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A user interface design of the health QR code system in China

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중국 보건 QR 코드 시스템의 사용자 인터페이스 설계

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Abstract In the pandemic era, smart medical technology has also been applied to prevent and control diseases such as COVID-19. Health QR code system shave sparked recent discussion in the hopes of improving its convenience and safety. The many types of current health QR code systems in China exists causes inconvenience to those that are vulnerable, as well as raising the issue of personal information protection. In order to solve this problem, this paper proposes transparent integration of the health QR code systems and the process of protecting personal information, as well as designs an interface for user convenience. Through the method presented in this paper and the newly designed interface, users can enjoy the smart pharmaceutical system more conveniently and safely, and ensure effective results in the prevention and control of diseases that are likely to spread.

Key Words : Smart medical technology, Health QR code, UI interface design, Convenience of use process, Privacy protection

요 약 팬데믹 시대를 맞아 코로나 등의 질병 예방과 통제에도 스마트 의료 기술을 응용하게 되었고, 중국의 스마트 의료 기술을 대표하는 개인 의료 QR 코드 시스템도 편리성과 안전성에 있어 개선되어야 할 문제점이 대두되었다. 즉, 현행 중국의 개인 의료 QR 코드 시스템은 그 종류가 많고 각각 독립적으로 존재하여 스마트 취약 계층의 사용자에게 큰 불편을 초래하고 있으며, 동시에 수집된 개인정보 보호와 처리의 문제도 제기되고 있다. 본 논문에서는 이러한 문제를 개선하기 위하여 개인 의료 QR 코드 시스템의 통합과 개인정보 보호 과정을 투명화할 것을 제안하고, 사용자의 편리를 위한 인터페이스를 설계하였다. 본 논문에서 제시한 방법과 새롭게 디자인한 인터페이스를 통해 사용자는 더욱 편리하고 안전하게 스마트 의료 시스템을 누릴 수 있으며 광범위하게 확산될 우려가 있는 질병의 예방과 통제에도 유효한 성과를 보장할 수 있다.

주제어 : 스마트 의료 기술, 개인 의료 QR 코드, UI 인터페이스 디자인, 사용 프로세스 편리화, 개인정보 보호

1. Introduction

The emergence of Health QR Code has laid the foundation for the resumption of production. On the one hand, it can dynamically monitor the trajectory of personnel, simplify the complicated procedures of manual registration; on the other hand, it effectively alleviates the contradiction

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between the outbreak and the resumption of work [1]. At present, epidemic prevention and control has become normal. However, there are still many people who cannot receive the Health QR Code because of “no operation, no smartphone, no mobile data”, which makes them unable to prove their health, and thus social activities are subject to certain restrictions [2]. The phenomenon of "one person with many codes" also affects the efficiency of normal people's travel. On the other hand, due to the lack of an institutional design of the Health QR Code, coupled with the opaque nature of privacy processing, data security issues are also troubling to people who are able to use the Health QR Code properly [3]. This all leads to a certain amount of negative emotion on the part of the user.

Redesigning the user interface and registration steps of the Health QR Code system not only solves the travel problems of the people of the day, but also optimizes the solution to ensure the security of personal privacy data. This lays the foundation for the vertical and horizontal development of Health QR Code in the future and is also of positive significance for the construction of smart cities [4].

In this paper, the development and use of Health QR Code system are studied. Surveys are conducted on people who do not use the Internet, people who do not operate, and people who use normally. This paper finds the user pain point and designs the User Use Interface and registration and use process of Health QR Code system, and puts forward the "Health QR Code Travel" scheme for non-touch people.

