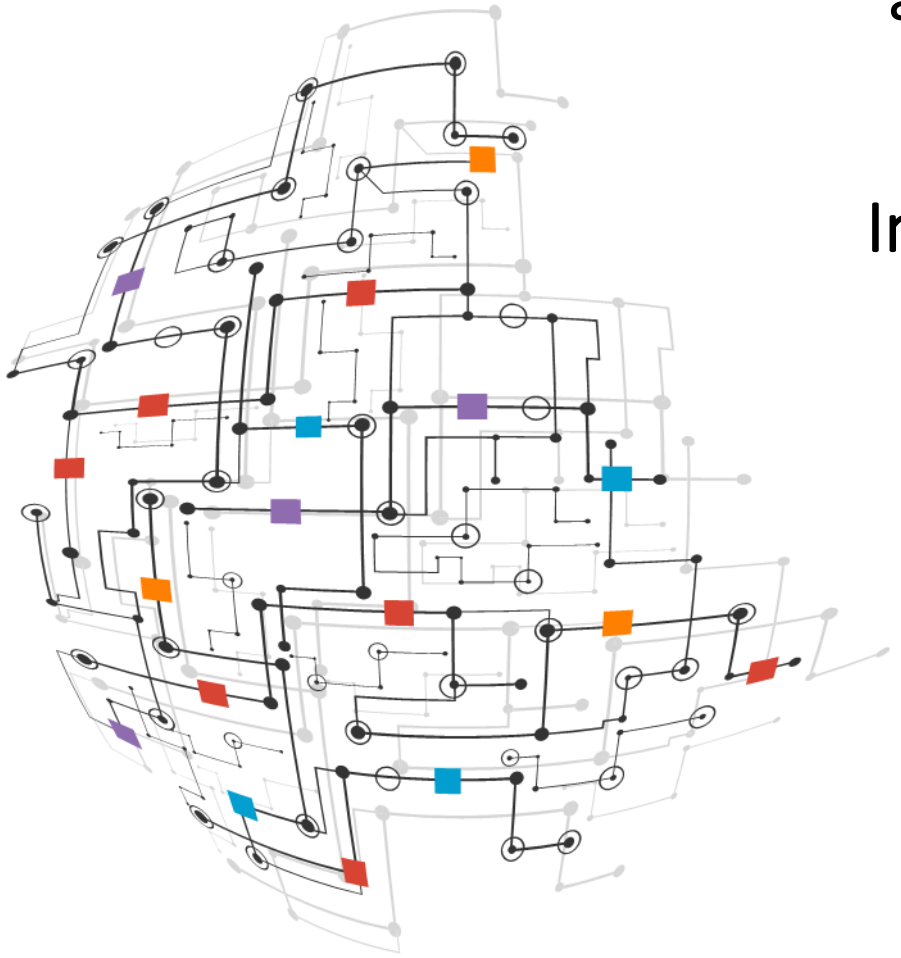
The Fourteenth International Conference on eHealth, Telemedicine, and Social Medicine eTELEMED 2022



Implementation of IoT data analysis in personal elderly home care system

Authors: Chuan-Zong Huang, Jung-Tang Huang

Graduate student of National Taipei University of Technology

Presenter: Chuan-Zong Huang
Email:t109408005@ntut.org.tw

TAIPEI TECH
國立臺北科技大學
National Taipei University of Technology

June 26, 2022 to June 30, 2022 - Porto, Portugal

IARIA

Chuan-Zong Huang

Email:t109408005@ntut.org.tw

Education

- M.S. Major in Department of Institute of Mechatronic Engineering, National Taipei University of Technology, 2022
- B.S. Department of Mechanical Engineering , National Taipei University of Technology, 2020

Research

- Network theory and application
- Cloud service
- Big data analysis
- Artificial intelligence(Deep Learning)

Introduction

Goals

- Accurate and effective collection of various user’s information.
- Maximize usage data.
- Build a personalized physiological model.

Contributions

- Collect the most data from a portable device
- Analyzed the user's lifestyle through the collected data
- Simulate user behavior
- Build a personalized physiological model.

