breakthrough than the ordinary Internet of things, and the application prospect is broader and broader[48]. At present, China is strengthening the standardization of rehabilitation institutions for the disabled and deepening community rehabilitation work. It worked with the Ministry of Civil Affairs and the National Health Commission to pilot the management of designated rehabilitation and Assistance service agencies for children with disabilities, and formulated and promulgated the Standards for Community Rehabilitation Services for Mental Disorders. Real-name training for rehabilitation personnel in the All-China Disabled Persons' Federation has been carried out. By the end of 2020, China had 10,440 rehabilitation institutions for persons with disabilities, including 2,550 under the CDPF system. The number of employees in rehabilitation institutions reached 295,000, including 31,000 managerial personnel, 213,000 business personnel and 51,000 other personnel[49]. In the field of rehabilitation medicine, community medicine mainly refers to the platform of providing medical diagnosis and treatment, postoperative rehabilitation and other content for the masses with families as units within the social scope. Internet of Things technology can make up for the deficiency of traditional artificial rehabilitation in rehabilitation medicine. Based on the application of Internet of things technology in the management of rehabilitation for the disabled, such as cloud computing and sensor technology is used to establish intelligent individuals, families, communities and hospital management systems, can not only realize the unexpected emergency processing, also can realize own limited resources optimization configuration, to ultimately improve the efficiency of management of rehabilitation for the disabled and enhance the level of rehabilitation services for the disabled[3].

3.3.1 Systematization of rehabilitation of disabled persons

For rehabilitation assessment and training equipment, standardized automatic data integration collection and implementation can realize the quantitative analysis of influencing factors in rehabilitation the process, and provide accurate data services for rehabilitation integration and clinical research[50]. The system consists of three parts. 1. Front-end information collection module. The front-end information collection module mainly uses equipment with an RFID chip to collect the physiological parameter information of the community masses or key monitoring objects, and sends the information to the management center module. 2. System middle layer module, including communication sub-module and data pretreatment sub-module. 3. The management center module is divided into data processing and system management. The data processing module is used to classify and store the medical data collected at the front end. The general frame is shown in the following figure[51].

