ISSN:2790-1688 Volume-14-(2025)

# Design and research of hospital accurate visual flow control and fabricated isolation chamber system

Shuai Zhang [1, a], Chenming Zhang [1, b, *], Fangtao Wang [1, c], Yuting Han [1, d], Ning Zhang [2, e], Xinyu Li [3, f], Xingyi Zhang [4, g]

[1] Beijing Jiaotong University Beijing 100044

[2] CABR Fire Technology Co., Ltd. Beijing 100013

[3] Central University of Finance and Economics Beijing 100098

[4] China CSCEC Design Group Co.,Ltd. Beijing 100037

[a] shuaizhang@bjtu.edu.cn, [b, *] chenming2503@163.com, [c] 22121776@bjtu.edu.cn

[d] 22121766@bjtu.edu.cn, [e] ning970521@163.com, [f] lixinyuart@yeah.net,

[g] zhangxingyi820@163.com

**Abstract.**While the novel coronavirus pneumonia epidemic was running at a high level in the world, the local epidemic in China was characterized by multiple points, wide coverage and frequent occurrence. The hospital system is the core of epidemic prevention and control in China, and the reason why hospitals are designated as risk points is largely due to the behavior trajectory of infected people in hospitals before being diagnosed. The Chinese government implemented the general policy of "dynamic zero clearing", the first is "fast", quick discovery and disposal, the second is "precision", accurate identification, delineation of the scope, and accurate flow regulation. In this paper, the small scale outbreak in scattered hospitals is focused, and the error of capturing information by existing flow modulation technology is large, which can not realize the track fine flow modulation. Isolation control lacks intensive control process and facilities. Due to the lack of intelligent control system and humanized design in the inner space of the isolation module, based on the technical methods of intelligent perception, intelligent construction and intelligent adjustment, the research scheme adopts intelligent operation and maintenance mode in the fields of associated personnel screening and isolation module location, transportation, construction, application and recycling, and the scheme accurately extracted the flow adjustment information in the first time to make it visualized. Site nearby and quickly build large-scale emergency isolation facilities that meet the needs of risk levels, while matching humanized isolation space, forming a multi-loop emergency management plan of "flow imaging - site selection - humanized service".

**Keywords:** Public health; Epidemic prevention and control; Accurate flow regulation; Prefabricated building; Intelligent isolation module.

## 1. Introduction

The outbreak of COVID-19 in early 2020 has caused incalculable damage to the world, posing major challenges to the operating model and development concept of the entire world[1]. In the battle against the epidemic of the century, under the strong leadership of the Party Central Committee, the Chinese people braced themselves with one heart, won one epidemic prevention and control battle after another, and accumulated rich experience in epidemic prevention and control[2].

At the critical moment when the global epidemic situation was running at a high level, the local epidemic situation in China showed the characteristics of multiple points, wide coverage and frequent occurrence[1]. In the face of future public health challenges, the report to the 20th National Congress of the Communist Party of China proposed that we should continue to actively promote the construction of healthy China, prioritize the development of the people's health in a strategic position, improve the public health system, strengthen the prevention and treatment system and

emergency response capacity building for major epidemics, and effectively curb the spread of major infectious diseases[2].

The impact of the epidemic is not limited to the infected people themselves, but also leads to a squeeze on public medical resources. In Beijing, for example, in 2022, the 5th floor of the emergency department building of Peking University People's Hospital, the outpatient building of the Civil Aviation General Hospital, Beijing Children's Hospital, and China Meteorological Hospital have all been designated as risk points. The reason why hospitals are designated as risk points is largely due to the trajectory of the infected person's behavior in the hospital before being diagnosed.

The effective implementation of the government's "dynamic zero clearing" policy relies on two key factors: speed and precision. Rapid discovery and disposal, along with accurate identification and delineation of the affected area, are crucial for success[2]. Unfortunately, in the context of mobile transfer and the relocation of isolated personnel, China's hospital system has largely depended on manual labor. Transporting epidemic-related personnel is complex, resource-intensive, and carries significant social risk. Moreover, isolation facilities are often located far from populated areas, resulting in a weak user experience for affected individuals.

Based on the above background, the research of "Hospital accurate visualization flow control and fabricated isolation cabin epidemic prevention system" is carried out to provide solutions to the above problems.

## 2. Literature review

### 2.1 Development of epidemic flow control techniques and methods

Epidemiological investigation is an important way to obtain information about the people involved in the epidemic and find out the transmission chain of the epidemic. In order to prevent the rapid spread of the virus during the epidemic period, rapid and accurate flow tracing has become the key to controlling the spread of the epidemic. At present, the research on epidemic outbreak monitoring mainly focuses on the use of big data to deal with macro trajectory mapping, regional delineation and other content. For example, Zhang Song et al., based on the characteristics of heavy workload, time-consuming, labor-intensive, and labor-intensive epidemiological investigation, used gait recognition technology to associate and recover the track information of infected persons, and effectively solved the track characterization of infected persons under conditions of large time and space span and wearing masks[3]. Tian Xuecheng et al. optimized the fragmented and unstructured characteristics of existing flow modulation data by modeling, screening, filtering, and processing flow modulation data[4]. In addition, Liu Jianyu et al. elaborated the methods and difficulties of audio and video flow tracking in the field of public transportation, compared it with general audio and video investigation, and pointed out new ideas for accurate flow tracking[5].

To sum up, the current personnel positioning system applied in the market at home and abroad mainly has two modes. One is to determine the location of the located personnel by laying the corresponding positioning base station within the region and using the UWB tag location[6]. The other is to automatically capture and locate the mobile phone signal through the traditional outdoor coverage of the 5G macro base station[7]. However, neither of the two existing models is suitable for visual flow control of sudden small-scale outbreaks in hospitals. On the one hand, the UWB positioning base station needs to realize personnel positioning with the help of positioning labels, and data acquisition is relatively passive, which cannot guarantee the tracking of all personnel. On the other hand, 5G macro stations are suitable for macro outdoor flow line acquisition, and there is a large error in indoor information acquisition in hospital buildings, and it cannot achieve fine flow adjustment of trajectory.

