Development of a Portal Collaboration Type Operation and Maintenance Support System

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Abstract:

Several machine tool vendors have developed maintenance support systems using the internet, but the systems are dependent upon each particular machine tool vendor. Moreover, most systems merely monitor Open NC's console. Consequently, these maintenance systems cannot accommodate other resources such as materials and documents. For that reason, this study examines a portal collaboration type operation and maintenance support system. The system accommodates a controller's information along with other resources. This paper describes the system concept and a document management system that collaborates with the 3-D Remote monitoring system as one system component.

Keywords: Operation and maintenance support, Remote monitoring, Document management, Collaboration, Open technologies, Multi-vendor

1. Introduction

Recently, for remote maintenance by machine tool vendors, internet based maintenance support systems that monitor Open NC's console of a user factory have been developed.

However, these maintenance support systems depend upon resources of each particular machine tool vendor. These maintenance support systems are inapplicable to multi-vendor machine tools in the factory. Moreover, these maintenance systems merely monitor the Open NC console. These maintenance systems cannot handle posture and sounds of the machine tools. In addition, these systems can not accommodate other resources such as tools and materials. Furthermore, document management systems which handle distributed documents, such as operation manuals for machine tools, maintenance reports, manuals for maintenance from service sections, and experience reports from users for maintenance are needed.

Therefore, this paper presents a portal collaboration type operation and maintenance support system which can handle not only a controller's information but also other resources such as tools, materials and documents. The system includes many collaboration tools: a remote monitoring and management system based on information-interoperable environment, a document management system, and a TV conference system.

A remote monitoring and management system based on information-interoperable environment was developed; the information-interoperable environment of the system manages device-level information for multiple devices, multiple generations, multi-vendor devices, and Manufacturing Execution System (MES)-level information [1][2]. This environment creates a user side programming environment for free development of application systems such as remote monitoring systems and operation management systems. A 3-D Remote monitoring system which is a part of the remote

monitoring and management system uses multimedia, i.e., camera images, text information, and 3-D models. The 3-D Remote monitoring system is from environment based application systems [3].

Furthermore, a document management system was developed to manage various documents which are located in different places such as the user side, maintenance center side, and machine tool manufacturer side [4]. Documents from this system can be searched using keywords of remote monitoring information such as error messages and production information from the remote monitoring and management system based on the information-interoperable environment. Users can thereby find documents depending on the situation of their own machine tools.

Moreover, TV conference systems were prepared as collaboration tools for portal collaboration type operation and maintenance support systems.

A study of a portal collaboration type operation and maintenance support systems is being done as an application of these research and development results. Using the portal collaboration type operation and maintenance support system, a maintenance staff can provide maintenance support services for machine tools in the factory from remote locations using the TV conference system, device-level information, and MES-level information from the information-interoperable environment, with documents from the document management system.

This paper describes concepts of the portal collaboration type operation and maintenance support system and development of a prototype system comprising the document management systems collaboration with 3-D Remote monitoring system. Results of prototype development verified the system operation.

Figure 1: Remote maintenance system based on multimedia collaboration

2. Portal collaboration operation and a maintenance support system

This chapter describes concepts of the portal collaboration type operation and maintenance support system. The portal collaboration type operation and maintenance support system has functions for indicating device-level information for multi-vendor, multiple devices, and multi generation devices. It also indicates MES-level information as monitoring information from the remote monitoring and management system. Furthermore, the system can seek and indicate documents that are synchronized with the monitoring information. Moreover, this portal collaboration type operation and maintenance support system can provide maintenance

support functions by sharing monitoring information, camera pictures of surrounding resources in the factory, and related documents with collaboration using a TV conference system.

As shown in Figure 1, the portal collaboration type operation and maintenance support system consists of a remote monitoring and management system based on the information-interoperable environment, a document management system, and a TV conference system as collaboration tools.

