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INFORMATION TECHNOLOGY SUPPORT FOR ATHLETE HEALTH MONITORING AND MEDICAL DIAGNOSIS

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Abstract. The paper uses WSN to monitor athletes' medical diagnosis information remotely. The aim is to strengthen the monitoring and management of athletes' medical diagnosis data. The method of wireless sensor node and IPv6 routing based on IPv6 is proposed. The terminal-to-terminal network structure based on IP can carry long-distance transmission and share athlete medical diagnosis information. The monitoring system's bottom structure design is realized using Contiki technology. At the same time, it also realizes the data acquisition and management in the monitoring system. The component interface is designed based on TinyOS. The design of the wireless client based on GPSR is completed based on GPSR. This paper uses the VanetMobiSim platform to complete a remote monitoring system's software development and simulation test based on wireless medical diagnosis information. The results show that this system's medical diagnosis information covers a wide range, and the information search efficiency is high.

Key words: Athletes' health monitoring; Medical diagnostic information; Remote viewing monitoring; WSN; IPv6 routing

1. Introduction. With the rapid development of information technology, computer-intelligent information management has been used increasingly. Resource information can be integrated and shared by a computer information management system. For example, the logistics information management system, the goods import and export information management system, and the library information management system are all based on the three-layer information management model [1]. This can then be divided into a data layer, a business layer, and an application layer. They achieve the purpose of information retrieval, resource allocation and database management by establishing a knowledge base and information analysis model [2]. In constructing an intelligent health management system, medical diagnostic information management is a crucial step. With the rapid development of the Internet and information technology, establishing a set of disease monitoring and management systems is of great significance to assist medical staff and patients in managing and tracking disease information. This paper presents a remote health diagnosis information monitoring system based on a wireless sensor network [3]. Firstly, the whole system is designed in this paper. A modular software platform monitors medical diagnosis information remotely and wirelessly.

2. System function structure analysis. A remote monitoring scheme based on wireless health diagnosis information is proposed. The remote health monitoring system based on WSN adopts a three-layer architecture model [4]. The three layers are the application, business, and data layers. They are using RFID tags and other methods to collect medical diagnosis information and establish the corresponding database and medical diagnosis knowledge rules. A network architecture based on a self-organizing and open network structure is proposed to monitor medical diagnostic information [5]. Figure 2.1 shows the three-layer module system of the remote monitoring system of medical diagnostic information (the picture is quoted in A Taxonomy on Smart Healthcare Technologies: Security Framework, Case Study, and Future Directions).

Practical analysis and mining of medical diagnostic information based on data and association rule mining is proposed [6]. The analysis and classification of medical diagnostic information are integrated with modeling analysis. The simulation engine is used to complete the logical control of medical diagnosis and processing of medical diagnosis events. A medical diagnosis information collection and analysis model based on Vannet MobiSim was established. The VanetMobiSim information processing system generates trace documents and establishes the related rule base. In this way, the organization and monitoring of medical diagnostic information

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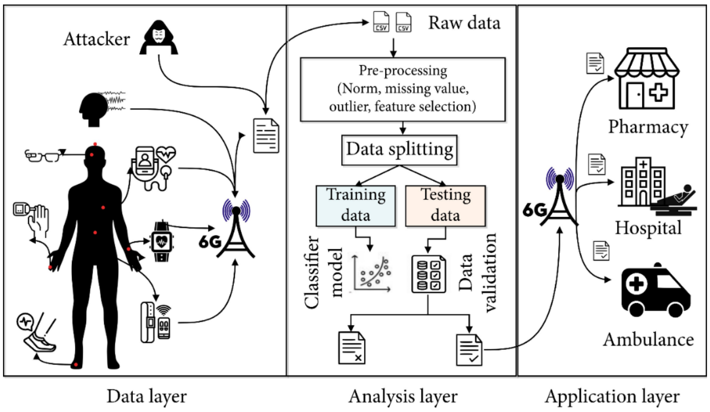

Fig. 2.1: *Three-layer module of medical diagnostic information remote monitoring system.*

are realized, and the logic control and engine analysis of medical diagnostic information are also realized. Keyword commands and events realize the control and output of the component interface.