### 2.2 Development of isolation control of associated personnel

Isolation control is an important means to prevent the rapid spread of the epidemic, but how to quickly build isolation facilities, how to accurately close-loop isolation and other issues have become important factors affecting the spread of the epidemic. Among them, Sun Wei et al., on the basis of sorting out domestic and foreign epidemic prevention and control measures, revealed the systematic shortcomings of quarantine control and the current situation of lack of epidemic control and transformation, and proposed optimization strategies from three aspects: system mechanism, practical experience and scenario transformation[8]. From the perspective of controlling the spread of the epidemic, Wei Xiongye et al. designed a wearable epidemic isolation monitoring system based on the situation of quarantined people without contact. The isolation monitoring work is optimized from the perspective of resource saving and efficiency improvement[9]. Based on the emergency project of nursing isolation rooms in Shanghai in 2022, Chen Kai et al. described the characteristics of the construction project of epidemic isolation facilities, such as heavy tasks, short periods and high requirements for epidemic prevention, and proposed solutions from material transportation and quality control[10].

To sum up, the isolation control plan implemented in China generally adopts the form of centralized isolation and centralized transportation. On the basis of receiving treatment in designated hospitals, most of them build makeshift hospitals in the suburbs or outer suburbs of cities, or rebuild large public buildings such as basketball parks, sports venues and exhibition halls. For the transport link, centralized transportation is generally used, the preliminary preparation process is cumbersome, the transfer process is complex, and the centralized transportation road is far away. However, this method lacks refined classification of large-scale centralized reconstruction isolation space in the high epidemic period, there is idle waste of fixed centralized isolation space in the stable epidemic period, and the risk of epidemic spread is increased during long-distance transportation, and the whole isolation control process lacks intelligent management measures.

### 2.3 Development of living services for isolated personnel

The COVID-19 outbreak has posed major challenges to medical emergency response systems across the country, and the shortage of isolation equipment and protection facilities and the insufficient number of isolation areas have brought great inconvenience and risk to isolation work. In view of the above problems, domestic scholars Qin Luofeng et al. carried out research on precise design and classification guidance for problems such as insufficient number of wards in the hospital isolation area construction system, imperfect isolation facilities and lack of infectious disease wards combined with peace and war, and proposed different reconstruction plans for isolation wards in new and old hospitals. And put forward the hospital isolation area module design system of different module construction solutions[11]. Based on the idea of building an infectious disease hospital "combining peacetime and war" proposed by the National Health and Health Commission, Wang Cong established a multi-objective planning model for frequent infections in hospitals during the epidemic period, and proposed that the key to "combining peacetime and war" lies in the design and construction according to the requirements of the "wartime" standard, and proposed optimized solutions from the aspects of functional zoning, isolation and protection[12]. Zheng Anbon et al. introduced a new model of temporary mobile isolation ward for the fever clinic on the West Campus of Wuhan Union Medical College Hospital, and proposed to build a mobile isolation ward complex to share medical resources with the fever clinic, effectively improving the ability and efficiency of receiving, screening, triage, isolation and observation of fever patients[13]. Wei Yanyong et al. solved the problems of oxygen supply system renovation, independent negative pressure system and exhaust device installation, functional zoning, sewage treatment system upgrade, etc., by transforming the old single building of the hospital[14].

To sum up, the existing domestic isolation zone settings are not perfect. On the one hand, the structure of the isolation point is not clear, generally concentrated on hotel isolation or suburban medical observation point isolation, different areas need to take physical partition hard isolation,

isolation point personnel must not cross. On the other hand, the existing isolation space generally adopts the method of manual response, requiring medical personnel to communicate and check the hot water supply, warm air, Internet, television and other conditions in the isolation room to ensure the living environment and needs of the isolated personnel. The manual process wastes a lot of manpower, lacks intelligent management and monitoring systems, and it is difficult to realize the safety, rationality and practicality of humanized design of isolated personnel living space.

## 3. Research content and significance

### 3.1 Research content

This paper focuses on the issue of sporadic hospital outbreaks in small areas. Based on the relevant technologies and methods of intelligent perception, intelligent construction and intelligent adjustment, this paper studies the accurate extraction of flow adjustment information for the first time to make it imaging and visualization, and then selects a nearby location and quickly builds large-scale emergency isolation facilities that meet the needs of risk levels, and at the same time, it is equipped with humanized isolation space. A multi-part closed-loop emergency management scheme of "flow modulation imaging - site selection - humanized service" is formed. The research contents are as follows:

**Research content 1: An accurate screening flow modulation imaging analysis system based on intelligent perception technology**

Aiming at the problem of inaccurate three-dimensional space-time trajectory of associated personnel, the precise visualization flow modulation technology scheme of hospital was researched and proposed, and the "five-in-one" imaging scheme of scene construction visualization, trajectory monitoring visualization, spatio-temporal coupling visualization, flow modulation information visualization, and demand-based visualization was realized.

**Research content 2: A three-terminal integrated control system of the whole chain "election-set-tube" based on wisdom**

In view of the lack of intensive management and control processes and facilities, the technical scheme of prefabricated epidemic prevention and quarantine cabin was researched and proposed, which realized the nearby location and construction of the isolation site, and the flexible assembly and disassembly of the "ready-to-use", forming the intelligent management of the full chain of efficient container transport, simulated construction, disassembly and recycling.

**Research Content 3: Humanized Design Based on intelligent regulation System -- "Photon Space"**

Aiming at problem of the lack of interaction demand between isolated personnel and the living environment, the service design of "Photon Space" was studied and proposed, which realized the interaction design of emotional care and the living environment, and met the safety, rationality and practicability of the humanized design of the living space for isolated personnel.

