Implementation of IoT Data Analysis in Personal Elderly Home Care System

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***Abstract*—At present, the proportion of the elderly population in the world is gradually increasing, but the fertility rate is very low. In the future, the elderly population will be much larger than the young population. More care institutions and systems are needed to share the pressure of the young population. This is a major issue in the future. However, many studies are now on the development of wearable devices and the implementation of non-care Internet of Things (IoT). The subjects must wear a number of uncomfortable sensors and bulky equipment, which is very difficult for the subjects. unfriendly, or developed care-related IoT systems without effectively utilizing the data collected. Therefore, this system combines a complete and novel Internet of Things architecture to effectively collect relevant physiological information of users through Bluetooth bracelets, Bluetooth security charms, depth cameras, and Google Home Nest Mini, and integrate these reliable and diverse Data processing and storage, detailed analysis of every tiny and available information in the data, effective analysis of the subjects' life patterns, and establishment of a personalized care model.**

Keywords-IoT;Smart Healthcare;Big Data;Wearable;Cloud computing;Data Analysis

I. INTRODUCTION

The purpose of big data analysis is to analyze large and complex data sources and discover trends, patterns, customer behaviors and market preferences. With various sensors in the Internet of Things and the Internet that plays an important role, an Internet of Things architecture is formed, resulting in a large number of compound data [2]. Through statistical calculation and data analysis, important information was previously ignored because only a piece of data can be obtained, and from a large amount of composite data and then through big data analysis, deep learning to obtain unknown related information. This research will focus on data analysis of smart home and elderly care applications, focusing on providing smart home and elderly living and improving services, using the data collected by sensors and Google Cloud Services applications to conduct a series of verification, processing, classification, storage, calculation, statistics and analysis are presented in a visual interface. The analysis results of these data can help to observe and adjust the user's related activities and formulate plans on dietary health, sleep quality, life health management and so on.

The main purpose of the care IoT application is to provide intelligent services. This proposal combines powerful cloud services to process a large amount of data to make the care environment more comfortable, convenient, and secure. It also uses data processing and analysis to achieve a personal system. This is the ultimate goal of a smart home for IoT applications [1]. Most of the care and medical IoT systems use existing data for analysis and machine learning [12], and some use simple circuit boards for data collection and focus on cloud computing and algorithm optimization [10] [11], or collect data through too many sensors and instruments, resulting in the burden of action. In this experiment, the combination of light and simple Bluetooth devices and cloud applications, and data analysis tools are used to complete the analysis of physiological information, diet and sleep.

Today's cloud services are divided into the following three categories: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). This research is based on PaaS, establishes a service-oriented cloud computing architecture, and provides users with SaaS so that users can use our existing services through simple settings, no need to consider storage, management, etc., carried out by the cloud unified management.

The purpose of this research is to focus on the data collection and analysis of the cloud-based care system of the Internet of Things. We used a combination of physiological bracelets, wearable amulet, Google Home Nest Mini and other various sensors to form a complete care Internet of Things (IoT) system. A complete and detailed collection of various physiological information, posture behavior and eating habits data were collected through the Bluetooth sensor and store it in the cloud database. We also stored the collected physiological data information, posture changes and design life dialogue questions and answers. Finally, we analyzed the collected physiological information and compared it with the content of the dialogue questionnaire. First, we obtained the difference between the user's subjective psychology, physiological feelings and physiological information. Further, we analyzed the user's living habits, eating habits, sleeping habits, etc., Based on it, we gave active suggestions through audio, and made daily health reports and weekly report analysis, providing doctors to judge the change of user's habits, and maximize the analysis. The approach helped the utilization of all kinds of big data collected, so as to achieve the ultimate goal of personalized care by the application of data in the Internet of Things system. Compared with reference [4], it can be found that through long-term behavior records, it is possible to understand what habits such as bad diet, sleep and so on before getting sick, which may lead to problems and proactively issue reminders and suggestions.

Finally, through a stable system and long-term records, four characteristics that meet the main points of big data are obtained:

- Volume: a lot of data.
- Variety: many different forms of data, unstructured and structured.
- Velocity: the frequency of incoming data.
- Veracity: the credibility of the data.

And analyze it through the following steps:

- Identify analysis goals.
- Data collection.
- Data preprocessing.
- Data analysis.
- Visual representation.

Through the above processing, we can get the highest value analysis results. However, our consideration of data collection may not be comprehensive enough, and users may use the device incorrectly, which will lead to the risk of data abnormality or loss. We need more accurate methods to judge the data. And in the case of collecting a large amount of data, it may cause the equipment to be overloaded or generate redundant data, which will be the goal we need to consider and solve.

Through the above introduction, we clearly understand the market demand and the purpose of the experiment, and we also discussed the initial system architecture and method. At the beginning of the second part, we will start to introduce the complete hardware device and system architecture. The third part will introduce the architecture of the cloud service and the dialogue flow. The fourth part will introduce the experimental procedure, data processing and complete data analysis.

