

## Intelligent Healthcare and Intelligent Medical Guide Vehicle Design Practice

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### ABSTRACT

With the rapid development of new-generation information technology such as artificial intelligence and Internet of Things, intelligent healthcare has become an important development direction in the field of healthcare. This study deeply explores the development status, key technologies and application scenarios of smart healthcare. Through the comparative analysis of domestic and international smart healthcare development modes, it explores the innovation points of technology integration, discusses the challenges and future development direction of smart healthcare, and provides new ideas and methods to promote the sustainable development of smart healthcare. In order to solve the problems of medical guide services and related products in the existing smart medical system, this paper takes the intelligent medical guide vehicle as the research object, systematically combs through the current situation and trend of the development of intelligent medical guide system in the context of smart healthcare, in-depth analysis of the pain points of the medical needs of the elderly patients and other special groups, and puts forward a design scheme for the intelligent medical guide vehicle that integrates the navigation, transportation, information interaction and other multi-functions. The results of the study show that the design can effectively improve the patient's medical experience, ease the pressure of hospital medical guide, and provide a practical reference for the innovation of intelligent medical services.

*Keywords:* Intelligent healthcare, intelligent medical guide vehicle, ergonomics, medical navigation.

### INTRODUCTION

In the era of deep integration of technology and healthcare, smart healthcare has become a key force in the innovation of healthcare system. With the aggravation of population aging and the increasing incidence of chronic diseases year by year, the traditional healthcare model is overwhelmed in coping with the increasing healthcare demand, and it is difficult to meet the patients' expectations for efficient, convenient and accurate healthcare services. At the same time, the rapid development of information technology, such as the Internet of Things, big data, artificial intelligence, cloud computing, etc., has provided a strong technical support for the changes in the medical field, and smart healthcare has emerged.

Through the deep integration of advanced information technology and medical services, smart healthcare realises real-time collection, transmission, storage and analysis of medical data, and is able to provide patients with full-process, personalised and intelligent medical services. From pre-diagnosis intelligent guidance, remote pre-diagnosis, to precise diagnosis, intelligent assisted treatment, to post-diagnosis remote rehabilitation monitoring, health management, smart healthcare throughout each link of medical services, greatly improving the efficiency and quality of medical services (Mi *et al.*, 2019). The development of smart healthcare has also been strongly promoted at the policy level. Governments around the world have introduced relevant policies to encourage medical institutions to carry out the construction of smart healthcare and promote the development of medical informatisation (Wang *et al.*, 2019).

### LITERATURE REVIEW

In foreign countries, the research and practice of smart healthcare started earlier and achieved remarkable results. The United States, as a scientific and technological powerhouse, has invested heavily in the field of smart healthcare and is committed to creating a comprehensive medical information network. Through the integration of electronic medical record system, telemedicine platform and intelligent diagnostic tools, the efficient sharing and deep mining of medical data have been realised. A research team from the Massachusetts Institute of Technology (MIT) uses artificial intelligence algorithms to analyse medical images, which can quickly and accurately detect diseases with an accuracy rate comparable to that of senior doctors (Esmailzadeh *et al.*, 2024). European countries are also actively laying out smart healthcare. The National Health Service (NHS) of the United Kingdom has introduced big data analytics to optimise the allocation of healthcare resources, rationally arranging hospital beds, equipment and healthcare staff according to the needs of patients and the distribution of diseases, thus improving the efficiency and fairness of healthcare services. In Asia, Japan has made remarkable progress in the field of smart healthcare with its advanced robotics and Internet of Things (IoT) technology, developing intelligent nursing robots that can assist

healthcare workers in taking care of patients, reducing the burden of nursing work and improving patients' quality of life (Rasoulia-Kasrineh *et al.*, 2023),.

In recent years, the research on smart healthcare in China has also shown a vigorous development trend. With the in-depth implementation of the "Internet + Healthcare" strategy, domestic scholars and medical institutions have launched extensive research in various fields of smart healthcare (Xu *et al.*, 2020). In terms of technology application, research on the application of big data, artificial intelligence, blockchain and other technologies in the medical field has been deepening. ZhongShan Hospital has established a cardiovascular disease risk prediction model using AI technology, which can predict patients' cardiovascular disease risk in advance and provide strong support for doctors to formulate personalized treatment plans. In terms of policy research, scholars have conducted in-depth discussions on the policies, regulations and regulatory mechanisms of smart healthcare, providing a theoretical basis for the government to formulate relevant policies. In terms of service model innovation, a variety of new smart medical service models have emerged in China, such as Internet hospitals and telemedicine collaboration networks, etc., which provide patients with more convenient and efficient medical services (Kwon *et al.*, 2020).