### 3.2 Research significance

Aiming at the problems such as inaccurate spatial and temporal trajectory flow adjustment of associated personnel in the hospital system, lack of intensive management and control process and facilities for associated personnel, and lack of interaction between isolated personnel and living environment, this paper proposes a whole chain service plan in the field of epidemic prevention and control in the hospital system to make the epidemic prevention and control process more targeted, intelligent, intelligent and humanized. In the field of low-carbon energy saving, the program adopts intelligent operation and maintenance modes from site selection, transportation and construction, adopts prefabricated intensive epidemic prevention cabin, reduces energy consumption, reduces construction waste, and realizes reuse after elimination, which is more humane, flexible and intelligent than ordinary epidemic prevention cabin.

The research of the paper has penetrated the epidemic prevention and control system, and contributed intelligent low-carbon solutions to the epidemic prevention and control technology of the hospital system, the overall planning of quarantine facilities, and the management and service of quarantine personnel.

## 4. Solution architecture

### 4.1 General idea of the solution

The plan focuses on intelligent epidemic prevention. In view of problems such as inaccurate spatial and temporal trajectory flow adjustment of associated personnel in the hospital system, lack of intensive control process and facilities for associated personnel, and lack of interaction between isolated personnel and human settlements, the following ideas and plans are proposed. The technical roadmap is shown in Figure 1.

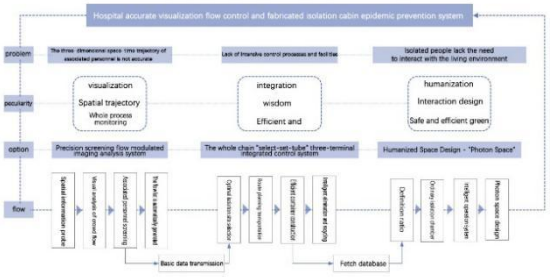


Fig.1 Overall technical route of the project

**(1) Accurate screening flow modulation imaging analysis system based on intelligent perception technology**

Through the whole process trajectory monitoring method, based on intelligent sensing technology, an accurate flow modulation imaging analysis system is formed. Through the five steps of spatial information exploration, visual analysis of crowd flow, related personnel investigation, automatic generation of flow lists and transmission to the construction system, the system realizes the effects of scene construction visualization, trajectory monitoring visualization, coupling space-time visualization, flow modulation information visualization and demand-based visualization.

**(2) Based on the wisdom of the whole chain "select-set-tube" three-terminal integrated control system**

Through the intelligent construction method system, based on the concept of prefabricated building, the intelligent construction system is formed by using BIM platform, geographic information system (GIS) and niu ROS intelligent route planning technology. Through the integrated services of location selection, line planning and transportation, container emergency construction, and disposal and recycling, the system realizes the intelligent management of the whole chain of optimal isolation point selection, efficient transportation, and container simulation, construction, disassembly, and recycling.

**(3) Humanized design based on intelligent regulation system -- "Photon Space"**

Through the design of intelligent operation systems and intelligent space, "Photon Space" carries out intelligent space perception of isolated living environment based on the Internet of Things platform, data acquisition module, embedded platform module and terminal control module. The system realizes the safety, rationality and practicality of humanized design of isolated people's living space through perception transmission, analysis and judgment, service provision, material selection and dimension optimization of "Photon Space", intelligent perception and emotional care, and interaction design of the living environment.

### 4.2 Implementation feasibility analysis

The construction of the scheme technology system includes three schemes. Scheme 1: Accurate

screening flow modulation imaging analysis system based on intelligent perception technology; Scheme 2: Based on the wisdom of the whole chain "select-set-tube" three-terminal integrated control system; Scheme 3: Humanized design based on intelligent regulation system - "Photon Space".

The first solution solves the problem of visual flow investigation and control of sudden small-scale epidemics in the hospital, and realizes the effects of scene construction visualization, trajectory monitoring visualization, coupled space-time visualization, flow adjustment information visualization, and demand-based visualization, which lays the data foundation for the second solution.

Plan 2 addresses the current situation of waste of public isolation resources, large investment in human and material resources, energy consumption and environmental pollution, and has the characteristics of high efficiency, standardization and precision, providing customized emergency isolation space guarantees for different scales and different types of epidemic emergencies, and also building a spatial basis for Plan 3.

The third solution solves that the traditional isolation space cannot meet the interaction requirements of people in the living environment, provides intelligent and efficient services for isolation personnel, and also shows the characteristics of humanity.

The three groups of technical solutions are progressive, logically rigorous, with technical support, and form a complete closed-loop logic.

### 4.3 Technical feasibility analysis

**(1) Accurate flow modulation imaging analysis system based on intelligent sensing technology**

Based on the ODA platform, the indoor positioning geographic information construction system is developed to realize the visualization of scene construction. Based on LBS service, intelligent spatial path monitoring system is developed to realize trajectory monitoring visualization. Based on GIS services and imaging technology, an intelligent digital epidemiology analysis system was developed to realize coupled spatiotemporal visualization. Based on data analysis, the intelligent portrait system of associated personnel is developed to realize the visualization of flow modulation information. At the same time, the information of epidemic point and situation analysis is transmitted through the situation analysis subsystem to realize the visualization of demand basis.

**(2) Based on the wisdom of the whole chain "optional - setup - tube" three-terminal integrated service system**

Based on GIS (Geographic Information System), site selection factors were established, based on multiple data such as basic terrain and electronic maps, combined with epidemic detection points, intelligent visual screening was carried out, and the best construction points were quickly and accurately located. The container splicing mode database was established, with "core cylinder+ 2N" as the basic construction mode, and screening conditions were set according to factors such as flow number, isolation level and emergency risk configuration. The container splicing mode and splicing scheme were quickly extracted and customized to serve different emergency scenarios based on the database. Through BIM platform simulation to achieve accurate construction, intelligent management and control, efficient construction of container modules, core tubes and corresponding supporting services; Intelligent route planning system is adopted to extract geographic information, formulate box loading schemes, and realize real-time visualization of optimal transport routes. After isolation, the BIM platform is used for orderly classification and disassembly. After recovery, sterilization and aseptic treatment are carried out, and then transported to the container database for recycling, forming a closed-loop management of "site-site-build-disassembly - recovery".