System Architecture

Bracelets、Amulets、Weighing machine、Depth camera、Video recording pen

IOTCARE WEB

ios

Android

Google Cloud Pub/Sub

Firebase

wifi

Google Home Nest Mini

Google Assistant

Dialogflow

Dialogflow Fulfillment

Google Cloud Functions

Google Cloud Firestore

Google Cloud Dataflow

Google Cloud Dataprep

Google Cloud Bigquery

Raspberry Pi

BwRouter

bluetooth

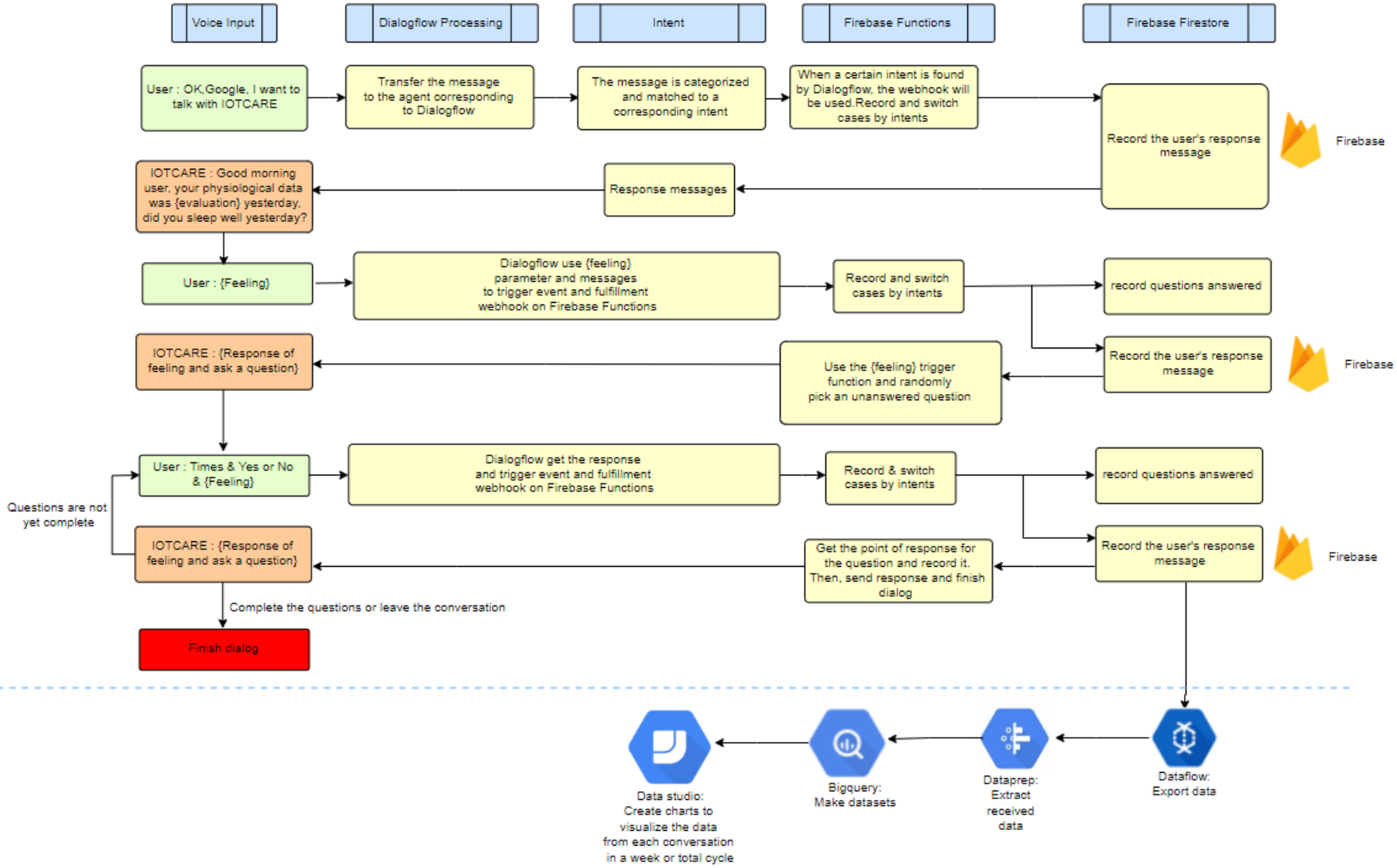
mesh

bluetooth

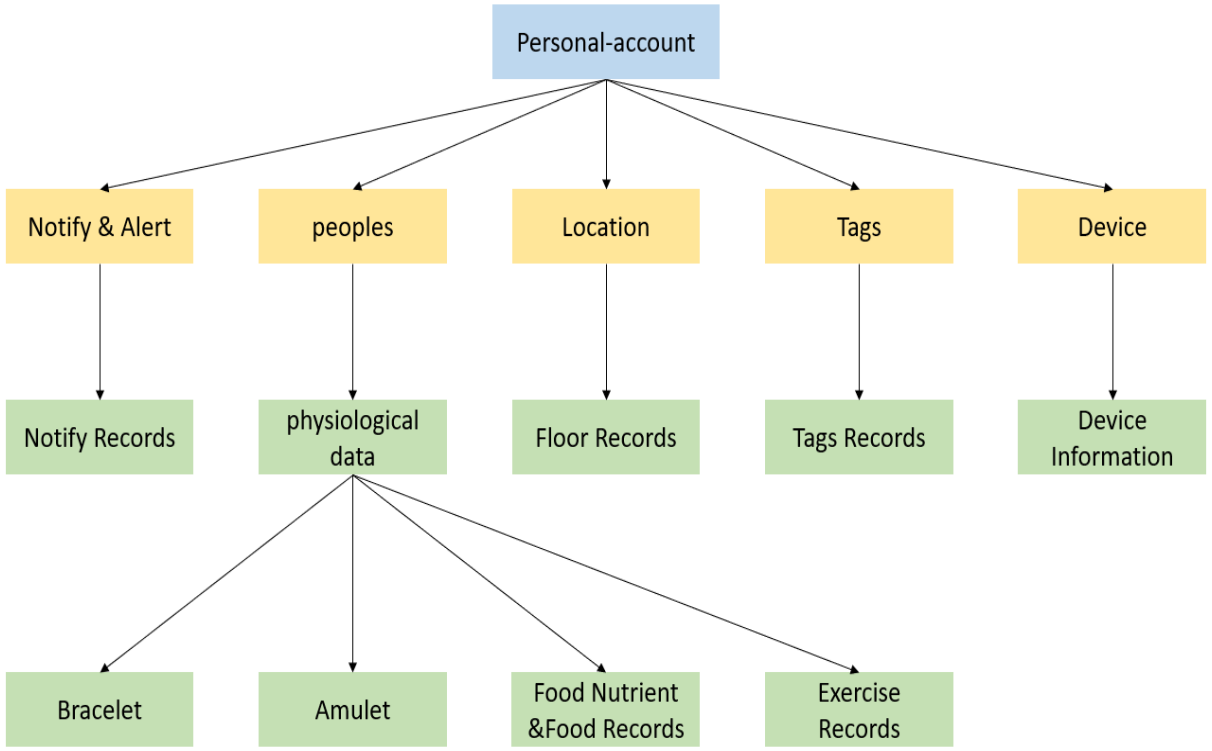