2. Status of Health QR Code System

2.1 Use status of health QR code

As of May 2020, Tencent Health QR Code has been used more than 1 billion times, reaching more than 800 million people. At present, China's Internet penetration rate is 64.5%, the size of the Internet users is 904 million, so the number of people who do not use the Internet is about 500 million, and they face the problem of not being able to receive the presentation of Health QR Code [5]. Registering health QR Code requires users to provide personal information about citizens, including: citizen personally identifiable information, personal health information, citizen personal relationship information, and personal trajectory information [6]. Currently, Health QR Code does not use this information to prompt the user for specific privacy where to go. Users are also not told how and where their privacy is stored, which creates some distrust of Health QR Code. The country launched the "National Edition health QR Code" on February 29, 2020, but "one person with many codes" and other phenomena are still emerging. In Xi'an, for example, there are still three Health QR Codes currently in use. This has a certain impact on the efficiency of the public's travel. Because the identification algorithms for each Health QR Code are slightly different, when the system identifies anomalies, it not only causes a degree of panic between the users, but also affects the user's personal life and the work of the organization and community in which the epidemic prevention is carried out [7].

2.2 Travel status of people without health QR code

Since the launch of Health QR Code, there have been many reports across the country of people who do not use the Internet (mostly older people) are unable to use public transportation and access to public places without Health QR Code [8], which has had a greater or less negative impact on their lives and has led to negative sentiment and opposition to Health QR Code. The main reason for this is that health QR Code's registration process is too complex for

older people, and the questions asked when signing up for Health QR Code may prevent older people from understanding or misjudging them, and Health QR Code's interface is not considered for older people. Some users expressed their desire to open a dedicated channel for the elderly [9]. The country's current solution to this phenomenon is to add a Health QR Code-free channel. People do not use the Internet can take public transportation and access some public places by binding to your family's Health QR Code or registering your ID card, filling out a “Personal Commitment”, and printing a paper Health QR Code. This not only consumes a lot of manpower and material resources, but also does not provide efficient governance [10].

2.3 Disadvantages of the Health QR Code

Users of Health QR Code often experience negative emotions due to personal privacy and inefficiencies caused by the excessive variety of Health QR Code. Due to the special nature of Health QR Code, personal information is exposed to the public from time to time and can easily be affected by improper regulation. Citizens still lack the informed consent they deserve for the collection, use, sharing, disclosure and storage of Health QR Code's information [11]. Due to the lack of agile innovation [12], for people without Health QR Code, issues such as "paper Health QR Code over time and not being able to pass ID verification" can also cause negative emotions for people without Health QR Code, and the absence of Health QR Code channels also increases the pressure on staff to work.

3. Design of Health QR Code System

3.1 Service overview of Health QR Code system

This paper studies the existing registration and use patterns of the Health QR Code system and related cases of travel without Health QR Code optimize the Health QR Code registration system and privacy, and propose a plan for people who do not use the Internet to travel without Health QR Code. At the same time, a unified standard for Health QR Code is formulated and a unified platform for Health QR Code is proposed.

3.2 Questionnaire

Many users are surveyed and volunteered to participate in the survey. This survey uses the network questionnaire and street interview survey method, according to the actual problem reference relevant literature and designs their own questionnaire. The survey included information on current use of Health QR Code system, problems and difficulties encountered during registration and use, views on Health QR Code privacy, and the role of the Health QR Code system and other areas in the future, such as Table 1.

Table 1. Main survey items

Key questionnaire	Key questions
Views on the current stage of the health QR code system	1. Are you satisfied with the current health QR code system 2. What do you think are the disadvantages of the current health QR code system? 3. Think the steps of registration and health QR code are cumbersome
Traveling for people without health QR code	1. Does the absence of a health QR code affect travel? 2. How to travel without a health QR code
Health QR code privacy handling	1. Do you pay attention to personal privacy issues? 2. Think how to deal with the privacy collected by the health QR code system
Future view of health QR code	1. Is there a need for "multi-card unification" 2. Whether it has commercial value

Analyze and summarize according to the user's answer to the questionnaire. Before using the question content, it is evaluated by relevant experts, and then the question is modified and

improved. The credibility is 0.9. A total of 27 users participate in the questionnaire survey. Through questionnaires, interviews, phone calls and WeChat surveys of users in multiple locations, the data are obtained as follows Table 2.

The results of the survey show that the current Health QR Code system still does not satisfy the vast majority of users, and its registration, procedures and pages are in urgent need of improvement. There is also a need to harmonize Health QR Code standards and transparently process personal information data collected by Health QR Code.