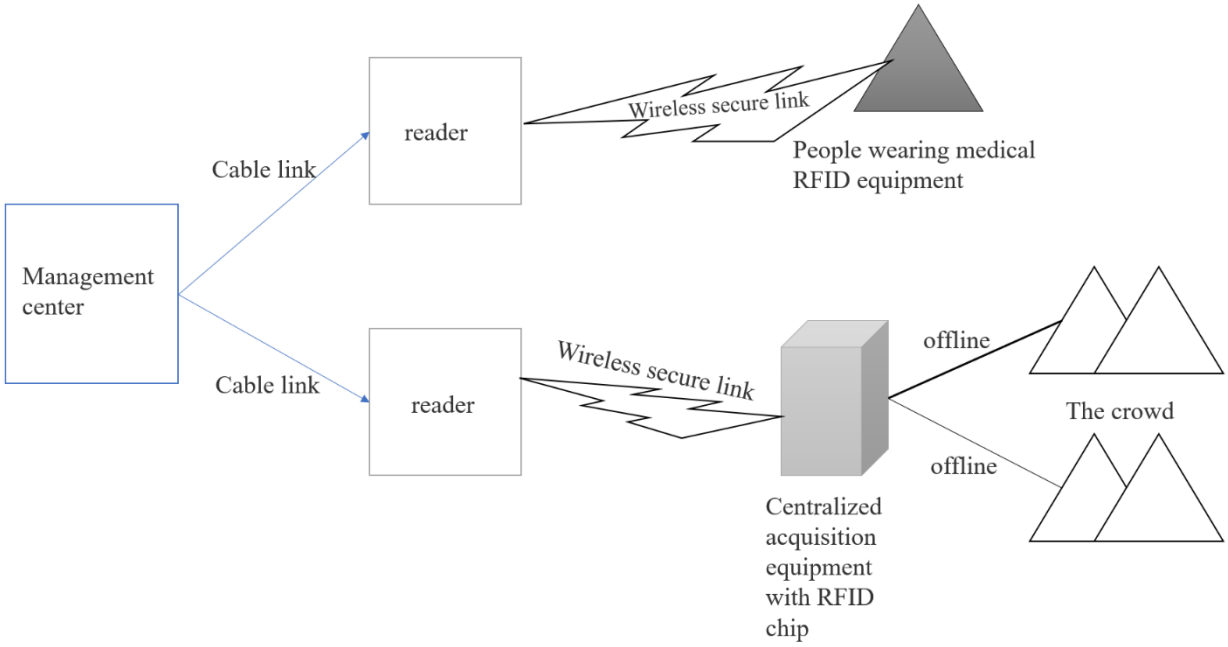

Figure 6. Overall framework of the system

3.3.2 Informatization of rehabilitation system for the disabled

The informatization of rehabilitation systems for persons with disabilities involves remote rehabilitation monitoring, which can identify and classify patient equipment and drugs through bar codes, two-dimensional codes, sensors, RFID and other technologies, and then transmit information through wired or wireless networks, and obtain patient sign parameters through a variety of sensors and medical equipment. Although there are many

explorations of Internet + rehabilitation mode in China, most of them are limited to local areas and lack awareness of the overall layout, making it difficult to effectively integrate the rehabilitation resources scattered in various lines[52]. To collect data with standardized specifications, realize medical information sharing and ensure system compatibility. Authorized medical staff in medical institutions can consult patients' medical records, medical history and treatment measures, and patients can also choose appropriate diagnoses and treatments according to the actual situation[53]. The construction of the platform is entrusted to third-party suppliers. Public health management agencies, health administrative departments and medical and health institutions at all levels in the region are open to the public. Under the premise of unified service access, differentiated construction is carried out for each region. The corresponding feature content is added to effectively reduce the construction cost, ensure the quality of medical IT construction, promote the standardization of medical IT, and finally achieve connectivity[54].

3.3.3 Intelligent rehabilitation system for the disabled

The establishment of a rehabilitation training management cloud platform is the embodiment of the intelligent rehabilitation system for the disabled. The fusion model management mode is adopted and the developed modal recognition algorithm is used for management. The administrator uploads and manages client information. The platform needs to establish related functions based on the information of different user types such as super administrator, regional administrator, institutional administrator, rehabilitation physiotherapists and the vast number of patients, as well as mutual rehabilitation training evaluation and testing management, data management, fusion model management, report management and other matters[55].

Because rehabilitation is a long process[56]. At present, the research on the secure transmission algorithm of intelligent reflective surfaces based on physical layer security is still in its infancy. Especially for the scenario where a large number of intelligent reflective surfaces are deployed, how to arrange the cooperative processing of multiple intelligent reflective surfaces efficiently and reasonably to achieve secure and effective transmission is still a major problem nowadays. Computer network security problems now include three points: 1. Security problems existing in the perception layer 2. Problems in data protection 3. Internet of Things systems is being attacked more widely. The corresponding measures based on the Internet of things are to strengthen the application of firewall and intrusion detection technology, strengthen the management of network security defense mechanism, real-time monitoring and control of the system, and establish a secure router[57].

4. Statistics, Analysis and Discussion

4.1 Review of research papers

As early as 13 years ago, the United States, Australia, the Netherlands and other developed countries have applied the new information technology to the home CR/SP rehabilitation procedures for patients with myocardial infarction[58, 59]. In 2019, Rachim et al. designed cost-effective wearable blood glucose (BG) sensor that enables continuous blood glucose (CGM) monitoring. The sensor performs real-time signal analysis by combining near-infrared visible spectroscopy (NIR-VIS) to identify the continuous components of changes in heart, blood and blood glucose (BG) concentrations to monitor the physical health of recovering patients[60]. The application of Internet of Things technology in the field of rehabilitation has been quite effective in foreign countries, which is due to the advanced development of information technology and high technical content, so the level of medical informatization is relatively high. However, China has a large population, limited resources, low technology content and insufficient development experience, so the application of the Internet of Things in China is still in its infancy.

In 2019, Costa and others proposed to apply VR technology and sensors to the hand rehabilitation care platform RehabHand[61], Therapists input information such as rhythm control and repetition times on the control end, and rehabilitation patients perform rehabilitation training on hardware devices. The patient can conduct rehabilitation training on his own, while the therapist can supervise, observe and guide each patient's treatment at the same time.

Gao Yufan[62] et al. designed and developed a medical adjustable lower limb raising device based on Internet of Things technology in 2019. The system consists of the user, lower limb rehabilitation instrument, client, database and doctor reading client. The client is developed based on Android technology, using a Tomcat server, a servlet to process user responses, Hyper Text Transfer Protocol (HTTP) to improve system performance. Through real-time data collection by the client and upload to the database, doctors access user data in the form of accessing the database,and then adjust the rehabilitation plan after analysis.

