HealTrace AI

White paper

2025.2

Contents

Preface

In 2020, the outbreak of the global COVID-19 pandemic caused a huge impact on the medical system, and the shortage of medical resources and the problem of data sharing became prominent. In the following years, although the COVID-19 pandemic has gradually eased, the damage to the human body is still continuing, and global health expenditures are increasing. Against this background, HealTrace AI came into being, aiming to provide decentralized diagnosis and medical assistance tools through blockchain and artificial intelligence technology, to achieve the optimal allocation of medical resources and the safe sharing of data.

The main application directions of HealTrace AI include:

1. Realizing the value of medical big data: by collecting and analyzing users' health data, providing users with personalized medical advice and diagnosis, and optimizing the allocation of medical resources.

2. Promoting the application of artificial intelligence and blockchain technology in the medical service industry: using AI technology to learn the treatment experience of famous medical workers, improve the accessibility and efficiency of medical services, and enhance user experience.

3. Improving the global medical service ecosystem: through decentralized networks and multimodal interactive systems, providing convenient and personalized medical services, and improving the global medical level.

4. Expand the use scenarios of digital assets: Through the token incentive mechanism, encourage users to contribute health data and computing resources, and promote the widespread application of digital assets in the medical industry.

HealTrace AI is committed to building a decentralized medical service platform to provide 24-hour uninterrupted medical services to users around the world. We believe that through technological innovation and ecological construction, HealTrace AI will bring new opportunities and changes to the development of the global medical industry. In the future, HealTrace AI will fully promote the integrated development of "blockchain + artificial intelligence + medical care", use the power of science and

technology to realize the value of medical big data, thereby protecting human health, meeting people's more intelligent medical needs, improving the global human health level, and creating a better life.

1. Market demand

1.1 Analysis of smart medical market

In recent years, with the rapid development of artificial intelligence technology, the global smart medical market has shown a booming growth trend. This trend not only reflects the urgent need for advanced technology in the medical industry, but also shows the broad application prospects of artificial intelligence in the medical field.

Global Market Insight data shows that the global AI medical market size in 2020 was only US$4.2 billion, but it is expected to soar to US$34.5 billion by 2027, with a compound annual growth rate of 35.1% from 2020 to 2027. This growth trend shows the potential of AI in the medical industry that cannot be ignored, covering multiple links such as imaging, health management, and clinical decision-making. By 2025, the total value of the global artificial intelligence application market will reach US$127 billion, of which the medical industry will account for one-fifth of the market size. This shows that the medical industry has become one of the important areas of artificial intelligence application.
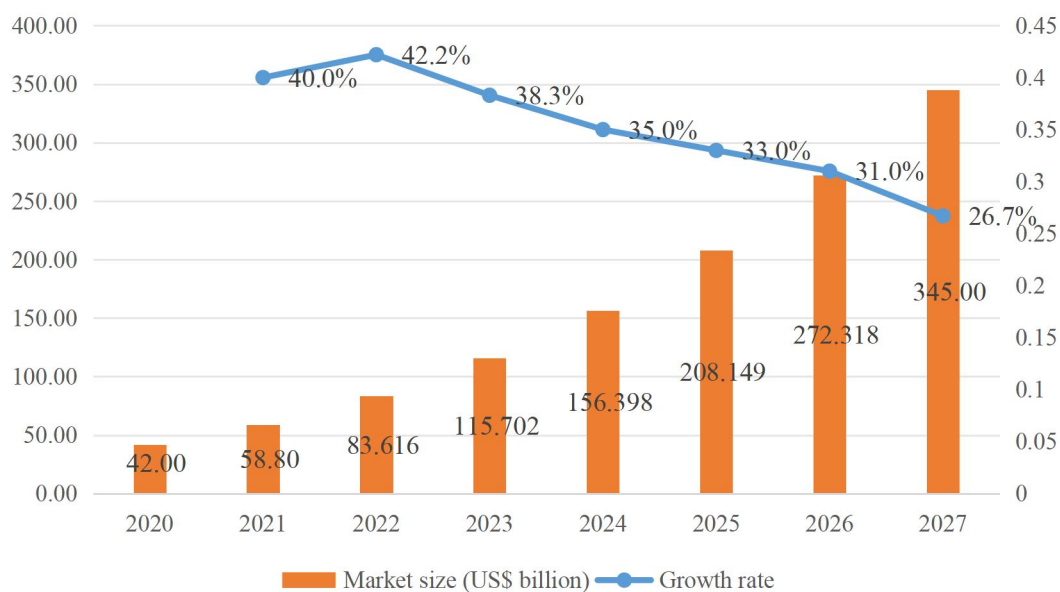
Figure 1-1: Global smart healthcare market size 2020-2027

In terms of specific application scenarios, artificial intelligence has shown great potential in medical image analysis, clinical decision support, health management, drug development, and smart medical equipment. For example, in the field of medical

image analysis, AI technology can quickly and accurately identify lesions, provide doctors with diagnostic basis, and improve diagnostic efficiency and accuracy. In clinical decision support, AI systems can provide doctors with personalized treatment plan recommendations by analyzing a large amount of patient data, helping doctors make more scientific decisions. In the field of health management, smart medical devices and applications can monitor users' health status in real time, provide health advice and warnings, and promote users' healthy lifestyles.

Policy support is also an important factor in promoting the development of the global smart medical market. Governments of various countries have introduced relevant policies to encourage medical institutions and enterprises to adopt artificial intelligence technology to improve the quality and efficiency of medical services. For example, the U.S. Department of Health and Human Services (HHS) released the Strategic Plan for Artificial Intelligence in Health, Human Services, and Public Health in January 2025. The plan aims to promote changes in medical research, pharmaceutical product development, medical institution management, patient service systems, and public health through AI technology, and make the United States a global leader in innovation and responsible adoption of AI.

In addition, technological progress is also an important driving force for the development of the smart medical market. With the continuous breakthroughs in artificial intelligence technologies such as deep learning, natural language processing, and computer vision, the performance and functions of smart medical products are constantly improving. For example, the application of generative AI and multimodal models enables AI systems to better understand and process complex medical data and provide more accurate support for medical decision-making. At the same time, the development of technologies such as edge computing and 5G communications also provides more powerful technical support for real-time data transmission and processing of smart medical equipment.

However, despite the rapid development of the global smart medical market, it still faces some challenges. For example, the privacy and security issues of medical data, the ethical and legal issues of AI technology in the medical field, and the

acceptance and use ability of medical professionals for AI technology are all issues that need to be addressed. In addition, differences in medical systems, policies and regulations, and cultural habits in different countries and regions have also brought certain difficulties to the promotion and application of smart medical products.

In summary, the global smart medical market is showing a rapid development trend driven by policy support, technological progress, and market demand. In the future, with the continuous advancement of artificial intelligence technology and the continuous transformation of the medical industry, the smart medical market is expected to continue to maintain rapid growth and make greater contributions to the development of global medical undertakings.

1.2 Market demand

With the continuous growth of global medical needs, the smart medical market is ushering in unprecedented development opportunities. People's demand for health is increasing, but the shortage of medical resources still exists, which makes smart medical care an important development direction for future medical services. Specifically, the current market demand for smart medical care is as follows:

1. Tight medical resources: Globally, the uneven distribution and shortage of medical resources still exist, especially in remote areas and grassroots medical institutions. Smart medical care can effectively alleviate the problem of tight medical resources and improve the accessibility and efficiency of medical services by providing services such as remote diagnosis and intelligent decision-making assistance.

2. Aging population: With the aggravation of population aging, the number of elderly patients continues to increase. Smart medical care can develop more aging-related specialties, such as cardiovascular and cerebrovascular diseases, orthopedics and rehabilitation medicine, to meet the medical needs of elderly patients.

3. Chronic disease management: The number of chronic disease patients is huge and requires long-term management and care. Smart medical systems can provide patients with personalized health management plans through data analysis and mining, and improve the efficiency and effectiveness of chronic disease management.

4. Demand for personalized medical care: Patients have a growing demand for personalized medical care. Smart medical care can provide patients with more accurate and personalized medical services through AI technology to meet the needs of different patients.

5. Policy support: Governments of various countries have introduced relevant policies to encourage medical institutions and enterprises to adopt artificial intelligence technology to improve the quality and efficiency of medical services. For example, in 2024, the U.S. Food and Drug Administration (FDA) launched an accelerated approval channel for AI medical devices, aiming to support the rapid implementation of innovative technologies through faster approval procedures.

The smart medical market is standing at the forefront of the times, with unlimited potential and a promising future. With the continuous advancement of technology and continued policy support, smart medical care will bring more innovation and development opportunities to the medical industry.

