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The Monitoring and Managing Application of Cloud Computing Based on Internet of Things

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Abstract

Cloud computing and the Internet of Things are the two hot points in the internet application field. The application of the two new technologies is in hot discussion and research, but quite less on the field of medical monitoring and managing application. Thus, in this paper, we study and analyze the application of cloud computing and the Internet of Things on the medical field. And we manage to make a combination of the two techniques in the medical monitoring and managing field. The model architecture for remote monitoring cloud platform of healthcare information (RMCPHI) was established firstly. Then the RMCPHI architecture was analyzed. Finally an efficient PSOSAA algorithm was proposed for the medical monitoring and managing application of cloud computing. Simulation results showed that our proposed scheme can improve the efficiency about 50%.

Keywords: *Information technology, Cloud computing, Monitoring application, Internet of Things, Network security*

1. Introduction

With the rapid information technology development, the data volume is increasing at a surprising speed as well [1]. Recently, cloud computing and Internet of Things are the hottest topic in the information technology industry [2]. Cloud computing has its advantages in excellent scalability, large scale and low price, while the main technique of Internet of Things, such as sensor and RFID have already been applied in a large scale[3]. Many famous IT enterprises like Microsoft, Amazon, IBM and Google have already built their own cloud successfully and offer cloud service in information management, data storage, information searching, etc [4]. However, people's acquaintance toward cloud computing and Internet of Things are not enough in modern medical application [5].

Internet of Things is the generation of information technology. It is an information field of significant development and the transformation opportunity [6]. European Union Committee believed that, Internet of Things development application will solve series of modern society problem in the future and bring the very big contribution [7]. The modern logistics uses the modernized information technology under modern management instruction logistics behavior. The three basic requests are: the service is better; the expense is lower; the speed is quicker. The medical information technology has the widespread function in the modern applications [8].

Medical information technology and healthcare service are closely related to the national welfare and the people's livelihood [9]. The integration of cloud computing and Internet of Things would be a great breakthrough in modern medical application [10]. Because cloud computing has its advantages in large scale, high reliability, virtualization, high efficiency and expansibility, the construction of public cloud in hospitals and patients can promote resources sharing, cost saving and construct medical monitoring and managing systems with high efficiency[11]. The Internet of Things, as an important support for realizing safe, high-efficiency and high-quality medical monitoring and management, its main techniques such as RFID and photo acoustic electromagnetic sensors, can make great breakthroughs on medical information transmission, intelligent medical monitoring and precise location[12]. The Internet of Things also brings great conveniences to hospital, especially in the patient monitoring and tracking

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management [13]. With the rapid development of Internet and the integration of cloud computing and the Internet of Things, the medical monitoring and managing platform is providing new opportunity for hospital and even all areas in the society[14].

This article summarized the medical information technology in the domain of the cloud computing and Internet of Things, especially in the application domain of the medical monitoring and management at present research condition. In this paper, we propose and analyze the model architecture for remote monitoring and managing cloud platform of healthcare information (RMCPHI). Then an efficient PSOSAA algorithm is proposed for the medical monitoring and managing application of cloud computing.

The rest of this paper is organized as follows. In Section 2, the medical application of cloud computing is introduced. Analysis of RMCPHI architecture is presented in Section 3. The monitoring and scheduling management algorithm in cloud computing is presented in Section 4. And the simulation result of proposed scheme compared with existing methods is presented in Section 5. In Section 6, we give some conclusions.

2. Medical Application of Cloud Computing

2.1 Medical information service

Cloud information services has advantages such as maximal efficiency, low upfront costs and service availability. By combining international advanced Cloud computing architecture and web-based internet service mode, we can build a high speed medical information system between the patient and the hospital. Secondly, we could build a cloud service platform for the information service in hospital which can enable data sharing, remote data storage, interaction with doctors, medical experts' consultation, etc. As cloud computing has already offered users, their demand can be obtained from the cloud service supplier through the network, which reduces their difficulty in building service portals. Cloud computing is a good way to deal with resources using and management. Cloud computing can be roughly divided into private cloud and public cloud. However, neither of these two clouds can suit patients' control. Thus an idea of effective cloud computing in medical control was put forward.