II. System Architecture

This section will introduce a flowchart of the IoT system architecture, including devices, cloud services, and dialog flows.

A. System Architecture

The system uses Bluetooth wearable devices, Bluetooth sensors, depth cameras, video pens and other Bluetooth devices, through the Node Network (the Node Network transmission process can perform indoor positioning and tracking) to automatically sense the sensors and push the data to the terminal through the Bluetooth mesh network (Bluetooth Router and IoT Edge Device), then authenticate the Bluetooth device through IoT Edge Device and transmit the data to the cloud database through W-Fi for processing, classification, storage, calculation and statistics, and finally, through other visualizations such as web pages interface for viewing.

The overall system architecture is mainly divided into six levels, and the architecture diagram is abstracted as shown in Figure 1. Each level from top to bottom is:

- Sensor: Responsible for sensing the measured information and converting the sensed information into specific information output. In this system, new Bluetooth devices can be added at any time for data collection
- Node network: A mesh network composed of Bluetooth is responsible for transmitting sensor information to the router through the Bluetooth mesh network.
- Bluetooth router: It is responsible for information transfer and manages the entire sensor network group, which is one of the important roles in the architecture.
- IoT Edge device: It can be said to be a gateway, responsible for controlling data flow, and connecting directly to the cloud to provide filtering, collecting, uploading data and control services.
- Cloud services: Push system services to the world through the public cloud. In this system, new cloud services can be added at any time for more diverse data processing
- User interface: Application(APP) 、 Raspberry Pi, Google Home Nest Mini、Web.

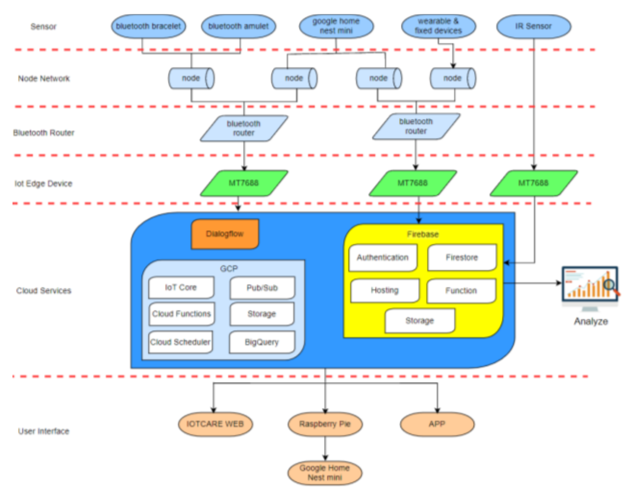

Figure 1. System Architecture Diagram.

B. Bluetooth Device and Sensor

The sensors used in this system are mainly divided into 3 major categories: wearable devices, stationary devices, Google Home Nest Mini.

The wearable devices are Bluetooth bracelets, Bluetooth amulets and Bluetooth tags, as shown in Figure 2. The Bluetooth watch is responsible for detecting physiological data, including heart rate per minute, body temperature, steps and calories. The Bluetooth amulet is responsible for posture monitoring, motion monitoring, height monitoring, and fall monitoring. It can clearly determine and record the user's current body posture changes and make notifications through the speaker and LINE APP in a timely manner. In particular,

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the Bluetooth Safety Amulet uses the 3D printed appearance and specially designed "gecko feet" are pasted on the user's chest, which can most accurately judge the user's posture changes. The Bluetooth tag is responsible for detecting the indoor mobile location of the user and its positioning.

Fixed sensors are touch sensors, and Google Home Nest Mini. A touch sensor is a weight machine, which is triggered by physical contact. Google Home Nest Mini is triggered by the user's voice message. They are all triggered by the same user. The difference is in how they are triggered.

Google Home Nest Mini runs based on Google Cloud Platform (GCP)[8] services, helping us create a dialogue system to process audio messages, processing flow: Voice input, Dialogflow, Agent, Intent, Fulfillment, Intent, Agent, Dialogflow, Voice output, can respond to different dialogue intentions, events, responses are classified, and their classification data are stored. When an abnormal situation occurs in the physiological data stored in Firebase Firestore [8] (for example, the state changes to a fall or an abnormally high heart rate), the speaker will broadcast a critical message in real-time, and transmit the information to the administrator through LINE.

Figure 2. Bluetooth watch and Bluetooth amulet.

C. Depth Camera

The depth camera used in this system is Intel's RealSense Depth Camera D435. Compared to the Microsoft Kinect series and Leap Motion Controller series, D435 has more detailed long-distance depth detection and has strong inter-SDK compatibility. As shown in Figure 3, this camera is used to take pictures of the user's three meals of food, and use the positioning function of the amulets and the attitude change to trigger the photo. Learn the types of different foods through algorithms, and calculate the volume, calories and nutrients of individual foods, record them in the database, and calculate the daily nutrient intake. For comparison, if the intake is insufficient, dietary advice will be given through the Google Home Nest Mini the next day.