1.3 Our Solutions

In response to the needs and challenges of the current medical market, we will provide an innovative decentralized diagnostic and medical assistance tool application solution by combining artificial intelligence, blockchain and medical technology. The following is our solution:
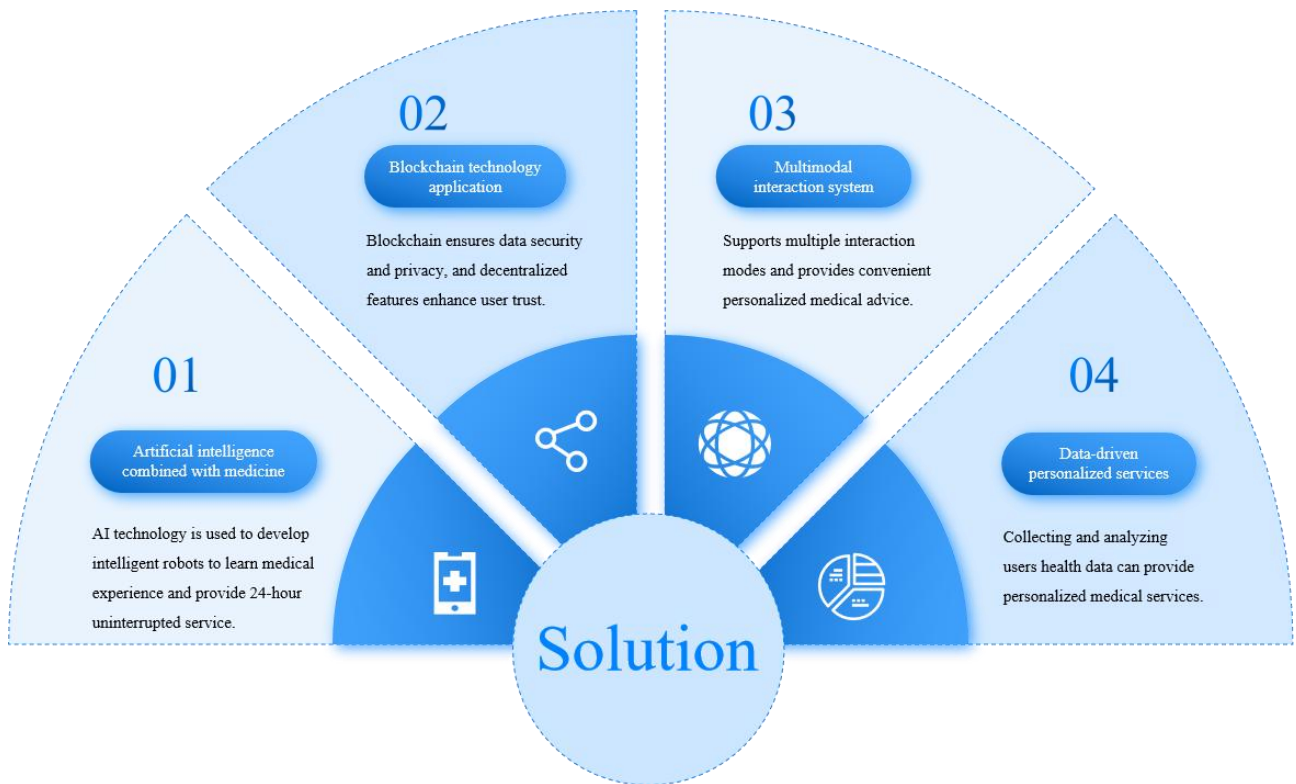
Figure 2-2: Solution

1. Combination of artificial intelligence and medical care: Using artificial intelligence technology, especially deep learning and natural language processing, to develop intelligent robots to learn and simulate the treatment experience of famous medical workers. These intelligent robots will be able to provide 24-hour uninterrupted medical services, including diagnosis, analysis and advice, thereby improving the accessibility and efficiency of medical services.

2. Application of blockchain technology: Through blockchain technology, the security and privacy of user data are ensured. User data will be encrypted and stored on the blockchain, and only intelligent robots authorized by the user can access it. In addition, the decentralized nature of blockchain will ensure that the data cannot be tampered with and enhance users' trust in the platform.

3. Multimodal interactive system: In order to provide more convenient and personalized services, our solution will support multiple interaction methods, including visual systems, voice recognition, natural language processing, image generation systems, and recommendation systems. Users can interact with the application in a variety of ways, such as images, voice or text, to obtain more accurate

and personalized medical advice.

4. Data-driven personalized services: By collecting and analyzing users' health data, our solution will be able to provide personalized medical services. For example, users can upload their own body data, and the application will provide customized diagnosis and treatment suggestions based on this data.

Through the above solutions, we will be able to effectively address the needs of the current medical market and provide a safe, convenient and personalized medical service platform.

2. HealTrace AI Introduction

2.1 HealTrace AI Positioning

In this context, the HealTrace AI team developed the HealTrace AI project. HealTrace AI is positioned as a decentralized diagnostic and medical auxiliary tool application platform based on blockchain technology. HealTrace AI closely combines artificial intelligence, blockchain and medical technology, with the core of providing 24-hour uninterrupted medical services to solve problems such as tight medical resources, medical data privacy and security. Specifically, the service directions of HealTrace AI include:

1. Realizing the value of medical big data: by collecting and analyzing users' health data, providing users with personalized medical advice and diagnosis, and optimizing medical resource allocation.

2. Promoting the application of artificial intelligence and blockchain technology in the medical service industry: using AI technology to learn the treatment experience of famous medical workers, improve the accessibility and efficiency of medical services, and enhance user experience.

3. Improving the global medical service ecosystem: through decentralized networks and multimodal interactive systems, providing convenient and personalized medical services, and improving the global medical level.

4. Expanding the use scenarios of digital assets: through token incentive mechanisms, encouraging users to contribute health data and computing resources, and promoting the widespread application of digital assets in the medical industry.
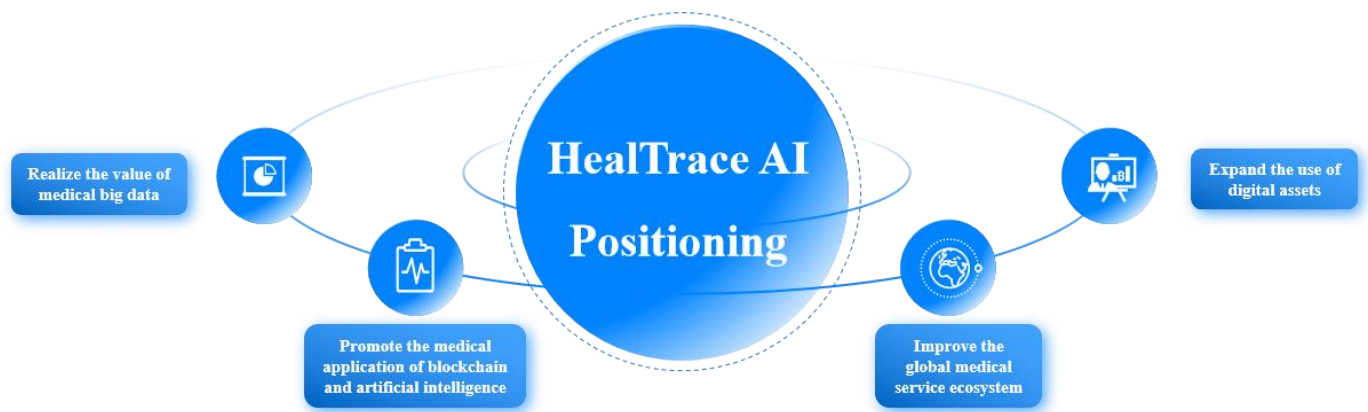
图 2-1：HealTrace AI 定位

2.2 HealTrace AI Application Scenarios

Through HealTrace AI, we will achieve diversified service application scenarios, the operating efficiency of the entire industry chain will be rapidly improved, and the patient experience will be greatly improved.

2.2.1 AI Diagnostic Service

HealTrace AI's AI diagnostic service uses deep learning and natural language processing technologies to develop intelligent medical robots to learn and simulate the treatment experience of famous medical workers. These intelligent medical robots are able to provide 24-hour uninterrupted medical services, including diagnosis, analysis and advice, thereby improving the accessibility and efficiency of medical services.

Users can interact with intelligent medical robots in a variety of ways, including uploading images, entering text descriptions, or using voice recognition functions. Intelligent medical robots will provide personalized medical advice and diagnosis based on the information provided by users and combined with their learned medical knowledge. For example, users can upload an image of tongue coating, and the intelligent medical robot will analyze the image and provide corresponding diagnostic advice.

In addition, the AI diagnostic service also supports multimodal interaction, simulates the real doctor-patient communication process, and provides more accurate and personalized diagnostic results. In this way, HealTrace AI can not only improve the efficiency of medical services, but also ensure that users receive high-quality
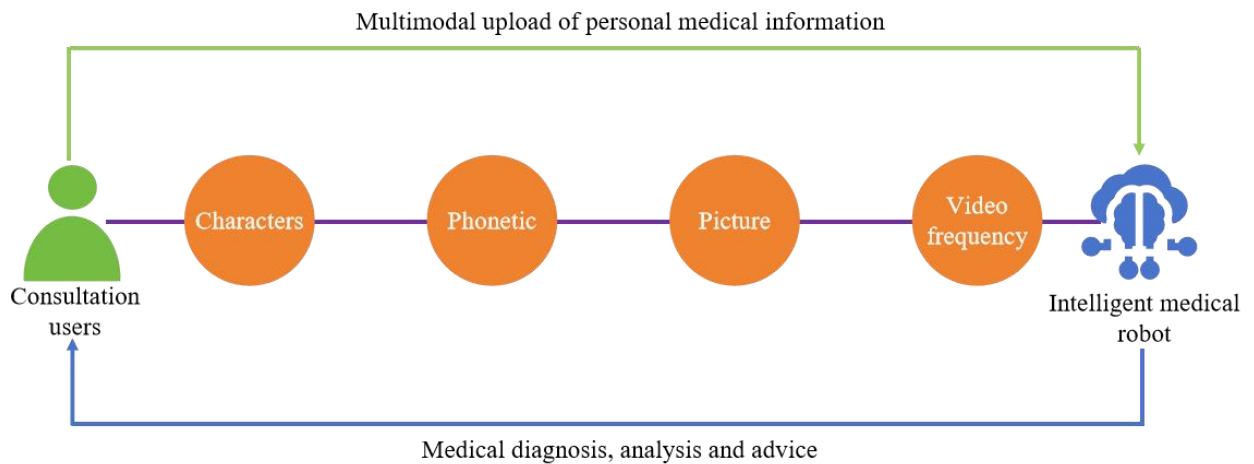
medical advice.