The data center that is in the effective cloud provides service mostly for patient control. The cloud computing provider provides an effective cloud computing solution. In effective cloud, one of its key features is effective operation. It integrates free scattered resources in the cloud and endows users with great operating power. This effective cloud combined network, server and various kinds of new technologies into effective cloud computing platform by virtualizing them seamlessly. To obtain advice and suggestions by analyzing the stored data, analysis engines such as data miners are operated on this large amount of data in the cloud. In cloud computing, the maintenance work for many users can be done simply by amending and adding to the software on the information system in the cloud center instead of a doctor having to do all this work.

The cloud computation center is very important in RMCPHI architecture. There some key technologies in the computation center. The main enabling technology for cloud computing is virtualization. Virtualization software separates a physical computing device into one or more "virtual" devices, each of which can be easily used and managed to perform computing tasks. Virtualization essentially creats a scalable system of multiple independent computing devices. Idle computing resources can be allocated and used more efficiently. Virtualization provides the agility required to speed up IT operations, and reduces cost by increasing infrastructure utilization. Autonomic computing automates the process through which the users can provide resources on-demand. By minimizing user's involvement, automation can speed up the process, reduce labor costs and reduce the possibility of human errors.

2.2 Healthcare application based on Internet of Things

Hypertension is one of the most common cardiovascular diseases. It is reported that there are about 160 million people who suffer from it. The incidence of hypertension and heart disease is trending to ascend [15]. With the accelerated pace of life, people's sub-health state is becoming more and more serious. Treatment and early detection of diseases have effect on the health level of the whole population. Remote monitoring cloud platform of healthcare information (RMCPHI) can provide services of monitoring and management of these diseases. RMCPHI can collect human body medical information by the body medical sensors; extract useful information by data encryption, analysis and processing. When the body appearance is abnormal, users are informed to take treatment. It ensures the early detection. When users are in emergency or hazardous state, it can inform the emergent agencies. So it improves the medical treatment. Furthermore, it is ease to establish national health records in order to provide the decision-making basis for the regional disease by comparing and analyzing the healthcare information. Abilities of disease prevention and disease treatment are improved largely in this way. This platform is able to manage and monitor the medical health information and behavioral state information of patients. The users of RMCPHI include patients with hypertension and other diseases such as stroke, heart disease, kidney disease, chronic lung disease, heart palpitations, chest tightness, disorders of consciousness, etc.

2.3 Remote monitoring cloud platform of healthcare information

Remote monitoring cloud platform of healthcare information includes body sensors, sensor network, communication module, home gateway, medical information analysis and processing platform, medical staff and so on.

Fig. 1 shows an overall architecture of remote monitoring cloud platform of healthcare information which is made up of three main modules, namely sensors and WSN, cloud computing center and users. It also can be considered as a coarse prototype of Internet of Things as it comprises:

- The computation center insider WSN, cloud computing modules, inference engine, etc.
- The resource scheduling center between user and database.
- The communication center among cloud computing, WSN and user modules.

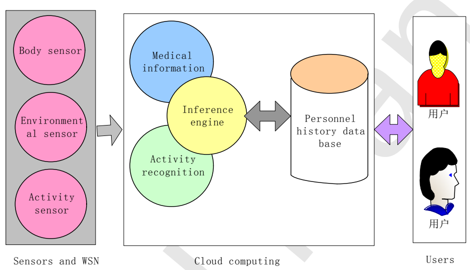

Figure 1. Overall architecture of RMCPHI

Body sensors are able to register and delete medical body area network. Body medical sensor may be divided into implant sensor and wearable sensor. It should be low power consumption, small and minimally invasive to human body. The advantage of the wearable sensor is its convenience to use. But its application is restricted since the sensing mode is confined. The implant sensor can expand its range. However it must be buried into body by operation. So it is difficult to manipulate. Furthermore sensors in RMPHI focus on mankind, so they need to take into consideration the portability and mobility. The common sensors in RMPHI are blood pressure, body temperature, position and so on.

Communication module transmits body medical information to home gateway or mobile phone. This medical information is uploaded to data storage and processing center. Then the health guidance will be fed back to the patients or the hospital after the processing of expert system.

