Research on emotional Interaction Service system and Design for the Disadvantaged Groups based on China Health Care Situation

Dottorato di ricerca in Architetcture, Design, Planning

Curriculum in Innovation Design

Ciclo XXXIV

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INDEX

CHAPTER 4
Case Studies

PART THREE
The Study of the Chinese Healthcare System

CHAPTER 5
Examines and analyzes the current state of Healthcare specific in China

PART FOUR
Design of an emotional interaction service system for disadvantaged people based on the current situation of Chinese healthcare

CHAPTER 6
Healthcare Service System

BIBLIOGRAPHY

ATTACHMENTS

Attachment A – *Questionnaire A1 and Questionnaire A2*

Attachment B – *Statistical bulletin on the development of healthcare of China in 2021*

GLOSSARY

Fig. As China's elderly population increases, 80–year–olds begin to live independently. Photographer : He Yuewei

Abstract

As group animals, human beings have emotional needs that we need at every stage of our lives. Emotional interaction is one of the main development trends of human-computer interaction and intelligent products in the future. Human beings hope that products can also have the same emotions as human beings to communicate with products.

According to the "World Population Analysis Report 2020, 2021 and 2022", we can see that the disadvantaged groups are the most who need the emotional care and needs .

The disadvantaged groups facing special difficulties such as illness, aging, physical or mental disabilities, lack of financial or economic support, and political weakness.They are facing different types of difficulties, but are receiving minimal emotional care and emotional need.

In this thesis, we found that the common denominator in the lives of the disadvantaged groups and high percentage of the part is health care.

The emotional need is how can get better , more suitable and convenient health care for them. Therefore, this thesis uses service design methodology to combine interactive products and service design realize their needs.Also emotional interaction enables products to understand people's emotions and give appropriate feedback,as to realize more humane intelligent services, built the whole service system for the disadvantaged group.

Finally, I focuses on China's Healthcare system, According to analysis and design,I found many problems with China's existing Healthcare system, especially for the disadvantaged, which is basically in its beginning stages.

Therefore,I am committed to providing better service design for the underprivileged in China's Healthcare system and establishing a New Healthcare Eco-System in China.

Keywords：*Emotional Interaction, The Disadvantaged Groups,Healthcare,Service Design.*

Introduction

This thesis is dedicated to the study of disadvantaged groups in China and finds that their emotional needs are significantly higher than those of the normal population. Because they face different difficulties in various aspects of their lives, some of them can take care of themselves while others even need to rely on others. However, they are the most ignored people in our life.Through the research of existing emotional design products and systems, mainly for normal people, there is very little emotional care for disadvantaged groups. Therefore, for many reasons, we want to make products and systems that target the emotional needs and care of disadvantaged groups.Then, through three years of continuous research and in-depth exploration, I found that a major part in the lives of disadvantaged groups is health care, and some even more than 70%. Therefore, facing the most important part of the lives for disadvantaged groups in health care, we started a lot of research, including the use of field research, follow-up interviews and other research methods and tools.

Through the research, will be found:

  - There are currently five types of health care available to the disadvantaged groups in China, including large public hospitals, community hospitals, small and medium sized clinics, pharmacies, online health care platforms and home care.

  - There are currently significant problems with all health care types and healthcare systems in China, especially after the COVID-19 explosion, and the shortcomings are even more pronounced.

  -At present, China's health care system is basically "zero" in terms of consideration and care for the disadvantaged groups, which means it is at the basic stage, but the disadvantaged groups account for more than half of the total daily health care.

The research conclude that if want to better provide more emotional care for the disadvantaged groups in China, satisfy their emotional needs，   to make them feel more care and concern in their inconvenient life, I need to build a new health care system to service and design for the disadvantaged groups.

Therefore, the scope of the thesis research contains the following aspects.

Scope of thesis topics:

・Emotional needs of disadvantaged groups in China
・The current health care system in China
・What research methods are more appropriate for emotional needs research and discovering pain points in the current health care system: using emotional computing, research studies (including questionnaires, field surveys, user interviews, etc.), case studies, and service design research methods
This thesis will follow this scope of research for an in-depth research analysis.

Overall research objectives

This thesis has been researched and analyzed through different stages of research objectives over the years, and finally resulted in the overall research conclusions of this thesis at this stage:

・*Stage 1 : Research Objective: Research Target 1 - Disadvantaged Groups in China*

The scope of this paper allows us to discover what the emotional needs of disadvantaged groups in China , and the reasons why they have these needs.
Our current design requires a human-centered design, fully understanding who our users , what are their scenarios, and what are their characteristics and needs. Therefore, I got four typical disadvantaged personas through the establishment of disadvantaged persona.Using these typical Persona of disadvantaged groups, we got the first stage of pain points and opportunity points for disadvantaged groups (quantitative).Then by substituting typical Persona into the double diamond and user experience journey map, I got more in-depth pain and opportunity points (qualitative) for the disadvantaged groups in the second stage through different scenarios and design perspective changes.
Through the above research methods, combined with existing case studies of disadvantaged groups in China, I have got a clearer understanding of the survival environment and the present of disadvantaged groups in China, therefore achieving a comprehensive and in-depth understanding of the research users of this thesis: disadvantaged groups.

・*Stage 2 : Research Objective: Research Target 2 - Existing Health Care Systems in China*

By searching a lot of information on existing health care systems in China and internationally, studying in the field and interviewing experts, I classified the existing China health care systems into five types, followed by research and experiments for one and a half years, I came up with the content of Part 3--chapter 5 of this thesis, which is the current situation of health care in China, the biggest problem of China's health care system is " unequal distribution of

resources, inefficient health care system, poor quality of health care services, difficult and expensive health care situation".

• *Stage 3: Research Objective: Research Target 3 - Pain and enjoyment points of disadvantaged groups in the existing health care system of China.*

After I have fully understood the emotional needs of disadvantaged groups and the current situation of healthcare specific to China in stage 1 and stage 2. Stage 3 examines the specifics of disadvantaged groups in the existing health care system.
It is also divided into five different sections.
  - Sometimes need health care and able to live independently
  - Sometimes need health care, unable to live independently (mostly live with family, not really unable to live independently)
  - Everyday need health care, able to live independently
  - Needs health care on a daily basis, unable to live independently
  - Emergency need for health care, able to live independently and unable to live independently
Through the different in-depth research and excavation of these situations, chapter 6 was concluded and based on these findings, we started to build the new system design concept and planning.

The overall research objective of this thesis is to establish a new health care eco-system for disadvantaged groups in China, in order to facilitate their lives and enhance their sense of well-being by providing them with psychological and physical emotional satisfaction in their lives.

Research methodology

• *Affective computing:* Affective Computing is related to emotion, so affective computing can help to get the emotional needs of disadvantaged groups. By understanding the emotional needs of disadvantaged groups, it can help me to achieve the first stage of my research objective, which is to fundamentally get the general needs points on disadvantaged groups.
• *Survey Research:* Survey Research is one of the most commonly used research methodologies in academic research. It contains questionnaires, field interviews, user interviews, expert interviews, experimental tests and other methods. Using research study method can help us get a planned, detailed and systematic understanding of educational phenomena, and analyze, synthesize, compare , generalize the large amount of data collected from surveys, so as to provide regular knowledge.
  - This thesis uses two questionnaires, the first time through the questionnaire to get quantitative data, help us to understand is the life of disadvantaged groups, preliminary

understanding of their life status, for example: what is the final proportion of life, what is the majority of the distress, etc.. The second questionnaire survey rather targeted to select the actual disadvantaged groups and have health care needs of the disadvantaged groups, through these users to get the disadvantaged groups of 4 persona. by different levels and purposes of the questionnaire survey, can help us to get the quantitative needs of the disadvantaged groups to help the research afterwards.

- Field research are one of the most used research methods in this thesis. Because the research scenario and design purpose is a health care system specific to China, a lot of field research and visits are needed to understand more about these target scenarios. Therefore, I spent more than a year continuously research and visit different types of health care systems in China, and got a lot of useful data from them to help the final new health care system.

- Experimental testing is one of the methods used in this thesis , and it is used in two main situations in the thesis. The first one is when I get the data, I have to increase the accuracy and authenticity in the research by using experimental tests to determine the authenticity of the data and the accurate numbers to help the research later.The second is the method of experimental testing and getting accurate figures to help me find out the problems. For example, when visiting large public hospitals in the field, through experiments, we get how long it takes for normal people and disadvantaged people to go from entering the hospital to finding a doctor respectively, and what problems they may encounter in between. Without experiments for testing, as normal people, we might have missed some of the problems we would experience as disadvantaged people, and would not have known that disadvantaged people will take more than twice as long as normal. Therefore experimental tests are very helpful for our research and can give accurate numbers to help build the system afterwards.

This thesis also used various methods such as user interviews to help me further identify data and discover problems in my research investigation.

• *Case Study:* The case study method is a research method in which a specific object is identified, investigated for analysis, and its characteristics and formative processes are clarified. In this thesis, three different case studies are used, all of which are three classic cases of disadvantaged groups in China. These three cases help us to better understand the current situation of disadvantaged groups in China , as well as their efforts and contributions to continuously improve the current situation of disadvantaged groups, achieve true respect for differences and remove barriers.

• *Service Design:* Service design is the construction of an overall service framework by exploring the needs of the various stakeholders in the system and designing the various types of touchpoints in the service framework. The services are used to provide better experiences and services to disadvantaged groups and other stakeholders in the health care system to meet their needs. This paper uses the two-diamond model in service design, user experience journey map, stakeholder map, and service design blueprint to help me get design opportunity points and improve the overall new system build.

The results of the study achieved

The most important outcome of this study that it helps disadvantaged groups to establish a new health care eco-system in order to help them to have better health care and get better health care experience services. Focus on disadvantaged groups, respect their emotional needs, respect their differentiation, and respect their lifestyles to achieve true elimination of differences and accessibility.

PART ONE

Research Objectives - Defining Emotional Interaction Products (Including Systems)

1 | Chapter One

Study of Emotional Interaction Products and Systems

Fig. 1 Father and Son.Photographer : Li Shuqi[1]

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[1] http://www.asia-photo.org/photo_view.asp?p_id=42337

1 Study of Emotional Interaction Products and Systems

1.1 Status of Emotional Interaction Products and Systems

1.1.1 Concept of Emotional design

Donald A. Norman, an American cognitive psychologist, mentioned in his book "Emotional Design" that design is actually an act of communication, which means to deeply understand the people who communicate with designers, fully communicate with users, understand their inner needs, and create products that are attractive, effective understandable, enjoyable and interesting.[2]

The meaning and role of emotional design is elaborated at three levels of human nature: instinct, behavior, and reflection, respectively *(Fig. 2)*.
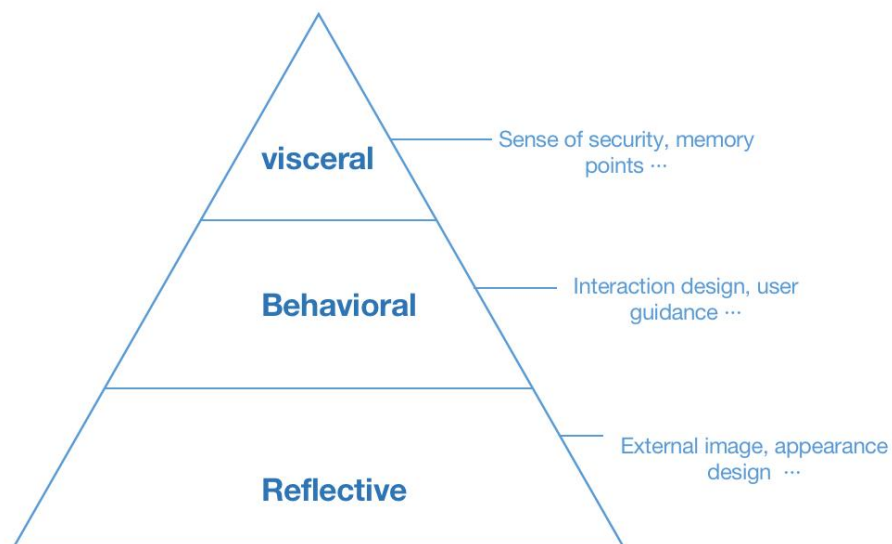

Fig.2   The three levels of emotional design in Donald Norman's "Design Psychology 3 – Emotional Design"

The instinctive level is concerned with the direct response of the visual and other senses out of instinct, and a good appearance is the first step to attract people to a product.

Secondly, the behavioral level is concerned with the efficiency and pleasure of use, which can be achieved by meeting the functional needs of users and improving ease of use.

Finally, the reflection level is related to the long-term feelings of users and requires establishing the long-term value of the brand or product. Only by establishing an emotional bond between the product/service and the user and influencing the image, satisfaction and memory of the product in the user's mind through interaction, can the user's perception of the brand be formed and the user's loyalty to the brand be cultivated.

1.1.2　Concept of emotional interaction design

Emotional interaction design is a design concept that takes users as the core, digs deep into their emotional needs, and generates emotional interaction with them by understanding their true feelings, and the interaction behavior makes them satisfied, so that they can have confidence in the product or system through emotional interaction design.

There are two main subjects of emotional interaction design: emotional design and interaction design.Affective design refers to the activity of creative behavior aimed at the emotional communication between people and things, aiming at getting the user's attention and inducing an emotional response to improve the possibility of performing a specific behavior design. Emphasis is placed on figuring out and exploring the user's emotions and imposing emotional features and elements in the product through psychological applications so that the user enjoys sufficient emotional satisfaction[3].

Interaction design is the main way to achieve good communication between people and products, defining and designing the behavior of man-made systems, and determining the content and structure of interactions between two or more individuals so that they can cooperate with each other and achieve their purposes. The essence of emotional interaction design lies in satisfying users' emotional needs and attaching importance to the interactive experience and emotional communication between people and people, people and products, and people and the environment[4].

Therefore, emotional interaction design products and systems are very important to understand users better and design real products for them that are more in line with what they have in mind.

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[3]　Maiocchi　Marco Maria，"Emotional Design and the Healthcare Environment ",Springer Berlin Heidelberg,2022.06

[4]　Jiang, Hong,"From Rational to Emotional Agents A Way to Design Emotional Agents" ,2008.12

1.2 Status of Emotional Interaction Products and Systems

1.2.1 Type and range of relevant applied research

Emotional interaction design seeks a balance between people and things, which is a human-oriented design philosophy, through interaction behavior to make the target user and product, system to achieve a win-win effect, mutually satisfied.[5]

At this stage, the types of emotional intelligent interaction products are divided into the following general categories *(Fig. 3)*:

- Wearable Emotionally Intelligent Products

- Artificially intelligent products and AI of systems (join IQ and EQ, IQ is the main focus at this stage)

- Emotional intelligent living products and systems (such as home, furniture. Home appliance category, etc.)

- Emotional intelligent care products and systems (e.g.for elderly safety and health, children's education-related products, etc.)

- Emotional public safety intelligent interactive products
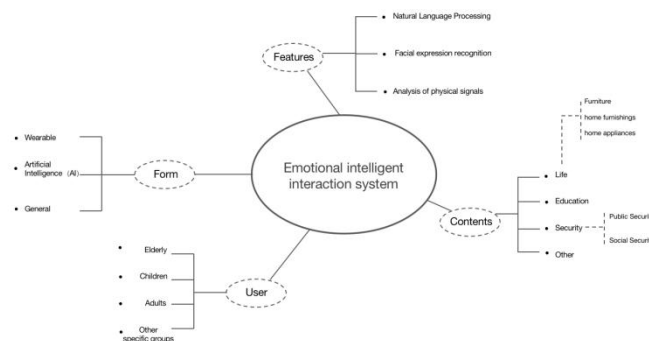
Fig.3　Emotional intelligent interaction system

These different types of products also belong to the emotional intelligent interaction system. The emotional intelligent interaction system starts from four aspects: user, content, form and characteristics.

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[5] Stephen P. Anderson,Heart-thumping Emotional Interaction Design Guide,2015.03

Establish user-centered, focus on the user's emotional needs, turn the needs into opportunities and develop a series of intelligent interactive products, then put these products in the intelligent Internet of Things (IoT) platform, thus forming a complete emotional intelligent interactive system.

1.2.2 Analysis of results and studies

Through a variety of different types of emotional intelligence products to find and analysis of their functions, users, it can be found that 63% of the target users of the current stage of emotional intelligence products are the general population, 29% of the target users are children's education and education category, 8% of the target users are special groups (a large proportion of which are elderly users health category)[6] - this research data is based on Taobao APP keywords in 2022 Taobao APP is currently the largest APP in China for sales category C. The data is based on the search of the listed emotional intelligent products .

Through the analysis of the research results data, we can conclude that the current Chinese market is a high percentage of emotional smart products for ordinary people, and the product similarity similarity is high, they are focused on smart home products or electronic devices.

Only a very small part is about the disadvantaged, relatively special target users. Among them, the special target users are mostly children *(Figure 4)*.
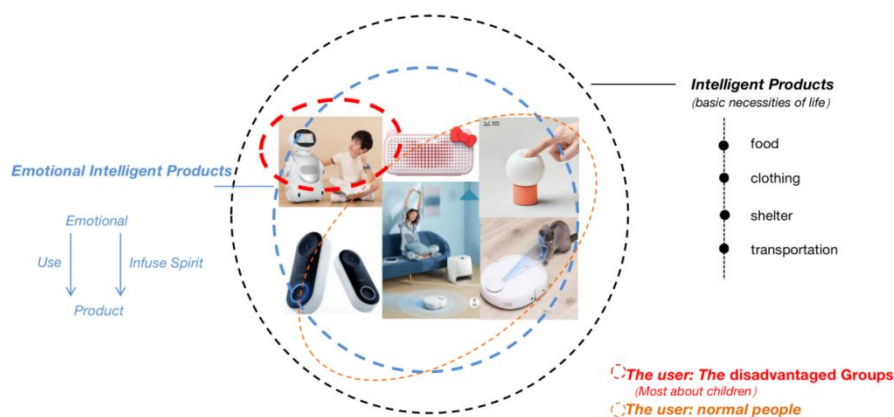
Fig.4   The percentage of emotionally intelligent interactive products currently on sale in China

These different types of products also belong to the emotional intelligent interaction system. The emotional intelligent interaction system starts from four aspects: user, content, form and characteristics.

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[6] Taobao 2022 data research report by category，2023.01

Establish user-centered, focus on the user's emotional needs, turn the needs into opportunities and develop a series of intelligent interactive products, then put these products in the intelligent Internet of Things (IoT) platform, thus forming a complete emotional intelligent interactive system.

Children's emotional intelligence products are concentrated in two major categories：

- Educational type (such as learning smart watches, etc.)

- Growing up companion type (such as intelligent robots, etc.)

Therefore, we can conclude that the current characteristics of emotional intelligent interaction products in the Chinese market are as such：

- Product design target users are mainly the same
- High functional similarity
- High sales and demand for the product
- A wide range of product prices, covering different consumer levels
- More products to choice, lack of accurate recommendation and comparison
- Ignore the people who need emotional care mostly

According to the related "2022 Year China Population Analysis Report"[7], it can be seen that the most emotional needs are disadvantaged groups in China, mainly among different groups of people, and next is young people. However, there is a serious lack of emotional intelligent interactive products for the disadvantaged in the Chinese market, and the majority of them focus on children, have a single variety and the same functions. Therefore, it is very important to design emotional intelligent interaction products for the disadvantaged groups.

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[7] "2022 Year China Population Analysis Report"

2 | Chapter Two

Target Users: The Study of the Disadvantage Groups

2.1   Research and analysis of target user – The disadvantage groups

   2.1.1   Definition of disadvantage groups

   2.1.2   Characteristics of the disadvantage groups in China

   2.1.3   Research and define the emotional needs of the disadvantage groups

Fig. 5 Disadvantaged groups – elderly living alone.Photographer : He Yuew[8]

[8] http://www.asia-photo.org/photo_view.asp?p_id=42336

2   **Target Users: The Study of the Disadvantage Groups**

2.1 Research and analysis of target user – The disadvantage groups

2.1.1 Definition of disadvantage groups

The disadvantaged groups facing special difficulties such as illness, aging, physical or mental disabilities, lack of financial or economic support, and political weakness.[9]

The specific composition of disadvantaged groups in China generally is the same as internationally; disadvantaged groups include children, the elderly, the disabled, the mentally ill, the unemployed, the poor, laid-off workers, those seeking help in disasters, migrant workers, those in informal employment, and those in a vulnerable position in labor relations. Of course, this is simply an enumeration, and there is actually crossover between the individual groups.

The relevant policies identify a number of principles for prioritizing support：[10]

- Priority support should be given to those who cannot solve their food and clothing problems.
- Priority support should be given to those who cannot enjoy any social security.
- Priority support should be given to those who have lost their labor capacity ,also those who despite their labor capacity, cannot be employed for a long period of time due to lack of employment opportunities or those who are significantly disadvantaged in the labor market.
- Priority support should be given to those who are the main bearers of the economic reform and social transformation costs. Only when the priority support targets are clearly defined can social support be carried out effectively. According to the actual situation of China's socio-economic development, it is only possible to gradually create conditions for the elimination of disadvantaged groups.

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[9] ANK.A D. Economic and Social Inclusion of the Disadvantaged Poor through Live hood Enhancement with Micro-irrigation [R]. Kingdom of Nepal,2006 .

[10] https://baike.baidu.com/item/弱势群体/912753?fr=aladdin

2.1.2 Analysis of results and studies

The concept of disadvantaged groups is an important element in the mainstream discourse on social science, and the use of the term "disadvantaged groups" in the Report on the Work of the Government by Premier Zhu Rongji at the 5th Session of the 9th National People's Congress in March 2002 has received widespread attention at both national and international levels.[11]

China's disadvantaged groups have the following five important characteristics：[12]

- Current classification of disadvantaged groups in China.

The main group of disadvantaged groups is socially disadvantaged. Chinese academics generally classify disadvantaged groups into two categories: physiological disadvantaged groups and social disadvantaged groups. The former fall into the disadvantaged group with obvious physiological reasons, such as age and disease; the latter are basically caused by social reasons, such as layoff, unemployment and exclusion. From the overall situation of China's disadvantaged groups, the main group is socially disadvantaged, mainly due to social reasons that lead to their disadvantaged status, therefore, we should focus on the perspective of social support.

- Laid-off workers created by unique circumstances *(Figure 6)*.

Many of the existing disadvantaged groups are people who contributed under the former system. In particular, some early retirees and unemployed and laid-off workers of state-owned collective enterprises.[13]

Fig.6   Free public transport policy for laid–off workers

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[11] "China report on the Work of the Government",2002.03

[12] Shen Liren,"Disadvantaged groups in China",Democracy and Construction Press,2005.01

[13] Yu Mingqin,"Questions and answers about the rights and interests of laid-off workers",1998.10

- Social differentiation due to economic development.

Disadvantaged groups emerge as a result of increased social differentiation, and many people have a strong sense for relative deprivation. Over the past 40 years of the reform and opening up, Chinese people's overall living standard has improved, but it is very uneven among regions, groups and individuals, China has transformed from a society where egalitarianism prevailed before the reform and opening up to a society with a wide gap in income distribution, and social differentiation based on economic differentiation is growing, some people's relative social status has declined, triggering a more serious sense of relative deprivation, which must be given high attention.

- Increasing polarization in the international development process *(Figure 7)*.

The process of globalization is more likely to adversely affect vulnerable groups within countries and to continue growing the size of the disadvantaged groups. In the process of globalization, powerful groups that are close to capital, close to power, or well-educated are likely to benefit more, while ordinary workers not only have fewer opportunities to profit, but may also have their welfare reduced and become the bearers the costs of globalization. This context of globalization must be fully taken into account when we focus on the problems of disadvantaged groups within the country.[14]

- Related government support policies and efforts are rather weak.

Support for disadvantaged groups is very limited, it is difficult to effectively change their disadvantaged status.

To summarize, we need to conduct a detailed classification and in-depth study of China's disadvantaged groups, discover the pain points in their lives, then find design opportunities from them and design modifications to help these disadvantaged groups effectively improve their difficult situations.

Fig.7   Globalization of the economy

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[14] Li Bochong,"Muskets and Ledgers: China and the East Asian World in the Era of Early Economic Globalization",2017.01

2.1.3 Research and define the emotional needs of the disadvantage
groups

Currently for supporting disadvantaged people, this can be divided into two parts, one is the type of need and the other is the nature of the need.
Starting from these two aspects, we look for opportunity points where design can be carried out, and then conduct in-depth research to uncover deeper emotional needs.[15]

- From the simple types of needs.[16]

Classified as needs for food and clothing, housing, education, health care, employment, security, social interaction, social participation, etc.

- From the nature of needs.

There are subsistence needs, development needs and enjoyment needs.
According to current research, protecting and supporting the disadvantaged groups should be given priority to guaranteeing their basic living needs, such as basic clothing, food and shelter needs. This is followed by medical needs, then gradually securing other needs to promote the overall development of disadvantaged groups in order to eventually change their disadvantaged status.

The next study will determine what the majority of disadvantaged people need most and what they need to solve most at this stage, based on different research methods, as well as demonstrate the corresponding design method。

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[15] Ruth Reiss,"Evolution of emotions:The Ascent of effect",2020.10

[16] Abraham H.Maslow,"Maslow's Hierarchy of Needs Theory",2021.11

PART TWO

Integrating different types of research methods to help and understand the disadvantaged groups

3 | Chapter Three

Research Methodology

3.1   Affective computing
   3.1.1   Status of research on affective computing
   3.1.2   Affective computing in the emotional interaction applications
3.2   Survey Research
   3.2.1   Definition of survey research
   3.2.2   Survey research methods
3.3   Case Studies
   3.3.1   Current status of the case study
   3.3.2   Case Study Classification
3.4   Service Design
   3.4.1   Concept of Service design and research status
   3.4.2   Service design research methods
   3.4.3   Service design application areas

Fig. 8 Hospital Children's Chinese Medicine Clinic

3   **Research Methodology**

3.1   Affective Computing

3.1.1 Status of research on affective computing

Affective computing is related to emotion[17] , It was first proposed by Professor Picard of MIT Media Laboratory. Professor Picard proposed capturing the external expression of emotion. For example ,How to use Electro dermal Measurement Technology, Electroencephalogram, Wearable Device Sensors, Network Camera getting emotional data. Through facial expression recognition, skin and sympathetic nervous system of stress response, analysis people's inner feelings, emotional calculation and understanding of emotions[18]. Janssen[19] study listener's emotional response to music，And establishes the emotional model. Wang Zhi-liang[20], a professor at the university of science and technology Beijing, has proposed the theory of artificial mind*(Figure 9)*.
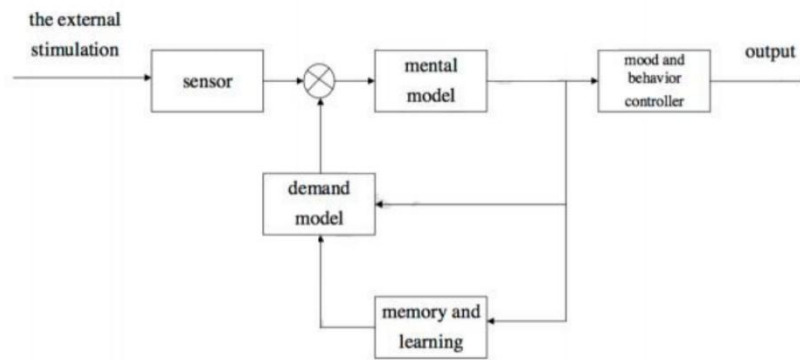
Fig.9   Theory of artifical mind model

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17   Picard R, Affective Computing[M].U SA:MIT Press, 1997.

18   Picard R. Surprising Discoveries from Afective Computing[R].The 15th Conference on computing in 21Century,2013.

19   Janssen J H, Broek E L, Westerink J H. Tune in to Your Emotions: a Robust Personalized Affective Music Player[J]. User Modeling and User-adapted Interaction, 2012, 22(3): 255—279.

20   Wang Zhi-liang. Artificial Psychology and Artificial Emotion[J]. CAAI Transactions on Intelligent Systems, 2006, 1(1): 38—43.

Tao Jian-hua[21] studied affective computing and intelligent interaction, and proposed that emotional computing integrates the disciplinary knowledge of computer science, perception science , and is an interdisciplinary research. Wang Shang-fei[22] has integrated users' emotional factors into his image retrieval research. Huang Cheng-wei[23] studied the problem of multimodal emotional recognition based on phonological signals .

Emotional computing theory has produced some valuable results, but it is less applied to the field of product practical design. Currently, emotional sensing is mainly used in the development of intelligent machines, human beings and humanization products, such as intelligent robots with emotion, wearable devices with emotion perception function, and usability testing. At present, many applications of emotion computing are still in the stage of research and exploration. It is great significance to products design ,the good emotional interaction for disadvantaged groups based on emotional calculation method, which can helpdisadvantaged groups improve their living ability 、 bring pleasant experience and intimate service .

3.1.2 Affective computing in the emotional interaction application

Product Emotional Interaction Design is a hot topic in current academic research.
research on product emotional interaction design for Disadvantaged groups has achieved results. Accele Glove*(Figure 10)*, an electronic glove designed by George Washington University, USA. This glove can translate sign language actions into voice language or text language. Products can help people with hearing and speech impairment Barrier-free communicate with normal people.Microsoft Asia Research Institute developed sign language translation system *(Figure 11)*based on Microsoft Kinect Technology. A network sign language graph model is developed to recognize the accurate recognition of sign language posture. Promoting communication between hearing impaired people and normal people. Providing scientific basis for intelligent product development.Realize to Intelligent Interaction between Users and Products.

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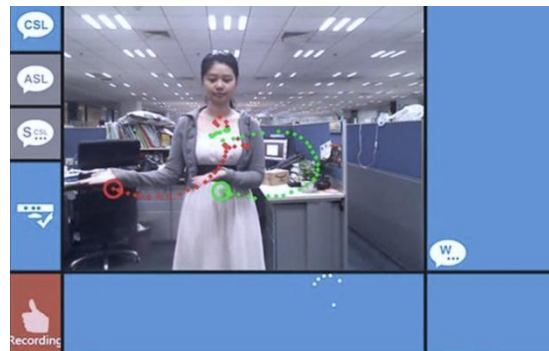
Fig.10 Accele Glove   Fig.11 Sign language translation system

Mao xia[24] analyzes the frontier research of human-machine emotion interaction, and introduces the latest research results of emotion recognition, emotion model, multi-modal emotion interaction, emotion extraction in text information and emotionparody.Wang，Guo-jiang[25] studied the related technologies of human-machine emotional interaction, such as emotion modeling, expression recognition and expression synthesis, and explored the technologies and methods of human-machine emotional interaction. Liu Yao-feng[26] has designed a humanoid head robot that can interact with emotions. Li Qing-yun[27] analyzed the emotions of the elderly and studied the product interaction model suitable for the emotional characteristics of the elderly. Chen Xiang[28] analyzed the demand of disadvantaged groups , and put forward the design strategy and method of intelligent products based on human.

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[28] Chen Xiang, Qian Xiao-bo. Research on the Humanized Design of Intelligent Products for the Vulnerable Groups Needs[J]. Journal of Machine Design, 2014(10): 126—128.

3.2　Survey Research

3.2.1 Definition of survey research

Survey research is one of the most common methods used in scientific research.Collecting information related to the actual or historical situation of the research object, it is a purposeful, planned and systematic method.[29]

Survey research is a basic research method commonly used in scientific research, which integrates scientific methods such as historical research, observation and conversation methods, questionnaires, case studies and tests to understand educational phenomena in a planned, meticulous and systematic way, and to analyze, synthesize, compare and generalize the large amount of data collected by the survey so as to provide people with regular knowledge.[30]

3.2.2　Survey research methods

• Questionnaire

The most commonly used survey method is the questionnaire, which is a research method that collects data by asking questions in writing. In other words, the surveyor prepares a format for the survey project, distributes or maps it to relevant people, asks for instructions and fills in the answers, which are retrieved for sorting, counting and research.[31]

Questionnaire is a method of collecting information by developing a detailed and well developed questionnaire on the basis of which the respondents are asked to respond. The questionnaire is a set of questions related to the objectives of the research, or a form of questions prepared for conducting the survey. It is a common tool that people use to collect information in social research activities.[32] Researchers use this tool to make accurate and specific measurements of social activity processes and apply sociological statistical methods to describe and analyze the quantities to obtain the required survey information.

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[29] Wang Xiyi,"Methodology of Survey Research"[M],Guangxi Normal University Press，2022.04。

[30] Luo Shengqiang,Jiang Yan,"Management questionnaire research methods"[M]， Chongqing University Press，2018.10。

[31] Zhang Shiyu,"Questionnaire data analysis practices"[M],Capital University of Economics and Business Press，2015.03.

[32] Xiao Haohui,"Dictionary of Decision Sciences"[M],People's Publishing House，1995.

