



**AIDOC**

**AIDOC**

Aldoctor on the Blockchain

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# Abstract

The year 2017 is the outbreak of blockchain technology. It has caused a sensation across the globe. Blockchain is defined as the next-generation of Internet technology which will transfer the interconnected information to the value of internet. Meanwhile, by utilizing the power and the value of the network with decentralization consensus. Blockchains technology can help the world build a better, more powerful, transparent economic system, reconstruct the business ecology. And even inspire great innovation in combination with many industries.

In particular, the distributed feature of the blockchain enables participants on the chain to share the economic benefits from the whole ecosystem without forming a monopoly. It can be used to break the isolation in the industry, encouraging it to compete in collaboration and exchange essential data, to form a beneficial technical and commercial cooperation.

Health care industry is an isolated system that exclusively maintains its own information and technology. But meanwhile, the industry needs to work together to safeguard the health and safety of human life. Other than that, many diseases need to improve the cure rate through sharing of data and technologies among the institutions. At present, the isolation in the industry is very common, and medical institutions are working independently and competing with each other. Governments and the United Nations have called upon the inter-enterprise collaboration to serve the health of all human beings, but it produces very little effect so far. The cause is rooted in the traditional business model that is not conducive to medical business collaboration and data sharing.

It is the relatively closed and semi-market-oriented feature of the industry that leads to the slow development in the medical

field. But the healthcare industry also has a very broad market space. The annual expenditure of the global medical and health market has reached tens of trillions U.S. dollars. In developed countries, the medical and healthcare industry in the United States reached nearly four trillion U.S. dollars, accounting for more than 15% of its GDP. Meanwhile, among developing countries, the scale of China's health industry has also reached nearly eight trillion-yuan, accounting for 5% of its GDP, and there is still huge room for growth.

The new business and technology cooperation mode created by the blockchain technology can completely eliminate the information gap of medical resources.

There is no doubt that the solution of "Medical Treatment + Artificial Intelligence + Blockchain" can thoroughly help the current dilemma in healthcare industry. The revolutionary business model and technical infrastructure enable various institutions on the chain to exchange data, develop, collaborate and obtain their own corresponding economic benefits.

The combination of AI with medical services can continuously collect data in a distributed network to form the functions of medical image diagnosis, medical bills OCR, electrocardiogram (ECG) monitoring, virtual health assistant. In addition to that, the network has the capability of self-evolution.

AIDOC is the pioneer in the field of distributed intelligent medical treatment system. It applies the cutting-edge technologies such as blockchain and AI to healthcare field and constructs the intelligent medical value chain - AIDOC chain, which links the participants on the chain, integrate the resources of healthcare industry, improve the value of health data, and maximize the value of each participant on the chain.

**After uploading their own health vital signs data and medical data to the AIDOC chain, users will get token rewards through the way that is similar to "mining", so that personal information are digitalized in the AIDOC chain. When the personal file written to the AIDOC chain, a "bit digital person" will be generated, which is the real mapping of the personal file on the AIDOC chain. AIDOC provides an Alddoctor for everyone. AIDOC combines the distributed framework with the blockchain, it provides real-time monitoring of data and knows your individual detail, vital signs indicators and abnormal statuses, so it can also provide valuable advices. The more accurate and comprehensive the data are, the more effective the health guidance and medical solutions can be.**

AIDOC hands over the retroactive rights, knowing rights and the access and control rights of health information, medical data to the owner. The users can authorize the data to be retrieved or sold directly to the relevant institution or AI engine technology service provider, thereby realizing the free trade of data.

Health information can be written on the blockchain, and users can clone the bit digital person in the digital world. Everyone can have an exclusive Alddoctor.

# **1. Project Overview**

## **1.1. Overview**

From the observation, listening, interrogation, and pulse-taking of traditional Chinese medicine (TCM) to the suitable remedy of the disease by western medicine, and to the precise

medical treatment of the targeted focus, the healthcare industry is undergoing unprecedented, profound changes. From health management, disease prevention, diagnosis to rehabilitation, all aspects are full of needs for change. The cross-application of science and technology are developing in a jaw-dropping speed, such as big data, artificial intelligence, cloud computing, virtual reality, and blockchain. Its deep penetration in the healthcare industry are injecting strong momentum for solving the hard problems in the industry.

Based on the blockchain, AI, and other technologies, AIDOC created the intelligent medical value chain - AIDOC chain, which consists of four modules: security, authentication, intelligent network, and data storage. And the servers for the AIDOC underlying layer. AIDOC also connects other DAPP with AI capability, and continuously expands its boundaries. AIDOC chain links health examination agencies, insurance companies, medical institutions, medical technology service providers. Users, and health workers together, it enables every participant in the chain create, contribute and share value.

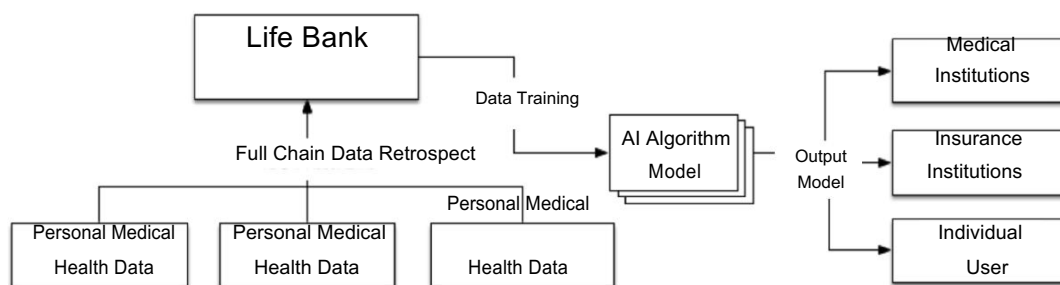
AIDOC puts forward three core concepts: bit digital person, life bank and AIDOC.

The bit digital person is a complete digitalized individual vital sign. Through wearable devices, smart hardware, biological sensors and other equipment, personal vital signs are continuously uploaded to the AIDOC chain, which forms the digital mapping object for the user in the network, making quantitative health management possible. Analyzing real-time health information, AIDOC chain network can timely spot abnormal signs from the collected data and guard against potential risks.



Life bank is a safe storage and public trading platform for health information, medical data on the AIDOC chain. Through homomorphic encryption, differential privacy and other encryption techniques, the user's information will be stored safely in the distributed network on the AIDOC chain, and it is permanently traceable and can never be tampered with. By uploading, sharing data, users can receive tokens, and they can use tokens to purchases healthcare services as well.

As the "brain" of AIDOC chain, AIDOC integrates the intelligent diagnosis modules and the API interface, which provides users the exclusive personal AIdoctor that offers comprehensive healthcare services. Medp.ai is the first technical service provider of AIDOC chain, and the modules currently deployed including medical image diagnosis, medical bills OCR, diabetic retinopathy screening, ECG monitoring, etc.



## 1.2. Market Sore Spots

There are a lot of sore spots in the healthcare industry itself, such as aging, sub-health and medical resources inequality, which have posed to be a great challenge to the human society. Unfortunately, it is difficult to solve these problems due to many factors, such as the unbalanced allocation of resources, the low level of intelligence of the information system, the information barrier between medical institutions, the high cost

of training healthcare workers, etc.

**1) Individuals lack of retroactive right,  
knowing right and access and control right  
over their own medical data**

Medical data are generated from users, but most of the data are stored in medical institutions. Users do not know the medical information, nor can control the information. When a patient sees a doctor, only limited information can be referenced, which often increases the difficulty of clinical decision-making and is not conducive to the patient's disease diagnosis and treatment process.

Moreover, users are not able to enjoy the benefits generated by their own medical data research. In 2005, an American leukemia patient's blood contained a biological mechanism that could cure leukemia. Without prior notification, his treatment medical research institute developed relevant medical techniques by his medical data and benefited billions of dollars. In comparison, the data stored in the blockchain can be traced back by the entire chain. Users have full control right and knowing right about their own data, and can enjoy the benefits brought by the research of the medical data.

**2) The data security problems are the major concerns, and it is getting really serious due to the fast growth of medical data, health information and centralized storage methods.**

In the typical situation, most of the medical data and health

information are stored in a data center, so the data are easily damaged by accidents such as malicious tampering, hacker attacks, natural disasters, etc. With the speeding up of the informatization of medical institutions, the hidden dangers of such centralized storage in data center are increasingly getting higher.