Medical information collected by sensor network is varied. The data of personal health record is huge and increasing rapidly. Thus a large amount of data needs automatic classification, analysis and processing. Information is available to all service providers. For example, safety service center supplies security services; Disease emergency control center detects and controls status of group disease in advance; Emergency service center does first aid according to the emergency information extracted; Hospital supplies remote diagnostics under medical information; Rehabilitation center provides remote rehabilitation guidance according to varieties of recovery information; Health service center provides health guidance to user via extracting its health information. Thus the network resource sharing means should be required. Moreover an effective method to extract information is required.

Medical body sensor network should be capable of reliable transmission function. Nowadays studies indicate that implant sensor tends to use 400MHz and wearable sensor is inclined to use 2.4GHz as its frequency range [16]. Its application should consider the following issues.

3. Analysis of RMCPHI Architecture

A modularized logical architecture of RMCPH divides the functionalities of sensing, communication, computation center into some smaller modules. The sensors are either attached to the walls at home or to a person himself. The sensed data is to be used to monitor human activities for health services. The video-based method is based on images that collected from camera or extracting the background to get the object and then inferring activities such as jumping, running, standing, sitting and so on. The activity-based access control mechanism can be adopted to improve the user's flexibility. The cloud computing services are integrated into the computation center for the economical reason.

3.1 Sensing and Communication Center

Wireless sensor networks are different from the traditional ad hoc networks in that they have a large scale, higher density and tighter interactions with the physical environment. The key issue is to sustain for long lifetime on the limited power supplies. Meanwhile, many communication and computation tasks must be finished within time constraint to avoid undesirable consequences since the IOT applications are of criticality. Thus it is an important and challenging research issue to ensure real time support in the large-scale wireless sensor network. The hierarchical communication can divide the network into different tasks with reconfigurable mapping and pipeline techniques. In this way, the communication center may efficiently improve the monitoring effect of patients.

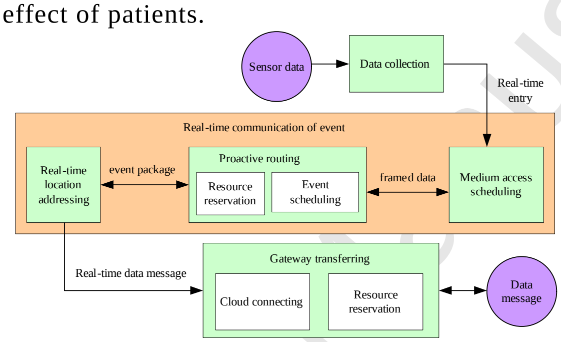

Figure 2. Data flow chart in sensing and communication center

Fig. 2 shows the data flow chart from sensor data to data transferred by gateway and stored in certain database for further processing. Some important research issues include real time location, routing, medium access scheduling, etc. Communication system may be soft real-time or hard real-time. The real time communication module is to build a real time abstraction layer which needs distributed real time computing technology and real time group communication method under dynamic network topologies.

3.2 Cloud Computation Center

The cloud services can provide upper layer users with applications such as social network of doctors for monitoring patient healthcare, environmental data analysis and analysis network etc. cloud computing plays an important role in providing high performance computing and supporting different types of operating system platforms.

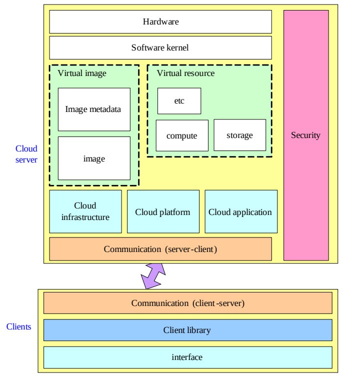

Figure 3. Cloud computing model in computation center

Fig. 3 shows the cloud computing model in computation center as an important module where three sub-modules provide basic services for it. Also it can be seen that the cloud computing model includes two sub-components named clients and cloud server. At the same time, it can support real time delivery services.

3.3 Monitoring and Real-time Scheduling Management

With the advent of the new cloud centric method, data center has been transformed into server virtualized networks that are supported by hardware assisted virtualization. So there is an increasing demand of new algorithm for resource management and real time scheduling in order to meet the ever increasing demand from users. In Fig. 4, a three layered reference model for monitoring and real-time scheduling is proposed.