Google Cloud Storage

Google Data Studio

Dialog Process



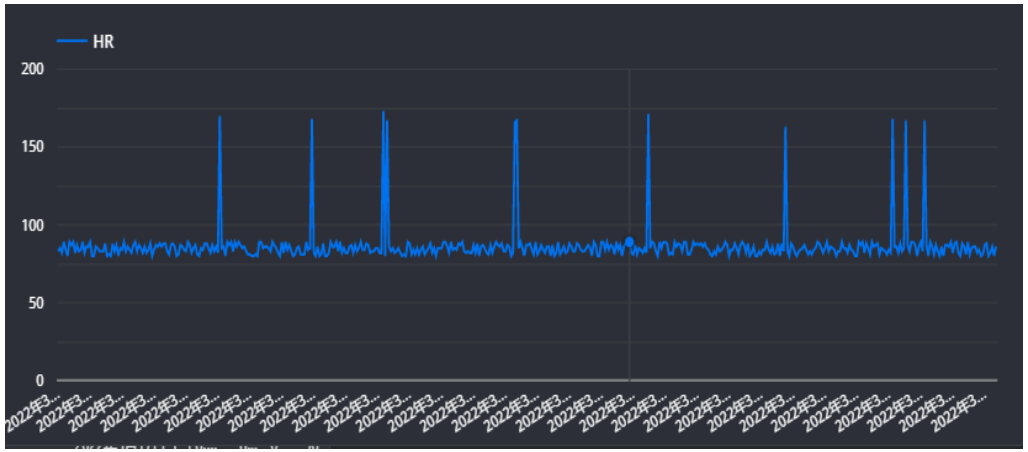
Data Model

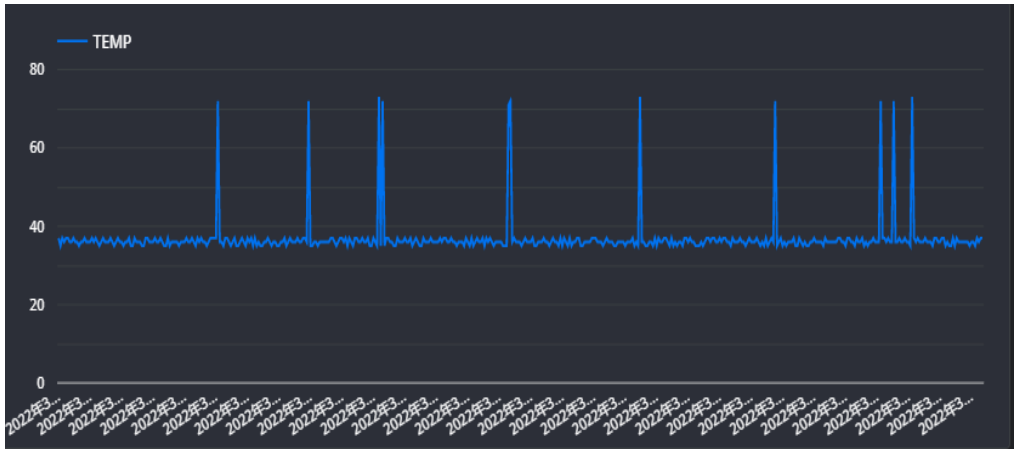


Data field	*Numbers of row data*
Bluetooth bracelet records	3344651
Bluetooth amulet records	1528487
Tag-records	11489
Device-records	10354
Data exception records	13
Speaker notification records	20
Diet photo records	105
Nutrient records	210

Daily Records(Bracelet)

Daily records of subjects A's heartbeat and body temperature.

