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무선 및 유선환경에서 임베디드 멀티에이전트 기반의 쌍방향 건강관리 서비스

(An Embedded Multi-Agent Based Healthcare Service with Two-way Handshaking Mode)

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요 약

자동화된 건강관리 모니터링은 많은 시간이 소요되고, 많은 문제들이 발생할 수 있다. 왜냐하면 정시에 환자들의 건강 상태에 대한 모니터링 정보를 제공받기 어렵기 때문이다. 이 논문에서는 임베디드된 건강 관리 서비스가 iSCSI 프로토콜에 의해 제안된다. 이 프로토콜은 자동화된 멀티에이전트와 제한된 자원의 디바이스들(예. PDA, 스마트폰, 테블릿PC)의 협력체계에 기반을 두고 있다. 이 둘의 협력체계는 쌍방향 iSCSI 프로토콜에 의해 유지된다. 자동화된 건강관리 제어는 반복되는 방식에서 매우 유용할 수 있다. 완전 집중화된 제어에서는 이 방법이 적용될 수 없다.

Abstract

An automated healthcare monitoring is demand of time, lot of problems occurring just because of less monitoring of patients health condition on time. In this paper an embedded healthcare service is proposed by an iSCSI protocol on an automated multi-agent coordination by resource-constrained devices controlled system for healthcare service. The coordination between the resource constrained devices (e.g. PDA, SmartPhone, Tablet PC), and automated agents are maintained by a two-way handshaking mode iSCSI protocol. The automated health care control could be useable, and beneficial in the repetitive way. A fully centralized control is not applicable for this kind of approach.

Keywords : iSCSI protocol, embedded, healthcare, two-way handshaking.

I. Introduction

An "agent" is something that acts in an environment, such as a mobile robot, a web crawler, an automated medical diagnosis system, or an autonomous character in a video game. An 'intelligent' agent is an agent that acts appropriately in order to satisfy its goals. That is, the agent must perceive its environment, decide what action to perform, and then carry out the action. Perception comes in many modalities - visual, haptic (touch), speech, textual/ linguistic, etc. Decision-making also comes in many flavors, depending on whether the agent has complete or partial knowledge of its world, whether it is acting alone or in collaboration/ competition with other agents, etc. Finally, taking actions can have different forms, depending on whether the agent has wheels, arms, or is entirely virtual. An intelligent agent should also learn to

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improve its performance over time, as it repeatedly performs this sense-think-act cycle.

The iSCSI protocol[1] is a transport for SCSI over TCP/IP[2~3]. SAM-2[4] defines an architecture model for SCSI transports, and iSCSI defines such a transport on top of TCP/IP. Other SCSI transports include SCSI Serial[5] and Fibre Channel Protocol (FCP)[6~7]. Until recently standard IP protocol infrastructure (i.e. Ethernet) could not provide the necessary high bandwidth and low latency needed for storage access. With the recent advances in Ethernet technology, it is now practical (from a performance perspective) to access storage devices over an IP network.

iSCSI protocol is based on TCP protocol, hence iSCSI can be adapted by any network system. This protocol uses block-based I/O data, in health care service we have to maintain a huge amount of data, which is controlled by database. Because of lots of patients information updated in every moment and should be separated from other patient's information. To have a good performance for network based database we can use SAN system. SAN system uses block based I/O data. In case of SAN based network storage system, iSCSI works very well. Multi-agent based healthcare service uses huge amount of data, for the healthcare system iSCSI based network storage (i.e. SAN) gives very good performance.

This paper discusses an optimized iSCSI protocol for multi-agent coordination and control system for healthcare service by resource constrained devices. The coordination between the resource control devices and automated agents are maintained by a two-way handshaking mode iSCSI. Our experiments, which are performed to investigate the best performance values of iSCSI parameters for iSCSI-based multi-agent for healthcare system, are taken out in wireless networks in order to realize the access the healthcare system anytime and anywhere. And after the experiment, we suggest the optimal value of parameters. The experiment results from several test cases show us the best values are not the default values specified in the iSCSI standard.

The organization of this paper is as follows. In Section Ⅱ, literature review is described. In section Ⅲ, problems of existing systems are described. The overall structure of our technique is given at the section Ⅳ. In Section Ⅴ, connection controller; two-way handshaking mode is shown in section Ⅵ, performance results are shown in section Ⅶ and in Ⅷ conclusions is made and future work is presented.