**3) It is difficult for medical data, health information to be effectively shared and utilized due to the isolated data islands.**

Due to historical reasons, there are information barriers between medical institutions, and their data cannot be communicated with each other. Medical data also cannot be effectively integrated and utilized. When users seek cross-hospital treatment, their medical history is difficult to obtain and retrieve.

Centralized storage also can hinder the efficiency of data research. For security reasons, it needs lengthy procedures for recording and filing users' medical data and for research institutes to transfer these data. However, the distributed storage data of the blockchain not only can ensure the security, but also can real-time transfer the data from the entire network.

Google once detected signs of flu outbreaks in some areas through users' search behaviors, and then it informed the relevant medical institutions to prepare flu drugs in advance. At present, in a typical clinic, a flu-receiving patient will take up to three months to report feedback for any signs and symptoms after diagnosis and observation, which might miss the best prevention and treatment period. The domestic SARS and flu outbreak also exposed the low efficiency and flaws of centralized medical data

#### **4) Contradiction exists between the outburst of personal health management demand and the effective management of health information.**

As the saying goes, “the best doctor helps people to prevent diseases”. As people's living standards improve, the demands for better health management also increase. Health management is the premise of disease prevention, and the premise of achieving effective health management is having stable monitoring sources of physiological data. Patients with acute and chronic disease, middle-aged group, seniors, and sub-health people all have high demands for an effective health management system. On the other hand, meanwhile, healthy people also have demands for stable health management.

The problem is that under the current health information management, users' previous medical records can only be accessed when the data are stored at the same hospital. But more diseases are related to the personal's past history and genetic information. The current data management mechanism is unable to establish such an exclusive medical file for a user, let alone using AI to analyze the user's health situation.

### **1.3. Solution**

Based on the blockchain and artificial intelligence, AIDOC establishes the intelligent medical value chain - AIDOC chain, creating bit digital person for users through their health information. Users' health information can be safely stored in the life bank, participants and institutions on the chain can utilize the value of the data in the transactions, and multiple intelligent diagnostic modules of AIDOC will analyze the bit digital person to make intelligent diagnoses.

Taking the medical data end as the pointcut, AIDOC chain conducts product designs based on key problems such as safety, sharing and use of medical data, breaking the barriers between the electronic medical records. The medical APP and the medical devices connecting AIDOC intelligent medical platform, mutual insurance platforms and offline agencies, AIDOC provides services for the data demand side of healthcare ecosystems such as patients, physicians, hospitals, technical service providers, insurance companies, gene sequencing companies and health authorities. In the future, AIDOC will provide the healthcare industry with a full range of medical service solutions based on blockchain and artificial intelligence as the core underlying technology.

## **2. Ecology**

AIDOC puts forward three core concepts: bit digital person, life bank and AIDOC. Taking the blockchain and artificial intelligence as the core underlying technologies, AIDOC establishes the intelligent medical value chain - AIDOC chain on the basis of users' physiological information. The AIDOC chain accesses image diagnoses, electrocardiogram monitoring, diabetic retinopathy screening and other diagnosis modules, providing basic services of medical technology for precision medicine, big data, medical robot, virtual reality, and health management.

### **2.1. Business Logic**

AIDOC constructs an open, equitable and secure platform on the intelligent medical chain, which enables all participants to create and share the value of the AIDOC chain. Everyone contributing data and resources to the AIDOC chain while using the AIDOC platform will receive the earnings he/she deserves.

Data is the cornerstone in the operation of the AIDOC chain. Users can upload real-time data to the cloud end on the chain through biological sensors, smart hardware and medical devices, and the data will be securely encrypted on the chain through the differential privacy technology in order to realize the storage, analysis and circulation.

Tokens are the certificates of rights and ownership in the AIDOC chain network. Users can get tokens by uploading and sharing data, and the tokens can be consumed by purchasing insurance, disease diagnosis services,

health assistant, and the real-time warning service of health conditions. When medical institutions need medical record to conduct research and development or need the resources from the AIDOC chain platform, they can use tokens as their economic means.

The core of AIDOC chain is the AIDOC medical data platform, and the AIDOC accesses image diagnosis, medical bill OCR, ECG monitoring and other modules for users to choose and use.

- 1) Users: real-time sensors will monitor and upload personal signs data, and users can obtain tokens to purchase diagnoses, insurance, and other medical services.
- 2) Insurance companies: relying on users individualized physical signs of data, insurance companies can develop targeted products, and the healthier the users are, the lower the insurance expenses are. Users can get timely treatment and warnings for abnormal signs, and can receive faster claims.
- 3) Pharmaceutical companies and medical equipment manufacturers: they can research, develop and optimize drugs and devices.
- 4) Technology companies: they can develop personalized diagnosis and treatment products. AIdoctor can provide patients health advice and diagnosis opinions.
- 5) Medical institutions: when the user's physical signs are abnormal and timely medical treatment is needed, the medical institution can request the complete medical record history of the user and achieve a comprehensive diagnosis.



## 2.2. Bit Digital Person

The traditional carriers of personal health information are hospitals, HIS systems in medical institutions which have noticeable disadvantages: the data have obvious discontinuity, and the data precipitated in medical institutions are hard to be effectively utilized across hospitals, which results in large amount of medical history and data are not being used properly. Individuals do not have the right to control, use and understand their own valuable medical data. For individuals, their own health information is particularly important in terms of health management: patients with chronic diseases such as diabetes and hepatitis, middle-aged group and seniors, the sub-health group and other groups all need long-term care and stable real-time health data monitoring to maintain healthy life and get timely warnings for any abnormal conditions to safeguard their life and safety.

With the rapid development of digital medical science and technology, users' full life-cycle behaviors and physiological states can be completely quantified. Users continuously generate behavioral data, and



bio-sensors, Internet of Things (IoT) devices, and intelligent hardware will ceaselessly collect the generated physiological signs and data, which is the digital cornerstone of bit digital person. The personal data will be permanently and safely stored on the AIDOC chain and can be fully analyzed. It provides users with feedback, suggestions to help them adjust physiological functions in real time, maintain a healthy state, and reduce the risk of diseases. Data partners are able to use data for clinical studies and research if they acquired users' authorization.

### **2.2. 3. Data Sources**

#### **1) Medical Hardware Sensor**

In health management, the most important thing is to timely find abnormal signs and symptoms in order to predict the potential disease risks. Traditionally, we would achieve this through annual physical examinations, which, however, it is very time consuming and its geographical coverage is insufficient. But wearable device can achieve the real-time monitoring of physiological signs. Important physiological activities can be managed by detecting vital signs data (such as heart rate, pulse rate, respiratory rate, body temperature, heat consumption, blood pressure, blood glucose level and blood oxygen, hormones and BMI, body fat content, and walking distance). The signs and data collected by sensors that can be used at this stage include:

- a. Body temperature sensor: the body temperature can be detected by a body temperature sensor in 24/7 which can help monitoring menstrual cycle and help female users prepare for pregnancy;
- b. Heat flux sensor: used to monitoring the heat consumption ability, and aided calculation of blood glucose and metabolism ability estimation;
- c. Weight measurement sensor: can be used to calculate BMI index;
- d. Pulse wave sensor: can be used to measure blood pressure, pulse rate and other data;

- e. Bioelectricity sensor: it can be used for ECG and EEG data collection, and calculate fat content, etc.;
- f. Optical sensor: can measure the blood oxygen levels and blood flow velocity.

The medical hardware sensors are the entrance of the data collection, and AIDOC provides an open access interface for medical hardware sensors, which allows all medical hardware to access to the chain, and makes it easier to collect medical data. Working with partners, AIDOC will research, develop and produce intelligent hardware sensor devices to create professional product matrix of intelligent medical hardware, providing accurate vital signs data.

## **2) Gene Data**

Gene determines the birth, aging, illness and death of humans and controls the metabolism of human body. As the cost of gene sequencing is greatly reduced, everyone is able to have its own comprehensive genetic information. When the user accepts the gene sequencing, the genetic information will be permanently stored in the AIDOC chain. After multiple gene sequencing and data comparisons, if a gene mutation is found, it will be responded immediately. In addition, after genome analysis, AIDOC can predict the potential risks, suggest precision medical treatment and provides customized health care.