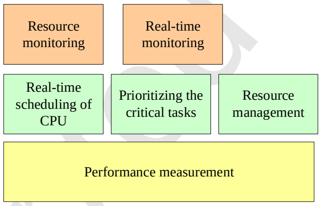

Figure 4. Reference model for monitoring and real time scheduling management

On the top layer, there are mainly two modules: real-time monitoring module and resource monitoring module. On the middle layer, prioritizing techniques is adopted to deal with emergent responses such as accident, medical health care, electricity blackout, etc. On the bottom layer, performance measurement can be done inside server or client cloud based on the real-time data collected by sensors. Some of the functions include creating virtual machines, managing virtual resources, improving computation time, reducing transmission time and meeting the QoS requirement.

4. Monitoring and Managing Algorithm in Cloud Computing

4.1 Particle Swarm Algorithm

In particle swarm optimization, a swarm of particles are used to represent the potential solutions, and each particle i has two vectors, the velocity $Vi = [v_{i1}, v_{i2}, \cdots, v_{in}]$ vector and the position $Xi = [x_{i1}, x_{i2}, \cdots, x_{in}]$ vector. Here n means that the solution is in n-dimension space. In the initialization, the velocity and position of each particle are set randomly within the search space[13-16]. During the evolutionary process, the particle i is evaluated according to its present position. If the present fitness is better than the fitness of p_{in}^{best}, which stores the best solution that the ith particle has been explored so far, then the p_{in}^{best} will be replaced by the current solution that includes the position and fitness. At the same time, the algorithm selects the best p_{in}^{best} of the swarm to be the globally best, which is regarded as G_n^{best} , Then, the velocity and position of each particle will be updated using the following two Equations (1) and (2).

$$x_{in}(t) = x_{in}(t-1) + v_{in}(t) \quad (1)$$

$$v_{in}(t) = qv_{in}(t-1) + k_1 r_1 (p_{in}^{best} - x_{in}(t-1)) + k_2 r_2 (G_n^{best} - x_{in}(t-1)) \quad (2)$$

Where k_1 and k_2 are acceleration constants. And r_1 and r_2 are random values in the range [0, 1], $x_{in}(t)$ and $v_{in}(t)$ represent respectively the position and velocity of the ith particle with n dimensions at iteration t. p_{in}^{best} and G_n^{best} are the best values of positions which are achieved respectively for the ith particle and all particles so far.

The parameter q in Eq.(2) is weight that increases the overall performance. A small value of weight tends to promote local exploration while a large one encourages global exploration. Suitable selection of weight q usually provides a balance between the local and global exploration and reduces the average number of iteration to locate the optimum solution. To achieve good performance, we linearly increase the value of weight q from about 0.5 to 0.9 during a run.

k_1 and k_2 represent respectively the cognitive component and the social component which lead each particle toward G_n^{best} and p_{in}^{best} position. High values result in abrupt movement toward the target region while Low values make roam far from the target regions before being tugged back. Thus the acceleration constant k_1 and k_2 are usually set to 2 according to the past experience [17].

4.2 Improved Optimization Algorithm

From the point of evolutionary process, particle swarm optimization algorithm (PSO) has fast convergence speed in initial phase, but through several iterations, particles tend to the same and the convergence speed becomes slow. Simulated annealing (SA) algorithm has fast random global searching ability and it is easy to be realized. However the defects of the simulated annealing algorithm are obvious. For example it has large calculation and low efficient. Moreover, it is easy to sink into local optima with serial search. When it comes to the large scale optimization problem, they are easy to sink into the local optima and the convergence rate is low. This paper is considered to combine SA with PSO to get the hybrid optimization algorithm. Thus the simulated annealing algorithm is added into every iteration of the particle swarm optimization algorithm in order to improve the convergence rate and guarantee solving the accuracy. At the same time the relative variation strategy is adopted, which avoids sinking into the local optima, increases or keeps population diversity.

Information is one direction flow in the global particle swarm optimization system. gB^k transfers information to other particles, other particles search near gB^k ,the whole particle swarm evolve to the optima with gB^k . gB^k has strong effect on the optimal performance of PSO. One of the main reasons for the prematurity of other algorithms is the poor searching ability for gB^k . To improve the optimal performance, gB^k can be sampled by the simulated annealing algorithm after every iteration of particle swarm, whose result can be taken as new gB^k of the particle swarm optimization system.

Application of the simulated annealing algorithm, which can increase the searching ability of PSO for gB^k . And it increases the probability of jumping out of the local optima. The hybrid algorithm of the simulated annealing algorithm and the particle swarm optimization algorithm is called the particle swarm optimization combined with simulated annealing algorithm (PSOSAA).