3. Communication scheme of a long-distance monitoring system based on the Internet. This project intends to establish a communication model of telemedicine diagnosis information for remote monitoring to monitor telemedicine diagnosis information remotely [7]. The communication architecture is constructed utilizing a wireless communication network so that data collection, remote communication and wireless information transmission can be carried out on the system. The network communication module of the monitoring system is designed according to the following three aspects:

3.1. Design of IPv6 Sensor Node. The data acquisition module of the wireless health diagnosis information remote monitoring system based on the network was built by the Contiki network platform, and the task generation of the learning system was completed. Then, the available resources are generated based on the ipv6-aware node function [8]. The pendulum is used to drive the medical diagnosis information of the data storage component to complete long-distance data communication and transmission. Build a 6LoWPAN wireless communication network terminal system with a built-in 6LoWPAN protocol stack. In this way, the corresponding operational units (CEs) and the collection and transmission of medical diagnostic information are completed.

3.2. Configuring WSN Addresses on an IPv6 Network. Select the AOSID 1709 series card reader as the RF communication component and RF antenna [9]. This paper presents a wireless health diagnosis information remote monitoring system based on IPv4/IPv6 protocol. The medical diagnostic information is divided by a hierarchical grid architecture. With Atmel1284P as the main control chip, IPv6 network address distribution is realized. This command is used to copy the data set of the IPv6 sensor gateway. The IPv6 network resource information service terminal for medical terminals is developed and used by medical terminals.

3.3. Operation of the driver in the network communication module. Due to the information capacity carried by the monitoring system and the need for real-time performance, a variety of communication technologies can be used. Among them, the connection between various monitoring devices and computer backbone networks is mainly wireless transmission [10]. The architecture consists of various sensory devices that collect medical information (Figure 3.1). This paper focuses on a critical link in the monitoring system as a communication link- Communication structure between terminals and networks. The gateway and RF components are built based on data packets to ensure the interconnection between the awareness network and the Internet. Through access to the IPv6 sensing gateway, the communication module is established for data mining. In this way, the whole process of the IPv6 awareness gateway is implemented. S3C2440 is the control center of the system. Use the kernel of routing Linux to manage the address space [11]. The driver software of the network communication module is carried out on an embedded Linux kernel. It is completed by three

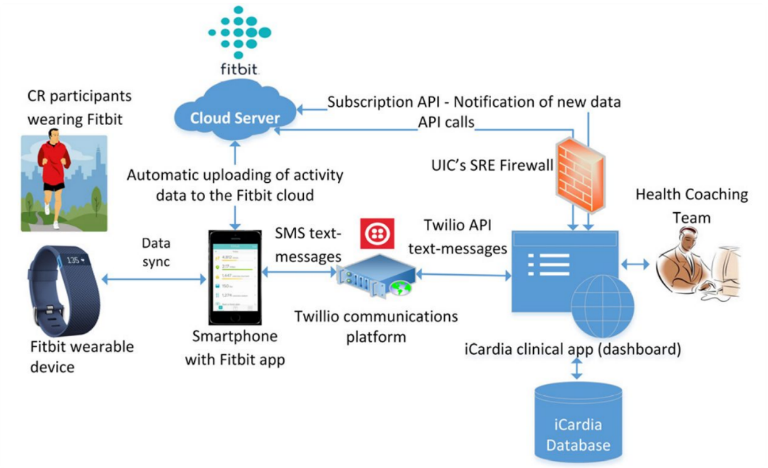

Fig. 3.1: *Communication architecture diagram of physical health monitoring system.*

modules: database access, network, and communication. At the same time, a wireless sensing network is established. The IP-based terminal-to-terminal network structure allows medical diagnosis information to be transmitted and shared at a distance. The development of the monitoring system's middleware and monitoring program is realized using Contiki technology.

4. Develop and design the software platform. The component interface is designed based on TinyOS. A project management system for wireless health diagnosis information is written using Busy box. Communicate with PC via RS232 before programming. Set the interrupt bit control module and root file system [12]. It is connected to 10 M/100 M Ethernet via a gateway. This paper builds a bus transmission control line based on ARM920T. Send data to RS485 and IPv6 using the VME bus or local bus. Use the aggregation mechanism built in TinyOS2.x to collect information.