Table 2. Survey results

Problem	% (Number of persons)
Not satisfied with the current health QR code	44.4% (12)
The steps to register and use the Health QR Code are cumbersome	51.9% (14)
Too many types of existing health QR codes	48.1% (13)
Travel difficulties due to lack of health QR code	25.9% (7)
Replace health QR code with ID card and other documents	66.7% (18)
Hope to update the privacy policy (transparency)	77.8% (21)
Want to delete private data regularly	18.5% (5)
Multi-codes unification, building an integrated health platform	74.1% (20)
Health QR code exerts its commercial value after the epidemic	7.4% (2)
Difficulties in registration for people over 65	81.5% (22)

3.3.1 User population

With the normalization of outbreak prevention and control, almost everyone needs to use the Health QR Code system. However, there are differences in the way of use, and it is necessary to distinguish between “Internet users" and "people who do not use the Internet". "Internet users" refer to people who can use mobile phones normally and can register and use Health QR Code. "People who do not use the Internet" refers to people who don't have smart phones or mobile data, mainly the elderly and children.

3.3.2 Choice of Health QR Code

Since the development of QR code, many different kinds have been born, including PDF417, DataMatrix, MaxiCode, Aztec, QR Code, and so on. Based on the different algorithms and advantages and disadvantages of these QR codes, QR Code, which has developed the international standard ISO 18004, was chosen as Health QR Code. In the form of PDF417 and QR Code, both are identified by barcode guns and information acquisition devices, and the advantages of QR Code are clear compared to PDF417. First of all, its maximum capacity is much higher than PDF417, second, its recognition speed is much higher than PDF417 and supports full recognition, for mobile phones and computer cameras, QR Code is easier to identify and decode. So in today's mobile phone popularity, QR Code has broader prospects.

3.3.3 Health QR code system registration interface design

Nowadays, a Health QR Code needs to go through many steps from receipt to use (search-geographic authorization-check a series of agreements-personal verification-receipt) and the interface design does not take into account the physiological conditions of the elderly. Therefore, many elderly people cannot apply for and use Health QR Code independently. The new Health QR Code system needs a "humanized design" to fully take care of the user's vision, hearing and touch [14]. Visually: it uses simple colors and a unified page layout, which will require prominent design of key parts. Hearing: it adds voice assist function to make it easier for the elderly to use. Tactilely: it forms feedback to the user after tapping the screen [15]. Combining the above design principles, design the interface

of the new Health QR Code system, as shown in Fig. 1.

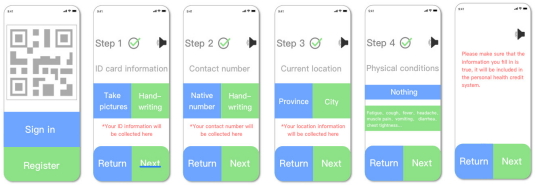

Fig. 1. Health QR Code registration interface

The new Health QR Code registration step omitted questions that had little impact on current health conditions, such as whether you had been to Hubei province in 14 days, your current body temperature, etc. Only the option of whether the current body is unwell is reserved. And it introduces a "health credit" in the last step of registration. If false information occurs, verification will have an impact on the special medical services that users will enjoy in the future. The new Health QR Code has a cleaner and more user-friendly interface, such as Fig. 2.

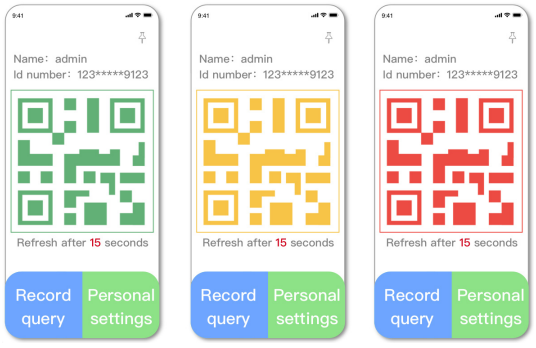

Fig. 2. User interface of the new Health QR Code

For medical information security reasons, in order to avoid users in the code scanning process encountered malicious code or harmful websites, decided to adopt dynamic QR Code. Health QR Code starts the countdown when it is turned on, refreshes every 15 seconds, and verifies the read status of QR Code when it is validated, which greatly improves its security.