Figure 3. Intel’s RealSense Depth Camera D435.

D. Audio and Video Recording Pen

The audio and video recording pens used in this system are V082S. It has high-quality video and enough memory space, and the battery is enough for a full day of use. The main function is to capture the users eating status outside the main mealtime, and use the RSSI change status to trigger the camera to take pictures. Through the algorithm, the type of each food can be known, and the individual food can be calculated. calorie, and record it in the database, analyze its calorie intake throughout the day, and give appropriate suggestions through the Google Home Nest Mini.

E. Bluetooth Mesh Network

The Bluetooth LAN is mainly composed of two parts: bNode and bwRouter, which play two important roles in the Bluetooth network, Central (Master) and Peripheral (Slave). The main function of the Master is to scan for the broadcast channel, the address of the Bluetooth tag can be known through the communication protocol defined by this research, and the data is transmitted to the slave through UART, and the slave plays the role of broadcast, responsible for the positioning of the device and the priority of data forwarding and continued transmission. Go to the next bNode until the Master scans its own return packet (Acknowledgement, Ack) and informs the Slave to stop broadcasting. This design can also reduce the delay to ensure whether each data reaches the next bNode. Figure 4 is a relationship diagram between bNodes.

BwRouter is composed of Bluetooth and Raspberry Pi. It is the transmission terminal in the Bluetooth local area network. It acts as a transmission bridge between Bluetooth and Wi-Fi. BLE transmits data to Raspberry Pi through the UART communication interface. Raspberry Pi is filtered, sorted and classified. After that, upload it to the cloud for data storage and analysis through Wi-Fi. BwRouter can achieve a two-way communication transmission system by returning an acknowledgment message (Acknowledgement, Ack) or issuing commands to the lower-level device of the Bluetooth LAN.

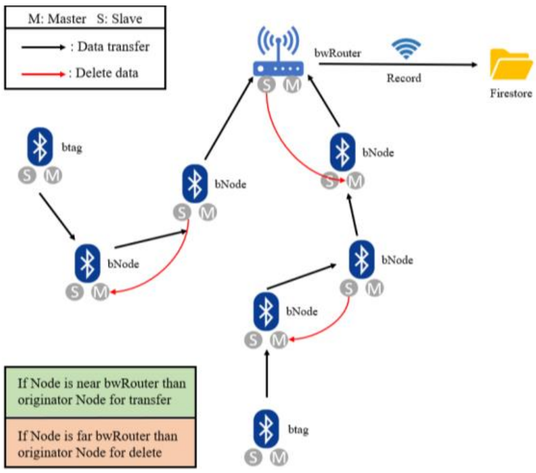

Figure 4. bNode transfer process diagram.

F. IOT Edge Device

The core of an edge computing device is to act as an entry point or an exit point and to control the data flow at the boundary or periphery between two networks, any hardware responsible for processing data, while edge computing is a large-scale service that was originally handled entirely by the data center. Decompose, cut into smaller and more manageable parts, and distribute to edge nodes for computing [3]. The main reason for using edge computing is that edge computing devices are closer to users than data centers, which can speed up data processing, improve response time, and improve bandwidth availability. It will be closer to the source of the data, so it is more suitable for processing big data and analysis.

G. BLE Initial Setting

The mobile phone application plays the role of the setting terminal in this system, and the mobile phone application is used to write the relevant information of bNode and bwRoute, so as to make the flooding of the Bluetooth network directional (Flooding is used to publish and relay the message), and use the built-in latitude and longitude of Google Map to locate the device, so as to know the location of bwRouter, distinguish the area of Mesh network and write the required information, so that Node can judge the distance and have directionality, in addition to setting the latitude and longitude In addition to positioning, field division can also be performed, such as dining room, toilet, living room, bedroom and other areas. As shown in Figure 5.

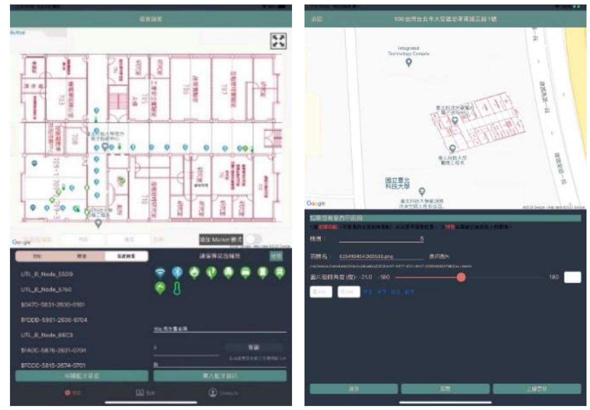

Figure 5. APP interface.