**3) Hospital Electronic Medical Record** This is the original record of a patient's whole diagnosis and treatment process reports in the hospital, which contains basic patient information, medical record, examination and test results, physician's notes, operation records, nurse's notes, etc.

#### **4)Health Applications**

At present, there are many kinds of health management APPs in the market. Currently, AIDOC mainly accesses APPs about female period care, self-examination + inquiry, diet instruction, and fitness management.

##### **2.2.3. Security**

Security is the key for guarantee the data smoothly running in the network, and the distributed storage system based on blockchain enables the AIDOC chain to have a high degree of security. The AIDOC chain conducts safety protection for the data uploaded by users through homomorphic encryption and differential privacy (DP), and stores data by a discrete storage manner. The nodes with maintenance functions in the whole system can be used to build consensus and make joint protection for the medical health data on the chain, and the data cannot be tampered with.

The AIDOC chain binds the medical data with the blockchain protocol to conduct trust authentication as well as safety and management, so that each person can manage their own health information and the right of controlling the data can be returned to users themselves. It can be economically beneficial for the data contributors. And users and institutions can share data, storage, computing power and other resources on the premise of safety, equality and trust. Thus, an open, transparent platform can be built.

The data on the chain can only be accessed by the owner or the authorized individual, and the access authorization is determined by the intelligent contract set by the user. For example, the user can authorize his or her own data access rights to 3A hospitals, and when the user needs it, the doctors can request the data for diagnosis directly from the user without going through a third part. By that way, the data can only be accessed by the owners, authorized group.

### **2.2.3. Extractor**

Data usage needs to meet the certification agreement of the AIDOC chain and must be authorized by the owner. All participants on the chain can become the data extractors, including general users, physicians, medical institutions, insurance agencies, physical examination agencies, etc.

## **2.3. Life Bank**

The data generated by users are extremely valuable resources, and can be used for various purposes such as disease diagnosis, clinical research, and drug research & development. Also, they are the key indicators reflecting the physiological condition. The data generated by the users can be safely stored in the life bank and can also be traded in a free market to obtain tokens or redeem corresponding services.

## **2.4. AIdoctor**

As the core module of intelligent diagnosis on the AIDOC chain, AIdoctor realizes the distributed doctor based on the blockchain network, follows the consensus mechanism and implements the core modules such as intelligent CT assisted diagnosis, intelligent diabetic retinopathy grading screening, and intelligent medical bill OCR. The whole network has a self-learning function, and the AIdoctor in the network can conduct active learning and self-reinforcement, which can be realized by the distributed online incremental learning.

Integrating a large number of intelligent medical DAPP, AIdoctor takes the underlying protocol of the AIDOC chain as its standard, and each DAPP can customize its own system architecture.

### **3. Medp.AI**

AIDOC corporate with its partners and developers, creates an ecosystem of distributed AI medical services. As the AI medical partner of AIDOC in China, Medp.AI jointly develops AIDOC's blockchain network applications and AI applications.

Medp. AI, the AI company consist of world's leading contributors in the field of artificial intelligence medical services, has solid accumulation in medical artificial intelligence and big data technology and possess the technological ability achieve top-level in both domestically and abroad in medical image processing, medical big data analysis and mining. The core members of founding team have work and research experience in high-tech enterprises such as Microsoft, European Interuniversity Microelectronics Center, Alibaba, and Baidu, and graduated from world well-known universities and medical research institutions such as Tsinghua University, Leuven University in Belgium and Peking University People's Hospital. The founder of Medp. AI was the leader of Baidu's business big data team, also the former co-founder of Tai Cloud Corporation / YB Coin, China's first listed blockchain company, the expert of big data and blockchain, the Annual Leading Figure of the Health Industry in 2017, the director of China's Non-public Medical Association, the director of China International Medical Association (CMFF) AI Professional Committee, and the standing director of the National Precision Medicine Industry Innovation Alliance.

Medp. AI has accumulated the experience of processing hundreds of millions of medical records, as result, it is recognized as the leading role in the industry; Also, as the pioneer of the application of artificial intelligence in specific fields, the company now has more than 40 national patents and related key technology property rights, and the core technology foundation of relevant research fields as well. Its core members have published more than 40 papers in PAMI, IJCV,CVPR,

ICCV, IJCAI, ACM MM and other international top magazines, journals and conferences. Many of the papers have won the best paper award, and the highest awards in several international evaluations such as FAT, Middlebury, etc. In terms of medical imaging, medical image information such as DR, CT, MRI, pathological sections, and fundus photographs can be intelligent input to make high-precision and high-recall rate image judgement on various medical image detection projects. At the same time, it also overcomes the technical issues of false positive rates in traditional computer-aided diagnosis, greatly reducing the misdiagnosis rate of patients.

With the national leading medical industry solutions and overall business expansion ability, the company connects the deep cross-border cooperation between AI and medical institutions. The technical team achieve that by using machine learning techniques and advanced statistical analysis. Through the DL-deep learning of data, the model can have an improvement and breakthrough in its ability. It can further obtain effective data in the field of medicine and health, applying the application services for various kinds of scenarios of professional medical institutions. At present, Medp. AI has provided medical artificial intelligence services for hundreds of top medical / insurance institutions at home and abroad, covering several areas including early lung cancer, cardiovascular disease, breast cancer, diabetic retinopathy screening in the ophthalmology department, hemodialysis, etc.

As the top company in many subdivisions in the fields of medical technology services, it has won the two titles Zhongguancun High-technology and National High-technology Enterprise, which makes it a benchmarking enterprise in the field of medical innovations and technology. The company has obtained multidimensional deep reports of authoritative media such as *"China Entrepreneur" magazine*, Sohu. com, and IFeng. com, and continuously won the titles of The Most Noteworthy Innovation Company, The Best Growing Medical

Innovation Company, The Best Artificial Intelligence Start-up Company, and The Best Promising Start-up Company selected by famous medical and technical vertical media. At the same time, Medp. AI has won deep favors of well-known venture capitals, and accumulated millions of investments from the U.S. Redpoint Ventures, a well-known global investment institution, New Version Health and Medical Fund which has a medical background, Ciming Checkup, Union Capital, Aplus Capital and other VC institutions.

### **3.1. Core Products of MEDP. AI**

#### **1) Intelligent Medical Image Diagnosis System**

With the DL-deep learning of 3D signals as a model, the system can detect CT nodules that are easy to miss (such as frequently-occurring small nodes, frequently-occurring, thin ground-glass, tiny nodes, perivascular nodes) and predict the incidence of lung cancer. When doctors read the image, it can significantly improve their reading speed, and reduce their missed diagnosis rate. The sensitivity is more than 90%, and the anastomotic degree of lung segmentation is more than 95%.

#### **2) Intelligent Electrocardiogram (ECG) Diagnosis System**

Relevant models are constructed by training ECG data are collected and labeled by experts. Combining its own advantages in AI technology and advanced algorithms with big data and professional clinical experience, it realizes the integration of collection, storage and analysis, and creates a comprehensive ECG-assisted diagnosis system by using the ECG data and treatment plans collected from a large number of users, which can reduce labor costs and provide new solutions for the early diagnosis and treatment for patients with acute myocardial infarction.

#### **3) Intelligent Analysis and Mining System of Medical Record Text**

**The company** has many mature medical AI core technologies, including

Chinese medical natural language processing. Chinese medical knowledge graphs, machine learning and cognitive computing, encapsulating data governance and AI application components based on medical artificial intelligence technology, and a series of key technologies. Relying on its owned technologies, Medp. AI independently develops the integration platform of clinical research. The platform, taking data governance as its concept, comprehensively releases and mines the core value of data, and constructs a patient-centered learning medical system.

#### **4) Intelligent Robot Platform of Medical Bills OCR**

The company owns the world's leading medical bill OCR and interpretation technology, covering the intelligent OCR of nearly 3,500 items of laboratory indicators and more than 100 kinds of common laboratory sheets, with 99% of its OCR accuracy, so it has been applied to major domestic leading medical institutions and the well-known insurance companies.

#### **5) Intelligent Doctor System in the Ophthalmology Department**

In the multilevel classification of diabetic retinopathy, the consistency of the Eye PACS dataset and diabetic retinopathy grading test results are over 85% under the intelligent diabetic retinopathy screening function of the system. The accuracy rate of the DIARETDB0 dataset is improved, and the accuracy rate of diabetic retinopathy diagnosis is over 90%. The technology is at the leading position in China, and is at the same level as the Google DeepMind team.