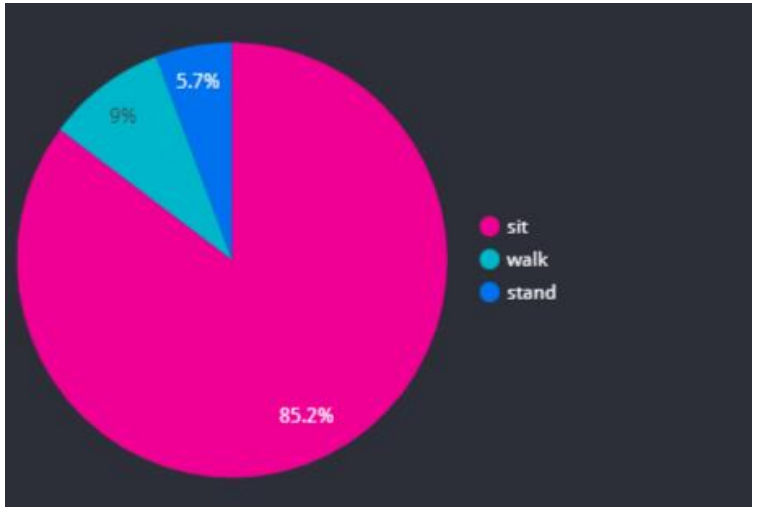


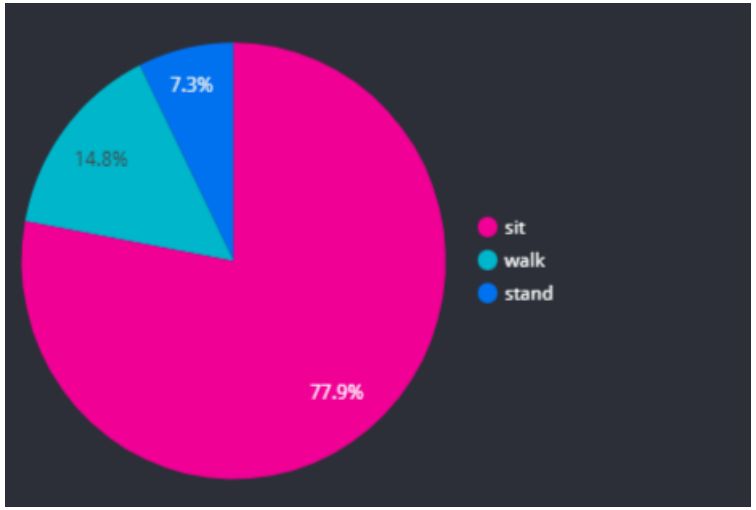


- It can be found that most of the heartbeat and body temperature fall within the stable range, but some abnormal values can be seen from the figure.
- The abnormal values look like a device abnormality. After inspection, it is found that the program calculation error

Daily Records(Amulet)

Compare the behavioral changes of subjects A(left) and B(rught) in one day.