**(3) Humanized design based on intelligent regulation system -- "Photon Space"**

**1) Intelligent operation system in the cloud**

The system requires no human intervention, Arduino controller, infrared sensor, temperature and humidity sensor, infrared body temperature detection sensor, voice broadcast, wireless transmission and other modules can realize automatic detection of body temperature, indoor numerical control,

real-time monitoring of indoor air quality, automatic control of door switch, fan speed control, spray disinfection and other functions. Monitoring data will be uploaded to the cloud in real time, and managers can query and monitor the total number of people in the room and air quality anytime, anywhere through the platform.

**2) Smart glass curtain wall**

The intelligent curtain wall developed by the combination of double-layer ventilated glass curtain wall and computer technology, the curtain wall in a dynamic form, according to the changes in the external climate environment, through the computer system to automatically regulate the ventilation, insulation, shading equipment system of the curtain wall, in order to reduce the primary energy consumption of the building as much as possible, and create a comfortable and healthy indoor environment to the maximum extent.

# 5. Research on accurate screening flow modulation imaging analysis system based on intelligent perception technology

## 5.1 Overview of scheme design

The program focuses on the visual flow modulation control of sudden small outbreaks in hospitals. Through the whole process trajectory monitoring method and based on intelligent perception technology, an accurate flow modulation imaging analysis system is formed. Through the five steps of spatial information exploration, visual analysis of crowd flow, related personnel investigation, automatic generation of flow lists and transmission to the construction system, the system realizes the effects of scene construction visualization, trajectory monitoring visualization, coupling space-time visualization, flow modulation information visualization and demand-based visualization.

## 5.2 Method and technical path

The methods and technical paths included in this scheme are shown in Figure 2.

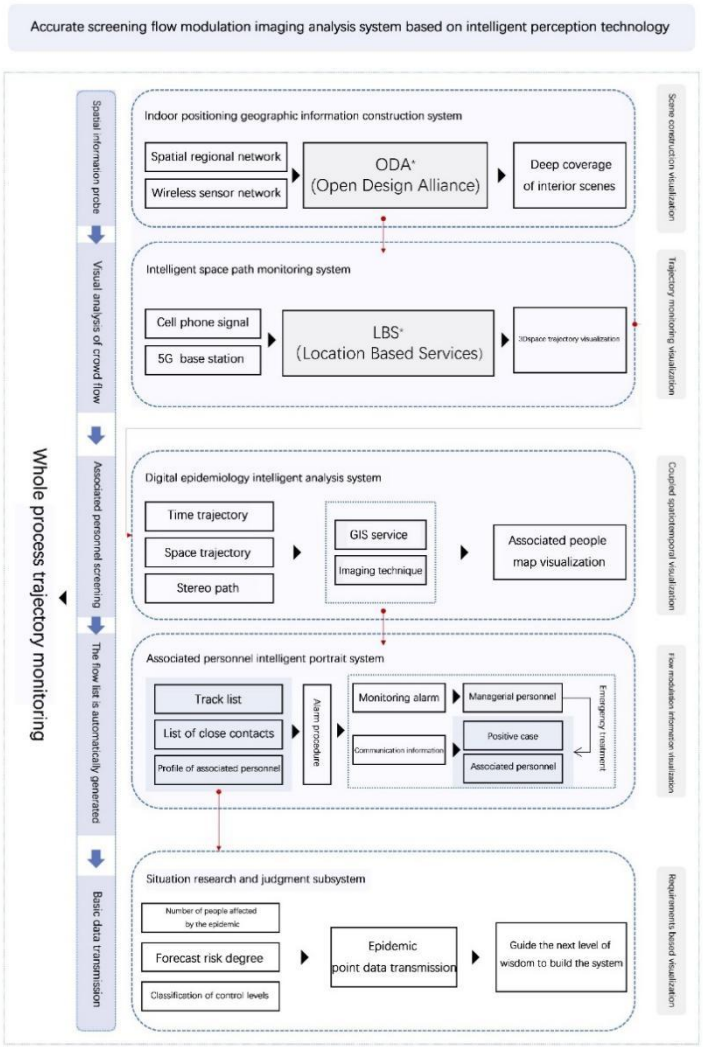


Fig.2 Technology roadmap

## 5.3 Implementation plan

### (1) Construct accurate hospital spatial information exploration points

Based on the Open Design Alliance (ODA) technology and wireless sensor network, data analysis and coordinated transformation of the information contained in the hospital space are carried out to quickly build an indoor geographic information model database and realize the three-dimensional visualization of hospital spatial information. And in the form of a three-dimensional electronic map display to the user.

Based on the geographic information of the indoor location, the system model is constructed, and base stations are arranged in outpatient clinics, wards, floors, channels, walls and other places as required to achieve full signal coverage of the monitoring areas in the hospital, as shown in Figure 3.

Fig.3 Hospital spatial information probe map


Fig.4 Three-dimensional space-time trajectory flow diagram

Fig.5 Digital epidemiology intelligent analysis system interface

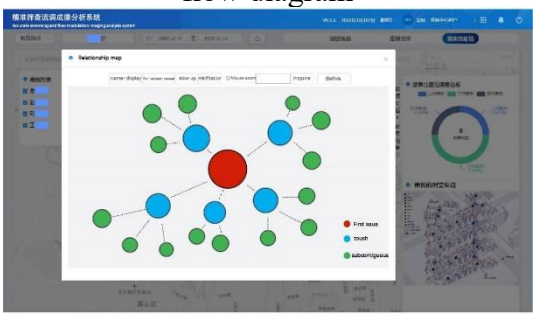


Fig.6 Generate the associated people graph

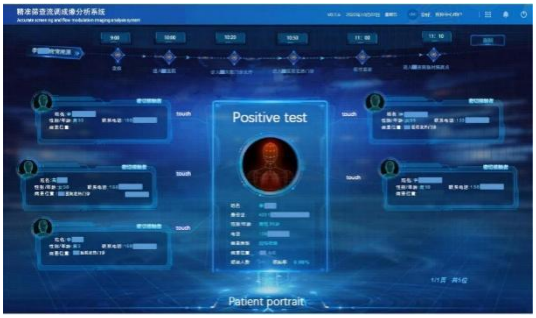


Fig.7 Generate intelligent portraits of associated people

**(2) Build a three-dimensional visual crowd track monitoring platform**

Relying on LBS service, the mobile phone signal within the perceived range is automatically captured through the small base station with deep coverage in the room, the three-dimensional space-time trajectory and streamline of the crowd after entering the hospital are monitored, and real-time feedback is provided, as shown in Figure 4 and Figure 5.

