웹기반 원격진료시스템에서의 가족간 진료자료공유 알고리즘

Sharing Treatment Information Between Family Members on the Web-based Telemedicine System

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요약

본 논문은 웹기반 원격진료시스템에서 대중적이면서, 저 비용이며, 다양한 의료서비스와 의료의 질을 높이고 개인병력사항의 관리와 협업진료, 가족간의 진료자료공유 등으로 인한 오진의 최소화와 빠른 치료 및 성공적인 e-비즈니스를 지향하고 있으며, 또한 회원관리기법에 대한 전반적인 솔루션이 제공되어 기존의 원격진료시스템과는 차별화 되어 효율적인 온라인과 오프라인을 연계한 시공간을 초월한 사이버진료를 행하게 하는 것이다.

특히, 본 논문에서는 가족 구성간의 진료자료를 공유하는 병력기록관리기법을 제안함으로써 가족간의 체질과 환경을 이해하고 가족 중 비슷한 병을 앓았을 경우는 빠른 치료효과를 가져오게한다.

■ 중심어 : | 원격진료 | 정보공유 | 가족회원 | 데이타베이스 |

Abstract

The paper's suggestion is Web based Tele-Medicine System will be open to public, low-budget featuring high quality of extensive medical services. It will keep a log of personal medical history to allow doctors to share information on patients and their families. This will result in the reduction of erroneous diagnosis and ensure successful e-business. On top of this, the new system will provide a solution for membership (client) management. It will combine online and offline medical services and be available 24 hours a day to anywhere users have Internet access, setting itself apart from the existing distance medical services system.

Specially, The paper's suggestion is sharing medical treatment information between family members is suggested. This approach makes possible understanding physical constitution and environment between family members, and can result in bringing a faster treatment effect if some family member suffers from a similar disease

■ Keyword : | Telemedicine | Information Sharing | Family Member | Database |

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I. Introduction

The conventional tele-medicine system supports two-way audio/video communications between doctors and patients for distance medical care using telecommunication networks with video and audio technology hardware and software that have become available with the development of technology. Data compression technology to transmit a large size data, high-speed Internet connection, video/audio technology to allow doctors and patients to communicate and creating session and its applications are prerequisite to materializing distance diagnosis services. This latest tele-medicine usually requires expensive hardware, network environment and advanced multimedia technology.

To reduce expenses and system requirements, a time-efficient Internet-based medical system connecting doctors, patients and pharmacists and the medical services should be offered at different levels depending on user fees.

Efficient diagnosis, prescription and dispense of medicines can be done over an Internet-based medical system, which manages data on the activities of patients, doctors and pharmacists. The database of patients, doctors and pharmacists allows doctors to keep trace of the long-term patient history for a precise, fast diagnosis and efficient material management. The objective of thesis is to specify the structure of distance diagnosis system and provide a solution that enables effective management of all the client members (patients) in order to ensure distance diagnosis system is widely adopted in medical sector as viable e-commerce model. In general, the conventional distance diagnosis system is comprised of streaming video diagnosis system, hospital medical center information system and Picture Archiving and Communication System. These systems consist of high-end hardware systems and don't talk to other versions.

The hardware-based high-end system transmits video and voice filesreal-time allowing doctors to give counseling with patients who are at a different location as well as transmitting radioactive screen. The streaming video diagnosis system allows doctors to keep a note of patients after answering questions to them, to have access to detailed patient information, refer to medical experts, and assist in an emergency care. Hospital Medical Center Information System (HMCIS) supports administrative process of hospitals like taking in patients, receipt of user fees, follow up on diagnosis, prescription and other administrations through LAN. This comprehensive hospital management system enables fast transportation of patients, logistics, documents and other supplies and exchange of transcribed information to ensure efficient hospitals management. Picture Archiving and Communication System(PACS) is a centerpiece of distance diagnosis system that uses computers to render radioactive-based diagnosis easier, save the visual files from X-ray, MRI and CT and transfer the files long-distance. Advancement in personal computers and high- speed communication network makes Inherent become a part of our lives. Distance diagnosis system proposed by this thesis, which is not bound by time or space, is experiencing fast development thanks to its user-friendly features and the ease of use.