### **3.2. Core Patents & Key Technologies of MEDP. AI**

#### **1) 3D GAN Technology (antagonism generation) for Image Data**



In the training of DL-deep learning, due to the lack of data, it is necessary to expand the data to assist the model training. At present, GAN, the existing data expansion technology, only can generate 2D spaces. If it is used to train models, it will result in: (1) only the 2D method can be used to conduct learning, and 3D DL-deep learning method cannot be used. (2) the generated 2D image will present an inauthentic structure and texture in 3-dimensional space. 3D GAN technology, which is suitable for image data, will generate 3D objects. Only the objects generated in 3D spaces can be maximally similar to the real 3D objects (such as lung and brain). In training, it can effectively reduce errors.

## **2) DL-deep Learning of 3D Signals for Image Data**

The conventional training platform of DL-deep learning is suitable for 2D signals, and for 3D signals training, its speed is very low due to the large memory consumption. Now, in combination with the particularity of image data, we adopt sampling technology that is especially suitable for 3D space to obtain a faster convergence rate under the same sample size, or to reduce the sample size under the same rate requirement. Various data demonstrate that the performance of 3D DL-deep learning is superior to that of 2D DL-deep learning.

## **3) Image Format Analysis Technology of Medical Cases and Medical Bills Based on Semi-supervised Learning**

The format of medical cases and medical billing differs in thousands of ways, so we can't simply adopt the traditional template method. Therefore, we proposed the feature extraction method based on semi-supervised learning to analyze the image features and judge the bills' image formats. The image format feature is extracted by the non-supervised learning and the gradient space characteristics combination, and the method adopts the extreme learning machine approach to realize the division and determination of the image content areas.

#### **4) Interpretation Technology of Words Meaning of Laboratory Sheet Based on Recurrent Neural Network**

There often exists ambiguity and polysemy in the medical vocabulary, which increases the difficulty of recognizing and understanding medical terminology. We propose the language model based on the recurrent neural network, and by the construction of the probability model between words, we can realize the understanding and comprehensive analysis of medical terms. The technology also has the feature of fast self-learning, which can iterate in applications to improve the understanding ability of the system.

#### **5) Medical Vocabulary Recognition Technology Based on Convolution Neural Network**

There is distortion and quality degradation in the image of medical bills acquired by taking photos, and the existing character recognition core functions can't effectively meet the recognition accuracy requirement. Through the training of the sample dataset of labeled entry and image blocks, we construct a multi-block identification model based on the convolution neural network model, which shows good robustness to medical vocabulary and image blocks with degraded and noise pollution. By building a richer sample set, we will further improve the robustness of medical vocabulary recognition technology.

## **4. Application Scenarios**

In the whole process of health management and medical treatment, artificial intelligence and blockchain technology have a wide range of application. New technologies, such as image diagnosis, medical bill OCR, health management, mutual insurance, and clinical treatment, have infiltrated into all aspects of the medical and health field.

### **1) Health Management**

Human physiological signs are constantly changing, and continuous monitoring can detect abnormal conditions in time and make timely responds. Through the intelligent wearing devices, the AIDOC chain can do real-time monitoring and analysis of users' health information, and when abnormalities occur, it can provide real-time warnings and give health conditioning evaluation and suggestions.

### **2) Mutual Insurance**

In the decentralized blockchain world, insurance and claim approaches will also undergo profound changes. Under the traditional insurance model, insurance costs are high and the process of claim settlement is also very difficult due to the information asymmetry between the insurance company and the policy holder. In the AIDOC chain network, the intelligent contract sets all claim settlement rules based on the principle of mutual assistance, and when the user needs to settle the claim, the chain can analyze the historical data of the user and realize a quick claim.

The health insurance, based on the intelligent contract of the blockchain, will provide a more optimized insurance model, which will replace insurance companies soon. Users will be able to set up intelligent insurance contracts directly on the blockchain without paying expensive insurance management costs and the management cost is close to zero, so that users' insurance funds are fully used for their benefits. Medical institutions on the chain can seamlessly connect to mutual medical insurance with data connectivity and economic connectivity, so that people can obtain better medical insurance services.

### **3) Clinical Treatment**

AIDOC contains core modules such as image diagnosis, diabetic retinopathy screening, ECG monitoring, etc. The comprehensive analysis

can be made based on the user's historical data, and intelligent analysis can be carried out according to the image uploaded by patients. At the same time, AIDOC can make intelligent diagnoses for diseases and give the best treatment suggestion according to the patient's physical characteristics.

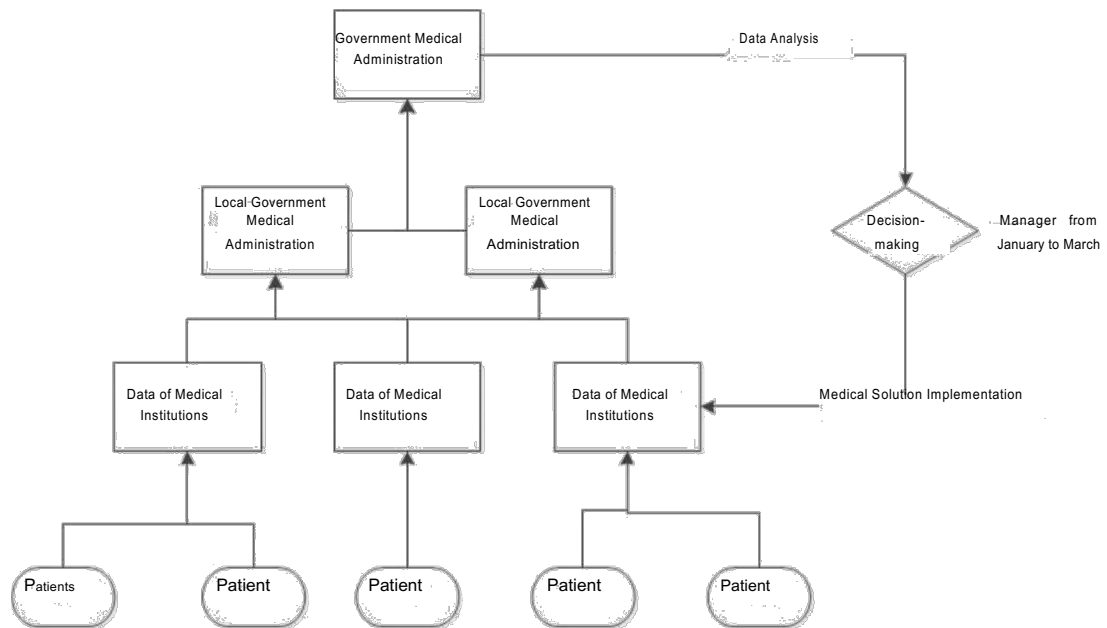
#### **4) Chronic Disease Management**

In particular, patients with chronic diseases need long-term and stable physiological status monitoring, and for patients with hepatitis, heart disease, diabetes and other chronic diseases, they can obtain reasonable health conditioning programs through AIDOC. It can real-time monitor patients' physical health indicators in order to achieve the best rehabilitation effect.