Figure 2-2: AI diagnostic service

2.2.2 Medical Data Analysis and Prediction

HealTrace AI can use artificial intelligence technology to conduct in-depth analysis and prediction of medical data, providing strong support for medical institutions and doctors. By collecting and integrating multi-dimensional data such as patients' medical records, examination results, and treatment processes, the application can use machine learning algorithms to explore potential patterns and trends in the data.

In terms of disease prediction, HealTrace AI can predict the risk of disease occurrence based on the patient's symptoms, medical history and other information, issue early warnings, and provide a basis for early intervention and treatment. For example, by analyzing the data of a large number of diabetic patients, the trend of changes in patients' future blood sugar levels can be predicted, helping doctors to adjust treatment plans in a timely manner.

In terms of treatment effect evaluation, the application can simulate and predict the effects of different treatment plans, providing a reference for doctors to choose the best treatment plan. For example, in cancer treatment, by analyzing the patient's tumor characteristics, genetic information and other data, the efficacy and side effects of different drug treatment plans can be predicted, helping doctors to develop personalized treatment plans.

In addition, medical data analysis and prediction can also be applied to the

optimal allocation of medical resources. By analyzing the hospital's patient flow, disease distribution and other data, we can predict medical needs in the future, rationally arrange medical staff and equipment resources, and improve the hospital's operational efficiency.
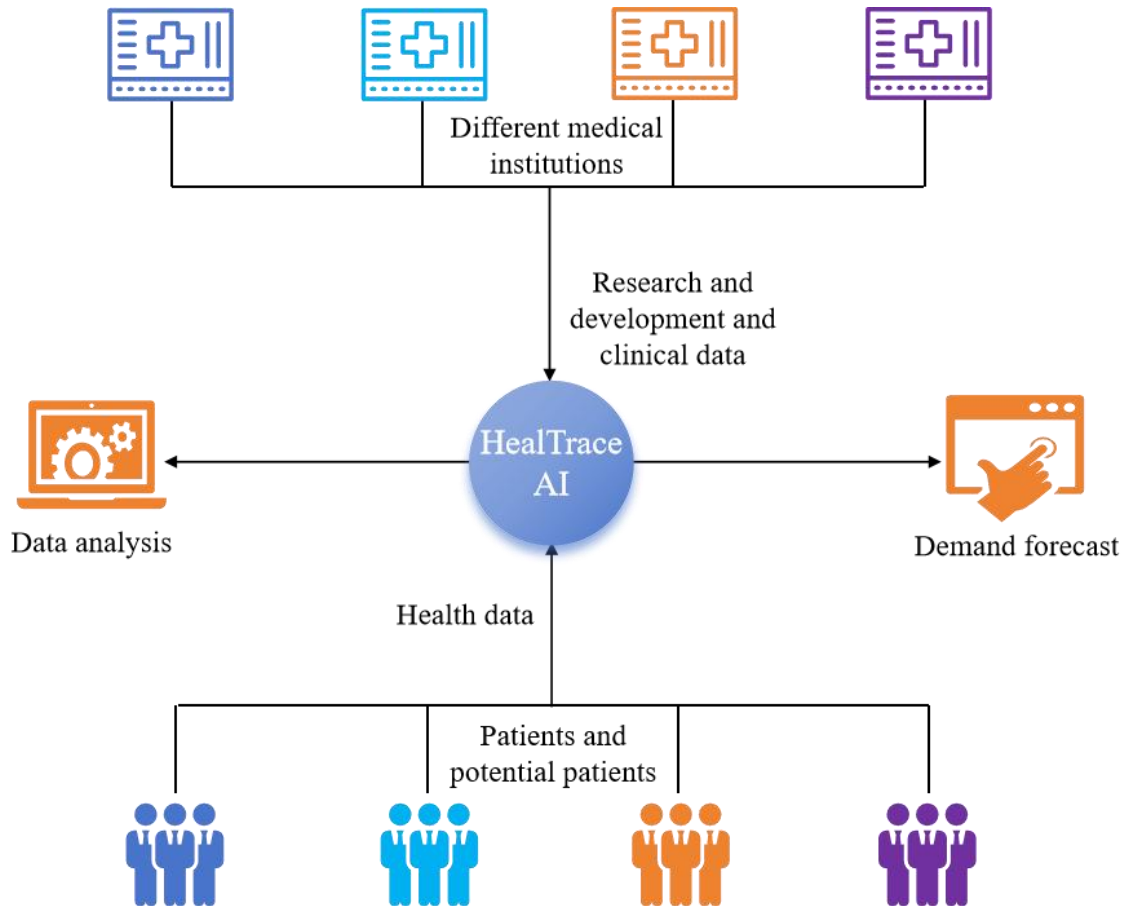

Figure 2-3: Medical data analysis and prediction

2.2.3 Personalized health management

On the HealTrace AI platform, users can upload physical data including symptoms, medical history, and test results. The platform uses artificial intelligence technology to conduct in-depth analysis of this data and provide users with customized diagnosis and treatment recommendations. For example, after the user uploads blood sugar data, the platform will comprehensively analyze factors such as their daily diet and exercise habits, and provide personalized diet and exercise plans to help users effectively control blood sugar levels. In addition, the platform will conduct regular health assessments based on the user's health status, promptly identify potential health risks and issue warnings, so that users can take measures in advance

to prevent the occurrence of diseases. Through this personalized health management method, HealTrace AI helps users better understand and manage their health and improve their quality of life.
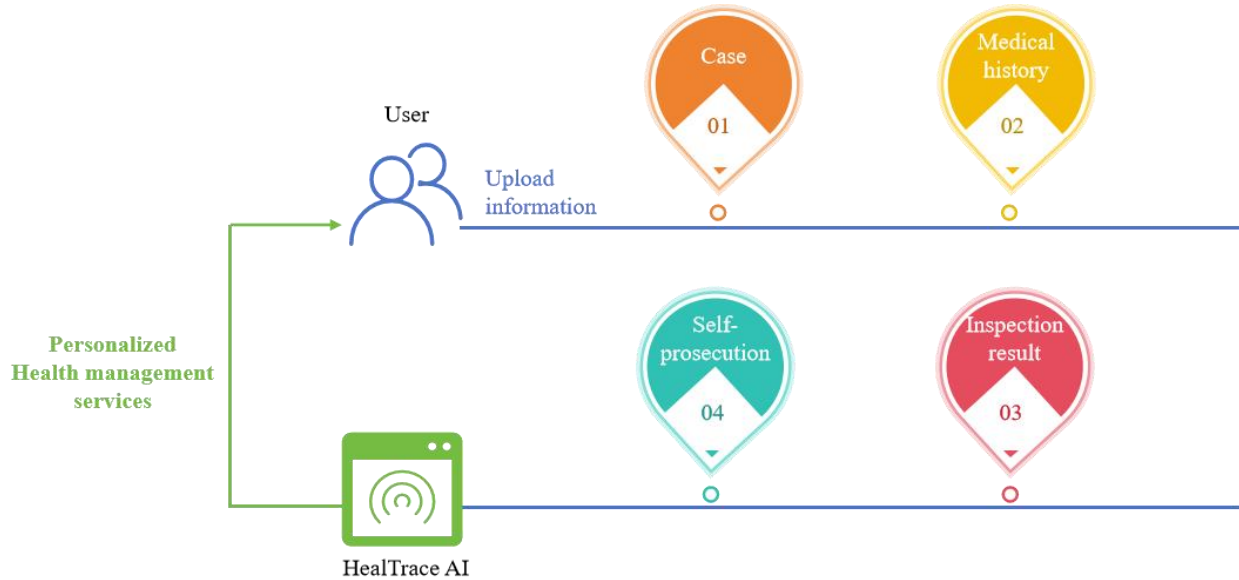