• Field Research

Field research is the process of collecting first-hand information by the researcher themselves. When market researchers do not get enough second-hand information, they have to collect primary information. The difficulty of collecting primary information abroad differs only in degree compared to that of domestic ones. The key factor affecting the success or failure of the research is the willingness and ability of the respondents to provide the required information.[33]

Three methods of field research:
   - Interview method
Interview method refers to the preparation of the matter to be investigated, in persons, telephone or written to the respondents to ask questions in order to obtain the required information of the survey method. It is one of the most commonly used field research methods. The interview method is characterized by the entire interview process is the investigator and the respondents to influence each other, the process of interaction, but also the process of interpersonal communication. It includes face-to-face interviews, telephone interviews, letter surveys, conference surveys and online surveys.[34]

   - Observation method
   Observation method refers to the investigator in the field from the side to the respondents' situation observation, recording, in order to collect the market situation of a method. It differs from the interview method is that the latter investigation allows the inquirer to feel that "I am being investigated", while the former observation method does not necessarily allow the respondents to be feeling out, only through the investigator's observation of the behavior, attitude and performance of the respondents to make speculative judgments on the results of the problem. [35]Commonly used observation methods are direct observation of the survey and the actual trace measurement method and so on.
   - Experimental method
   Experimental method is the most formal one. [36]It refers to the control of the object under study from one or more factors, under controlled conditions to determine the

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[33] Robert G. Burgess,"Field research sourcebook and Field Manual"[M].

[34]Chauncey Wilson,"Interview Techniques for UX Practitioners: A User-Centered Design

Method"[M],1988.08.

[35] Rodriguez, Noelie Maria,Ryave, Alan Linc,"Systematic Self-Observation:A Method for Researching

the Hidden and Elusive Features of Everyday S",2002.01.

[36]Townsend, John C,"Introduction to Experimental Method for Psychology and the Social Sciences"[M].

relationship between these factors. It aims to capture causality by excluding competing explanations of the observed results, and the experimental method is a very important tool in the research of causality. It mainly has methods such as product test marketing and market experiments.

- Interview Research

The interview survey method is a basic psychological research method to understand the psychology and behavior of the interviewees ,through face-to-face conversation of the interviewer and the interviewee.[37] The interview method has different forms depending on the nature, purpose, or target of the research questions. Depending on the degree of standardization of the interview process, it can be divided into structured and unstructured interviews. The interview method is widely used and enables the collection of multifaceted job analysis information in a simple and narrative manner.

3.3 Case Studies

3.3.1 Current status of the case study

The case study method is a research method that identifies a specific object within a research subject, conducts an investigation and analysis, clarifies its features and formation process.[38]
There are three basic types of case studies[39] :

- Individual investigation, that means the investigation of a person in the organization ;

- Group investigation, that is a study of an organization or group;

- Problem investigation, that means the investigation and study of a phenomenon or problem.

The researcher selects one or several scenarios as the object, systematically collects data and information, then conducts an in-depth study to explore the situation that a phenomenon has in a real-life context. It is suitable for answering research questions such as "how it changed", "why it became this way" and "what happened" when the

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[37] Ullrich, "The Discursive Interview: Method and Methodological Foundation" [M].

[38] Yin , R.K., 1984, Case study research: Design and methods , NewburyPark, CA : Sage Publications.

[39] Lu Xiongwen,"Dictionary of Management"[M],2013.

boundary between the phenomenon and the actual environment is unclear and not easily distinguishable, or when the researcher cannot design precise, direct and systematic control variables. What is the outcome?

It also incorporates a unique design logic, specific data collection, and unique data analysis methods. Information can be obtained from field observations or through research documents. [40]

The research is more qualitative in nature and has special features in data collection as well as data analysis, including reliance on multiple sources of evidence, different data evidence must be able to converge in a triangulated way to reach the same conclusion; there are usually pre-developed theoretical propositions or problem definitions to guide the direction of data collection and the focus of data analysis; [41]the focus is on the examination of the events at the time without getting involved in the manipulation of the events, which can preserve the holistic nature of life events and find meaningful characteristics.

It is possible to preserve the totality of life events and discover meaningful characteristics. Compared with other research methods, it is possible to obtain a more comprehensive and holistic view by providing a thick description and systematic understanding of the case, and by grasping the dynamic process of interaction and the contextual context in which it occurs.[42]

3.3.2　Survey research methods

Different types of case studies can be distinguished according to different division criteria. The methods that serve different case study types are different, and there are some case study methods that are only applicable to specific case study types. [43]There

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[40]　Masten, Scott E.,"Case Studies in Contracting and Organization",1991.

[41]　Linda A.Macaulay,Ian Mies,Jennify Wibly."Case Studies in Service Innovation".

[42]　Cheryl Vince Whitman,Carmen E.Aldinger"Case Studies in Global School Health Promotion: From Research to Practice".

[43]　Creswell, J., 1994, Research Design：Qualitative and Quantitative Approaches, Thousand Oaks ，CA ： Sage Publications.

are also some case studies where multiple case study methods can be applied simultaneously in combination.[44]

• Types of case studies by research tasks

Depending on the research task, case study methods can be distinguished into five types[45]*(Figure 12)*:
   - Exploratory
   - Descriptive
   - Illustrative
   - Experimental
   - Explanatory

Exploratory case studies often go beyond the existing theoretical system and use new perspectives, hypotheses, perspectives and methods to analyze socio-economic phenomena, and these studies take the task of paving the way for the formation on new theories, which are characterized by the lack of a systematic theoretical system and the imperfection of relevant research results.[46]
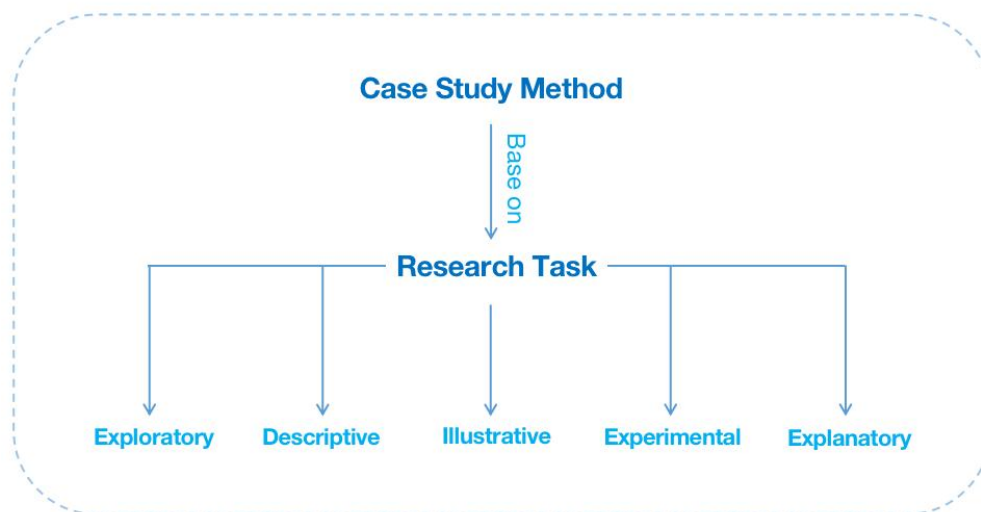

Fig.12   Methods of case studies by research tasks

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[44] Creswell，J.，1998，Qualitative inquiry and research design：choosingamong five traditions，Thousand Oaks，CA：Sage Publications.

[45] Scapens，R.W.，1990，Researching management accounting practice ：Therole of case study methods，British Accounting Review.

[46] Hussey，J.，&Hussey，R.，1997，Business Research，Basingstoke：Macmillan Press.

Within the existing theoretical framework, the descriptive case study approach can be used when the researcher wishes to provide an exhaustive description of business practices; the illustrative case study approach can be used when the researcher wishes to elaborate on the creative practices of business organizations or new trends in business practices[47].Experimental case study methods can be used when a researcher wishes to test the implementation of new practices, processes, and technologies in an enterprise and evaluate their benefits. Explanatory case studies, however, apply to research tasks that use existing theoretical assumptions to understand and explain the activities of real-life business practices.[48]

In the same way that the classification is based on the different research tasks, four types of case study methods can be distinguished: exploratory, descriptive, interpretive, and evaluation.[49]

- Single and multiple case studies

Case studies are generally conducted by selecting one or several cases to illustrate a problem. Depending on the number of cases used in actual research, case studies can be divided into Single Case studies and Multiple Cases studies.[50]

- Single case studies

A single case study is primarily used to confirm or falsify an aspect of an existing theoretical hypothesis, and it can also be used to analyze an extreme, unique, and rare management situation. [51]Usually, single case studies are not suitable for the systematic construction of new theoretical frameworks. Scholars who prefer the single case study approach argue that a single case study can reveal the context of the economic phenomenon to which the case corresponds in depth and in depth to ensure the credibility of the case study.[52]

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[47] Lincoln，Y.S.，&Guba，E.G.，1985，Naturalistic inquiry，BeverlyHills，CA：Sage Publications.

[48] Sturman，A.，1994, Case study methods.In J P Keeves（Eds.），EducationalResearch, Methodology and Measurement：An International Handbook：49～53Oxford：Pergamon.

[49] Bassey，M.，1999，Case Study Research in Educational Settings，Buckinghamand Philadelphia：Open University Press.

[50] Stake，R.E.，1995，The art of case study research，Thousand Oaks，CA：Sage Publications.

[51] Yin，R.K.，1994，Case study research：Design and methods （2nd ed），Newbury Park，CA：Sage Publications.

[52] Patton，M.Q.，2002，Qualitative evaluation and research methods（3rded.），Thousand Oaks，CA：Sage Publications.

- Multiple case studies

In a multi-case study, the researcher first analyzes each case and its subject matter as an independent whole in depth, which is called Within-Case Analysis; based on the same research theme, the researcher will summarize and conclude all cases independently of each other on the basis and draw abstract conclusions, which is called Cross-Case Analysis. [53]

This analysis is known as Cross-Case Analysis. Kathleen M. Eisenhardt's preference for a multi-case approach is based on the idea that multiple case studies can better and more comprehensively reflect different aspects of the case context, especially when multiple cases point to the same conclusion, and the validity of the case study is significantly increased.[54]

Therefore, the case study, which is an important methodological approach for the research of my thesis, will be used as a multi-case study and an exploratory study.

3.4　Service Design

3.4.1 Concept of Service design and research status

Service design is the activity of planning and organizing the people, infrastructure, information communication and material components of a service for the purpose to improve the quality as well as the interaction between the service provider and the customer.[55]

Service design is the activity of planning and organizing the people, infrastructure, information communication and material components of a service for the purpose to improve the quality as well as the interaction between the service provider and the customer.[56]

Service design can be about making changes to existing services or creating entirely new ways of delivering services. In simple terms, it is the construction of an overall service framework by exploring the needs of the various stakeholders in the system, and to design the various types of touchpoints in the service framework. The goal is to create a

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[53] Eisenhart，K.M., 1989., Building theories from case study research，Academy of Management Review.

[54] Eisenhardt，K.M., 1991, Better stories and better constructs：Thecase for rigor and comparative logic，Academy of Management Review.

[55] Andy Polaine,Lavrans Lovile,Ben Reason,"Service design from insight to implementation",2015.06.

[56] Huang Wei,"Service Design:winning users' followings with the ultimate experience",2020.11.

better experience and value for users and other stakeholders in the system through services.[57]

- The initial development stage of service design research*(Figure 13)*

In 1982, the concept of Service Design was first introduced by G. Lynn Shostack[58], who first proposed the concept of Service Design. In the thesis[59], the authors first proposed the Service Blueprint, and set up the Line of Visibility and Service Evidence, taking the shoe shine service as an example, and proposed to use the Service Blueprint to improve the experience of the service.

In 1986, Donald A. Norman, a famous design writer, introduced "User Centerd Design" in his research laboratory at the University of California.

In 1991, Service Design was officially introduced as a discipline in the field of design. IDEO's design thinking tools and methodologies are still used by many service designers today.

Between 1993 and 1994, Angus and Jenkinson created the tool Persona (character archetype). This tool is still one of the best tools designers can use to build user profiles based on research, helping designers to better frame their stories and research their target users.

In 1998, the Customer Journey Map was created. Today we more often refer to it as the User Journey Map. This map is arguably one of the most widely used methods in service design and is often used to visually represent intangible services.

In the late 20th century, the concept of Product Service System (PSS) became popular in the design community. Product Service System Design (PSSD) focuses on the systematic design of all aspects of product service systems, including strategy, concept, product, management, process, service, use, and recovery.
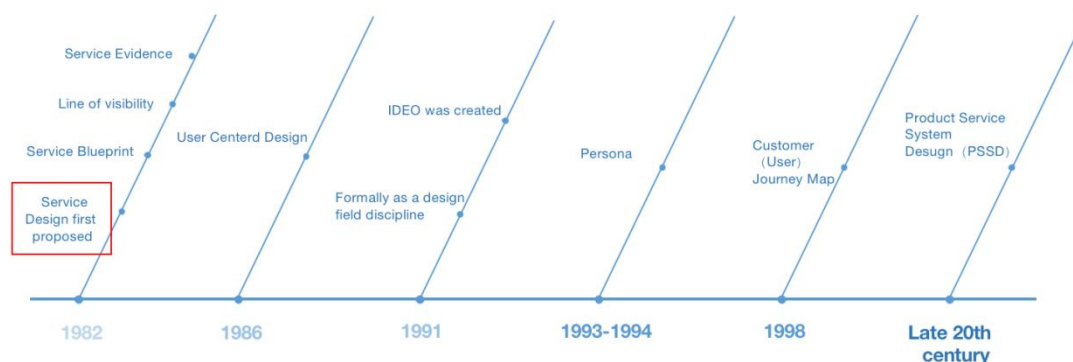

Fig.13 First Development period of Service design research

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57 Mark Sticdor,Max Hommes,Adam Lawrence,Jakob Schneider,"This is Service Design Method",2021,08.

58 G. Lynn Shostack,"How to Design a Service",1982.

59 G. Lynn Shostack,"Designing Services That Deliver",1984.

54

- High-speed development stage of service design research*(Figure 14)*

At the beginning of the 21st century, the concept of "service design" has gradually become clear, more and more service design consulting companies have started in Europe and America. They include Live ｜ work, IDEO, Frog, etc. External and internal governmental design organizations, such as UK Design Council, KISD, Mindlab, have also been promoting the development of service design in practice. At the same time, the theory of service design has also been rapidly developed. For example, in 2005, the UK Design Council released the famous Double Diamond model. This design model demonstrates that design work is a continuous process of divergence and convergence, which further explains design thinking.

In 2005, the Oslo School of Architecture and Design started an explicit education for service design in the education sector. Higher education in service design was also opened up.

In 2008, the International Design Research Association gave a new definition of "service design": "Service design" sets the function and format from the customer's perspective. The goal is to ensure that the service interface is useful, usable and desired by the customer, while the service provider finds it effective, efficient and recognizable. This decade has been a period of rapid development for service design.

The new century (2010-2019), the beginning of the 21st century, "service design" to become mature,and proposed 5 basic principles of service design[60]:

- User-centered
Services should be experienced through the customer's perspective.

- Co-creative
All stakeholders should be considered in the service design process.

- Sequential
Services should be visualized as a series of interrelated behaviors.

- Evidence-based
Intangible services should be visualized in the form of physical artifacts.

- Holistic
The entire context of the service should be considered.

In 2015, the Service Blueprint approach was updated by Practical Service Design to present new methods and techniques for using service blueprints, making it easier to create service blueprints.

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[60] Schneider Jakob，Mark Stikdorn，"This is Service Design Thinking：Basic-Tools-Cases"，2010.

In 2017, the new basic principles of service design were updated in accordance with the evolution of service design: [61]

  - Person-centered

   Consider all those affected by the service.

  - Collaborative

Stakeholders from different backgrounds and functions should be involved in the service design process.

  - Iterative

Service design is an exploratory, adaptive, and experimental approach based on iterative implementation.

  - Organized

Services should be visualized and organized into a series of interrelated behaviors.

  - Authentic

Requirements should be researched in practice, ideas prototyped for real-world use, and intangible values evidenced in the physical or digital real world.

  - Holistic

Services should continually emphasize the needs of stakeholders across the entire service and business entity.
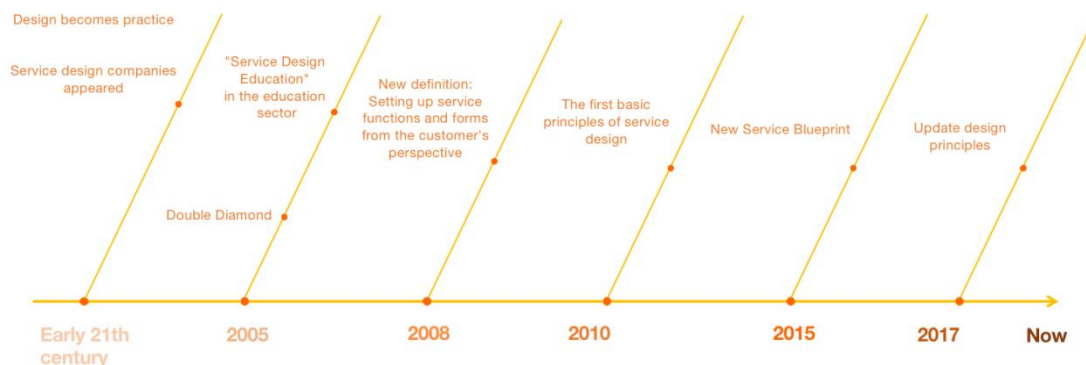

Fig.14 High–speed development period of service design research

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[61] Marc Stickdorn , Markus Edgar Hormess , Adam Lawrence , Jakob Schneider , "This is service deisng doing" ,2016.11.25.

3.4.2 Service design research methods

There are many different research methods and tools used in service design, all based on the main principles of service design, which are human-centered and consider all the people affected by the service. [62]

The most commonly used research is based on four phases,[63] and in each service design phase, there are tools and methods to help you get more effective information about users and their stakeholders to implement the final design goals more efficiently.

There are four phases:

- Identify the problem (insight)

The first phase is how designers can identify problems at the early stage of design, or rely on existing problems to find out the nature of the problem. The tools we can use in this phase include Hypothesis Journey Map, Stakeholder Interviews, Alignment Workshop, Stakeholder Map, Current-state blueprint and so on.

Using these tools in the pre-design phase allows us to better understand the users and identify their potential problems. This phase is the process of paying attention to the quantity, need to get a lot of data accumulation to help us better understand the user, the scenario in which located and related stakeholders situation, without filtering or selection, just discovery, the phase where we accumulate the number of problems, the more the number of problems proves that you are getting closer to really understand the user.

- Discovering problems (deep thinking)

The second phase is to take the data and information obtained in the first phase, conduct secondary selection, explore the problem in depth, and discover what are the potentially relevant nature of the same type for the problem? How can we help these users in the relevant scenarios to reduce the level of the problem or perhaps completely solve it. The tools we can use in this stage are Qualitative Research, Experience Map, Research Insights, Experience Principles, Archetypes and so on.

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[62] Banerjee, Maithili ,"Service Design:A comparative study of design and service in UK and india with the idea of introduction service design in india".

[63] Stickdorn, Marc; Frischhut, Birgit,"Service Design and Tourism".

Through the use of these tools, we can understand more about what and where the design opportunities are and how to effectively help users solve their pain points.

- Conceptualization and Envisioning (Solution)

Conceptualization and Envisioning (Solution)
The third phase is the design ideation and visioning based on the existing design opportunities, which is what we usually call the architecture and prototyping phase. The tools we can use in this phase are Ideation, Prioritization Framework, Storyboarding, Vision Stories, Prototyping and so on. By using these tools, the initial prototype or product of our service design project is available, that is, our design is basically completed.

- Planning and Operation (Implementation)

The last phase is to build on the Phase 3 prototype and refine the design in more depth to reach delivery. For example, some designs are product + service, and some designs are full service design planning, and running tests on these designs, feedback, modifications, and eventually until the end. The tools we can use in this phase are Future-state Blueprint, Project / Feature Cards, Evolution Plan and so on.

Through the using these tools, we can make our design go through rigorous examination and testing in the final stage to ensure its implementability and sustainability.

Through the above 4 phases design method*(Figure 15)*, it can promote the completion of the whole service design project , and the project will have better worthiness and sustainability .

Fig.15   Service Design tools and method

3.4.3 Service design application areas

At this stage, service design is mainly applied in two fields: public service and business innovation. The public service field generally cooperates with the government, charities, and service organization groups to seek better solutions to social public problems, improve the basic living standards and some difficult problems to solve. Most of the users are disadvantaged groups, and the proposed solution is to solve the fundamental problems of these disadvantaged groups, for example, New York City Mayor Bill de Blasio launched NYC HOME-STAT[64] at the end of 2016 to provide services for homeless New Yorkers.

Through the use of Stakeholder research insights and Journey Map, a series of tools to identify what homeless New Yorkers need, and to provide Dashboards with information, Turning the tide on homeless policy report, to better assist these homeless people.

The field of business innovation is currently a relatively large number of service design applications to improve customer experience, traverse the cycle, and help brands continue to grow steadily. The areas involved are also relatively wide such as restaurants, real estate, finance, auto life services, technology manufacturing vehicles and other fields. We create new consumer experiences to enhance the value of corporate brands for sustainable growth. For example, China TANG Experience Consulting company[65] has helped Xiao Guan tea[66] to stand out among the many tea brands in China and to dominate and lead the high-end tea market in China.

Therefore, it can be seen that service design application has a long lasting and effective effect on public services or enterprises. Service design goes beyond the traditional design thinking and pays more attention to the design and user subjects, who are consumers and at the same time co-creators or executors of solutions, making users solve real problems in an invisible way and get a better service experience.

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[64] HOME-STAT." Civic Service Design Tools Tactics". September 22, 2017.

[65] http://www.tangux.com/index_T.html

[66] https://www.xiaoguantea.com

4 | Chapter Four

Case Studies

Fig.16   In 1996, Qisehua Kindergarten started accepting the first group of children with special needs under very difficult conditions.[67]

[67] http://www.inclusion.org.cn/kuangchanziyuan/539.html

4   Case Studies

4.1   Research on emotional interaction products for

disadvantage groups

4.1.1 Sign Language Translation System - Youtu AI Sign Language

Translator

According to the World Health Organization report[68], in 2017 there are about 466 million people around the world suffering from disability hearing loss, China's hearing impaired people reached 72 million, about 15.4% of the world, the number of people accounted for a rather large proportion.

So how to solve the difficulties for this group of people? This is a social issue that has always needed to be addressed. Therefore, May 16 is designated as Global Accessibility Awareness Day every year in order to solve the problem of how the disadvantaged people who have physical disabilities and cannot be cured , also able to live their lives without barriers and even free to do what they want to do, without the help.

However, in real life, as for the hearing-impaired people who can communicate daily by virtue of sign language, while in public places such as airports, high-speed trains and civil service windows, they communicate with a hearing person who has never received professional training, sign language is basically an impossible tool to achieve communication, and this dilemma of not being understood is exactly the daily life of hearing-impaired people. Therefore, how to solve the communication barrier for them is the most important problem that needs to be solved for the hearing-impaired people in terms of their emotional needs.

The current forms of sign language translators are divided into two types： [69]

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[68] https://who.foundation/wp-content/uploads/2022/10/Annual_Activity_Report_21_final.pdf

[69] https://www.maigoo.com/top/421669.html

- camera-led APP cell phone form and professional translator combined with network and computer。

For example, "the voice of the hand"[70]. Through APP mode, help hearing impaired people come ture functions like: remote video*(Figure 17）*, telephone substitute dialing, voice to text conversion*(Figure 18）*, etc.Promoting communication between hearing impaired people and normal people. Providing scientific basis for intelligent product development.

在线翻译　　　　　　　　　　　　　　手语翻译中心

Fig.17　　Remote Video[71]

文字转语音

交流
无障碍

聋人看文字　　　　　听人说语音

语音转文字
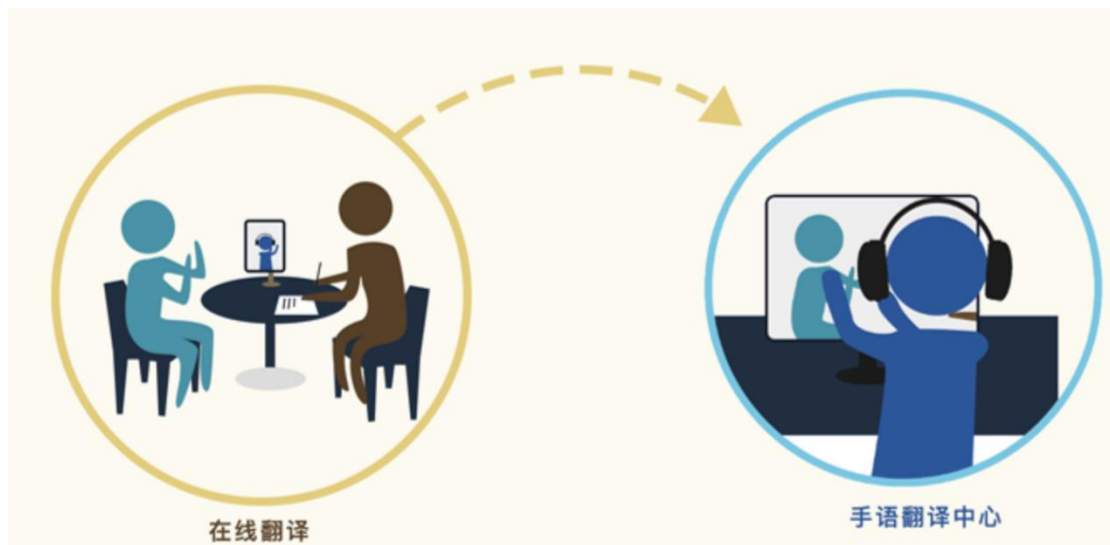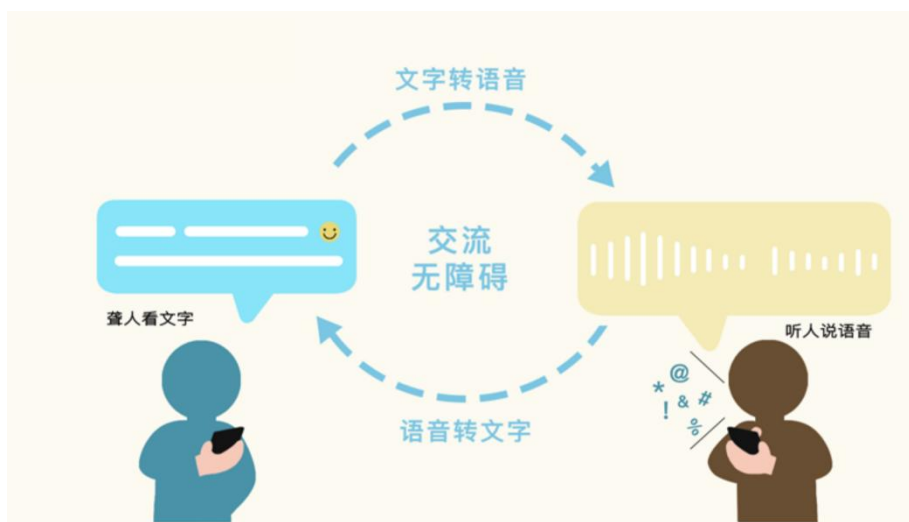
Fig.18　　Voice to text conversion[72]

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[70] http://www.voiceofhand.com
[71] http://www.voiceofhand.com/product.html
[72] http://www.voiceofhand.com/product.html

- wearable devices

Roozbeh Jafari[73], assistant professor and principal investigator in the Department of Biomedical Engineering at A&M University, is developing a new sophisticated tool to make ASL (American Standard Sign Language) understandable to all.

The electrical signals transmitted to the muscles by motor neurons can be detected*(Figure 19）*, and EMG can translate these signals into values that computers and professionals can understand.

Fig.19   A&M University Sign Language Translate Wearable Device

A team of UCLA bioengineers has introduced a new sign language interpretation system [74]*(Figure 20）* that is more compact and lightweight than previous designs.
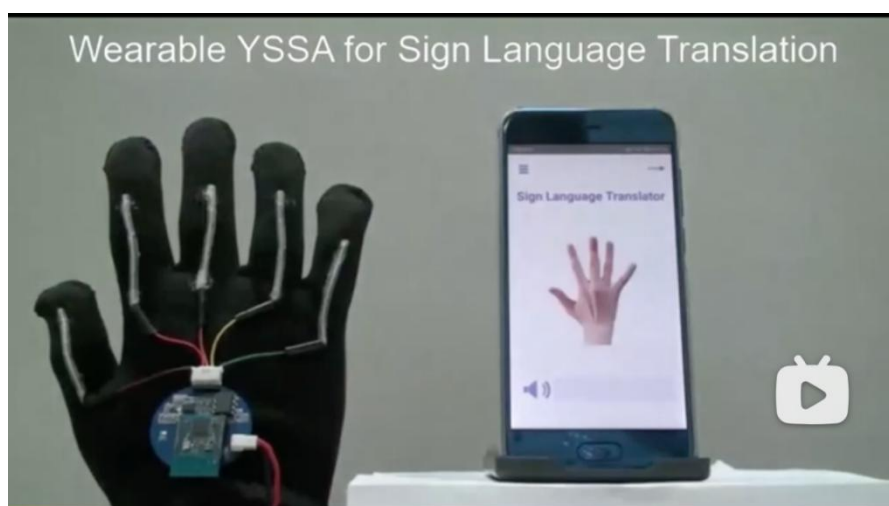
Fig.20   New Sign Language Translate System

[73] http://mt.sohu.com/20151117/n426720876.shtml
[74] https://www.bilibili.com/video/av583678216/

Tencent[75], China's largest Internet technology company, has established an AI hearing-impaired accessibility project team and launched the "Youtu AI Sign Language Translator" in 2019 to translate sign language information for the hearing-impaired and convert it into text to facilitate their communication with others in public.

The translator uses the ordinary camera of the cell phone as the data collection device, and relies on the high performance computer in the background for computing and recognition.

The usage method：

When the user completes the sign language expression in any white background area and faces the camera*(Figure 21）*, the screen of the interpreter will convert the sign language expression into text feedback to the user in real time, so that the hearing-impaired people can quickly understand what they want to express and achieve barrier-free communication.

Fig.21 Youtu AI Sign Language Translator

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[75] https://www.tencent.com/zh-cn/

This is the combination of sign language expression and recognition algorithm. The end-to-end sign language recognition algorithm is finally completed based on structured feature learning by collecting a dataset of sign language expressions from hearing impaired people in the first stage, and analyzing and generalizing tens of millions of sentences from the data using sentiment computing methods.

The biggest difficulties in sign language translation recognition[76]:

- Specificity and locality of sign language expression.

- The overall attention of the outside world to the hearing-impaired group is not enough, and the data collection is relatively poor.

- Incapable of adapting to more scenes, and the corresponding expressions *(Figure 22）*.

Fig.22　Hearing–impaired volunteers test the " Youtu AI sign language interpreter" at Shenzhen People's Hospital

Therefore, " Youtu AI Sign Language Translator" has done a lot of work to solve these problems, the core of which is to solve the problem of gesture recognition[77].

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[76] https://arxiv.org/abs/1908.01341v1

[77] Zhaoyang Yang, Zhenmei Shi, Xiaoyong Shen, Yu-Wing Tai,"SF-Net: Structured Feature Network for Continuous Sign Language Recognition."

Continuous sign language recognition(*SLR*)[78],It means to automatically distinguish various types of gestures, actions in sign language expressions and the switching between these gestures and actions through computer algorithms, finally translating the expressed sign language into words. However, compared to the research of other AI visual recognition technologies, the development of sign language recognition has greater difficulties and challenges. The unique locality, complexity and diversity of sign language expressions greatly increase the difficulty or cost of data collection and cleaning, while many traditional research methods are limited in adaptability and generalization due to the size of data volume and the defects of manually designed features.

The " Youtu AI Sign Language Translator" [79]collects sign language data by combining the sign language expression habits of the hearing impaired, and achieves a breakthrough in recognition technology of complex sign language expressions through self-researched algorithms with reference to advanced gesture recognition, action recognition and sequence translation technologies.

Samples of glosses that look similar in the Chinese Sign Language Dataset,[80]Yellow and blue boxes represent hand locations in the two frames. In each gloss pair, gloss on the top differs from the bottom one only either in motions or gestures. However, they are very different in meanings*(Figure 23）* .
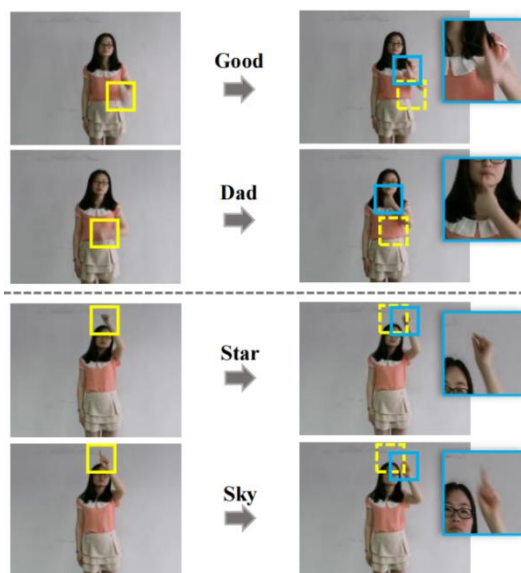
Fig.23   The seemingly similar actions do have different meanings

[78] J. Huang, W. Zhou, Q. Zhang, H. Li, and W. Li." Video-based sign language recognition without temporal segmentation." In AAAI Conference on Artifificial Intelligence, 2018.

