



Happiness

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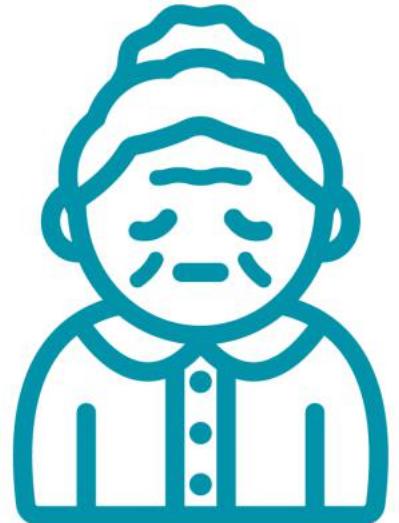


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1-1 Introduction : Background

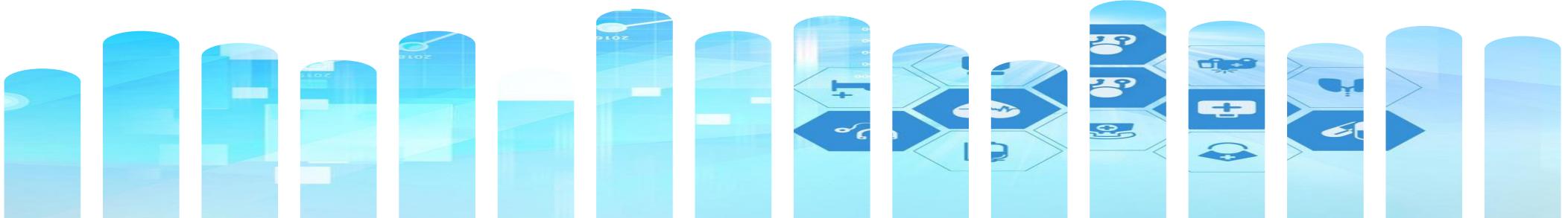
- With the ageing of population, the increasing of elderly population not only bring instability to family life with **the health problem**, but also bring **extra pressure** of medical system (Tun, Madanian & Mirza, 2021). Especially in the period of COVID-19.
- Most elderly people still have **old ideas of medical care**, which contradicts the development of Internet of Things (IoT) and Smart City Technology (2021). This situation happens especially in developed city, and the trend will keep increasing with the development of society and economy.
- Some **reasons** such as the following are also needed to be considered:
 - Lack of care because their children go out for work or no child
 - Lack of willingness to go outside for seeking medical treatment
 - Inconvenience of physical problem
 - ...





1-2 Introduction

- In order to improve the quality of elderly's life and reduce stress of medical system, we design a smart robot called '**Happiness**' which can manage and improve elderly's health care in their daily life at home.
- Based on a convenient and easy-to-use **intelligent voice recognition system**, elderly can measure and centralized manage health data by IoT and get AI improvement advice through **Health Profile**. Also, the elderly can receive **Health Inquiry** at home, as well as timely assistance in emergencies.
- This presentation includes the purpose and features of the product 'Happiness' based on investigating user needs. Also, the **whole process** of its development to 'High-fidelity Prototype' from 'Empathize' will be described in detail. The existence and value of the product will be proved by evaluation. Also, some **potential risks or challenges** will be described.





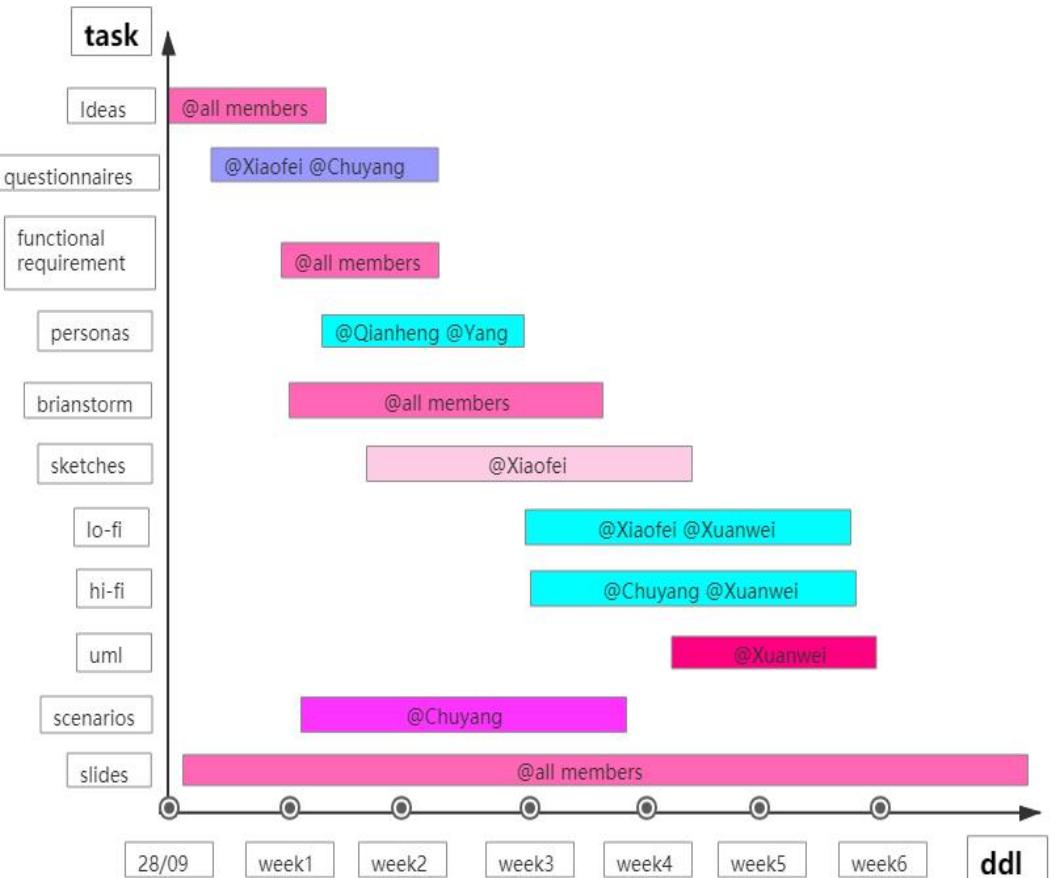
1-3 Introduction : Team Management - GRPI Model

- Goals: Wellness is a very large topic, so we held **quite different ideas** when we discussed in first group meeting. However, all of us had the **same goal** that we intend to design really useful and exciting product. Therefore, we were not persuading others based on what individual wanted to do, but **brainstormed** and **analyzed** which idea was better in reason.
- Roles: Every teammate had their own different skills, so the **allocation** of tasks was easy for us. We also participated in each other's tasks to communicate more efficiently and learn the whole design process more comprehensively.
- Processes: We all understood that a good start is half the battle, so we were very serious at the **goal set** and **weekly planning**. During the team working, besides regular meetings, we followed the **philosophy of Agile** to cooperate by discussing and reviewing in real-time.
- Interpersonal relationships: We are a very friendly and tacit team. Regarding **conflict**, we believed that it should be reasonably transformed into a discussion of different points of view to achieve the optimal solution and avoid quarrel.



1-4 Introduction : Project Management - Agile

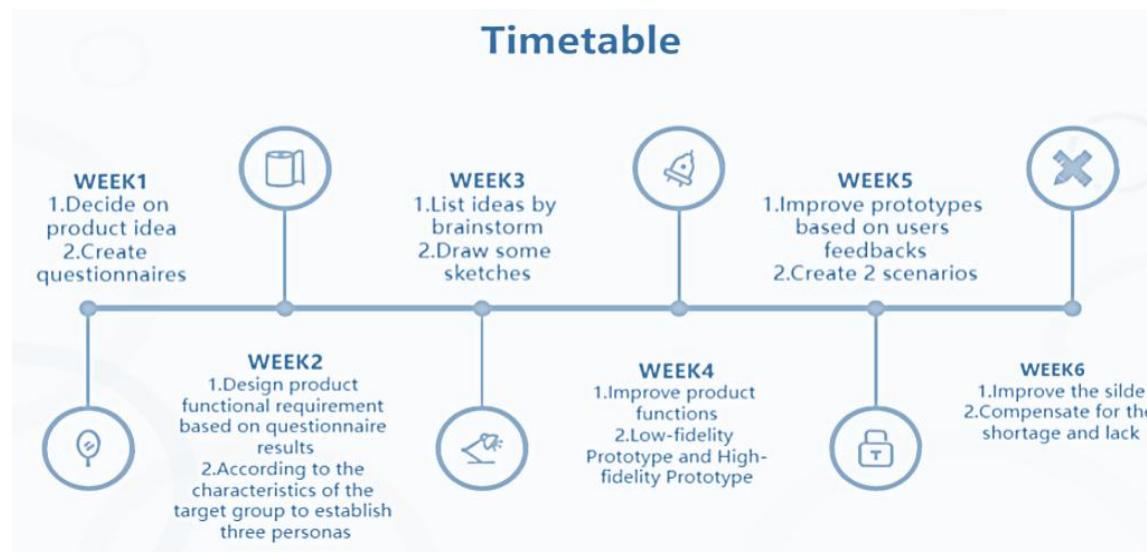
- We didn't have a strict methodology of project management, because we thought that it would take extra cost to adapt professional processes in a month that not **cost-effective**.
- However, we learned the **principle of Agile** which is values to follow rather than a tool (Abrahamsson, Salo, Ronkainen & Warsta, 2017). This help us collaborate effective and respond to change flexible.
- We had a clearly **schedule** suggested by Module Page in Canvas. Although the process was flexible, the whole tasks of each week must be completed by time. We also **planned** and **evaluated** our tasks at the beginning and ending of each week.
- We **worked** and **managed** our PowerPoint with all of its related materials via Google Drive, participated in practical activities and held regular group meeting by Zoom. Also, we used Wechat Group to communicate in real-time.





2-1 Empathize : Planning

- When designing product ideas, almost every people were the potential users for the topic Wellness, so it was necessary to **narrow the scope**.
- After background research and discussion, we agreed that the elderly have greater risk factors for health management and worse self-control ability. We also hoped to show more care and respect to the elderly. Therefore, we decided to design a technology product to manage and improve the **elderly's health**.
- As for the methods of gathering requirement, we firstly collected data from large scale by **questionnaire**. We also organized **interviews** for several different targeted audiences to help establish persona.





2-2-1 Questionnaire : Establishment



- The target of our questionnaire was to **collect information** that what elderly really needed about their health status and what features they wanted to have if had a technology product to help manage and improve their health, etc. Also, we had done **two versions** of the questionnaire, which only difference of countries from China and UK. We hoped to understand whether there were different results in countries by **controlling variables**.
- The style of questionnaire was **internet**, so it was convenient and effective to do the survey. We spread the questionnaire from the start of our own and our tens of friends, let elderly in our families to attend that made the process more efficient and accurate.
- We initially set many questions that we thought were useful. However, when we tested to let several people to do that and receive the response that it took too long time to finish the questionnaire. Therefore, we controlled the numbers of questions that could be done **within two minutes** to give respondent a better experience.
- We used anonymous method and only structured and compared the results of the questionnaire in order to **protect respondents' privacy**.



2-2-2 Questionnaire : Process

- In addition to let respondents enjoy the experience, it was also very important to make result **effective**. Our 9 questions were divided into 4 sections including multiple choice, checkboxes with preference, Likert Scales and short answer. The contents of questionnaire avoided **Russell's guide to 12 common mistakes** in questionnaires.
- We had received **totally 106 responds**. We used Excel chart to analyze the data and read answers of short questions one by one.
- The answer **mostly fulfill** our request, but there were still some problems: We couldn't determine elderly respondent's authenticity because of internet style. Also, some short answers were not effective.
- The full version of questionnaire is in **Appendix1** via link of Google Drive.

