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Internet Video based remote customer services

By

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Abstract:

This paper proposes a new remote diagnosis and repair services based on interactive visual and audio communication over Internet. The proposed service contains three levels of different remote diagnoses: Level (1): Video and audio interaction between customer and remote service sites; Level (2): Simple signal collection from customer to remote service sites; Level (3): Diagnostic commands and responses between remote service and customer sites. The proposed remote diagnose and repair services have been successfully tested and evaluated for its efficiency in technical manpower saving (approximately 85% lesser than traditional service), in service response time saving (approximately 90% lesser than traditional service), in mean time to repair saving (approximately 60% lesser than traditional service), and in service cost saving (approximately 95% cost down). In the near future, we intend to implement automated diagnosis and repairing suggestion mechanism to further improve the efficiency of technical manpower of the proposed remote diagnosis and maintenance platform.

Keywords:

Remote service, Fault diagnosis, Internet video

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1. Introduction:

On-site customer services have been very time wasting (waiting for service personnel arrival from distance away) and very money spending (expensive service charge) for all kind of business. No matter how the business is large or small, local or global, commercial or military, undersea or out to space.
However, due to the rapid development of Internet in recent years, business behavior has been significant changed. For example, the rise of Internet shops has invaded and occupied much of the traditional store market. For high-tech, remote maintenance, makes the Mars Exploration Rover (MER) can be up to 5 years of continuous exploration mission [1]. Modern medicine also applies remote video technology to help general surgeons in remote areas to perform a complicated and difficult surgery, under the visual supervision of experienced specialists. From previous examples, remote maintenance services not only can effective utilize technical human resources, to save money and time required for service, but also can provide maintenance work in space or on Mars, where humans can not reach. In this paper, we propose a new Internet video based remote maintenance service, to reduce high service cost and long waiting time, which are the major disadvantages of traditional maintenance services.

2. Previous Works:

The existing remote maintenance services [2, 3, 4, 5, 6], is available from a remote diagnostic computer connecting to machines or equipments at the customer site through Internet. First, the diagnostic computer remotely starts a testing program located in the customer's machines or equipments to diagnose equipment faults or possible failures.
This kind of diagnostic method has at least two disadvantages:

1. System must be designed to take into account the testability, and at any design changes, testing programs are also changed. With the rapid technological advances now, on-board testing codes and circuits gradually become the burden to the rapid advancement of equipments.
2. From a remote connection to collect diagnostic information of customer's equipments, often makes users are worried about the company's operation secrets may be leaked, resulting in the majority of companies are not willing to allow the remote diagnosis of their equipments.

3. Proposed method and system:

The proposed service platform contains three levels of different remote diagnoses:
Level 1 : Video and audio interaction between customer and remote service sites;
Level 2 : Simple signal collection from customer to remote service sites;
Level 3 : Diagnostic commands and responses between remote service and customer

sites.
The three level diagnoses are briefly described as follows.
Usually on the equipment diagnosis, the first step is to carry out visual inspection on the indicator lights at the front panel or at each individual module. From the indicators' lighting status, most of equipment failures or problems can be detected.
The purpose of level 1 diagnose platform is to provide remote service personnel and on-site users of (1) voice message and pictorial information exchange, (2) remote demonstration of hands on equipments, and (3) remote monitoring of on-site operations. The necessary set up for level 1 diagnosis, simply say, may be a Skype phone with visual capabilities, such that both sites at distance away can see, hear and talk to each other in a very efficient manner. Thus, most of on-site services, such as updating software or hardware, adding more or new functions, demonstrating and training of new facilities, can be provided and/or performed without service personnel appearing on-site.
With the Level 1 interactive video test equipment, the operational status of the equipments at customer site and the operations or actions of on-site personnel can be transmitted via Internet-video and displayed at remote maintenance specialists' screen. Under the surveillance of long-distance, remote service experts can have complete control over on-site operators of any operations and actions, so the possibility of errors or misconducts is minimal. In determining the fault module through interactive video, the remote service experts can determine the fault module, and direct on-site operator to replace the fault module with spare parts (if any). Otherwise, the remote service personnel can immediately use Express Delivery Service to deliver needed parts to the customer site.
When level 1 diagnosis is not capable of finding possible faults, before dispatch maintenance personnel to customer site, the remote maintenance expert can consider using the level 2 diagnoses mechanism to further testing and detecting of equipment failures. By using Level 2 diagnostic mechanism, some preliminary circuit signals, such as power supply levels, basic system signals and pre-determined testing signals are collected.
In addition to display these signals to the on-site customer, these signals are sent through Internet to the remote maintenance specialists to identify possible failures. Displaying a variety of collected signals directly and immediately to on-site customers, may eliminate the customer's concerns on the leakage of company secret information through Internet connection.
For faults that are difficult to be diagnosed by just examining a few simple or basic signals, such as transient faults, or equipments in need of parameter value adjustments to improve the operational performance, often need to use the aforementioned level 3 diagnostic method to reach the goal of remote services. At this time, remote maintenance experts need to issue multiple testing commands, and in accordance with

the equipment reaction to give the correct parameter values or to find out where the transient faults are.

4. Implementation:

A PC based prototype of the proposed remote diagnose service platform was implemented and tried on commercial manufacturing equipments. The basic architecture of the proposed system is depicted in Figure 1. As shown in the module 1 of Figure1, a visual Skype phone [7] was installed to provide two way interactive audio and video communication between client (equipment user) and server (manufacturer and/or service provider) sites. The module 2 is used to monitor and to display testing signals for level 2 and level 3 diagnoses, respectively. The module 3 at the server site, receives the level 3 diagnosis commands (CMDs) given by service experts, and sends the CMDs to the corresponding client site. The module 3 in the client site receives level 3 diagnosis CMDs and sends these commands to the designated testing points or pins at the tested or faulted equipments.