In 2019, Lu Jiajie[63] et al. developed an intelligent lower limb rehabilitation system based on network technology and force-sensing technology, as shown in the figure below. The system is mainly composed of three parts: user workstation, doctor workstation and Windows Server Server. It mainly consists of three parts: user workstation, doctor workstation and Windows Server Server. Patients use lower limb rehabilitation robot training equipment for rehabilitation training at home or in community hospitals. Pelvic parameters in the training process were collected by encoder, potentiometer and other sensors on the pelvic mechanism. After preliminary processing by the lower computer, the data was transmitted to the upper computer, and the upper computer reprocessed some parameters and sent them to The Windows Server through the network. Rehabilitation doctors can access Windows Server through the expert-

side software system and receive training data from users, to monitor patients' rehabilitation training in real-time and give real-time training guidance, to make a more accurate assessment of rehabilitation.

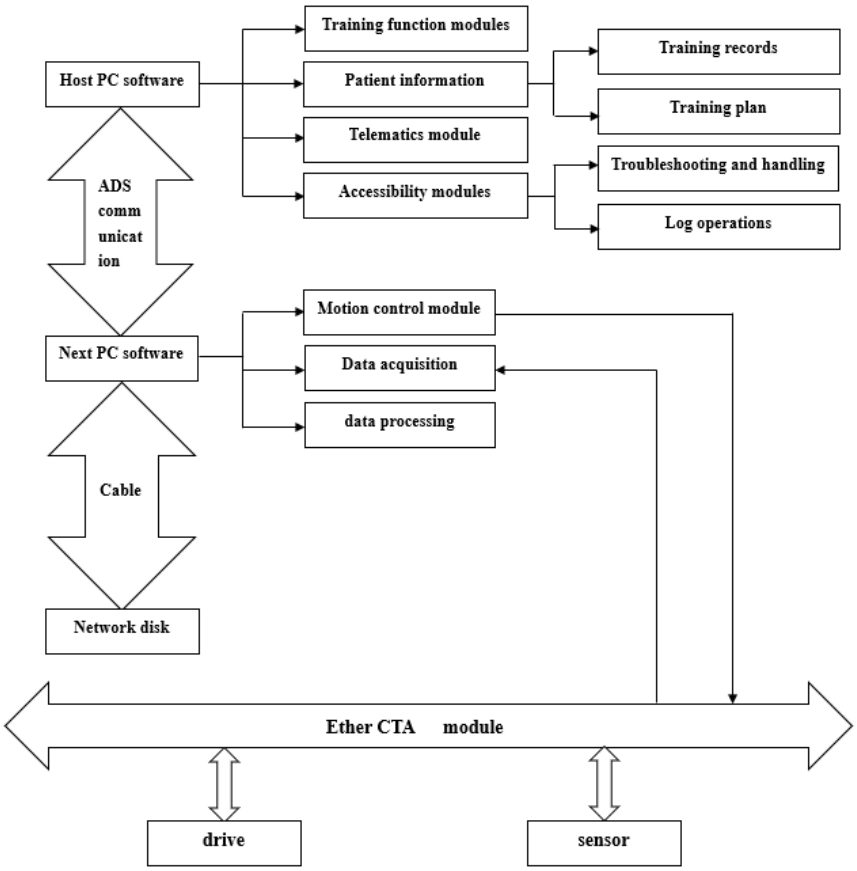

Figure 7. Remote system design of lower limb rehabilitation robot

In 2020, Siyuan Lu[64] proposed a new computer-aided diagnosis method for CMB detection in the paper "A Diagnosis Method for Cerebral microbleeds Based on Feature Network and Integrated Random Neural Network". First, a neighborhood algorithm is used to generate weighted images of CMB and non-CMB samples from brain susceptibility. Then, a 15-layer feature network is trained for feature extraction. Then, cerebral microbleeds (CMB) were detected on the extracted 15-layer feature network. The proposed feature-based NET-EN method has an accuracy of 98.60% and a 5-fold cross-validation of 13,031 samples. The results are better than the comparison of the five most advanced methods published recently. The artificial intelligence model can help doctors to use the results as a basis for verification in their diagnosis, but the method still has some defects. More case samples are needed to complete the database to improve diagnostic accuracy.