However, there are still some shortcomings in the current research on smart healthcare. At the technical level, although the application of various information technologies in the medical field has made some progress, the integration and synergistic application of the technologies are not mature enough. The accuracy and reliability of artificial intelligence algorithms in medical data processing still need to be improved, and there are still barriers to data sharing and interaction between different healthcare systems, resulting in the value of medical data not being fully explored (Chatterjee *et al.*, 2020). At the ethical and legal level, the development of smart healthcare has brought about a series of ethical and legal issues, such as the protection of medical data privacy and the definition of responsibility for AI-assisted diagnosis, etc., and no sound legal regulation and ethical guidelines have been formed yet to regulate and safeguard the healthy development of smart healthcare (Xiang *et al.*, 2016). At the level of application and promotion, the development of smart healthcare is unbalanced among different regions and medical institutions, and some primary medical institutions have a lower level of application of smart healthcare due to the limitations of technology, funds and talents, which makes it difficult to meet the needs of patients.

## **THEORETICAL CORNERSTONE AND TECHNICAL SUPPORT OF INTELLIGENT HEALTHCARE**

### **Theoretical System of Intelligent Healthcare**

#### ***Concept definition and connotation explanation***

Smart healthcare refers to a new medical model that realises the digitalisation, networking and intelligence of medical and healthcare services through new generation of information technology such as the Internet of Things, big data, cloud computing, artificial intelligence and so on (Xiang *et al.*, 2016). This concept originated from the "Smart Earth" strategy proposed by IBM in 2009, the core of which lies in the use of advanced information technology to solve the core problems in the medical field. In essence, smart healthcare is not only a technological innovation, but also a fundamental change in the medical service model, which breaks the time and space limitations of traditional healthcare and reconfigures the way of doctor-patient interaction (Cheng, 2017).

Smart healthcare contains three levels of connotation: at the technical level, it is the system integration of multiple information technologies; at the application level, it covers the whole healthcare process of prevention, diagnosis, treatment, rehabilitation, etc; and at the value level, it aims to improve the quality, efficiency, and accessibility of medical care. The World Health Organisation (WHO) has emphasised that smart healthcare should be committed to the vision of "health for all" and reduce the gap in healthcare resources through technological means (WHO, 2025).

Smart healthcare covers the whole process of healthcare services, including the three stages of pre-diagnosis, diagnosis and post-diagnosis. In pre-diagnosis, through the intelligent diagnosis system, patients can initially judge their conditions based on their symptoms, choose the right department and doctor, and make an online appointment for registration, which reduces the time spent waiting in queues. Remote pre-diagnosis technology allows patients to communicate with doctors by video at home, and doctors give preliminary diagnosis and treatment suggestions based on the information provided by patients and the uploaded examination reports. During the diagnosis, with the help of intelligent diagnostic tools, doctors are able to quickly obtain information such as the patient's medical history and examination results, and make a more accurate diagnosis by combining the auxiliary diagnosis of artificial intelligence (Ramgopal, 2023). The application of surgical robots and intelligent assisted treatment equipment improves the accuracy of surgery and the effect of treatment. After diagnosis, the remote rehabilitation monitoring system tracks the patient's recovery in real time, and the doctor adjusts the rehabilitation plan according to the monitoring data to ensure that the patient can recover successfully. The health management platform provides patients with personalised health advice to help them prevent disease recurrence.

#### ***Characteristics of intelligent healthcare***

Intelligent healthcare has the characteristics of intelligence, personalization, convenience and efficiency. Intelligence is reflected in its ability to use artificial intelligence technology to achieve automatic diagnosis, intelligent decision-making and other functions (Reddy, 2022); personalization is through the in-depth analysis of patient data to provide patients with customized medical services; convenience is manifested in the fact that patients can access medical services anytime and anywhere through the Internet; high efficiency is embodied in the optimization of the medical process and the rational allocation of medical resources, which greatly shortens the patient's medical treatment time and improves the efficiency of medical services.

### **Development history of intelligent healthcare**

The development of smart healthcare has roughly gone through three stages (Table 1):

**Informatisation stage (1990s-2010):** this stage is mainly about the internal informatisation construction of medical institutions, including the application of hospital information systems (HIS), electronic medical record systems (EMR) and medical image archiving and communication systems (PACS). These systems have digitalised medical processes and improved hospital management efficiency, but there is a lack of interconnection between the systems and a low degree of information sharing.

**Networking stage (2010-2020):** with the development of mobile Internet and Internet of Things technology (IoT), smart healthcare entered the networking stage. Telemedicine and mobile medical applications began to be popularized, medical equipment was networked, and regional medical information platforms were gradually established. The typical feature of this stage is that the time and space limitations of medical services have been broken, and patients can obtain some medical services through the network (Jiang, 2015). China's "Internet+ Healthcare" policy has contributed to the rapid development of this phase.

**Intelligent stage (2020-present):** The mature application of artificial intelligence, big data, 5G and other technologies has enabled smart healthcare to enter a new stage of intelligence (Lei, 2022). Intelligent diagnostic systems, medical robots, virtual reality surgeries, and other applications continue to emerge, and medical services become more accurate and efficient. The construction of smart hospitals is in full swing, and medical systems have the ability to learn and make decisions on their own (Yuan *et al.*, 2024). The application of generative artificial intelligence in the medical field has even opened a new chapter of smart healthcare.

In China, the development of smart healthcare is strongly supported by national policies. The Outline of the "Healthy China2030" Plan explicitly proposes to promote the application of healthcare big data and develop smart healthcare services for the convenience and benefit of the people. Under the guidance of national policies, China's smart healthcare construction has made significant progress, with the popularity of electronic medical record systems increasing, the coverage of telemedicine continuing to expand, and the application of AI healthcare at the forefront of the world.