Suppose c is the weight decrease coefficient, b is the annealing coefficient, U_{min} is the minimum sampled length, U_{max} is the maximum sampled length, and q is the inertia weight. Fig.5 is the flow of PSOSAA algorithm.

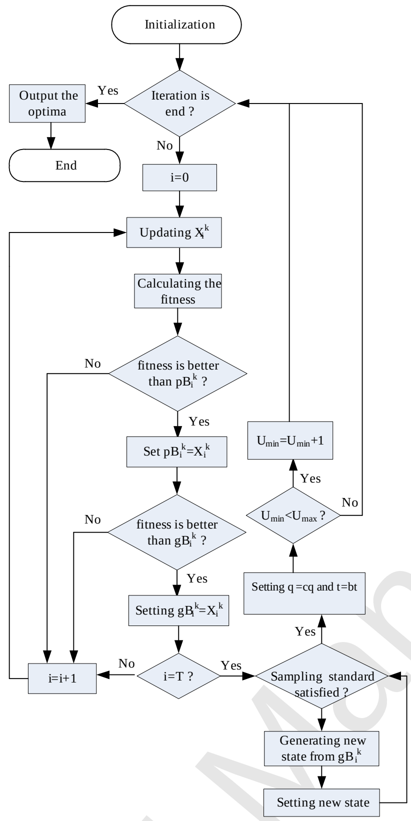

Figure 5. The flow of PSOASA algorithm

The application of PSOSAA is very extensive, which includes data mining, fuzzy modeling, clustering analysis, network routing optimization, vehicle scheduling optimization, etc.

4.3 The healthcare application scenario

The healthcare application scenario is showed as follows. It is accessible from anywhere using any device, such as a smart phone, a desktop or a PDA. Fig.6 is the healthcare application scenario.

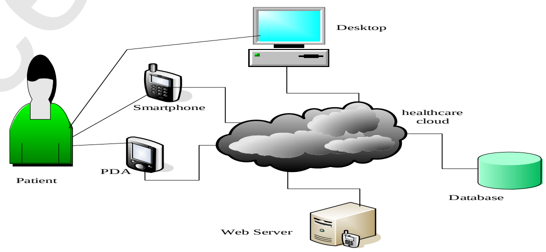

Figure 6. The healthcare application scenario

5. Simulation results

In order to verify the effectiveness of the proposed method above, we took some experiments and simulation. This section mainly includes simulation environment, comparison of the average execution time, and the comparison of the number of completed service applications.

5.1. Simulation environment

The simulation environment was conducted on the CloudSim computing environment [18]. Six physical machines which were equipped with 2 TB hard disks and 8GB RAM was used, and a simulation software installed in the Windows XP platform with Intel Core 2 Quad 3.2 GHz and 4 GB RAM. CloudSim, was adopted as the simulator of cloud infrastructures. In the same condition, the simulated annealing algorithm (SA), the ant colony optimization algorithm (ACO) and the particle swarm optimization combined with the simulated annealing algorithm (PSOSAA) were taken to solve the medical monitoring and scheduling management problem. Their performances and results were compared. Experimental parameter setting was shown in the following Table1.

Table 1. Experimental parameters setting

Algorithm	Parameter	Value
ACO	Ant number Updating constant Evaporation parameter Heuristic information weight Hormone tracking weight	6 9 0.3 6 1
SA	Operation times before adjusting Initial temperature Temperature decrease factor Controlling step vector	25 55 0.88 2
PSOSAA	Population size Inertia factor Self consciousness study factor Self consciousness study factor	25 0.87 1.5 1.5

5.2. Average execution time

The execution time of each task is shown in Fig.7. As a whole, the ant colony optimization algorithm and the simulated annealing algorithm spend more time as the number of tasks increases. The ant colony optimization algorithm executes task slowly at first, but at the later period its time increasing is less than that of the simulated annealing algorithm because of the improved positive feedback.