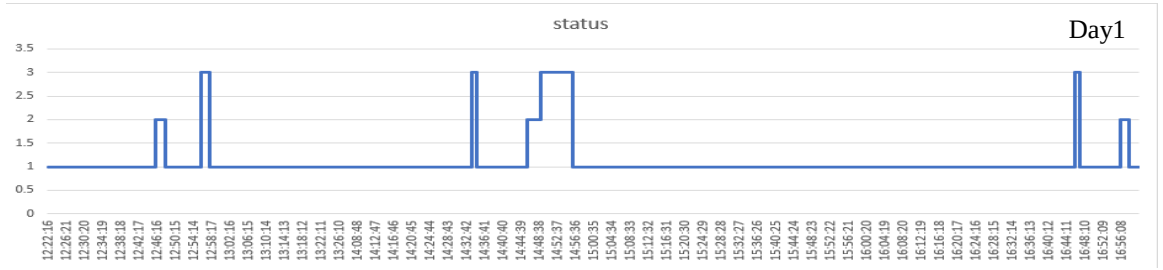


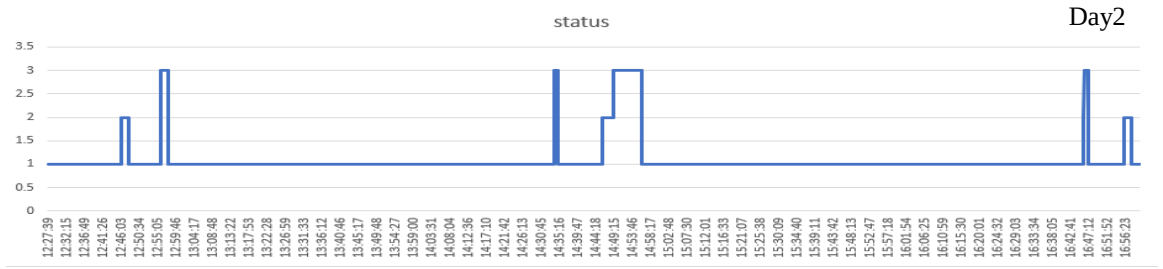


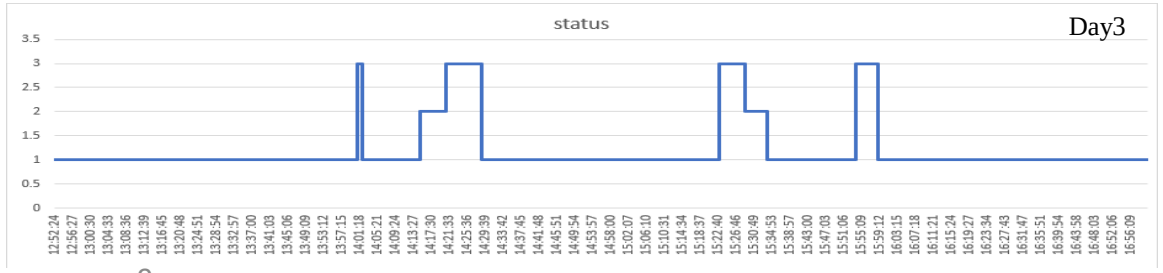
- After comparison, it can be found that the proportion of the subjects in the left picture(subject A) sedentary is higher than that in the right picture (subject B). And the proportion of walking and getting up is relatively small.
- The speaker will inform you of yesterday's sedentary behavior early in the morning and give advice.

Data Analysis

Next, let's discuss the posture change curve of subject A within a week, and we will pick out 3 interesting observations for discussion.







The vertical axis in the figure is the posture and the horizontal axis is the time axis.

- 1 represents sitting
- 2 represents standing
- 3 represents walking

Data Analysis

As can be seen from the previous projection:

- The posture changes on the day1and the day2 are almost the same, the difference lies in the different time points, which means that the subjects have almost the same behavior on these two days. Through indoor positioning we can know the detailed activity status more clearly.
- We can infer whether the user has the same activity schedule on the day of the week based on the data of one month and two months, and can remind the schedule through the speaker or care about the user when he does not follow the activity schedule(due to time factors, longer time data could not be obtained).
- After a long period of recording and analysis, the user's social relationship can be further confirmed, and the interaction and closeness between family members can be observed through indoor positioning and behavior analysis.