[79] https://tech.qq.com/a/20191025/007962.htm

[80] J. Huang, W. Zhou, Q. Zhang, H. Li, and W. Li." Video-based sign language recognition without temporal segmentation." In AAAI Conference on Artifificial Intelligence, 2018.

In solving the difficult problem of how to better and accurately recognize gestures, they created a gesture set and tested it in a hierarchical structure and then in different ways.The tests they did on the dataset（RWTH-PHOENIX-Weather-2014 dataset.），set key layers and compared，Recognition results on full videos of the RWTH-PHOENIX-Weather-2014 dataset. Deletion, insertion and substitution errors are colored in green, blue and red respectively. Sentences below each sample are ground truth and then results of SF-Net. Translations to English are single word based. _on _and _off are starting and ending flflags while * represents absence of glosses. Samples are chosen from the validation and testing sets（Figure 24）.
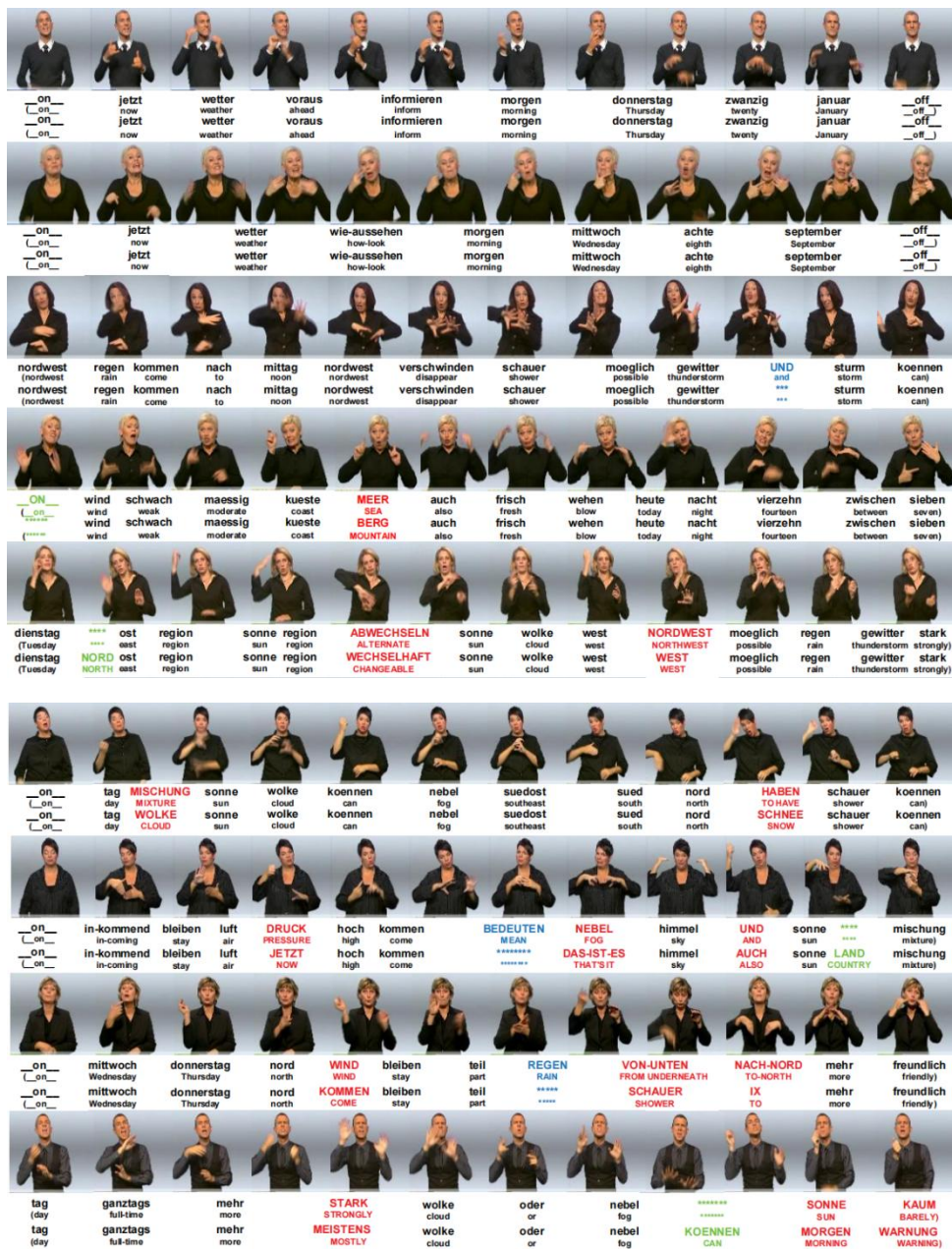
Fig.24　Recognition results on full videos of the RWTH–PHOENIX–Weather–2014 dataset

After getting results in the RWTH-PHOENIX-Weather-2014 dataset, They started to set keywords in the Chinese sign language test set as well and tested them.Deletion, insertion and substitution errors are colored in green, blue and red respectively. Sentences below each sample are ground truth and then results of SF-Net. Translations to English are single word based*(Figure 25）*.

Fig.25　Recognition results on full videos of the CSL dataset(Samples are chosen from the testing set)

The final effect test results are very positive and effective, so this algorithm is used in the backend algorithm of Utu AI sign language translator.

Compared with other methods, the data set of Youtu AI sign language translator covers nearly 1,000 daily expressions and 900 commonly used words, while further analyzing and summarizing the data, it has the largest Chinese sign language recognition data set at present, and supports the recognition of whole sign language expressions, and can directly judge whether the user is finished and complete real-time translation.

Secondly, to enhance advocacy for the needs of disadvantaged groups, we set up a long-term cooperation lab with the government to carry out long-term in-depth cooperation on sign language data collection and product algorithm optimization, as well as expand data capacity and improve data specifications through further contact with hearing-impaired people or sign language users, dedicated to promoting subsequent product and service deployment to promote the construction of information accessibility. The company has also combined with and polished the OCR engine technology together with mobile QQ, based on computer vision algorithms and natural language processing capabilities, which can directly convert the text on pictures into editable structured text, helping visually impaired groups to realize information communication accessibility.

Therefore, it can truly help the hearing-impaired disadvantaged people to achieve barrier-free communication in a variety of public places and realize the real emotional interaction of intelligent products.

4.2 Case studies of service design for disadvantaged groups

4.2.1 Inclusion Kindergarten – Zhengzhou Qise Flower Welfare Kindergarten

What is an inclusive education kindergarten?

Special children are accepted according to 7:1, which means that for every 7 normal children accepted, one more child with special needs (what we call disadvantaged children with physical disabilities) is accepted. The special children are then allowed to live and learn together with the normal children to promote each other and grow.

Before 1990 in Henan, it was not the usual practice for regular kindergartens to accept children with disabilities and special needs. Children with special needs would go to special education schools. However, special education schools did not accept

preschoolers, so preschoolers with special needs had to be cared for by their parents at home.

In 1996, Qise Flower Kindergarten began accepting children with disabilities*(Figure 26）*. Until now, Qise Flower Kindergarten is the most typical integrated kindergarten for children with disabilities in Zhengzhou.

Fig.26   A boy helps button a girl's jacket during a Qisehua Kindergarten students' outing in October.[81]

At this stage, there are 12 classes in the Qisei Flowers Kindergarten with 356 children *(by the time of the research in August 2022)*, including 50 children with special needs.

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[81] HANG LIQUN/For China Daily

https://enapp.chinadaily.com.cn/a/202203/21/AP6237cc15a3104446d8d13b02.html

These special needs children are mainly children with disabilities, including 26 children with autism, 10 children with developmental delays, 7 children with Down syndrome, 3 children with brain injury, and 1 child each with hearing impairment, visual impairment, angel syndrome, and Rubinstein Taibbi syndrome.

How to enable normal children and children with special needs to learn and live together, and to promote each other's growth.

The overall kindergarten service is designed with the goal of having each child be present and involved in all activities; the teacher provides guidance, sees the needs of the special needs children, and gives more support so they can learn better.
And to fully understand the emotional needs of children with special needs by doing the following*(Figure 27)*.

- Music is the soul of children with special needs.

- Play is the life of a special child.

- Play is the work of special children.

Fig.27   Teachers play with nondisabled and disabled children at the Qise Flower Kindergarten in Zhengzhou, capital of Henan province.[82]

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[82] SUN GANGJUN/FOR CHINA DAILY,
https://enapp.chinadaily.com.cn/a/202203/21/AP6237cc15a3104446d8d13b02.html

In accordance with these service design goals, the specific service design details of the Qise Flower Kindergarten:

- Environmental Accessibility - Barrier Free Facilities

The kindergarten has installed a large number of barrier-free facilities and play devices that make different sounds in the campus and school building *(Figure 28),(Figure 29).* In between classes, through the children's play, those devices make different sounds, which can help children with visual impairment to quickly understand and familiarize themselves with the campus as well as their location, and to walk around the kindergarten by themselves without any obstacles.

Fig.28　Sound from keyboard tapping can help
hearing–impaired children determine location

Fig.29　Barrier–free facilities

Kindergarten washbasins set at different heights allow children with physical disabilities, such as those in wheelchairs, to use these facilities freely *(Figure 30)*. Classroom seating and classroom materials are adjusted for children with different special needs. For example, children with autism and hearing impairment are more sensitive to sound, so they are arranged away from windows and indoor electrical appliances, air conditioners, sterilizers, etc. in order to protect them from hearing interference.

Fig.30　Washbasins of different heightss

- Integration of rehabilitation into life

Children with special needs have different emotional needs features, in order to meet their emotional needs at the same time, also join the rehabilitation training in their learning life, help them to learn better as well as physical recovery exercise.For example, for children with autism, their bodies sway constantly when they sit or stand, and they move their arms and legs around, so massage mats are placed on their seats and small brushes are put on their hands when they read to help distract them from thinking about their swaying bodies or moving their arms and legs around*(Figure 31)*。 Some children's attention will not concentrate, and learning will cause temper tantrums, so kindergartens are equipped with swing seats, adjust sitting attention at any time, and adjust the central nervous system, to help children better into learning*(Figure 32)*.

Through these auxiliary aids, children learn that this helps them to be quiet and engaged in their learning, and children will seek the support of these aids on their own in many cases.

Fig.31   Swaying Seat   Fig.32   Massage cushion and Small brush

- Communication picture cards to protect children's desire to communicate

Children with special needs generally have delayed speech, and their language comprehension and language expression skills are very different from those of normal children. How can teachers communicate with special needs children and be able to make themselves understood?

Kindergartens will use communication graphics cards, which are generally composed of several parts

Who?
Which one parts of the body?
What you want to do?

What are the benefits of doing this：

- This way the teacher, children and classmates can clearly know what he is trying to say or what he understands.

The first and uppermost picture show that I heard a sound. The second picture card child tells the teacher and classmates that I want to play soccer. The third picture card child tells the teacher that I want a bear toy*(Figure 33)*.

Fig.33   Communication Graphics Cards

- The kindergarten will also make "one day flow chart cards" in advance*(Figure 34)*.

The One Day Flow Chart shows children what they need to do during their kindergarten day, reducing the anxiety of special needs children, especially for those who are not so comfortable with just entering kindergarten and do not understand and are not comfortable with some of the steps, such as, washing hands, hanging clothes, moving chairs, etc. These special needs children are well guided by visual pictures of kindergarten life.

Fig.34   One day flow chart card

This non-verbal communication of pictures helps children to be willing to initiate expression and protects their desire to communicate. In teaching everyday life, protecting children's desire to communicate is more important than their learning to express themselves with words.

- New student welcome party and star moment

New student welcome party

When a child is going to the new environment of kindergarten, the kindergarten will hold a welcome party for new students. Before entering kindergarten, the kindergarten will visit the child's home according to the information provided by the parents, and take pictures and record videos of the child's daily life, especially the special places, and finally make a PowerPoint.

After that, before the special needs child arrives, the teacher will show a PowerPoint to introduce information about this special child. For example, this child likes to hold a doll in a quiet corner, he is small, walks unsteadily, and may fall easily when walking.

When all the information has been introduced, the teacher will guide the other children on what we can do for this child when she arrives.
   - This is when the children started to think about what they could do for this special child. For example, the washbasin was very high, so they brought a ruler to measure it, and then according to the height of the special child, they found large blocks from outside and put it in front of the washbasin, so that the child could wash his hands independently. They can also go to the toilet together and hold hands when they walk to protect them from falling down. The children can learn to use their brains and learn the ability to help others.

   - New student welcome parties are not reserved for special needs children, also for every child who enters kindergarten. At the beginning of the new school year, children introduce themselves to all the children*(Figure 35)* , or ask their parents to introduce themselves.Children influence each other and learn from each other.

Fig.35   New student welcome party[83]

Star Moments

Every child can be a star. The star moment is when the teacher picks one child in the class each month and everyone sits around and each talks about what the child likes, what she's good at and what I've learned from her*(Figure 36)*.

Fig.35   Star Moments[84]

- Teaching evaluation, assessment for each child, and overall classroom planning

The plan is developed by assessing each child in the class. The average children have more common needs, so the kindergarten makes a big plan, after which an individualized plan is created based on the overall plan for the average child combined with the individual needs of the special children to support the kids' learning together.
In other words, "same activity, different learning objectives."

For example 1, learning the song -" *Little Doll Fell Down*".
Different children have different learning goals in this activity. The goal for normal children is to learn to sing the song, feel the melody of the song and be able to create movements. Special needs children are different depending on the individual, some understand the lyrics; some like to walk back and forward, so they can participate in creating actions with the group and sway with the music; others are relatively strong in their abilities and can sing along with other children.

In kindergarten, children also learn more than just a lesson; they learn all day every day of their lives.

For example 2, learning the number"*Three*"
one of the special needs children has a learning goal of matching numbers up to three

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[84] https://baijiahao.baidu.com/s?id=1757214724883656556&wfr=spider&for=pc

and this child is very active. The kindergarten teacher would have this child hand out tableware. In the process of handing out tableware, the teacher would show the number 3 and the child would take out the corresponding bowl and plate. In this way, the child learns to make pairs.

Through such service goals and implementation plan steps, Qisei Flower Kindergarten has become a leader of integrated education in Henan Province, and with the promotion of Qisei Flower Kindergarten, the Henan Provincial Government started a kindergarten integration pilot in 2014. As of today, there are 182 pilot kindergartens in Henan province, covering 158 counties and cities in the province*(Figure 37)*, and they are also starting to be promoted in primary and middle schools on a trial basis.

Fig.37   Map of pilot kindergartens[85]

As a result, inclusive education is a process that respects differences, removes barriers, and is an excellent example of service design for disadvantaged groups in China that has been successful.

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[85] http://inclusion.org.cn/Focus%20News/rongheshidianyuan/?id=26

4.2.2 Beijing Lizhi Rehabilitation Service Center

From the original old concept, management. Change to a new concept and management.

Beijing Lizhi Rehabilitation Service Center*(Figure 38)* was established in 2000, is a non-profit organization.[86]

service concept : "equality, respect, trust, care, pragmatism and innovation", practices and promotes the mission of independent living, and creates a better vision of "making decisions for oneself" for people with disabilities.

Target User: mentally challenged and elderly people over 15 years old.

Services: Independent living service, independent study service, independent work service, independent leisure service, community-based vocational service, stable vocational service, vocational rehabilitation service. In other words, it provides free living services for adult mentally disabled people.

Fig.38   Beijing Lizhi Rehabilitation Service Center–Emotional interaction room[87]

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[86] http://260780230.cn.gongxuku.com

[87] https://baike.baidu.com/item/北京市丰台区利智康复中心/7542114?fromtitle=北京利智康复中心 &fromid=16925975&fr=aladdin

In 2010, the official statistics of China Disabled Persons' Federation[88], there are 11.97 million mentally disabled people in China. Mental retardation refers to the developmental period (from conception to the age of 18) when intellectual functioning is significantly lower than normal, accompanied by deficits in adaptive behavior, including autism, cerebral palsy and Down syndrome disorder.

Before 2013, Lizhi was an institution that used the traditional residential service model. All mentally challenged people lived together in groups, and because of the lack of quality of life, mentally disabled people were prone to emotional turmoil, creating outbursts and other emotions that led to fights, sleeplessness, and glass smashing all over the institution, like in the movie "One Flew Over the Cuckoo's Nest". Almost all the mentally disabled people said "I don't like it", then as a service organization they started to prepare for the transformation.

Therefore, after 2013, Lizhi became a rehabilitation center with a focus on people services.
Specific service measures：

- Start with the name*"Xin Qingnian"*and *"Assistants"*

The society calls the mentally disabled "slow flyers" and "snails", and the mentally disabled call the service providers and staff "teachers". However, mentally disabled people do not like these names and feel that they are not treated with respect and equality. Therefore, Lizhi named the mentally disabled people living here as "Xin Qingnian", which means young people who live with heart, and named the service providers and staff as "Assistants". To satisfy the emotional needs of people with mental disabilities.

- Self-directed living

The mentally disabled person is easily agitated and always makes demands by making trouble, and this is also caused by the same model of family, staff and the person. It is often the case that the mentally disabled person does not know how to do anything and we arrange everything for them, but this mode often brings bad results. There is no real service for the person, thinking in terms of his needs and thoughts.

So mentally disabled people from being arranged to live their lives and forced to do something every day with no freedom changed to being able to arrange their own lives. and do dream interviews and let them speak their minds like normal people. And they can choose the time, place and people they want to attend to have a chat conference.

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[88] https://www-current.cdpf.org.cn

- Dream Interviews.

Let them speak their mind*(Figure 39)*. And they can choose the time, place and who they want to participate in a chat conference.

Fig.39   Results of the dream interview – in the form of words with pictures

Each person with a mental disability can make his or her own plan, as well as choose between an individual plan of action alone and a plan of action for a willing group*(Figure 40)*. Based on these plans, the agency service staff will make arrangements according to the plans and the service staff will follow the implementation of the plans. The plans are generally created using pictures from which the mentally challenged person can choose the activities she likes.

Fig.40   From being arranged to self–arrangement

Each week on Friday the schedule is posted for the next week and everyone has a different idea of what they want to learn and explore outside the community*(Figure 41)*.

Fig.41   From being arranged to self−arrangement

- Familiarization with the environment

At the service center, mentally disabled people will learn some professional courses , such as buying things and other common scenarios in life. But the previous familiarization course is all about simulating the society in the center, and going to simulate training in a closed scene.

For example, if you want to cross the street, you have to simulate a traffic light, and if you want to teach the etiquette of riding a bus, you will simulate a bus. One time when I went out to explore the bus, there were many problems such as forcing people to give their seats to themselves, so through a lot of training and teaching, they found that mentally disabled people would still encounter many problems in the real environment.

   - Simulating society is not the same as learning social planning; they need real community exploration.

Hao, a mentally disabled person, who was supported by the service center to take the subway, go to the Red Brick Museum, and go shopping in Dazhalan according to the plan he made, was very happy and successful*(Figure 42)*. Thus, it was found that independent living is not a matter of ability, but of familiarity with the real social "environment".
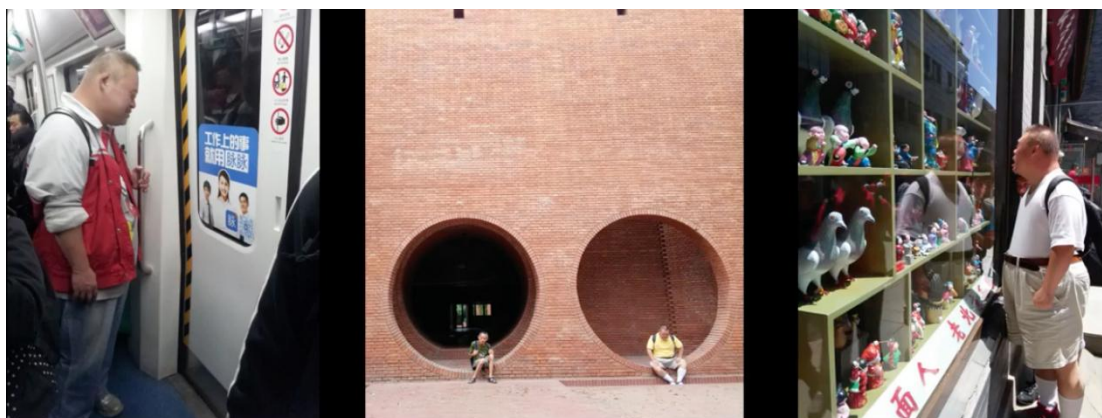
Fig.42   According to Hao's plan:take the subway and go shopping

- Accommodation scenario change

Through the previous dream interviews, many mentally disabled people expressed their wish to go out for living, feeling that it is too noisy and too many people inside the institution."*I don't like it, I want to live in the community with my little sisters inside the institution.*"*(Figure 43)*

Fig.43   Want to go out and live in the Community

The previous rehabilitation center had all the living places and scenes happening inside the center, the mentally disabled people couldn't come and go as they pleased, and every time they went out of the rehabilitation center, they had to have a strict plan and management. This kind of life caused most mentally disabled people to stay together and want to go out, but when they actually went out, they were afraid to go out and didn't get much exercise and change. The service center has since changed this approach, allowing them to live independently in the community instead of in an institution, and establishing independent living centers in the community.

Community Living Process for the Mentally Disabled:

  - The "Assistant" accompanied the "Xin Qingnian" and his parents to see the house, choose a roommate, and then move in.

  - In the beginning, the "assistant" will help him/her to get familiar with the surroundings, make a life plan, and implement the division of labor.

  -Then, based on the service center's assessment, they will retrain the "Xin Qingnian" in areas where they are weak in independent living.

  - If the assessment is good, the "Assistant" can be released, leaving the "Xin Qingnian" to live independently. (The service center has set up autonomous living centers in the same community as the "Xin Qingnian"residence, thus providing easy access to some emergency situations.)

Nan and her little sister moved to a house in the community and had two service workers to help and support them in making community connections. They returned to the service center during the day to learn and participate in activities, and finished their activities in the evening to buy groceries for cooking at home, starting a two-year period in which the staff supported them to move back and forth to the community every day, while supporting them to explore the community environment, to master resources, to establish a rhythm of life,   therefore to help them plan their lives and develop bookkeeping each week, and to live their lives in a good way*(Figure 44)*.

Fig.44   Make a weekly life plan with bookkeeping

Since they are living independently in the community for the first time, they need to get familiar with each other. After that, the support will be slowly reduced according to the assessment and their autonomy status, so they can go to the movies and eat on their own*(Figure 45)*.

Fig.45   Nan and her friends pick their own restaurant for dinner

- Help them find jobs

At present, people with mental disabilities have very few opportunities to find jobs, basically in the types of housekeeping, kitchen helpers and delivery workers.

What can they do to help them find jobs?

Before looking for a job, interviews are conducted with interested people who have mental disabilities to fully understand the individual's employment intentions as well as past experience and strengths, etc. The service center integrates this information and consolidates it.

Then, they help to match the potential employers, assist the mentally disabled person to create a resume and sign an employment contract. In the first 1-3 months of their employment, Lizhi help them understand the workflow and develop good workplace habits and attitudes, also help them find natural supporters in the workplace, such as their bosses, supervisors, and colleagues who are more accepting and have good relationships.

When all the support is established and complete, Lizhi service staff can temporarily quit helping, and slowly go from once a week to once a month to return phone calls, and if it is stable for more than six months, it means the employment is successful.

At present, Lizhi has successfully supported more than 90 mentally disabled people to find jobs*(Figure 46)*.

Fig.46   "Shunli" successfully worked in a bakery

Through the changes in the service programs of the rehabilitation service center above, more and more mentally disabled people can live autonomously with other companions now, and the environment is getting better and better, they learn more and more things independently, so they can live independently like normal people, instead of needing care at all times.

The service center has also set up a special work center to help "Xin Qingnian" who are living independently and have the desire to work, in order to help them achieve a truly independent life.

Lizhi did what they expected in the beginning, which is that one day mentally disabled people will have the opportunity to choose living away from home or living with his companions. So that he has his life and his parents have their lives, only for his family to be there when he needs help.

This is true service design changes lives.

4.3   Summary of cases

Through three different cases studies about disadvantaged groups, we can find that disadvantaged groups do have a lot of pain points in their lives, and these pain points have different impacts on their lives, learning and other aspects.But through their scenarios, user analysis, etc. also through different ways, such as intelligent products, service design and other methods to improve or even change their living conditions, improve their quality of life, to achieve the real elimination of barriers*(Figure 47)*, so that design serves the population, design brings convenience to life, design produces greater social value.

Fig.47   Children with mental disabilities and normal children play games together at Qisei Flower Kindergarten[89]

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[89] https://baijiahao.baidu.com/s?id=1757214724883656556&wfr=spider&for=pc

PART THREE

The Study of the Chinese Healthcare System

5 | Chapter Five

Examines and analyzes the current state of Health care specific in China

Fig.48　Hospital elevator scene at the First Affiliated Hospital of Zhengzhou University, Henan Province

5 Examines and analyzes the current state of Healthcare specific in China

5.1 Analyze and summarize the needs of the disadvantage groups in Healthcare

Through the previous research on the five important characteristics of China's disadvantaged groups and related population categories. The next step is to understand their needs and make relevant designs according to their needs to solve these pain points, which is the focus of this research.

Therefore, the target objects of this research to find the conditions of the relevant disadvantaged groups are *124* people.

According to the disadvantaged groups their own situation, age, social and other factors, the target group of this research, classified by these factors, divided into 4 categories*(Figure 49)*：

- **Children**：

  Age Range：5-10 years old
  Number: 30 people

- **Disabled** （Includes psychological and physical） ：

  Age Range：16-27 years old
  Number: 14 People

- **The elderly**

  Age Range: 61-72
  Number: 35 people

- **The patient(inclede Pregnant women**）

Age Range:28-68

Number: 45 people.

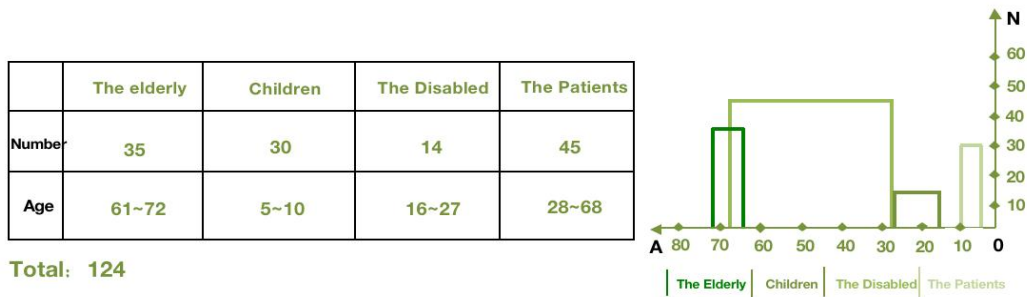|	The elderly	Children	The Disabled	The Patients
Number	35	30	14	45
Age	61~72	5~10	16~27	28~68

Total：124

Fig.49   Target classification and number of people in this research

Then, according to the methodology, the questionnaire was selected to facilitate the quantitative analysis in the early period and to derive most of the needs for disadvantaged groups. The questionnaire questions were set to a number of 38, a number of 124 participants, and 124 valid responses were collected.

The purpose of the questions was to get to know the real conditions and needs of the disadvantaged groups.

For example, one of the questions was "If you were to classify your life into 4-5 categories according to situations (types of things that happened most frequently), give the percentage of your overall life in each section and give reasons."

Then we can observe through the 124 questionnaire answers that a large percentage of the lives given to all disadvantaged groups are *Healthcare*, even though they are in different categories of people, different ages, and other completely different conditions, but the common and large percentage is *Healthcare(Figure 50)*.
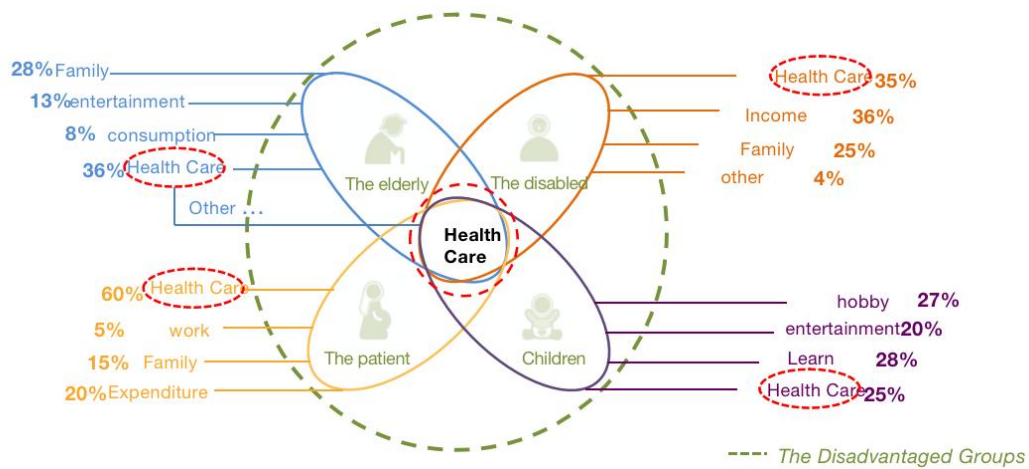
Fig.50   Common Needs of The Disadvantaged Groups – Health Care

Finally, the whole research was summarized and analyzed, finding that most of the disadvantaged groups have raised concerns about healthcare and inconvenience, etc. Furthermore, they can hardly live without healthcare, such as the simplest medication, injection and then rehabilitation training and eventually they need to be in hospital all year round.

Therefore, healthcare basically permeates most of their lives, and combined with the analysis of different user profiles in China from 2021, as well as the new Covid-19 starting in 2019, all these situations can help us to analyze the needs of disadvantaged groups. So I can conclude that the common need of disadvantaged groups is health care by combining this research.

5.2   Current status of Healthcare in China

In China, The healthcare service system that covers both urban and rural areas consists of hospitals, primary health care institutions, and specialized health institutions.[90]According to data from the National Statistics Bureau[91], at the end of 2019, there were 1.01 million medical institutions in China, including 34,000 hospitals,

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[90] https://tv.cctv.com/2016/08/23/VIDAShHHfWeYifHpn4SXtvLp160823.shtml

[91] https://data.stats.gov.cn/easyquery.htm?cn=C01

accounting for 3.4%; 959,000 primary medical and health institutions, accounting for 95%; and 17,000 professional public for even institutions, accounting for 1.6%.

With the fast development of the economy and the importance of health for the population, combined with the large population in China, as of late 2019 before the Covid-19.The total number of Healthcare institutions for the whole year is 8.52 billion people[92], and the rapid rise in the number of consultations has prompted China's healthcare institutions to maintain high growth in hardware facilities such as, for example, hospital beds. By the end of 2019, there were 8.92 million beds in Healthcare institutions in China, including 6.97 million in hospitals and 1.38 million in rural health centers.

As China's public healthcare management system is still incomplete, there are problems such as high healthcare costs, low access, and low coverage that affect people's livelihood. In particular, the "inefficient healthcare system, poor quality healthcare services, and difficult and expensive healthcare" are the main concerns of the society.

Problems such as overcrowding in major hospitals, lack of interest in community hospitals and complicated procedures for patients are caused by poor healthcare information, polarization of healthcare resources and lack of medical supervision mechanisms.

Especially, as China is officially entering the aging society, the proportion of people over 60 years old is increasing year by year.

The seventh national population census bulletin [93]shows that the proportion of people who aged 65 is 13.5% in China , up 3.8% compared to 9.7% in 2013, and the trend of population aging will continue further in the future. With the aging population, this number is still on the rise. In terms of incidence rate, the older the age, the higher the incidence rate, especially for those aged 65 years and above, the two-week incidence rate is as high as 465.9%[94].

Before the COVID-19, as people's standard of living is getting better and better, the quality of life is improving, and human life expectancy is increasing.