1.What is your age? *
<input type="radio"/> less than 60
<input type="radio"/> 60-69
<input type="radio"/> 70-79
<input type="radio"/> 80-89
<input type="radio"/> more than 90
2.What is your Gender? *
<input type="radio"/> Male
<input type="radio"/> Female

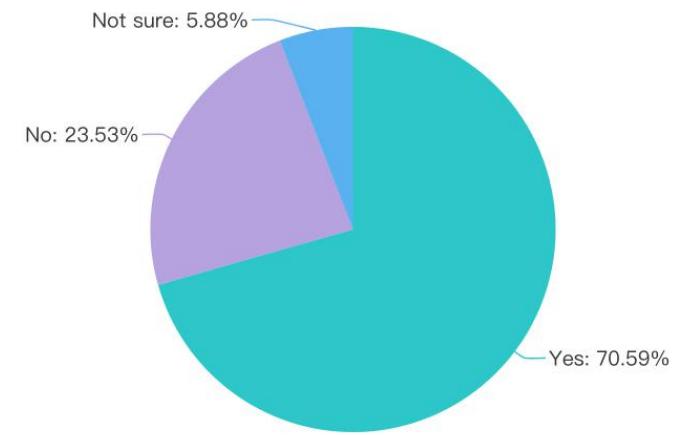
**We had deleted such questions for both not very relevant and data privacy consideration*



2-2-3 Questionnaire : Result

- We recognized that questionnaire was really **necessary** after the collecting results.
- For example, the first technology product we came out from our mind was a emotion recognition system by monitoring elderly's daily life via AI camera and feedback abnormal status in time.
- However, a high percentages of respondents showed that they didn't want to be monitored. This feedback let us rethink the **privacy protection** and **people's initiative** of HCI.

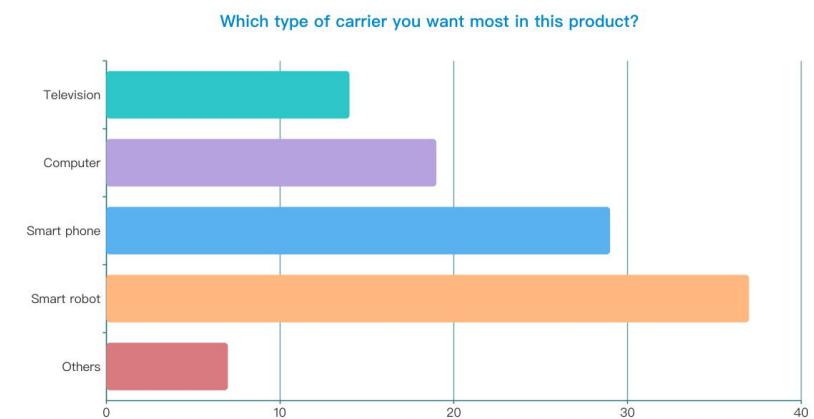
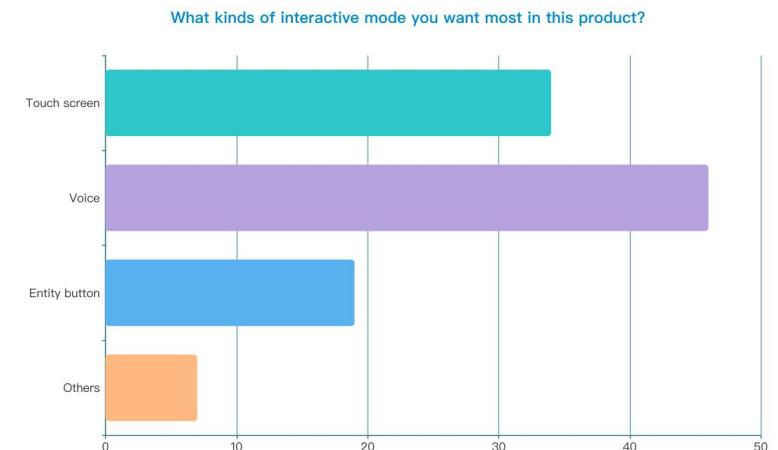
If this product that can monitor your personal status in real time, can you accept it?





2-2-3 Questionnaire : Result

- The results of questionnaire showed that the **vast majority** of elderly people paid attention to their health care. Among them, in a questions of checkboxes with preference showed that some of the elderly couldn't manage well with their health, and **some of them** were unable to understand their problems in time when they were uncomfortable.
- Likert Scales showed that the average of acceptability with healthcare technology product was between accept and very accept.
- It could be seen that relatively few elderly people were willing to use computers, TVs and even mobile Apps. **Robots** had a relatively high percentage. Similarly, with regard to the way of interaction, the elderly prefered **voice interaction** rather than manual operation.
- To our surprise, although the questionnaire was divided into different regional versions, the results were quite **similar**.





2-2-4 Questionnaire : Evaluation

- We were very happy that the elderly were generally **willing to accept** the technology product which could manage and improve health. And most of the questions in questionnaire had played their due value. We confirmed it by collecting and analyzing more than one hundred pieces of data.
- Regrettably, we found that most of the respondent only had one or two sentences in the part of short question, or even left it blank. It was **difficult** for us to collect effective suggestions on this question. However, according to our planning of Data Gathering process, we decided to put this part in **Interview session**.
- After the part of questionnaire had done, we started the design of Interview Question based on the result of questionnaire.





2-3-1 Persona : Establishment

- Some of us studies remotely who were outside of UK and some were in-campus. Luckily, these gave us **condition** to interview elderly people in different regions.
- Based on the results of questionnaire and interview, we captured the understanding of target user. Before processing our design, it was necessary for us to create **personas**. We aimed to segment the users to determine **different features** in our product.
- We had made 5 different personas hierarchy including 3 primary personas, 1 secondary personas and 1 exclusionary persona. We only showed primary persona for the limitation of page and clear display. The portrait was generated using **AI**, also **virtual** in naming.





2-3-2 Primary Persona 1 : Ron Hagrid



"I don't want there isn't any change of my life."

Name: Ron Hagrid

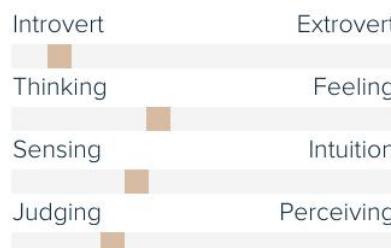
Age: 70

Family: Divorced, no child

Location: Oxford, UK

Character: Low self-esteem

Personality



Goals

- Be healthy
- Have regular schedule and diet
- Need company

Frustrations

- Anxious of overweight and high blood pressure
- Poor memory and willpower
- Seldom be took care by others

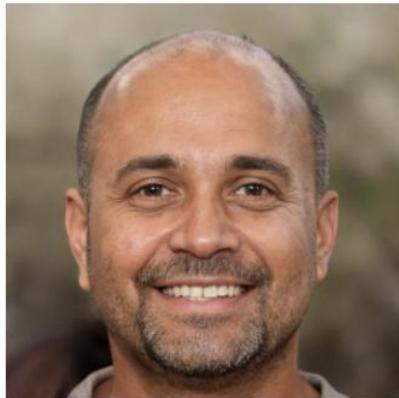
Bio

Hagrid is an elderly man who is at home alone. He is overweight and has high blood pressure. Also, he is lacking company because divorced and has no children.

Although he takes his health seriously, he often forgets to take medicine and measure physical signs such as his weight and blood pressure, due to poor memory and willpower. Also, he has trouble controlling regular schedule and diet. He was discouraged because he thinks it is difficult for him to change himself, and afraid that don't know what will happen if keep his current status.



2-3-3 Primary Persona 2 : Bob Colemen



"Being sick is really a troublesome thing!"

Name: Bob Colemen

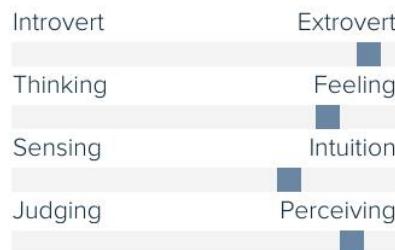
Age: 66

Family: Live with family

Location: London, UK

Character: Casual

Personality



Goals

- Be healthy
- Can accurately and quickly know the cause when discomfort
- See doctor without going to hospital

Frustrations

- Worry of heart disease
- Others' advice may not always be reliable
- Afraid of trouble

Bio

Bob Maintains a traditional attitude towards medical treatment. He thinks only the one with a serious disease needs to go to the hospital. However, when he feels uncomfortable, he wants to quickly get the correct reason and solution rather than always ask family or friends.

He also suffers from heart disease. Although the doctor had given the prescription and advice, the doctor recommends regular review. Because his home is too far from the hospital and his laziness, Bob is usually unwilling to return to the hospital for review as the frequency doctor recommends.



2-3-4 Primary Persona 3 : Hua Zhang



"I can no longer understand the novel technology of this era."

Name: Hua Zhang

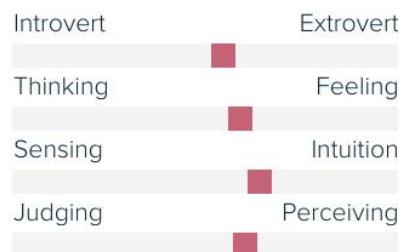
Age: 75

Family: Live with family

Location: Shanghai, China

Character: Stubborn

Personality



Goals

- Hope to use electronic products through talking
- Want someone can take care of her at any time

Frustrations

- Don't know how to use mobile phones and other electronic products
- Children always go out to work and rarely have time to take care of her

Bio

Hua is an elderly person who can't understand the new technology product, and doesn't even know how to use most of the apps on her iPhone. Although she loves watching TV, she doesn't understand most of the remote control's functions except for the program and volume buttons. She likes Siri because she prefers to talk rather than control by hand.

Though she lives with her children, they go out for work for most of the day. She needs to take care of her grandson and husband, but she also really wants someone to take care of her.



2-3-5 Persona : Evaluation

- We were happy that personas were created with **value**, but we thought the **process** was more important than the results. Because we deepened the understanding of user requirements and realized that our ideas of product should be considered more based on **reality** rather than just in mind.
- We were satisfied that **most** of the elderly agreed with our idea that designed a health management and improvement technology product. And we knew the difference of concepts between us during the process: **easy** rather than complex, **talk directly** rather than explore by hand and a way of accompany.
- Although some were exclusionary persona that not our targeted users, such as healthy enough or fully controlled of their lives, we would try to provide health support any time they needed.
- Finally, we were really appreciate with all respondents and interviewees with kindly attendance.



2-4-1 Scenario : Establishment

- After establishing personas, we were more clear about the concept of our product. Before going the next step of definition, we decided to build scenarios to give the **concise description** of our product and what it expected to used for.
- Also, scenario effectively show how users might act in several specific environments that could help us design better solutions (Nicólas, Carlos & Aurisicchio, 2011).
- We will give two scenario including **health profile** and **health inquiry** features we assumed in product that most of the respondents needed in our results of data gathering.



2-4-2 Scenario : Health Profile

- Ron is an overweight old man with high risk of hypertension. He tried to improve his health but failed because of **aimless** and **lack of willpower**. He started to use 'Happiness' robot and hoped to find some changes.
- Ron is woken up by the Happiness. He wants to sleep more time but he is reminded by Happiness that a good start of losing weight should be based on **regular sleep time**. He then wake up and use sphygmomanometer and a weight scale. He was told to do so by his doctor but he doesn't know the reason for doing this.
- Ron is surprised that Happiness tell him the data and some kind suggestions **as soon as** he finish testing. He is moved that someone can help him and he start **trying to change his life** from improve his health.