H. Analyze

Behavior pattern analysis: Physiological data (heartbeat, body temperature, calories, number of steps, posture, movements, etc.) can be obtained through the Bluetooth wearable device to determine behavior patterns, such as daily moving route, which can be used to know whether to go to the toilet, The number and time of filling water, eating or watching TV, and can analyze whether the number of drinking water is insufficient, whether the number of times to go to the toilet is abnormal, etc., and give reminders, and rely on the heartbeat, posture, height changes and location to determine whether it falls or not As well as the location of the fall, it will immediately notify other members of the family through the Google Home Nest Mini, and make appropriate measures immediately.

Sleep quality analysis: You can know the sleep posture change and breathing rate through Bluetooth amulets. Combined with the heartbeat and body temperature changes of the bracelet, you can simply analyze the sleep quality. If there is an abnormal heartbeat change or a large posture change Further in-depth analysis can be carried out. Combined with the question and answer of the Pittsburgh Sleep Quality Scale [6], it can be further confirmed with users, and the results can be analyzed by deep learning training.

Analysis of eating habits: Use the positioning function and posture change of the amulet to trigger the depth camera to shoot the contents of the three meals, and use the audio and video recording pen to capture the eating status outside the mealtime, and conduct in-depth training to identify the types of food and calculate their calorie and nutrient content. The number of weekly exercises, height, weight, age, and gender calculates the individual basal metabolic rate (BMR). The calorie intake per meal obtained by the depth camera is compared with the BMR to determine whether the daily intake of sufficient nutrients is sufficient. And analyze the picky eating behavior, and suggest giving reminders of supplementary nutrients in a timely manner.

Exercise habit analysis: Through the Bluetooth wearable device, you can determine whether you are in a state of exercise. If so, record the duration of the exercise and the total calories consumed after the exercise, and give suggestions for exercise intensity, duration, etc. after each exercise. And record long-term exercise habits. If the habits change or there is no exercise habit, exercise suggestions will be given by analyzing the data.

Based on the above four types of analysis results, it is found that through long-term observation, users can be very familiar with the daily life and various habits of users, even those habits that users themselves have not noticed. Take care of the big and small things in the user's life to achieve the purpose of care and companionship. Finally, the application of deep learning can be added to more deeply simulate the user's habits and status, and establish a personalized digital avatar.

III. CLOUD SYSTEM ARCHITECTURE

This research relies on the application of a large number of cloud services and uses part of the cloud functions of Google's cloud platform GCP to classify, organize, store and analyze the data collected by wearable devices, and use the development framework of web pages and related tools. Combined with the personnel positioning and life data collected by the device, it is stored in the object database for web page and APP access, and the data regularly output statistical reports through Extract-Transform-Load (ETL). Then we will analyze the user's behavior, and send it to the front-end community and smart speakers through the push broadcast platform. The cloud architecture of this system is shown in Figure 6.

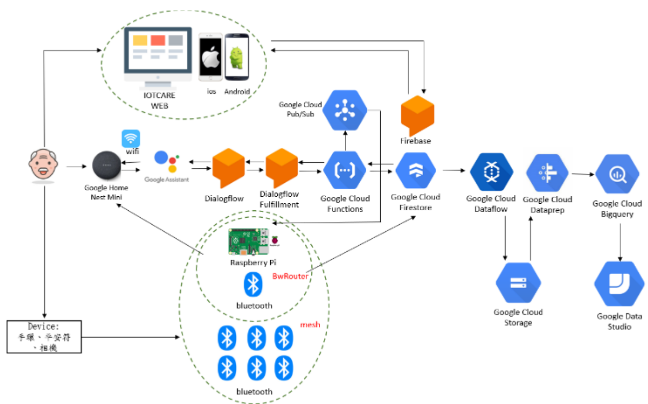

Figure 6. Cloud system diagram.

In this system, we use Google Home Nest Mini to communicate with users, such as proactive reminders, proactive push messages, and in order to collect useful messages through conversations and Q&As with users, we have written many functions and designed different Conversation flow templates. For example, about the Geriatric Depression Scale [6] and the Pittsburgh Sleep Quality Scale [7], we have a preliminary understanding of their emotions and sleep problems, and by analyzing the content of the scales, physiological signals and behavior patterns, we can identify problem points and improve them. factor. The dialogue flow takes the question and answer of the Pittsburgh Sleep Quality Scale [7] as an example, as shown in Figure 7.

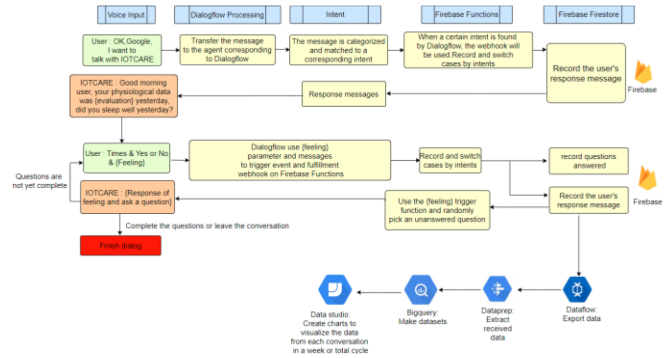

Figure 7. Dialogue questions and answer process.