Daily Records(Diet)

Observe the diet of subjects A and B for a week

We can observe the subject's diet (lunch) and intake through the depth camera, as shown in the figure on the right, but we will find the following shortcomings:

- It is difficult to see the relationship between the foods in the table.
- No direct understanding of food intake

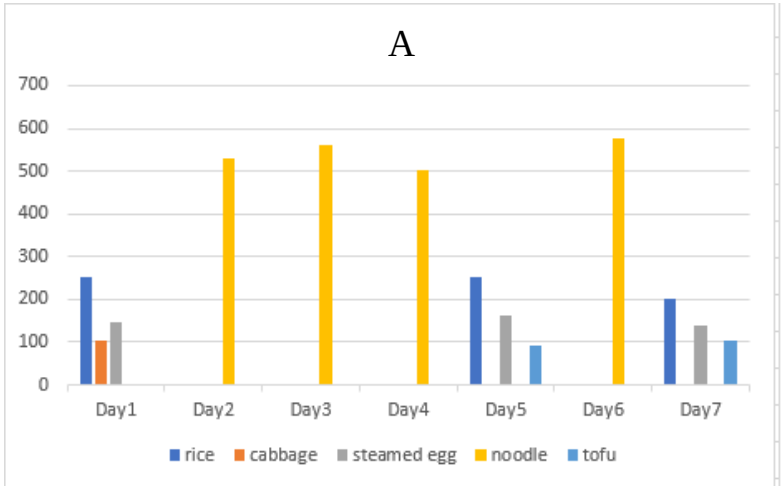
We will find that there are not many kinds of food, this is because the processing of image recognition still needs intensive training

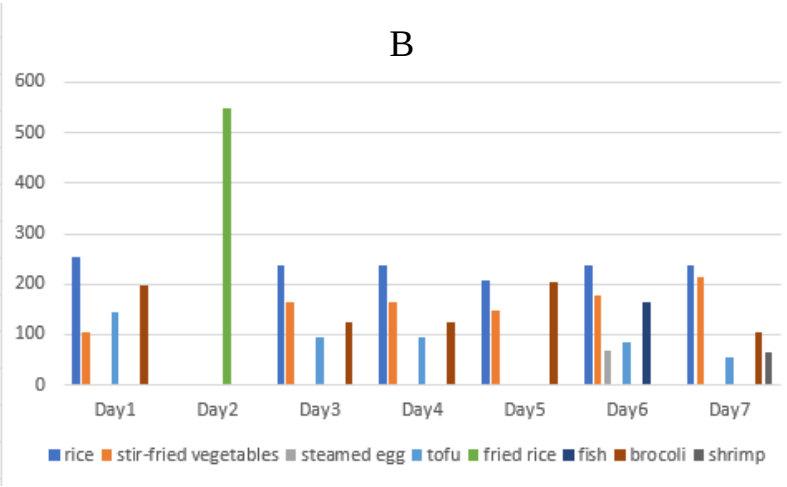
	Day1	Day2	Day3	Day4
A	rice:254g cabbage:105g steamed egg: 145g	noodle	noodle	noodle
	Day5	Day6	Day7	
	rice:251g tofu:92g steamed egg: 163g	noodle	rice:202g tofu:105g steamed egg: 140g	

	Day1	Day2	Day3	Day4
B	rice:254g stir-fried vegetables:105g tofu: 145g brocoli:198g	fried rice:548g	rice:237g stir-fried vegetables:165g tofu: 95g brocoli:125g	rice:237g stir-fried vegetables:165g tofu: 95g brocoli:125g
	Day5	Day6	Day7	
	rice:207g stir-fried vegetables:146g brocoli:204g	rice:237g fish:165g stir-fried vegetables:176g tofu: 84g steamed egg:68g	rice:237g shrimp:65g stir-fried vegetables:213g tofu: 54g brocoli:105g	

Daily Records(Diet)

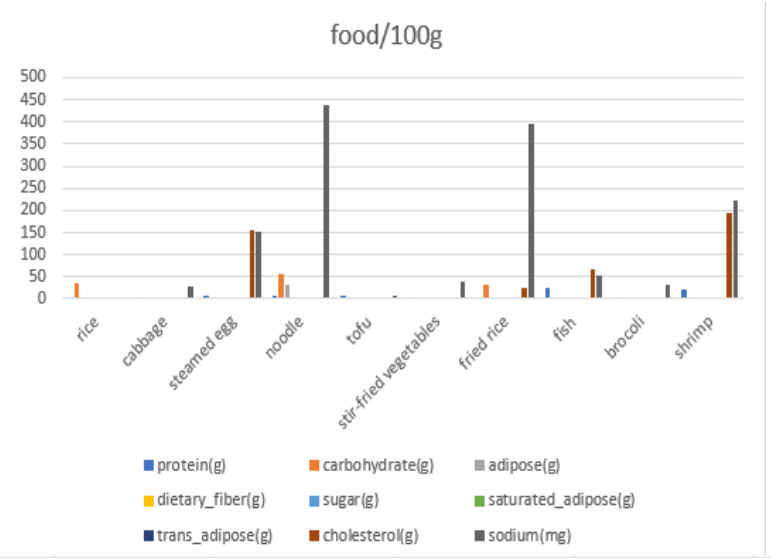
As shown in the figure below, we can easily identify the subject's preferred food and intake. It can be clearly seen that subject A eats less food, while subject B eats a variety of food. Intake of nutrients from fish and vegetables to better supplement the nutrients required by the human body.