Figure 2-4: Personalized health management

2.2.4 Medical Evidence Storage

The advancement of digitalization will inevitably make all kinds of traditional physical elements, such as contracts, evidence, bills, etc., eventually presented in the form of electronic data evidence storage. However, electronic evidence generally has the characteristics of difficult evidence collection, easy disappearance, easy tampering, and strong technology dependence, which makes it difficult to implement in practical applications. Especially in the medical field, the reliability requirements for data and credentials in various medical processes are extremely high. These data play a very important role in the fields of justice, insurance, etc. HealTrace AI makes full use of the characteristics of blockchain technology "open, transparent, tamper-proof, and traceable". By combining blockchain technology with medical data evidence storage, a blockchain trusted data channel from electronic data to electronic evidence storage has been established. With the application of smart contracts, safe, efficient, and low-cost electronic evidence storage can be achieved.
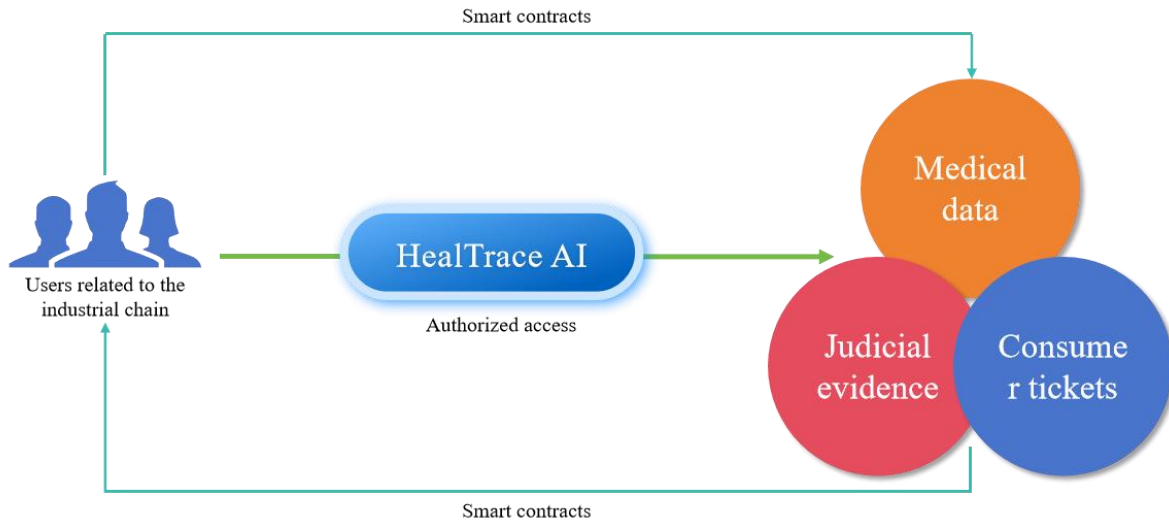
Figure 2-5: Medical evidence

2.2.5 Medical Insurance

The traditional insurance industry often encounters the problem of inefficient claims settlement due to inaccurate subjective judgments when making claims, especially for medical insurance claims, which involve many stakeholders and professional knowledge, and the insurance claims process is very lengthy. However, using HealTrace AI, the claim trigger conditions based on unchangeable data sources can quickly solve the problem of subjective judgment of claim standards through medical evidence storage and shared data. Because the blockchain smart contract cannot be modified, the claim process will be executed through the digital currency locked in the smart contract, thereby ensuring that the promised claim will be fulfilled quickly.
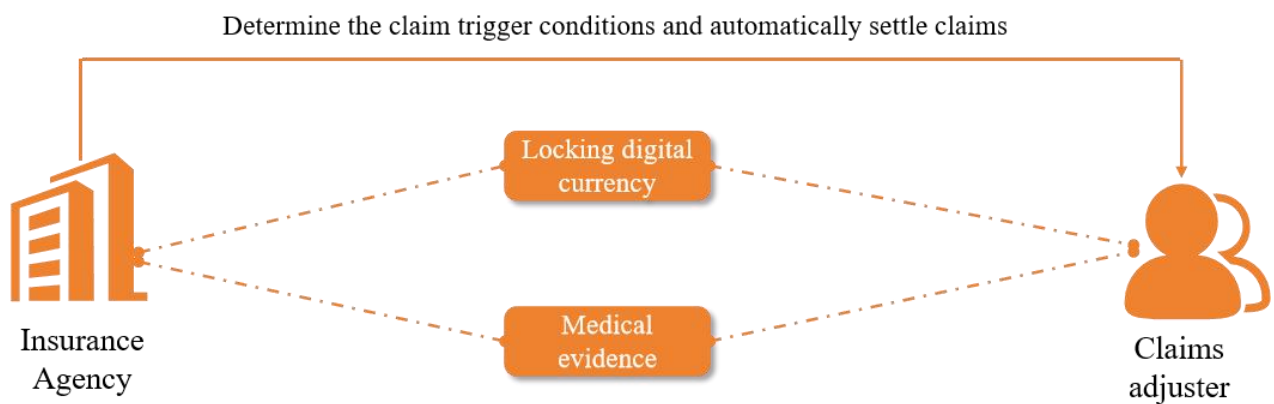

Figure 2-6: Insurance Services

2.2.6 Medical supply chain management

HealTrace AI uses blockchain technology to optimize medical supply chain management, ensuring that the entire process of drugs and medical equipment from production to delivery is transparent and traceable. Through a decentralized network, each link is recorded in detail to ensure the authenticity and traceability of the source, effectively curb counterfeit and shoddy products, and improve supply chain efficiency and security. Blockchain technology can track the flow and status of medical supplies in real time, improve supply chain transparency, and help medical institutions make more accurate decisions. At the same time, the immutability of blockchain effectively prevents data from being maliciously tampered with or forged. Each medical device has a unique digital identity, which enables full traceability and combats counterfeit and shoddy products. In addition, blockchain is combined with the Internet of Things to achieve intelligent inventory management, reduce human intervention and error rates, and improve operational efficiency.
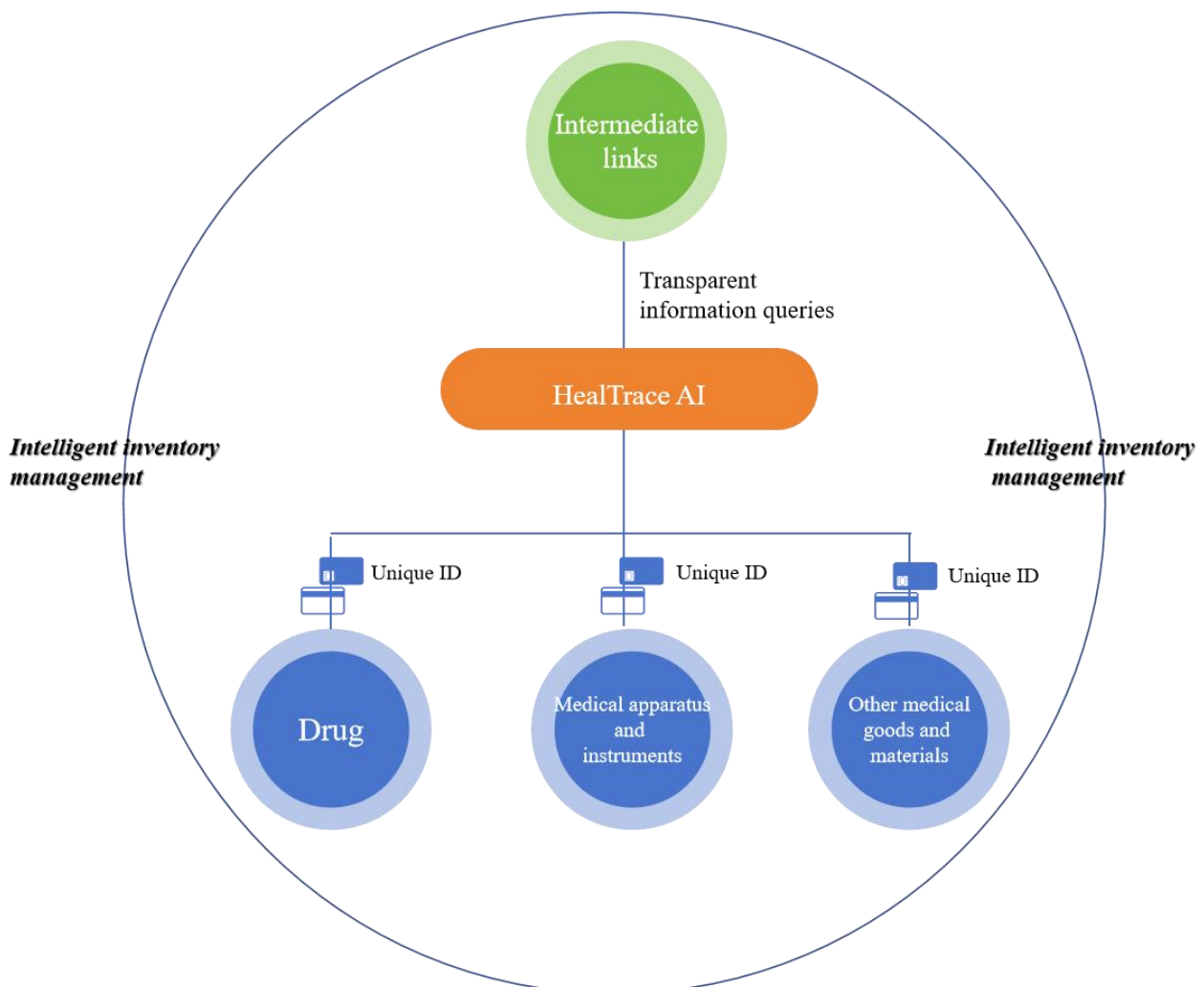
Figure 2-7: Medical supply chain management

2.3 The Value of HealTrace AI

HealTrace AI brings innovation and change to the medical industry through blockchain and artificial intelligence technology. The value of the project is mainly reflected in the following aspects:

1. Improve the accessibility and efficiency of medical services: Through AI diagnostic services, users can get professional medical advice and diagnosis anytime and anywhere without waiting for the doctor's appointment time. This not only improves the accessibility of medical services, but also greatly improves the efficiency of diagnosis.