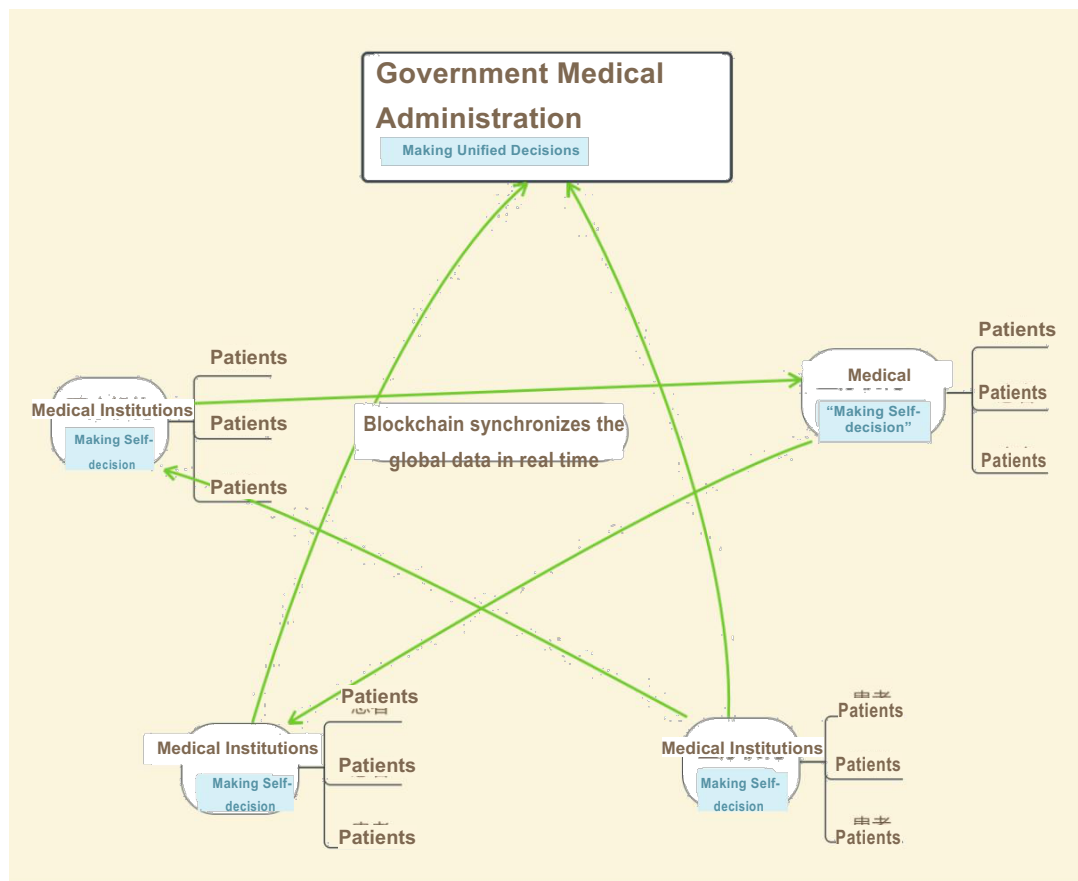
#### **5. Medical Institutions**

The blockchain can connect various institutions, and the institutions will instantly synchronize their own data which can be protected by encryption. For example, institutions can flexibly adjust their medical resources based on global data, and governmental agencies can view data from various medical institutions in real time. Therefore, it is more flexible for the agencies to make decisions and deploy medical resources.

The traditional medical data management mechanism is shown in the following figure:



AIDOC helps medical institutions to reconstruct the management mode through its technical capabilities, which are as shown in the figure below:

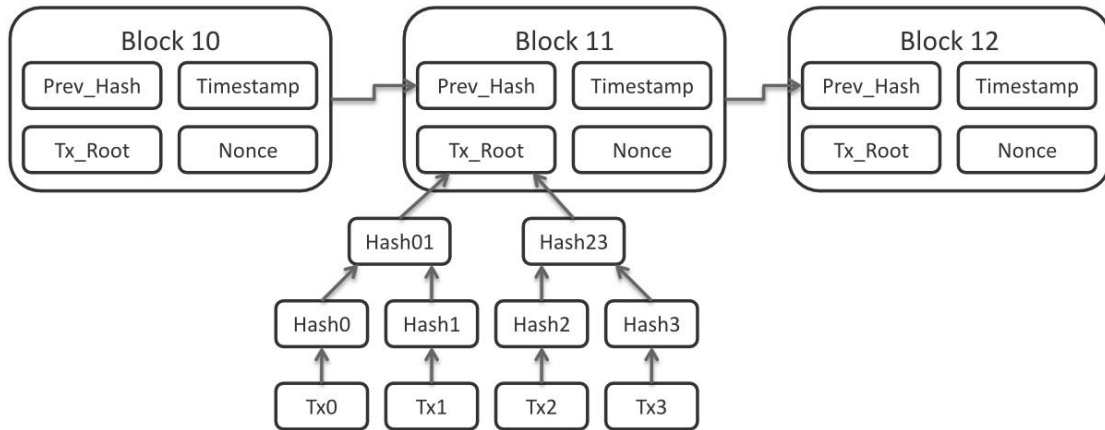


## 5. Technical Characteristics of AIDOC

### 5.1. Blockchain

Blockchain is the new application of computer science such as distributed data storage, peer-to-peer transmission, consensus mechanism and encryption algorithm. The consensus mechanism can be realized by the mathematical algorithm of establishing trust and obtaining benefits between different nodes in the blockchain system. Precisely speaking, the blockchain is a kind of chain data structure which is composed of data chunks sequentially connected in a chronological order, and it is the distributed ledger cryptographically being secured to ensure that it will not be tampered with or forged. Broadly speaking, the blockchain technology is a new type of distributed infrastructure and computing paradigm which verify and store data by using chain data structure,

generate and update data by using the distributed node consensus algorithm, ensure the security of data transmission and access by right owner, and program and operate data by intelligent contracts consisting of automated script code. As shown in the figure:



Structure Diagram of Blockchain

With all the advantages of the blockchain, the AIDOC chain can be divided into the token chain, data storage chain and AI model chain. According to the functions, we independently developed a cross-chain protocol, which can maintain the instant communication between chains, improve the concurrency capability of the whole system, and reduce service response time.

### 5.1.1 Token Chain

The token chain is the carrier of digital tokens which features decentralization and is based on the blockchain as the payment technology. The encrypted digital AID token system realizes the point-to-point direct transaction, thereby avoiding the problems in traditional centralized payments, such as high service fees and complicated processes. All transactions must be authenticated by the network node and permanently recorded in the public distributed ledger of the token chain based on blockchain technology. AID token is the most important tool to realize the value delivery of AIDOC.

### **5.1.2 Data Storage Chain**

Users' personal data are securely encrypted through differential privacy technology to integrate IPFS (interplanetary file storage) system, and we redevelop IPFS to create the engine that is suitable for medical and health data storage, and construct the bit digital person through the data storage chain.

### **5.1.3. AI Model Chain**

The AI model chain will also use IPFS for model storage, and the AI model is the core of the company. On the chain, we will solve the security problem of the AI model storage and operation so that the AI model cannot be stolen by other competitors.

At the same time, different research institutes can set up different AI models through the data on the AIDOC chain, and other medical institutions and users can choose different AI models to assist their medical treatment and achieve the purpose of continuously iterating AI model evolution with blockchain value consensus.

## **5.2. Security**

AIDOC conveys security throughout the system, because security is the cornerstone of the system, such as system security, platform robustness, data security protection, token safety, etc.

Generally, when hackers find software defects, they undertake malicious attacks to achieve their goals. Therefore, we need to strictly control the code quality, avoid defects in the system code, and set up a special code review and assessment department which consists of top companies to ensure that each line of code in the system is safe and reliable.

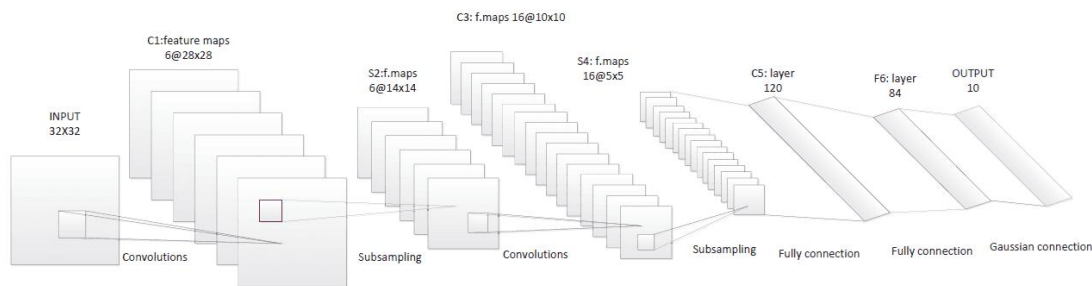
Users' data are protected by differential privacy, which is a typical



strategy of security protection for statistical databases and is widely used in the fields of release and mining of privacy protection data. Its working principle, simply speaking, is similar to "trying to hide by exposing wrong information": makes random changes, does data noise modification to the database, and disguises the individual information without affecting the overall output, which will feed back results with errors. In this way the purpose of protecting privacy is achieved.