Table 1: Three stages of smart healthcare development.

Development Time Core Stage	time Span	Core technology	Main features	Typical Applications
Informatisation stage	1990s-2010	Database computer network	Business process digitisation, single system application	HIS, EMR, PACS
Networking stage	2010-2020	Mobile Internet Internet of Things	Interconnection and remote services	Telemedicine and mobile healthcare applications
Intelligent stage	2020-present	AI, Big data, 5G	Independent decision-making and precise service	Intelligent diagnosis, medical robots

Source: This study.

### **Future Development Trend and Application Mode Innovation of Intelligent Healthcare**

#### ***Prospects for the integration and application of emerging technologies***

In the future development process of smart healthcare, the integration and application of emerging technologies such as artificial intelligence, blockchain, Internet of Things, big data, cloud computing and so on will show a broad prospect (Zafar *et al.*, 2024). Artificial intelligence has shown its first signs in smart healthcare, and through deep learning algorithms, it is able to quickly analyse huge amounts of medical data and assist doctors in disease diagnosis. In the field of medical image recognition, AI can accurately identify abnormalities in X-ray, CT, MRI and other images. For example, the AI system developed by DeepMind, a subsidiary of Google, is able to accurately diagnose a wide range of eye diseases by analyzing fundus images in ophthalmology disease diagnosis, with an accuracy rate comparable to that of professional ophthalmologists. In the future, AI will be deeply integrated with IoT technology, and wearable medical devices and home medical monitoring devices will collect patients' physiological data in real time, such as heart rate, blood pressure, blood sugar, etc., and transmit them to the cloud through IoT, and AI algorithms will analyse them in real time, and issue early warnings to patients and doctors as soon as they find an abnormality, so as to achieve early detection and prevention of diseases (Chen *et al.*, 2023).

Blockchain technology, with its decentralised, non-tamperable and traceable features, provides a strong guarantee for data security and privacy protection in smart healthcare. Medical data involves patients' privacy, and security is crucial. Blockchain technology can encrypt and store patients' medical records on a distributed ledger, so that only authorized doctors and patients themselves can access and modify the data. In terms of medical data sharing, blockchain technology can ensure the secure transmission and sharing of data between different healthcare organisations and improve the efficiency of medical collaboration. In clinical trial data management, blockchain technology can ensure the authenticity and integrity of data and provide reliable data support for new drug development.

IoT technology will enable interconnectivity between medical devices, patients and healthcare organisations. In addition to the wearable medical devices and home medical monitoring devices mentioned above, various medical devices in hospitals will also be intelligently managed through IoT. Surgical robots, intelligent monitors, automated pharmacies and other equipment can upload real-time operational data and patient treatment data, and doctors can remotely monitor the operational status of the equipment and make timely adjustments to the treatment plan. IoT technology will also facilitate the development of telemedicine, where patients can have video consultations with doctors through smart devices at home, and doctors can provide diagnosis and treatment guidance based on real-time patient data.

Big data and cloud computing technologies provide powerful data processing and storage capabilities for smart healthcare. With the explosive growth of medical data, big data technology can collect, organize, analyze, and explore the potential value of this data. Through the analysis of a large number of patients' medical records, genetic data, treatment effect data, etc., it is possible to discover the pathogenesis of diseases, differences in the effectiveness of treatment plans, etc., providing a scientific basis for clinical decision-making. Cloud computing technology provides a convenient solution for the storage and calculation of medical data. Medical institutions do not need to invest a large amount of money in the construction of a local data centre, and only need to achieve data storage and processing through the cloud computing platform, which reduces operating costs.

#### ***Deepen intelligent medical services and optimize diagnosis and treatment processes***

The diagnosis and treatment process has been optimised in all aspects. In the registration process, the hospital has launched an registration platform, where patients can book appointments in advance through various channels such as the hospital's official website etc., and choose their own convenient consultation time and doctor. This measure not only avoids the tedious process of patients waiting for a long time in the hospital queuing for registration, but also allows the hospital to understand the patient's medical needs in advance, and rationally arrange medical staff and medical resources. According to the hospital's statistics, the proportion of online appointment registration has been increasing year by year, greatly improving the registration efficiency and reducing the waiting time of patients.

The deepening development of intelligent medical services in diagnosis, treatment and rehabilitation will be an important trend in the future of intelligent healthcare (Cross *et al.*, 2024). In the diagnosis process, artificial intelligence will play a more critical role. At present, the AI-assisted diagnosis system has been able to make preliminary diagnosis of common diseases, but its function will be more comprehensive in the future. Through multimodal data fusion technology, AI can comprehensively analyse the patient's symptom description, medical images, laboratory test results and other information to make a more accurate diagnosis. For complex diseases, AI can combine gene sequencing data, proteomics data, etc., to conduct accurate cause analysis and disease classification, providing the basis for personalized treatment. Artificial intelligence will also make breakthroughs in disease prediction, predicting the risk of diseases and taking intervention measures in advance through long-term monitoring and analyzing the health data of the population (Rajashekar *et al.*, 2024).