The cloud services used in this cloud system are described as items E-L in Section 3 of [8], respectively using the cloud service functions shown in Figure 6 to perform data trigger functions, data storage, processing, analysis, visual presentation, etc., and through Google's services, such as Action on Google, Google Home, etc., to deploy and use cloud services.

IV. EXPERIMENTAL STEPS AND DATA ANALYSIS

This experiment integrates the above-mentioned system architecture and cloud system architecture, and then conducts experiments and data collection, and finally analyzes and validates the data.

A. Experimental Field Environment

The experimental field is a 45 x 31 meters area located on the 7th floor of the Tzung-He hall, which is in the National Taipei University of Technology. The 31 Bluetooth light source devices (bNodes) are subordinated as shown in Figure 8. A one-week (7-day) experiment was conducted from 12:00 pm to 5:00 pm every day to collect each subject's physiological data, posture changes, and daily lunch status, and to analyze each person's physiological information, behavior patterns, diet records and stored in firebase Firestore. Finally, place the Google Home Nest Mini in the center of rooms 709-2 and 709-3 for notification of various conditions.

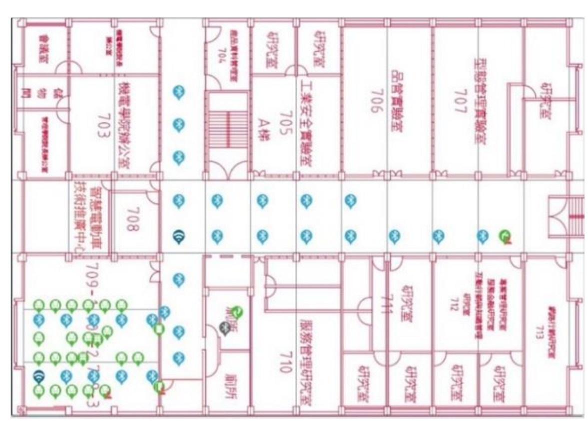

Figure 8. Experimental field and bNode location.

B. Data and Data Model

As shown in Figure 9 the following are noun description and explanations:

- Personal account: Record user permissions and personal related information, user information covers individuals and organizations.
- Notify & Alert: Record alert notifications due to abnormal user status or behavior.
- People: When the user is an individual, this node records all the physiological data information of the current user. Its child nodes include: bracelets, amulets, diet records, exercise records, respectively record physiological and behavioral posture information, and continue to add diet and exercise habits information.
- Location: Record one or more addresses. Its child nodes include floor records, inheriting the address information of the previous floor, and combining multiple floor information, including the latitude and longitude of the floor boundary and the floor plan of the floor.
- Tags: This is a wearable device. The current wearable device of the system is the bracelet and safety charm, which records the current address of the wearable device, floors, mobile fixed equipment. Its child nodes include tags record, which records the historical information of the previous wearable device, including positioning latitude and longitude information.
- Equipment: Inherit the information of the previous layer and record the real-time status of the fixed equipment of this layer. Fixed device information includes weight scales, reed switches, etc., as well as mobile devices, such as tablets, etc., and its child nodes include Device information, the content of which is the contact history information of the device.

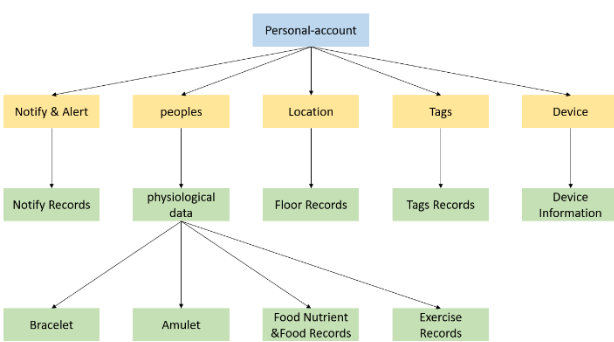

Figure 9. Data model.

In this experiment, we obtained a total of 3,344,651 data records from the Bluetooth bracelet; 1,528,487 records for posture changes of the amulets; 13 records for abnormal data; 20 records for notifications from Google Home Nest Mini; 105 records for food Photo records; 210 nutrient records; 11489 tag records, 10354 equipment records. In this study, we analyzed the subjects' physiological conditions, behavioral patterns, and eating habits. Due to the limitations of the experimental site and experimental time, we could not collect relevant data on sleep and exercise habits. The full quantity chart is shown in Table 1.

TABLE I. 10-DAY EXPERIMENT DATA VOLUME

Data field	***Numbers of row data***
Bluetooth bracelet records	3344651
Bluetooth amulet records	1528487
Tag-records	11489
Device-records	10354
Data exception records	13
Speaker notification records	20
Diet photo records	105
Nutrient records	210

C. Physiological Status Analysis

This part focuses on the use and analysis of the data of the bracelet. You can view the changes of the subject's physiological data and other related information in time through the display of the webpage, as shown in Figure 10, or you can extract the history stored in the database by extracting. The data is analyzed, and a personalized physiological model is analyzed for different people so that the data can be effectively and correctly processed in the subsequent analysis of behavior and sleep.