### 5.3. AIdoctor

With the advent of the big data era and the continuous improvement in computing ability, AI solutions led by DL-deep learning have made great progress in the medical industry. As an important branch of artificial intelligence, DL-deep learning is receiving more and more concern and recognition from both the scholarship industry and industrial community. DL-deep learning is a method of modeling data by using a deep neural network. The network automatically learns the hidden features of data layer by layer, and then carries out the corresponding tasks of classification, regression and segmentation. As shown in the figure below:



Model Diagram of DL-deep Learning

Behind the DL-deep learning lays a deep neural network, which, through simulating human brain neurons, can learn potential features from the source data, thus activating the neurons corresponding to the hidden layer and finally mapping the output. As shown in the above

figure, convolution neural network, as the classic of DL-deep learning, takes partial human visual feelings as a basis and extracts features layer by layer by visual neuron nodes. Finally, partial features are fused at high level and mapped to the final output. The circulation neural network is good at modeling time series data and can do a better job on modeling patients' cases consisting of the time axis, so as to give a comprehensive judgment on the patient's condition by better using their cases and medical history.

DAPP in AIDOC adopts DNN-deep neural network technology as its core, and the enhancement of the DAPP capability requires training by a large amount of data. AIDOC provides an online training platform, and the data in the platform is open after users' authorization. It supports a series of DL-deep learning frames such as the mainstream Tensor Flow and Caffe, and the AI model trainer can only get the conclusion of the AI model without taking data. AI model training needs to hold a certain amount of AID tokens, then will consume the tokens, and the consumed AID tokens will be rebated to the data provider.

The AI model is the nerve system of the AIDOC network. AIDOC puts the AI model provided by the DAPP provider on the AI model chain, and the model has the ability to operate independently, and lets the model have incremental learning ability. Compared with the traditional batch machine learning algorithm, distributed online incremental learning is the general method that is more in line with reality. In general terms, distributed online incremental learning can continuously learn new knowledge from the newly added data around, and it overcomes the time and computing ability-consuming disadvantages in past data redundancy learning, which is more in line with the human development process. Generated by the combination of DL-deep learning and blockchain, distributed online incremental learning is to share data on the chain by using the data stealthies of the blockchain. With the increase of blockchain nodes, data is also increasing. At the same time, the existing

model can be rapidly updated by using the online incremental learning, which means when the disease prediction is given, the model is also updating and growing. In conclusion, the distributed online incremental learning system can utilize the advantage of fairly recording events on the time line by using the blockchain, and overcome the disadvantages of traditional batch learning, which means it can adapt continuous learning and improving at the same time of giving prediction results for the patient.

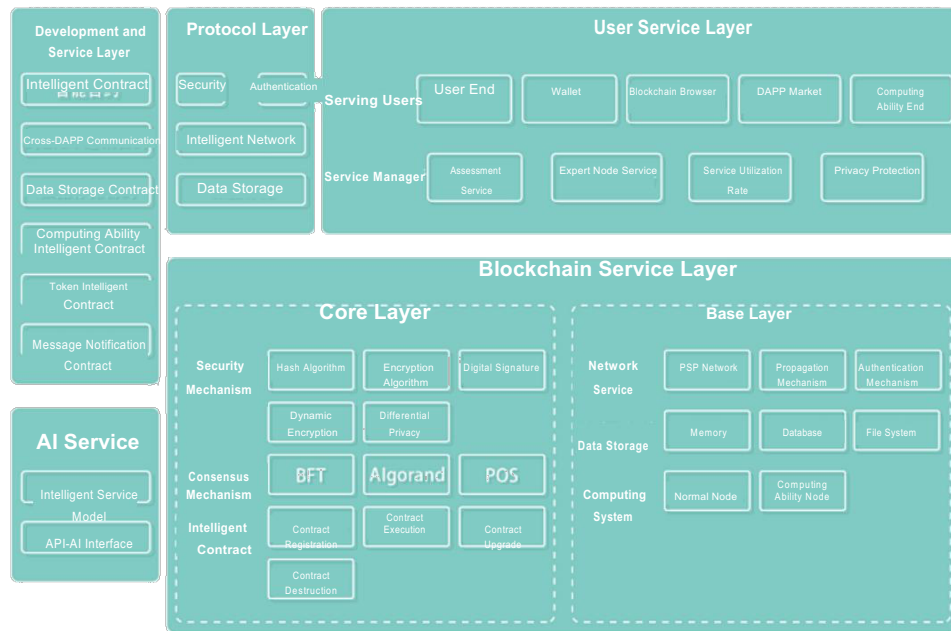
## **6. Overview of System Architecture**

The AIDOC platform mainly focuses on the underlying system architecture with large flow and high concurrency. The operation of AIDOC needs an application system platform that is reliable, safe, scalable and easy to maintain as its support, so as to ensure the smooth operation of the AIDOC platform.

**AIDOC divides the system into the following layers:**

- 1) Development and Service Layer
- 2) Protocol Layer
- 3) AI Service Layer
- 4) User Service Layer
- 5) Blockchain Service Layer

**The hierarchy and module details of the AIDOC system are as following:**



System Architecture Diagram

## 6.1. User Service Layer

### 6.1.1.1 User End

The user end mainly includes the wallet, user service APP, AI model market, and other functions. Users can create their own private key via the wallet so as to conduct token transactions and call and execute intelligent contract, and the whole network can be maintained by the consensus mechanism.

Collecting users' vital signs data, the AI intelligent doctor engine will call upon the DAPP service application aiming for the data, providing users with timely health advice and health warning.

### 6.1.2. Blockchain Browser

Users can inquire block generation, transactions and address details in real time with the blockchain browser. With a specified transaction number, users can inquire the completion status of the transaction.

### **6.1.3. DAPP Market**

- AI model suppliers can publish models, model types, task requirements, and settlement methods of tokens in the AI model market.
- Normal users can conduct call and query.

### **6.1.4. Computing Ability End**

Computing ability providers shall download the specified computing end, which will automatically detect whether the minimum requirements of the computing ability are met. If the requirements are met, it can add to the whole network and get a certain amount of the token revenue.

### **6.1.5. Assessment Service**

Users can give their product experience to the corresponding DAPP service providers to adjust and improvements, and smooth communication is conducive to the iterative update of products.

### **6.1.6. Expert Node Service**

The expert node will conduct special audits and assessments on a certain number of cases randomly selected by the DAPP from the records of recent services every three months, and the cases that fail to meet the standard will be taken off the shelf.

### **6.1.7. Computing Ability Node Monitoring**

Monitor the current running condition of computing ability nodes on the network, and maintain a complete list of computing nodes according to the computing processing capacity and the credit score.

### **6.1.8. Privacy Protection**

Offer protection by using advanced technologies such as homomorphic encryption, differential privacy, and discrete storage.

## **6.2. Development and Service Layer**

Intelligent contract means that the clauses are recorded in computer language rather than legal language. By using the AIDOC network capability, developers can build a decentralized app based on intelligent contracts with the focus only on business layer development. At present, the main built-in contracts of the system include cross-DAPP communication contracts, data storage contract, computing ability intelligent contracts, token intelligent contracts, and message notification contracts.

### **6.2.1. Cross-DAPP Communication Contract**

Each DAPP is independent on the AIDOC platform, and can intercommunicate with each other to handle tasks through the cross-DAPP communication contract. For example, if a patient uploads a laboratory sheet, then the medical bill OCR DAPP will handle the sheet, and through the across-DAPP communication contract, the handling results will be transferred to the medical bill interpretation DAPP for giving health advice.

### **6.2.2. Data Storage Contract**

The data store contract writes the handling results of DAPP onto the data chain for later retrospect and service effectiveness evaluation.

### **6.2.3. Computing Ability Intelligent Contract**

When DAPP needs to calculate GPU computing ability, computing ability intelligent contracts can choose the nodes that meet your algorithm conditions to conduct a more efficient calculation.

### **6.2.4. Token Intelligent contract**

The token intelligent contract is used for token query, token collection, token refund, and transaction status query.

### **6.2.5. Message Notification Contract**

DAPP actively or passively pushes the message to users via the message notification contract.

## **6.3. AI Service Layer**

### **6.3.1. Diagnostic Model**

- AI providers use DL-deep learning technology to model such tasks as categorization, regression, and segmentation for a certain magnitude of data samples.
- As the nerve center of the AIDOC network, the diagnostic model is stored on the blockchain and has the ability to operate independently.

### **6.3.1. AI-API Model**

The AIDOC network provides support for the AI-API access, allowing AI providers to operate the diagnostic model off the chain.