In the treatment process, intelligent medical equipment and treatment means will continue to emerge. Surgical robots will be more intelligent and precise, enabling more accurate operations in complex surgeries and reducing surgical trauma and complications. The Da Vinci surgical robot has already been applied in many fields, and its operation will be more flexible in the future, able to adapt to more complex surgical scenarios. Intelligent drug research and development will also make progress. Screening drug targets and designing drug molecular structures through artificial intelligence technology can shorten the cycle of new drug development and reduce research and development costs (Kp *et al.*, 2024). The development of personalized treatment plans will become the norm, and doctors will tailor the most suitable treatment plans for patients based on their genetic characteristics, disease history, lifestyle habits and other factors to improve treatment effectiveness.

In the rehabilitation process, intelligent rehabilitation equipment and remote rehabilitation services will be widely used (NOVA *et al.*, 2023). Intelligent rehabilitation robots can provide personalized rehabilitation training programmes according to the patient's recovery progress and physical condition, monitor the training effect in real time and make adjustments. Remote rehabilitation services allow patients to receive professional rehabilitation guidance at home, and doctors can understand the patient's recovery situation through video monitoring and data transmission, and give timely advice and guidance. Virtual Reality (VR) and Augmented Reality (AR) technologies will also be applied in rehabilitation treatment to create an immersive rehabilitation training environment for patients and improve the fun and effect of rehabilitation training.

#### ***Intelligent management of medical equipment***

In terms of medical equipment management, the hospital has introduced intelligent equipment management system to realise the full life cycle management of medical equipment. The system connects all medical equipment in the hospital to a network platform through IoT technology, and collects real-time equipment operation data, including usage status, operating parameters, fault alarms, and other information. Hospital equipment managers can check the operation of the equipment anytime and anywhere through the computer or mobile phone, timely discover potential faults and hazards of equipment, and carry out repairs and maintenance.

Intelligent equipment management system also has device deployment function. Hospitals can be based on the actual needs of various departments, through the system of medical equipment for reasonable deployment, improve the equipment utilisation

rate. During the peak period of surgery, the system can deploy idle surgical equipment to the urgently needed operating rooms according to the use of equipment in each operating room, ensuring the smooth progress of surgery. At the same time, the system can also arrange the maintenance and servicing plan of the equipment in advance according to the frequency of use and maintenance records of the equipment, prolonging the service life of the equipment and reducing the failure rate of the equipment.

Through the application of intelligent equipment management system, the efficiency of medical equipment management has been significantly improved. The failure rate of equipment has been reduced by about 30%, the maintenance time has been shortened by more than 50%, and the utilization rate of equipment has been increased by about 20%, which provides a strong equipment guarantee for the hospital's medical services.

#### ***New mode of medical service based on the intelligent platforms***

With the rapid development of Internet technology, new modes of medical service based on intelligent platforms have emerged, such as mobile healthcare, telemedicine, pharmaceutical e-commerce, etc. These new modes break the traditional medical service. These new models break the time and space limitations of traditional medical services, provide patients with more convenient and efficient medical services, and promote the innovative development of the medical industry.

Mobile medical application is another important embodiment of smart healthcare, which uses smartphones, tablets and other mobile devices to provide patients with convenient health management services. There are a wide variety of mobile medical applications, including health monitoring, medical consultation, appointment booking and online consultation, etc. Health monitoring apps can monitor patients' heart rate, blood pressure, blood sugar, sleep and other health data in real time by connecting to smart wearable devices, and upload the data to the cloud for doctors and patients to view at any time. Once abnormal data is found, the app will issue a timely warning to remind patients to take appropriate measures. Medical consultation apps provide a platform for patients to communicate with doctors online, so that patients can consult doctors on health issues and get professional advice at any time. Appointment registration apps allow patients to book hospital appointments anytime, anywhere via their mobile phones, avoiding the hassle of waiting in queues. Online consultation apps further realize remote video consultation between patients and doctors, so that patients can enjoy doctors' consultation services at home.

Remote diagnosis and consultation is one of the important applications of smart healthcare, which realizes remote communication and diagnosis between medical experts and patients or primary care doctors through network technology. In remote areas where medical resources are scarce, it is often difficult for patients to receive timely and accurate diagnosis and treatment. Remote diagnosis and consultation breaks the geographical limitation and enables patients to enjoy expert medical services. Through telemedicine technology, experts can provide remote consultation and surgical guidance to patients in remote areas or primary medical institutions. During remote consultation, experts can view the patient's medical records, image data and other information in real time, and conduct video communication with local doctors to jointly formulate treatment plans. In remote surgical guidance, experts can guide local doctors to perform surgery through high-definition video and remote control technology to improve the success rate of surgery. The application of telemedicine has effectively solved the problem of uneven distribution of medical resources, enabling high-quality medical resources to cover a wider range of areas, so that patients can enjoy expert diagnosis and treatment services at their doorsteps (Della, 2001).