The new Health QR Code system includes a personal track information query feature that allows users to view recorded personal track information and where it is currently stored, as Fig. 3 shows.

As you can see, the system will be based on the user's daily travel in chronological order, click the details button to enter the detailed personal track query interface. The red text below alerts the user to what department is currently in control of the message and shows the countdown to the automatic deletion of the information, with a standard deletion time of 30 days. For user convenience, click the "Pin" button in the upper right corner of the interface to secure Health QR Code to the phone lock screen, just click the Health QR Code button on the lock screen to open, as shown in Fig. 4.

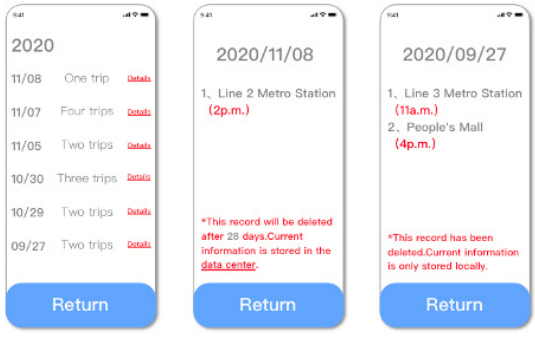

Fig. 3. Query of personal track information

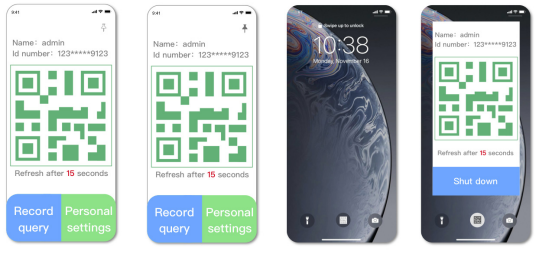

Fig. 4. Use in the lock screen interface

Click on the personal settings in the lower right corner, in addition to the user can be switched; you can also bind personal health card, ID card and other identity cards. When your

phone doesn't have a network or power, you can use a bound card. To prevent mishaps, it sets the log-out button above the screen, as Fig. 5 shows.

3.3.4 User journey map

Compared with the current Health QR Code, the registration and use steps of the new Health QR Code have been greatly simplified, and personal privacy data has also been processed transparently and regularly deleted. This has significantly improved user registration and travel efficiency. The specific situation and pain points are shown in Fig. 6.

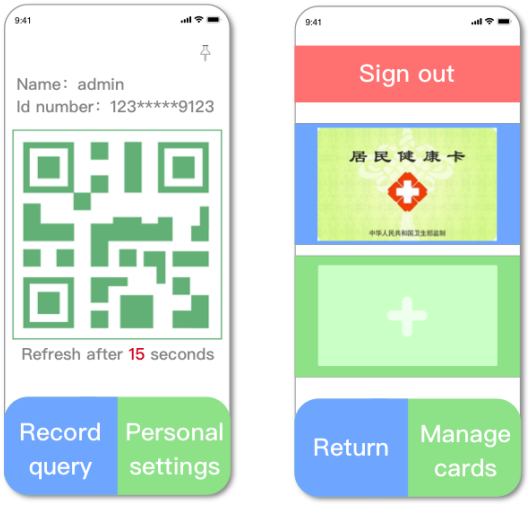

Fig. 5. Personal setting interfaces

3.4 Comparative analysis with the existing health QR code system

The Health QR Code system currently in use is mainly developed with enterprises as the main body. Due to the different data sources, not only the coverage of data information is limited, but also the users are often troubled by the non-interoperability of data [16]. The registration and use steps of the existing Health QR Code are too complicated, the font of the registration interface is too small, and the text is too much, which increases the difficulty of registration. Since the current Health QR Code is attached to the super network platforms (Alibaba and Tencent), if you want to open the Health QR Code, you must first open Alipay or WeChat, and then find it in the applet to open it. This makes the use efficiency low and the interactivity is not high enough.