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[92] http://www.gov.cn/fuwu/zt/ylws/index.htm

[93] https://data.stats.gov.cn/search.htm?s=总人口

[94] http://www.gov.cn/fuwu/zt/ylws/index.htm

The chronic disease is currently the most important issue and the biggest challenge for healthcare,[95] and we can find through the literature review that many studies are currently using EBCD (experience-based co-design),Co-innovative design using past experience and with the user in focus. But with the Covid-19 epidemic outbreak in 2019, the fading infectious diseases are back on our horizon, so the new challenge in the healthcare arena will be the combined control of infectious and chronic diseases as the Leading prevention*(Figure 51)*.
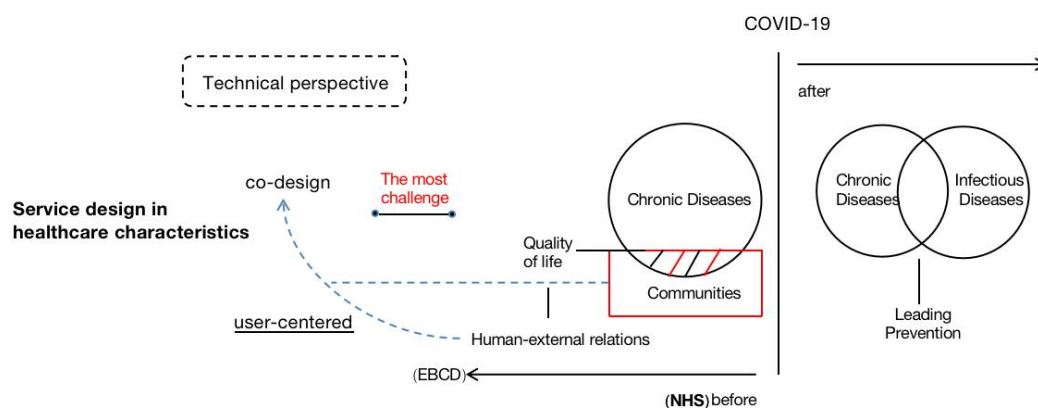

Fig.51　Analysis of existing healthcare（Source：Sangiorgi, Prendiville, Jung and Yu, 2015；Cottam & Leadbeater,2004)

Therefore, the current state of healthcare and the current state of China's healthcare system are combined to study, analyze the problem areas and design interventions using service design. While the Chinese healthcare system is improving as a result of economic development and healthcare system change, there are still many problems, especially healthcare overload concentrated in large public hospitals, and multiple problems such as asymmetric healthcare information, so the current situation of different types of Chinese healthcare systems is analyzed in detail.

5.3　Service Design in Healthcare

Service design as a collaborative and creative approach focused on achieving new types of value co-creation among participants.[96]Therefore, it is very appropriate to use service design to solve existing healthcare system problems in China.

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[95]　Sangiorgi, Prendiville, Jung and Yu, 2015；Cottam & Leadbeater,2004

[96]　Wetter-Edman et al., 2014; Ostrom et al., 2015

Existing service design analyses of healtcare, they divided into three areas[97] *(Figure 52)*.

- Chanllge

It is include namely long-term healthcare, aging, social interaction and support, environment and lifestyle,non-communicable diseases, wellbeing and mental health, active life/living.

- Trends

It is include self-care or health management, person-centric healthcare, holistic healthcare, community healthcare and preventative healthcare.

- Chance

It is include health communication, prototyping, co-design, evidence-based design, digital design salutogenic design and holistic design.
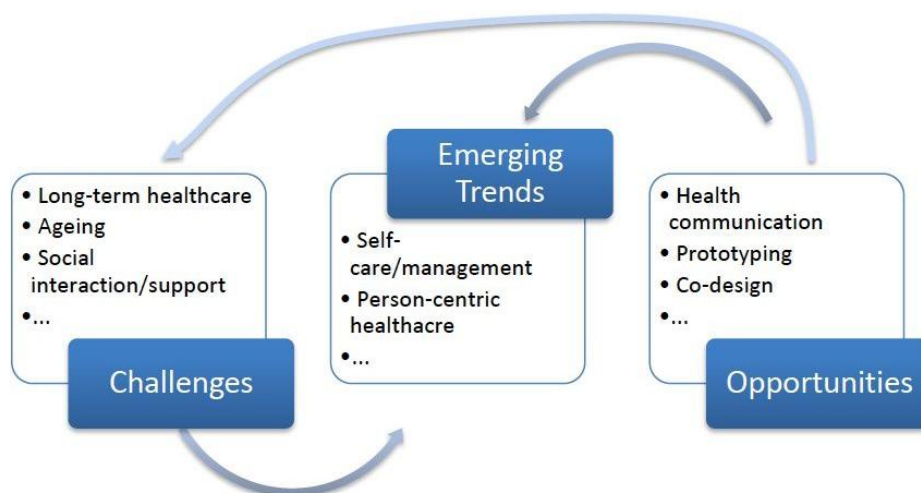
Fig.52   Service Design in Healthcare （Source：Tsekleves & Cooper, 2017)

According to the current state of healthcare in China, there is a serious imbalance in the distribution of resources， We should more focus on public healthcare service system.[98]Because the public healthcare system is currently the choice of more than 80% of the Chinese people.

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[97] Tsekleves & Cooper, 2017

[98] Sangiorgi, Prendiville and Ricketts, 2014

The same, i found the table[99]*(Table 1)*. According pre-existing diseases and Preventive measures，we need use new healthcare Service design leading a health lifestyle.

	SERVICE DESIGN AS A SKILLED CONTRIBUTION	SERVICE DESIGN AS A PEOPLE CENTRED, CREATIVE AND SYSTEMATIC PROCESS	SERVICE DESIGN AS A PEOPLE CENTRED AND COLLABORATIVE MIND SET AND APPROACH
Procurement	Chosen for their skills (e.g. user studies and engagement, co-design, visual or creative skills)	Chosen for their process and organisational fit	Chosen for their approach to change and innovation
Well defined and output oriented	Oriented toward outputs; focused on developing/improving an offering	Open and exploratory; focused on developing/improving an offering	Open and exploratory; focused on learning a new way of doing things
Contribution to NSD	Initial stages of NSD (e.g. research and design activities)	All main NSD stages toward implementation	All main NSD stages toward staff independence
Design outputs	Distinct designed deliverables	Work in progress documents and prototypes	No definite deliverable
Innovation outcomes	Changes are informed by design contribution	Changes are led by design process	Change is enabled through learning
Designers / Client relationship	Separate processes with distinct roles	Collaborative processes led by designers	Integrated and emerging processes

Table.1　What Service Design can do for us（Source: Sangiorgi, Prendiville, Jung and Yu, 2015）

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[99] Sangiorgi, Prendiville, Jung and Yu, 2015

5.4 Research and analysis of the current Chinese Healthcare system

5.4.1 Large general public hospitals

The large general public hospitals are the main part of China's healthcare service system.[100] Chinese Minister of Health "Chen Zhu" said: "The public hospital is the main part of the public service, to solve the basic healthcare, to relieve the difficulties of the people to see the doctor, the contradiction problem is more concentrated.To strengthen its public service, we must reverse the trend of over-emphasis on hospital income generation and make it a basic healthcare service platform for the public to treat major, serious and difficult illnesses."

There are 3 levels of public hospitals in China：

- Level 1 is community hospitals;

- Level 2 is county (regional) hospitals;

- Level 3 is city hospitals.

We first study large general public hospitals, so we study level 2 and level 3 hospitals in this case, which are county (regional) level and municipal level hospitals. By the end of 2021, there were 3,275 tertiary hospitals (including: 1,651 tertiary class A hospitals) and 10,848 secondary hospitals.[101]

According to the "Statistical Bulletin of China's Health and Health Development in 2021",[102] the total number of visits to healthcare institutions was 8.47 billion, an increase of 730 million (9.4%) over the previous year, and the average number of visits to healthcare institutions by residents in 2021 was 6.0.

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[100]https://baike.baidu.com/reference/129255/06171Vn32JFb6d3JzQy2DgsxIm_Zqn2tONmWlLpSmEnCP_-W4Io97cVllshM6tC4s_JFUre3xPAViUUQEHOePU9uvbVHF-8D7WgbHlb-A54e5ZO0

[101] 2021 China Health Development Statistics Bulletin ,From Chinese government website.2022.

[102] Statistical Bulletin of China's Health and Health Development,2021.

Among the total number of visits in 2021, hospitals had 3.88 billion (45.8%) and primary healthcare institutions had 4.25 billion (50.2%).

We can find that hospital visits account for half of all visits, and the number of visits to large general public hospitals is 3.27 billion, accounting for 84.2% of total hospital visits. In other words, 3.27 billion visits were made to large public hospitals*(Table 2)*.

表5　全国医疗服务工作量

机构类别	诊疗人次数（亿人次）		入院人次数（万人次）	
	2020	2021	2020	2021
医疗卫生机构合计	77.4	84.7	23013	24726
医院	33.2	38.8	18352	20149
公立医院	27.9	32.7	14835	16404
民营医院	5.3	6.1	3517	3745
医院中：				
三级医院	18.0	22.3	9373	11246
二级医院	11.6	12.5	6965	6890
一级医院	2.0	2.2	1117	1120
基层医疗卫生机构	41.2	42.5	3707	3592
其他机构	3.0	3.4	953	985
合计中：非公医疗卫生机构	18.2	19.3	3569	3820

Table.2　China's medical service workload[103]

Therefore, we can find that the majority of Chinese people prefer to visit large general public hospitals based on the data given by the government, and even more than 50% of these diseases can be solved in community hospitals (level 1 hospitals), but the number of visits to community hospitals in 2021 is only 220 million, which is 6% of the total number of visits. The fact that a large number of people who need to visit a doctor will all choose a large general type of public hospital leads to a number of problems.

Large general public hospitals are generally structured using a three-part structure in China.

103

https://baike.baidu.com/reference/129255/06171Vn32JFb6d3JzQy2DgsxIm_Zqn2tONmWlLpSmEnCP_-W4Io97cVllshM6tC4s_JFUre3xPAViUUQEHOePU9uvbVHF-8D7WgbHlb-A54e5ZO0

Divided into :

- Inpatient Department,

- Outpatient Department

- Medical technology:Logistics and Emergency.

Outpatient and inpatient settings are on both sides, and medical technology is in the middle. Some doctors are in charge of diagnosis in outpatient clinics, some are in charge of blood draws and tests in medical technology departments, and some check in inpatient departments, while patients transport themselves on this industrial assembly line, they need to run back and forth which wastes a lot of time.

Field Research:

The survey research is based on the " *First Affiliated Hospital of Zhengzhou University*", which is the largest general public hospital in Henan Province *(Figure 53)* Also the largest hospital with the largest number of patients in central China. The hospital currently has three different campuses in Zhengzhou- the city where it is located. The purpose of the different campuses is to alleviate the pressure on the hospital and to implement a patient triage orientation.

Fig.53   The First Affiliated Hospital of Zhengzhou University

105

This thesis analyzes the hospital district that currently has the largest number of patients among the three hospital districts.

This hospital area has 12 buildings *(Figure 54)*, Inpatient Department has 6 buildings, Outpatient Department has 2 buildings, Medical technology:Logistics and Emergency has 8 buildings.

It can be found that the overall distribution of the hospital area is complicated and there are too many buildings.
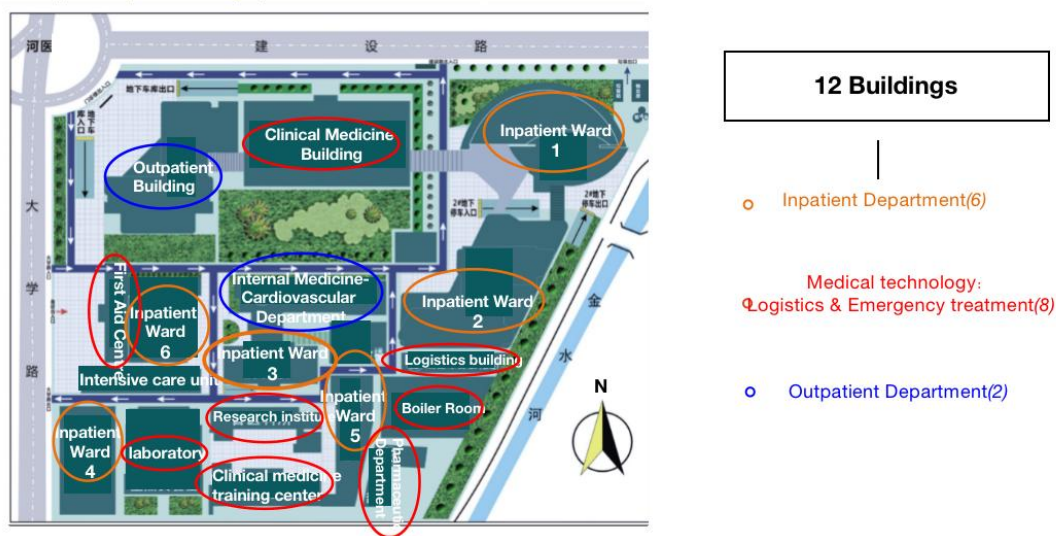

Fig.54   Plane Graph(The First Affiliated Hospital of Zhengzhou University)

Then we look at one of the inpatient units*(Figure 55)*, which has 27 floors and can also accommodate 10,000-13,000 people at the same time, with 12 escalators and 17 direct elevators in the building.
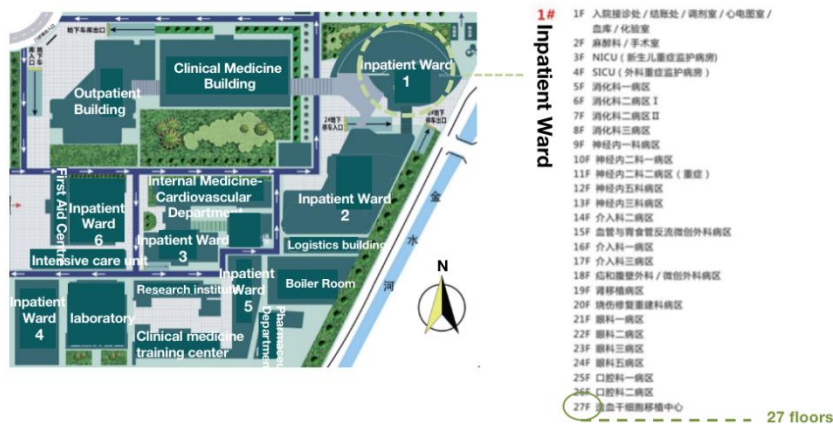

Fig.55   Inpatient Ward 1 (The First Affiliated Hospital of Zhengzhou University)

We took out the floor plan *(Figure 56)*,of the whole hospital area, we can find that not only Inpatient ward 1 has so many floors, but each building has many floors, and Outpatient ward 2 is also divided into two north and south buildings, each side building has 28 floors, which means that the floors of the north and south buildings are totaled to 56 floors, and there are two other buildings also divided into north and south buildings, as well as a ward building of 22 floors and a ward building of 4 floors.

Fig.56   Overall hospital floor distribution map

Therefore, we can see that the structure of the building is extremely complex and widely distributed, and it is necessary to go back and forth to multiple places to visit the doctor, and it is difficult for the patient to distinguish the route, it is easy to get lost and not find the place they want to go.

When we walked inside the outpatient building or any of the buildings in the hospital area, we found a large number of people gathered there *(Figure 57)*. Especially at the elevator entrance, even though there are 27 elevators in Outpatient Building 1, there are still a large number of consultation patients gathered in front of the waiting elevator entrance. Because there are more floors, the direct elevator is relatively faster than the step escalator, so most of the patients of high floors will directly choose the direct elevator, which is divided into single and double floors and full floors, so as to enhance the efficiency.
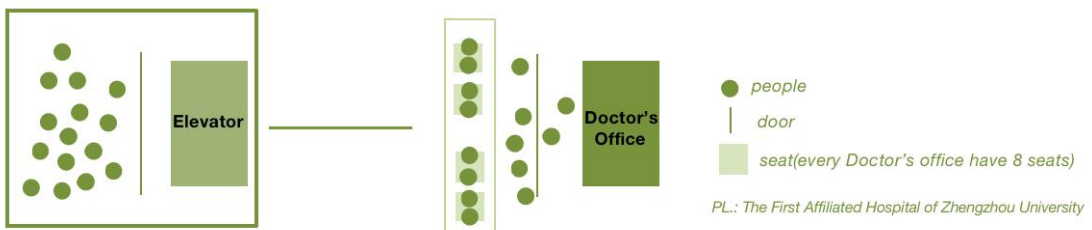
Fig.57 long waiting time（Doctor's office and elevator entrance）

All areas of the hospital have a large number of seating and waiting areas, for example, the outpatient clinic building 1, each floor has roughly 56-65 seats placed, but due to too many patients, hardware facilities are limited.so that many patients in the long run, there is still no place to rest, can only choose to stand or sit on the ground waiting*(Figure 58)*.
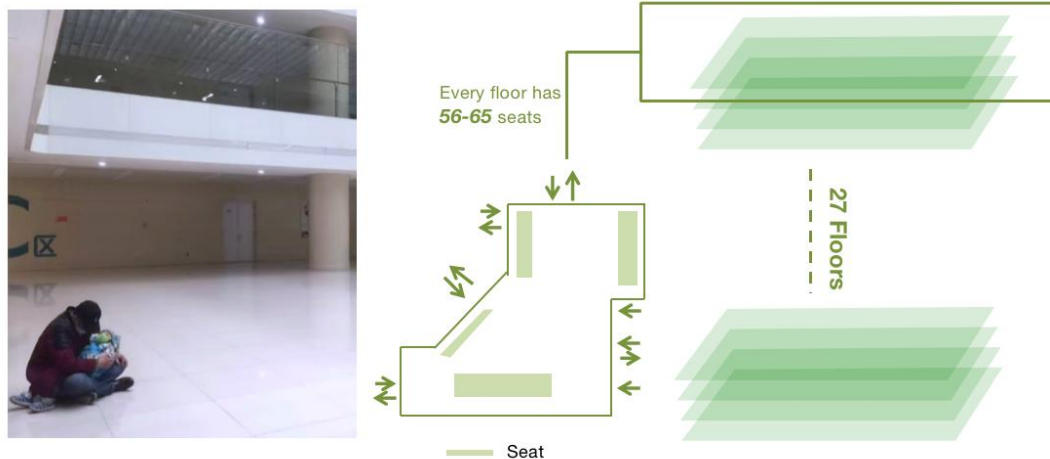
Fig.58   No place to rest

There is basically an exhibition area on each floor of the hospital, where a wide range of diseases and related information are displayed on the walls*(Figure 59)*. However, the acceptability of the content of the pictures does not take into consideration the real needs of the patients, whether the information will increase the pressure of the heart after a long wait, especially some pictures are not suitable for an excessive exhibition, and the content is relatively hideous, which may cause discomfort of the patients. And the text part is generally relatively academic in language, the ordinary patients may not have the means to understand the meaning of these words。

Because of the possible discomfort and the difficulty of understanding the content, the general consultation patients will choose not to read these information, which will lead to some effective information missed. Originally these positions belong to the central position, should be placed in some effective information to remind patients or achieve the effect of science information, but the content is not attractive enough and easy to cause disgust, resulting in these positions are not playing a better value.

Position is important, but the display content is not attractive enough

Show pictures that are too real and easily cause discomfort

Stomach Ulcer

1. Excessive display of negative information.
2. The language is too academic, with many rankings, and not easy to understand.

Fig.59   Too much pathological information, Cause psychological discomfort

After all the field research,I made an experiment.

Experiment ：   "*How long it takes from registration to finding a doctor*"*(Figure 60)*

- **Experimental site:**

  The First Affiliated Hospital of Zhengzhou University

- **Experimental purpose:**

  Time spent from registration to final arrival at the hospital office

- **Experimenters：**

  - the general population
  - disabled people in wheelchairs（Use wheelchairs size：41-43 cm）

Time：51minutes

11:46   12:03   12:19   12:37

Determine the visiting Department

Register

Find the floor   Find the Department   Find the doctor

1.Find the location of the department and determine the location
2.Wait in line for the elevator,
3.find the corresponding department.

Continue to line up and wait for the number to be called.

To much information，the route is too long to get lost

Time：1Hour23minutes

11:46   12:17   12:37   13:09

41-43cm

Find the floor   Find the Department   Find the doctor

Determine the visiting Department
Register

1.Find the location of the department and determine the location
2.Wait in line for the elevator, more long time because wheelchair size
3.find the corresponding department. Must be 2 people

Continue to line up and wait for the number to be called

To much information and ways，twice difficult than normal people

Fig.60   Routes for general public and disabled wheelchair users

- **Experimental results：**

Through two different experiments, we can find out. The first visit to the doctor's office took 51 minutes from the beginning of registration to the end of the visit, especially for the average patient with normal behavior.

Patients in wheelchairs take much more time, 1 hour and 23 minutes, nearly twice as long as the average patient. This is particularly inconvenient for the disadvantaged, not to mention the different parts of the visit, such as the examination, the waiting, and the injection, which take a considerable amount of time after the doctor's visit.

However, disadvantaged groups are themselves at a disadvantage to the general population for various psychological or physical reasons, and visiting the doctor as well as health care accounts for a large part of their lives as seen through the previous research, so we can conclude that the current large general public hospitals for disadvantaged groups,to much information and ways,twice difficult than normal people.

Here is a summary of the pain points that exist in some large general public hospitals *(Figure 61)*.
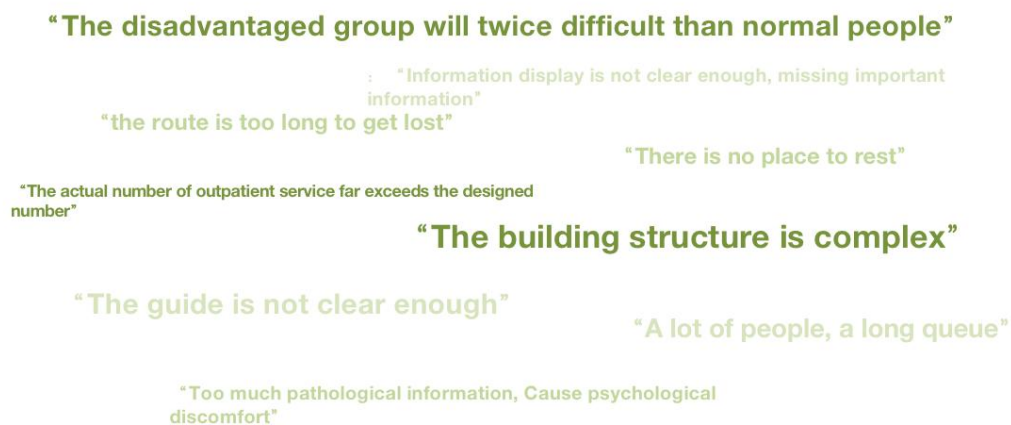
PAIN POINTS

"The disadvantaged group will twice difficult than normal people"

:   "Information display is not clear enough, missing important information"

"the route is too long to get lost"

"There is no place to rest"

"The actual number of outpatient service far exceeds the designed number"

"The building structure is complex"

"The guide is not clear enough"

"A lot of people, a long queue"

"Too much pathological information, Cause psychological discomfort"

Fig.61   Pain Points

5.4.2 Small and medium-sized clinics and community hospitals

- **Small and medium-sized clinics**

Clinics, also known as consultation clinics, medical clinics, health clinics, and medical offices.Generally a private practice, clinics play a significant role in our country. Due to the large and non-uniform distribution of our rural population, large hospitals cannot satisfy such a large number of rural people in   a wide distribution area. Therefore, the promotion of small clinics is both cost effective and beneficial to the people.[104]Most of the clinics are specialty clinics, such as internal medicine, dentistry, Chinese medicine,Pediatrics and are mostly named after doctorss*(Figure 62)*.

Because of the medical qualifications and medical conditions of small clinics, most clinics are named after individual doctors and the specialty of this doctor determines the specialty of this clinic, for example, if this doctor specializes in pediatrics, it is usually a pediatric clinic.

Medium-sized clinics are larger than small clinics and are generally equipped with 3-5 doctors and have more types of treatment, but because of the limitations, there are generally more internal medicine, Chinese medicine and dentistry.

Fig.62   Different small and medium–sized clinics

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[104] Sichuan Provincial Health Department on the forwarding of the "Ministry of Health on the issuance of the "basic standards of clinics notice" (04/17) .   Sichuan Provincial Health and Family Planning Commission. 2010-10-25

The clinics are generally between 40-100 plane meters in size and are not large*(Figure 63)*. The clinic is divided into three rooms: consultation room, treatment room, and disposal room, which are separate spaces and have at least one licensed physician.

The four rooms of the clinic are: consultation room, treatment room, pharmacy, and observation room. The four rooms are required to be set up independently with reasonable layout.

Due to the large number of clinics, they are closer to home, but the number of patients seen is less.

Therefore, the doctor-patient relationship is close, each patient is allocated a long consultation time, the doctor can help the patient to examine carefully and can get more attention.

Also, the clinic is usually seen by a single doctor, so there are not as many interns or patients in the queue as in a large hospital, so there is a relatively high level of privacy and the consultation time can be arranged based on individual time.

Fig.63   Different small and medium–sized clinics

- **Community Hospitals**

Community hospitals mainly provide public health and basic healthcare services to community members and are characterized by public benefit, not for profits. Some are under national ownership and some are under individual ownership, but their essence remains the same. Community hospitals belong to the same community health service institutions. The purpose of establishing community hospitals is to hope that the people in the community and nearby can directly in the doorstep of medical treatment to resolve the disease, without having to run to a large hospital far away. However, only 2.1% of the patients who choose hospitals in the research report will choose the community hospital in front of their homes.

The community hospital is mostly a stand-alone building, which aims to solve the problem of difficulty in accessing medical services and alleviate the pressure of hospital visits. It is advocated that minor illnesses do not leave the community and only major illnesses go to the hospital*(Figure 64)*.

Fig.64   Community hospital

Most people think that a community hospital is just a place to see patient with a cold and get a few pills. However, in many community health service centers, three health care services are offered at the same time: outpatient, inpatient and family bed.

When you walk into a community hospital, the environment is same like the large hospital.

Some are even basic social health insurance point, also can receive 200 outpatient clinics every day, the inpatient department has 50 beds, and the same as the Large hospitals, with single, double, triple and multiple rooms.moreover, each room has a separate bathroom, there are TV and air conditioning, but the cost is much cheaper than the large hospitals.

The average total cost of a family bed is about 50 Chinese Yuan per bed per day, which is only 1/4 of the cost in large hospitals, and the starting line of medical insurance in community health service centers for employees is 500 Chinese Yuan and for retired people is 350 Chinese Yuan, which is popular among community residents, especially the elderly, the disabled and the chronically ill.

Even community hospitals can provide services at home. The community hospitals follow the principle of "small illnesses in the community, big illnesses in the hospital, and big illnesses back to the community after discharge".

Common and frequent minor illnesses can be treated in community health services, while major illnesses are referred to major hospitals above the second level, while chronic illnesses diagnosed in major hospitals and rehabilitation after surgery can be transferred to community health services, which is convenient and can save medical costs.

5.4.3 Pharmacies

Pharmacy*(Figure 65)*is a comprehensive service place that integrates management, technology, operation and service. [105]Pharmacies must not only ensure that accurate, quality-qualified medicines are provided to patients, but also that they are used safely and effectively to ensure that medical costs are more economical and reasonable.

The pharmacy mainly sells western medicine, Chinese medicine, herbal medicine and other kinds of medicines to make convenient for the people to buy medicines in order to benefit people's health. Pharmacies are also responsible for planning and budgeting, receiving and storage, issuing and storing medicines, and statistical reimbursement of medicines*(Figure 65)*。

Fig.65   Outside the pharmacy

[105] https://baike.baidu.com/item/药房/11047302?fr=aladdin

Chinese pharmacy is a characteristic of Chinese pharmacy,It is the medicine used in Chinese medicine, of which plants are the most common, but also includes animals and minerals*(Figure 66)*.

There are medicine cabinets in the Chinese medicine room, which are arranged in different categories according to the medicinal properties and categories of Chinese medicine; there are also places for making and processing Chinese medicine.

Fig.66   Chinese medicine counter at the pharmacy

The basic work of the pharmacy is divided into three categories：

- Dispensing room work (responsible for the dispensing of Chinese medicine according to the prescription of the pharmacist).

- Preparation room work (generally for the preparation of Chinese medicine).

- Medicine supply and storage work.

Chinese pharmacies also have a special feature is the doctor consultation*(Figure 67)*, usually mostly for Chinese medicine.

Large pharmacies will have special different kinds of Chinese medicine doctor shifts, help to consult the patients to take the pulse to prescriptions, with a doctor's license and Chinese medicine prescription right, convenient and simple to see and take medicine.

Fig.67   Chinese medicine doctor consultation in the pharmacy

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5.4.4 Online Healthcarel platform

Online healthcare, which is also known as Internet healthcare, refers to online healthcare services based on information technology such as the Internet, including consultation guidance, online booking and online registration before consultation, online consultation, remote consultation, electronic prescription, health consultation, disease prediction and remote monitoring during consultation, as well as online payment, medical insurance reimbursement and medicine delivery after consultation.

In recent years, China's Internet medical market has grown rapidly. In 2021, the market for China's Internet healthcare market reached 223 billion Chinese Yuan, up 43.87% year-on-year, and in 2022, the market for China's Internet healthcare industry will reach 309.9 billion Chinese Yuan.[106]

The operation mode of Internet healthcare in China is mainly three types ：

Telemedicine, Internet consultation and Internet hospital.

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[106] https://baijiahao.baidu.com/s?id=1749840729584282059&wfr=spider&for=pc

One of the most categories is currently mostly applied to the hospital pre-registration payment and other business, remote consultation between hospitals and hospitals, consultation and treatment.

Relatively or auxiliary operations, and generally serve large general public hospitals, which are Large hospitals, the scope of services is narrower.

Another category is the rapid development of the Internet in China since 2014, when online shopping and payment platforms gradually grew like crazy and entered a high peak in 2018.

As a result, a large number of healthcare service network companies were established at this time, but the final orientation was basically all online B- or C-side medication sales platforms, which did not combine the existing types of healthcare, but instead caused a great impact on offline pharmacy sales.

The companies on the picture *(Figure 68)*. are all currently the largest healthcare internet platforms in China, as well as their main business profiles and when the company's stock was listed, which shows that they are all ultimately oriented towards the sale of health products or medicines, etc

企业	LOGO	成立日期	上市日期	证券代码	简介
京东健康	JDH京东健康	2018年11月30日	2020年12月8日	06618.HK	京东健康是中国最大的在线医疗健康平台，也是医疗产业链数字化改造的领跑者，致力于打造以医药及健康产品供应为核心、医疗服务为抓手，数字驱动的用户全生命周期全场景的健康管理平台。其零售药房和在线医疗健康服务业务可以满足用户对于健康领域的各方面需求，让国民享有易得、便捷、优质和可负担的医疗健康产品与服务。
阿里健康	Alihealth阿里健康	2014年1月23日	1972年7月6日	00241.HK	阿里健康(00241.HK)是阿里巴巴集团"Double H"战略 (Health and Happiness 健康与快乐)在大健康领域的旗舰平台，是阿里巴巴集团投资控股的公司之一。凭借阿里巴巴集团在电子商务、互联网金融、物流、大数据和云计算等领域的优势，阿里健康以用户为核心，全渠道推进医药电商及新零售业务，并为大健康行业提供线上线下一体化的全面解决方案，以期对现有社会医药健康资源实现跨区域的共享配置，同时在保障专业安全的基础上，大幅提高患者就医购药的便捷性，满足消费者对健康生活方式的追求。
平安好医生	平安好医生	2014年11月12日	2018年5月4日	01833.HK	平安健康医疗科技有限公司(以下简称:「平安好医生」;股份代码:01833.HK)是中国领先的一站式医疗健康生态平台，致力於通过「移动医疗 AI」，为每个家庭提供一位家庭医生，为每个人提供一份电子健康档案，为每个人提供一个健康管理计划。目前，平安好医生已经形成家庭医生服务、消费型医疗、健康商城、健康管理及健康互动等重点业务板块。
新氧	专业医学 先帮新氧	2014年4月1日	2019年5月2日	SY.O	新氧国际公司是一家致力于用科技的方式帮助爱美女性健康变美的公司。创始人成立了新氧，通过提供透明的信息，改变中国快速增长但不透明的医学美学市场，最终使他们能够建立一个一站式的平台，用户可以方便地找到优质的服务。
1药网	1药网	2013年5月1日	2018年9月12日	YI.O	111, Inc.是111集团的境外控股公司。1药网由于刚和刘峻岭于2010年创建，是中国互联网医药健康的领军企业，致力于用数字科技将患者和药品及医疗服务有机连接，打造中国最大的医药健康平台。1药网基于在互联网科技、智能供应链、全渠道药品商业化、云服务方面建立的优势，与药企、药品流通商、保险企业等合作伙伴共建供应链服务平台，为B端的药店、医生赋能，从而更好地服务用户(S2B2C)。

Fig.68 Introduction of China Online Medical Platform（Source：www.gonyn.com

5.4.5 Home Care

Home care[107], mainly refers to the care of body temperature, pulse, respiration, blood pressure, pupils, etc. The changes of these vital signs reflect the improvement or deterioration of the disease. Therefore, disease observation is the key element of basic nursing care. In addition, the changes of skin mucosa and the color, amount, nature and frequency of vomit and stool must be noted.

There are four main types*(Figure 69)*:

- Medical care
    ① Therapeutic care, such as fever reduction, infusion, oxygen, venting, draining inflammation, catheterization and other care when using therapeutic means.

    ② Medication nursing, supervising patients to use medications, taking them correctly, observing adverse reactions to medications, etc.

    ③ consultation care, such as the correct collection of laboratory specimens, care when doing various types of examinations, etc.

- Life care
    The content of life care is mainly to take care of the patient's cleanliness and hygiene, such as hair washing, oral cleaning, showering, dressing, bedside assistance, finger (toe) nail trimming, etc., as well as some necessary disinfection.