## **DESIGN PRACTICE: INTELLIGENT MEDICAL GUIDE VEHICLE DESIGN BASED ON INTELLIGENT HEALTHCARE SYSTEM**

### **Analysis of the Current Situation**

Through the systematic analysis of the medical guide services and related products in the existing intelligent healthcare system (Liu *et al.*, 2017), it is found that the current hospital medical guide system mainly has the following problems:

#### ***Unclear navigation signs***

The internal space of the hospital is complex, the distribution of departments lacks regularity, and the traditional signage system often has incomplete information and discontinuous instructions. Surveys show that more than 60% of patients have been lost or gone to the wrong department due to unclear signage, wasting an average of 15-20 minutes looking for their destination. Elderly patients and first-time patients encounter particular difficulties in this regard.

#### ***Inefficient queuing management***

Queuing is serious in all parts of the hospital, and patients often need to queue repeatedly in several parts of the process, such as registration, waiting, examination, payment, and medicine collection. The existing calling systems are independent of each other and lack overall coordination, resulting in patients shuttling back and forth between different areas. About 75% of patients reflect that the queuing time accounts for more than 50% of the entire consultation time, which seriously affects the experience of medical treatment.

#### ***Inconvenient information query***

It is difficult for patients to conveniently obtain information about the consultation process, department location, doctor's expertise, etc.. Although some hospitals provide self-service enquiry terminals or mobile phone apps, older people have difficulty operating and low usage rates. A survey found that less than 30% of patients over 55 years of age were able to use the available electronic enquiry devices independently.

### ***Inadequate services for special groups***

Special groups such as the elderly and the disabled face more barriers in traditional healthcare environments (Ahmed *et al.*, 2024). Wheelchairs and other assistive devices are limited in number and inconvenient to use; there is a lack of guiding services for visually impaired and hearing impaired patients; and standing in queues causes physical burden to some patients. These factors lead to a generally poor medical experience for special groups.

### ***Limitations of existing medical guide equipment:***

Currently, the medical guide robots applied in hospitals mainly provide simple Q&A and guidance services with a single function (Chen *et al.*, 2017). It has limited mobility and cannot accompany patients to complete the entire medical process; the interaction mode is mainly touch screen, which is not friendly enough for the elderly; it lacks deep integration with the hospital information system, and it cannot provide personalized guidance for medical consultation.

Based on the above analysis, a multifunctional intelligent medical guide vehicle design solution is proposed, which needs to focus on solving the following key problems:

1. how to achieve accurate indoor navigation;
2. how to optimize the queue management process;
3. how to provide convenient information query services;
4. how to meet the needs of special groups;
5. how to reduce the burden of healthcare staff.

The solution of these problems will significantly improve the patient's medical experience and the service efficiency of the hospital.

### **Design Programme Conception**

The solution (Figure 1) integrates navigation guidance, queue management, health monitoring and information services (He, 2020), aiming to provide patients with comprehensive medical support (Table 2).

Table 2: Functional modules and technological implementation of the intelligent medical guide vehicle.

functional module	major function	core technology	Innovation point
intelligent navigation	Real time guidance indoor positioning path planning	SLAM algorithm multi-sensor fusion	Adaptive path planning real-time crowd sensing
Queue management	Intelligent reminder queue query time estimation	Data mining prediction algorithm	Full-process queue Cross-departmental collaboration
Health monitoring	Vital signs measurement data recording abnormal warning	Biosensor Internet of Things	Automatic data upload intelligent health assessment
information service	Hospital Introduction Department Inquiry Doctor Expertise	Knowledge Graph Natural Language Processing	Multi modal Interaction Personalized recommendation
Auxiliary functions	Seat article storage infusion support	Modular design ergonomics	Multi function integration special group adaptation

Source: This study.

### ***Intelligent navigation***

It covers the navigation of the whole medical process for patients, from registration, outpatient, triage, to the completion of medical treatment, which includes the functions of obstacle avoidance, automatic control and homing. Based on the 3D map of the hospital, it plans the optimal path of medical treatment for the patients, guides them to the target department in real time, and supports voice input of the destination.

### ***Queue management***

Docking with the hospital information system, automatically obtaining patient consultation queue information, reminding the consultation period, can estimate the waiting time and suggest the best course of action.

### ***Health monitoring:***

By connecting with portable medical equipment, basic vital signs such as blood pressure, blood oxygen and body temperature are measured, and the data are automatically uploaded to the hospital information system for doctors' reference.

**Information query**

Provide query service for information such as hospital introduction, department distribution, specialist expertise, consultation process, etc., and support voice Q&A.

**Emergency help**

One-key connection to the hospital service centre for emergency help, automatically sending location information for staff to quickly locate.



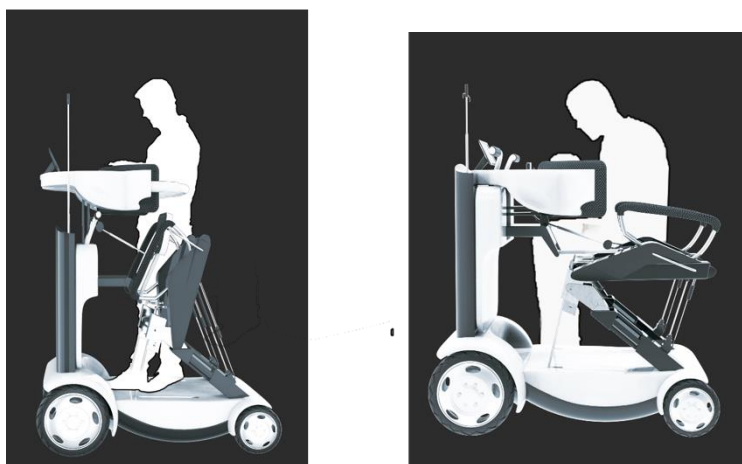
Source: Author's drawing.