This research focuses on affordable version that resolved the problems with the existing distance diagnosis system. The research

establishes database of patient's records on an Internet-based intelligent distance system, which is available to anybody with Internet access and not bound by time or space. As doctors' seeing patients are primary in the forms of regular medical check-up or answering patients' questions except the cases of emergencies, distance diagnosis system will save up time and costs involved with routine patient care. Structured and precise management of the patients' history that ensures reliable and free patient care at anywhere for 24 hours a day gives the system a tremendous edge and efficiency. The present distance care system is simply providing a channel of communications between doctors and patients in the forms of expert system, counseling and cyber care. The current systems do not come with database to help patients and doctors share information, or to make sure doctors work together nor it has recordings of family medical history for early detection of genetic decease. The current system failed to provide ultimate solutions for fast diagnosis and treatment.

II. e-business aspect of distance health care

As demands for online-based patient care services are expanding, some Internet-based health services have undergone development. Patient medical history system for Internet-based distance health care is a part of e-business and catching the attention of many hospitals that are clamoring to incorporate online and offline services in order to offer a variety of services to clients and to expand client base. This distance medical care services combines online counseling with offline diagnosis and treatment. In general, the system ushers online clients into offline diagnosis. This system brings patients, doctors and pharmacists together online and allows them to interact in the process of diagnosis, prescription and dispensing to the effectof increasing efficiency of medical services and rendering the medical services more user-friendly. Some distance patient care connected with the system in a large-scale hospitals or government's health department is heading for the comprehensive portal medical services.

This distance health care system must build a medical portal site and expand client base to be successful in e-business. However, studies or discussion on business and medical aspects of distance health care is just scratching the surface, while no online medical system has gone deep into the essence of the medical practices. To enhance e-business aspect of Internet-based distance health care system, efficient membership management, content services and more advanced patient care and diagnosis solutions intertwining online and offline activities are crucial tasks to service providers.

III. The medical record algorithms

The medical record algorithms keep a log of counseling and patient care information for doctors to refer to before making diagnosis and treatment on a come-back patient. The figure 1 showed algorithms and the table 1 is the knowledge frame to for information.

Clients (patients) may view the recording of

counseling and answers from their doctors as well as the results of treatment (RN).

To fulfill the objective of the system-efficient patient care, results of treatment (Rn) completed by doctors will serve as reference material: It goes into the archive of specialists to be used for corporation between doctors or by other doctors seeing patients with similar medical problems.

Writing RN includes description of decease, details of treatment, period of treatment other facts worth recording.

Specialists may view all the information about patients with medical problems they are specialized in.

Information on the archives is for viewing only. No modification is allowed.

Modification is permissible for a certain period during a treatment period.

```
P_Insert_Module(RN)
{       if( RN == "" )  {
                        P1 = Write_Module();
                        return P1; }
        else    {
                        Show(RN);
                        PN = Write_Module();
                        RPN = RN + PN;
                        return RPN;
        }
}
D_Insert_Module(PN, RN)
{       if( RN == "" ) {
                        Show(PN);
                        D1 = Write_Module();
                        R = PN + D1;
                        return R;  }
        else    {
                        Show(PN, RN);
                        DN = Write_Module();
                        RDN = RD + DN;
                        R = PN + RDN;
                        return R;  }
}
```

Figure 1. Algorithms that connect doctor-patient information

Table 1. Knowledge Framework interconnecting databases between doctors and patients

	T1	T2	T3	.....	TN
Patient	P1	RP2= R1+P2	RP3= R2+P3	.....	RPN= RN-1+PN
Doctor	D1	RD2= R1+D2	RD3= R2+D3	.....	RDN= RN-1+DN
Result	R1=P1+D1	R2= RP2+RD2	R3= RP3+RD3	.....	RN= RPN+RDN

Ⅳ. Sharing treatment information between family members

4.1 Needs for sharing information between family members

The existing treatment types have had a limited interconnection between individual patients on a temporary basis.

Interconnections have been only possible in part, using the treatment charts stored in the relevant hospitals. The information is not in a digitized form; thereby its use was still very limited.

Besides, an unequal diagnosis is made even with the same disease of a patient, dependent upon the hospital where the patent is treated. This undesirable results, mainly generated from a point either a hospital overly trusts in its diagnosis types, or tends not to provide a patient information to others, the damages of which are eventually shifted to the patients themselves.

While avoiding such an undesirable situation, and also facilitating to acquire medical treatment activities at a faster speed, the method of sharing medical treatment information between doctors and patients, as stated in the previous chapter, serves the basic objectives of

providing a faster diagnosis and treatment for the patients.

Based on the past information of consultations and treatments between doctors and patients, secondly suggested is to facilitate inter-doctoral cooperation treatments, and also to share medical expertise and know-how among many doctors for patients faster treatments.