4.1. Resource Retailing Module. The resource acquisition module is an essential basis for realizing the whole architecture of the telemedicine diagnostic information monitoring system. Select the reader of AOSID 1709 to partition its resource structure, set its initial state Flag=0, and then reconfigure the 6 LoWPAN adapter through the IPv6 awareness gateway. The short address function of 6 LoWPAN is used to query the location of diagnostic information. The diagnostic information is integrated with the IEEE 802.15.4 protocol in IEEE 802.15.4. The 6 LoWPAN adaptation layer instructions identify the required medical diagnostic information. The GUI view management tool is used to customize the label identification and block calculation, and the required treatment information is transmitted to the business side, and the work log is stored. Finally, use it as a kind of buffer copy.

4.2. Data processing module. A new type of sensor network is designed utilizing extensive data analysis and intelligent control—issue instructions to the appropriate I/O pins during event monitoring. The log-saving work based on the monitoring application unit is constructed, and the consistency management is carried out with the high-level components [13]. The event collection, application labeling, WSNs-based prediction document processing and MVB bus-based medical diagnosis information are graded and labeled. Call the message restorer on TinyOS2.x to capture events generated by the application. The Task Basic interface is used to construct a communication, protocol, core, and resource library. At the same time, the module can load and restore the events of medical diagnosis monitoring.

4.3. Human-computer interaction module. User-to-user communication is a health monitoring system based on the wireless network. The project builds IoT addresses for 5 LoWPAN. Run Next Task (TRUE) is used for more abstract data processing. The monitoring data of diagnosis and treatment information is

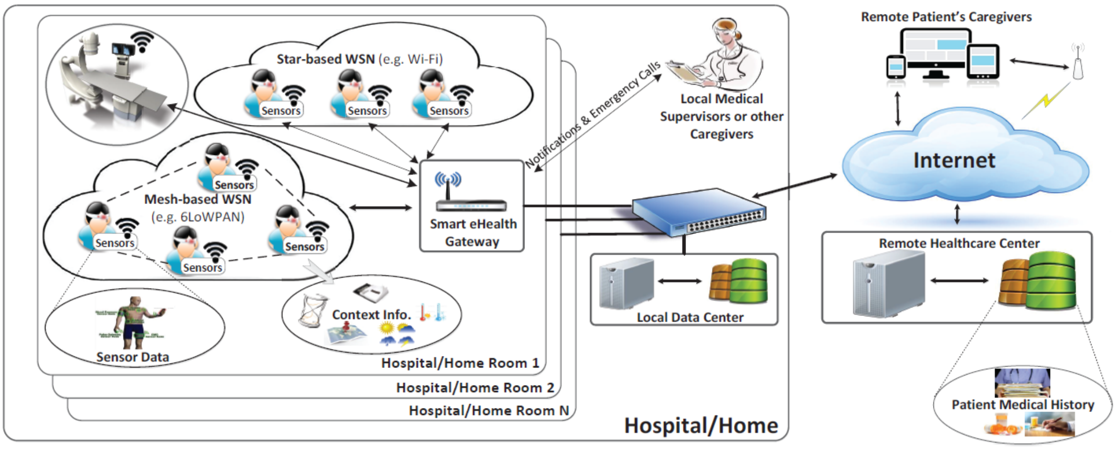

Fig. 4.1: *Map of the distribution of health monitoring centers in each region.*

collected through the Internet/enterprise Intranet, wireless sensor network, etc. TinyOS is used to design a component interface, and medical diagnosis information is shared through the database and Web server.

4.4. Information Management and Security Unit. The information management architecture is shown in Figure 4.1. This area includes a decentralized health monitoring center. Each user is connected to a health monitoring center with a family database, and their permanent electronic records are stored in the center's household database [14]. And will have the relevant home healthcare institutions carry out regular updates. If the user is within the purview of the local health supervisory authority, medical data is transferred to the center. Therefore, the medical professionals of the Home Health Monitoring Centre will liaise with the users' home medicine service agencies and cooperate.