Figure 1: Design programme conception.

**Product Function Design and Analysis**

In addition to the most basic navigation, positioning and transportation functions. Adhering to the principle of ergonomics, this guide vehicle divides the travelling mode into standing and sitting modes. In order to bring a more humanized experience to patients, it also provides a medical item storage function and an intelligent triage interaction system related to artificial intelligence technology.

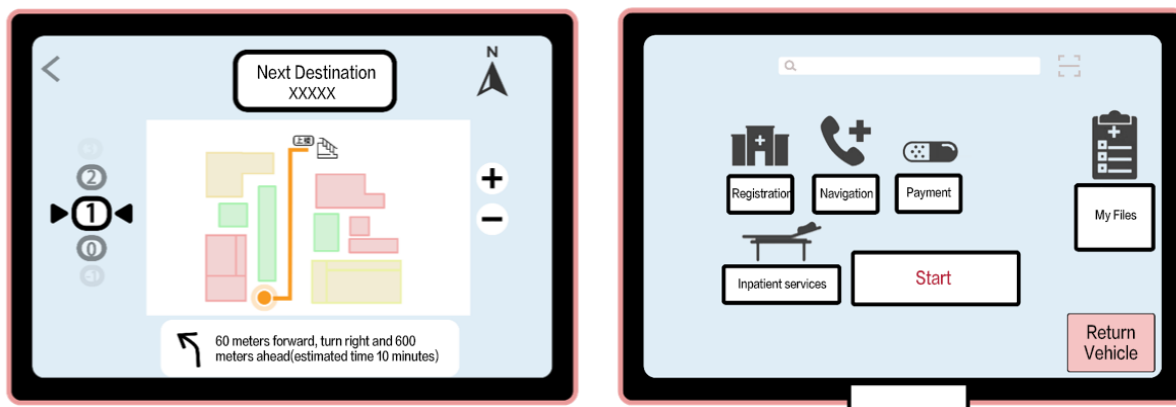
1. The standing assistance function provides the user with an assisted standing function through the telescopic structure of the vehicle (Figure 2), which adjusts the tilting angle of the vehicle by rotating the wheels on both sides of the arms. Regardless of the travelling mode, the patient can choose whether to be navigated by the guide vehicle itself.



Source: Author's drawing.

Figure 2: Schematic diagram of standing and sitting mode.

2. In order to provide the user with a direct visual display of the navigation function (Yuto *et al.*, 2023), the chest flap is fitted with a display screen which (Figure 3), in addition to indicating the route and current location, also shows nearby points of interest, and if still in the process of medical treatment, the next destination department is displayed. A user-friendly interactive interface is provided with specialized assistive functions for elderly and disabled patients, which allows optimization of font size and button layout, support for large icons and voice interaction (COOPER *et al.*, 2007).



Source: Author's drawing.  
Figure 3: Navigation interface.

- The storage function includes a retractable infusion rack (1.2-1.8m in height) and a storage space for temporarily placing medicines and medical orders (Figure 4), aiming to improve the patient's medical experience in the smallest detail (GARRETT, 2008).

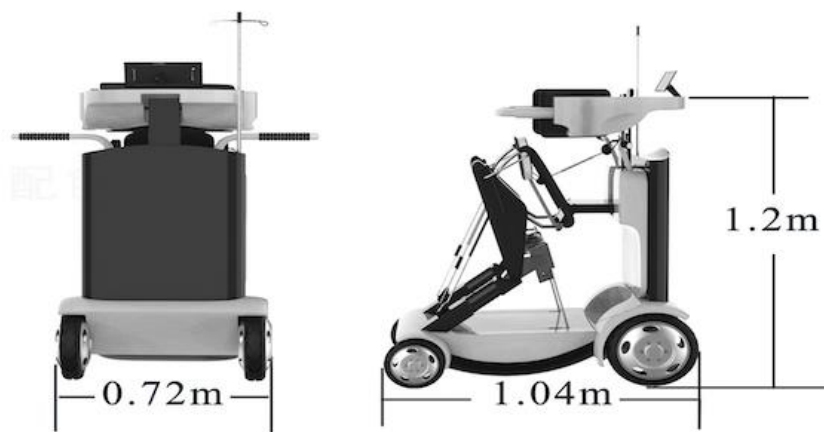


Source: Author's drawing.  
Figure 4: Storage function.

- Intelligent triage system can automatically sort and call the number of the department where the patient consults, and the patient can also query the consultation information summarised into the hospital information system through the on-board system and display it on the screen in real time.
- The function of medical information summarisation is to record the patient's consultation information in the vehicle's system through the Internet of Things, Bluetooth function, and allow patients to make consultation appointment, information query, payment and other functions in advance through the vehicle's screen, and to some extent solves the problem of excessive flow of hospitals in part of the time period.