The final suggestion is about hereditary facts between family members. Diagnosing patients from the point of patients temporary conditions, and so performing primitive examinations and treatments, can lead not only to frequent wrong diagnoses, and to huge medical expenses and times to the patients, but even to critical situation of patients or taking lives away. As a means to cut these cases down to a minimum, sharing medical treatment information between family members is suggested. This approach makes possible understanding physical constitution and environment between family members, and can result in bringing a faster treatment effect if some family member suffers from a similar disease.

This approach, since a participation in a family membership effectuates all of family members, can minimize the membership fees, thus enabling inter-family health care on a home doctor_ basis. The family membership is made applicable for members ranging from parents, children or family members in ones wife home or on ones mother side from a master membership viewpoint. The masters membership fee is twice the fee of general membership, and the rest of the family becomes members at no additional membership fees. Moreover, since receiving medical treatments to a paymember in cyberspace applies as fixed rate of around say $1 per each treatment, members can get medical consultations and treatments at a much lower price. Also, as this applies to each doctor membership, all of the family members can receive each professional consultation and treatment of each respective field of doctors. For example, a family has a membership of 4 departments of internal, surgery, dermatology, and pediatrics, then each member can receive each departments medical benefits, once its respective primary doctor of these four fields is decided. The membership bases normally one (1) year, and general membership costs $10, while family membership $20 on an annual basis. The range of a family, from a membership participant viewpoint, is limited towife, children, parents, brothers and sisters, parents in ones wife home, and brothers and sisters in ones wife home. When an application is made for a membership, all of its own family information is entered. The rest of family members can also receive membership benefits in cyberspace, by entering family identification issued already, and its own population registration number. This system enables not only sharing inter-family member information between family members, but cutting the membership fees down as well, makes it possible to get regular family medical cares under home doctor_ system. From the primary doctors viewpoint, they can secure more off-line pay memberships, so the system is mutually beneficial.

4.2 Effects

By sharing treatment type information

between family members, it can bring many advantages in regard to diagnoses and treatments by taking references to past medical records between family members.

1) Reviewing family diseases can minimize wrong diagnoses relative to family hereditary characteristics.
2) Reviewing family constitution and environment can facilitate a faster diagnosis and treatment.
3) On-line cooperation treatments are easily accomplished as most cases are related to relatively simple diseases.
4) Reviewing past treatment information can speed up the primary doctors medical expertise, enabling fast treatments for the patients.
5) A safer family health system is ensured under home doctor environment.
6) Interconnecting PACS system can facilitate accurate treatments for the patients.
7) From the doctors viewpoint, a more reliable relationship can be encouraged, bringing in more off-line outpatients.
8) Considerable influences are exerted on the public health welfare. In other words, all of the relevant parties of patients, doctors and site service providers can take the best advantages respectively, and furthermore, the site service providers can set a foothold for an opportunity in securing many client memberships and business profits.

V. Algorithms for family medical history

The family medical history algorithms compile the medical history of all the family members to help doctors identify genetic health problems that may run in a family, corporate with other doctors, share counseling and medical share information for efficient treatment. The following figure 2is family medical history algorithms and the table 5.5 is the knowledge frame for family medical history algorithms.

$F^4 = (P4^2+P4^3+P4^4)$: F is comprehensive information that covers decease that have struck the family and treatment they have received. As an example, the treatment 4 aims at treating the present decease. F comes in when a new event in the family medical history arises. A head specialist is responsible for writing events and all the specialists may use them for doctor-to-doctor corporation (between doctors).

In other words, $F^{ij} = \bigcup_{1}^{j} Pn^j : (j=1,2,...,j)$.

$P4^1$: A patient is receiving 4th counseling.

$P2^{23}$ indicates the present status of family member 3, when the patient is getting 2nd session of care for a present decease. If family member 3 has no medical problem at present, P223 contains no information. Reversely, this factor has to be filled out when a patient has a decease.

$P2 = P2^1+F^2$: comprehensive information that relates a patient to his family (F:Family) in light of genetic decease, when a patient is in the 2nd session of care for his/her present illness. This indicator leads up to the final diagnosis material, after taking into consideration of all the diagnosis from doctors who participated in doctor-to-doctor corporation (between doctors).

The form of latest care and results go on R1(R2,...,Rn), a composite index that includes

diagnosis from a master and other specialists. .

The above rule applies to second care. As a rule of thumb, doctors take into account the results of the first care (R1) for their second care.

This rule goes on for all the subsequent care (3,...n).

Summary of the results like RPn, Rn should be done by a master specialist. The summary will be used for next care.