The new Health QR Code uses a unified platform and unified data for construction. This solves the phenomenon of "one person with many codes" from the root cause. Registration of the new Health QR Code only needs to enter basic information and express whether the body is unwell. The interface design of the new Health QR Code uses simple and vivid color blocks, and the page layout is unified. After the user fills in the information, the background will automatically review and prompt the user whether the information filled in is correct. The user does not have to check the entered information over and over again. After each step, the user will be given corresponding feedback. The new Health QR Code is also equipped with voice assistance. When users have poor eyesight or encounter difficulties in registration, they can click the "horn" button in the upper right corner to allow users with poor eyesight to complete the Health QR Code registration independently. At the same time, the new Health QR Code has added a "Pin" function, which allows the Health QR Code to be opened directly on the lock screen of the phone. At the checkpoint where the Health QR Code is presented, the user does not need to unlock the phone to find WeChat or Alipay and then find the Health QR Code applet to show the Health QR Code. This has significantly improved travel efficiency, and the interaction of Health QR Code has been greatly improved.

Health QR Code personal information security issues have also received widespread attention. Although Health QR Code uses dynamic codes to reduce the risk of use and display, the

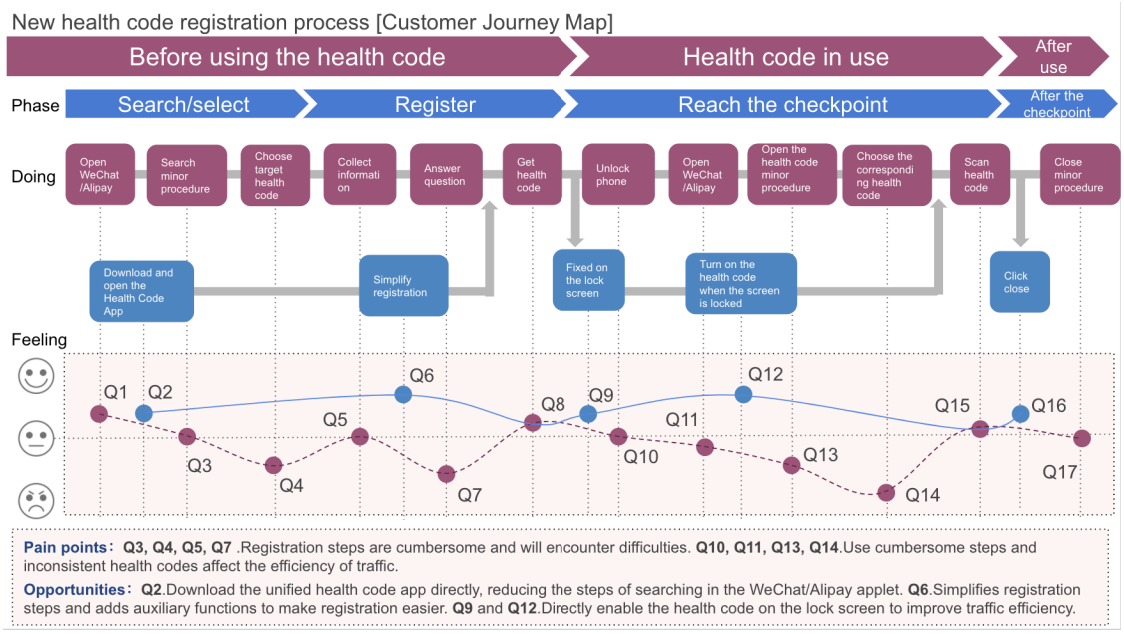

Fig. 6. User journey map

transmission and circulation of data is still in an opaque stage. The massive aggregation of background data is a huge security risk [17]. Therefore, the privacy issue of Health QR Code is improved based on the data of the questionnaire. The new Health QR Code system adopts the transparent processing of private information. Users can check where their information is recorded on their own, and these personal track records will be automatically deleted after 28 days. This not only saves background data storage space, but also reduces users' concerns about privacy and security, and can eliminate negative emotions to a certain extent.