    The improvement and recovery of any disease requires sufficient rest and sleep, therefore, it is necessary to create a peaceful environment to ensure that the patient has sufficient rest and sleep.

- Dietary care
    According to the needs of patients' diseases and conditions, we make specific meals for patients and arrange their diets scientifically and reasonably in order to supplement sufficient nutrition and promote recovery of the organism.

- Psychological care

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[107] https://baike.baidu.com/item/家庭护理/895207?fr=aladdin

When a person is ill, especially some more serious diseases can cause different degrees of psychological burden, fear and anxiety, which will affect the patient's recovery. Therefore, reducing the patient's psychological stress is also one of the elements of nursing care.
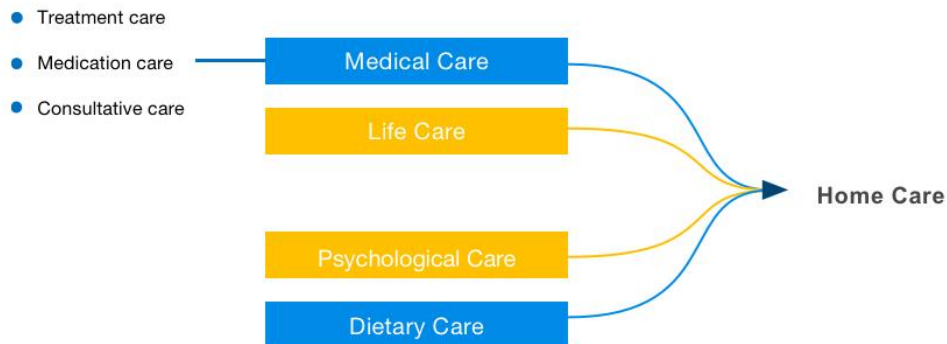

Fig.69　Home care classification

At present, Chinese family care is generally divided into *2* types:

One is to ask professional caregivers to care, but the level of care is different, most of them are simple life care。

The other is family members, such as children, couples and other care, is generally limited to life care.

Therefore, the degree of professionalism is low and can only provide simple living care and dietary care, while psychological and medical care is basically rare.

Even for caregivers, the degree of professionalism in the market is still generally low, without professional healthcare knowledge, and more as a nanny to take care of life*(Table 3)*.

● Representation degree, the more the better

Home Care	Availability	Professionalism	Servers
Medical Care	●	●	Family
Life Care	● ● ● ●	● ●	Family or caregiver
Psychological Care	● ●	●	Family
Dietary care	● ● ●	●	Family or caregiver

Table.3   China Home Care Fact Sheet

5.5 Summary – Building an Integrated Healthcare System

Currently, China's healthcare system is divided into five different types: large general public hospitals, small and medium-sized clinics and community hospitals, pharmacies, online healthcare platforms, and home care.

Through the analysis of the five major healthcare system platforms in China, we can see that the biggest problem is the serious skewing of healthcare resources at present. Large general public hospitals occupy nearly half of the yearly patient intake, and although they continue to improve their intake capacity every year, their number determines a limited reception capacity, and once exceeded, there will continue to be large hospital doctors working at high capacity, community hospitals and clinics unattended, and patients have difficulty seeing patients, long waiting times, and other problems.

For the disadvantaged, a large part of their lives may be related to health care, but now the Chinese health care situation is very difficult for ordinary people, there is no reasonable guidance, everyone flock together to large public hospitals, endure long queues, fast access to doctors, difficult hospitalization, etc. Even less relevant measures and design for the disadvantaged.

Then, based on the data from the Statistical Bulletin on the Development of Health Care in China 2021 *(Figure 70)*, which maps out the number of available visits and the actual number of visits for five different types of health care, we can very clearly see that there are two types of health care that fall into the category of actual visits being much larger than the number of available visits.
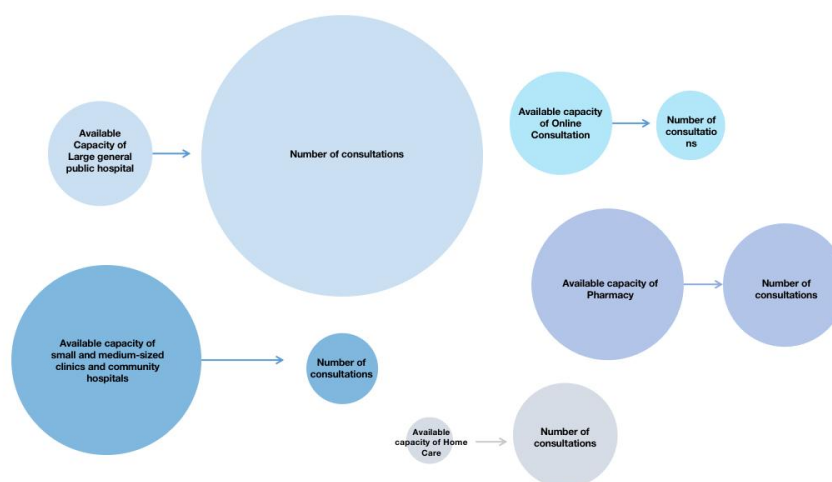

Fig.70   Available and current volumes of different types of medical treatment in China

The first of these is that large general public hospitals are seriously overloaded, with the actual number of consultations being many times higher than the number of consultations they can receive.

Another one is home care. At present, there are many people who need home care in China, but there are very few professionals who can provide home care, which is basically replaced by family members or ordinary nannies, thus not being able to meet the standard of home care.

The other three types of small and medium-sized clinics, community hospitals, pharmacies, and online medical treatment are larger than the number of available consultations, resulting in a great waste of resources and unbalanced development of resources, which is the primary problem to be solved.

Therefore, how to change the current situation of serious imbalance and imbalance of healthcare resources, while helping the disadvantaged groups to better reduce healthcare overcrowding and get better health care.

There is a need to establish a new, responsive health care system that combines the resources of all existing health care platforms to better serve vulnerable populations*(Figure 71)*.

Fig.71   Integrating medical resources for disadvantaged groups

PART FOUR

Design of an emotional interaction service system for disadvantaged people based on the current situation of Chinese healthcare

6 | Chapter Six

Healthcare Service System

6.1   Design of healthcare services
    6.1.1   Research and analysis of existing healthcare systems
    6.1.2   Persona of the disadvantaged groups
    6.1.3   Service design opportunity points
6.2   Service design method for Healthcare system
    6.2.1   Double Diamond
    6.2.2   Service Design Blueprint
6.3   New Healthcare Eco-System
    6.3.1   Building the system
6.4   Summary
    6.4.1   Research on emotional Interaction Service system and Design for the
               Disadvantaged Groups based on China Health Care Situation

Fig. 72   Hearing impaired children enjoy reading books in the library.Photographer : Tan Yingxin[108]

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[108] http://www.asia-photo.org/photo_view.asp?p_id=48615

6   **Healthcare Service System**

6.1   Design of healthcare services

6.1.1 Research and analysis of existing healthcare systems

In Chapter 5, through the methods of continuous field surveys, user interviews and experimental tests on large general public hospitals, small and medium-sized clinics, community hospitals, pharmacies, online treatment platforms and home care, it can be observed that these different types of health care platforms have the following strengths and weaknesses in China at present*(Table 4)*.

Table.4   Strengths, weaknesses and relationships between existing healthcare types

They are also all related to some degree, and pharmacy is essentially related to each of these types.

The strengths and weaknesses of these different types of healthcare can help us to quickly identify problems, to consider all problems in the context of the full range the

types, and to consider the possibilities of complementary and alternative solutions between these types in an integrated way, depending on the degree of their relationship.

I labeled each type of health care with a different color for my research and turned the 2 strengths and weaknesses of each type of health care analyzed into a square and made a statistical table to converge into a graph*(Figure 73)*.
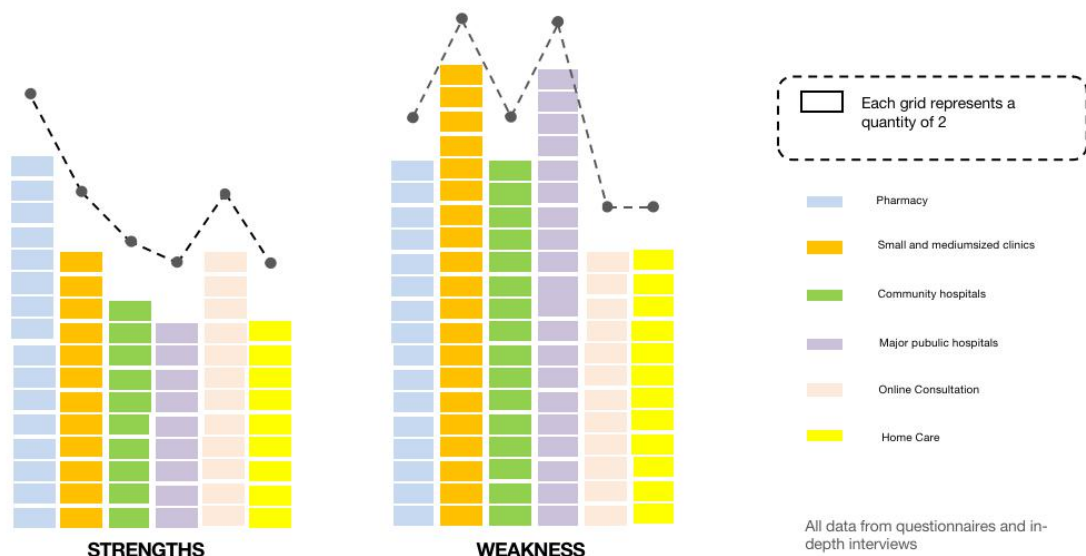
Fig.73   Strengths, weaknesses and relationships between existing healthcare types

The table clearly shows that pharmacies have the most advantages, while online medical platforms and small and medium-sized clinics are the next. The most disadvantages are found in large general public hospitals, as well as small and medium-sized clinics, and the least disadvantages are found in online medical platforms and home care.

How to change these most problematic types into our design opportunities to complement the types with more advantages is what we need to consider in the following design approach.

6.1.2 Persona of the disadvantaged groups

Persona[109] is a fictional persona that contains typical user characteristics based on a deep understanding of real users and the generalization of highly accurate relevant data. although Persona is a fictional image, the detailed description of the characteristics embodied in each Persona should be real, and is based on real user data collected by qualitative and quantitative research means such as user interviews and questionnaires.

The essence of Persona is a tool for communication, which helps different roles in the project process to get rid of their own thinking patterns, immerse into the target user role and think from the user's perspective.

By building Persona of representative disadvantaged groups, can help us better understand the needs and opportunities of disadvantaged groups in health care. In this research to build User Persona, the second questionnaire was used, including some user interviews to get more accurate data to build User Persona.

A total of 231 questionnaires (80 from online and 51 from offline) were collected *(Figure 74)*, and user interviews were conducted with 25 of them.

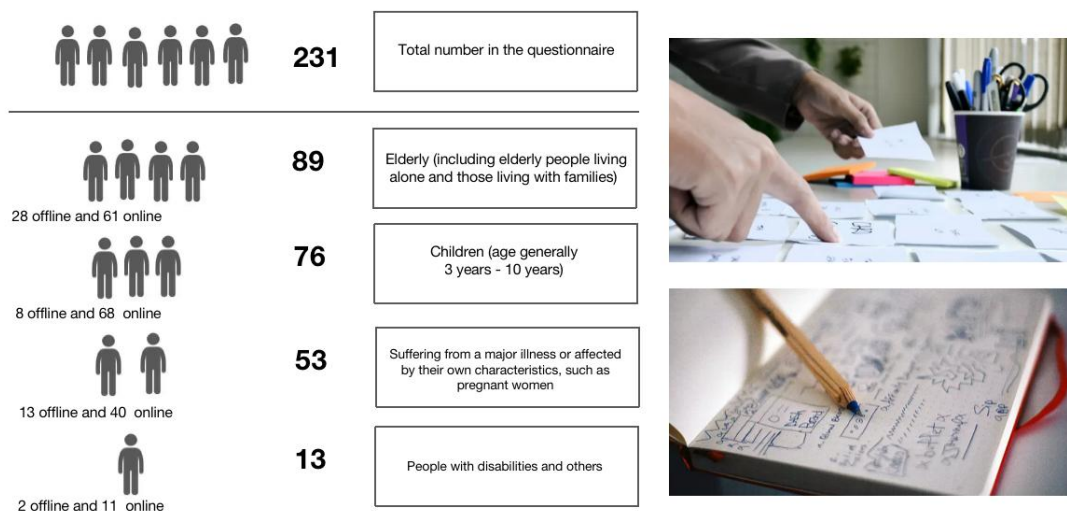|		
231	Total number in the questionnaire	
89	Elderly (including elderly people living alone and those living with families)	28 offline and 61 online
76	Children (age generally 3 years - 10 years)	8 offline and 68 online
53	Suffering from a major illness or affected by their own characteristics, such as pregnant women	13 offline and 40 online
13	People with disabilities and others	2 offline and 11 online

Fig.74   Types of people surveyed by questionnair

[109] Liu H, Lu H, Ruan JH, Tian BQ, " Research on precise marketing segmentation model based on Persona mining". CNKI , 2015

• Find the key variables[110]

The first step in building a Persona is to analyze the key information obtained from previous research on disadvantaged groups, in order to extract the key factors that produce different behaviors related to disadvantaged groups relative to the target product/service.

Each disadvantaged group has many characteristics, such as gender, age, family status, education level, personality features, Internet behavior preferences, consumption views, financial views, personal preferences, etc.

We need to identify from these many characteristics which are the main reasons for the differences in the attitudes and usage behaviors of disadvantaged groups towards our target products or services.

After identifying the key variables, each variable is used as a core dimension to analyze the collected data of disadvantaged groups, and the relevant behavioral data of disadvantaged groups are distributed as some "information values" in this dimension.
For example, "health care place," "health care frequency," and "self-mobility" are the key variables that differentiate the needs and attitudes of disadvantaged groups toward related services.
The information collected from the disadvantaged groups is evenly arranged in these three dimensions, and some typical characteristics of the disadvantaged groups are selected as the "information values" in this dimension. The following figure is the first step of clustering information of disadvantaged groups, the framework of key variables*(Figure 75).*
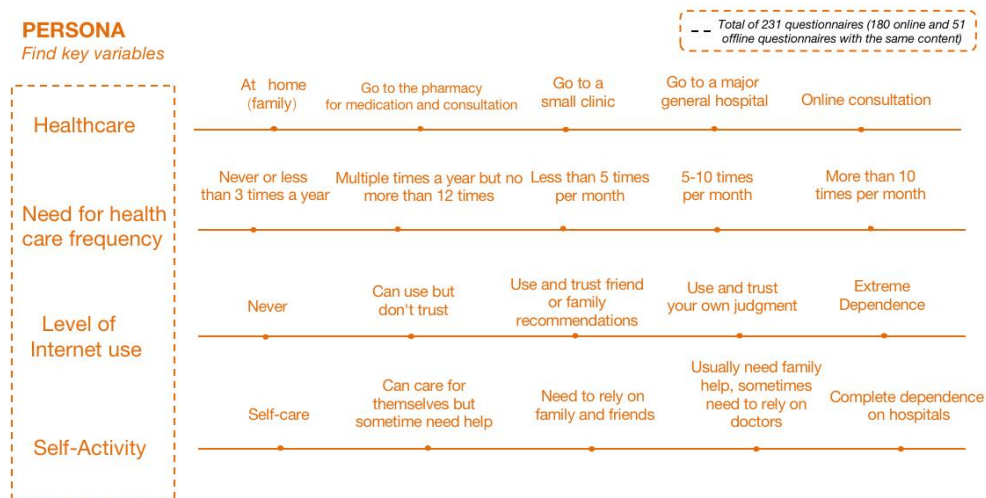

Fig.75   Find key variables

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[110] https://mp.weixin.qq.com/s/ct3CaY6X4vF8Jouq4v__Dw

- Clustering[111]

The key variables are the core dimensions that help the disadvantaged groups to cluster, and with the key variables, the core features of Persona can be obtained by concatenating the "information values" of each dimension, so the next step is to "connect the dots".

First, reviewing the collected data of disadvantaged groups (the behavior of each interviewed disadvantaged group is marked in each dimension to record the probability that the behavior characteristic appears, which is used to impute the number of users covered by that information value) and marking down the number of disadvantaged groups under each key variable, this process is a process of re-sorting and reviewing the disadvantaged groups again*(Figure 76)*.
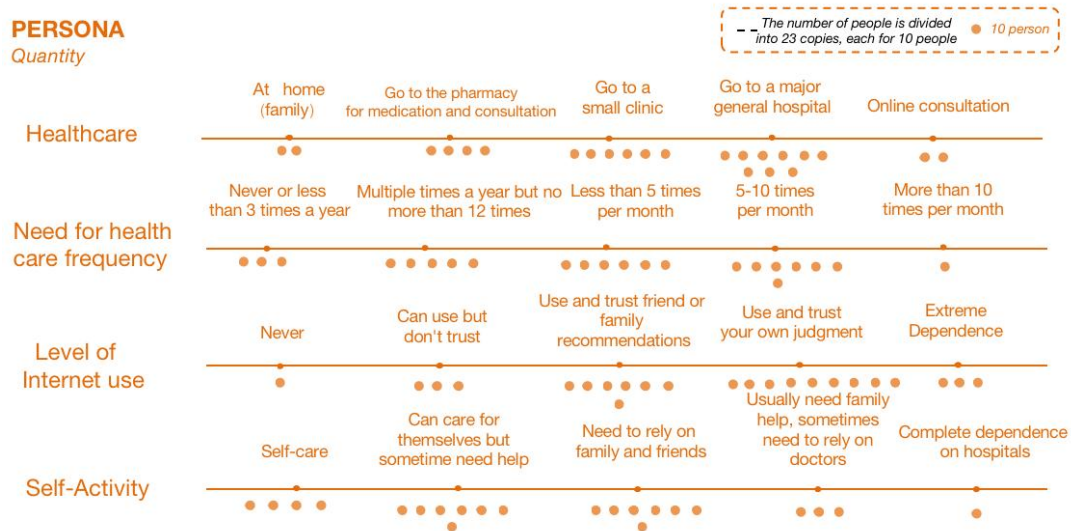

Fig.76   Mark the frequency of appearance

Next, I try to connect the "information values" distributed in each dimension to find out the representative images of disadvantaged groups.

Based on experience, the distribution pattern of typical users generally has the following two cases:

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[111] https://mp.weixin.qq.com/s/ct3CaY6X4vF8Jouq4v__Dw

- Try to cover the "extreme information values" at both ends of each variable reasonably[112].

The process of creating Persona is to find representative typical users among many target user groups. The so-called typical users are those who have one or more of the core features that have extreme needs among all user groups, and by covering the extreme needs of these users, we have found the edge of the needs and the edge of the design from the design point of view, covering the extreme edge needs, and in theory, needs not exceeding the edge can also be covered.

It is important to note that many researchers or designers tend to notice the "high information value" edge, which is the section that favors expert users, and tend to ignore the "low information value" edge, which is the extreme beginner user .

Therefore we still have to consider the coverage of the target user group in a comprehensive way when we make persona.

Also, the word "reasonable" needs to be specifically mentioned here.

Some people may seek to connect the extremes of all variables in the hope of finding the most typical target users.

However, when we reduce the connected variables to a realistic image of the user, we may find such people rare in life, or even weird, or somewhat deformed.

Of course, if your target user is the weirdo user, it's a different thing.

So, a reasonable connection to extremes, however, is very important to ensure that the users we connect out are real, the simplest way is to go back and see if any of the interviewed users have real character prototypes to be matched.

Therefore, on this basis, I derived two extreme disadvantaged persona - Extreme type 1 *(Figure 77)*and Extreme type 2*(Figure 78).*

PERSONA
Clustering

Extreme type 1

Fig.77　Extreme type 1

PERSONA
Clustering
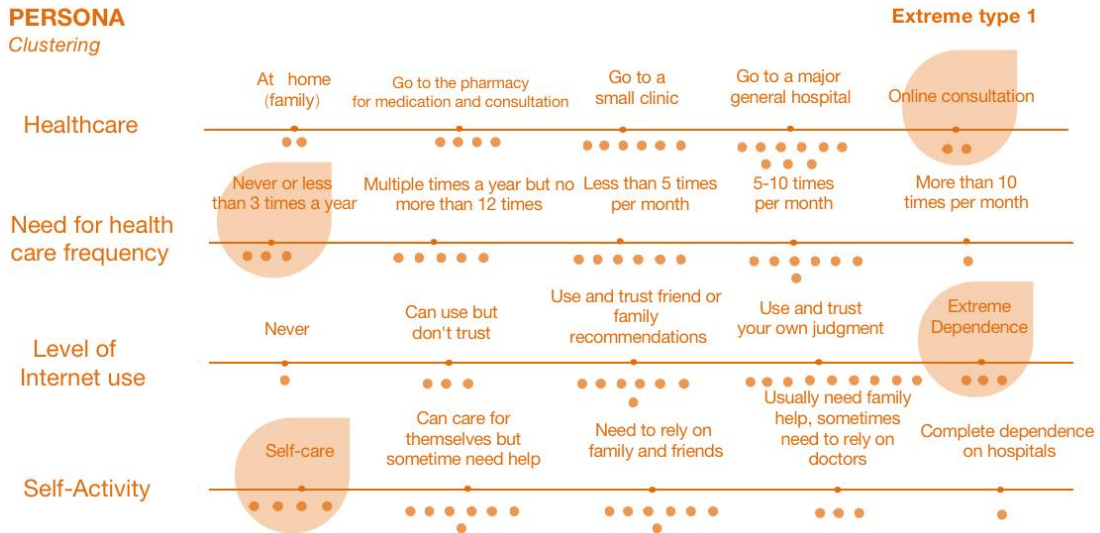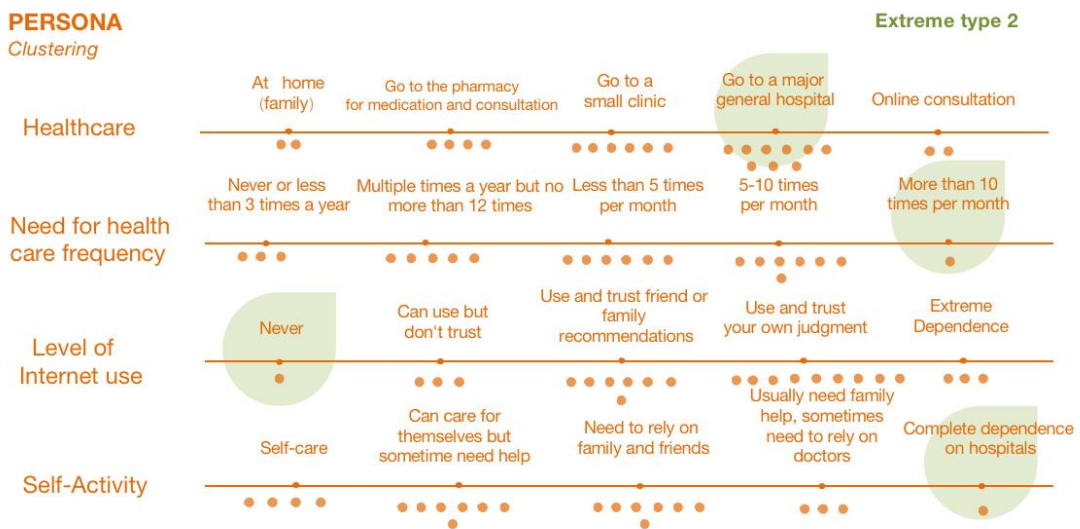
Extreme type 2

Fig.78　Extreme type 2

- Try to reasonably connect the information value of user behavior concentration*(Figure 79),(Figure 80).*

The typical users, in other words, also represent users with a certain popular foundation, which means a relatively large base of users.

Therefore, when we connect the information values in the key variables, we also need to consider the number of disadvantaged groups to which the behavioral characteristics belongs. This is where our previously marked frequency of disadvantaged groups interviewed comes in handy. It means that we only need to connect the information values with intensive behavioral distribution and to a high extent, we can successfully find the target disadvantaged groups.

Of course, it is also important to pay attention to the word reasonable to prevent us from linking up only an empty character or an ideal user, which does not exist in real life.
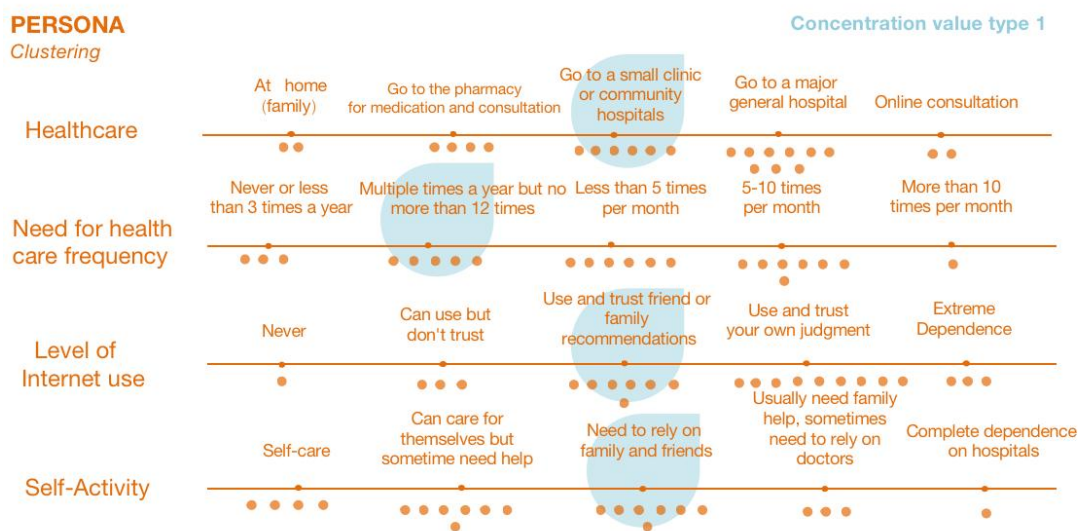
Fig.79   Concentration type 1
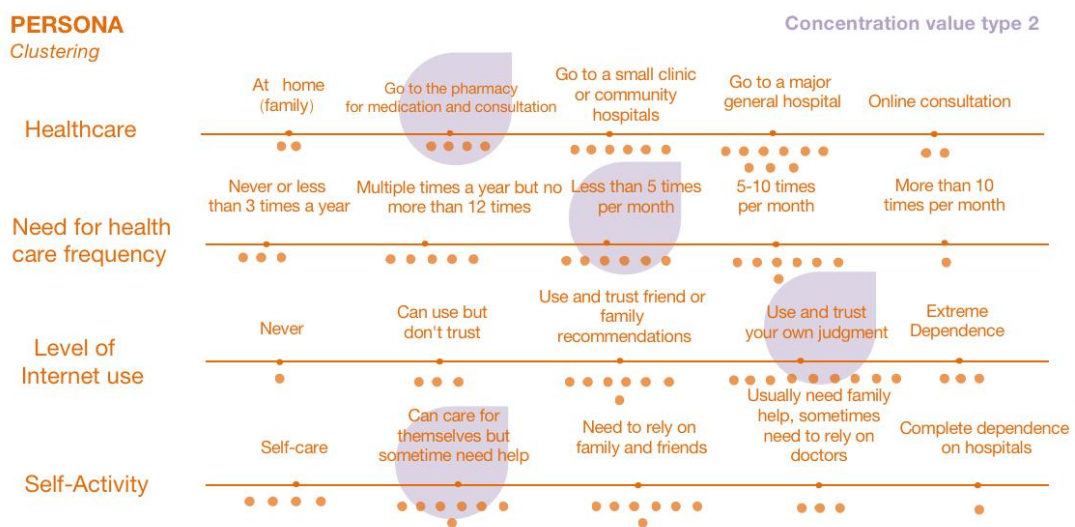
Fig.80 Concentration type 2

- Enrich the character Persona[113]

The typical disadvantaged types after clustering will be finely portrayed, adding some detailed descriptions to make people more picturesque, and also more convenient for us to do analysis on the basis of typical disadvantaged user portraits and design afterwards.

The following figure is the above to get four typical disadvantaged group Persona, two typical disadvantaged group Persona, two relatively extreme disadvantaged group Persona*(Figure 81).*

Zhang Ping

The **usual online consultation** on maternity care information and then **regular medical checkups** at the hospital is best for me.

Ye Yahui

My family often took me to a familiar **clinic nearby** when I was sick, and the uncle there made me well right away every time

Zeng Shaofu

Every year, we choose a **general public hospital** for our health care, where the **professional** is reassuring.

Sun Yang

The **usual health** care to the **pharmacy** can be, life can rely on their **own** as far as possible **not to bother** others

Fig.81　Persona of the disadvantaged groups

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[113] https://mp.weixin.qq.com/s/ct3CaY6X4vF8Jouq4v__Dw

6.1.3 Service design opportunity points

By researching the data of disadvantaged groups in health care for several times,
I establish the Persona of disadvantaged groups, and according to the characteristics of users of different persona to figure out the design opportunity points of disadvantaged groups in the existing health care system, and summarize them into four aspects:

Integration，More think and Service for the disadvantaged groups(Specific thoughts),Enhance professionalism and credibility(Professional and Credible),Medical information search and display is intuitive and convenient(Easy and Intutive)(Figure 82).
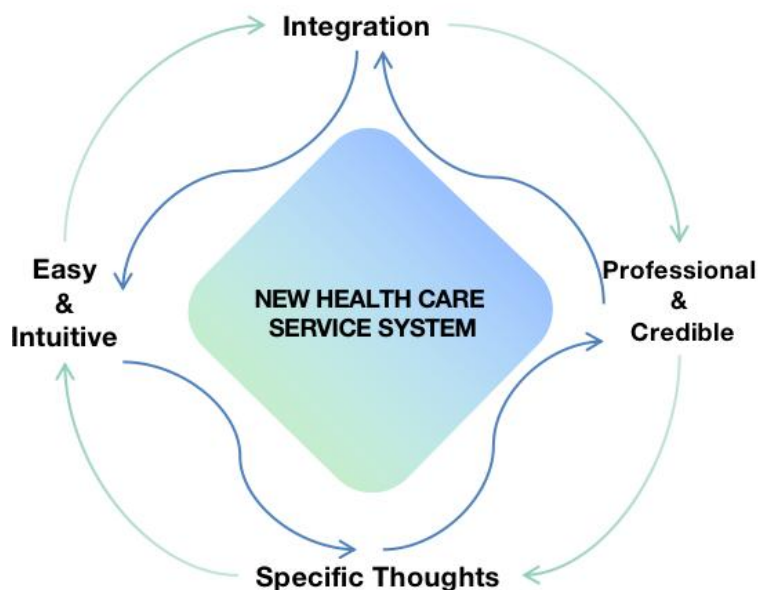
Fig.82   Service Design opportunity points in Healthcare

· **Integration**

From the research, it was found that different types of medical institutions are integrated to complement each other's shortcomings and maximize their respective advantages.

139

・More think and services for the disadvantaged groups

There are many types of medical care available, but few are specifically designed for disadvantaged groups (more are available for children and increasingly for the elderly).

・Enhance professionalism and credibility

After research, many users have shown distrust in multiple types of medical institutions, especially the frequent medical accidents and some malignant incidents in recent years

・Medical information search and display is intuitive and convenient

The existing medical information display and search is relatively complicated, especially the mixed real and fake information, it is difficult for users to find useful information.

6.2 Service design method for Healthcare system

6.2.1 Double Diamond

The Double Diamond model of service design is divided into four broad stages: discovery, definition, development and delivery.

Also known as the process of dispersion and summarization, I substitute the disadvantaged Persona based on the four stages of the Double Diamond Model, and divided into two different perspectives, one centered on the disadvantaged Persona and the other on the health care system.

Thinking differently about the whole design of health services for disadvantaged groups in two different centers, It can lead to many different key design information, such as: how to better integrate different kinds of health care types in a system-centered discovery period, whether it is based on more intersections of relationships, similarity of duties and functions or its own optimization and other auxiliaries*(Figure 83)*.
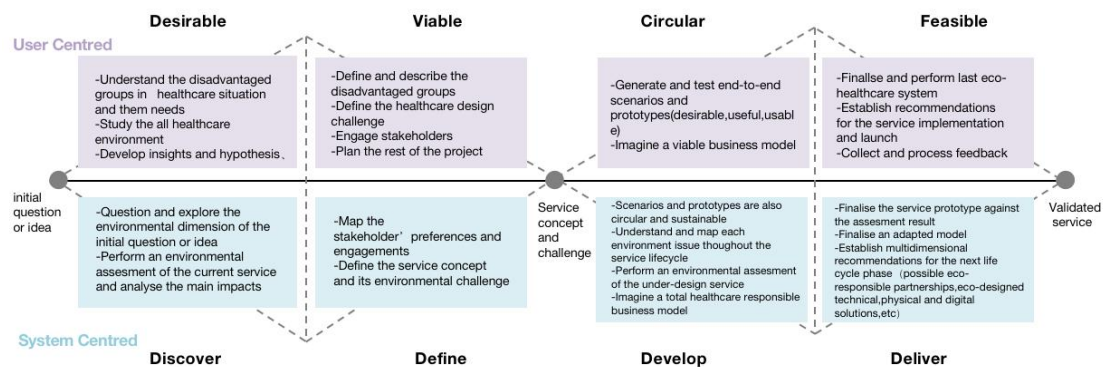

Fig.83   Double Diamonds for the disadvantaged groups

・Centered on the portrait of Disadvantaged groups.