5. Improved time synchronization algorithm. In wireless Physiology Sensor Networks (WBSN), many biosensors are placed on the body's surface in a wearable manner. It has the characteristics of small size, lightweight and limited carrying energy, so it is necessary to reduce energy consumption as much as possible [15]. At the same time, because the physiological sensor network is mainly applied to the acquisition of physiological signals of the human body, it puts forward higher requirements for the timing accuracy of data, which makes the timing synchronization of WBSN have high accuracy and high-power consumption. A real-time data processing method based on a neural network is studied aiming at the deficiency of monitoring human physiological condition. Firstly, the advantages of TPSN and RBS are combined to make full use of the broadcast characteristics of wireless communication. Each node in the two networks can synchronize the network by monitoring the packet exchange between the two networks.

In Figure 5.1, node Q_a sends a sync request information packet to node Q_b at time T_a. This data packet can be monitored by node Q' at time T_b'. Similarly, the packet of reply messages transmitted by node Q_b at time T_c can also be monitored at time T_d'. For node $Q', \Delta Q_b Q'$ is the time deviation from node Q_b to node Q', and the transmission delay between node Q_b and node Q' is s'. So:

$$\Delta Q_b Q' = \left(2T_b' + T_c + T_d - 2T_d' - T_a - T_b\right)/4$$
$$s' = \left(2T_b' + 2T_d' + T_d - T_a - T_b - 3T_c\right)/4$$

As far as Q' is concerned, its clock can be synchronized with node Q_b after finding $\Delta Q_b Q'$ and s'. This reduces the number of synchronous packet switches. In particular, this method only needs to send one synchronization, and all nodes are in the single-hop interval.

The model is further modified by using the least square method. This project presents a new wireless sensor system suitable for the biomedical field. Because of the different clock frequencies of each node, a method of

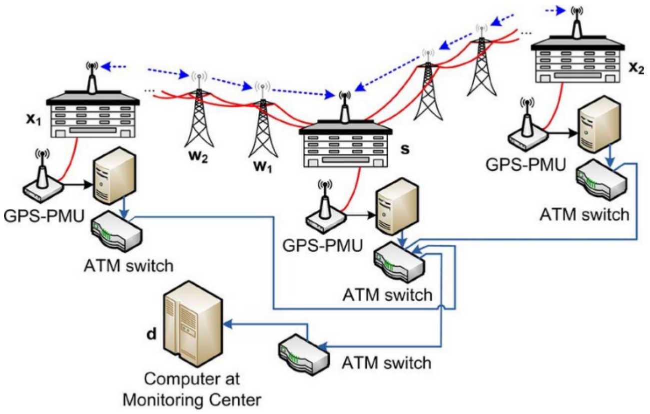

Fig. 5.1: *Packet exchange between three nodes.*

timing drift and timing drift is proposed [16]. At point Q_b, the transmission delay is s, the time difference between Q_a and Q_b is ΔQ_aQ_b, if T_b is used to represent the real receiving time, then the corresponding time at Q_b is t, then

$$t = (T_a + T_b + T_d - T_c)/2$$

Establish mathematical model:

$$T_b = \gamma t + \Delta Q_aQ_b$$

γ means the passage of time. The synchronization is now complete at time i,

$$T_{ib} = \gamma (T_{ia} + T_{ib} + T_{id} - T_{ic})/2 + \Delta Q_aQ_b$$

Let $v_i = \gamma u_i + \Delta Q_aQ_b$, then the estimates of γ and ΔQ_aQ_b (that is, $\hat{\gamma}$ and $\left.\Delta\hat{Q}_aQ_b\right)$ are obtained by the least squares method, $\hat{v}_i = \hat{\gamma}u_i + [\Delta\dot{q}_aq_b]$. Then the sum of squares of the deviation and error between the estimated and actual values is:

$$\zeta_i = v_i - \hat{v}_i = v_i - \hat{\gamma}u_i - \Delta\dot{q}_aq_b$$

$$W = \sum_{i=1}^{n} \zeta_i^b = \sum_{i=1}^{n} [v_i - \hat{\gamma}u_i - \Delta\dot{q}_aq_b]^2$$