Ⅱ. Literature Review

There is no remarkable work found on healthcare by multi-agent over iSCSI network protocol, though few researchers have done some work on healthcare. In paper [8], the author shows the design and architecture of a mobile multi-agent based information platform - MADIP - to support the intensive and distributed nature of wide-area (e.g., national or metropolitan) monitoring environment. In paper [9], the authors present an autonomous intelligent agent developed for monitoring Alzheimer patients' health care in execution time in geriatric residences. The AGALZ (Autonomous aGent for monitoring ALZheimer patients) is an autonomous deliberative case based planner agent designed to plan the nurses' working time dynamically, to maintain the standard working reports about the nurses' activities, and to guarantee that the patients assigned to the nurses are given the right care. The agent operates in wireless devices and is integrated with complementary agents into a multi-agent system, named ALZ-MAS (ALZheimer Multi-Agent System), capable of interacting with the environment. AGALZ description, its relationship with the complementary agents, and preliminary results of the multi-agent system prototype in a real environment are presented.

Ⅲ. Problem with existing techniques

During the implementation of the proposed technique and architecture, few works found concerned with healthcare monitoring service. Most

of the work focused on wireless or wired data transfer while patients' status was not considered. Few works found where some devices attached with patient's body to send current physical status information. While physically connected devices are not convenient for old people as well as child. The proposed method focused on faster and convenient technique. For the faster transmission handshaking mode already changed, with iSCSI protocol (iSCSI itself a faster protocol). Agents are used to check and send patients information automatically; this status transmission has done in real-time.

Agent based healthcare service need to send huge information, because it is receiving information from several sensor agents, from several patients. In the final stage of the proposed model a good suggestion is to sort all received data after every 24 hour and only should keep the significant changed data.

From the sorted information, medical board could decide

IV. Overall Structure

In our work, we approach a simple but effective method of network-based healthcare monitoring system by multi agent; the total system is designed for resource-constrained device with high-speed iSCSI protocol.

Figure 1: shows the overall structure of our proposed technique, where the resource-constrained devices (e, g., PDA, Tablet PC etc) are used as an initiator and, there is an iSCSI server, which is acting like a iSCSI target. The server computer is connected with different kind of sensor agents (e.g., Body temperature measurement sensor, sound measuring sensor), simultaneously the sensor agents are sending patients health monitoring information to the server computer. The doctors and other concerned persons can access the monitoring server by their resource-constrained device to get the patients present and previous condition.

It is reasonable that we do not need much security for the mentioned system, but faster connection and

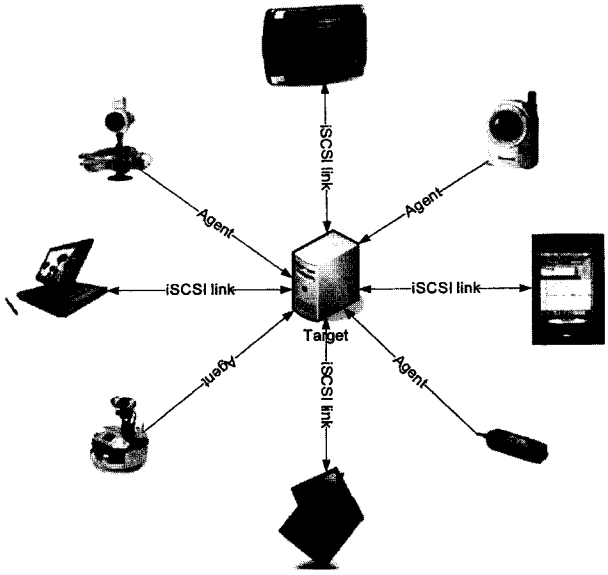


그림 1. 제안된 건강관리 시스템의 총체적 구조
Fig. 1. Overall structure of the proposed healthcare system.

data transfer. Our proposed two-way-handshaking iSCSI is able to ensure the faster connection and high-speed transmission.

V. Connection Controller

In order to alleviate the degradation of iSCSI communication service caused by TCP congestion control, we propose Multi-Connection and Error Recovery method for one session, which uses multiple connections for each session.