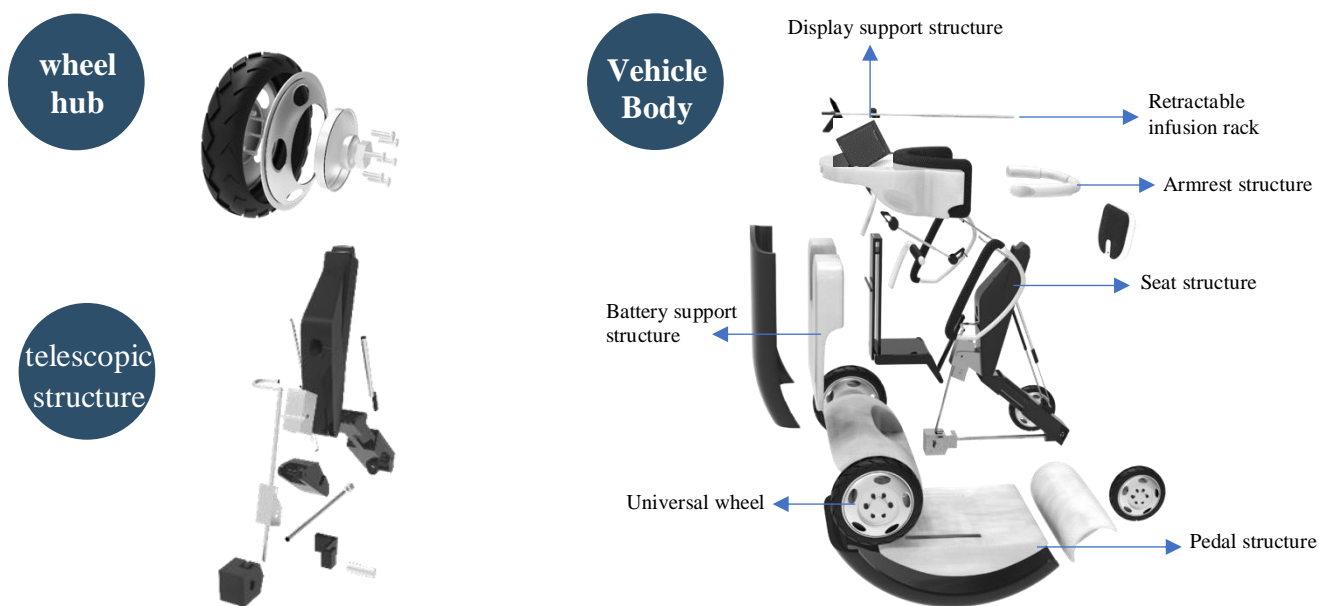
#### Product Structure Design and Analysis (Figure 6)

- The main body of the vehicle is made of aluminium alloy, which is lighter than other metal materials, and its strength is enough to support the user's body weight, and the dimensions of the vehicle are 104cm in length × 72cm in width × 120cm in height (Figure 5), and the weight is about 35kg.



Source: Author's drawing.  
Figure 5: Dimension drawing.

2. The frame of the medical guide vehicle is divided into armrest structure, display support structure, pedal structure, battery support structure, seat structure, wheel hub structure, and telescopic structure.
3. The wheel hub structure is selected to be a wheelset structure, because of its simple structure, simple control, high efficiency of flat ground travelling, and easy implementation of obstacle avoidance function.
4. The pedals and rear wheel hub structure are made of carbon fibre, which is an excellent material, stronger than steel and lighter than aluminium. Although it has poor bending properties, the material is one of the best choices considering that the guide vehicle is lightweight and at the same time can maintain its balance in the standing mode.
5. The front wheels use a special universal wheel structure, in order to be able to easily steer in narrow space to cope with crowded medical scenarios.