2. Optimize the allocation of medical resources: Using blockchain technology, medical data can be safely shared and exchanged, promoting the optimal allocation of medical resources. Medical institutions can better understand patient needs, reasonably arrange medical resources, and improve the overall efficiency of medical services.

3. Enhance data security and privacy protection: The decentralization and encryption technology of blockchain ensure the security and privacy of user data. Users can independently control their own data and choose whether to authorize application access, which guarantees the user's right to know and right to choose.

4. Promote innovation in the medical industry: Through artificial intelligence technology, HealTrace AI can provide personalized health management solutions to help users better manage their health. This not only promotes innovation in the medical industry, but also provides users with more convenient and personalized medical services.

5. Promote the release of the value of medical data: User data can be converted into valuable assets. Through the token incentive mechanism, users can be rewarded for contributing data. This not only encourages users to actively participate in data sharing, but also promotes the release of the value of medical data.

6. Build a decentralized medical ecosystem: HealTrace AI uses blockchain technology to build a decentralized medical ecosystem, which promotes collaboration

and sharing among various entities in the medical industry. This not only improves the overall efficiency of medical services, but also lays the foundation for the future development of the medical industry.

In summary, HealTrace AI has brought innovation and change to the medical industry through blockchain and artificial intelligence technology, improved the accessibility and efficiency of medical services, optimized the allocation of medical resources, enhanced data security and privacy protection, promoted innovation in the medical industry, promoted the release of the value of medical data, and built a decentralized medical ecosystem.

2.4 HealTrace AI Business Model

As global medical needs continue to grow, HealTrace AI achieves universal access to medical services and maximizes value through innovative business models. HealTrace AI's main business models are as follows:

1. Free basic functions: Provide basic medical services such as search, diagnosis, treatment, and analysis to lower the user threshold, attract more users to use the platform, and improve user stickiness and platform activity.

2. Paid functions:

(1) Advanced AI model subscription: Users can subscribe to advanced AI models to enjoy more accurate and personalized medical services, meet users' needs for high-quality medical care, and create a source of income for the platform.

(2) Eternal Life Image NFT Customization: Provide Eternal Life Image NFT Customization Service, users can transform their medical data and health information into unique digital assets to maximize the value of data.

(3) Data Cooperation: Cooperate with medical institutions, pharmaceutical companies, etc. to provide partners with valuable medical data and analysis reports to achieve mutual benefit and win-win results.

3. Technical Implementation

3.1 Technical Architecture

The technical architecture of HealTrace AI is divided into the following levels:
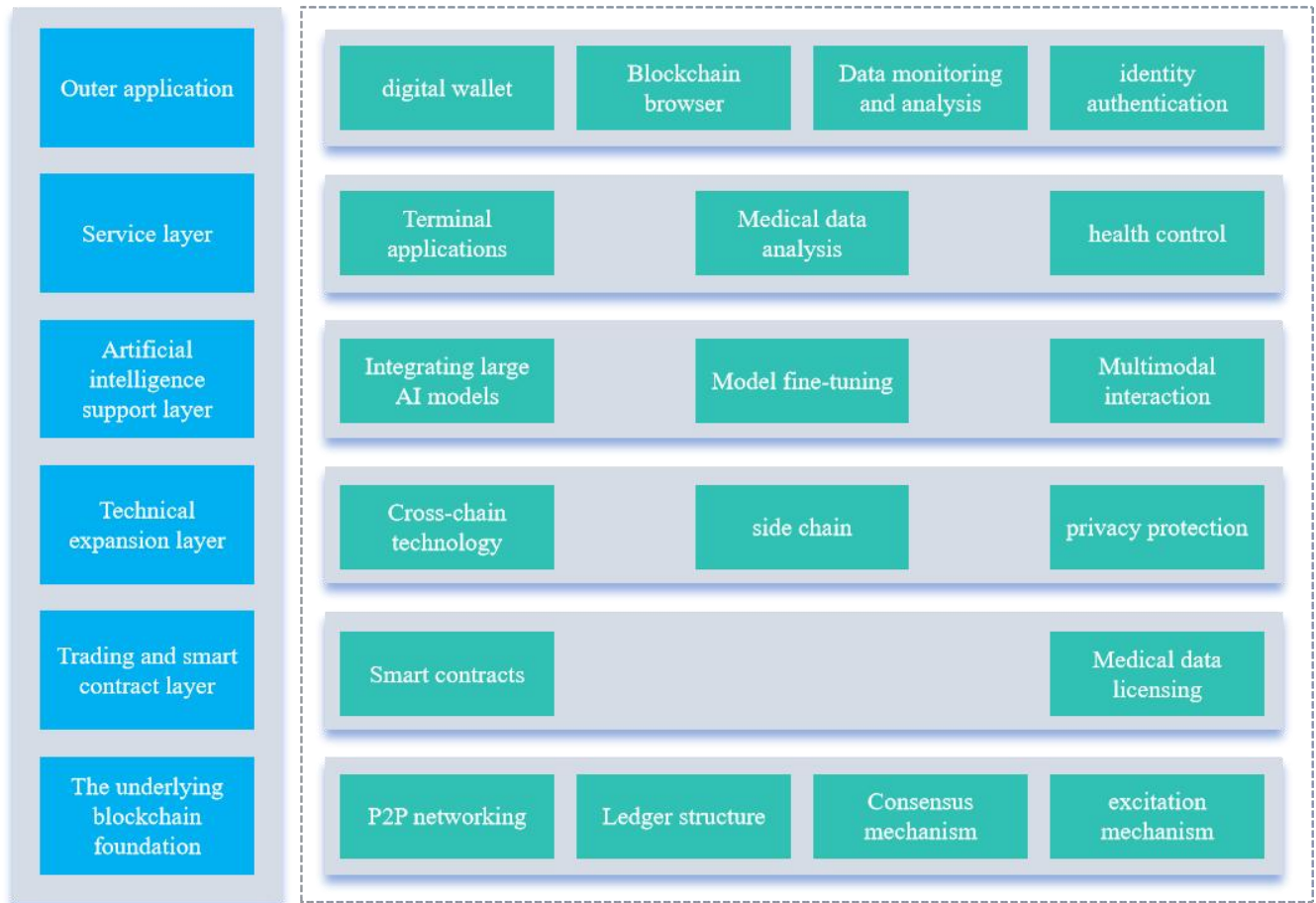
Figure 3-1: HealTrace AI technical architecture

3.1.1 Underlying blockchain foundation

● P2P networking: Build a decentralized network to ensure efficient data transmission between nodes.

● Ledger structure: Define and store ledger data to ensure data integrity and consistency.

● Consensus mechanism: Adopt an efficient consensus algorithm to ensure strong consistency of data while resisting attacks from malicious nodes.

● Incentive mechanism: Through the token incentive mechanism, encourage users to contribute computing power and data to achieve economic game.

3.1.2 Transaction and smart contract layer:

- Smart contract: Support programmable transaction automation execution, manage medical data authorization and transactions.

- Medical data authorization: Users can authorize applications to access their health data through smart contracts to ensure transparency and compliance of data use.

3.1.3 Technology Extension Layer

- Cross-chain technology: realize data sharing and interaction between different blockchains and expand the scope of application.

- Side chain: support side chains for specific medical application scenarios to improve transaction processing efficiency.

- Privacy protection: use advanced encryption technology to protect the privacy and security of user data.

3.1.4 Artificial Intelligence Support Layer

- AI large model integration: access to Grok3 and DeepSeek AI models, providing powerful natural language processing and deep learning support.

- Model fine-tuning: fine-tune Grok3 and DeepSeek models according to medical scenario requirements to improve the accuracy of diagnosis and analysis.

- Multimodal interaction: support multiple interaction methods such as visual system, speech recognition, natural language processing, etc. to improve user experience。

3.1.5 Service Layer

- Terminal application: Provides a user interface to support users in data upload, diagnosis, analysis and suggestions.

- Medical data analysis: Use Grok3 and DeepSeek models to conduct in-depth analysis of user data and provide personalized medical advice and diagnosis.

- Health management: Provide users with personalized health management solutions to help users better manage their health。

3.1.6 External Application

- Digital wallet: manage users' digital assets and support the storage and trading of tokens.

- Blockchain browser: provide query and browsing functions for blockchain data to enhance transparency.

- Data monitoring and analysis: real-time monitoring and analysis of network data to ensure the stable operation of the system.

- Identity authentication: provide user identity authentication services to ensure the security of data access.。

Through the above technical architecture, HealTrace AI can provide a safe, efficient and decentralized medical service platform, combining blockchain and artificial intelligence technology to provide users with 24-hour uninterrupted medical services.

3.2 Key technologies and implementation

The goal of HealTrace AI is to build a decentralized AI medical platform. We will apply the latest technology to build this system, with the key parts including the following:

3.2.1 Multimodal Perception and Interaction

HealTrace AI integrates multimodal perception technology to enable AI Agents to understand and respond to multiple forms of input, significantly improving the user experience and system intelligence. This technology not only includes traditional text and voice input, but also extends to the processing of images, videos, and sensor data, enabling AI Agents to more fully understand complex real-world environments.