## **6.4. Blockchain Service Layer**

### **6.4.1. Security Mechanism**

Data on the chain will be encrypted with the SHA-256 encryption mechanism, and the transaction data and the trader information between users can be viewed only by the transaction parties and users with the appropriate authorizations.

### **6.4.2. Consensus Mechanism**

We choose a variant of BFT (Byzantine Fault Tolerance Mechanism) as the underlying consensus algorithm, and in the future, we plan to choose Algorand (lottery based on cryptography), which won the Turing Award in 2017, as the underlying consensus algorithm.

### **6.4.3. Intelligent Contract**

- This provides support for the entire intelligent contract life cycle, including deployment, execution, upgrade, and destruction. We plan to support solidity, go, java and other languages to develop intelligent contracts.
- With the user account system, user credit system, data access system, and other built-in systems, the secondary development costs of intelligent contract will greatly reduce, and developers only need to request the intelligent contract.

### **6.4.4. Network Service**

The message communication will use a gossip protocol based on the UDP protocol.

### **6.4.5. Data Storage**

The AIDOC chain supports LevelDB, the non-relational database, for data storage (LevelDB is a persistent open source KV stand-alone database of Google).

### **6.4.6. Computing System**

The normal node and computing ability node support EVM virtual machine (Ethereum Virtual Machine) to guarantee the efficient execution of intelligent contracts.

### **6.4.7. Protocol Layer**

The protocol layer is the core function of AIDOC, including security, authentication, intelligent network and data storage.



## **7. Business Model Architecture -**

### **Maximizing Economic Interests**

As a win-win ecosystem based on blockchain, AIDOC can run through the whole healthcare industry. Under the new business model, it will surely stimulate greater economic potential and promote the progress of technology, cooperation and healthcare service throughout the industry.

Under the new business model, the node on each link of the AIDOC chain will maximize the economic interests, squeeze out the redundant consumption under the traditional medical and commercial cooperation, and set up an economy model with more efficiency, fairness and stability.

#### **7.1. User**

"Life Mining", by uploading his/her own medical data, the user will obtain the interests mark. When other institutions use the medical data to do research and development and get benefits, the blockchain will permanently mark the interests, so that the data owner can have guaranteed interests.

At the same time, the built-in mutual health insurance of the AIDOC chain provides health insurance businesses without any intermediary agents, costs and threshold, so that users can enjoy health insurance with a higher cost performance ratio and even enjoy the benefits brought by the insurance.

Most importantly, users can get an exclusive AI medical manager on the chain to enjoy better medical services.

#### **7.2. Medical Institutions, R&D Institutions, and Enterprises**

Original medical institutions did not have much impetus to work

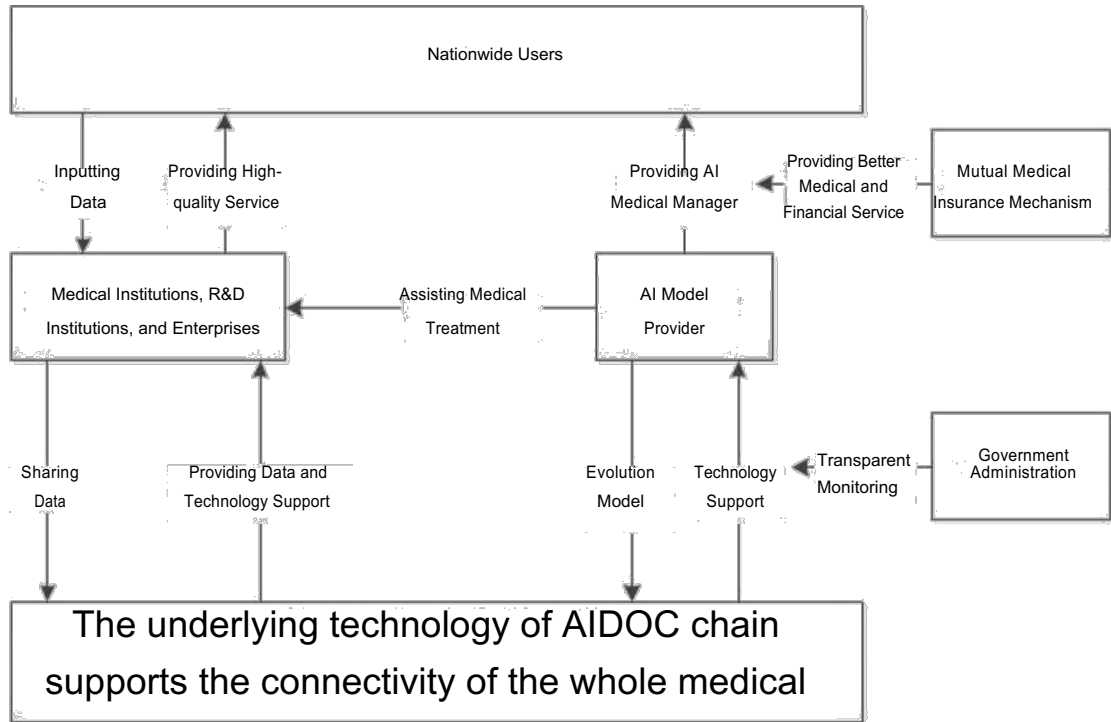
with other agencies. On the AIDOC chain, medical institutions can enjoy the benefits of maintaining the network. Moreover, medical institutions are also able to issue data and research results, and other institutions using these data and results must pay the corresponding costs, which can promote medical institutions to cooperate with other agencies. And in the treatment of patients' data, they will serve more seriously.

### **7.3. AI Model Providers**

The AI model requires constant evolution, and the code of the AIDOC chain also needs to be constantly updated and iterated. The code iteration, based on the blockchain consensus, refers to the numerous development agencies that developed different AI models and codes, and when the copyright and the distribution weight are equal, the nodes on the whole network chain will vote (consumption behavior) by tokens, making AI and codes on AIDOC chain to be evolved and perfected, and AI development agencies can get profits to support their research and development.

### **7.4. Government Medical Administration**

Medical care concerns people's livelihood, so it is impossible to neglect the role of the government. The transparent nature of the AIDOC chain can assist government medical administration to better manage medical institutions, monitor national health, and make quick and flexible medical resource allocation possible.



## 8. Distribution Plan

The total amount of AIDOC's token (here in after referred to as the total amount) is 777.77777 million, and its distribution plan as follows:

### 1) 45% for Issuance and Replacement

Under the guidance of AIDOC Foundation, according to the requirement of project development progress, partially AIDOC, will be distributed to the communities through the replacement in batches, so as to raise sufficient funds to support the development and improvement of the project.

The distribution plan is as follows:

(1) Distributing 10% in the angel round investment: for the early community influential investors and strategic investment partners, the distribution proportion is 10% of the total amount, totaling about 77.77 million tokens.

(2) Distributing 35% in public raising: for early community investors, major players, industry partners and business customers, the distribution proportion is 35% of the total amount, totaling about 272.22 million tokens, which will be released in two rounds:

The first round, private: 22% of the total amount will be released, totaling about 171.11 million tokens, which is mainly for the early investors and the eco-cooperative enterprises introduced in early stage the upper limit in angel round and private investment is 199 people;

The second round, formal raising stage: 13% of the total amount will be released, totaling about 101.11 million tokens, which is mainly for global market investors.

## **2) 20% for Life Mining & User Incentives**

The unique “life mining” mechanism of the AIDOC chain enables users to upload their health information and medical data to the chain and build their own bit digital person to get token rewards through the way that is similar to "mining". On the AIDOC chain, users can upload health information and medical data for mining, holding positions, and making transactions, and 20% of tokens will be reserved as rewards.