Stage 1: Desirable and Viable

We can guide disadvantaged users based on previous research that the desired state of health care is fast and efficient ,Healthcare that is relatively professional with a certain level of privacy and patience.

Thus feasibility depends on those types that fit these characteristics and that can be relatively maximized, requiring analysis and linkage.

Stage 2: Circular and Feasible

By determining the Persona, we know that most of the disadvantaged groups have a relatively high frequency of health care and do not only go to health care for a long period of time.

Instead, it is a short period of multiple times or long-term maintenance of a certain frequency, so the whole health care cycle how to do better, to form a closed circle and each part can be quickly re-used as well as how to achieve these ideas are very important when considering for the disadvantaged groups.

・Centered on establishing a health care service system

Stage 1: Definition and Discovery

After the research, the key issue was distilled: At this stage, each health care type is independent of each other in China, Also it is basically difficult to intersect with each other.

For example, hospitals, clinics, and online platforms all have pharmacies or medicines for sale, with some special medicines available in hospitals, etc.

The pharmacies basically do not intersect with these types either, but being independent of each other will produce some overloads of intake and some too empty, resulting in wasted resources.

Stage 2: Development and Delivery

Five different types of health care types are integrated, managed and received in a hierarchical way, with links to each other.

Therefore, the resource imbalance can be eliminated while avoiding competition between each other, forming a closed loop of virtuous service design.

The four phases of the two centers are inventoried through fieldwork to identify current health care resources in China.

Problems are presented for systematic analysis, solutions are developed to integrate new health service system planning for disadvantaged groups, and finally the service system is designed and tested.

This is the double diamond model to give preliminary about the new service system design, but the results are not comprehensive enough as a whole and relatively general.

So more detailed service design methods are needed for secondary validation and design, resulting in a more comprehensive service design for the emotional needs of disadvantaged groups.

6.2.2 Service Design Blueprint

The Service Design Blueprint[114] is a diagram that visualizes the relationships between different service components - people, objects (physical or digital evidence), and processes - that are directly related to touchpoints within a given customer journey. [115]

Service design blueprints play a role in complex scenarios across many service-related offerings that are well suited for combing out individual touchpoints and design pathways across relatively multiple health care types.

It is an excellent method for sorting out logic that is whole omnichannel, involves multiple touchpoints, or requires cross-functional (i.e.coordination of multiple departments).

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[114] https://zhuanlan.zhihu.com/p/541517583

[115]Toshiaki Kurokawa,"Service Design and Delivery: How Design Thinking Can Innovate Business and

Add Value to Society"

Working on the dependency map of the service design blueprint helped me to be able to identify Pain points and areas where connections could be made at the source. Similarly, the service design blueprint can help identify optimizations, the visualization of relationships can reveal potential improvements and eliminate redundancies.

For example, when mapping disadvantaged groups in their daily care, we can reduce their access to large general public hospitals by organizing these daily care at home or at nearby clinics with community hospitals.

These care data can be synchronized and uploaded to the hospital system for easy access to the hospital and doctors afterwards.

Service design blueprint based on health care for the disadvantaged groups based on all the data from the disadvantaged research and the disadvantaged Persona, as well as the five different types of health care in China*(Table 5)*.

Duration		Within 120Mins			90Mins -- 300Mins		More than 60Mins
Stage		**Daily Care**			**Professional Care (clinics and hospitals) ③**		**Newly Emerging Conditions**
User		Inside the home	Pharmacy ②		Frequently	Occasionally	
			Two most common cases as examples				
	Contacts	1.Furniture, 2.medicines, 3.home medical instruments (e.g. hypertension measuring devices)	Buy medicine with a goal: counters, shelves, cash registers	Non-targeted buying medicine, counters, shelves, cash registers, information desks	Consultation room, treatment room, pharmacy, cashier, ward, toilet, elevator, lobby	Registration room, waiting area, consultation room, treatment room, pharmacy, cashier, ward, toilet, elevator, lobby	The situation is the same as ② & ③
	Behavior	Can be divided into independent or supportive behaviors: taking medication, instruments, exercise, rest	Buy medicine, go home	Recommend medicine, doctor consultation, buy medicine, go home	Fixed doctor consultation to see patients Get medication, injections, treatment, go home, hospitalization	Registration, queuing, consultation, examination (e.g. CT, blood sampling, etc.), medication, injection, treatment, hospitalization, going home	
Front stage	Equipment	Furniture, home medical equipment, medicine boxes, first aid kits	Pharmacy stores, medicine counters, promotional display areas, consultation desks, cashier desks		Information desk, triage desk, registration desk, elevator, waiting area, toilets, treatment rooms, radiology rooms, specialized medical equipment		Severity of disease
	Behavior	Rest, exercise, medication, treatment	Consultations, consultations, medicine purchases, checkout		Queuing, waiting, resting, treating, exercising, going to the bathroom, talking and chatting		Severity of disease urgency
	Visualization Dividers						Disease familiarity
Back stage	Tools	Cell phone (for in-home discussions or online consultation with physicians)	Warehouse, chain pharmacy management, cashier system, doctor consultation system		Internal hospital systems (such as registration systems, patient record management systems, etc.) pharmacies, specialized medical equipment consultation rooms, medical equipment, cashier departments, logistics departments		
	Technology	Softwares	Medical support, warehouse, logistics		Finance, Medical, Management, Logistics, Personnel		
	People	Family members	Store staff, store managers, doctors, logistics staff, supply department staff, warehouse staff		Logisticians, doctors, pharmacists, specialized equipment therapists, physical therapists, nurses, caregivers, registration staff, administrators, etc.		

Support	System	Phone, mail, different software	Phone, mail, different software	Telephone, e-mail, different software, management support systems, warehouse systems, logistics systems, etc.	
	People	All support software service personnel	All support software service personnel	All support software service personnel, managers, warehouse personnel, logistics personnel, etc.	
Analysis	Nodes	Waiting (Inquiry - Self Care)	Seeing a doctor (getting medicine)	Checkout	Leaving	The situation is the same as ② & ③
	Determination	Failure Point (F)	Decision Points (D)	Waiting point (W)	Experience point (X)	Severity of disease
	Reason	1. Too long F 2. Self-checking information is too much and complicated to verify the authenticity 3. No or too little waiting area 4. Some medical types, too many other steps before waiting 5. No special guidance	1. Professionalism cannot be judged 2.Time is too short 3.Equipment problem F 4. Lack of self-guidance F 5. No accompanying person design	1. Involving medical insurance, instructions are unclear W 2. Management confusion 3.Not enough professionalism	1. unclear description of follow-up treatment 2. Resulting in secondary time and cost wastage 3. Not high professionalism 4. Insufficient number of different levels of medical institutions in different areas	Severity of disease urgency
	Measures	1. Integration of different medical institutions D 2. Clear division of labor 3. Clearly directed 4. Professional degree classification level (new standard after integration) 5. Triage of different populations	1. Increase different guides 2.Increase waiting area 3.Improve the trust level 4. Perform diversion and integration	1. Adjust the key information display 2. Simplify the process steps (online platform, such as APP) 3.Training related personnel professionalism X	1. The partition is obvious and the division of labor is clear 2. Professional degree training X 3. Reduce the frequency of travel, increase and guide online or in-home care	Disease familiarity

Tabke.5   Service Blueprint of the disadvantaged groups

Based on the four different Persona of Disadvantaged Groups, each is represented inside the service design blueprint.

The main health care scenarios and the average hours of care collected are classified.

The overall health care of disadvantaged groups is divided into three different phases, namely daily care, specialized care and emergency care.

・ **Daily Care**

Daily care duration was found to be within 120 minutes on average through research data, and the scenarios of daily care for disadvantaged groups were mostly at home and in pharmacies (mostly for common or chronic illnesses, etc.).

- *User health care touch points in the home:* furniture, medications, home medical equipment (e.g. blood pressure monitors, etc.)

Behavior: can get medication independently or with help from others, daily rehabilitation exercises, measure health data, use home health care equipment, etc.

Frontstage: the home environment and home furnishings belong to the disadvantaged home care accessible frontstage, have chronic diseases or need long-term health monitoring disadvantaged users will often use home healthcare equipment, and some disadvantaged groups need daily rehabilitative training, always have a medicine box, or even an emergency medical box to take care of daily.

Backstage: daily medication buying for family members to meet the need of constant medication, daily update and training of home rehabilitation equipment, doctor's medication guide and medical advice, etc.

Support: Mobile phones are used to contact family members or healthcare professionals, such as doctors. Various home healthcare equipment software, daily medical knowledge for disadvantaged groups and his family, etc.

Analysis: Analyze the reasons for a series of behaviors and actions, the problems in the process of behavior production, and give which behaviors are failure points, decision points, waiting points, and experience points in this process.
And then according to these give the opportunity points, which is the specific design program. The details are shown in the table.

- There are two types of users' health care at pharmacies: one is purposeful purchase of medicines, and the other is purposeless purchase of medicines with only a medical condition that requires recommendation or treatment.

① *Purposeful users in pharmacy health care touch points:* relatively simple touch points, pharmacy stay time is short, such as: counters, shelves, cash registers.

Behavior：Buy medicine, go home.

② *Purposeless users in pharmacy health care touch points:* relatively longer stay in the pharmacy, because China's general pharmacy will be equipped with TCM physicians, may need to visit, the touch points are relatively more complex, such as: visit the counter, queue, TCM physicians, TCM pharmacists, counters, shelves, cash registers, information desks.

Behavior: The behaviors are mainly focused on the processes of recommend medicine, doctor consultation, buy medicine, go home.

The front desk of all daily care: pharmacy stores, medicine counters, promotional display areas, consultation desks, cashier counters, and other places where disadvantaged groups may do consultations, purchase medicines, and check out.

The all Daily Care Backstage: The backstage may involve the entire pharmacy supply chain, biopharmaceutical companies, transportation companies, storage, chain pharmacy management, cashier system, doctor consultation system and so on, it is a backstage with many components and every step is important.

The all Daily Care Support: The support system is much more complex, as it involves operations and storage, etc. including telephone, email, different software, management support systems, storage systems, logistics systems, etc.

The all Daily Care Analysis: also divided into four different points (F,D,W,X), such as: relatively complex information, unsure of how to choose, no follow-up health care support (see table for detailed analysis).

· **Professional Care**

Professional care can be concluded within 90 minutes-300 minutes on average according to the research data, but longer time cannot be excluded. Health care

scenarios are more concentrated in small and medium-sized clinics as well as hospitals (more than 78% of hospitals are large general public hospitals according to selection habits).

According to the disadvantaged groups themselves, the research data shows that professional care is divided into frequent need for professional care and occasional professional care, and other time daily care.

- ***Higher frequency of professional care：***
  Contact points： Consultation room, treatment room, pharmacy, cashier, ward, toilet, elevator, lobby、Vending Machines and so on.

  Behavior ： Fixed doctor consultation to see patients,Get medication, injections, treatment, go home, hospitalization.

- ***Occasional professional care：***

Contact points： Because of the unfamiliarity with the environment and professional care generally for the hospital, the hospital premises are larger, the structure is more complex, so go to other places and stay relatively long, relative to the point of more contact. For example:Registration room, waiting area, consultation room, treatment room, pharmacy, cashier, ward, toilet, elevator, lobby、Vending Machines.

Behavior： Registration, queuing, consultation, examination (e.g. CT, blood sampling, etc.), medication, injection, treatment, hospitalization, going home.

The all Professional Care Frontstage ： The disadvantaged groups maybe will go Information desk, triage desk, registration desk, elevator, waiting area, toilets, treatment rooms, radiology rooms, specialized medical equipment. They will do like Queuing, Because the hospital is full of people,so long time waiting, also having a rest when they waiting ,then treating and exercising, going to the bathroom， talking , chatting and so on.

The all Professional Care Backstage ： Because Chinese hospital buildings are relatively complex in terms of structure, environment and overall supply relationships, the backstage is a rather large system, It is contains Internal hospital systems (such as registration systems, patient record management systems, etc.) pharmacies, specialized medical equipment consultation rooms, medical equipment, cashier departments, logistics departments and so on,also so many people in this system like: Logisticians, doctors, pharmacists, specialized equipment therapists, physical therapists, nurses, caregivers, registration staff, administrators, etc.

The all Professional Care Support:All systems that supply the overall normal operation of the hospital.Telephone, e-mail, different software, management support systems, warehouse systems, logistics systems, etc.

The all Professional Care Analysis: also divided into four different points (F,D,W,X), such as: the hospital building structure is too complex, the signage system is not clear enough, the disadvantaged groups are more difficult to differentiate the route, etc. (detailed analysis can be seen in the table).

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・Newly Emerging Conditions

The general situation of new emergent health care is that it is beyond the scope of everyday health conditions and is a new emerging medical condition, and can be divided into those where everyday care can solve the new emergent condition and those where professional care is required for the emergent condition, so the situation is the same as everyday care and professional care.

- -

Therefore we can find the blueprint most useful when coordinating complex services, as it bridges cross-departmental work.

Typically, the success of a department is measured by the touchpoints. However, disadvantaged groups will encounter many touchpoints in health care and will not know (or care) which health care type owns which touchpoint. While a health care type can meet its own goals, the bigger picture, organizational level goals can be missed.

Service design blueprints allow us to capture what is happening internally throughout the health care process for disadvantaged groups - gaining insight into overlaps and relationships of dependency that cannot be seen on their own.

6.3　New Healthcare Eco-System

6.3.1 Building the system

The new healthcare eco-system was created to better serve the needs of disadvantaged groups in healthcare.

This is due to the fact that they have always been long-term users of health care, but the current five types of health care in China, which are not more thoughtful for this group of users, how to make their health care convenient, fast and efficient, all steps are guaranteed with continuous follow-up, which is a very rare thing in the current model.

This is because the different types of health care in China, which are basically independent of each other, implicitly compete with each other, which is the worst experience and service for general users, especially for the disadvantaged, because some of these users cannot take care of themselves and are independent enough to need care and companionship.Health care in this situation can conceivably be more than two or three times difficult than normal.

Therefore the establishment of a new health care eco-system is essential.

The new health care eco-system is an important expression of the intelligent development for healthcare services and an emotional design for the disadvantaged users, focusing on their real emotional needs in healthcare.

And through the needs of the disadvantaged groups to connect the originally divided healthcare service system in series, each part complement each other, forming a complete healthcare service loop.

・**New Health Eco-System Hierarchy Composing**

Based on the preliminary data and design opportunity points, we can find a way to use the existing online platform model to integrate existing health care through a mobile application, using the application as a medium to connect all health care types in series.

- ① According to statistics from the Ministry of Industry and Information Technology (MIIT) [116]up to June 2022, China's cell phone coverage rate reached 95% and smartphone coverage rate reached 75%.At present, smartphones are widely used in China, and the popularity rate is further increasing. Smartphones are necessary for all aspects of life, such as mobile payment, government online office, online shopping, online entertainment, etc.

Meanwhile, China has been promoting information barrier-free for people with disabilities since 2013. Therefore, smartphone and application have good popularity in China. Even for children, elderly and disabled people, application is very suitable as an entry point and connection means for integration.

- ② Through the service design blueprint and preliminary research data, we can see that the disadvantaged group of users currently adopts the most in the field for health care is daily care which is also home care, followed by the need for regular rehabilitation training and hospital follow-up.

Therefore, we can take daily care, or home care, as the first level platform. we can instruct the disadvantaged groups how to provide better and more professional home care through Application.

- ③ Because of the extreme resource imbalance in the healthcare system, a large number of patients are choosing large general public hospitals, causing the actual number of consultations to exceed the number of available consultations, causing a vicious circle in which doctors do not have time and patients feel that doctors are doing a perfunctory quick consultation and other situations are frequent, causing a very stressful doctor-patient relationship and a poor experience for all the participants in the process.

Therefore, a large number of available small and medium-sized clinics and community hospitals are used as the second level platform to guide the disadvantaged groups who are not satisfied in the first level platform into the second level platform.

On the one hand, it can reduce the intake of large hospitals, and on the other hand, it can make more healthcare resources and privacy space available to the already inconvenient disadvantaged groups.

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[116] https://www.xinqtech.com/news/201712/319823.html

- ④ Large general public hospitals are the last level platform, which is the third level platform. If the disadvantaged groups want to enter the third level platform quickly, the first level platform to set up a Quick Access for disadvantaged groups (after satisfying certain conditions, there will be some conditions set to avoid wasting resources), after the disadvantaged groups choose the Quick Access, there will be a professional team from a large general hospital to quickly access, all treatment steps are relatively simplified, the follow-up situation has the environment, second level platform will continue to provide feedback as tracking at any time .

The second level platform will continue to serve as a tracking feedback at any time to understand the situation of the target disadvantaged groups, and users in the second level and the third level of data will be shared.

- ⑤ Pharmacy as an auxiliary, can play in each level of the platform about the most important is the tool to connect the platform that is online Application, disadvantaged groups can directly contact with the pharmacy physician, the related distribution logistics for user medicine delivery, so as to maximally help disadvantaged groups at home, you can get the service that originally need to go out to get.

If disadvantaged groups want to go offline to buy medicine (such as on the way to work), they can plan the nearest route through the platform and make an appointment with the pharmacy, which can greatly facilitate the disadvantaged groups.

The hierarchy of this healthcare integration platform will be particularly clarified according to this approach, helping disadvantaged groups to better know where they are and what to do *(Figure 84)*.
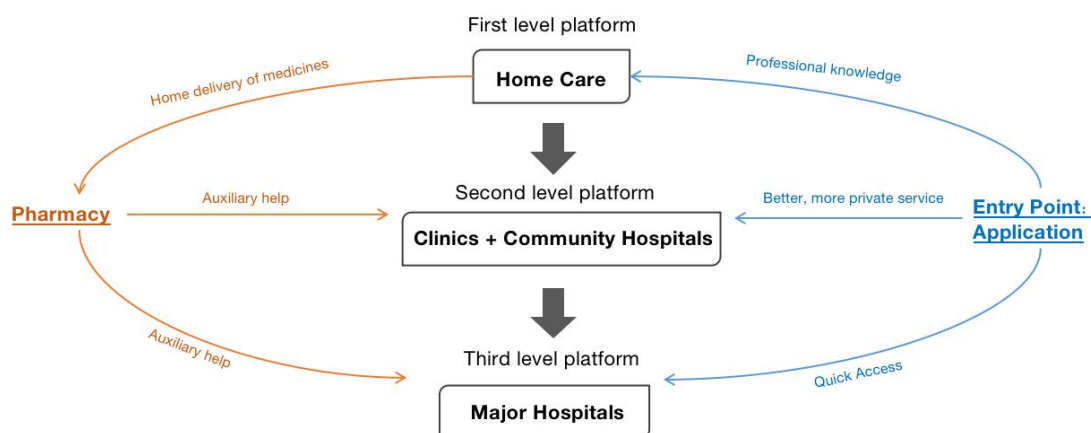

Fig.84   System platform hierarchies

As the whole service design system is very important to play a connection to the system Application, the design must meet the following four principles, which are obtained from the previous disadvantaged research data, disadvantaged groups hope that they can get the relevant services and attention in this health process.

These principles are also in accordance with the application development process and enhance user stickiness.

· **System Entry Point - Application**

Therefore we have to do the following*(Figure 85)*:

Fig.85   Principles of health care software design for the disadvantaged groups

- *Focus on perception*

We must first focus on the perceptions of disadvantaged groups of software use and what type of interface they find most convenient and quicker to find for them.

Most application is currently available with age-appropriate and accessible versions in China, which are designed to ensure the rights and fairness of disadvantaged groups when using the application.

As an example, one of the largest knowledge-based platforms in China*(Figure 86).*

In order to accommodate the disadvantaged groups, two versions of the barrier-free version and the care version are launched.

We can see that the barrier-free version is mainly suitable for people with visual impairment, but is limited to the partially sighted group, which can see the function of reading and adjusting the screen.

The care version is mainly to adapt to the increasing aging and the growing number of elderly people, but many elderly people become the mainstream of Chinese online social media at present, so many applications have an aging-friendly design.

The aging-friendly care with triple font enlargement, setting with finger reading mode and continuous reading mode, which is relatively simple compared to the functions.
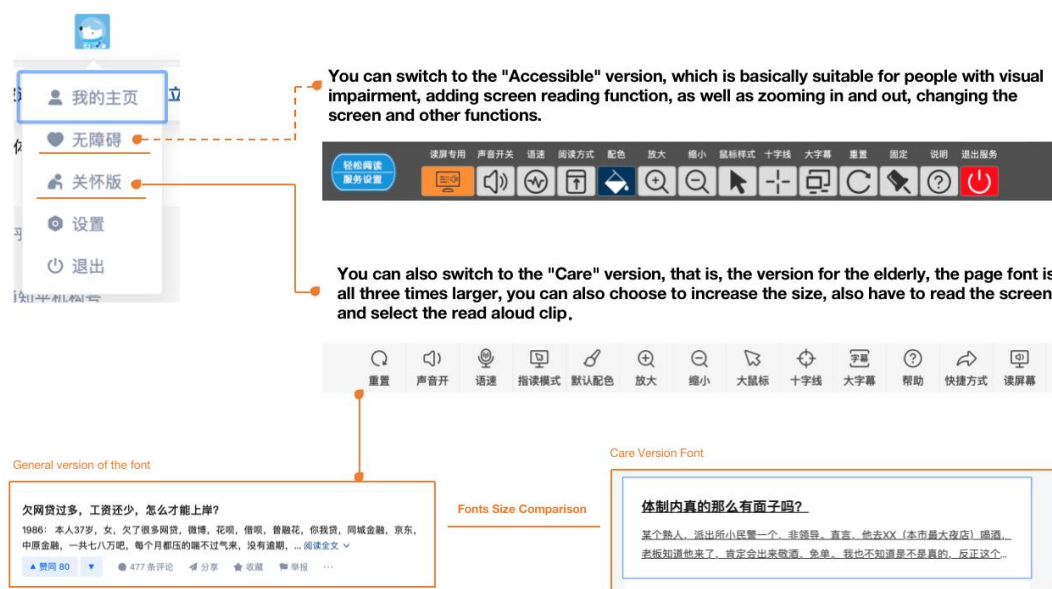

Fig.86   System platform hierarchies

Both versions use the least expensive pop-up box operation on the existing version, and the pop-up box directory was set in the middle of the top, the most obvious position, to facilitate user operation.

In fact, these changes are basic and relatively stay on the surface needs of the disadvantaged, but also shows that we are more and more concerned about the disadvantaged , pay attention to their needs and willing to make design changes.

Therefore, when we set up the functions and pages of the application, we should pay attention to the service needs of the disadvantaged groups and the relationship between the products to better help them to use the application.

- First Contact

As a new integrated platform operating on Application, the first contact with users is very important ,because the application is the entry point and serial product of the whole integrated system.

Through the previous research we can know whether the disadvantaged groups want their needs to be satisfied on this platform.

For example: whether they can quickly book the health care that they need, whether more specialized advice and guidance can be reflected in here, whether the price is cost-effective if medicine delivered to their homes, whether there is a level of privacy in seeing a doctor, whether there is a timely and professional reminder for regular follow-ups in the later stage, how much more convenient they may be in this platform than the original operation, etc.

Consider all of these into account and set up attractive and specialized small services to differentiate them from other applications, increase the favorability of the disadvantaged groups' first contact with the application and system, and enhance user stickiness.

- User Loyalty

After the first contact, giving the disadvantaged groups good feeling, how to enhance user stickiness, that is loyalty.

We need to meet the needs of disadvantaged groups in health care at a deep level, such as: keeping the timely update of health care information for a long time, fast appointment system, timely visit in return, real-time policies changes, some preferential information, rights and benefits and word of mouth, etc.

These are all ways to increase user loyalty. In addition to the general rights and interests, we should consider the special characteristics of the disadvantaged groups and go to a greater extent for them to design services and build a better system.

- Habitual use

The application should be set up the usage habits to satisfy the disadvantaged groups.
For example, the common interface settings of the existing application should be adjusted based on the special conditions of different disadvantaged groups, and the basic operation should be in compliance with habits. Sustainable return visits to update, community establishment, increase the communication between more disadvantaged groups, help them to share their experience, etc.

∙ **Analysis of Related Applications**

- Daily Rounds[117]   *(Figure 87)*:

Daily Rounds has more than 120 cases from different healthcare institutions, where users can find relevant medical records and get professional help.
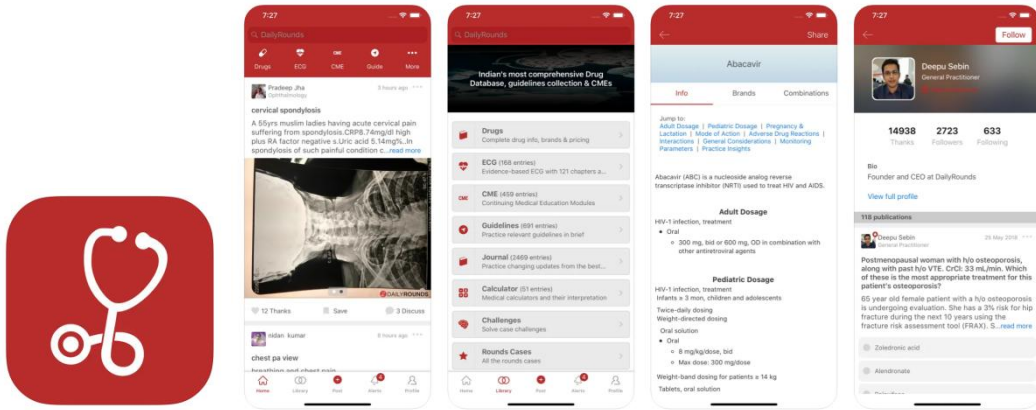

Fig.87　Daily Rounds

- ResolutionMD[118]   *(Figure 88)*:

ResolutionMD(ResMD) medical imaging software, provided as a client-server architecture product, enables doctors to securely view patient images and reports from a wide variety of computers and mobile devices, collaborate with other practitioners and diagnose from any location. Whether you are a single facility or a large healthcare system with tens of thousands of users.
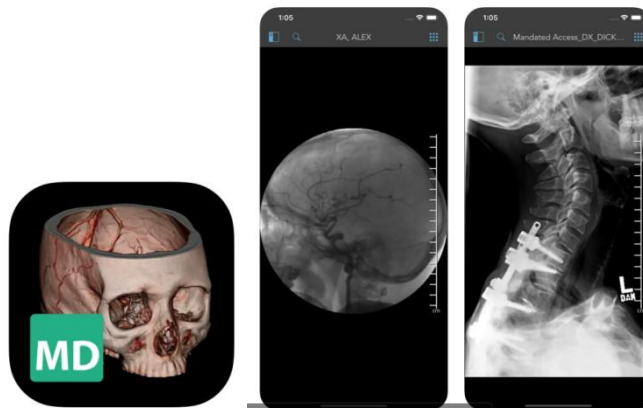

Fig.88　ResolutionMD(ResMD)

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[117] https://apps.apple.com/us/app/daily-rounds-for-doctors/id1003799400

[118] https://apps.apple.com/us/app/resolutionmd/id444336555?platform=iphone

- Asthmapolis[119]for childern version *(Figure 89)*:

Asthmapolis is a healthcare app that is a service dedicated to the treatment of asthma patients, using inhalers with GPS trackers to get user data and use the app to give trends in the onset of asthma at the individual level and the population level, Also with advice from advanced care doctors and specialists to plan a better asthma treatment plan.

Asthmapolis is a technology that combines a GPS tracking device with a mobile smartphone application. These technologies engage the patients where they are through a combination of text reminders and educational content along with the ability to track rescue inhaler usage when it happens and where it happens.

Aggregated usage patterns are then provided to the patient in the form of weekly e-mail and portal reports. These reports summarize usage patterns and allow the patient an opportunity to evaluate the number and location of actual triggers and determine if specific locations or activities result.
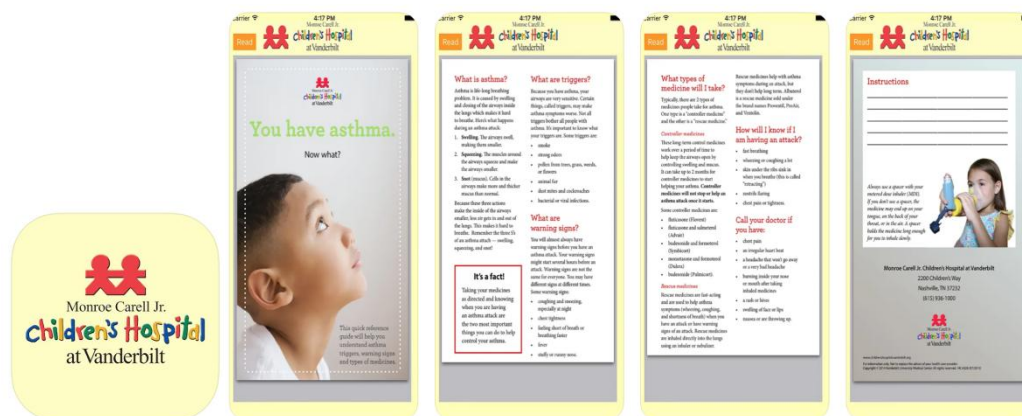

Fig.89   Asthmapolis Chidren verison

- Allayo[120] *(Figure 90)*:

Allayo is a virtual health assistant that saves 100 hours of exercise activity per year for users and their family members.

Allayo has created a new type of health care service, the virtual health consultant. In today's increasingly complex healthcare system, Allayo provides users with "certified medical help" via cell phone or confidential chat.
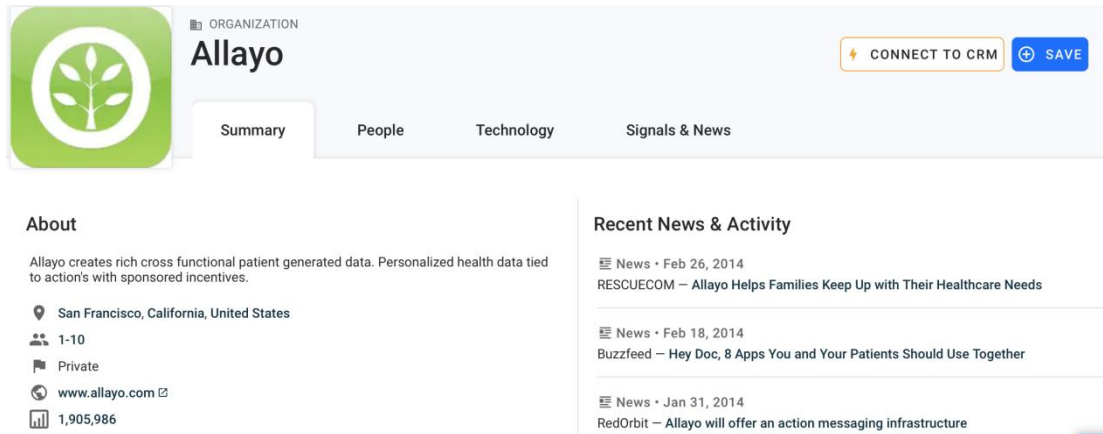
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[119] http://chest.dxy.cn/article/25614

[120] https://www.crunchbase.com/organization/allayo

Fig.90   Allayo

- Caremerge[121]   *(Figure 91)*:

Caremerge provides a communication platform for caregivers to communicate and cooperate in a timely manner with hired senior users. Through the web and mobile app, care can be coordinated with stakeholders working outside the home (e.g. doctors, family members, etc.) to organize care in a timely manner.