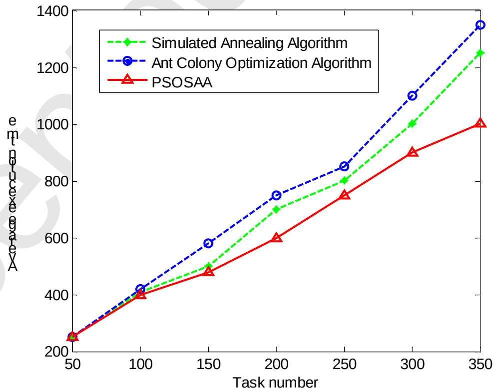

Figure 7. Average execution time

The experimental results indicate that, the execution time of PSOSAA algorithm is better than that of other two algorithms. The main reason is that PSOSAA algorithm combines the fast searching ability of the simulated annealing technology, which can not only increase the convergence speed, but also avoid sinking into the local optima. Thus PSOSAA algorithm shortens the average operation time of tasks.

5.3. Comparison of the number of completed service applications

Fig.8 shows the accumulated counts of completed service applications in the form of a comparison among the above three algorithms.

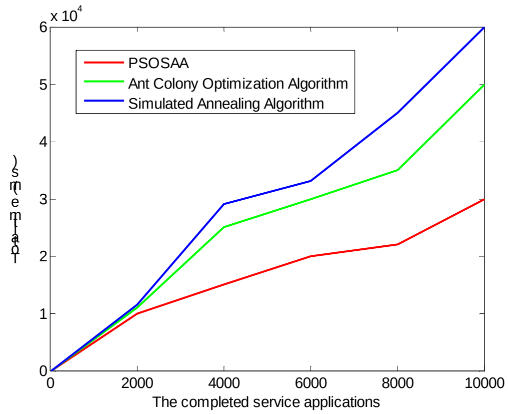

Figure 8. The comparison of the completed service applications

From figure 8, we can observe that the proposed algorithm has better performance than other algorithms. It is indicated that the efficiency of PSOSAA algorithm is about 50% higher than that of other algorithms. The main reason is that the proposed PSOSAA algorithm adopted the SVR technique, which can supply proper resources to user efficiently in the cloud environment, and increase the utilization ratio of resources.

5.4. Comparison of the energy cost

Fig.9 shows the comparison of the energy cost among the above three algorithms.

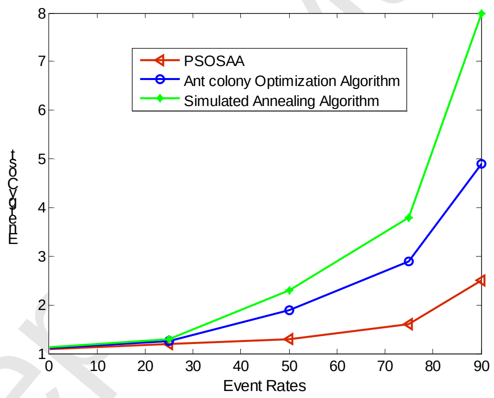

Figure 9. The comparison of the energy cost

From figure 9, we can observe that PSOSAA algorithm has better performance than other algorithms. It is indicated that the energy cost of the three algorithms are not big and their differences are not big. The main reason is that the energy cost is mainly determined by the density of the nodes. However, with the increasing of the event rates, the energy cost of the three algorithms are bigger and bigger. The energy cost of PSOSAA algorithm is the smallest and is lower than the other two algorithms. The reason is that the load of the whole network is balanced in PSOSAA algorithm. It is also indicated that the network lifetime of PSOSAA algorithm is longer than the other two algorithms.

6. Conclusion

This paper focused on the study on the application of cloud computing based on the Internet of Things in medical monitoring and management. In this paper, the model architecture for remote monitoring cloud platform of healthcare information (RMCPHI) was established firstly. Then the RMCPHI architecture was analyzed. Finally an efficient PSOSAA algorithm was proposed for the medical monitoring and managing application of cloud computing. Simulation results showed that our proposed scheme can improve the efficiency about 50%. However the PSOSAA algorithm also meets some challenges. Such as, strict mathematical proof of the convergence. The future research directions may be the followings: (1) the extended application domain of it. (2) the cross research with other disciplines.

7. References

[1] Howarth LC, Cronin C, and Slawek AT, “From personal information system to collective information system: Realities and mirages of information sharing at the firm”, 30th Annual Conference of the Canadian-Association-for-Information-Science, TORONTO, CANADA, 2002.

[2] Zseby T, Savola R, and Pistore M, “On Using Home Networks and Cloud Computing for a Future Internet of Things”, 2nd Future Internet Symposium (FIS 2009), Berlin, GERMANY, 2009.