Daily Records(Diet)

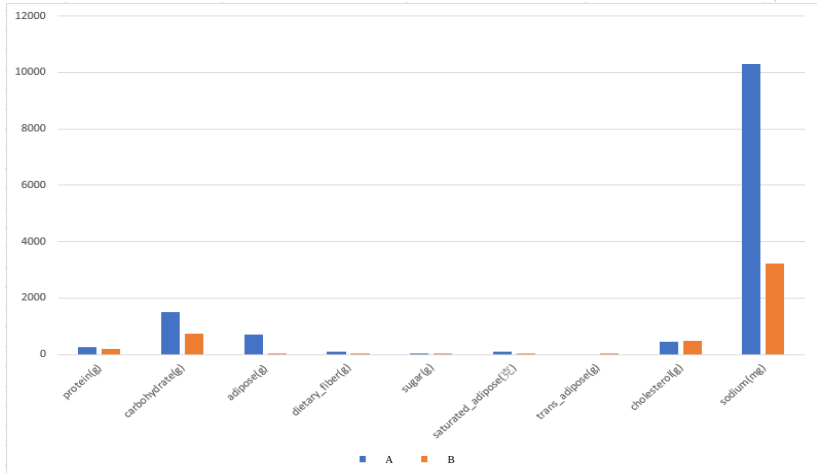
This is the nutrient content per 100 grams of the diets of subject A and subject B and intake.



We can find the following:

- Fried noodles are very high in sodium
- Fried rice is very high in sodium

We can find that the sodium content of subject A is very high. According to the reference intake of dietary nutrients for Taiwanese, it can be found that the sodium content of subject A is much higher than the standard value. When this situation is detected, the speaker will immediately suggest users improve their dietary content and recommend suitable food content.



Conclusions

- Effectively collect user physiological information, including: heart rate per minute, body temperature, calorie consumption, steps, moving distance, posture changes, motion detection, indoor positioning, diet status, etc.
- Use the collected data to analyze behavior patterns, sleep quality, eating habits, exercise habits, etc.
- Verification of analysis content by combining questionnaire design and speaker dialogue design
- Simulate user behavior through daily behavior and physiological signal curves
- Build a personalized physiological model

Future Work

Experiment

- Access to care centers to verify system integrity
- More subjects with different personalities and needs are needed to conduct experiments

Technology

- Add deep learning technology for more accurate and in-depth model building.More efficient use of data.

Market

- Market survey(The needs of the elderly)
- Gain the trust of senior users
- System fee

References

[1] Haijun Gu, Yufeng Diao, Wei Liu and Xueqian Zhang, “The Design of Smart Home Platform Based on Cloud Computing,”
International Conference on Electronic & Mechanical Engineering and Information Technology, 2011.

[2] Tamal Mondal, SujayMugaloremutt Jayadeva, Rojalin Pani, Muthukumar Subramanian, Ashokkumar. P and B. k. Sumana, “E marketing strategy in health care using IoT and Machine Learning”, DOI: 10.1016/j.matpr.2021.11.417,pp. 2087-2091, 2021.

[3] D. C. Yacchirema, D. Sarabia-JáCome, C. E. Palau and M. Esteve, "A Smart System for Sleep Monitoring by Integrating IoT With Big Data Analytics" in *IEEE Access*, vol. 6, pp. 35988-36001, 2018.

[4] Geriatric Depression Scale, Keelung City Government, 2017.