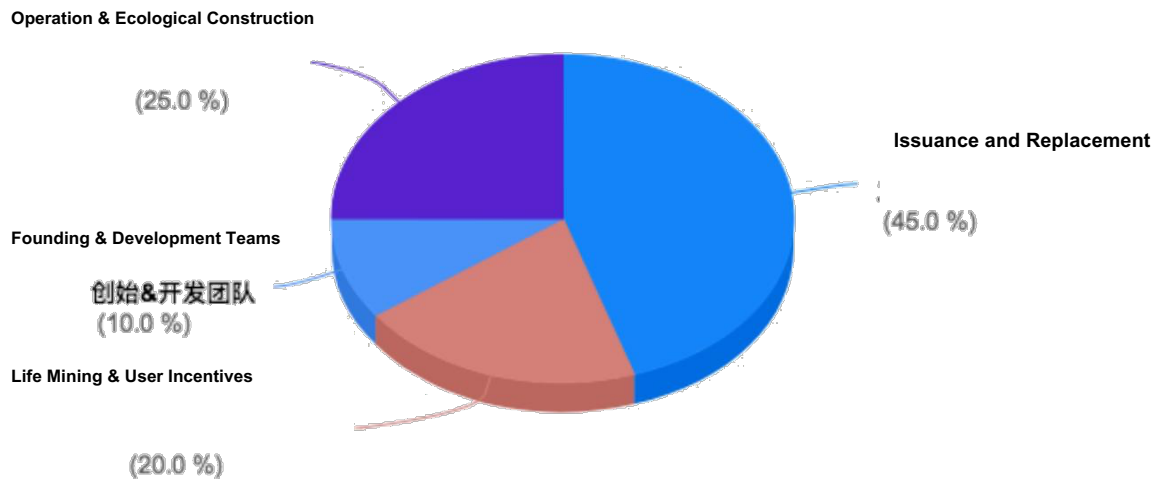
## **3) 10% for Founding & Development Teams**

The founding & development teams of AIDOC have done a great deal of work in project design, resource organization and early stage commercial environment incubation, and have continuously made manpower, intelligence and material investment in shaping the ecological environment. Therefore, 10% of tokens will be reserved as team rewards in the token distribution plan made by the Foundation. From the time of public crowdfunding finishing, we will unfreeze 20% of number of tokens belonged to the team. The left will be unfrozen by 10% every season in one year, totally lock-up time about 3 years.

## **4) 25% for Operation & Ecological Construction**

In order to maintain the rapid establishment, sustained and healthy development of the community and the entire ecological environment, the Foundation will reserve 25% of tokens for eco-incubation, market promotion, business development, legal compliance, early special contributions awards, liquidity plan, etc.

In summary, the distribution plan is as shown in the following figure:



## 9. Use of funds

### 1) 50% for Technology Research and Development

AIDOC establishes a commercial distributed artificial intelligence platform with high-concurrency, high-availability and safety, and the system adopts advanced technology and concept, which is very difficult to realize. In addition, in order to promote the rapid formation of the commercial ecosystem, the rapid iteration of products will take the way of fast running with small steps, and the bit digital person, life bank, and AIdoctor will consume a large amount of research and development power. Therefore, AIDOC will invest a lot of money raised for the development and forming of the basic technology platform.

### 2) 15% for Operation and Maintenance and Security

Both the time commodity exchange and the time asset exchange of the AIDOC platform have high requirements of security, and they have high hardware and security requirements, which need targeted optimization and investment, and need establish a scientific management mechanism.

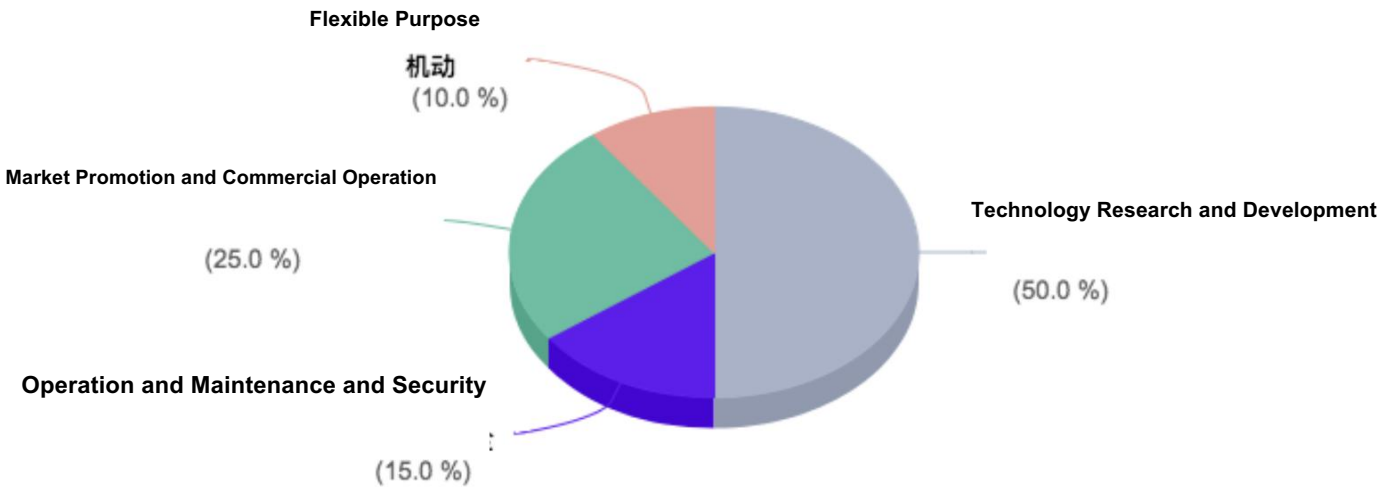
### 3) 25% for Market Promotion and Commercial Operation

In order to construct the scale platform ecosystem in a relatively short time, which can be compatible with more payment scenarios of end users, AIDOC will face a complex business scenario and diverse roles, so it needs a diversified strategic layout. In order to promote the rapid formation of the ecological environment and to provide initial closed-loop service for end users, it is necessary to maintain a large proportion of input in overall publicity and promotion, the promotion of commercial clients and the design of operation service capabilities.

**4) 10% for Flexible Purpose**

A small amount of funds is reserved for handling emergencies and for other financial items beyond the above-mentioned.

In summary, the fund usage plan is as shown in the following figure:



**10. Contact Information**

Telegram: <https://t.me/AidocMe>

Official website: <http://www.aidoc.me>

# 11. Risk Description

Investors shall pay attention to the following risks existing in the project:

## 1) Compliance and Operational Risk

Compliance and operational risk refer to that if the AIDOC platform violates local laws and regulations during the process of raising funds and doing business, which will cause that the operation cannot be continued. For this type of risk, measures taken by the operation team for avoiding risks are as follows:

- The operational team and decision-making committee will take a distributed approach to eliminate single-point risks;
- Employ local professional lawyers where it conducts business, and design digital asset issuance, digital asset transactions, blockchain finance, blockchain applications and other businesses under the legal framework.

## 2) Market Risk

Market risk refers to the fact that if the AIDOC platform is not accepted by the market, or is not used by enough users, and its business development is stagnant without enough profits support. For market risk, measures taken by the operation team for avoiding risks are as follows:

- Share the concept of the AIDOC platform with the industry, learn from the operation experience of similar products, and optimize AIDOC services;
- Rapidly incubate the platform ecosystem and generate profits by using the experience accumulated by the founding team in AI health and the



medical market.

### **3) Technical Risk**

The technical risk refers to that if there emerge major problems in underlying technology, which causes the AIDOC platform to not achieve the expected functions and the key data will be tampered or lost. For technical risk, measures taken by the operation team for avoiding risks are as follows:

- Based on mature, open-source and secure blockchain technology, develop the AIDOC system with a framework that has been approved and validated by commercial clients;
- After raising sufficient resources by a special committee, it can absorb more high-end talents from the industry to join the development team, which can lay a foundation, enrich strength and learn from the mature development experience.

### **4) Fund Risk**

Fund risk refers to that if any major losses happen in the project fund, such as fund theft, fund loss, sharp depreciation of reserves, etc. For fund risk, measures taken by the operation team for avoiding risks are as follows:

- Reserves adopt multi-signature wallet + cold storage mode and are in joint charge of the decision-making committee. Under the 5-7 multi-signature mode, reserves will be at risk only when three directors cannot perform their duties at the same time.
- With rich risk control experience, the operation team can effectively control project risks and protect users' fundamental interests.

## **12. Disclaimer**

This document is for information delivery purpose only and does not constitute relevant opinions on the sale of AIDOC. The above information or analysis does not constitute investment decisions. This document does not constitute any investment proposal, investment intention or investment abetment. This document does not constitute and is not any act of purchase and sale or any invitation of purchasing and selling securities, nor any form of contract or commitment. The intended users shall clearly understand the risks of AIDOC, and when investors are involved in the investment, it means they understand and accept the risks.