[3] Wang Jian, Zhao Yan, and LeJiajin, “A New Privacy Preserving Approach used in Cloud Computing”, International Conference on Advanced Measurement and Test (AMT 2010), Sanya, CHINA, 2010.

[4] Mejia J. D. , Salgado N. , and Orrego C. E., “Effect of blends of Diesel and Palm-Castor biodiesels on viscosity, cloud point and flash point”, INDUSTRIAL CROPS AND PRODUCTS, vol.43, no.1, pp.791-797, 2013.

[5] Castellani Angelo P. , Dissegna Moreno, and Bui Nicola, “WebIoT: A Web Application Framework for the Internet of Things”, IEEE Wireless Communications and Networking Conference (WCNC), Paris, FRANCE, 2012.

[6] Das Sanjukta, “Timing movie release on the internet in the context of piracy”, JOURNAL OF ORGANIZATIONAL COMPUTING AND ELECTRONIC COMMERCE, vol. 18, no.4, pp 307-332, 2008.

[7] Liekenbrock Dirk, “Scientific Workshop 4: The Internet of Things State-of-the-Art and Perspectives for Future Research”, 2nd European Conference on Ambient Intelligence, Nuremberg, GERMANY, 2009.

[8] Bulgiba A M, “Information technology in health care--what the future holds”, Asia-Pacific journal of public health / Asia-Pacific Academic Consortium for Public Health, vol.16, no.1, pp.64-71, 2004.

[9] Pederson Lorraine and Leonard Kevin, “Measuring information technology investment among Canadian academic health sciences centres”, Healthcare quarterly, vol.8, no.1, pp.94-101, 2005.

[10] Randles Martin, Lamb David, and Odat E., “Distributed redundancy and robustness in complex systems”, JOURNAL OF COMPUTER AND SYSTEM SCIENCES, vol. 77, no. 2, pp. 293-304, 2011.

[11] Gu Jie, Li Chi-wai, and Yang Hong, “Numerical study on instantaneous discharge of unsorted particle cloud in cross flow”, CHINA OCEAN ENGINEERING, vol.21, no.2, pp.305-316, 2007.

[12] Kostas Psannis, Marios Hadjinicolaou, and Anargyros Krikelis, “MPEG-2 Streaming Of Full Interactive Content”, IEEE Transactions on Circuits and Systems for Video Technology, vol.16, no. 2, pp.280-285, 2006.

[13] Wang Bo, Dong Yunlong, and Wang CanLin, “A new particle swarm optimizer algorithm and application”, 1st International Symposium on Systems and Control in Aerospace and Astronautics, Harbin, CHINA, 2006.

[14] Chang Kai-Di, Chen Chi-Yuan, and Chen Jiann-Liang, “Internet of Things and Cloud Computing for Future Internet”, 2nd International Conference on the Emerging Areas of Security-Enriched Urban Computing and Smart Grids, Hualien, TAIWAN, 2011.

[15] Baraona Fernando, Gurvitz Michelle, and LandzbergMichael J, “Hospitalizations and mortality in the United States for adults with down syndrome and congenital heart disease”, The American journal of cardiology, vol.111, no. 7, pp.1046-1051, 2013.

[16] Chen Shih-Lun, Lee Ho-Yin, and Chen Chiung-An, “A wireless body sensor network system for healthcare monitoring application”, IEEE Biomedical Circuits and Systems Conference, Montreal, CANADA, 2007.

[17] Kostas Psannis and Yutaka Ishibashi, “Efficient Error Resilient Algorithm for H.264/AVC: Mobility Management in Wireless Video Streaming”, Springer Telecommunication Systems Journal, vol.41, no. 2, pp.65-76, 2009.

[18] Belalem Ghalem and Limam Said, “Towards Improving the Functioning of CloudSim Simulator”, International Conference on Digital Information Processing and Communications (ICDIPC 2011), Ostrava, CZECH REPUBLIC, 2011.

Highlights

- an efficient PSOSAA algorithm for the medical monitoring and managing application of the hospital information system is proposed.
- introduce the information cloud system based on IoT for hospitals.
- the cloud computing and IoT technologies are used in medical area.
- presents a model architecture for remote monitoring cloud platform of healthcare information.