In terms of visual perception, HealTrace AI uses state-of-the-art computer vision algorithms such as convolutional neural networks (CNNs) and Transformer architectures for object detection, scene understanding, and behavior recognition. These models are pre-trained on large-scale datasets and fine-tuned through transfer learning to adapt to specific application scenarios. For example, in a smart home environment, AI Agents can automatically adjust the indoor temperature or activate a security alarm based on the activities of family members captured by the camera,

combined with timestamps and other sensor data.

For voice interaction, HealTrace AI leverages the latest automatic speech recognition (ASR) technology and natural language processing (NLP), including an end-to-end speech-to-text (STT) model and a context-aware dialogue management system. By introducing pre-trained language models such as BERT and RoBERTa, HealTrace AI's AI Agents can accurately parse users' spoken expressions and maintain high accuracy even in noisy environments. In addition, the sentiment analysis module is able to identify the user's emotional state, thereby providing more personalized responses and services.

In order to achieve a richer interactive experience, HealTrace AI also supports tactile feedback and gesture control. With the help of deep learning-driven gesture recognition algorithms, AI Agents can extract hand posture information from RGB-D cameras in real time and convert it into operation instructions. This contactless interaction method is particularly suitable for fields such as medical care and education, providing higher hygiene standards and interactive flexibility.
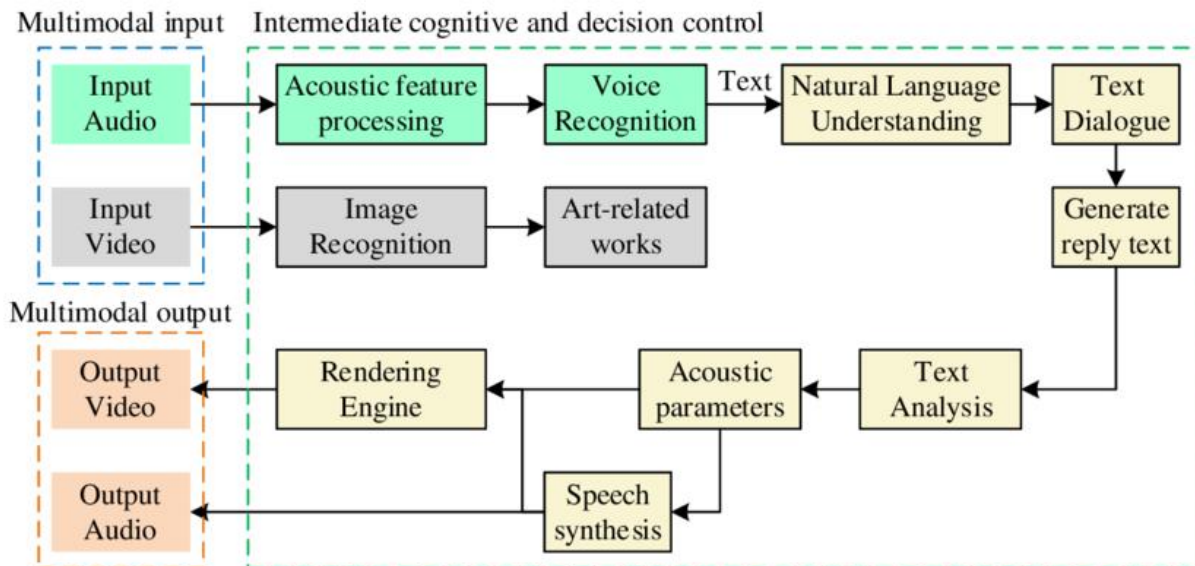

Figure 3-2: Multimodal perception and interaction

HealTrace AI integrates multimodal fusion technology to comprehensively process data streams from different senses. By building a unified feature representation space, AI Agents can simultaneously process multiple types of information such as text, images, and sounds within the same framework to generate

more coherent and consistent output results. For example, in an intelligent customer service scenario, when a user uploads a product picture and describes the problem, the AI   Agent can not only identify the faulty part in the picture, but also understand the user's questions and provide detailed solutions.

3.2.2 Adaptive Learning Framework

HealTrace AI's adaptive learning framework uses reinforcement learning (RL) and deep learning (DL) technologies to enable AI Agents to continuously optimize behavioral strategies in dynamic environments to cope with changing task requirements and user preferences. The core of this framework lies in its flexibility and efficiency, ensuring that the AI system can quickly adapt to new situations and maintain high performance in complex and changing environments.
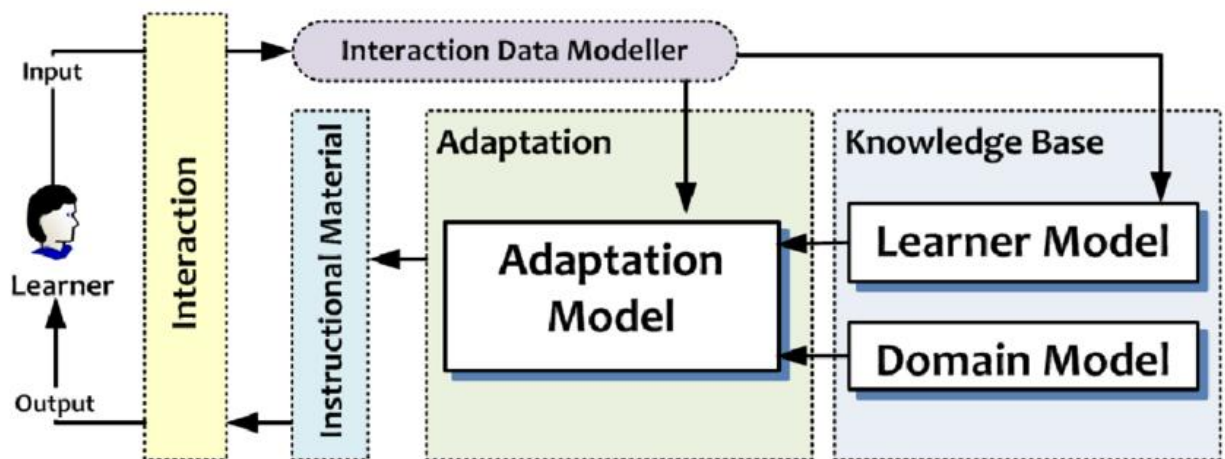

Figure 3-3: Adaptive learning framework

HealTrace AI uses model-based reinforcement learning algorithms such as Proximal Policy Optimization (PPO) and Soft Actor-Critic (SAC), which allow AI Agents to conduct a large number of experiments in a simulated environment and gradually learn the optimal decision path. To accelerate the learning process and reduce sample complexity, HealTrace AI introduces an Experience Replay Buffer to store past interaction data for subsequent training. Hindsight Experience Replay (HER) technology further improves the goal setting mechanism, extracting valuable lessons from failures even when the expected results are not achieved, thereby improving learning efficiency.

The adaptive learning rate adjustment mechanism is an important component of

the HealTrace AI framework. The system dynamically adjusts the parameter update speed based on task difficulty and environmental feedback. For example, when encountering new challenges or performance degradation, the system automatically reduces the learning rate to ensure stability; while in the exploration phase or after discovering an effective strategy, the learning rate is appropriately increased to accelerate convergence. This approach not only improves learning efficiency, but also enhances the robustness and generalization ability of the system, allowing AI Agents to respond flexibly in different environments.

When dealing with large-scale data sets and high-dimensional state spaces, HealTrace AI leverages deep neural networks (DNNs), especially convolutional neural networks (CNNs) and recurrent neural networks (RNNs). These network structures are able to capture complex patterns and time series dependencies, providing AI Agents with more accurate state representations. Transfer learning technology allows pre-trained models to be applied to different but related fields, reducing the time cost of training from scratch while improving the applicability and efficiency of the model.

HealTrace AI supports a combination of online and offline learning, which can not only continuously accumulate new knowledge in real-time interactions, but also batch train by batch processing historical data. This hybrid mode ensures that AI Agents are always up-to-date and can respond to user needs and environmental changes in a timely manner. For example, in the intelligent customer service scenario, AI Agents can quickly adjust their response strategies based on recent conversation records to provide more personalized and efficient customer service.

HealTrace AI's adaptive learning framework integrates a variety of advanced technologies and optimization strategies, giving AI Agents a strong ability to self-evolve. Through continuous learning and optimization, HealTrace AI not only improves the intelligence level of the system, but also provides users with a more flexible, reliable and efficient interaction platform. The application scope of this framework covers multiple fields such as financial transactions and supply chain management, demonstrating its wide technical potential and practical value.

3.2.3 Distributed Agent Collaboration

HealTrace AI has achieved efficient cooperation and knowledge sharing among multiple AI Agents by introducing Distributed Agent Collaboration, significantly improving the overall performance of the system and its ability to cope with complex tasks. This mechanism not only enhances the decision-making ability of a single agent, but also promotes information exchange and collaborative work across agents.

In distributed agent collaboration, HealTrace AI uses Federated Learning technology, which allows each agent to train the model locally, and then aggregate the updated parameters to the central server or synchronize through a P2P network. This approach avoids the privacy issues caused by data centralization while reducing communication overhead. Each agent can independently optimize the model according to its own environment and task requirements, while the global model integrates the experience of all agents to form a more general and powerful system. For example, in supply chain management, agents in different regions can optimize based on local inventory and logistics information, while collaborating to improve the efficiency of the entire supply chain.