In China, Internet of Things technology has broad prospects and infinite potential in the field of rehabilitation. First of all, the application of the Internet of Things is still not popular in the domestic rehabilitation field. Domestic smart medical applications are mainly concentrated in the medical and health service system constructed by electronic medical records, electronic archives and other information, and the rehabilitation equipment integrating the Internet of Things technology has a low level of commercialization. The application of software and hardware system for networking is very weak, and the technology and equipment are not mature.

4.2 Data statistics and chart summary

China's research on the application of Internet of Things technology in the field of rehabilitation is still in its infancy. According to literatures searched on CNKI, the first research paper in this direction appeared in China in 2013, According to the keywords "Internet of Things" and "rehabilitation", a total of 192 relevant research literatures at home and abroad have been retrieved by CNKI, Weipzhicube, Wanfang Medical Network and CALIS foreign language database. After analyzing these literatures, we removed the literatures that were repeated and did not match the topic of Internet of Things rehabilitation, and finally retained 99 literatures. Among them, sensor technology was the most widely applied in 36 literatures, accounting for 36.37%. Artificial intelligence was next, accounting for 17.17 percent. According to the research, wearable technology

equipment and some rehabilitation equipment are most widely used for carrying sensors, mainly including emG sensors, inertial sensors and motion sensors[65].At the same time, doctors can use special monitoring instruments or various communication terminals (such as PC, handheld devices, etc.) at any time and anywhere, through wireless (such as mobile communications networks:3G, GSM; Wireless LAN: Wi-Fi, ZigBee, etc.) simultaneously monitor multiple rehabilitation training instruments, and monitor the training status and rehabilitation of patients through the data collected by various sensors on the rehabilitation training instruments[66]. Intelligent and computer-assisted rehabilitation patented technology has appeared frequently in the past five years, which is a hot technology in the field of rehabilitation with the Internet of things technology. Intelligent, computer-aided rehabilitation realizes the interconnection of objects and people through building information systems in the whole rehabilitation process. It mainly uses radio frequency identification (RFID) technology, combined with area identifier, automatic liquid extraction identifier, name tag, Internet of Things gateway and medical Internet of Things platform[67].The use of this technology can also make patients in the hospital registration, pricing, charging and reimbursement will be directly through the network, medical personnel, equipment, logistics supplies, vehicles and security to implement intelligent, humanized management[48]. Sports function training rehabilitation patent technology is in the forefront of rehabilitation nursing technology, the technology comprehensive use of sensor technology, model parameterization, mechanical drive technology and other technologies, the design of rehabilitation products, to achieve sports function rehabilitation training. Some products also use mind control to add technical biological consciousness control system (CVC) and autonomous control system (CAC) into the design of rehabilitation products to make the use of rehabilitation products more convenient[68].Its specific account for such as the following.

Table 2. Internet of Things technology application proportion overview chart

technology	The total number of applications	The percentage
The sensor	36	36.36%
VR	6	6.06%
Artificial intelligence (ai)	17	17.17%
Wearable devices	5	5.05%
Wireless technology	6	6.06%
Rehabilitation robot	9	9.09%
Others	20	20.20%