Caremerge Family Engagement[122] is your one-stop shop to connect family members with their loved one's senior care or other healthcare providers. We all live busy lives and this app helps us stay on top of our loved one's care as it's delivered in various care settings.
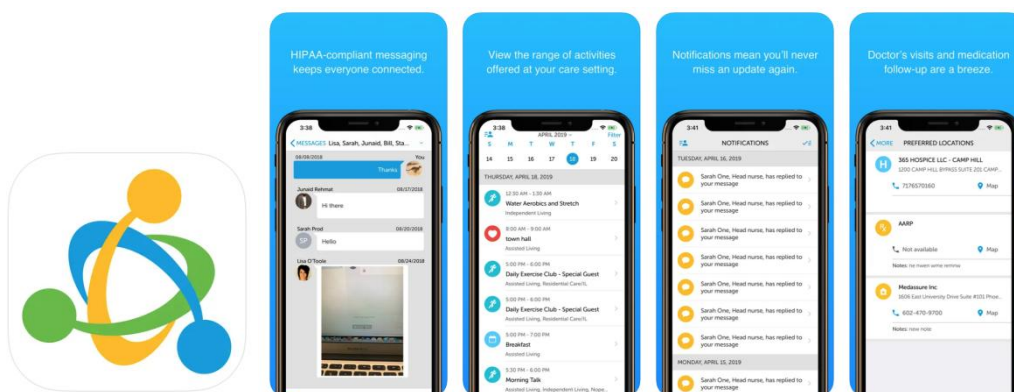

Fig.91   Caremerge

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[121] https://www.crunchbase.com/organization/allayo

[122] https://apps.apple.com/us/app/caremerge-family-app/id983623200

157

- Sunrise Mobile[123] *(Figure 92)*:

Sunrise Mobile extends the use of your hospital's Electronic Health Records to mobile devices. Its role-based approach lets physicians and nurses manage their daily activities. Intuitive and easy to use, Sunrise Mobile enables physicians and nurses to immediately benefit from having detailed patient data with them whenever they need it, wherever they are.
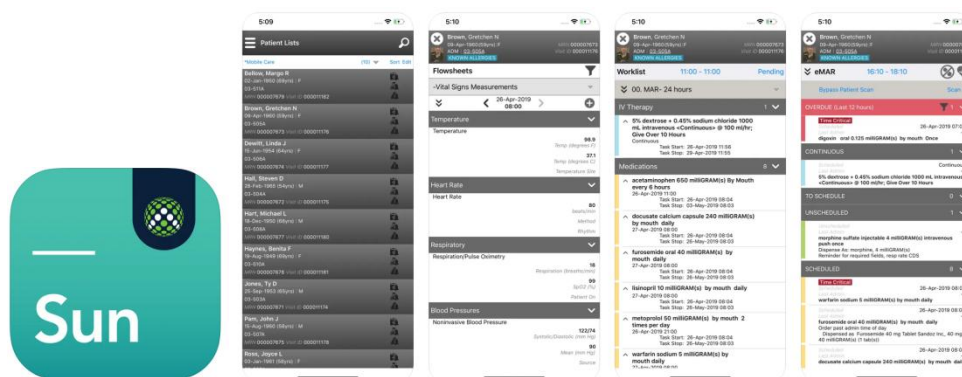

Fig.92   Sunrise Mobile

I summarize and analyze the related types of applications above to understand the advantages of currently using APP for multi-platform connection. It can provide and improve the whole APP architecture ideas and design *(Table 6)*.

Application Name	User (whether disadvantaged)	Feature Highlights	Connected medical platform	Strengths
Daily rounds	General users, doctors, medical students (×)	Provide real case search and establish archives for easy access	Medical institutions	Rich and realistic cases
Resolution MD	General users (×)	Provide acute mobile telemedicine services	Medical institutions	Image and remote services

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[123] https://apps.apple.com/us/app/sunrise-mobile/id1125534902?platform=iphone

Asthmapolis	Asthma patient (✔)	Collect asthma data to build a large database, develop plans and tips	Family members, doctors	Plan and alert to potential risks
Allago	General user (×)	Customize and renew prescriptions, schedule doctor and testing appointments, and deliver medications to your home	Doctor, Pharmacy	Home appointment and medication delivery
Caremerge	Elderly people (✔)	Help elderly people connect with family members, professional caregivers, doctors and provide health care services	Family, caregiver, doctor	Provide home skilled care to reduce the risk of hospitalization for older adults
Sunrise Mobile	General users (×)	Provide assistance in organizing information to send to doctors	Medical institutions	Physician access to records at all times to fully understand the condition

Table.6 Related App analysis table

・**Application Architecture Design** *(Figure 93)*

According to the opportunity point and system framework combing, the architecture of the application functions will be designed to clarify the hierarchical relationship and the logical sequence between the application functions. The first-level catalog has **Homepage, Quick Access, Popular Science, Healthcare+, Me**.

- *Homepage*: In the homepage to classify the first level, second level, and third level platforms according to the disadvantaged groups for triage, and help them to solve their needs quickly. Three main functions are set: medicine delivery to home (pharmacy assistance), quick access, and search.

- *Quick Access:* A quick access to the third level platform (large general public hospitals).

- *Healthcare+*:
① Making a health plan for family care. Enter your information, the system gives a plan list, and follow the list for health care.

② Synchronizing health care files to family members and community doctors (can be specified according to habits).

- *Popular Science*: Popularize health care knowledge, according to different disadvantaged groups, the first choice and habits of users, and develop related to understand health care knowledge.

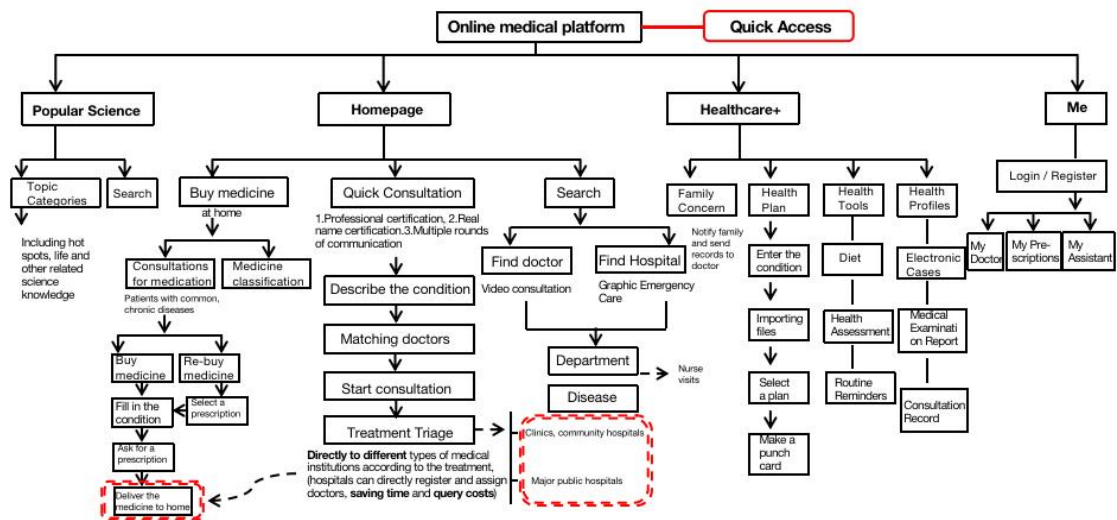- *Me* : Basic information, login and logout, doctor management and assistant help.

Fig.93   Application Architecture Design

· **Application Prototyping**

Create a prototype of the Application *(Figure 94)* for initial design, enabling users to clearly understand the design concept and operation.
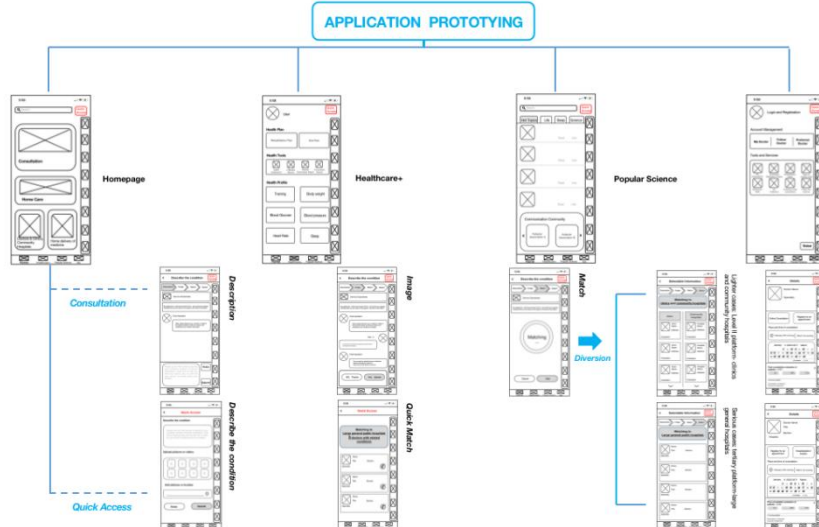

Fig.94   Application Prototype

The next is the specific analysis and demonstration of the main functions of the
Application.

- *Homepage*   *(Figure 95)*:
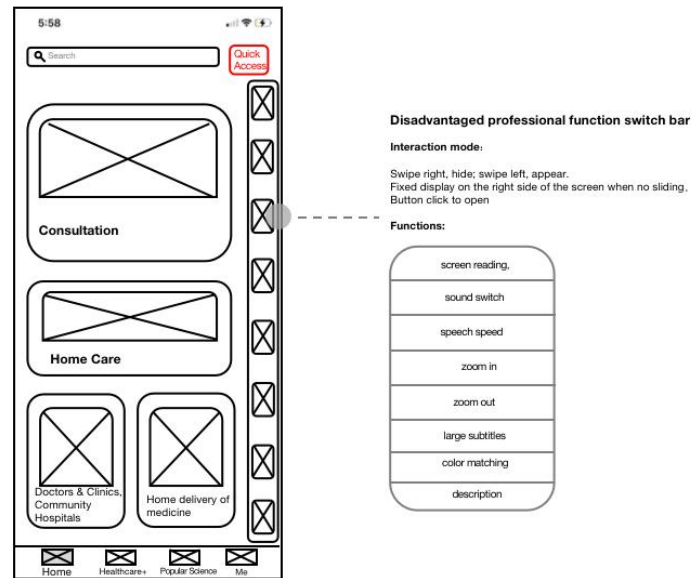
Fig.95   Application– Homepage

- *Quick Access*   *(Figure 96)*:

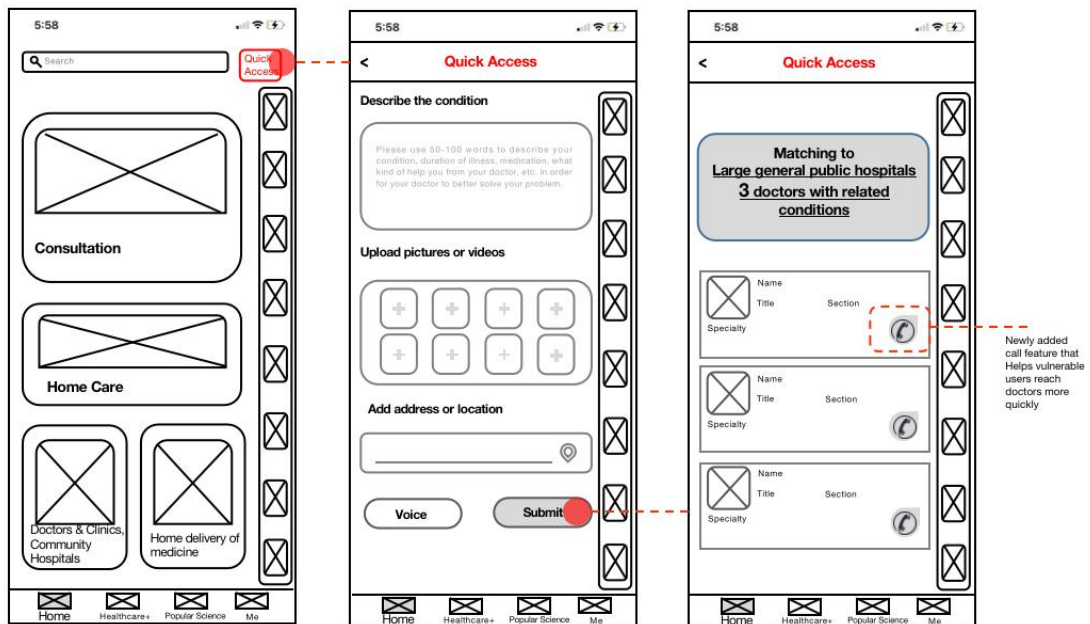Fig.96   Application – Quick Access
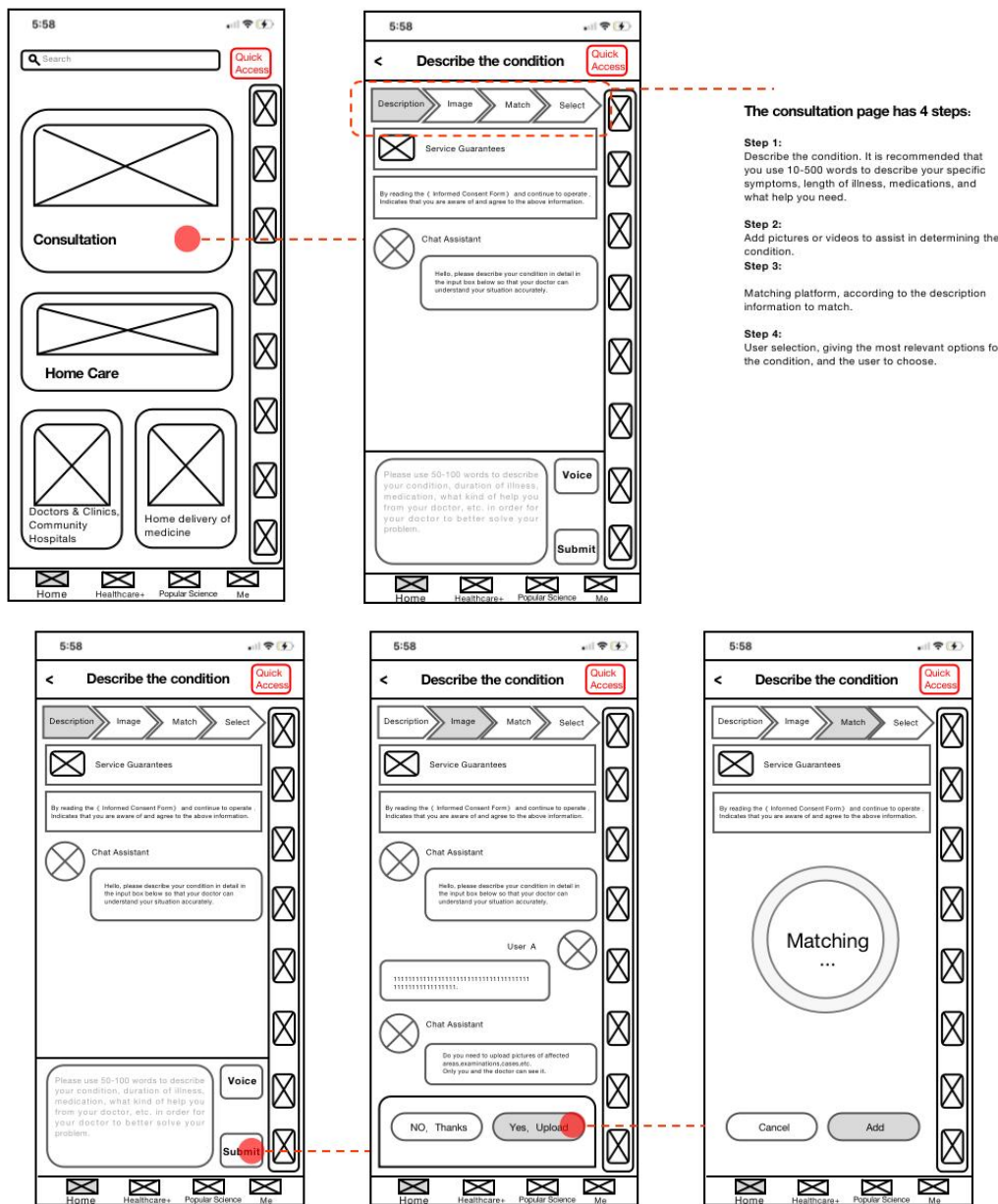
161

- Consultation page (Figure 97):

Fig.97   Application – Consultation page

Based on the description of the relevant condition, a match is made and the matching platform has 2 conditions：

① **second level platform:** small and medium-sized clinics and community hospitals. Conditions that are not very serious, such as simple care, rehabilitation checks, colds,

etc. will be automatically matched to small and medium-sized clinics and community hospitals that are closer to home.

② **Third level platform:** large general public hospitals..

If the disease is relatively serious or requires high precision equipment for regular follow-up, the system will automatically match to the third level platform of large public hospitals.

- Matching to second level platform (Figure 98):
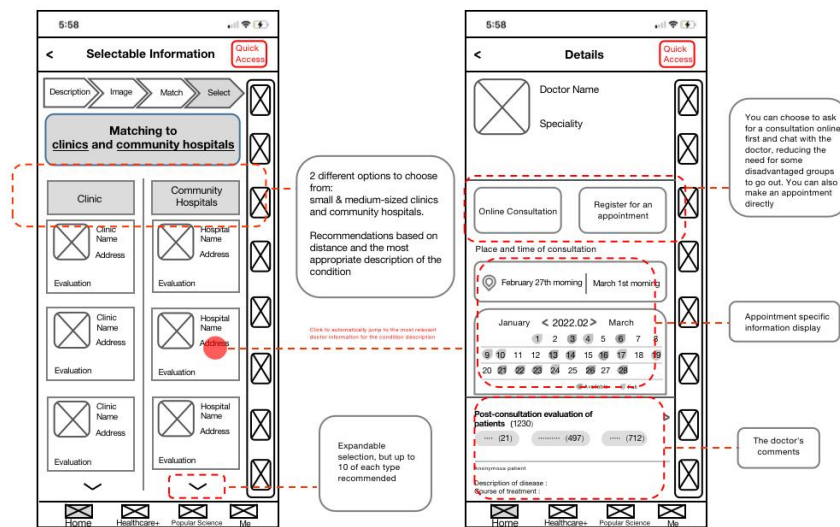
Fig.98   Application – Matching to second levelplatform page

- Matching to third *level platform   (Figure 99)*:
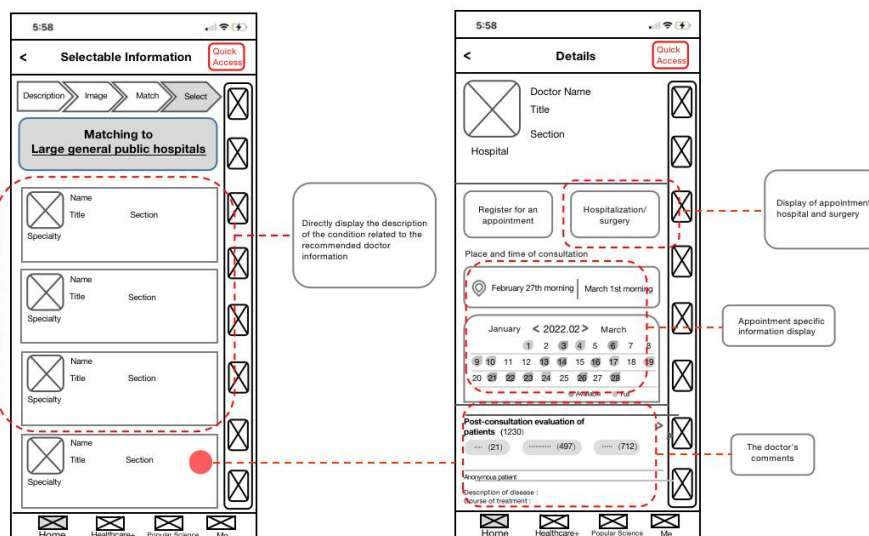

Fig.99   Application – Matching to third levelplatform page

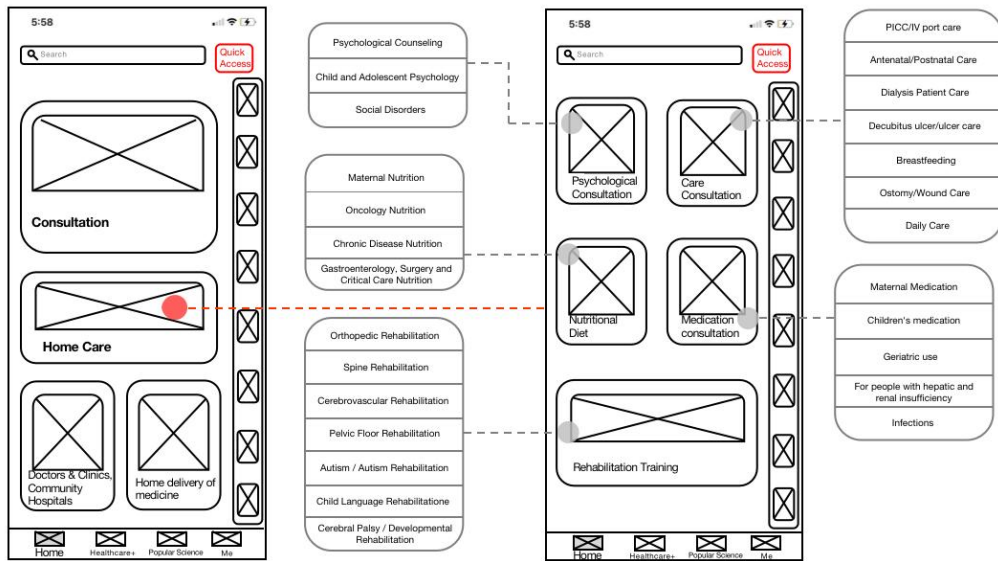## - Home Care page *(Figure 100)*:

Fig.100   Application – Home Care page

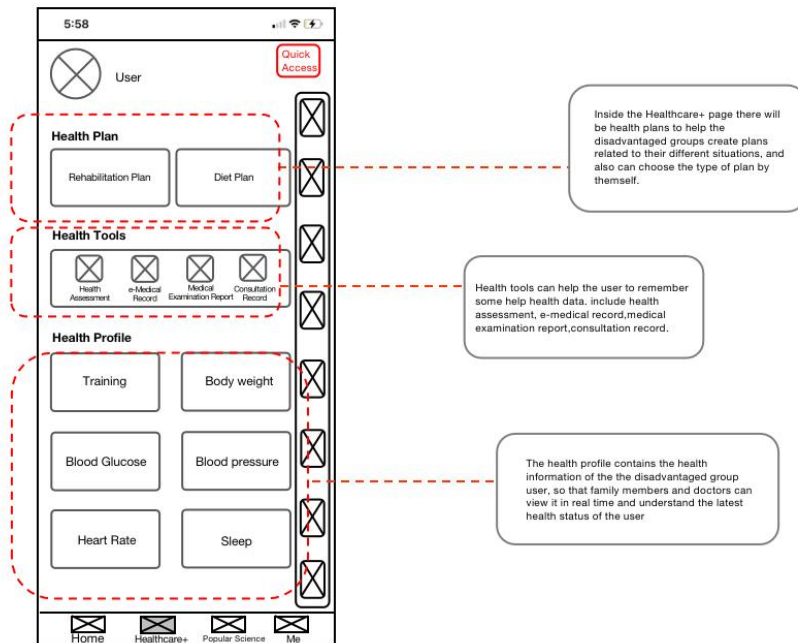## - Healthcare+ page *(Figure 101)*:

Fig.101   Application – Healthcare+ page
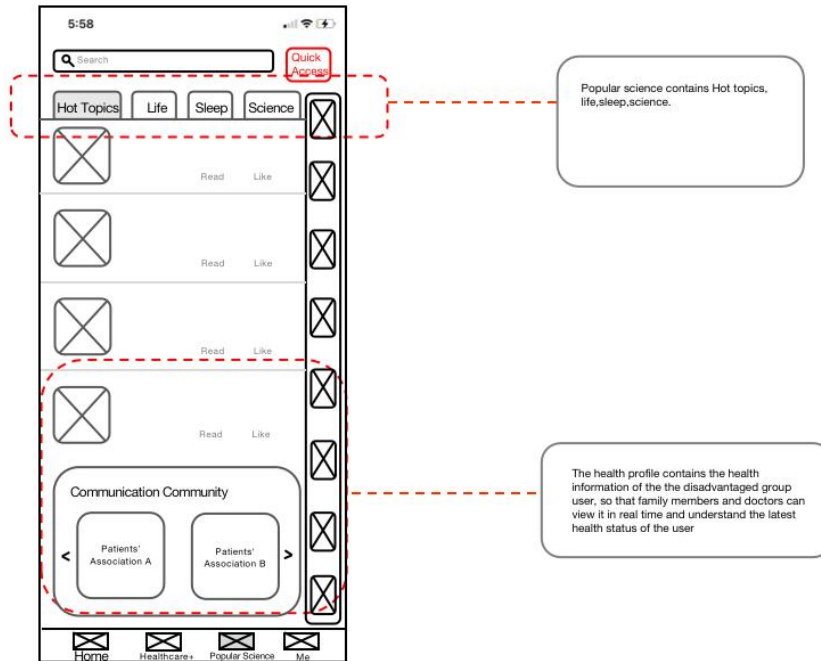
- Popular Science page *(Figure 102)*:

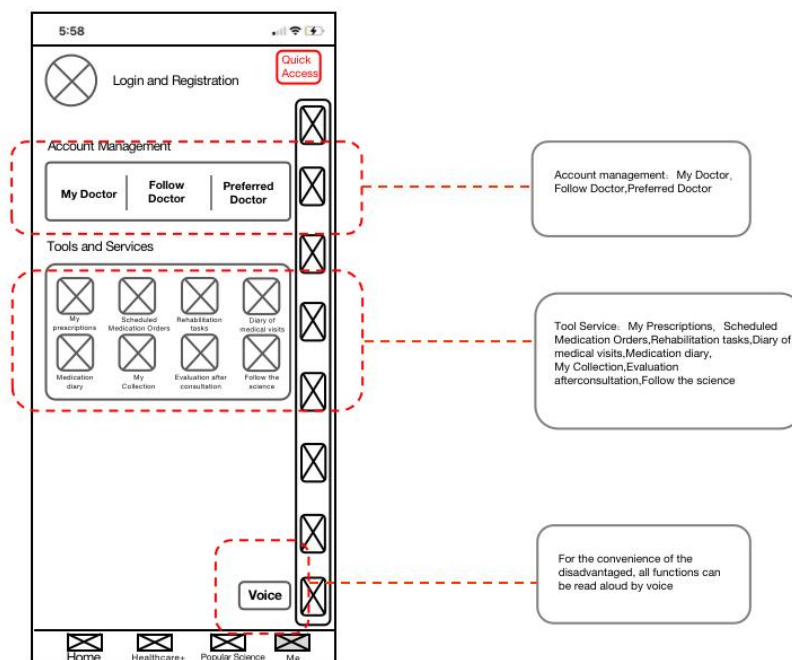Fig.102   Application – Popular Science page

- Me page *(Figure 103)*:

Fig.103   Application – Me page

· System Operation Procedure *(Figure 104)*：

The One entry point, three levels of platform ,one assistance.

- Through the mobile application as an entry point.
① Daily level (first level platform): daily rehabilitation training, maintenance, etc. will be pushed by APP for professional knowledge and plan to help disadvantaged groups to better health care.

If it is beyond the scope of daily care and requires a treatment level, disadvantaged groups can use the application and enter information related to their condition in the app. The application provides different triage through different levels of the user's condition and there are two main levels.

② Lighter level (second level platform): generally for daily care or common diseases with recorded medical history. It will automatically assign the nearest clinics and community hospitals at the current address through information input from disadvantaged groups, and describe the basic information of these medical institutions including doctor information, reviews, etc. Finally, the choice is made by the user himself. The application can also help the user to make an appointment directly (showing time, place, doctor) and just follow the above information for treatment or communicate with the doctor directly through the application.

③ The heavier level (third level platform): there are two different ways.
    *a.*Through the home page of the Quick Access function button directly into the page between the input of relevant information (only one page, you can save the user time, faster for the user to achieve the selection page), after the application system review . Application will directly give 3 doctors to choose (reduce the time of self-selection, achieve the purpose of saving time), choose all of the large public hospitals, All doctors with the most relevant condition descriptions can make appointments and conversations directly, and the doctor's phone number is also added to facilitate direct communication with the doctor in case of emergency.

    *b.*The list of doctors will be given through the application of the condition triage arrival and the recommendation will be based on the one related to the condition and the distance. Disadvantaged groups can choose and make appointments according to their own pages.

When the patient's condition improves or recovers, the information of this consultation will be entered into the app file for easy access by the doctor afterwards.

For care, review and follow-up, the patient is directly transferred to the nearest professional clinic or community hospital (second level platform) for post-service tracking and feedback.

- Pharmacies are available as an aid to help at any level to achieve home delivery service.

- System guarantees: cover all types of health care in China; automatically assign to provide professional certified doctors (wide range and full range of specialties); expert science to become health advisors to better serve the needs of disadvantaged groups; communicate sincerely with every disadvantaged group that needs to provide services; as well as take into account every stakeholder and interest level in the system to make every aspect better help.

- Physician Resources: Integration of all health care types of physicianresources; Famous doctors and specialists in the triage range.
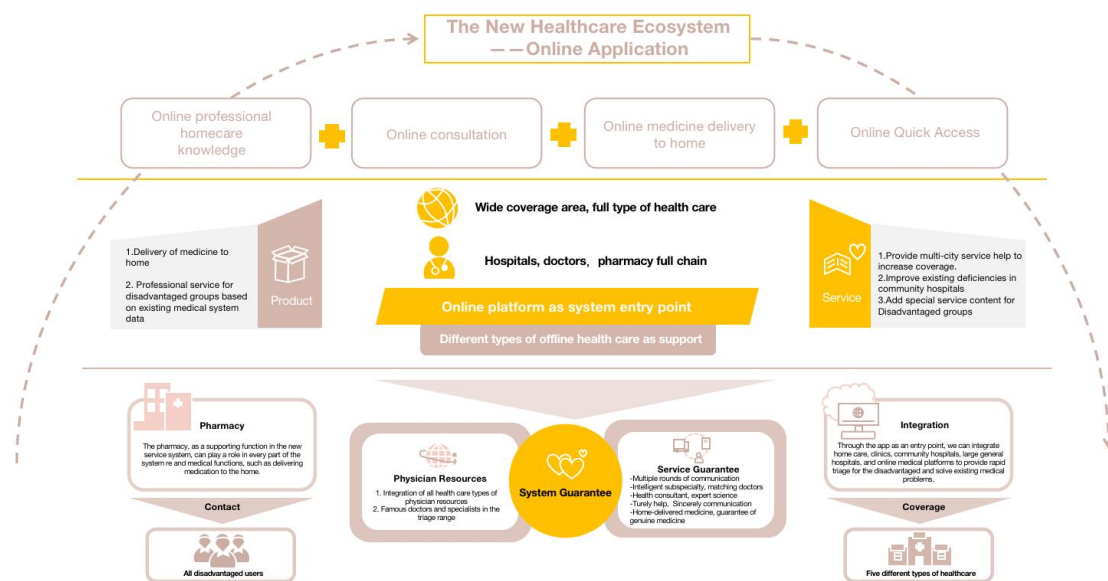
Fig.104　New Healthcare Eco–System

· **Specific operation flow chart** *(Figure 105)*

The application as a whole integrates the entry point of the entire healthcare system is very important, especially the Online Consultation which realizes the triage function, and through professional evaluation, the second level (clinics and community hospitals) and the third level platform (The third level platform (large public hospitals) is triaged.

It reduces the imbalance of resource allocation in health care, which makes it difficult to see patients in large hospitals and unattended in community hospitals. After receiving better services and symptom reduction in the third level platform (large public hospitals), they can be transferred to the first level (home care) and the second level platform.
In other words, each level of the platform is transferred to each other and resources are converted to make the process of seeing a doctor and health care more convenient for the disadvantaged groups,   pharmacies serve as auxiliary services in each link and platform to help the disadvantaged groups to realize the real delivery of drugs to their homes and get better and more professional health care without leaving home.

Fig.105   Specific operation flow chart

6.4　Summary

6.4.1 Research on emotional Interaction Service system and Design for the Disadvantaged Groups based on China Health Care Situation

This study clearly shows that the emotional needs of the disadvantaged are significantly more than the normal people, and the highest proportion of their lives is health care, which is basically the need of the disadvantaged for health care. I conducted an in-depth study and research on the existing health care system in Chi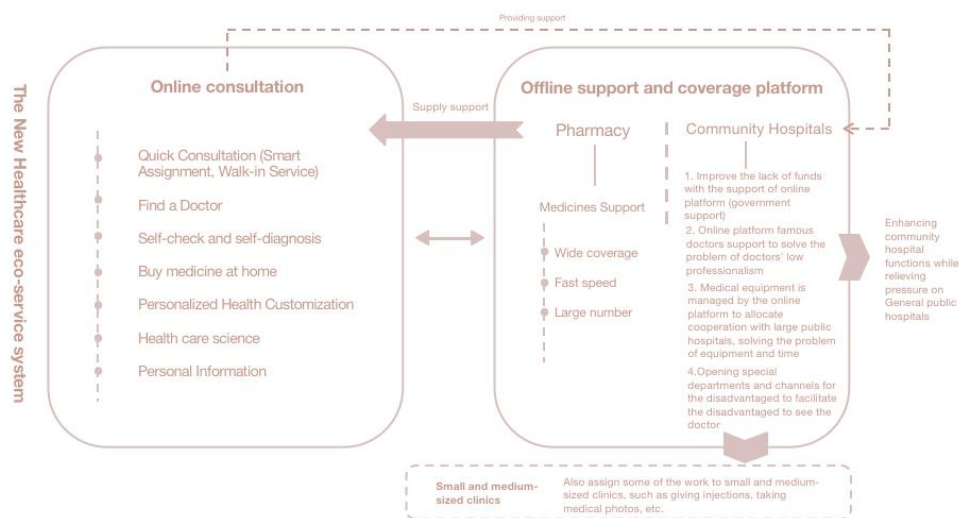na, and found that the current health care system has many problems in China, such as "difficult to see a doctor and uneven distribution of resources", which makes it more difficult for patients to see a doctor in the long time, and the healthcare resources are becoming more and more uneven.