**(3) Generate accurate flow profile of associated personnel**

Relying on the intelligent digital epidemiology analysis system, after the patient is diagnosed as positive, the location of the case is quickly locked, its spatial and temporal trajectory is analyzed, the associated personnel who have intersection with it is screened, and finally the GIS service is used for accurate positioning, and the associated personnel map is generated by relying on imaging technology, as shown in Figure 6.

Relying on the intelligent portrait system of associated personnel, the map of associated personnel was refined, and the track list of positive cases and the list of close contacts were generated. Contact positive cases and their associated personnel according to the communication information obtained by the system. At the same time, the monitoring alarm system informs the manager to handle and control the associated personnel, as shown in Figure 7.

Through the situation research and judgment subsystem, information such as the number of infected people, the degree of risk prediction, and the classification of management and control levels are transmitted to the intelligent integrated service system of the whole chain "election-setting-management" to provide auxiliary decision-making support for epidemic prevention and control.

### 5.4 Scheme summary

This program focuses on the visual flow modulation control of sudden small epidemic situations in hospitals. Through the whole process trajectory monitoring method and based on intelligent perception technology, an accurate flow modulation imaging analysis system is formed. The research, development and application of this system is of guiding significance for the information extraction and analysis of personnel transfer in rapid response to hospital emergencies. It has social significance to reduce the pressure of epidemic prevention and control work caused by accidental non-precise injury of epidemic prevention and control. And it has practical significance to improve the common mental health problems caused by the wrong information of locked associates. At the same time, it lays the data foundation for accurate isolation, thorough isolation and scientific isolation of epidemic prevention work in the next step.

## 6. Research on the three-terminal integrated control system of the whole chain "choose-setting-tube" based on wisdom

### 6.1 Overview of scheme design

This plan focuses on quickly building large-scale emergency isolation facilities that accurately meet the risk level requirements in the hospital after a sudden outbreak of the epidemic. Through the method system of intelligent building, based on the concept of Prefabricated building, the intelligent building system is formed by using BIM platform, geographic information system (GIS) and niu ROS intelligent planning line technology. Through the integrated services of site selection and positioning, route planning and transportation, container emergency construction, and disinfection and sterilization recovery, the scheme realizes the intelligent management of the whole chain of optimal isolation point location, efficient transportation, and container simulation, construction, disassembly, and recovery.

### 6.2 Method and technical path

The methods and technical paths included in this plan are shown in Figure 8.

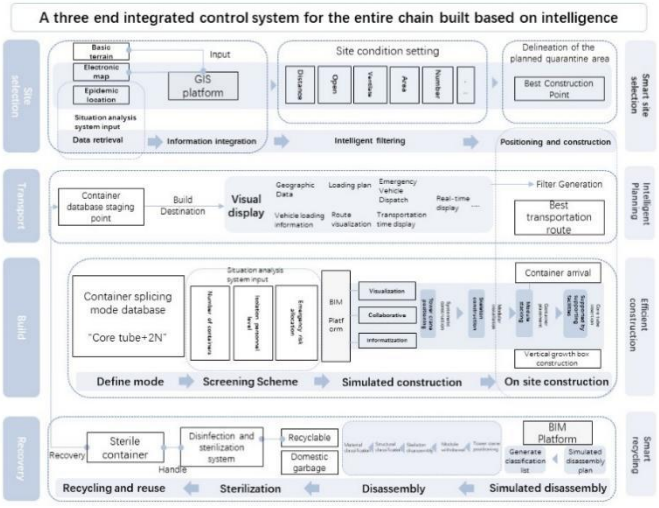


Fig.8 Technology roadmap

### 6.3 Implementation plan

#### (1) Smart site selection

Download high-resolution point cloud data through relevant electronic map software as basic terrain measurement data to accurately reflect the geometrical and texture information of the terrain, generate a basic terrain model around the hospital, publish and integrate the model data through the platform[15], set location screening conditions, and use geographic positioning and remote sensing positioning functions in GIS to calculate and analyze urban space with the hospital as the core and at different radius scales. Accurately locate the optimal isolation point to be installed within a certain range around the hospital, as shown in Figures 9 and 10.