Patients may view their personal counseling with doctors from database, doctors' answers to their questions as well as the results of treatment (Rn) composed by doctors.

As the objective of this system is to deliver efficient care to patients, the report of treatment result goes to the archives of a specialist who wrote the report, doctors on corporation program and other specialists taking care of the patients with the same decease.

Rn includes description of decease, details of treatment, period of treatment and other facts worth noting. A specialist may view all the information about patients who have medical problems he/she is specialized in. Previous records are not available for modification. They are for viewing only. Modification is possible within 10 days of treatment to ensure accuracy of recording. Master specialist can view all the information on patient counseling and diagnosis of specialists. As a moderator between doctors and as a guide, master specialist performs the final diagnosis for the sake of efficient patient care.

Table 2. Simulation table for family medical history

	T1				
	t1	t2	t3	.....	tn
Patient 1	$P1^1$	$P2^1$= R1+P^{21}	$P3^1$=R2+P^{31}	.....	Pn^1= Rn-1+P^{n1}
Family 2	$P1^2$	$P2^2$= R1+P^{22}	$P3^2$=R2+P^{32}	.....	Pn^2=Rn-1+P^{n2}
family 3	$P1^3$	$P2^3$= R1+P^{23}	$P3^3$=R2+P^{33}	.....	Pn^3=Rn-1+P^{n3}
family 4	$P1^4$	$P2^4$= R1+P^{24}	$P3^4$=R2+P^{34}	.....	Pn^4=Rn-1+P^{n4}
Doctor 1 (Master)	$D1^1$	$D2^1$=R1+ D^{21}+CD^2	$D3^1$=R2+ D^{31}+CD^3	.....	Dn^1=Rn-1+ D^{n1}+CD^n
Doctor 2		$D2^2$=R1+ D^{22}+CD^2	$D3^2$=R2+ D^{32}+CD^3	.....	Dn^2= 0
Doctor 3			$D3^3$=R2+ D^{33}+CD^3	.....	Dn^3=Rn-1+ D^{n3}+CD^n
Result	R1= P1+$D1^1$	R2=P2+ $D2^1$+$D2^2$	R3=P3+$D3^1$+ $D3^2$+$D3^3$	.....	Rn=Pn+Dn^1 +Dn^3

* Dn^i : Doctor i's diagnosis on doctor-to-doctor corporation No. n
Dni = R(n-1) + Dni + CDn : (i=1,2,...,i), (n=1,2,..,n)
"n" refers to 1~n care on the same decease. "i" is doctor "1~i." In other words, this formula updates the present situation to the last diagnosis material (R(n-1)) and the add the materials coming out of corporation between doctors (CD^n).

* Pn^j : (j=1,2,...,j), (n=1,2,..,n)
"n" refers to care No. 1~n for the same decease. (j=1) is a patient and (j=2,3,...,j) is other family members suffering from the same decease.

* Rn: The completed care report

$$Rn = \bigcup_{1}^{j} Pnj + \bigcup_{1}^{i} Dn^i : (j=1,2,...,j), (i=1,2,...,i), (n=1,2,..,n)$$

The completed care report integrates comprehensive patients reports ranging from patient P^2 to Pj including P^1 (oneself) with the doctors' care reports up to the care No. no by i number of doctors (D^1=doctor in charge, $D^{2,3,\cdots i}$=doctors on corporation program.)

* CD^n : (n=1,2,..,n): Corporation between doctors on care No. n

Figure 2. Knowledge frame for family medical history and corporation between doctors

Ⅵ. Conclusion

This tele-medicine system is an Internet-based one that provides e-based treatment chart system linked with off-line data, making possible to search and reuse a variety of treatment data stored in the medical database storage.

Adding to that advantage, this system structure serves the purpose of high-quality services that conform to membership system structures among system administrator, pay and free memberships as well, and also serves respective advantages between medical doctors in bringing both medical consultation profits and off-line profits alike.

This paper's suggestion is about hereditary facts between family members. Diagnosing patients from the point of patients temporary conditions, and so performing primitive examinations and treatments, can lead not only to frequent wrong diagnoses, and to huge medical expenses and times to the patients, but even to critical situation of patients or taking lives away.

As a means to cut these cases down to a minimum, sharing medical treatment information between family members is suggested. This approach makes possible understanding physical constitution and environment between family members, and can result in bringing a faster treatment effect if some family member suffers from a similar disease. This approach, since a participation in a family membership effectuates all of family members, can minimize the membership fees, thus enabling inter-family health care on a home doctor_ basis.

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