2-4-3 Scenario : Health Inquiry

- A old man drinks a whole bottle of wine, this is what happen to his body.
- Bob is a 66-year-old man lives with his wife. One day, Bob watches a game of a team he likes very much. It is a so exciting competition that he has been drinking without awareness. After the match, he return calmly and feel something wrong. His head is very dizzy and can't even walk straight.
- His wife asks him to sleep because she thinks he just drank a little bit as usual. However, he feels so giddy that couldn't sleep. The closest hospital is 20 miles from their home, and they don't have car.
- His wife then ask Happiness for suggestion. After **analysis**, the acute reaction caused by alcohol is not a daily discomfort and their profile shows far from hospital, so Happiness called **online doctor**.
- The doctor looks at the screen and request him to follow the instruction: vomiting, drinks lots of water and have furosemide. Bob feels much more comfortable after doing these. To be safe, the doctor tells JD that call Happiness for **emergency help** if situation worsens.



2-5 Storyboard

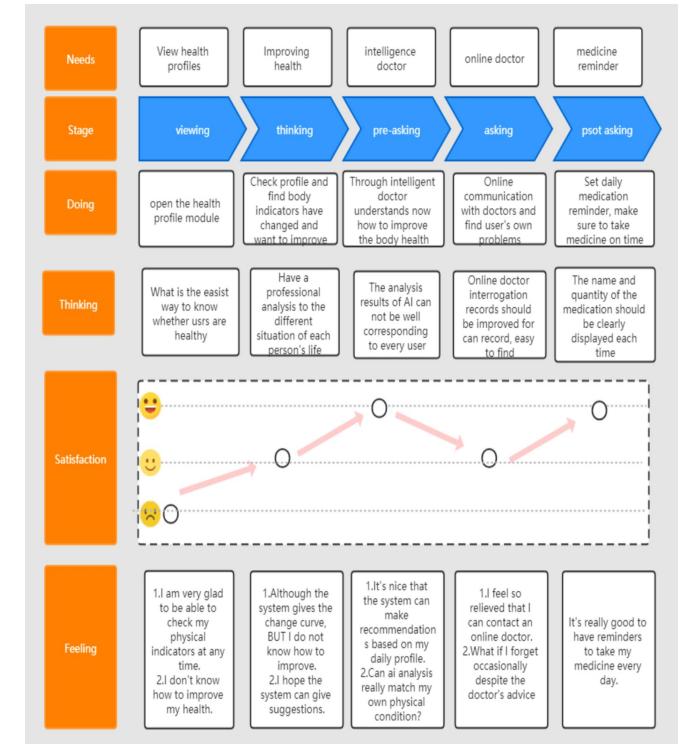
- We also drew a sample **Storyboard** as below to show the intuitive scenario how Happiness works we assumed:





2-6 Empathize : Evaluation

- The process of Empathizing were not only conclusions that were drawn after all methods established, but also deepened our understanding **step by step** throughout the whole process.
- If questionnaires and interviews helped us determine the **real requirement** of the elderly users, then the persona and scenarios provided the user group's **behavioral tendencies** and clarified **the scope of features**.
- We also tried to draw **User Experience Map** to help further establish requirements. However, our assumed product features were instant and flexible rather than a full phased process, so it was difficult to use a complete map to present it.
- We will describe the **clear definition** of the product next page, to make the final preparation for the design.



*The draft of User Experience Map we tried



3-1 Define : Defining the Problem

- ❖ We defined the problem as the following that needed to be solved in the process of brainstorm and sketch:
 1. Elderly needs a **simple** and **convenient** way of HCI
 2. Many elderly people need someone to help **manage** their health information
 3. Elderly need someone to provide them with **health advice**. These are not general, but **customize for individuals**
 4. Elderly need an expert to help them **answer their health problems** at any time
 5. The old people prefer the machine to **keep turning on**, rather than always switching it on and off manually
 6. Some elderly people want the product to appear in human form, such as **robots**



3-2 Define : Product Definition

- Happiness is a smart robot that can help **manage** and **improve** elderly's health.
- There is a convenient and easy-to-use **intelligent voice recognition system** in robot, with a big screen that showed results in robot's head.
- There are mainly two core features:
 1. Manage health data of elderly and give them personal advice by data analyze
 2. Provide health inquiry including AI Doctor, Online Doctor and Emergency Support





3-3-1 Define : Technique 1. IoT

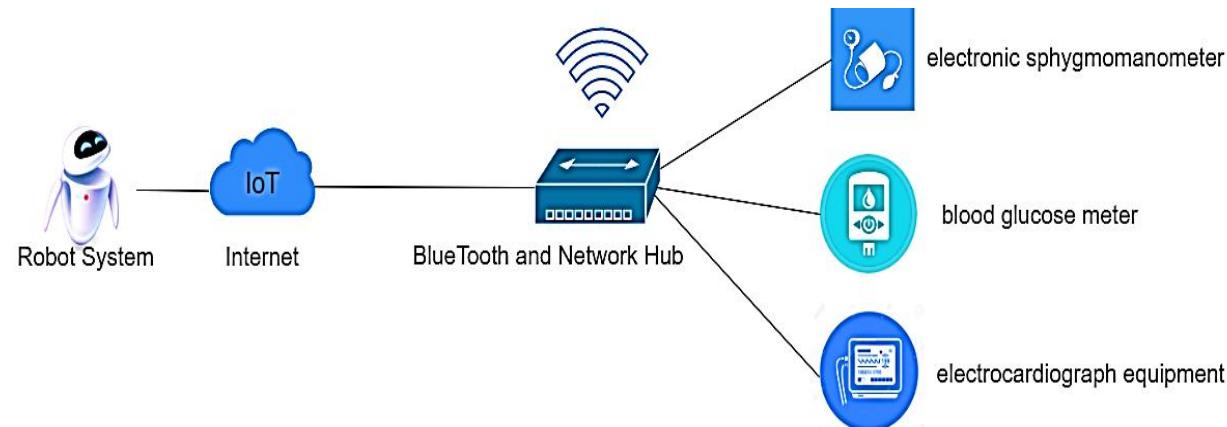
*The definition of technique helped us to form a deeper understanding of the development that the technique has achieved in recent years, including IoT, 'ASR->NLP->TTS' and Full Duplex.

IoT is implemented through some information sensor equipments to collect the required data and connected with the Internet to achieve information exchange and communication.



Wireless communication technology : Bluetooth

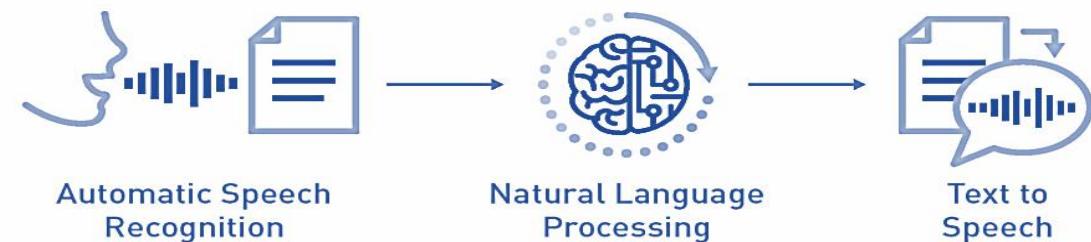
In this case, we realized data transmission between devices through Bluetooth technology. As we can see the right diagram, we equipped 3 medical devices (electronic sphygmomanometer, blood glucose meter, electrocardiograph) and robot terminal system with **Bluetooth transceiver module** respectively, then a huge **network cloud** is formed by connecting these devices to the internet, which allows the measured physical signs can be transmitted as data to robot's system.





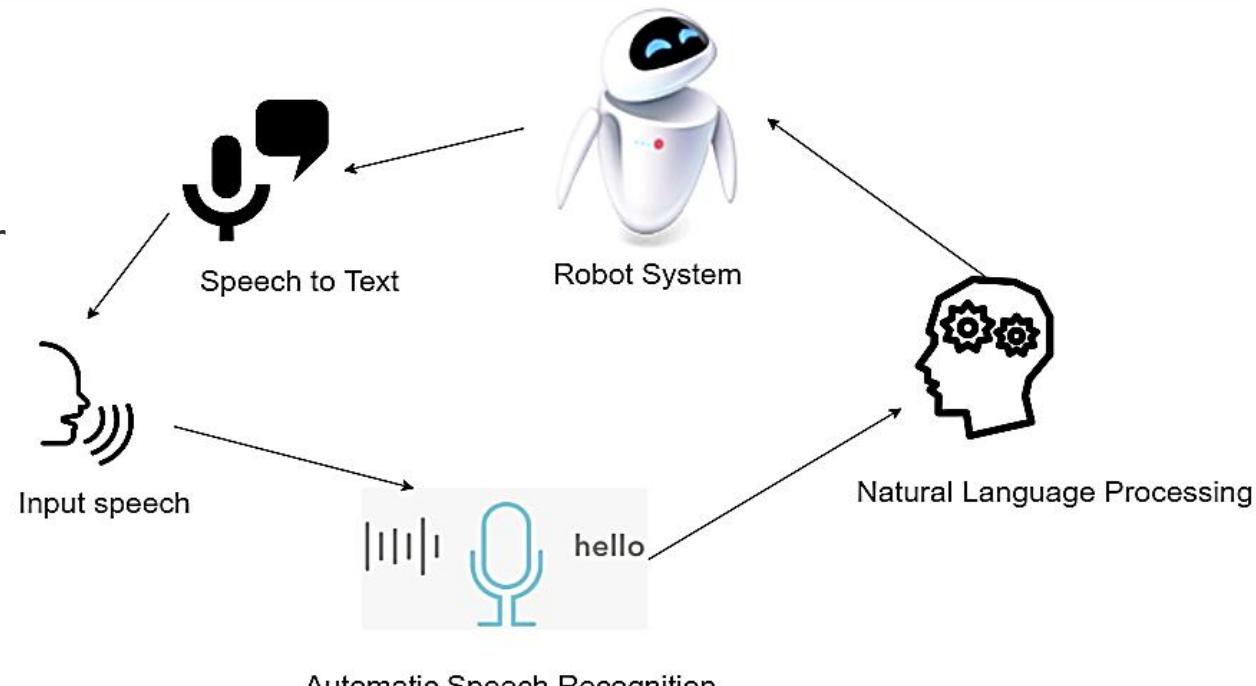
3-3-2 Define : Technique 2. ASR -> NLP -> TTS

A conversational AI application uses three subsystems to do the steps of processing/transcribing the audio, understanding human language, converting to speech and speaking the response back to the human.



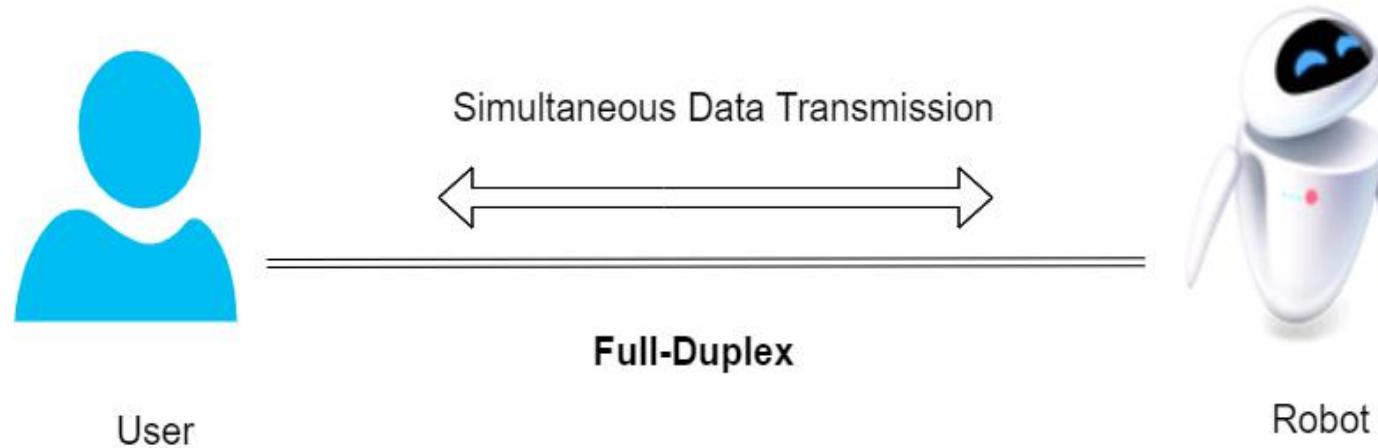
As we can see the right diagram describes the process of conversation between human and our robot and it is divided into 3 steps:

1. **Automatic speech recognition (ASR)** is used for our robot to receive and process the raw audio signal from users, then it transcribes text.
1. **Natural Language Processing (NLP)** used to convert to language that robot understands from ASR output text.
1. **Text to Speech (TTS)** used to generate human speech from text, robot gives response to human.