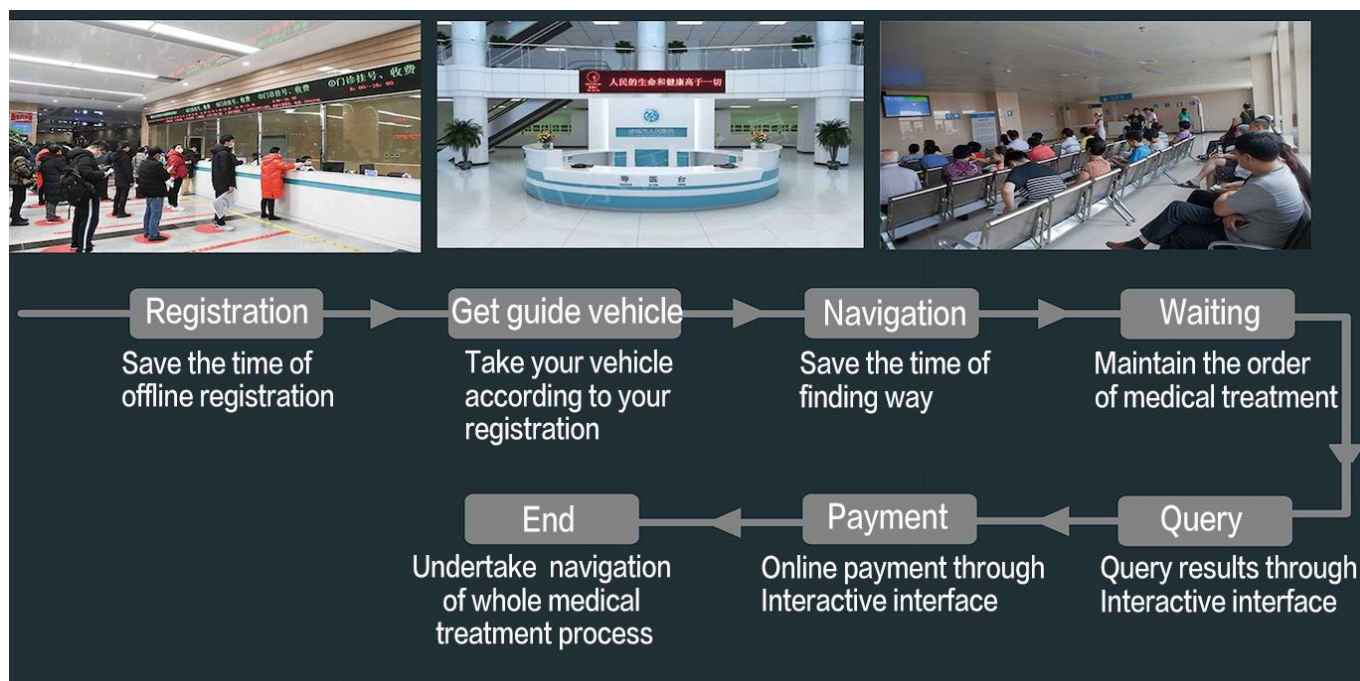
Source: Author's drawing.  
Figure 6: Product structure design.

### Product Design Innovations

Compared with the traditional medical guide service, the intelligent medical guide vehicle has the following innovations:

#### **Full-process accompanying service**

Unlike guidance robots that only provide a single point of service, the intelligent guide vehicle can accompany the patient to complete the entire medical process from admission to discharge (Figure 7): Registration—Get the medical guidance vehicle—navigation—Waiting for treatment—Query results—Online payment—End. It records the patient's medical plan and actively reminds what to do next and where to go, just like a caring medical assistant.



Source: Author's drawing.

Figure 7: Full-process accompanying service.

### **Multi-mode adaptive design**

Different service modes can be switched according to user needs. "Navigation mode" focuses on path guidance; "rest mode" provides seats and infusion racks; "companion mode" provides transportation support for patients with mobility problems; "information mode" answers various consultation questions. This adaptive design greatly expands the application scenarios.

### **Group intelligent collaboration**

Multiple medical guide vehicles work together through the cloud. When patients are concentrated in a certain area, the system automatically dispatches nearby free vehicles to support them; real-time flow and queuing information is shared between vehicles to help patients avoid congested areas, and continuously optimise the service quality (Susilawati *et al.*, 2020).

### **Emotional interaction design**

Focus on emotional factors to enhance user experience. The voice assistant adopts a warm and friendly tone; the interface design incorporates humanized elements; soothing music or health knowledge is provided during waiting time; and extra care is given to special groups. These design details enhance users' emotional connection and trust (Chen *et al.*, 2020).

## **CONCLUSION AND PROSPECT**

This study systematically explores the design practice of intelligent healthcare and intelligent medical guide vehicle, and provides new ideas and solutions for the development of the field of intelligent healthcare through the combination of theoretical research and design practice.

Firstly, the cutting-edge field of intelligent healthcare is analysed comprehensively and in depth, covering a wide range of dimensions from its current development to its technical architecture, application scenarios, challenges and response strategies. It shows certain innovative qualities in the exploration of the field of intelligent healthcare.

Secondly, in terms of research perspective, it breaks through the limitations of traditional isolated research on the application of various technologies or a single link of smart healthcare, and analyses in-depth the application mode and value creation of smart healthcare in each stage of pre-diagnosis, diagnosis and post-diagnosis from the macroscopic perspective of the whole process of healthcare services. By constructing a comprehensive analysis framework, it clearly reveals how smart healthcare achieves the optimization and reconstruction of healthcare service processes, providing a new perspective for an in-depth understanding of the internal logic of intelligent healthcare.

Finally, new discoveries are made in the study of the mechanism of influence of smart healthcare on the transformation of healthcare service model. It reveals that by promoting the sharing and circulation of medical data, smart healthcare breaks down the medical information barriers and achieves the optimal allocation of medical resources; by introducing artificial intelligence, Internet of Things and other technologies, it realizes the intelligence and automation of medical services, and improves the accuracy and timeliness of medical services; by constructing the online-offline integration of the healthcare service model, it expands the spatial and temporal scope of healthcare services and meets the diversified medical needs of patients.

In the future, the research of intelligent healthcare will be expanded in multiple dimensions, bringing new breakthroughs and changes to the development of the healthcare industry.

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