As mentioned in [10~11], in a single TCP network

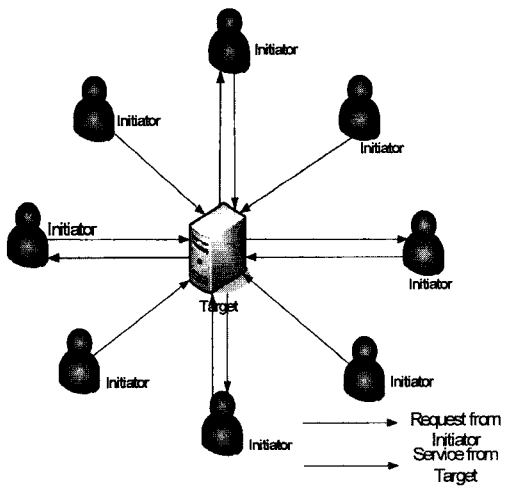


그림 2. 연결 제어와 부분 제어 모델
Fig. 2. Connection Control and Session Control Model.

connection the initiator can send connection request to the target. If there is number of initiator then they may send number of request at a same time, it may happen the cause of congestion. Hence, we decide not to send any acknowledgment weather target is free or not. If the target is free then it will send the data requested by the initiator, if not free then the target will not send any response signal and there will not be establish any connection as well as session shown in Figure-2.

VI. Two-way Handshaking

TCP two-way handshaking to measure RTT between the initiator and the target, it can be more efficient at avoiding filtering and inflation of packet than ICMP probes. Multi TCP connections controller negotiates the number of connections between the initiator and the target for data transmission according to equation (2) using parameter (RTT), which were collected by the parameter collector. Given a packet drop rate of p, the maximum sending rate for a TCP connection is T bps, for a TCP connection sending packets of B bytes, with a fairly constant RTT of R seconds. Given the packet a TCP connection sending packets of B bytes, with a fairly constant RTT of R seconds. Given the packet drop rate p, the minimum Round-trip time R, and the maximum packet size B, the mobile client can use equation (1) to calculate the maximum arrival rate from a conformant TCP connection[10].

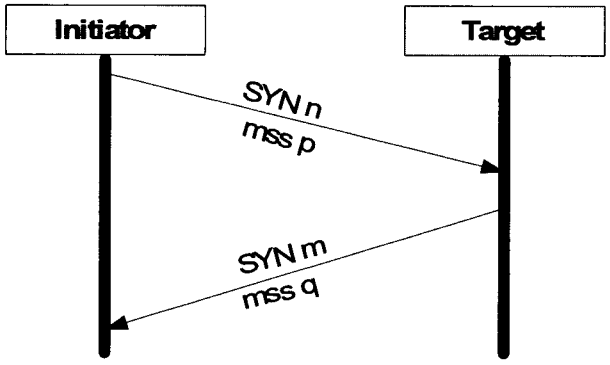


그림 3. 쌍방향 핸드쉐이킹 모드의 진행 순서
Fig. 3. Working Procedure of Two-way Handshaking Mode.

$$T \leq \frac{1.5 * \sqrt{1 * B}}{R * \sqrt{p}} \quad (1)$$

Equation (2) shows that the number of established TCP connections (N) used in Multi-Connection iSCSI depends on RTT (Rt) measured by parameter collector. The minimum RTT can determine the large number of connections to be opened between the mobile client and the storage device shown in Figure-3.

However, while the use of concurrent connections increases throughput for storage service it also increases the packet drop rate. Therefore, it is important to obtain the optimal number of connections in order to set the expected throughput.

$$T \leq \frac{1.5 * \sqrt{1 * B}}{R * \sqrt{p}} \leq \frac{N * W}{Rt} \quad (2)$$

(Where, W is window size of each TCP connection.)

The receive acknowledgement from initiator and sending acknowledgement from target will be integrated with next request and next acknowledgement response.

VII. Performance Evaluations

This section describes the experimental environment and then shows the results of performance evaluation for the proposed two-way handshaking method for iSCSI protocol. The performance analysis shows the three-way-handshaking iSCSI and with our proposed two-way-handshaking method in constraint devices.