3-3-3 Define : Technique 3. Full Duplex



Full duplex is a communication term that means data can be transmitted simultaneously in both directions during a call.

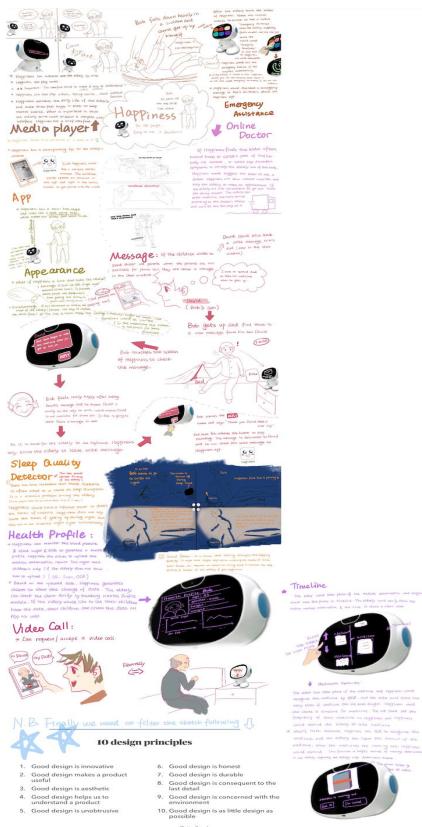
The communication between our robot and users is based on full duplex and there are 2 features:

1. Continuous dialogue: after the user wakes up the robot, users can **continuously issue commands** to our robot within a period of time without re-awakening each time.
2. Listen and talk and interrupt at any time: Our robot is able to listen to the user's instructions while it is speaking to users. If users are not interested in the topic of the robot's conversation, users can **interrupt at any time** in order to end this conversation, which will increase interaction efficiency between them.



4-1 Ideate : Brainstorm

After definition, we started brainstorm and had **3 editions** of sketch. In the beginning, we covered both mental and physical health. After discussion and analysis of **10 design principles**, we think that the functions of the first editions are **too scattered**, so we narrowed down the scope and gradually focus on health in the second and third editions (full HD picture is in [Appendix 2](#))



Edition 1

Edition 2

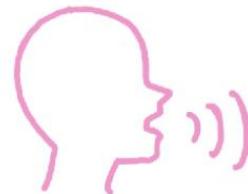
Edition 3 (final)



4-2-1 Ideate : Sketches - Overview

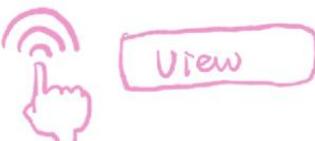
Therefore, in order to make it easier for the elder to use, there are 3 ways to interact with Happiness. They are listed according based on frequency.

①



Intelligent Speech Interaction

②



Touch Button

③



Scroll to view more

Our sketch is based on happiness and an 83 year old man named Bob who lives alone.

The main functions of Happiness are:

- **Health Profile**
- **Health Inquiry**

Considering that the interactive designed for the elderly should be as simple as possible, we mainly have three ways of interaction:

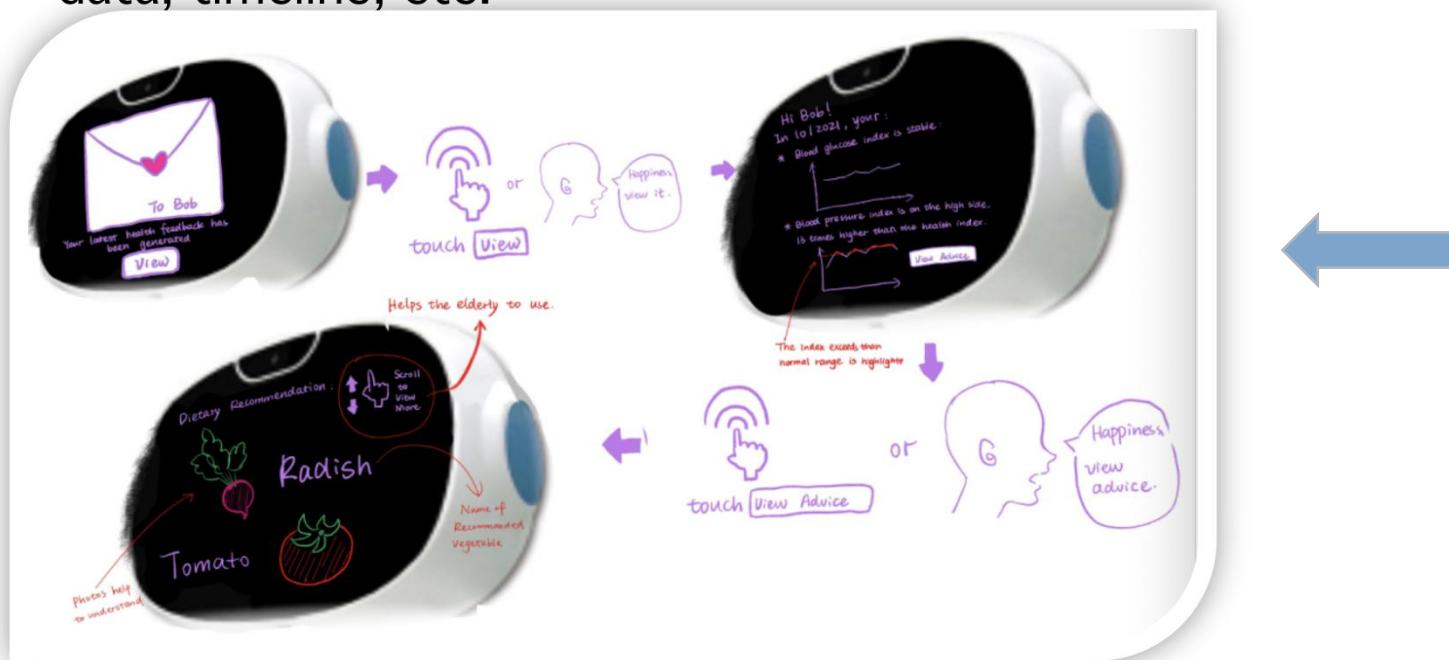
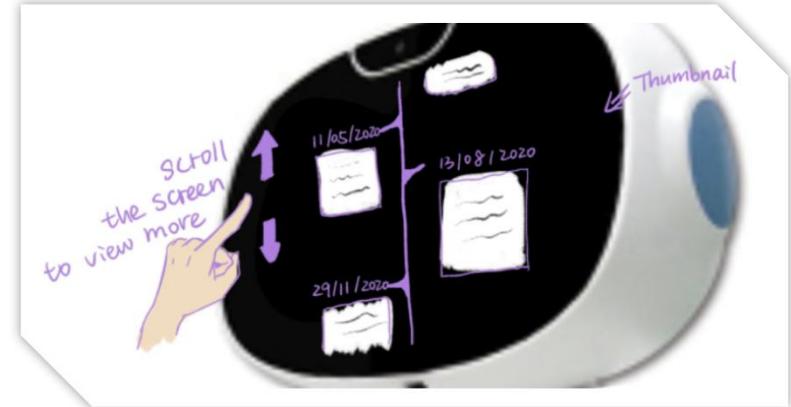
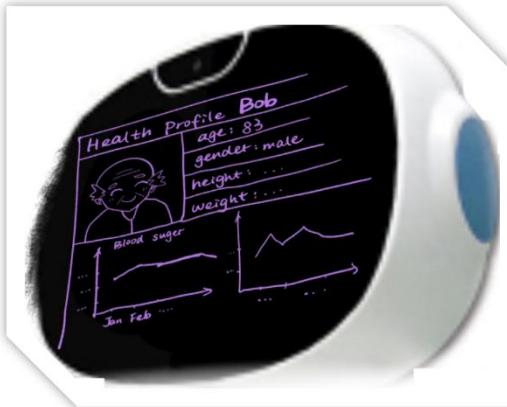
- **Intelligent Speech Interaction**
- **Touch Button**
- **Scroll**





4-2-3 Ideate : Sketches - Health Profile 1

- After importing the data (e.g. blood pressure), Happiness generates **health profile** including basic personal information, line charts showing the change of data, timeline, etc.



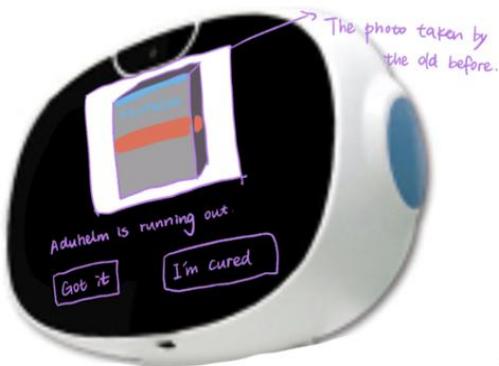
- Based on the data in health profile, Happiness would give **feedback** regularly.
- For example, if the blood pressure of a old man always exceeds the range of a normal person, Happiness would **give advice** such as dietary recommendations.



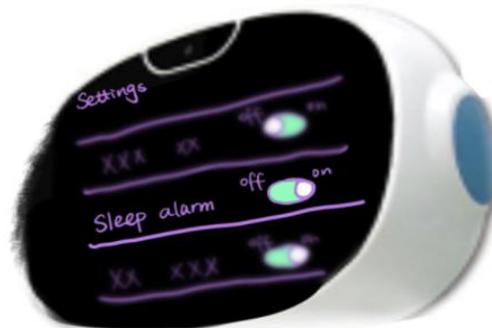
4-2-4 Ideate : Sketches - Health Profile 2

Happiness has many reminders considering many older people are absent-minded

medication Reminder



Alarm for Sleeping



Water Reminder

The elder can choose whether to enable drinking-water reminder.



- Happiness will remind the elder to **take medicine** on time.
- Happiness **records the remaining medicine** and it will remind the elderly to purchase when the medicine is going to run out.