3.5 User evaluation and usability evaluation standards of the new Health QR Code interface

The paper model was used to demonstrate, and 50 people were simulated and evaluated by users. While the user evaluation was conducted, the usability evaluation standards were formulated. Because Health QR Code is different from other ordinary applications, the evaluation criteria are formulated in five dimensions: cognitive load, ease of use, safety, use efficiency, and interface design. The full score is 5 points, and each dimension is 1 point. Through data collection, it finally gets an average score of 4.6 points. At the same time, users have also received suggestions for the new interface, which needs to be enhanced in terms of ease of use. Users hope to have more login methods (face recognition, fingerprint recognition, etc.). In addition, users are basically satisfied with the evaluation of other aspects of the new Health QR Code interface.

3.6 The overall framework of the new health QR code system

The new Health QR Code system is improved and changed on the previous system. The system mainly includes: registration and display system, information collection system, personal track query system, risk analysis system, and privacy information processing system, as shown in Fig. 7.

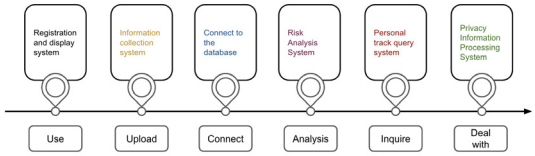

Fig. 7. The framework of the new Health QR Code system

4. Use service of Health QR Code system

4.1 Solving the problems of difficult registration, difficult use and travel efficiency

Most elderly people cannot receive and use Health QR Code independently. The reason is that the current Health QR Code system is not an independent system. It is attached to the super network platforms Tencent and Alibaba. Therefore, when you want to register and use Health QR Code, you must first open WeChat or Alipay and then perform cumbersome operations. This is also one of the problems that affect the travel efficiency of users who use Health QR Code normally. Therefore, we recreated a platform dedicated to Health QR Code, and all information is independent. The new Health QR Code system is no longer attached to the super network platform, so users only need to click on the "Health QR Code" icon to directly display the Health QR Code. Thanks to its optimized interface and better interaction methods for the elderly, the elderly can complete the registration and use steps of the Health QR Code independently. Users can also fix the Health QR Code on the phone's unlock screen, which can further improve travel efficiency.

4.2 Solving the travel problems of people without health QR code

The new Health QR Code system can not only be the precise prevention and control of the COVID-19 epidemic [18], it will also be a proof of personal identity and health. The new Health QR Code system will implement a unified