In paper [10], authors show a three-way handshaking. The derived the maximum arrival rate from a conformant TCP connection[10, 12] shown in Equation (3).

$$T \leq \frac{1.5 * \sqrt{2/3 * B}}{R * \sqrt{p}} \quad (3)$$

Given a packet drop rate of p, the maximum

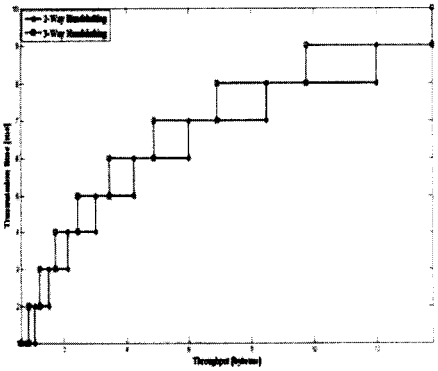
sending rate for a TCP connection is T bps, for a TCP connection sending packets of B bytes, with a fairly constant RTT of R seconds. Given the packet a TCP connection sending packets of B bytes, with a fairly constant RTT of R seconds and given the packet drop rate p, the minimum Round-trip time R, and the maximum packet size B.

They obtained the throughput equation shown in Equation (4),

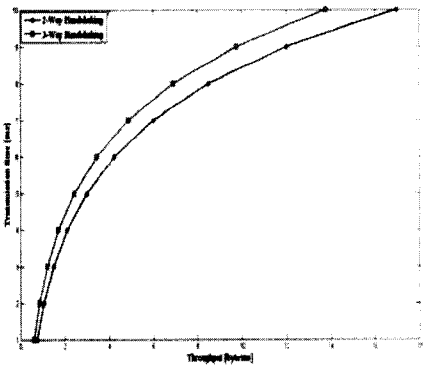
$$T \leq \frac{1.5^* \sqrt{2/3^* B}}{R^* \sqrt{p}} \leq \frac{N^* W}{Rt} \quad (4)$$

Where, W is window size of each TCP connection.

Comparing our proposed handshaking method with three way handshaking, we have achieved better performance which is shown in figure-4(a) & in 4(b) 4(a) shows the performance comparisons of two-way handshaking and three-way handshaking with communication delay. 4(b) is showing performance comparisons of two-way handshaking and three-way handshaking with different packet size and bandwidth.



(a)



(b)

그림 4. 무선 및 유선환경에서 쌍방향 과 셋방향간의 데이터 교환 비교

Fig. 4. comparison of data transmission in between two-way handshaking and three-way handshaking mode.

Ⅷ. Conclusions

In this work we have developed the iSCSI protocol by optimizing the parameters, a two-way-handshaking also shown here. Obtained results are also suggesting the two-way-handshaking instead of three-way-handshaking. Transmission became much easier for the two-way-handshaking; the communication between multi-agents and server achieved fastest communication and less bandwidth use. This paper can be helpful for the researchers who are working on iSCSI protocol for large-scale data transmission; also it can be helpful for those who are working with resource-constrained devices over wired and wireless environment.

Appendix

Suppose, in any medical center there are five numbers of patients are taking medication. Patient's are denoted by P_i (Where i = 1, 2, 3 ...n). Also, suppose in the mentioned medical the proposed agent based system is working, denoted by *AgHC*. Aforementioned that *AgHC* is working based on different agents, such as sound sensor (denoted by $A_{\_sosi}$), temperature measurement sensor (denoted by $A_{\_tmsi}$), and moving object detection sensor ($A_{\_modsi}$) etc.

Now, let in *AgHC* there are five different patients are taking medication (every patient has different problem with each other). If Patients P_1, P_2 is a child and has problem in their stomach and P_3, P_4 is oldmen has problem in speaking i.e. oldmen cannot speak clearly.

P_3, and P_4 has cardiac problem, P_3, P_4, and P_5 has

serious fever.

P_1 and P_2 will not be able to mention when they will need extra care, but they may be have abnormally. They may move in their bed very quickly and that attitude can be detected by *AgHC*, i.e. agent sensor $A_{\_modsi}$ can send information to central server computer and update to emergency medical team.

In case of P_3 and P_4 all agent may be engaged to detect patients' abnormality as well as suffering. Temperature sensing agent will be helpful for the patient who has fever (i.e. P_5). It is important to mention that temperature sensing agent is a special type of agent which is just sensing the patient's body temperature without touching the patient (e.g. $A_{\_tmsi}$).

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