Figure 10. Web page real-time data update.

One subject was selected from the experiment for detailed analysis, as shown in Figure 11 and Figure 12, which are the daily records of heartbeat and body temperature, respectively. It can be found that most of the heartbeat and body temperature fall within the stable range, but some abnormal values can be seen from the figure. When the abnormal value occurs, the speaker will broadcast a reminder immediately.

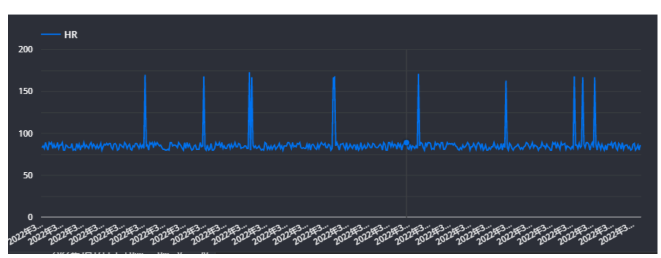

Figure 11. Heart rhythm model diagram1.

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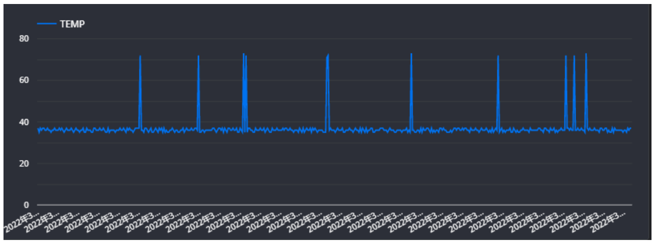

Figure 12. Heart rhythm model diagram2.

By recording and comparing each person's physiological information over a long period of time, a personalized physiological information model can be constructed, which can be clearly recorded when sleeping, walking, and sitting in different situations. Due to the influence of experimental environmental factors, the analysis and simulation in sleep and other situations cannot be more effectively displayed, otherwise, the importance of physiological information in this study can be more clearly realized.

D. Behavior Pattern Analysis

Through the changes of positioning and posture, it can be very accurate to judge where the user is, what to do, and how long it takes, and through the daily record, the daily behavior of the user can be analyzed, as shown in Figure 13. It is a graph of the number of records, the number of experimenters, state changes, etc.

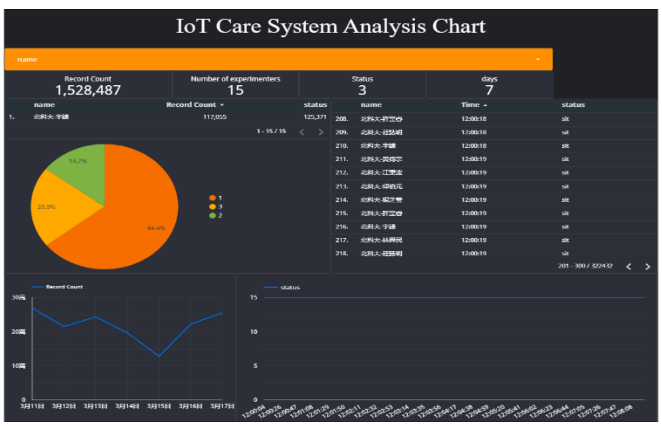

Figure 13. Behavior analysis diagram of the experimenter(In the pie chart, 1 represents sitting, 2 represents standing, and 3 represents walking.).

In the following, we select the posture changes of 2 subjects for further analysis and discussion. As shown in Figure 14, this is the posture record chart for a week, with Person 1 on the left and Person 5 on the right. It can be found from the figure, the proportion of 2 subjects sitting is extremely high, as high as 85.2 % and 77.9 %, respectively, there is a risk of sedentary, and it can be seen that the activity ratio of Person 5 is higher than that of Person 1, so they will use the speaker when they are sitting for a long time. Proper reminders are given to encourage increased activity.

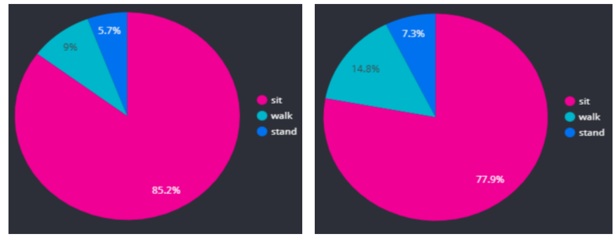

Figure 14. Attitude proportion pie chart(Person 1 on the left, Person 5 on the right).