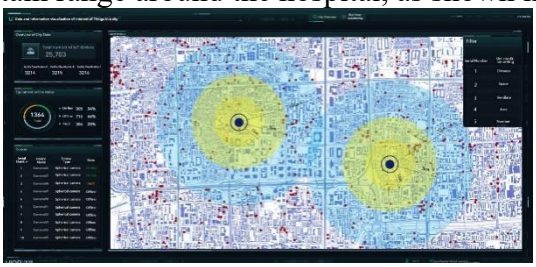

Fig.9 Multi scale radius filtering

Fig.10 GIS location selection

Fig.11 Intelligent path planning diagram

Fig.12 Road condition prediction

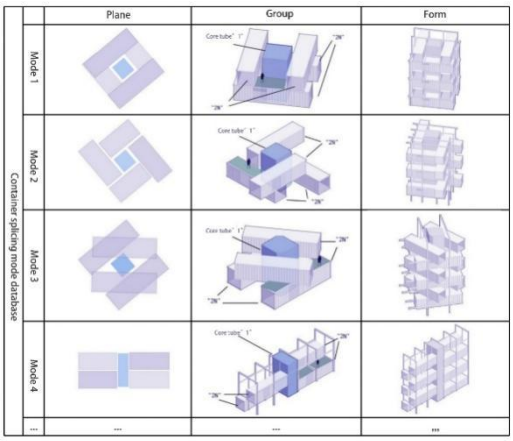


Fig.13 Container splicing mode database

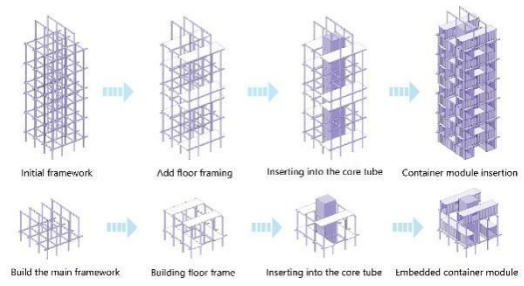


Fig.14 Build a technical flowchart

Fig.15 BIM operating platform Fig.16 Building rendering

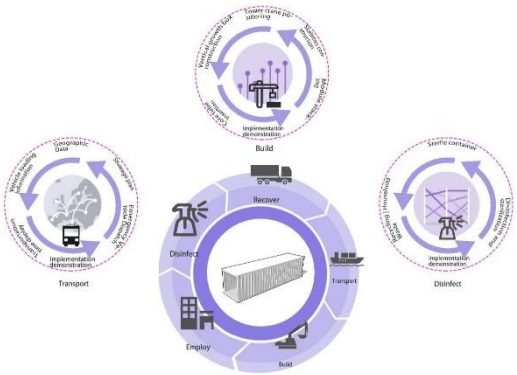


Fig.17 Recycling and Reuse Flow Chart

**(2) Intelligent route planning**

Based on geographic data and container demand quantity, with the help of NIU ROS intelligent route planning technology, input container demand quantity and model, quickly calculate and intelligently match vehicle type and loading plan; Input geographic information data of construction points to achieve real-time visualization of transportation routes and time; During peak traffic hours, emergency vehicle dispatch is carried out in real time, as shown in Figures 11 and 12.

**(3) Smart construction**

Based on the BIM platform, establish a database of container splicing modes with "core cylinder+2N" as the basic unit, and define multi-level splicing modes based on factors such as the number of box requirements and personnel risk levels. Using the VDC function of the BIM platform for simulation, quickly verify the feasibility and rationality of the plan, predict the difficulties and risk points that may be encountered during the construction process, and complete the entire construction simulation of "systematic construction, modular installation, container placement, and core tube embedding"; By combining 5G technology with front-end data collection equipment and using backend artificial intelligence algorithms, intelligent control forms such as automatic data collection, automatic analysis of on-site conditions, automatic storage and recording of construction records, and automatic organization of construction data can be achieved[16]. At the same time, the BIM platform controls on-site construction, positioning tower cranes, building skeletons, stacking modules, and supporting facilities, as shown in Figures 13, 14, 15, and 16.

**(4) Smart recycling**

At the end of the isolation period, with the help of the BIM platform, the demolition scheme is simulated before the isolation is removed, and a classified list of different materials, structures and skeletons is generated for orderly on-site disassembly, recycling and reuse. The recyclable module and the domestic waste module are automatically generated by on-site classification. The domestic waste of the isolated personnel will be integrated into the urban waste treatment system and treated separately, and the recyclable module will be professionally treated through the medical disinfection and sterilization system. Then transport the sterile container back to the container database to form a closed loop system of "site selection construction disassembly recycling", as shown in Figure 17.

### 6.4 Scheme summary

This scheme provides integrated positioning and location services, route planning and transportation, container emergency construction, disinfection and sterilization recovery for the rapid establishment of emergency isolation points after the outbreak of an epidemic in the hospital, and realizes closed-loop intelligent management of the whole chain of "location construction disassembly recovery".

The development and application of this system can quickly respond to higher-level prevention and control instructions. The "Use It Now" feature avoids the waste of more public isolation

resources. The hierarchical container building model database, combined with efficient, standardized and precise construction plans, provides customized emergency isolation space for epidemic emergencies of different scales and types, and also provides a solid foundation for emergency medical support in various cities. It has some practical significance.

## 7. Humanized design based on intelligent regulation system -- "Photon Space" research

### 7.1 Overview of scheme design

This solution focuses on the problem of traditional isolation spaces that are difficult to meet the interaction needs of isolated individuals in the living environment. The isolation space is divided into ordinary cabins and intelligent cabins, thus proposing the design concept of "Photon Space". Through the design of smart operation systems and intelligent spaces, based on IoT platforms, data collection modules, embedded platform modules, and terminal control modules, intelligent space perception of isolated living environments is carried out. The system realizes the safety, rationality and practicality of humanized design of isolated personnel living space through perception conduction, analysis judgment and service provision, as well as material optimization and dimension optimization of "Photon Space", intelligent perception and emotional care, and interaction design of residential environment.

### 7.2 Method and technical path

The methods and technical paths included in this plan are shown in Figure 18.