W can be used to quantitatively characterize the relationship between v_i and each discrete point. When the W value is low, the curve-fitting effect is better. From these vertices:

$$\frac{\partial W}{\partial\Delta\hat{Q}_aQ_b} = -2\sum_{i=1}^{n} [v_i - \hat{\gamma}u_i - \Delta\dot{q}_aq_b] = 0$$

$$\frac{\partial W}{\partial\hat{\gamma}} = -2\sum_{i=1}^{n} [v_i - \hat{\gamma}u_i - \Delta\dot{q}_aq_b]\,u_i = 0$$

$$\gamma = \hat{\gamma} = \frac{\sum_{i=1}^{n}(u_i - \bar{u})(v_i - \bar{v})}{\sum_{i=1}^{n}(u_i - \bar{u})^2}$$

$$\Delta Q_aQ_b = \Delta\dot{Q}_aQ_b = \bar{v} - \gamma\bar{u}$$

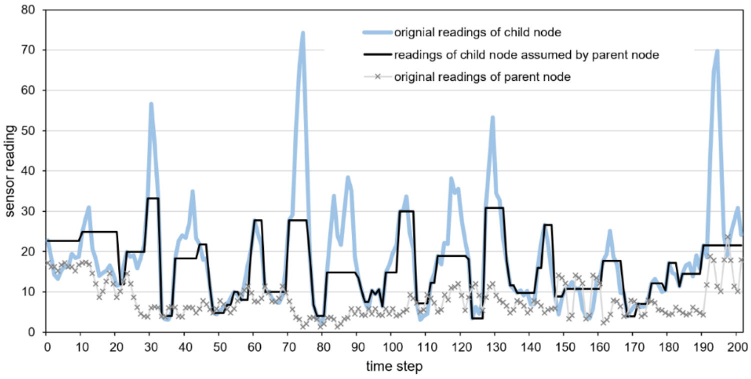

Fig. 6.1: *Wireless data transmission test results.*

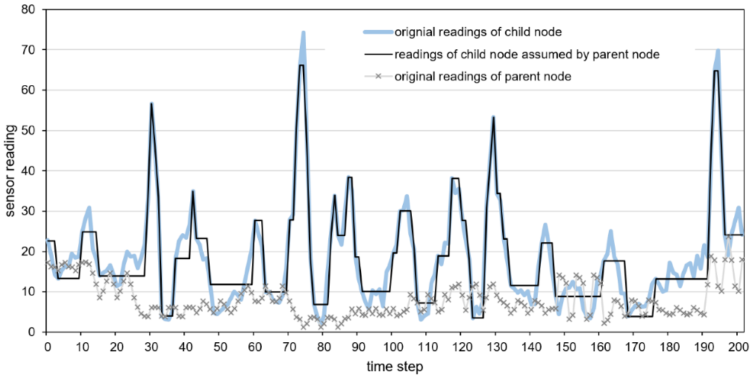

Fig. 6.2: *Medical diagnostic information transmission accuracy test.*

Q_b can modify its own local time according to γ and $\Delta Q_a Q_b$, thus achieving synchronization. Similarly, in terms of node Q', that is, the time shift of node Q_b (that is, γ' and $\Delta Q_b Q'$),

$$\gamma' = \hat{\gamma}' = \frac{\sum_{i=1}^{n}\left(U_i - \bar{U}\right)\left(V_i - \bar{V}\right)}{\sum_{i=1}^{n}\left(U_i - \bar{U}\right)^2}$$

$$\Delta Q_b Q' = \Delta \hat{Q}_b Q' = \bar{V} - \gamma' \bar{U}$$

According to the result of the operation, the local time is corrected to make it consistent with the time of node Q_b.

6. Experimental test analysis. This project takes the wireless user terminal based on GPSR as the research object. With Vannet MobiSim as the platform, the software development and simulation test of wireless health diagnosis information remote monitoring system based on GPSR is carried out. The precise scheduling function of real-time monitoring of remote health diagnosis information based on GPSR is studied [17]. Through the analysis and testing of the experimental data, it is found that the monitoring system can achieve good network connectivity. It reduces the error rate of medical diagnostic information and realizes the monitoring of remote information.

7. Conclusion. This paper studies a new medical diagnosis information remote monitoring system based on WSN. Experiments show the system can realize good remote wireless communication function and accurately transmit medical diagnosis data. The system can also query and retrieve effectively.

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