Swarm Intelligence is another key technology of HealTrace AI's distributed collaboration. By simulating collective behaviors such as insect swarms and bird flocks in nature, HealTrace AI has designed a set of self-organizing algorithms that enable agents to coordinate actions autonomously without a central controller. These agents make decisions based on local information and implement complex collective behaviors through simple rules and interaction patterns. For example, in intelligent transportation systems, vehicle agents can automatically adjust driving paths by exchanging position and speed information in real time, reducing congestion and improving traffic safety.

To ensure effective communication between distributed agents, HealTrace AI has developed a set of standardized communication protocols and interfaces. These protocols support asynchronous messaging, event-driven architecture, and fault-tolerant mechanisms, ensuring reliable communication of agents under high-latency or unstable network conditions. In addition, HealTrace AI has also

integrated multimodal perception technology, enabling agents to process data from multiple sensors, such as images, sounds, and tactile signals, so as to better understand the surrounding environment and respond accordingly.
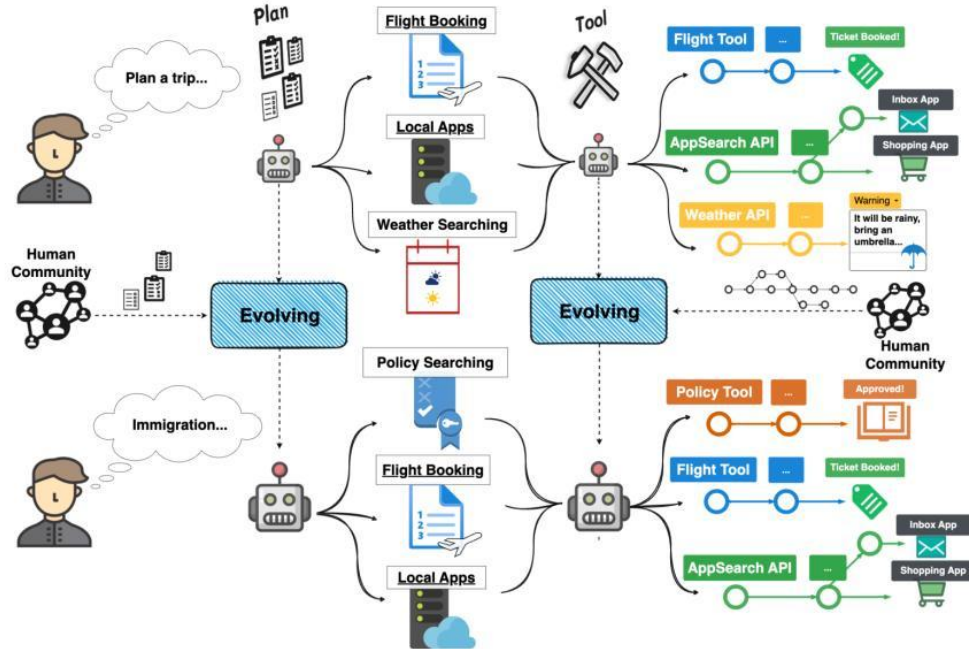

Figure 3-4: Distributed Agent Collaboration

Distributed agent collaboration also emphasizes the flexibility of task allocation and resource management. HealTrace AI uses a dynamic task scheduling algorithm to allocate tasks according to the capabilities and current status of the agent, ensuring load balancing and maximizing resource utilization. For example, in a smart factory, the robot agent can flexibly adjust work tasks according to the needs of different workstations on the production line to improve production efficiency. At the same time, HealTrace AI supports temporary alliances and collaborations between agents. When encountering complex tasks, multiple agents can temporarily form a team and disband after completing the task together, maintaining the flexibility and adaptability of the system.

3.2.4 Homomorphic encryption and multi-party secure computing

HealTrace AI integrates homomorphic encryption and multi-party secure computing (MPC) technologies to ensure data privacy and security while achieving efficient execution of complex computing tasks. These cutting-edge cryptographic

tools enable HealTrace AI to perform calculations without leaking the original data, providing users with a strong privacy protection mechanism.

Homomorphic encryption allows specific types of operations to be performed directly on ciphertext without decryption. This means that on the HealTrace AI platform, data can always remain encrypted, and only authorized operations can access plaintext results. For example, in medical data analysis, medical institutions can use homomorphic encryption algorithms to calculate disease risk scores or market trend forecasts without exposing specific patient data. This not only protects users' sensitive information, but also meets strict privacy regulations. In addition, homomorphic encryption supports basic operations such as addition and multiplication, allowing complex machine learning models such as linear regression and decision trees to run on ciphertext, greatly expanding its application scenarios.
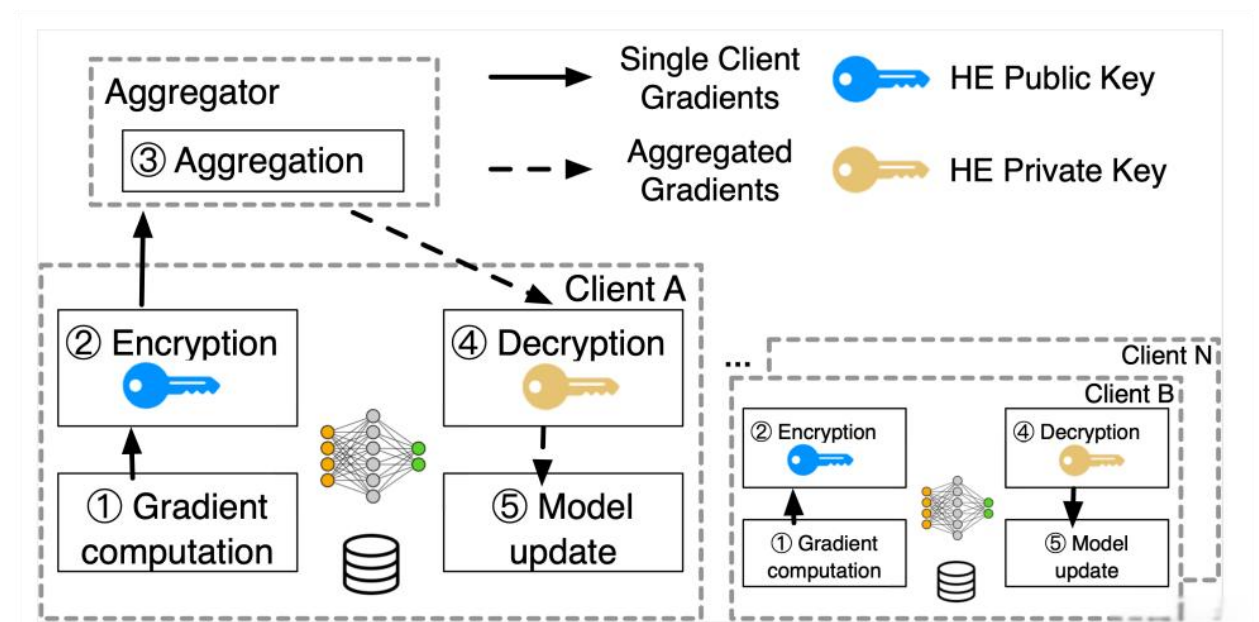

Figure 3-5: Homomorphic encryption

Multi-party secure computation (MPC) allows multiple parties to complete a computing task together, while each party only needs to provide partial input and cannot obtain data from other parties during the entire process. HealTrace AI uses the MPC protocol to build a secure collaborative environment where multiple agents or users can work together to solve problems without sharing private data. For example, different hospitals can jointly train disease diagnosis models through MPC without

having to exchange detailed medical records of patients. This technology is particularly suitable for scenarios that require multi-party collaboration but are highly concerned about data privacy, such as supply chain management, joint marketing analysis, etc.

In order to improve the efficiency of MPC, HealTrace AI adopts optimized communication protocols and computing strategies. Traditional MPC solutions often lead to performance bottlenecks due to a large amount of communication overhead, while HealTrace AI reduces communication rounds and data transmission by introducing technologies such as threshold signatures and secret sharing. In addition, HealTrace AI also implements hardware acceleration, using dedicated encryption chips and GPU clusters to accelerate computationally intensive operations, significantly improving the overall performance of MPC. This improvement enables the system to maintain efficient response speed even under large-scale data sets and complex computing tasks.

In summary, HealTrace AI provides users with a secure and efficient computing platform by combining homomorphic encryption and multi-party secure computing. These technologies not only protect data privacy, but also promote cross-organizational collaboration, and are applicable to multiple fields such as finance, medical care, and supply chain. Through continuous optimization and innovation, HealTrace AI is committed to promoting the development of privacy-preserving computing and laying a solid technical foundation for the future digital society.

3.2.5 Contribution Incentive Economic Model (CREM)

This is the core economic model of this project platform. The providers of various resources act as nodes to maintain the stable operation and value output of the entire ecosystem. In the architecture of the distributed node network, the state changes of each individual node will not affect the operating efficiency of the overall network and the acquisition of resources. Therefore, in terms of architecture, not only the stability of the network is maintained through technology, but also the corresponding reward acquisition behavior and feedback mechanism are defined for various resource

contribution behaviors through the unique transaction model of CREM. Therefore, from the perspective of resource providers, resources can be allocated spontaneously, automatically, and autonomously through the market economic supply and demand relationship model. In this way, when the node status changes, the network can automatically respond and adjust intelligently to keep the resource call and distribution efficiency stable and efficient.