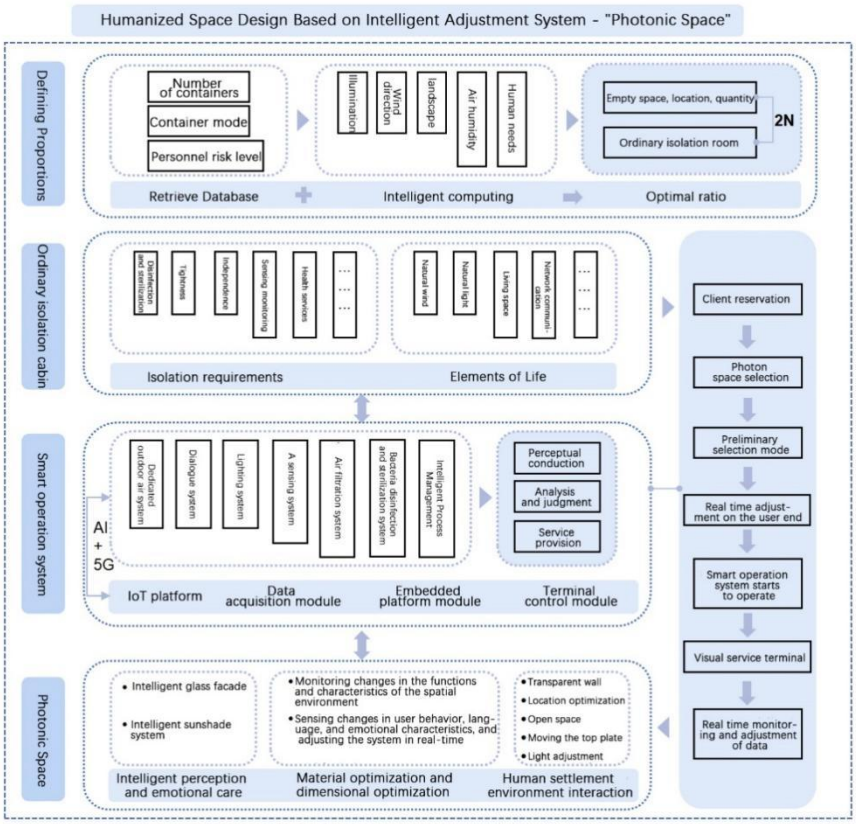


Fig.18 Technology Roadmap

### 7.3 Implementation plan

**(1) Building a smart operation system**

By connecting the seven major living systems in the room through 5G and AI technology, the dual guarantee for ordinary isolation cabin and "Photon Space" living is achieved. After completing

the corresponding functions through the integrated and designed sensors of each system, the collected data is packaged and sent to the Internet of Things platform, which is used to adapt to various sensor and communication networks, and to standardize the management and operation of equipment interconnection and meet remote scheduling needs, as shown in Figures 19 to 21.

Fig.19 Photon Space position selection (1)


Fig.20 Photon Space position selection (2)

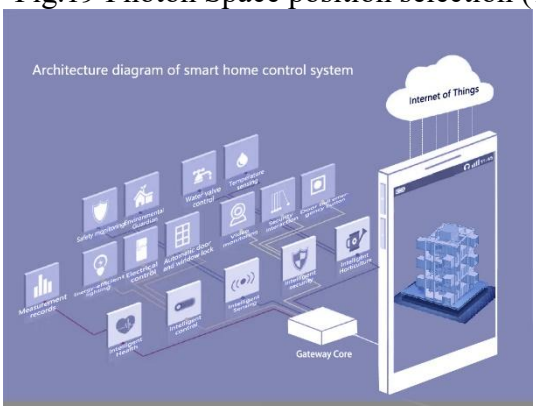


Fig.21 Intelligent Control System Architecture


Fig.22 Intelligent regulation system cloud monitoring interface

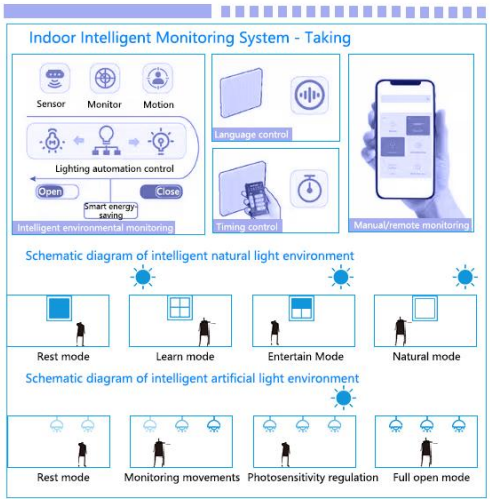


Fig.22 Intelligent lighting detection system

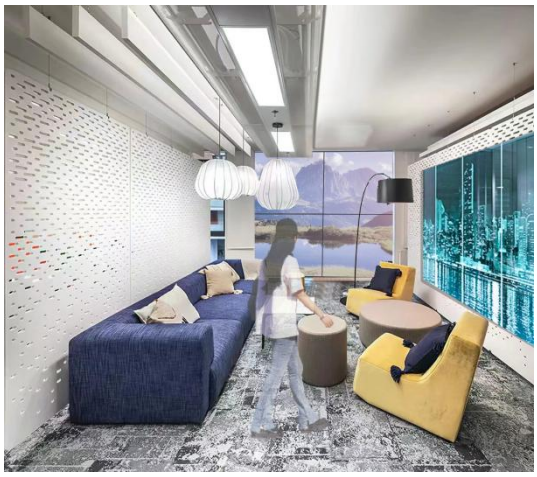

Fig.23 Indoor adjustment effect of "Photon Space"

**(2) Intelligent space creation**

Unlike traditional ordinary isolation compartments, creating a "Photonic Space" relies on the design of intelligent operating systems to create an intelligent space. Adopting intelligent glass curtain walls, using the reflective properties of glass to make the space multi-dimensional and multi-level. By relying on AI sensing systems, changes in the functionality and characteristics of the environment can be monitored, and changes in user behavior, language, and emotional

characteristics can be sensed. The interaction of the living environment is achieved through the design of transparent walls, open spaces, mobile roofs, etc., as shown in Figures 22-23.

### 7.4 Scheme summary

When designing living spaces for isolated individuals, it is not limited to meeting basic physiological needs, but more importantly, the psychological needs of this group should be considered. This plan utilizes an intelligent regulation system to improve the safety, rationality and practicality of the living space, while also adding more humanized "Photonic Spaces".

This plan plays the role of intelligent ecological health isolation, showcasing the safe, efficient and green concepts of intelligent regulation and operation systems, achieving the effect of integrating humanistic care and adapting to the development of the times with humanization and sustainable development.