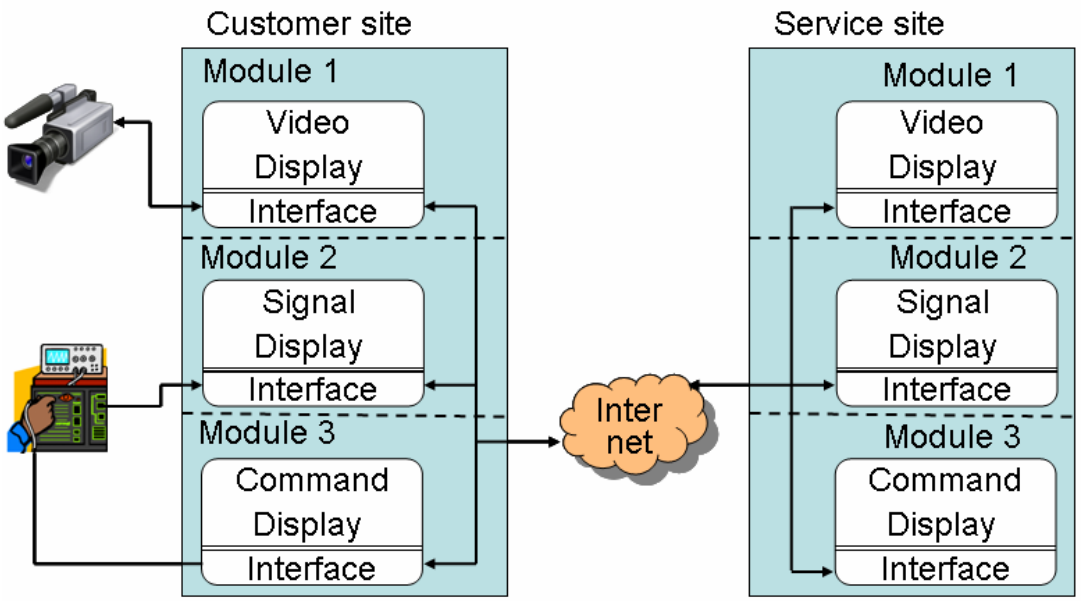

Figure (1): *Architecture of the Internet video based remote service platform.*

5. Testing and performance results:

The proposed prototype has been tried on several commercial products. In the following, testing and performance results are shown and discussed. The prototype platform was tried on the new products of COB (chip on board) manufacturing machines [8], which contains electrical measurement and mechanical lead bonding

subsystems.

The evaluation was performed between the traditional services and newly developed remote services. The traditional services were conducted as: (1) equipment user calls for system repair or maintenance, (2) service scheduled, (3) on-site inspection or diagnosis, and (4) equipment repaired. In order to minimum the cost due to equipment failure, most of the COB manufactory requires fast repair service, which allows 6~12 hours on-site inspection and 24 hours of equipment repairing. Thus, service for COB manufactory machines is very monetary costliness and timing tightness. Table 1 shows the comparison between traditional and newly developed remote service in service charge and time to repair of each service call. Service charge includes hourly charge of on-site working and transportation to user site. In general, most of this charge comes from transportation distance. As far as the evaluation on time to repair, the time needed for the traditional service is again spent on the service person traveling to the customer or equipment site, and for the proposed remote service, the time needed is the shipping time for delivering the repair parts to the customer site. By using express mailing or shipping, the delivering time can be 1 to 6 hours of local delivery, or 24 to 48 hours of world-wide shipping. During a 6 month of trial period, 100 service calls were tested and evaluated. Among the 100 calls, 38 and 33 calls were handled by level 1 and/or level 2 diagnoses respectively, and 16 cases were successfully diagnosed by level 3 diagnoses. Among the rest 13 cases, 5 cases were failure of level 3 diagnoses, and the other 8 cases were refused by customers of using level 3 diagnosis. All these cases were finally fixed by sending service personnel to customer site as the traditional services.

Table (1): *Comparison of service charge and time to repair for each call between traditional service and the proposed remote service. *Service cost is measured in units, which is the service charge per person and per hour for either on-site or transportation time. ¶Time to repair is measured in hours between service call and service finished.*

SERVICE DISTANCE	WITHIN 200 KM		200 ~ 500 KM		500~1000 KM		1000 ~ 2000 KM		INTERCON-TINENTAL	
Service type	*Traditional*	*Propsd*	*Traditional*	*Propsd*	*Traditional*	*Propsd*	*Traditional*	*Propsd*	*Tradi-tional*	*Propsd*
Service cost*	1 & 4	1	1 & (2~4)	1	1 & (4~8)	1	1 & (8~12)	1	TBD	1
Time to repair ¶	8	1& 4	8~ 12	1& 8	12~24	1&1 2	24~ 48	24	TBD	24~48

6. Concluding remarks:

This paper proposes a new remote diagnosis and repair services based on visual and audio communication over Internet. The proposed remote diagnose platform has been

successfully tested and evaluated for its efficiency in technical manpower saving (approximately 85% lesser than traditional service), in service response time saving (approximately 90% lesser than traditional service), in mean time to repair saving (approximately 60% lesser than traditional service), and in service cost saving (approximately 95% cost down). In the near future, we intend to implement automated diagnosis and repairing suggestion mechanism to further improve the efficiency of technical manpower of the proposed remote diagnosis and maintenance platform.

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