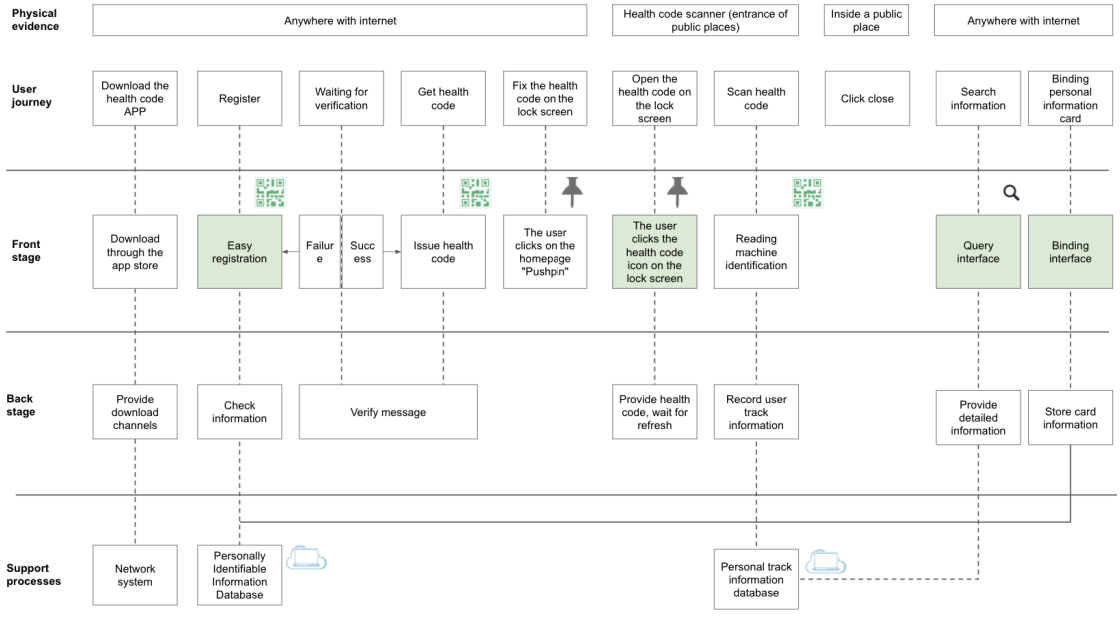

Fig. 8. Service Blueprint

platform to exchange data that can prove identity, such as resident ID cards, senior citizens cards, and student cards. Therefore, if you carry any ID that can prove your identity and can be scanned, you only need to swipe the ID like a bus when you pass the checkpoint. It not only solves the problems that people who do not use the Internet cannot use public transportation and cannot enter some public places due to the absence of Health QR Code, but also avoids the complicated procedures of manual registration and re-entry system, and improves travel and work efficiency.

4.3 Personal privacy handling transparent service

Currently, Health QR Code in different provinces and cities is implementing data interoperability, but there is a risk of information leakage in the process of data interoperability. Health QR Code's privacy information is approximately: name, ID number, contact details, location, itinerary, health, etc [19]. The new Health QR Code system follows the "clear, necessary, minimized" principle for data collection. By transparently processing personal hidden data, users understand what data is collected at what time and at what level. Personal information is also cleaned up on a timely and timely process to ensure that personal information is protected so that users of the new Health QR Code system are no longer concerned about the potential for the disclosure of personal information data.

4.4 Service Blueprint

While presenting the service blueprint, it is clear that the steps and time for users to register and demonstrate Health QR Code have been greatly reduced. Users can complete Health QR Code applications on their own, while improving the efficiency of their travel. The transparent handling of privacy and periodic deletions also address user concerns about personal data breaches. Fig. 8 is the blueprint for the service.

5. Conclusion

In this paper, Health QR Code is improved from existing systems, the user interface is redesigned in accordance with user ease of use principles, and use scoring standards are developed. With a score of 5 out of 1, it received an average of 4.6 points of user feedback. It has been observed that user convenience is much improved compared to the older Health QR Code, especially during the registration and use phases. With improvements, users can query their own where-to-go personal trajectory information and users' concerns about privacy issues have decreased significantly. The emergence of Health QR Code represents the emergence of big data governance. We need to pay attention to the undeniable disadvantages of using big data rationally. The times are developing at a high speed; we should not only integrate into the science and technology society, but also let the elderly also integrate. The essence of the Health QR Code system is actually the government's "government service", which has done an unprecedented "big experiment" in digital governance, in which we can find a lot to ponder. Any idea, design must take into account the elderly group, not only consider the majority of the user group, as long as we think a little more, leaving users with less problems.

In the future, with the development of Health QR Code, in terms of privacy, we can try to introduce "block chain technology" and introduce zero-knowledge proof to prove "I am me" to them without revealing privacy. The "Citizen Health Credit" proposed during the registration phase may also be implemented in the near future. Health QR Code plays a big role in the control of the outbreak. At a time when

the outbreak is relatively stable, we should consider more about the horizontal development of the Health QR Code system. We should use Health QR Code wisely to govern society and build smart cities. Health QR Code could also be developed into a universal health platform that provides features such as "online consultation, online health insurance audit" and more. Not only that, but the Health QR Code system has great commercial value. The development of Health QR Code has a great impact on society, and I believe that in the near future, Health QR Code will be presented to the world with a new look.

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