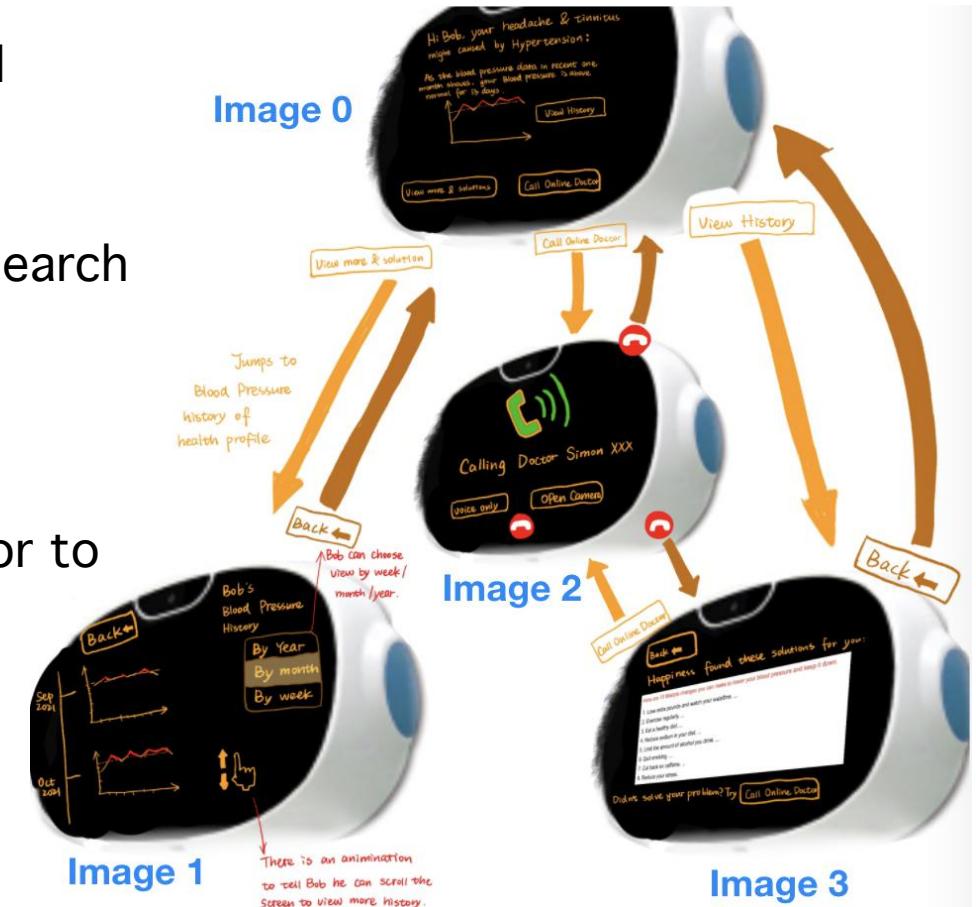
- The elderly can set their **preferred sleep time** in settings.
- When it is time to wake up, the alarm will ring and the elderly can choose whether to "Remind later" or "Stop"

- The elderly can set their **preferred reminding interval**.
- Happiness will ring with a sound of river.



4-2-5 Ideate : Sketches - Health Inquiry 1

- When the old man (Bob) feel not well, he can just tell Happiness his symptoms.
- Happiness will **analyze** Bob's recent health data and search online, and then give **feedback** including the possible causes and solutions.
- Bob can also have a **online video call** with a real doctor to consult via Happiness.





4-2-6 Ideate : Sketches - Health Inquiry 2

- If Bob wants to have further consultation with the previous doctor, Happiness will show the **call log with details** (e.g. date of the last call, doctor's name, symptom, etc.) and then Bob can call the doctor.



- When Bob has an **accident** (e.g. falling down), Happiness can call the hospital for help. If Bob is not convenient to talk, Happiness will give hospital the preset address of Bob's home and tell them that there is an old man who needs **emergency assistance**.



4-3 Ideate : Evaluation

- Ideation let us clearly know the **detailed features** what we should include in our product after definition.
- The process of brainstorm help us collect many of ideas related to wellness technology product. Though some were not very related to the topic and there were too many in total, the process of **narrowing down** the idea help us find what was appropriate and what was not.
- Therefore, we had **accurate** and **clear** features in sketches by ideation, and were ready for the following step of prototyping.

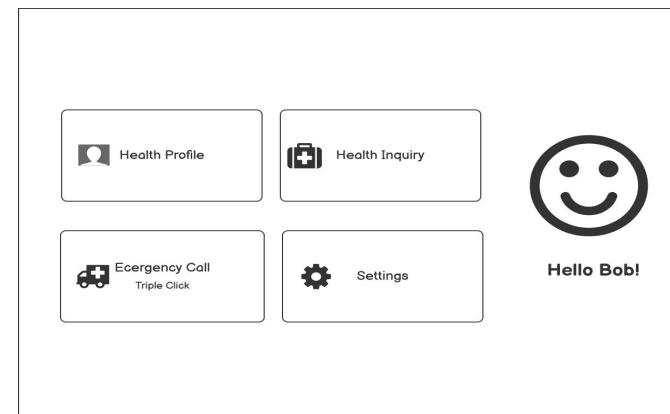


5-1 Low-fidelity Prototype : Design

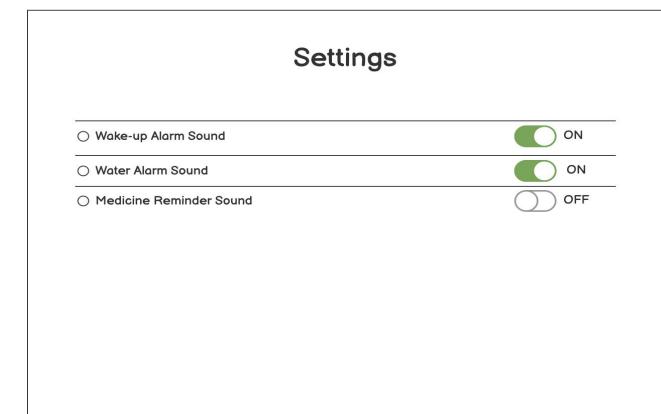
1. The lock screen will be displayed when our robot enters the standby state. If the screen is locked, touch anywhere will bring up the lock screen and enter the home page.
1. The home page contains **four functional modules**:
 - Health profile module: generate users' health profiles by recording **measured physical signs** of users as data and giving **feedback** within a specific number of days through data analysis, users can also set medication alarm, sleep alarm and water alarm in their health profiles.
 - Health inquiry module: provide two etiology consultation channels for users, **intelligent doctor** and **online doctor**. Intelligent doctor will give the possible causes and solutions to users according to the etiology described by users and the users' previous health profiles. Online doctor allows users to browse a list of doctors they have consulted or find a new one, and make voice or video calls with doctors to consult on health issues.
 - Emergency call: Users can triple click (to avoid mistouch) the button to send help to the hospital.
 - Settings: Whether to enable or disable the sound of alarm.



Lock Screen



Home Page Screen

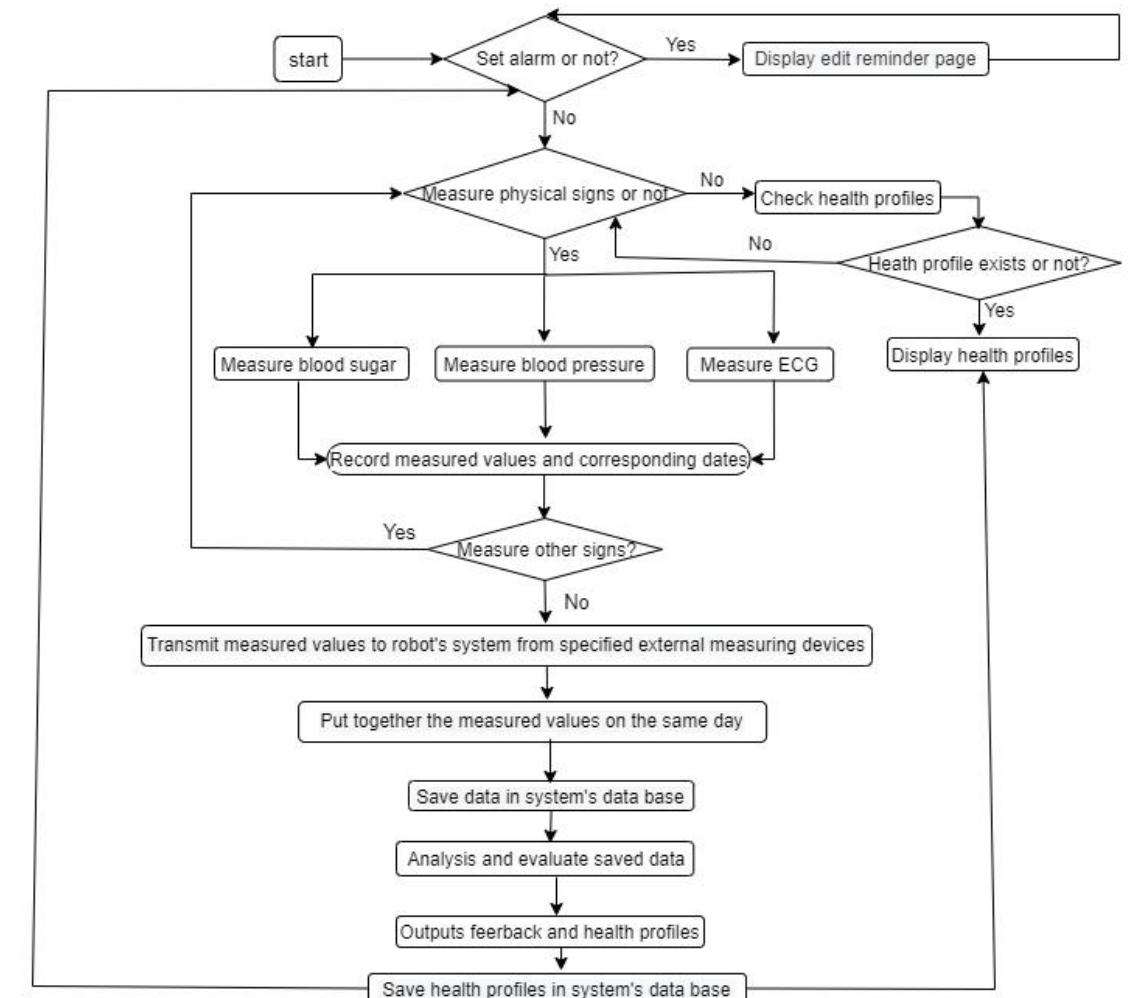
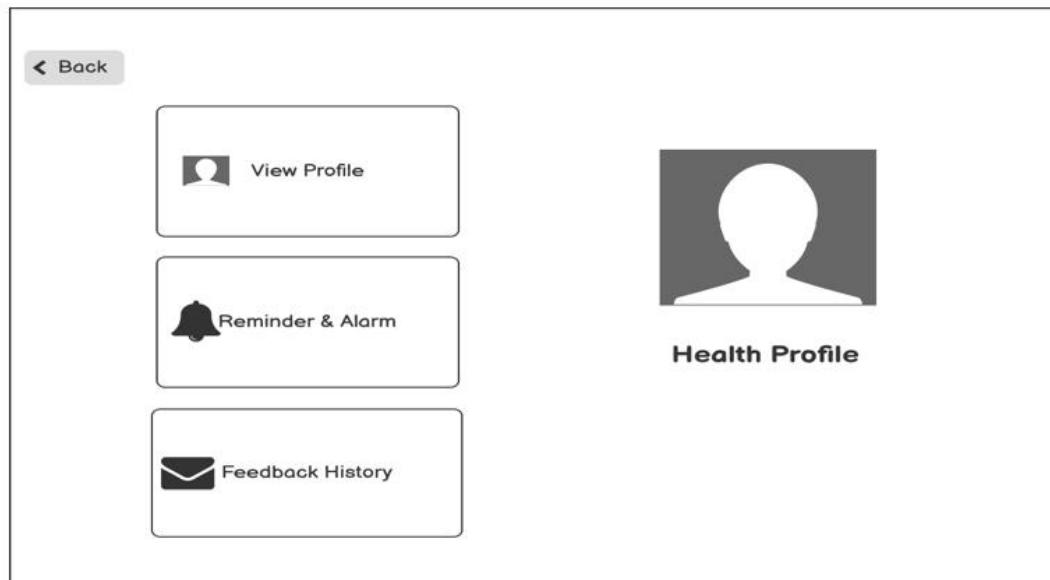


Setting



5-2-1 Low-fidelity Prototype : Health Profile - Overview

- Health Profile
- 1. View health profile
 - 2. Check health feedback
 - 3. Healthy Reminder

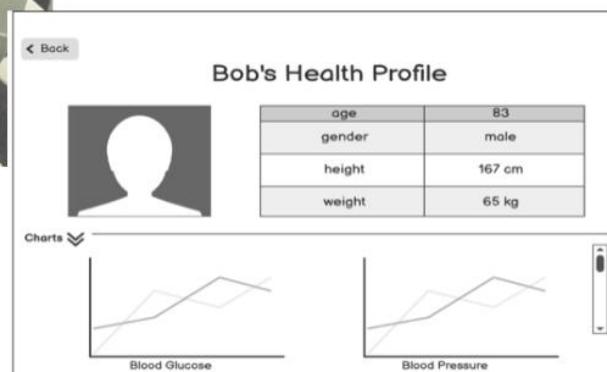




5-2-2 Low-fidelity Prototype : Health Profile - 1. Profile, 2. History & Feedback