First, the ResourceMining protocol in the CREM layer will define the behavior of the providers of resources required by DCC and RDSN, and regulate the output of the token-HDT through the MAP (MiningApplicationProtocol) protocol.

The economic model framework of CREM adopts the supply and demand theory in economics, and uses the invisible hand to make spontaneous adjustments. As a node of the network, the model of resource providers providing resources in exchange for benefits is not static and unchanging. Because in the real world, due to the non-homogeneity of geographical space, computing power/access requirements, bandwidth requirements, etc., each individual request will have different specific requirements for related resources. Only by responding and allocating resources dynamically according to the actual requirements of each request can we maximize the utilization of resources and maximize efficiency and value. In the decentralized world, the most suitable and feasible is the automatic adjustment of the system caused by supply and demand.

Whether it is DCC or RDSN, both can be defined and adjusted dynamically in real time through CREM. When there is a request where demand is greater than supply, the node that provides resources for the request will receive feedback higher than the MAP baseline, thereby attracting more capable resource nodes to contribute; similarly, when there is a request where supply is greater than demand, the node that provides resources for the request will receive feedback lower than the MAP baseline, thereby guiding the redundant resource nodes to choose to respond to the remaining demands rather than repeatedly wasting resources. As the redundant nodes leave, the income from providing resources for the demand can also return to the MAP baseline, making the resource providing nodes stable.

As a service platform, HealTrace AI carries the heavy responsibility of the orderly operation of the entire ecosystem. Therefore, Behaviour Mining, as an independent module in CREM, defines the basic elements that make up the ecosystem - the behavior and incentives of individual participants. After individuals make behaviors that are beneficial to the development and growth of the entire ecosystem, they can obtain tokens through the MAP protocol as incentives for contributions and stimulate the generation of more beneficial behaviors and contributions. In the entire ecosystem, the constant total amount of HDT will be used as a carrier of value, circulated and increased in value among all participants. When all HDT is mined, it also means that all the value of the platform is distributed to all ecosystem participants through HDT. Therefore, through BehaviourMining, CREM can provide long-term and stable value circulation norms, so that the entire ecosystem can grow long-term and stably as a self-consistent economy.

[CREM fair resource pricing formula]

Storage resources:

According to the storage time and resource occupancy size, only the storage cost is consumed, and the resource cost is calculated according to the backup rate. The unit price of storage cost is dynamic and is jointly determined by the alliance members.

●Storage cost (SC) = resource size (RS) * storage unit price (SUP) * storage time (ST) * number of backups (NB)

Network resources:

Network resources will only be charged by traffic. Data synchronized from the node will pay the network resource fee. Ordinary users have a certain resource. According to the P2P protocol, some resources will be downloaded from the user node, so the network resources consumed by this part of the content will not be calculated. The unit price of network resources is also jointly determined by the alliance members.

Network cost (NC) = traffic (Traffic) * traffic unit price (TUP)

Traffic resources:

Traffic adopts fixed traffic rental system + elastic traffic. Based on the transparency of the service, the traffic should be high. Projects need additional mechanisms to counter fraud. Different computing power strategies can be selected for different projects. Elastic traffic can solve the problem of computing peak.

Traffic cost (CC) = fixed traffic unit price (FCUP) * time (T) + elastic traffic cost (ECC)

Total cost (TC) = storage cost (SC) + network cost (NC) + traffic cost (CC)

4. Governance

The HealTrace AI project is governed by a foundation. The foundation is committed to the construction and governance of HealTrace AI. Its main goal is to ensure the sustainable development of the project, as well as the security of fund raising and the effectiveness of management. The organizational structure of the HealTrace AI Foundation consists of a decision-making committee, a public relations committee, and an executive committee. The governance structure includes operating procedures and rules for daily work and special situations.
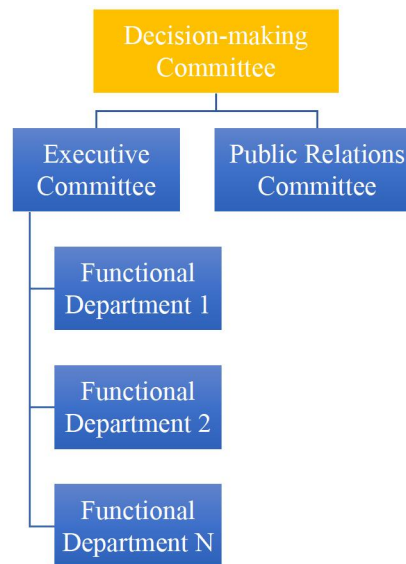

Figure 4-1: Organizational Structure

In order to avoid inconsistencies in direction and decision-making among community members, and even the resulting division of the community, the Foundation has established a good governance structure to explain the general affairs and privileges of managing the community. The design goal of the foundation's governance structure is to maintain the sustainability of the development of the platform ecology, the efficiency of decision-making, and the compliance of fund management. The foundation exercises daily power through the decision-making committee.

[Decision-making Committee]: The decision-making committee of HealTrace AI must maintain high standards of integrity and ethical business behavior standards;

comply with relevant laws and regulations and industry self-discipline principles; provide transparent financial management; HealTrace AI will invite third-party auditing agencies to audit and evaluate the foundation's use of funds, cost expenditures, profit distribution, etc. The functions of the decision-making committee include appointing or dismissing executive directors and heads of various functional committees, making important decisions, and convening emergency meetings. Its responsibilities are equivalent to those of the board of directors, and it has the right to appoint and dismiss personnel.

After the term of the decision-making committee expires, the community will vote to elect 5 core members of the decision-making committee. The elected core members will make important and emergency decisions on behalf of the foundation and must undergo credit investigations during their tenure. In the early stage of the foundation, in order to facilitate the rapid advancement of the project, the first decision-making committee members will be composed of team members and early investor representatives, with a term of 2 years. After the expiration of the term, they will be re-elected by community voting. The decision-making committee consists of 5 members, including 3 team representatives and 2 early investor representatives. All decisions are made under a 3/5 multi-signature system.

[Public Relations Committee]: The goal of the Public Relations Committee is to serve the HealTrace AI Foundation and the global community, and is responsible for the legal, legal affairs, technical intellectual property, open source projects, brand promotion and global strategic alliances of the HealTrace AI global market.

[Executive Committee]: The members of the Executive Committee are elected by the members of the Decision-making Committee and are responsible for the daily operation and management of the foundation, the work coordination of various subordinate institutions, and the implementation of the resolutions of the Decision-making Committee. It is composed of the executive director and executive committee members. The executive director regularly reports to the Decision-making Committee on the work situation. His responsibilities are equivalent to the company's CEO, and the subordinate functional departments are responsible for specific matters.

5. About the Team

6. Disclaimer and Risk Warning

6.1 Disclaimer

This document only provides information related to the project; this document or anything in it shall not be considered a solicitation, offer to buy, sell any securities, futures, options or other financial instruments, or to provide or offer any investment advice or services to any person in any jurisdiction; nothing in this document constitutes investment advice or any opinion on the suitability of any asset. Past performance is not necessarily indicative of future performance. Any forecasts, market prospects or estimates in this document are forward-looking statements based on certain assumptions and should not be regarded as indicating actual events that will occur.

If the intended redeemer makes the redemption after making his own decision, he shall fully accept such risks and be willing to bear all corresponding results or consequences. The development team and the community clearly state that they will not bear any direct or indirect losses caused by participating in the HealTrace AI project, including but not limited to:

● Economic losses caused by user trading operations;

● Any errors, omissions or inaccurate information caused by personal understanding;

● Losses caused by personal trading of various blockchain assets and any resulting actions.

6.2 Risk Warning

The HealTrace AI development and operation team believes that there are countless risks in the development, maintenance and operation of HealTrace AI, many of which are beyond the control of the team. In addition to the other contents described in this white paper, each user of HealTrace AI should read, understand and carefully consider the following risks:

Information disclosure risk: As of the date of publication of this white paper, HealTrace AI is still being improved, and its philosophy, consensus mechanism,

deduction algorithm and code, as well as other technical details and parameters may change and update frequently at any time. Although this white paper contains the latest key information of HealTrace AI, it is not absolutely complete. And it will still be adjusted and updated from time to time by the HealTrace AI development and operation team for specific purposes. The HealTrace AI development and operation team has no ability and obligation to inform participants of every technical detail of HealTrace AI in development, so insufficient information disclosure is inevitable and reasonable.

Risks arising from market competition: Blockchain is an extremely competitive field, with thousands of teams planning and developing different projects. Competition will be brutal, but in this era, any good concept, startup or even mature company will face the risk of such competition. But for us, these competitions are the driving force in the development process.

Legal and policy risks: HealTrace AI may be regulated by the competent authorities of various countries, and because the issuance of cryptocurrencies is extremely innovative, there are legal gaps in most countries around the world, and there is great legal and policy uncertainty in the industry.

Price volatility risk: If traded on the open market, encrypted digital assets usually fluctuate sharply. Price fluctuations often occur in the short term. The price may be denominated in Bitcoin, Ethereum, US dollars or other fiat currencies. Such price fluctuations may be caused by market forces (including speculative trading), changes in regulatory policies, technological innovations, the availability of exchanges and other objective factors, and such fluctuations also reflect changes in the balance of supply and demand. The development and operation team of the HealTrace AI project is not responsible for any secondary market transactions. The risks involved in the trading price of digital assets issued by HealTrace AI must be borne by the trader.