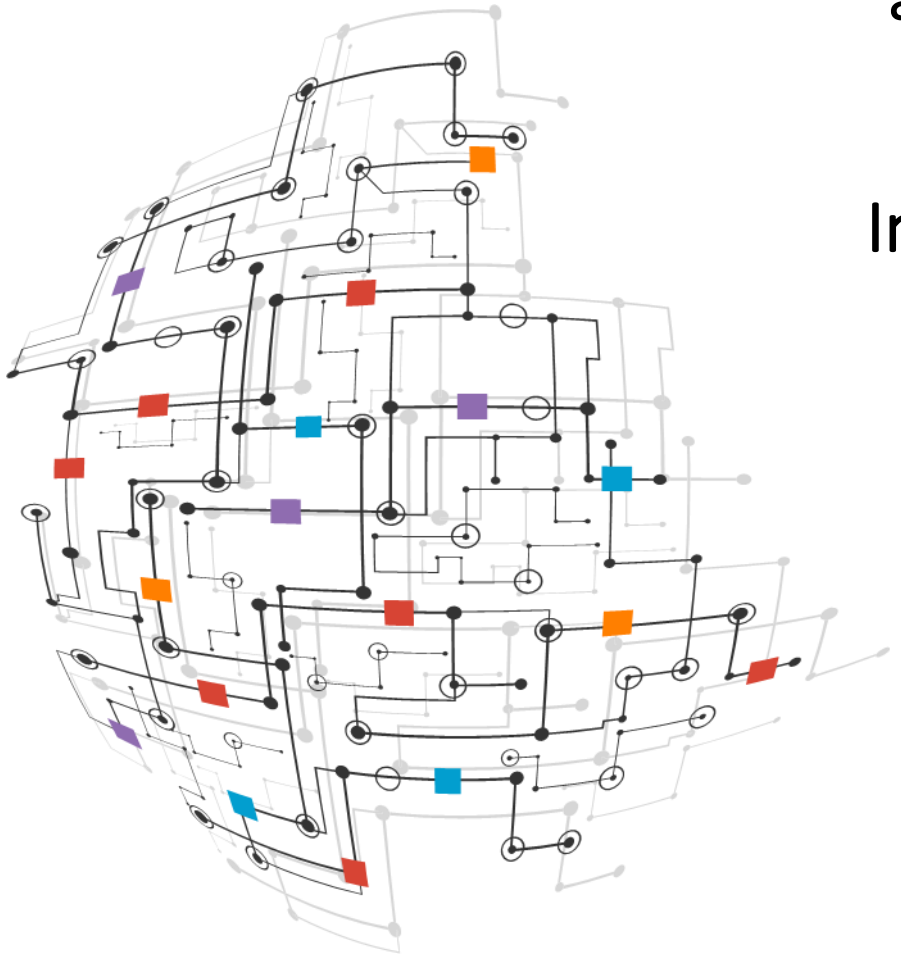
[5] Pittsburgh sleep quality index(PSQI),University of Pittsburgh,1989.

[6] O. Dawelbeit and R. McCrindle, "Efficient Dictionary Compression for Processing RDF Big Data Using Google BigQuery" 2016 IEEE Global Communications Conference (GLOBECOM), Washington, DC, 2016, pp. 1-6, doi: 10.1109/GLCOM.2016.7841775.

References

[7] Dietary Reference Intakes(DRIs), Taiwan Health Promotion Administration, Ministry of Health and Welfare,2021
[8] Jung Tang Huang, Li Ying Chang and Hsin-Chang Lin, “Implementation of IoT, wearable devices, Google Assistant and Google Cloud Platform for elderly home care system”, in ICT4AWE21-PP-23, 2021.
[9] Zhaoli Liu and Jing Wang, “Associations of perceived role of exercise in cancer prevention with physical activity and sedentary behavior in older adults”, in ScienceDirect Geriatric Nursing, volume 44, pp. 199-205, March–April 2022.
[10] Md. Milon Islam, Ashikur Rahaman and Md. Rashedul Islam, “Development of Smart Healthcare Monitoring System in IoT Environment” , SN COMPUT. SCI. 1, 185, 2020.
[11] Ankur Goyal, Hoshiyar Singh kanyal, Shivkant Kaushik and Rijwan Khan, “IoT based cloud network for smart health care using optimization algorithm” , Informatics in Medicine Unlocked, Volume 27, 100792, 2021.
[12] Rahat Iqbal, Faiyaz Doctor, Brian More, Shahid Mahmud and Usman Yousuf, “Big data analytics: Computational intelligence techniques and application areas” , Technological Forecasting and Social Change, Volume 153, 119253, April 2020.

The Fourteenth International Conference on eHealth, Telemedicine, and Social Medicine eTELEMED 2022



Implementation of IoT data analysis in personal elderly home care system

Authors: Chuan-Zong Huang, Jung-Tang Huang

Graduate student of National Taipei University of Technology

Presenter: Chuan-Zong Huang
Email:t109408005@ntut.org.tw

TAIPEI TECH
國立臺北科技大學
National Taipei University of Technology

June 26, 2022 to June 30, 2022 - Porto, Portugal

IARIA