Resources are becoming more and more uneven. as the survey progresses, we can find that there is basically no emotional care or emotional design for disadvantaged groups, such as the elderly, people with disabilities, etc. Some hospitals do not even have the most basic barrier-free access, and health care accounts for a large proportion in the lives of disadvantaged groups. Some of them need rehabilitation training, and some of them need professional care and return visits, which are basically non-existent in the existing health care system.

Therefore, we need to pay attention to the emotional needs of disadvantaged groups and establish a new health care system for them to facilitateand enhance their life security and quality.

Our results show that the establishment of new health care eco-system can significantly help disadvantaged groups to get several benefits when it comes to health care.

・**More professional daily care**

　- The system app provides expert advice, daily scientific promotion, disadvantaged groups and their families can scientifically base on the content for daily care.

- Establish an archive to record every health care situation, so that the doctor can quickly understand the user's previous situation and give more professional medical judgment in the future.

- Establish a daily care plan, which can be punched according to the relevant plan to play a supervisory role, while the plan itself is set up to contain (different contents such as diet, exercise, lifestyle, rehabilitation, etc.) depending on each disadvantaged group with different conditions and judgments.

- Establish daily communication between experts and disadvantaged groups
We all know that many diseases and problems are caused by a small number of people, so we can get more professional answers to small questions and situations in health care, and reduce the number of users who are misled by false or false information from the online world.

· **Better solve the existing imbalance in the distribution of health care resources and the gap between different types of health care.**

We have divided the existing health care system into one entry point, three platforms, one auxiliary *(Figure 106)*.
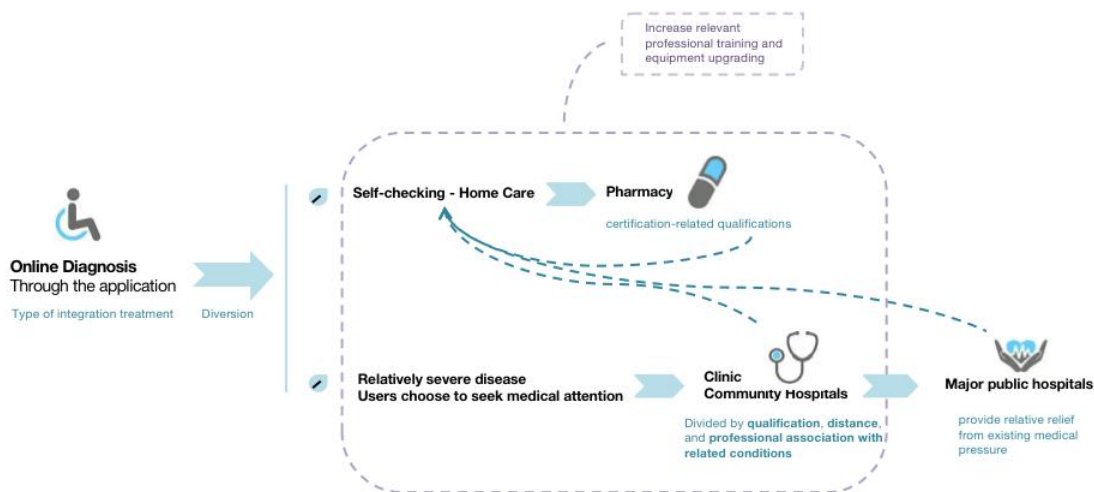

Fig.106   The Healthcare Eco–system process

Use the application as an entry point to integrate the entire health care system.

170

First-level platform (professional home care): The application assists to provide better expert and professional home care services.

Second level platform (clinics and community hospitals): Triage less serious illnesses into the second level platform to achieve resource balance and solve the current situation that a large number of empty and wasted medical resources.

Third-level platform (large public hospitals): the emergency or more serious cases will be diverted to the third-level platform, the establishment of Quick Access and hospital flow-oriented triage. Solve the difficulty of seeing patients, large public hospitals are overcrowded status through professional assessment, users third level platform to the second level (first level) platform, reduce the pressure third level platform pressure, so that users get better service.

Pharmacy as an auxiliary can be realized in the whole system and each platform, especially to help the inconvenient disadvantaged groups to send medicine to the home service.

· Better post service tracking and record review

The system has a post service aspect to help each disadvantaged group to achieve clear records, on-time reminders, on-time return visits and other services, without the existing situation of leaving the medical institution unattended and having to wait in line to register again for a review.

· Every stakeholder in the new service system is better designed and has more value *(Figure 107)*

Because of the health care system contains more types and complex aspects, when we sorted out the overall health care system, we divided the overall system into the first level of stakeholders and the second level of stakeholders.

This will better help us build the new system and also maximize the role of each stakeholder to understand their needs and pain points, so that each link and contact point within the new system can provide better services for the overall system to bring out the maximum value.
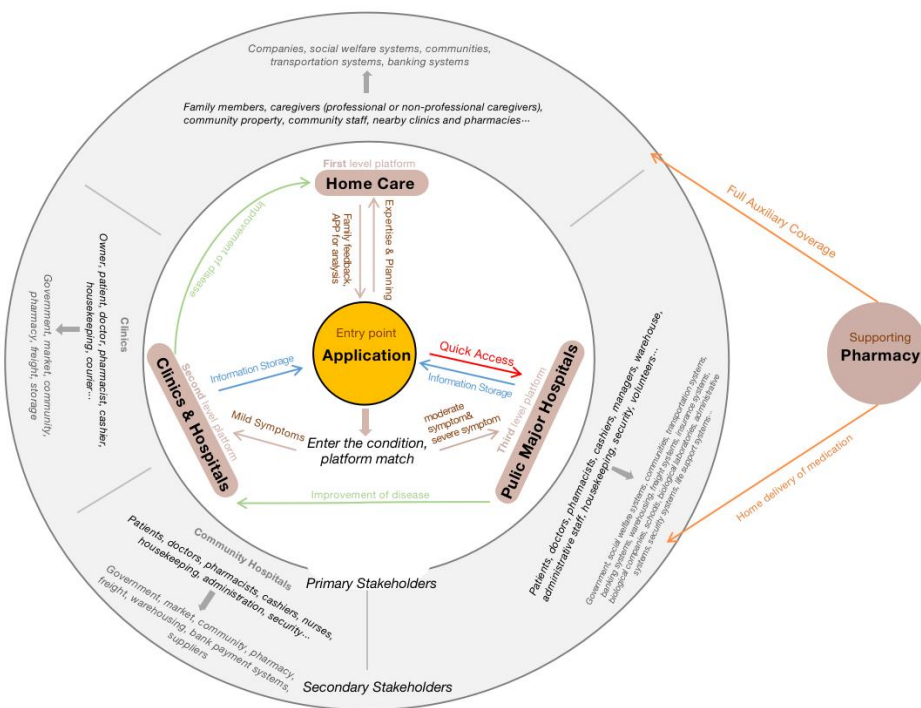
Fig.107　System images (with stakeholder)

・Integrate existing health care types into a holistic, approach to better leverage the value of each type.

This is due to the fact that there are varying degrees of business overlap and crossover in all existing health care types. For example, online health care platforms are operating more online medicine sales now, leading to a certain degree of reduction in offline pharmacies. There is also a big difference between community hospitals and clinics in most users' psychology, but in fact ,their functions are very different, leading to a certain degree of competition between them, with community hospitals unattended and clinics blossoming everywhere, but their professionalism needs to be improved.

Therefore how to more reasonable planning, the function of each type to the maximum, after the integration of resources to reflect the greatest advantage, but also the necessary path.

172

· The emotions of disadvantaged groups being cared

Through the professional health care system built for them, we let the disadvantaged know that we respect their emotional needs, their differentiation, their way of life, and every user, and have been working to create better design, better services to help them, achieving true non-differentiation and eliminating prejudice.

This is also the purpose of this thesis research, hoping that the world can respect every living creature and person, without differences, to achieve true accessibility.

Therefore, I made a new user journey map *(Figure 108)* for disadvantaged groups at the end of the conclusion, and found that through the new service system, disadvantaged groups can realize four stages of health care: Pre Service, Pre Attendance, will Attendance and Post Service *(Figure 109)* , so that each step can satisfy their real needs and provide better health care services for them.
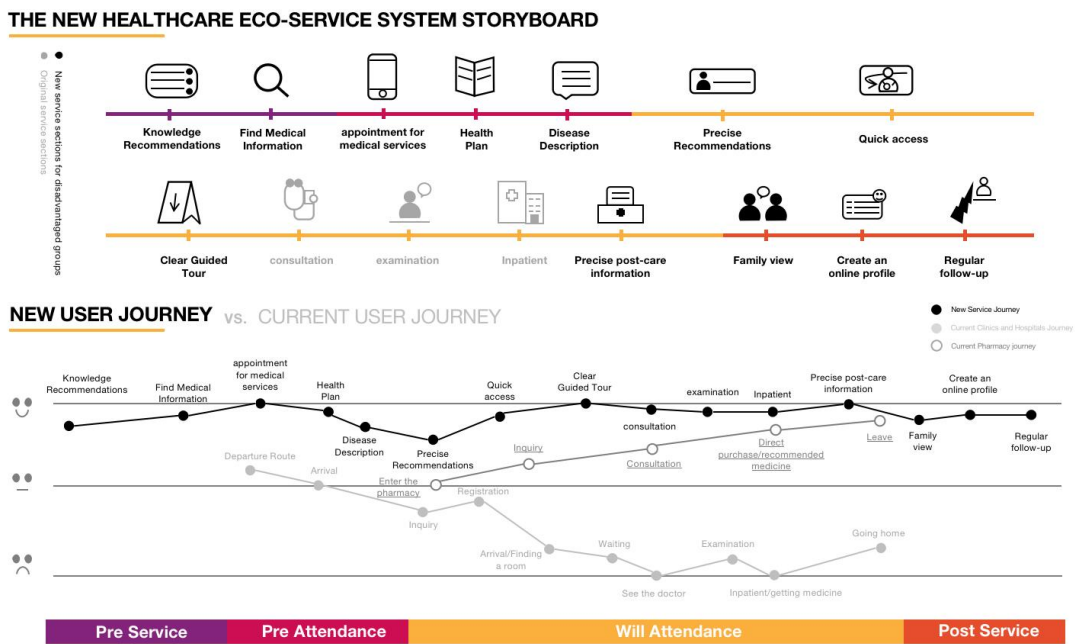
Fig.108 The new healthcare eco–system storyboard and new user journey

173
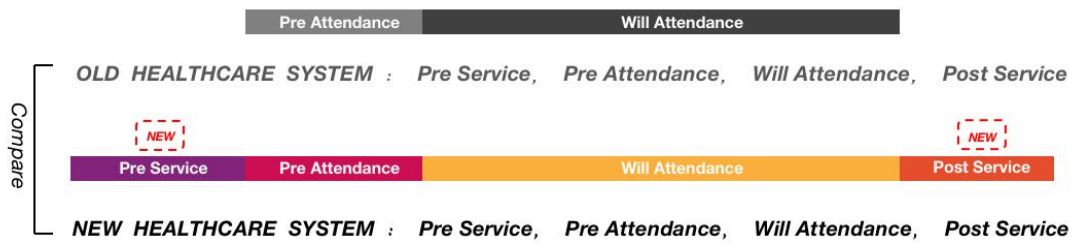
Fig.109 Old Health Care Service System vs. New Health Service System

Through the user journey map, we can find the purpose of our study.The result is currently a good phase success in the new system service. The satisfaction of disadvantaged groups is obviously well above the existing service system in the new system service. In the new service system, each step is evaluated highly and well above the existing health care system, which shows that the new service design system has achieved the desired objectives.

Finally, the research hope everyone can pay more attention to the disadvantaged groups, feeling the multiplicity and differences of life, respecting the differences and removing the barriers.

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ATTACHMENTS

Attachment A

Attachment A

Table A1. *Questionnaire survey on the living needs of disadvantaged groups*

		0	1	2	3	4	5	6	7	8	9	10
Emotional												
1.	Who am I? Children, the elderly, the disabled, the mentally challenged · · ·											
2.	My age? (Please fill in)											
3.	Will I be able to live on my own? Yes Yes, but sometimes I need to rely on others No,											
4.	Who do I live with? Myself. Family members. Institutional residence (name of institution)											
5.	When I am on Home , I notice if I am angry or happy (I play, I communicate . . .) When I am on Home with family or professional assistants, I notice if I am angry or happy (I play, I communicate . . .)											

6. Would you like it if you lived with other people?

Who is this person?

Living with someone else, I often feel

(I feel happy, dislike, angry)

Why?

7. If you had the opportunity to live on your own,

would you choose to live on your own?

Because you don't like to bother others?

Or don't like others to control you?

8. What time do you start each day?

What time do you rest?

9. What are the parts that make up my day?

(Learning, playing, recovering, healing, Healthcare, enjoying・・・)

10. What do I do most often?

Do I feel happy?

If not, why?

11. Is your life arranged by yourself?

Or are you forced to accept some arrangements?

(For example)

12. Can you describe your day specifically?

13.   Please rate the things that you would do in your life?
 (out of 10 points)

        Do you want to change?
  14   Don't want to, usually, very much, especially

        If I could change, what part of my life would I like to change?
  15.   Why?

        When you are outside, do you care about the eyes of others?
        In terms of caring?
  16   What are your emotions at this time?
        (unhappy, angry, cranky)
        Why?

---

  17.   Please remember specifically, and describe a day in your life?

---

  18.   Would you mind if I observed a day in your life, if that's okay?
         If not, why?

Attachment A

Table A2.   *Questionnaire survey on health care aspects of disadvantaged groups*

	0	1	2	3	4	5	6	7	8	9	10

Emotional

1.	Who am I? Children, the elderly, the disabled, the mentally challenged・・・
2.	My age? (Please fill in)
3.	Will I be able to live on my own? Yes Yes, but sometimes I need to rely on others No,
4.	Who do I live with? Myself. Family members. Institutional residence (name of institution)
5.	How often do you have health care? (Frequency)

6.   What is the reason for each health care session?

        Is it always the same? Or is it the same occasionally? Not at all?

7.   What is the duration of each health care session?

        Half an hour

        Half an hour - one hour

        One hour - two hours

        More than two hours

8.   What types of health care have you been in contact with so far?

        Where is (multiple choice)?

        (Large general public hospital, clinic, community hospital, pharmacy, online health care platform, home care)

9.   Based on the type of health care you have been in contact with so far,

        Which one do you like the most?

        Reason

10.   Based on the type of health care you have been in contact with so far,

        Which one do you like the most?

        Reason

11.   What do you think is the difference between

        your favorite type of health care and your lowest favorite type of health care?

12.   Why would you choose just one type of health care?

        Why would you choose more than one type of health care?

13.   Can you help me remember when was the last time you went to health care?

14.   What were the reasons for your visit to health care?

How did you feel about it?
15.   Very good, fair, bad…

16.   What do you think made you feel this way?

Can describe your health care life up to now?
17.   What has been the most impressive?
Was it a good or bad experience?

Do you think the impact on your health care after covid-19 has been significant?
18.   What are the main impacts?

How much do you use your cell phone?
Unfamiliarity.
Fair operation, not used much.
19.   Fair operation, mostly used to make payments and view information.
Operation is proficient , can use it freely
Very proficient, can't live without the phoneIf not, why?

What do you think is the biggest problem in health care today?
20.   What is the main type of health care?

If you had the opportunity to experience more specialized health care content without leaving your home,

21. would you like to do so?

Why?

If all existing types of health care were made into one,

22. Do you think you would like it?

Why?

Please rate the different types of health care available (out of 10)

large general public hospitals.

23. clinics.

community hospitals.

Online health care platforms.

Home care.

24. Can you describe your ideal health care?

Attachment B

Statistical bulletin on the development of healthcare of China in 2021

表 1　全国医疗卫生机构及床位数

机构类别	机构数（个）		床位数（张）	
	2020	2021	2020	2021
总计	**1022922**	**1030935**	**9100700**	**9448448**
医院	**35394**	**36570**	**7131186**	**7412566**
公立医院	11870	11804	5090558	5206065
民营医院	23524	24766	2040628	2206501
医院中：三级医院	2996	3275	3002503	3228967
二级医院	10404	10848	2718116	2743079
一级医院	12252	12649	712732	726054
基层医疗卫生机构	**970036**	**977790**	**1649384**	**1712115**
#社区卫生服务中心	9826	10122	225539	239139
#政府办	6848	7042	177263	188550
社区卫生服务站	25539	26038	12804	12581
#政府办	10482	10631	2704	2238
乡镇卫生院	35762	34943	1390325	1417410
#政府办	35259	34494	1370674	1402629
村卫生室	608828	599292	-	-
诊所（医务室、护理站）	259833	271056	564	1343
专业公共卫生机构	**14492**	**13276**	**296063**	**301566**
#疾病预防控制中心	3384	3376	-	-
专科疾病防治机构	1048	932	42323	40611
妇幼保健机构	3052	3032	252920	260132
卫生监督所（中心）	2934	3010	-	-
计划生育技术服务机构	2810	1588	-	-
其他机构	**3000**	**3299**	**24067**	**22201**

注：#系其中数。以下各表同。

（二）**床位数**。2021年末，全国医疗卫生机构床位944.8万张，其中：医院741.3万张（占78.5%），基层医疗卫生机构171.2万张（占18.1%），专业公共卫生机构30.2万张（占3.2%）。医院中，公立医院床位占70.2%，民营医院床位占29.8%。与上年比较，床位增加34.8万张，其中：医院床位增加28.1万张（公立医院增加11.6万张，民营医院增加16.6万张），基层医疗卫生机构床位增加6.3万张，专业公共卫生机构床位增加0.6万张。每千人口医疗卫生机构床位数由2020年6.46张增加到2021年6.70张。

图2　全国医疗卫生机构床位数及增长速度

（三）**卫生人员总数**。2021年末，全国卫生人员总数1398.3万人，比上年增加50.8万人（增长3.8%）。

2021年末卫生人员总数中，卫生技术人员1124.2万人。卫生技术人员中，执业（助理）医师428.7万人，注册护士501.8万人。与上年比较，卫生技术人员增加56.4万人（增长5.3%）（见表2）。

2021年末卫生人员机构分布：医院847.8万人（占60.6%），基层医疗卫生机构443.2万人（占31.7%），专业公共卫生机构95.8万人（占6.9%）。

2021年，每千人口执业（助理）医师3.04人，每千人口注册护士3.56人；每万人口全科医生数为3.08人，每万人口专业公共卫生机构人员6.79人（见表3）。

图3 全国卫生技术人员数

表2 全国卫生人员数

指 标	2020	2021
卫生人员总数（万人）	1347.5	1398.3
#卫生技术人员	1067.8	1124.2
#执业（助理）医师	408.6	428.7
#执业医师	340.2	359.0
注册护士	470.9	501.8
药师（士）	49.7	52.1
技师（士）	56.1	69.2
持乡村医生证的人员和卫生员	79.6	69.7
每千人口执业（助理）医师（人）	2.90	3.04
每万人口全科医生（人）	2.90	3.08
每千人口注册护士（人）	3.34	3.56
每万人口专业公共卫生机构人员（人）	6.56	6.79

注：卫生人员和卫生技术人员包括公务员中取得"卫生监督员证书"的人数，下表同。2020年全科医生数指注册为全科医学专业和取得全科医生培训合格证的执业（助理）医师数之和；2021年全科医生数指注册为全科医学专业的执业（助理）医师与注册为乡村全科执业助理医师之和，不含尚未注册的取得全科医生培训合格证书的人数。

表3 全国各类医疗卫生机构人员数（万人）

机构类别	人员数		卫生技术人员	
	2020	2021	2020	2021
总计	1347.5	1398.3	1067.8	1124.2
医院	811.2	847.8	677.5	711.3
公立医院	621.3	646.1	529.2	552.4
民营医院	189.9	201.7	148.2	158.9
基层医疗卫生机构	434.0	443.2	312.4	330.2
#社区卫生服务中心	52.1	55.5	44.4	47.6
社区卫生服务站	12.7	12.8	11.4	11.6
乡镇卫生院	148.1	149.2	126.7	128.5
专业公共卫生机构	92.5	95.8	72.7	76.4
#疾病预防控制中心	19.4	21.0	14.5	15.8
妇幼保健机构	51.5	54.2	42.9	45.4
卫生监督所（中心）	7.9	8.0	6.4	6.7
其他机构	9.8	11.4	5.2	6.3

（四）卫生总费用。2021年全国卫生总费用初步推算为75593.6亿元，其中：政府卫生支出20718.5亿元，占27.4%；社会卫生支出33920.3亿元，占44.9%；个人卫生支出20954.8亿元，占27.7%。人均卫生总费用5348.1元，卫生总费用占GDP的比例为6.5%（见表4）。

二、医疗服务

（一）**门诊和住院量**。2021年，全国医疗卫生机构总诊疗人次84.7亿，比上年增加7.3亿人次（增长9.4%）。2021年居民平均到医疗卫生机构就诊6.0次。

2021年总诊疗量中，医院38.8亿人次（占45.8%），基层医疗卫生机构42.5亿人次（占50.2%），其他医疗卫生机构3.4亿人次（占4.0%）。与上年比较，医院诊疗增加5.6亿人次，基层医疗卫生机构诊疗增加1.3亿人次。

2021年公立医院诊疗人次32.7亿（占医院总诊疗人次的84.2%），民营医院诊疗人次6.1亿（占医院总诊疗人次的15.8%）（见表5）。

图4　全国医疗卫生机构诊疗量

2021年，乡镇卫生院和社区卫生服务中心（站）诊疗人次20.0亿，比上年增加1.5亿人次。乡镇卫生院和社区卫生服务中心（站）诊疗量占总诊疗人次的23.6%，所占比重比上年下降0.3个百分点。

表5　全国医疗服务工作量

机构类别	诊疗人次数（亿人次）		入院人次数（万人次）	
	2020	2021	2020	2021
医疗卫生机构合计	**77.4**	**84.7**	**23013**	**24726**
医院	33.2	38.8	18352	20149
公立医院	27.9	32.7	14835	16404
民营医院	5.3	6.1	3517	3745
医院中：				
三级医院	18.0	22.3	9373	11246
二级医院	11.6	12.5	6965	6890
一级医院	2.0	2.2	1117	1120
基层医疗卫生机构	**41.2**	**42.5**	**3707**	**3592**
其他机构	**3.0**	**3.4**	**953**	**985**
合计中：非公医疗卫生机构	18.2	19.3	3569	3820

2021年，全国医疗卫生机构入院人次24726万，比上年增加1713万人次（增长7.4%），居民年住院率为17.5%。

2021年入院中，医院20149万人次（占81.5%），基层医疗卫生机构3592万人次（占14.5%），其他机构985万人次（占4.0%）。与上年比较，医院入院增加1797万人次，基层医疗卫生机构入院减少115万人次，其他医疗机构入院增加32万人次。

2021年，公立医院入院人次16404万（占医院总入院人次的81.4%），民营医院入院人次3745万（占医院总入院人次的18.6%）（见表5）。

图5 全国医疗卫生机构住院量

（二）**医院医师工作负荷**。2021年，医院医师日均担负诊疗6.5人次、住院2.2床日，其中：公立医院医师日均担负诊疗7.0人次、住院2.2床日（见表6）。

表6 医院医师担负工作量

机构类别	医师日均担负诊疗人次		医师日均担负住院床日	
	2020	2021	2020	2021
医院	**5.9**	**6.5**	**2.2**	**2.2**
公立医院	6.3	7.0	2.2	2.2
民营医院	4.3	4.7	2.1	2.3
医院中：三级医院	6.3	7.2	2.1	2.2
二级医院	5.8	6.2	2.3	2.3
一级医院	4.5	4.8	1.8	1.9

（三）**病床使用**。2021年，全国医院病床使用率74.6%，其中：公立医院80.3%。与上年比较，医院病床使用率增加2.3个百分点（其中公立医院增加2.9个百分点）。2021年医院出院者平均住院日为9.2（其中：公立医院9.0日），与上年比较，医院出院者平均住院日减少0.3日（其中公立医院减少0.3日）（见表7）。

表7 医院病床使用情况

机构类别	病床使用率（%）		出院者平均住院日	
	2020	2021	2020	2021
医院	**72.3**	**74.6**	**9.5**	**9.2**
公立医院	77.4	80.3	9.3	9.0
民营医院	58.3	59.9	10.3	10.5
医院中：三级医院	81.3	85.3	9.3	8.8
二级医院	70.7	71.1	9.3	9.4
一级医院	52.1	52.1	10.2	9.9

（四）**改善医疗服务**。截至2021年底，二级及以上公立医院中，54.5%开展了预约诊疗，91.3%开展临床路径管理，64.6%开展远程医疗服务，87.6%参与同级检查结果互认，92.0%开展优质护理服务。

（五）**血液保障**。2021年，全年无偿献血人次数达到1674.5万人次，采血量达到2855.9万单位，较2020年分别增长7.5%和8.0%，千人口献血率12。

三、基层卫生服务

（一）**农村卫生**。2021年底，全国共有县级（含县级市）医院17294所、县级（含县级市）妇幼保健机构1868所、县级（含县级市）疾病预防控制中心1999所、县级（含县级市）卫生监督所1761所，四类县级（含县级市）医疗卫生机构共有卫生人员352.1万人。

2021年底，全国2.96万个乡镇共设3.5万个乡镇卫生院，床位141.7万张，卫生人员149.2万人（其中卫生技术人员128.5万人）。与上年比较，乡镇卫生院减少819个，床位增加2.7万张，人员增加1.1万人（见表8）。

表 8　全国乡镇卫生院医疗服务情况

指　标	2020	2021
乡镇数（万个）	3.00	2.96
乡镇卫生院数（个）	35762	34943
床位数（万张）	139.0	141.7
卫生人员数（万人）	148.1	149.2
#卫生技术人员	126.7	128.5
#执业（助理）医师	52.0	52.5
诊疗人次（亿人次）	11.0	11.6
入院人次数（万人次）	3383.3	3223.0
医师日均担负诊疗人次	8.5	8.9
医师日均担负住院床日	1.3	1.2
病床使用率（%）	50.4	48.2
出院者平均住院日（日）	6.6	6.6

Glossario

Emotional Design - By understanding the user's true feelings, interacting with the user emotionally, the interaction behavior makes the user satisfied, making the user feel confident about the product or system through emotional design.

Interaction Design - It defines the content and structure of communication between two or more interacting elements that work together to achieve a purpose. Interaction design is an effort to create and establish meaningful relationships between people and products or services.

Intelligent Product - Intelligent products are defined as any kind of equipment, apparatus or machine with computing and processing capabilities. A fully functional intelligent device must have sensitive and accurate perception, correct thinking and judgment, and effective execution functions.

The Disadvantaged Groups - The disadvantaged groups facing special difficulties such as illness, aging, physical or mental disabilities, lack of financial or economic support, and political weakness.

Affective Computing - Affective computing is related to emotion.Emotional computing theory has produced some valuable results, but it is less applied to the field of product practical design.

Service Design - Service design is a process where designers create sustainable solutions and optimal experiences for both customers in unique contexts and any service providers involved.

Line of Visibility - The demarcation line between customers and front desk staff, crossing the demarcation line means that customers and service staff interact.

Service Evidence - Online/offline touchpoints that impact customers at different behavioral nodes, including brick-and-mortar stores, brochures, websites, mobile alerts, etc.

User Centerd Design - User-centered design methodology. It is a design process that puts the user experience at the center of design decisions and emphasizes a user-first design model with a deep understanding of who will use the product.

Persona - Persona is a fictional persona containing typical user characteristics based on a deep understanding of real users and the generalization of highly accurate relevant data.

Customer Journey Map - The Customer Journey Map is a visual representation of the relationship between the user and the product/brand over a period of time and across touchpoints.

Product Service System - It is a business model in which a company sells products and provides sales services at the same time.

Double Diamond - The essence of the Double Diamond Model is a way of thinking about problems and solutions in design composition, which can be used as a daily design process with the core of: finding the right problem and finding the right solution.

Service Blueprint - A service blueprint is a service design relationship diagram that shows the relationships between different solutions (e.g. products and services) and their components (people, physical or digital evidence and processes).

Service Stakeholder Map - Stakeholder mapping is a business tool designed to clarify roles and relationships. It is used to identify individuals or organizations that have a stake in a project , and to rank these individuals or organizations in terms of their relevance to the project, their influence on the project, as well as their importance.

User Experience Principles （UX/UE） - It is a subjective feeling that users build up in the process of using the product. However, for a well-defined user group, the commonality of their user experience can be recognized through well-designed experiments.

Storyboard - Storyboards are visual narratives - they can help you visualize your ideas and help you explain them to your clients, and plan a creative project.

Vision Stories - Using Future Stories to Translate Strategy into Action.

SLR - Continuous Sign Language Recognition.

Artificial Intelligence (AI) - Artificial intelligence is a branch of computer science that attempts to understand the essence of intelligence and produce a new intelligent machine that can respond in a similar way to human intelligence, and research in this field includes robotics, language recognition, image recognition, natural language processing, and expert systems.

Integration - The physical sense refers to fusing or melting into one as in melting. In the psychological sense, it means the cognitive, emotional, or attitudinal tendencies of different individuals or groups melt into one after certain collision or contact.

Rehabilitation - Rehabilitation is the integrated and coordinated application of medical, educational, social and vocational methods to restore and rebuild the lost functions of the sick, injured and disabled (including congenital disabilities) as soon as possible to the greatest extent possible, so that they can recover their physical, mental, social and economic abilities as much as possible and return to life, work and society (WHO). Rehabilitation focuses not only on the disease but also on the whole person, physically, psychologically, socially and economically.

Communication Cards - The communication cards are used to help disadvantaged people, especially the mentally challenged, etc. by helping them to understand and communicate.

Qualitative Research - Qualitative research is about gaining insight by uncovering problems, understanding the phenomena of events, analyzing human behavior and perspectives, as well as answering questions.

Quantitative research - Quantitative research refers to the systematic empirical examination of social phenomena using statistical, mathematical or computational techniques.

Ageing - Ageing of the population refers to the dynamics of a corresponding increase of the proportion among the older population in the total population. Due to the decrease in the number of young people and the increase in the number of older people, caused by the decrease in the fertility rate of the population and the increase in the life expectancy.

Chronic Diseases - Chronic disease is a general term for diseases that do not constitute an infection and have a long-term accumulation to form a disease form damage.

Infectious Diseases - Infectious Diseases are diseases caused by various pathogens that can be transmitted from human to human, animal to animal, or human to animal.

Large general public hospitals - Large general public hospitals are the economic type of state-owned and collective-run hospitals (including government-run hospitals), large generally refers to tertiary municipal hospitals.

Clinic - Clinics are smaller medical institutions than hospitals, usually with only outpatient services and pharmacies, most clinics do not have hospitalization, emergency rooms and operating rooms, etc. They are usually private practices and smaller than hospitals.

Community Hospital - Community hospitals mainly provide public health and basic medical services for community members, with the characteristics of public welfare, not for profit.

Medical Insurance - Medical insurance generally refers to basic medical insurance, which is a social insurance system established to compensate workers for financial losses caused by the risk of illness.

Pharmacy - A pharmacy is a store that retails medicines.

Dispensing Room - Where the medications used are mixed and matched according to medical advice.

Traditional Chinese Medicine - Traditional Chinese medicine is a discipline that studies human physiology, pathology, disease diagnosis and prevention. It inherits the experience and theories of the ancient Chinese ancestors in treating diseases.

Online Healthcare Platform - Online medical care, also known as Internet medical care, refers to online health care services based on the Internet and other information technology, including medical guide triage, online reservation and online registration before consultation, online diagnosis, remote consultation, electronic prescription, health consultation, disease prediction and remote monitoring during consultation, and online payment, medical insurance reimbursement and drug delivery after consultation.

Home Care - Home care means taking care of body temperature, pulse, respiration, blood pressure, pupils, etc. The changes of these vital signs reflect the improvement or deterioration of the disease. Therefore, disease observation is the key element of basic nursing care.

Psychologiced Care - Psychological care is a psychotherapeutic approach to the care process in which the nurse positively influences the patient's mental activity through various ways and means (including the application of psychology and technology) to achieve the goals of care.

Clustering - Clustering is the cascading of information values that have the same characteristics and can be grouped into one class

Variables - ariables are the core dimension to help find from the many information.

Service Design Opportunities - Service design opportunity   are points in the service design process that can benefit the design itself or the system

Competitive Analysis - competitors' products. Competitive analysis, as the name implies, involves a comparative analysis of competitors' products.

User Loyalty - User loyalty, also known as User viscosity, is a tendency for customers to develop a preference for a particular product or service, form an "attachment" preference, and then make repeat purchases.

Architecture Design - Architectural design is the product of a subjective mapping that one makes of elements and relationships between elements within a structure. Architectural design is a set of related abstract patterns that guide the design of various aspects within a large software system.

Prototyping Design - The prototype can be summarized as a framework design for the entire product before it is introduced to the market.

CSL - Chinese Standard Sign Language

ASL - American Standard Sign Language