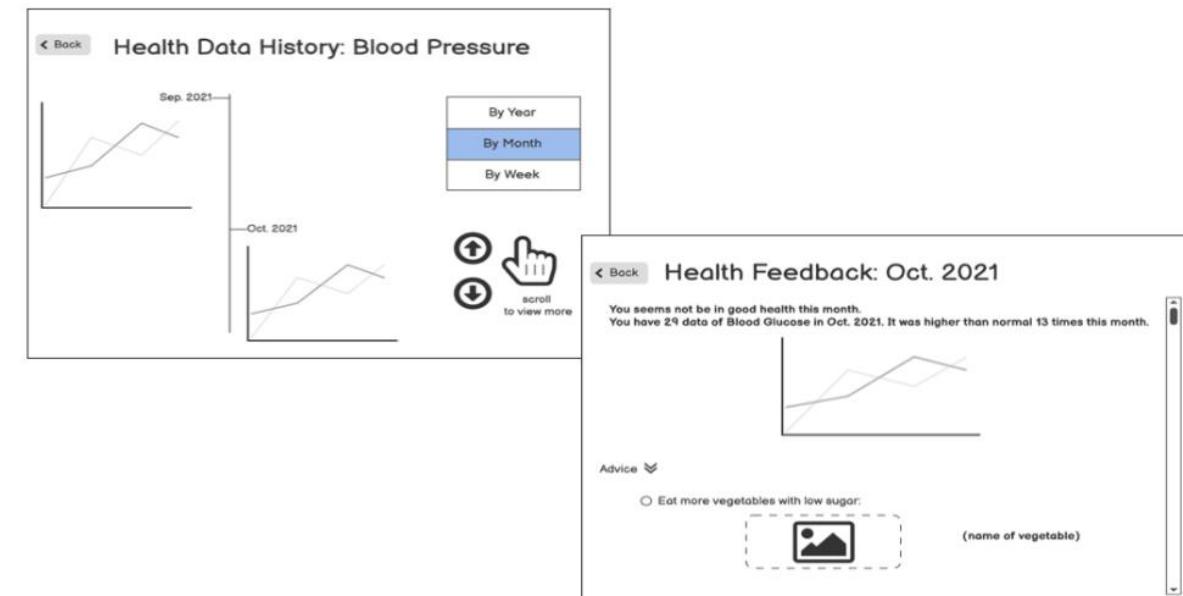
Health Profile

- Health Profile page shows basic **physical indicators** and **line charts** of measured data.
- The elderly measure physical signs like blood pressure using **IoT medical devices** equipped with bluetooth and the data will be imported to Happiness automatically. Happiness uses the data to generate line charts in health profile.



History & Feedback

- History page shows the timeline with the line charts generated based on recorded data of **physical signs** over a period of time.
- Happiness **analyzes** the data and give health **feedback**. The feedback page includes a line chart and relevant health advice.





5-2-3 Low-fidelity Prototype : Health Profile - 3. Health Reminder

Health Reminder

- The elderly can set **medication reminder, wake-up alarm, etc.** in “Reminder & Alarm” page or by voice interaction. For example, the elderly speak to robot “Happiness, set a wake-up alarm for seven o’clock tomorrow morning”. When the alarm rings, the elder can choose whether to remind later or just stop the ringing.



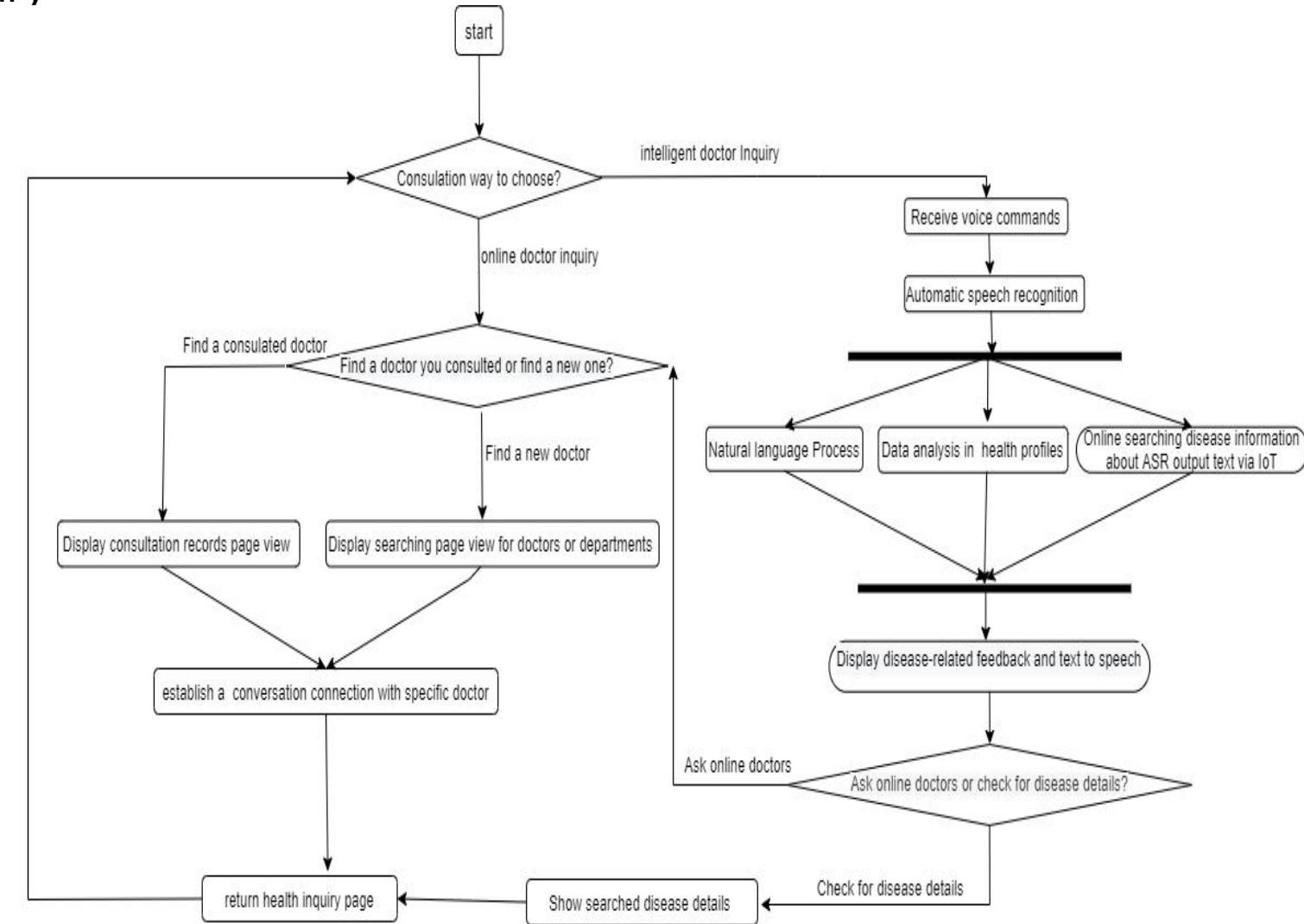
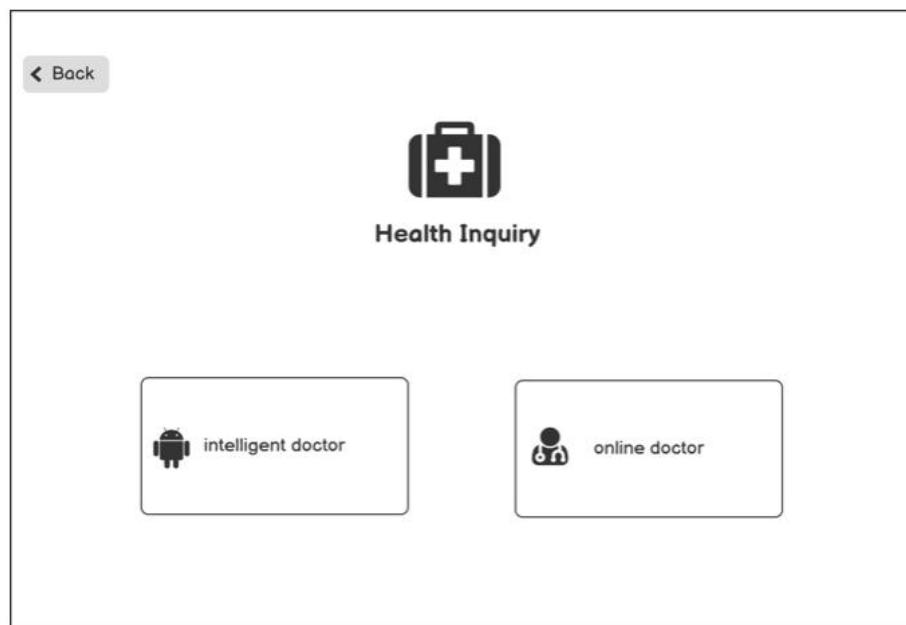


5-2-4 Low-fidelity Prototype : Health Inquiry - Overview

Health Inquiry

1. Intelligent doctor inquiry

2. Online doctor inquiry





5-2-5 Low-fidelity Prototype : Health Inquiry - Intelligent & Online Doctor

Intelligent Doctor Inquiry

- Intelligent doctor inquiry allows users tell Happiness the symptom, and Happiness will analyze the health data with big data, and then give the **possible causes and solutions**.
- Users can learn more searched results or find online doctors by clicking the “view more solutions” button or “Call online doctor” button.

The screen shows a back button and the title "intelligent doctor". Below it is a "Results and Feedback" section with the message "Hi Bob, your headache might caused by hypertension". It includes a line graph showing blood pressure statistics and the text "According to your blood pressure statistics diagram for one month, your blood pressure is above normal for 13 days!". At the bottom are two buttons: "view more solutions" and "Call online doctor".

Online Doctor Inquiry

- In online consultation records, there is a list which includes doctors that the user consulted before and it recorded detailed list with doctor's names, their departments and the last time they connected, which is convenient for users to recontact with **the specific doctors**.
- Users can also find new doctors by searching the names of the disease or hospitals, symptom, departments, names of doctors in search box.

The screen shows a back button and the title "Online doctor". Below it is a section titled "Online Consultation records" containing three items, each with a doctor's profile picture, name, department, last call date, and a "call" button. A vertical scroll bar is on the right side.

The screen shows a back button and the title "Online doctor". Below it is a section titled "Looking for a doctor" with a search bar labeled "search for the name of disease,department,symptom,hospital". Below the search bar is a grid of eight "Depaeture" buttons arranged in two rows of four. A vertical scroll bar is on the right side.



5-3-1 Low-fidelity Prototype : Evaluation - Usability Evaluation Model

Defined **specific** conditions:

1. Users: old People who have the needs for health management and improvement.
2. Tasks: Improve health by visualizing health status and giving health feedback.
3. Environment: robot will work with Internet, bluetooth and power supply.

We use **Usability Evaluation Model** to evaluate and improve low-fidelity Prototype, this model looks into four aspects of usability with provision of respective measurement, **Effectiveness , Efficiency, Satisfaction and User value**.

Effectiveness: measured by task completeness, results are divided by fully completed, partly completed and fail.

Success rate of the task = $(\text{Users number of Fully completed} + \text{Users number of partially completed users} * 0.5) / \text{Total number of users}$

Efficiency: Average time to complete a task for users divided by skilled completion time.

Satisfaction: subjective evaluation points of users from 1 to 7 points, measured by Likert scale.

User value: the user's perceived value of the function from 1 to 7 points, measured by Likert scale.