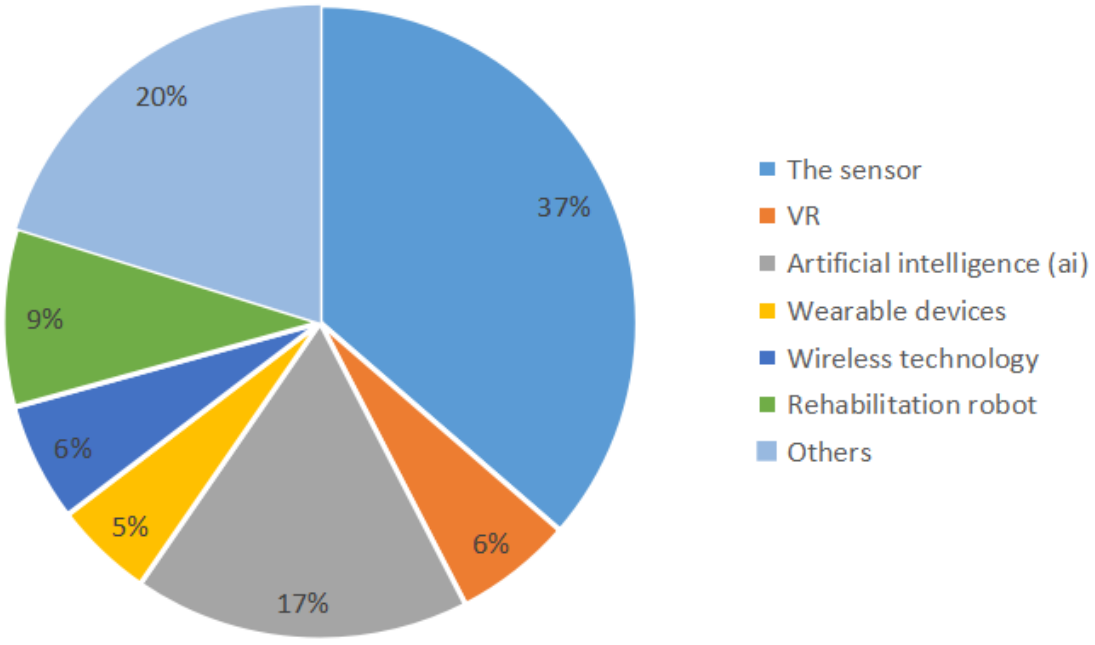

Figure 8. Proportion of IoT technology application

4.3 Analysis and summary

From the technical perspective, the domestic research on the Internet of Things technology applied Sin the field of rehabilitation can be seen that China's technological

research is still in its infancy, and the categories mainly focus on sensor technology, artificial intelligence and wearable devices. Other technologies, such as VR and wireless technology, still have a lot of space to explore.

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To sum up, the application of IoT technology in rehabilitation mainly focuses on monitoring systems and assistive devices, but has not yet formed a comprehensive application integrating medical treatment and rehabilitation. The application of technology is monotonous and there is room for further exploration in the combination of multiple technologies. The application scope of technology is relatively narrow and involves little in daily life rehabilitation, so it can broaden the application level of technology and integrate rehabilitation with real life. The application of the Internet of Things in the field of rehabilitation in China is developing, but both technology and application need more professional and innovative talents to time to communicate with the world's cutting-edge research and integrate with the actual situation in China to promote the further application of the Internet of Things technology in the field of rehabilitation in China.

5. Conclusion

In this paper, from the perspective of informatization and intelligence of rehabilitation management for special population, starting from the Internet of Things technology and making full use of the advantages of the Internet of Things, the wide application of the Internet in the medical intelligent management system is discussed and analyzed. We know that there is no balance between the needs of special groups for rehabilitation and the development of rehabilitation in reality, on the one hand, due to some human, material and financial restrictions, on the other hand, the technology has not been developed to a certain level or has not been well applied to the population. So, we are looking forward to and believe that in the near future, China's Internet of things technology can timely communicate with the international cutting-edge level, make progress together, to further integration of the Internet of things technology in the field of rehabilitation, eventually realizing the let China, let the world disabled people can reduce the limitation of objective factors, to enjoy the Internet of things technology application in the field of rehabilitation for the disabled is convenient.

IoT technology has had a mixed impact on rehabilitation management. Through the Internet of things technology, telemedicine and self-help medical care can be realized, and the new diagnosis and treatment mode can change the current treatment based on treatment in most hospitals to prevention and rehabilitation. Reduce the use of medical resources, reduce the workload of medical staff, improve the efficiency of hospital operation, which is conducive to relieve the pressure of medical resources shortage. However, as the whole Internet of Things industry is still in its infancy and the industrial chain and business model are not mature enough, the development of the current Internet of Things market mainly depends on the support of the government.[48]

As influence society's most widely used system, clinical information system, medical Internet of things by a smart mobile clinic, surgery teaching, X.Yao accident alarm and tracking, intelligent security system, patients rescue system, wireless positioning system, wireless temperature monitoring, intelligent ward, industry type, gathered into present development trend. In 2015, the government began to invest in the application of the Internet of Things in hospitals, aiming to make more efficient use of medical resources in the region[69]. Rehabilitation of persons with disabilities is no longer a traditional problem of individuals or families, but requires the comprehensive use of multiple means by individuals, families, communities, schools and medical institutions. Rehabilitation of persons with disabilities is not only medical, but also involves and integrates educational, psychological and social aspects. These integration also marks that the rehabilitation of the disabled is moving from a single to a comprehensive.

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