Next, we observed the daily posture change curve of Person 5 within a week, and selected the curve changes of Day 2, Day 3, and Day 6 for discussion, as shown in Figure 15, Figure 16, and Figure 17. The vertical axis in the figure is the posture, 1 represents sitting, 2 represents standing, 3 represents walking, and the horizontal axis is the time axis. It can be found that the attitude changes models of Person 5 on Day 2 and Day 3 of the experiment are very similar, representing Person 5 in the week. In the afternoon of some days, there are similar itineraries and attitude changes, and these attitude models can be effectively recorded. Combined with the analysis of the position records, the activity position and activity itinerary can be further analyzed. Figure 17 obviously has a completely different itinerary from the other two days, which obviously means a new behavioral attitude model, which is completely recorded, which is conducive to longer-term experimental behavioral analysis.

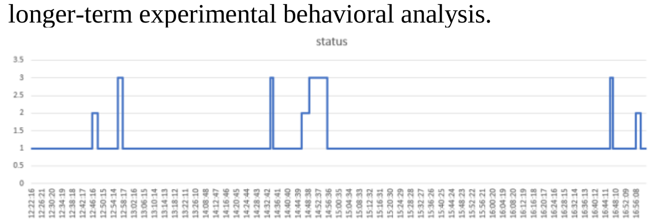

Figure 15. Attitude change model diagram1.

Figure 16. Attitude change model diagram2.

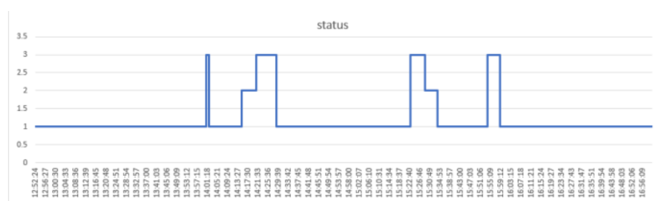

Figure 17. Attitude change model diagram3.

According to the above analysis content, in fact, the elderly's habits of getting up, going to the toilet, brushing teeth, eating, watching TV, sitting for a long time, standing for a long time, etc. can be accurately confirmed, and the behavior model can be recorded, and when abnormal activities occur. Notifications are made through speakers or LINE APP. Among them, sitting for a long time is a behavior that is easier to ignore and more likely to occur. Sedentary is related to cancer prevention in the elderly [10]. Therefore, the assistance of speakers is more needed to improve the elderly's health and bad habit.

E. Diet Habit Analysis

In order to clearly grasp the subjects' eating habits, we calculated the volume of food through the depth camera and combined deep learning to identify the type of food, and then grabbed and calculated the intake of nutrients, conducted a 7-day experiment, and recorded the daily lunch. Food content, a total of 105 records were collected and recorded in the database.

We selected the dietary contents of 2 subjects from the experimental data for comparison and analysis, and presented the data in the form of a table. We can clearly see the content and types of food they eat every day. The dietary contents are shown in Figure 18.

person1	Day1	Day2	Day3	Day4
	rice:254g	noodle	noodle	noodle
	cabbage:105g			
	steamed egg: 145g			
	Day5	Day6	Day7	
	rice:251g	noodle	rice:202g	
	tofu:92g		tofu:105g	
	steamed egg: 163g		steamed egg: 140g	
person5	Day1	Day2	Day3	Day4
	rice:254g	fried rice:548g	rice:237g	rice:237g
	stir-fried vegetables:105g		stir-fried vegetables:165g	stir-fried vegetables:165g
	tofu: 145g		tofu: 95g	tofu: 95g
	brocoli:198g		brocoli:125g	brocoli:125g
	Day5	Day6	Day7	
	rice:207g	rice:237g	rice:237g	
	stir-fried vegetables:146g	fish:165g	shrimp:65g	
	brocoli:204g	stir-fried vegetables:176g	stir-fried vegetables:213g	
		tofu: 84g	tofu: 54g	
		steamed egg:68g	brocoli:105g	

Figure 18. Weekly food content chart(Description of Person 1 and Person 5).

Arrange the data into a bar chart, as shown in Figure 19, from the figure we can easily observe the food intake and the number of items for a week. Person 1 prefers pasta in the staple food category, while Person 2 prefers meals. Then it can be clearly seen that Person 1 eats less food, most of which are about 3, and the intake of vegetables is not enough. On the contrary, Person 5 is in the intake of food types is relatively sufficient, and the intake of various seafood, vegetables, beans, etc., the intake of nutrients is quite sufficient for Person 1.

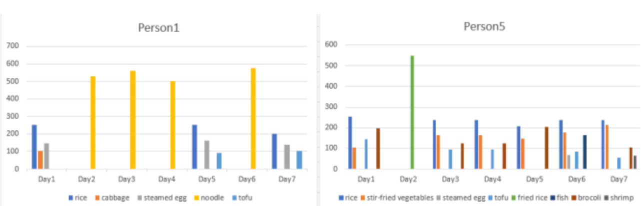

Figure 19. Histogram of weekly food intake.