Usability level is computed after **effectiveness, efficiency,User value and satisfaction** were standardized and scored according to the weight of 5:3:2

$$\text{Usability level} = \text{Effectiveness} * 0.5 - \text{efficiency} * 0.3 + \text{satisfaction} * 0.2$$



5-3-2 Low-fidelity Prototype : Evaluation - Usability Testing

As shown in the figure, we designed four tasks for 5 old people as users to evaluate usability of our low-fidelity prototype. In this process we recorded the average time and completion of each task for 5 elderly people. During the observation process, almost all five elderly people had high **completeness and efficiency** in measuring physical signs and consulting with online doctors, with usability level of 1.19 and 1.21. They successfully implemented an interactive process that included measuring their own physical signs, consulting with doctors online by browsing the records of doctors they had consulted and looking for new doctors by typing the names of departments.

However, in the 2nd Check Health Profile task, 3 elderly people did not browse their health profiles history as required so **we plan to add a button to view their health profiles history on the screen of health profiles to make it easier for the elderly to find the past health profiles and check feedback.**

In the intelligent doctor task, most of the elderly did not complete the voice interaction with the robot, we found that they didn't know when to start giving voice commands to the robot, So **we plan to add an interactive page that shows when the robot will receive voice commands from the users.**

Order	Task Description	Effectiveness			Efficiency			Satisfaction (1-7 points)	Uservalue (1-7 points)	Usability level computation	Usability level
		User Number of Fully completed	User Number of Partly completed	User Number of failed	Skilled completion time	Time limit	Average Completion Time				
1	Measure physical signs	5	0	0	1 min 10 sec	4 min	2 min	6	6	$1*0.5-(2*60/70)*0.3+6*0.2$	1.19
2	check health profile	2	3	0	2 min 15 sec	8 min	6 min	3	4	$0.7*0.5-(6*60/135)*0.3+3*0.2$	0.15
3	Consult with Intelligent doctor	1	1	3	2 min 56 sec	7 min	9 min	1	4	$0.3*0.5-(9*60/176)*0.3+1*0.2$	-0.57
4	Consult with online doctor	4	1	0	1 min 21 sec	7 min	2 min	6	7	$0.9*0.5-(2*60/81)*0.3+6*0.2$	1.21



5-3-2 Low-fidelity Prototype : Evaluation - Think Aloud

- In order to help us understand more of users' idea, we used **Think Aloud** as another usability testing to help evaluate our prototype. Based on the principle of **flexible and convincing** way, we allocated the role, design the tasks and related tips by following the Think Aloud Protocol.
- At first we used specific instruction tasks for participants. However, we thought that we shouldn't play the role of rulers but the recorder and observer. Therefore, after discussion, we finally used **scenario** as the format of task in order to find out more of users' **cognition and behavior** by practice in reality.
- After the testing, we collect the results. And it was really important for us to transfer testing records to **design inspiration**.

Think Aloud Feedback	
Measure physical signs	Very good idea. Very convenient and useful
Check health profile	Very good idea. Data has its meaning when receiving feedback of suggestions; Want to have more types of feedback such as by week/month; Concern about data privacy
Process of Voice Interaction	Good idea. Not sure whether robot can receive their feedback, are it listen?
Experience of User Interface	Too simple. Lack of colorful; Lack of other functions such as Wi-Fi and volume setting



Design Inspiration	
Measure physical signs	-
Interface of health profile	Health data should be designed more intuitive; More types of feedback display; risk of data privacy protection
Voice Interaction Interface	Design of Voice Interaction Interface
User Interface Design	User Interface Design, User Experience and Functions Improvement



5-3-3 Low-fidelity Prototype : Evaluation - Summary

Based on the methods of evaluation we used, we came out of the following solution as the **conclusion** of evaluation and **aims** of High-Fidelity Prototype we needed to focus:

1. **User Interface Design & User Experience:** UI should be designed more **practical and beautiful**. For example, some content does not need to be presented on two different pages. For this reason, ensuring the simplicity of the interface, we should merge the pages reasonably to avoid old people switching pages frequently.
2. **Realness:** There should be icons such as Wi-Fi on the top of the interface to make product completely and show the **state of the robot clearly**.
3. **Functions Improvement:** On the one hand, some functions in settings should **be further improved**. For example, the functions in settings are limited now and lack of some basic settings such as volume. On the other hand, there would be better to have some guidance (like animation) to help the old be familiar to the interface.
4. **Intuitiveness:** Health data should **be more intuitive** to allow the old have an overview of daily data.
5. **Feedback:** There isn't **voice interaction interface**, which means it is hard for an old man to know if Happiness is hearing him or not.
6. Risk and challenge analysis: Considering the potential risks such as **protection of data privacy of elderly**, it was necessary to show the related statement in the process of High-Fidelity Prototype design.



High-Fidelity Prototype

The High-Fidelity Prototype is a mobile application designed to support users in managing their health and well-being. It includes features such as a lock screen, home screen, health profile management, online doctor consultations, emergency calling, voice recording, feedback history, medicine reminders, and more.

- LOCK:** Displays a smiley face and the message "Hello Bob, how's your day?" with a red heart icon. A button at the bottom says "Touch ANYWHERE to Start".
- HOME:** Shows a grid of icons for Health Profile, Health Inquiry, Emergency Call, Settings, and a "Hello Bob! have a nice day!" message.
- Health Profile Home:** Displays a portrait of a man and buttons for "View Profile" and "Reminder & Alerts".
- Online Doctor Home:** Features "Intelligent doctor" and "online doctor" buttons.
- Intelligent Doctor:** Shows a graph titled "Results are Feedback" with the message "According to your Blood Glucose previous statistics the last 10 days your blood glucose levels were normal for 10 days".
- Online Doctor:** Includes a search bar for "Looking for A Doctor" and categories for "Cardiology", "Orthopedics", "Neurology", "Gastroenterology", "Endocrinology", and "Rheumatology".
- Emergency Call:** Shows a location map with a red dot and a red phone icon. A message says "Don't worry! Happiness will tell the hospital your present address".
- Health Profile:** Displays a portrait of a man, today's date, and blood glucose levels. It also shows a graph of blood glucose over time.
- Health Profile Anime:** Shows a portrait of a man, today's date, and blood glucose levels. It includes a "New History & Feedback" button.
- Voice Recording:** Shows a portrait of a man and a microphone icon. A message says "Hi Bob, I am hearing..." followed by a transcription of the message.
- Feedback & History:** Shows a history of blood glucose levels from September 2021 to October 2021, with options to view feedback by year, month, or week.
- View Feedback:** Shows a graph of blood glucose levels for October 2021, with a message about a value exceeding normal range.
- Wake-up Reminder:** Shows a cartoon house and tree icon with buttons for "Remind Later", "Stop", and "Stop All".
- Medicine Reminder:** Shows a message about medicine running out and buttons for "I've been seen" and "Get it".
- Settings:** Shows a "Time for Medicine!" message with a medicine bottle icon, and a "Settings" screen with various account and device management options.
- Settings:** Shows a "Settings" screen with account information, device management, and reminder settings.



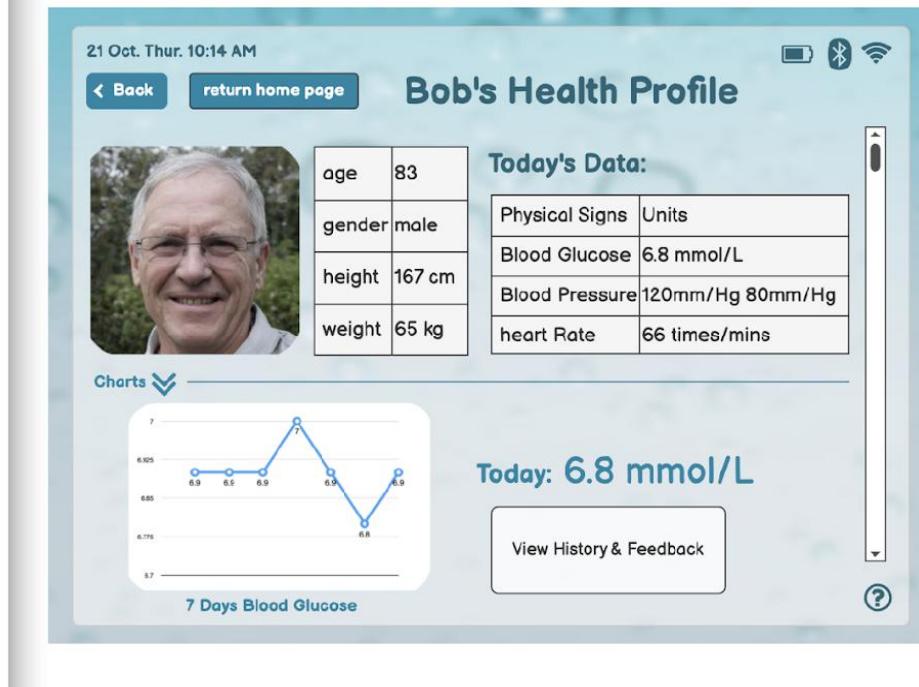
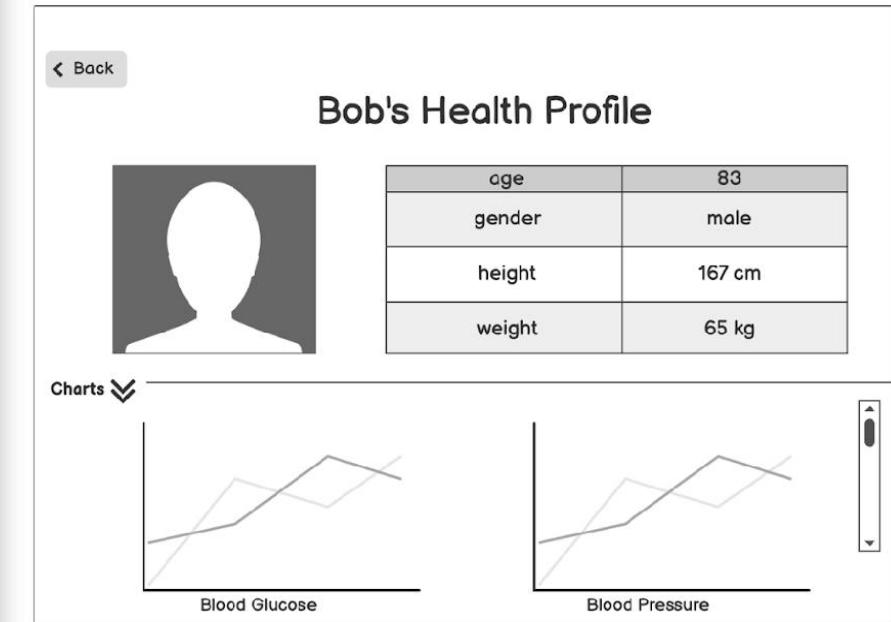
Health Profile

more beautiful and practical now

A table of “Today’s Health Data” was added, which allows the elderly to check the daily health data more intuitively instead of scrolling down and check each chart.

The daily data of measured physical signs and a “View History and Feedback” button were also added. The value besides the chart is convenient for the elderly to compare the data of the day with the previous days. The button will be introduced in the next page.

*It must be stated that the data would only be analyzed by the current device and stored locally. All data would be strictly confidential and couldn't be used for any other purpose.





Data History & Feedback

The button “View History & Feedback” was moved next to the chart of a certain physical sign from the Health Profile Home page.

It allows the elderly to view the history and feedback simply by touching the button beside the chart of a certain physical sign which the elderly want to check, rather than going back to the Health Profile Home page and check the “Feedback History”.

History and Feedback of health data are integrated together now.

It allows the elderly to view the latest and previous health data with brief feedback on the same page instead of switching windows to view them separately. If the elderly want to view the feedback in detail, they can just touch the “View Feedback” button and there will be both feedback and health advice.