## 8. Conclusion

The paper focuses on the hot topics of epidemic prevention and control and the era of low-carbon environmental protection, and conducts research on the development of a full process service for epidemic prevention and control based on smart links. In response to issues such as inaccurate three-dimensional spatiotemporal trajectories of associated personnel, lack of intensive control processes and facilities, and lack of interaction needs between isolated personnel and the living environment, integrated closed-loop services, precise screening of personnel, and intelligent transportation construction are proposed The diversified isolation space four in one solution has formed a precise screening flow imaging analysis system, a full chain "selection design management" three-terminal integrated control system, a humanized space design "Photon Space" system, continuously forming a full process service mode of "perception judgment decision action", and continuously becoming a dynamic feedback continuous evolution closed-loop management of "quantifiable + manageable + decision-making + governable", Providing new system concepts for the "Internet plus medical" industry and public health emergency epidemic prevention and treatment will bring new breakthroughs in the field of intelligent epidemic prevention, with the following innovations:

Innovation point 1: A precise screening and flow imaging analysis system based on intelligent perception technology, with functions such as spatial information exploration, visual analysis of crowd flow, associated personnel screening, automatic generation of flow imaging lists, and basic data transmission. Through the construction system of indoor positioning geographic information and intelligent spatial path monitoring system, it can meet the real-time tracking of three-dimensional trajectories of fever patients in the hospital. The digital epidemiological intelligent analysis system, the associated personnel intelligent portrait system, and the situation analysis subsystem promptly conduct close contact screening, tracking, management, and automatically generate a close contact list after a case is confirmed. Use ODA platform, LBC service, GIS service and imaging technology to realize the effects of scene construction visualization, trajectory monitoring visualization, coupling space-time visualization, flow scheduling information visualization, and demand foundation visualization. Active capture and analysis of personnel's mobile phone signals, indoor and outdoor location tracking, regional control and other supervision have solved the problem of visual flow investigation and control of small outbreaks in the hospital, laying the foundation for precise isolation, thorough isolation and scientific isolation.

Innovation point 2: Build a "flexible" and precise scale emergency isolation facility that meets the requirements of the risk level quickly, nearby, and in response to a sudden small-scale outbreak in hospitals. The innovation of this scheme is to form a set of intelligent building systems through the integrated intelligent management method and the overall use of BIM platform, geographic information system (GIS) and niu ROS intelligent planning line technology. This system alleviates

idle waste from fixed isolation sites through the entire process of locating the best building site, route planning, container transport and isolation, flexible construction of emergency containers, and disinfection and sterilization recycling. We have provided "nearby", "flexible" and "inclusive" isolation facilities that are consistent with small-scale outbreaks and exhibit scattered characteristics.

Innovation point 3: In response to the traditional isolated environment being unable to meet the interaction needs between the living environment and the quarantined, this article proposes the concept of "Photon Space". The operation of "photonic space" is not only from the physical level, but also through the creation and optimization of space to achieve the extension and expansion of people's spiritual level. Based on 5G and AI technology, connect the seven major living systems in the room, and intelligently perceive the living environment through the Internet of Things platform, data collection module, embedded platform module, and terminal control module. The intelligent operation system carries out perception transmission, analysis and judgment, and provides services, as well as optimizing the design of the "photonic space", achieving the safety, rationality and practicality of the residential space for isolated personnel, and achieving the effect of integrating humanistic care and adapting to the development of the times with green, efficient and sustainable development.

## References

[1] Zhou Z B, Yin M. "The novel coronavirus pandemic remains a major public health challenge" [N]. The People's Daily, 2022-05-16 (016).

[2] Wu Yandong. The leadership of the party is the fundamental guarantee of epidemic prevention and control major decisive victory [N]. Journal of chongqing, 2023-02-20 (009).

[3] Zhang Song, Li Jianglong, Liu Jing, Wang Liuren. Application of gait recognition in flow control screening for epidemic prevention and control [J]. China Security,2022(11):95-99.

[4] Tian Xuecheng, Han Ning. The outbreak of public security work flow up data modeling and safety analysis [J]. Journal of network security and data management, 2022, 9 (1) : 31-36.

[5] Liu Jianyu, Hu Yanqiu, Yang Jun. Practice of simultaneous audio and video stream tracing of COVID-19 in urban public transportation [J]. Journal of Suzhou University,2022,37(03):11-15.

[6] Xin Jinlong, Wang Chaochao, Liu Shaojun, Cong Chaojie. Research and implementation of wireless upgrade of Location tag based on UWB Communication [J]. Electronic Quality,2021(08):50-53.

[7] TANG Jianghui, Su Ziyun, Wang Yingqiu, Zhao Meng, Liu Chuanfei, Xu Jieyan. Potential analysis of air conditioning load participation in demand response considering 5G macro base station [J]. Electric Power Demand Side Management,2022,24(06):77-83.

[8] Sun Wei, Jin Fengjun. Problems and countermeasures in COVID-19 isolation management and control from the perspective of space organization [J]. The proceedings of the Chinese Academy of Sciences, 2022, 5 (8) : 1108-1115.

[9] Wei Xiongye, Wang Jin, Ren Danqing. Epidemic isolation monitoring system based on Internet of things technology [J]. The design and implementation of computer knowledge and technology, 2022, 17 (26) : 4244.

[10] Chen Kai. Discussed about temporary isolation room emergency project supervision control [J]. Journal of construction supervision, 2022 (7) : 102-104 + 108.

[11] Qin Luofeng, Fu Jingwen. Hospital isolation and thinking of the study on building the system [J]. Journal of architecture and culture, 2021 (6) : 169-170.

[12] Wang C. Research on optimization method of graphic design of infectious disease hospital under "peacetime combination" model [D]. Huazhong university of science and technology, 2021.

[13] Cheng, A., Chen, Y., Gao, Y., Sun, P., Chang, R., Zhou, B.,Cheng, F.(2021). Mobile isolation wards in a fever clinic: A will be operation model during the COVID - 19 studio. Epidemiology & Infection, 149, the E61.

[14] WEI Yanyong, Song Ting, HU Zhijia, LU Furong, HU Xuming, Luo Yong, LI Yongguo, Xu Ping. Reconstruction of old hospital building based on "combination of epidemic prevention and Treatment" [J]. China Hospital Architecture and Equipment,2022,23(01):71-75.

[1] Deng Qiunan. The Application of BIM+Smart Construction Site in the Construction Phase of Qinzhou Port Automated Container Terminal [J]. Water Transport Engineering, 2022 (10): 223-227.

[2] Zhao Yanjun, Zhang Jianjun, Ji Pengfei, Zhao Chenxi. From "Digital Construction" to "Digital Intelligent Construction" - Intelligent Transformation of Construction Sites under the Background of 5G Technology [J]. Intelligent Building, 2022 (04): 10-12.