Figure 20 shows the nutrient content per 100 grams of food, and the content is the type of food contained in Figure 19. It can be found that the cholesterol content of streamed eggs and shrimp is high, and the sodium content of noodles, fried rice, and shrimp is high, so you should pay attention to the intake of these foods containing higher nutrients.

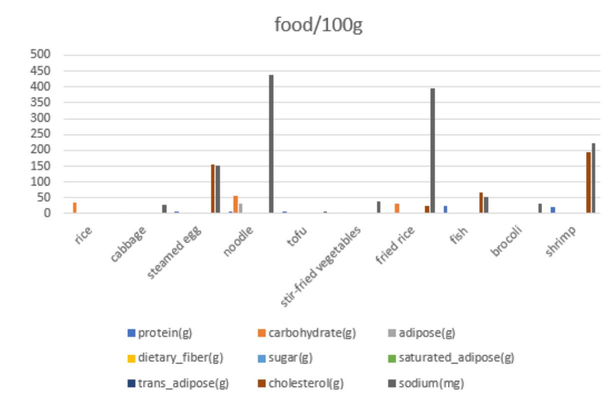

Figure 20. Histogram of nutrient content per 100 grams.

As shown in Figure 21, by observing the total nutrient intake of Person 1 and Person 5 for one week of lunch, it can be found that some situations are that Person 1 consumes too much sodium, which is much higher than the sodium intake of Person 5, and then uses the daily nutrients provided by [8]. By comparison, it can be more accurately found that the sodium intake of person 1 at noon is already close to the upper limit of the intake of three meals a week, so when the daily intake exceeds the standard, an immediate reminder will be given to inform you of the lack of those nutrients.

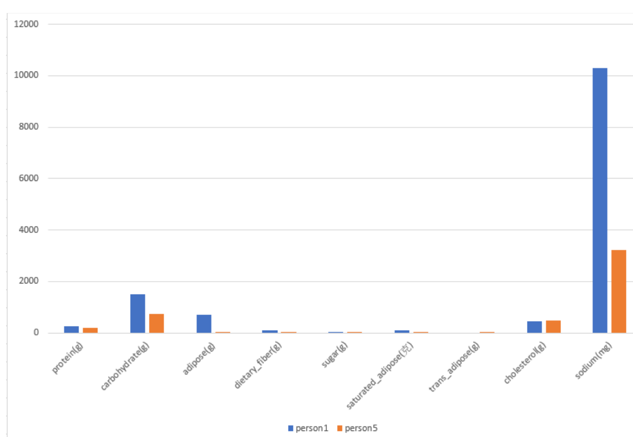

Figure 21. Histogram of total nutrient intake in one week.

After processing the data in the database and creating a data table for Big Query, 2 family doctors assisted in the analysis and verification of the data. With the help of doctors, we can have more accurate analysis results. Then, the analyzed data was discussed with the subjects. The subjects reported that there was a lack of dietary content, and when communicating with the Google Home Nest Mini, the speakers occasionally could not understand the user's words.

For this, we gave some responses, regarding the food image recognition ability, more image recognition is still needed and more diverse food models are established. Regarding the Google Home Nest Mini, it is necessary to strengthen the design of sentences and the use of different languages, and it can be modified in the program to match the relevant language supported by the speaker.

Finally, we effectively apply this intra-experimental result in real life. By observing the nutrient intake status every day, it is possible to immediately suggest the part of the nutrient intake that is insufficient on the next day, but the daily observation may not be able to understand the number of missing nutrients. The nutrients that the elder lack is very large, especially in the intake of some vitamins A, D, E, etc., it is easy to be ignored, so with the real-time reminder of Google Home Nest Mini, and the required food intake. It is recommended to gradually improve the user's eating habits, and also through the analysis of records, to know the relationship between the elderly's eating habits and physical conditions, to more effectively improve the elderly's bad eating habits, and to build a personalized diet model.

V. Conclusion and Future Work

This research is devoted to making a personal physiological data analysis system, completing data collection through the Internet of Things network combined with simple Bluetooth devices and cloud platform applications, and establishing a complete data analysis, through Google Home Nest Mini has established a good interaction with the elderly. Through daily data analysis and active push notifications, the elderly can instantly understand their own conditions and precautions. Through long-term data analysis, the following items can be effectively analyzed: Behavior patterns, eating habits, sleep quality, exercise habits, closely record and analyze the living conditions of the elderly, and through long-term analysis and suggestions, effectively improve the elderly's bad eating habits, and also use the Bluetooth wearable device. And the combination of the questionnaire content can more accurately analyze the sleep status and exercise habits of the elderly. These analysis contents can completely display the daily life pattern of the elderly and establish a personal model.

Although we have completely designed the entire care system and conducted some experiments and tests, the data volume and experimental environment of the experiment are still not perfect, and the data analysis can still be improved. In the future, we will continue to optimize the system and analyze and optimize it, and add the application of deep learning, so that the entire system can completely analyze and simulate various conditions of the elderly.

It is hoped that in the near future, a perfect personal digital avatar will be established through this system.

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