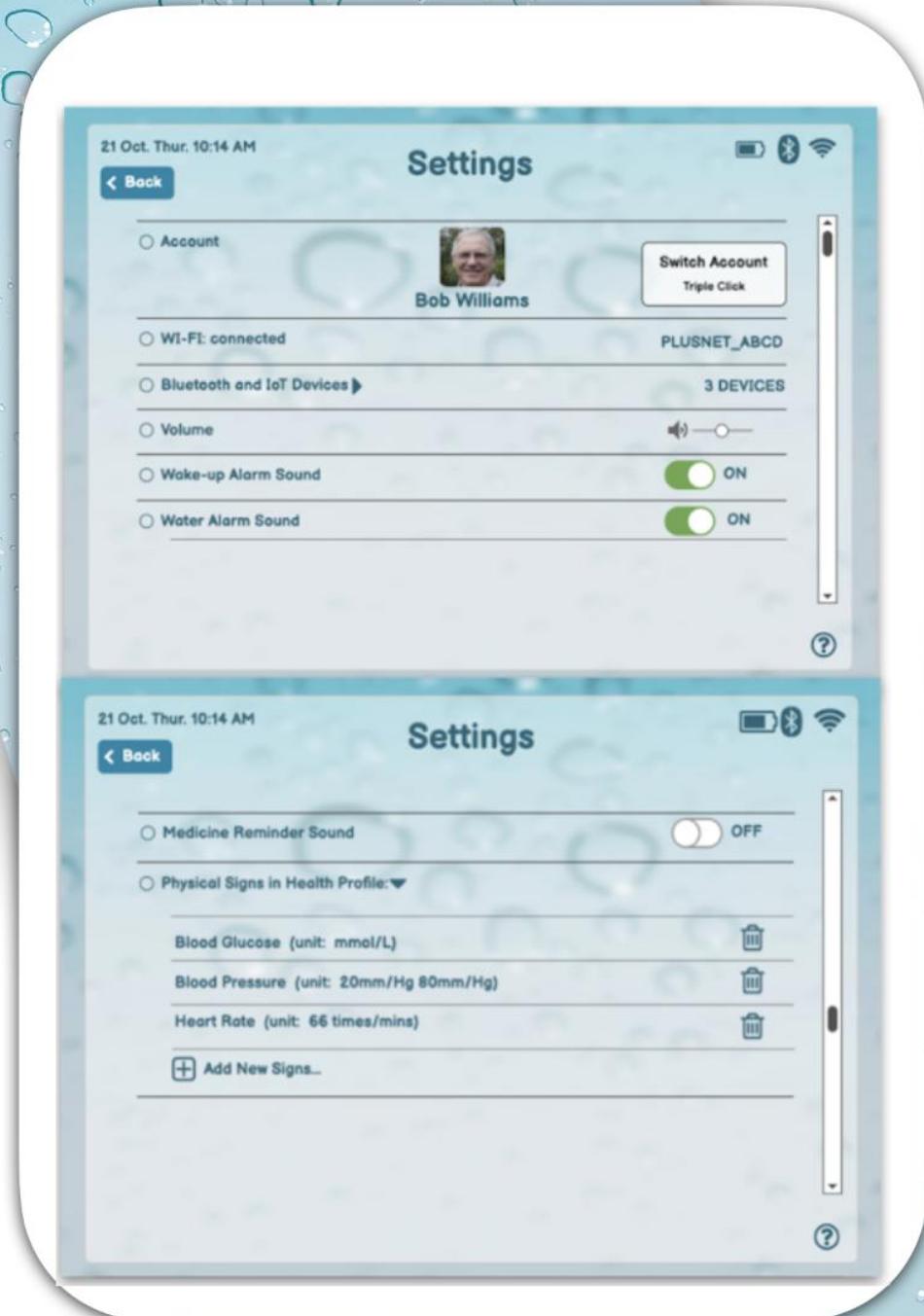
The screenshots illustrate the user interface for Bob's Health Profile, showing how historical data and feedback are integrated.

- Bob's Health Profile:** Shows Bob's basic profile (age 83, male, 167 cm, 65 kg) and two line charts: Blood Glucose and Blood Pressure over time.
- Health Data History: Blood Pressure:** A chart comparing blood pressure in September and October 2021. It includes a dropdown menu for viewing data by Year, Month, or Week, and a scroll control icon.
- Health Feedback: Oct. 2021:** Provides feedback for October 2021, stating "You seem not be in good health this month." It shows a chart of blood glucose levels and a section titled "Advice" with a suggestion to eat more vegetables with low sugar.
- Oct. 2021 Feedback: Blood Glucose:** A detailed feedback page for blood glucose in October 2021, noting that the index exceeded normal range 13 times. It includes a chart and a section titled "Advice" with a suggestion to eat more vegetables with low sugar, specifically mentioning "pumpkin".



SETTINGS

more features are available now



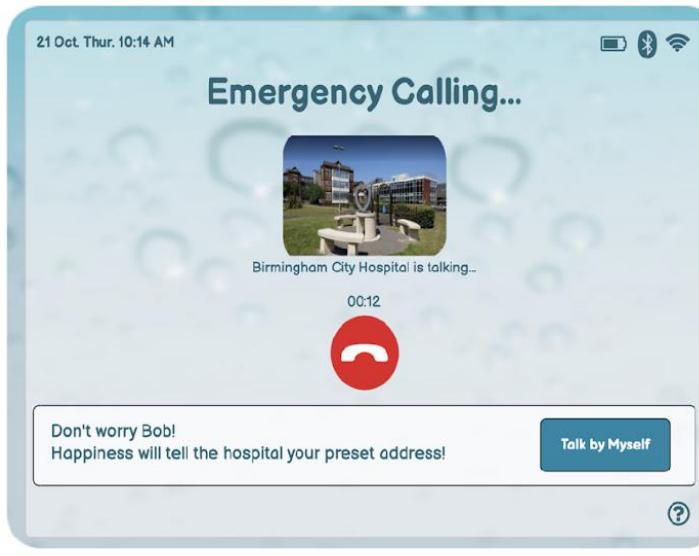
- **Account**
- **Wi-Fi**
- **Volume**
- **Bluetooth and IoT Devices:** allows the elderly to manage the IoT Devices. (Connect/Disconnect the devices with Happiness)
- **Physical Signs In Health Profile:** allows the elderly to customize the physical signs in Health Profile. (e.g. When Bob adds a new sign "Blood Lipids" and imports relevant data, he can check the data and the chart generated based on the data in Health Profile.)



EMERGENCY CALLING

An **Emergency Calling page** was designed.

In our original idea, this page only contained the phone icon and the end call button. Now there is a "**Talk by Myself**" button for the elderly to choose whether talk by themselves or not. If the elderly have difficult in talking in the emergency, Happiness will help to tell the hospital the preset address automatically.



MORE INTERFACE



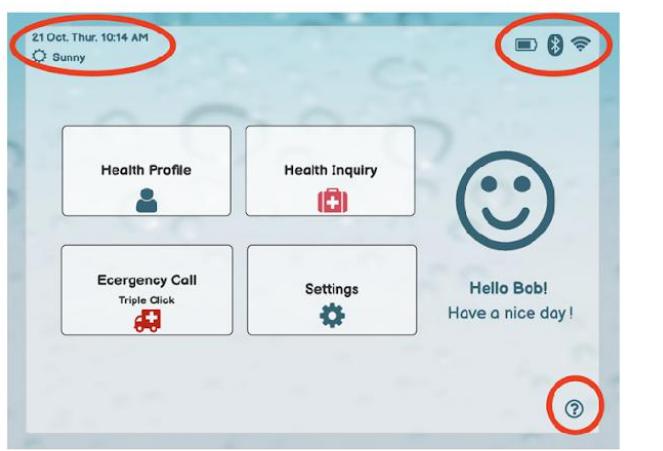
A voice interaction interface was designed.

It appears when the elderly wants to start a conversation by saying "Happiness" and disappears when the record of the voice stops. There is also a text box to show what the elderly said. These give the elderly a feedback and let them know what is going on in time.

**VOICE
INTERACTION
INTERFACE**



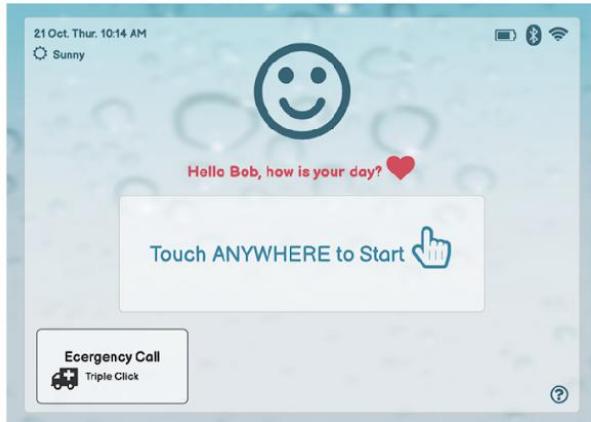
The date, time, weather, help icon, Wi-Fi icons, etc. were added for each page.



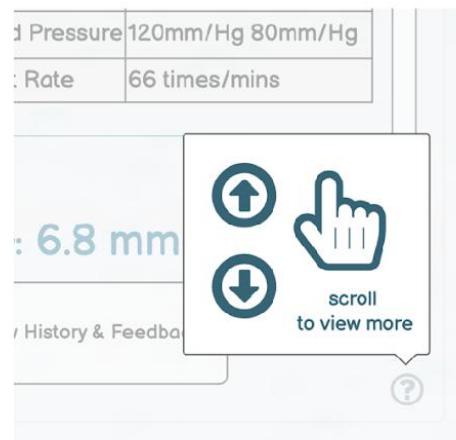
Added a “Return Home Page” button at some pages, which avoids the elderly “get lost” and help them get back to home page quickly.



A Emergency Call button were added to Happiness's Lock Page. This button needs triple clicks to start to avoid being touched by mistake



A help animation was designed to help the elderly understand the interaction. It shows automatically at the very beginning.





6 Conclusion

- To review from our process, we **successfully** designed the High-fidelity Prototype that both fulfill the requirement and easy-to-use. More importantly, we all focused on participating this process by **thinking, recording and evaluation**. These not only deepened our understanding of life cycle of each stages in designing a product, but also improve the our ability of project management and teamwork in future.
- However, it is regrettable that we are still lack of several cases of **risk and challenge analysis** such as the qualification of doctors, the accuracy of intelligent doctor, etc. due to the limits of pages and time.
- Also, if we have opportunities or conditions, we would like to try analyzing the impact of Happiness on **global medical system** and the possibility that it brings the value to **society**.
- Overall, this was a wonderful journey for us. We would like to deepen the evaluation and even develop the prototype demo in future, as we all see Happiness as our true friends.



*Appendix

**This is an additional page for providing all related full-version documents during our process of designing. We would be very happy if you could look at them at your convenience.*

- All **Appendices** are in the same folder named *Appendix_HCI_Group9*:

<https://drive.google.com/drive/folders/10iLoz9US2Afxx-nTVvLmz0-skjvLj8Rm?usp=sharing>

- Appendix1 *Questionnaire_HCI_Group9.pdf*:

https://drive.google.com/file/d/1R_q3M6XRo4N6ynsLmwDe-IJ5qgnQK6E8/view?usp=sharing

- Appendix2 *AllSketches_HCI_Group9.pdf*:

<https://drive.google.com/file/d/10MbHVyPIE7qlg8QoGlOM1DDTXrAOOfd/view?usp=sharing>

- Appendix3 *Lo-Fi_Prototype_HCI_Group9.pdf*:

https://drive.google.com/file/d/1gSw_uoICK8YILeWRRVUuEl49DFxPMJ04/view?usp=sharing

- Appendix4 *Hi-Fi_Prototype_HCI_Group9.pdf*:

https://drive.google.com/file/d/1Ef3_unqhqv9VJVtbrIAfE1LV4nSj3EJB/view?usp=sharing



*References

**This is an additional page for providing any references we researched or used during design process.*

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