The remote monitoring and management system based on the information-interoperable environment can manage multiple vendors and device types. Moreover, the system can integrate device-level information along with MES-level information. Because, the

Figure 2: The information-interoperable environment

Figure 3: 3-D Remote monitoring system

information-interoperable environment uses open and/or standard technologies mutually such as ORiN (Open Resource interface for the Network [5]), MESX [6], and PSLX (Planning and Scheduling Language on XML specification [7]), as shown in Figure 2. This remote monitoring and management system contains a 3-D Remote monitoring system using multimedia such as 3-D models, camera pictures and text information as shown in Figure 3.

The document management system can manage various documents that are located in different locations such as the user side and machine tool manufacturer side. Those documents can be searched using keywords from remote monitoring information such as error messages and production information. Users can therefore find documents depending on the machine tool situation. Moreover, if the document management system is using with the 3-D Remote monitoring system, those documents can be searched using keywords by mouse-clicking a part of a 3-D model. Therefore, even if the part names are unknown, a user can obtain documents.

A TV conference system is used for collaboration between the user side and the machine tool manufacturer side. The same indications from 3-D Remote monitoring system and documents management system can be shared in both sides with the user and machine tool manufacturer simultaneously using the system. They can collaborate for remote operation and maintenance support using the system with monitoring information and documents.

Usually, factory side users can use the remote monitoring functions of the portal collaboration type operation and maintenance support system for KAIZEN activities and production activities. Moreover, the portal collaboration type operation and maintenance support system are useful for remote operation support and/or remote maintenance support as the occasion demands.

3. Document management system collaboration with 3-D Remote monitoring system

A document management system that collaborates with a 3-D Remote monitoring system as one component of the portal collaboration type operation and maintenance support system was developed.

Before development of the document management system, the following problems persisted. Many kinds of

documents exist: maintenance manuals as accessories of machine tools, maintenance notebooks based on user experiences, and maintenance documents based on experiences of machine tool service staff. Moreover, many maintenance documents are scattered over several locations: the user side, machine manufacturer side, and service staff of machine tools. When machine tool repair is done over the telephone by a user with maintenance support from the machine tool manufacturer service staff, the user side document often differs from the service staff document. Consequently, much time is wasted to complete a necessary document for the user because users often must then receive documents by fax. Often, machine tool parts names differ depending on the machine tool builder. Sometimes, different names of machine tool parts are used in the document and by regular users. Therefore, it is difficult to do maintenance well.

These subjects are solved for this system by the following characteristics. First, a document server should be installed in the factory side. This document server can link not only to user side places but also to machine tool manufacturer documents over the internet. A way to download documents regularly exists if the link between the user and machine tool manufacturer document provision service is unavailable. Using this server, documents scattered at various locations such as the user side, maintenance service side, and machine manufacturer side can be controlled.

The problem of different names of machine tool parts in the document and those of regular use by the user has been solved using the 3-D Remote monitoring system. First, part names of machine tools in documents must be added to 3-D models as attributes. If users click 3-D models of the machine tool part, the part name will appear. In addition, the document management system can search a document using the part name as a keyword.

The document management system can recognize text in the documents for searching if documents are made using Word or CAD as electronic files. Then these documents can be stored to the document server of the document management system. However, for printed documents, these must be scanned using OCR software to recognize text. After that, the documents can be stored in the document server. If the documents are handwritten, OCR processing is difficult. By adding an index page for seeking keywords in advance, the document management system can handle these documents.

4. Development of prototype system and results of test operations

Document search methods by clicking text indicating the production or device information from remote monitoring system was developed as an additional function of the 3-D Remote monitoring system. By this development, when a machine is broken, a necessary maintenance document can be searched by mouse-clicking on the 3-D models or the error message indicated from the Remote monitoring system. Moreover, plan charts or set-up information charts can be searched by mouse-clicking on the production information message

Figure 4: Document search by mouse-clicking of 3-D models

Figure 5: Document search by mouse-clicking of text indication from the remote monitoring system

indication.

A prototype system including these methods was developed; prototype system testing was done. This feature was added to an information indication function of the 3-D Remote monitoring system for a Toyota Machine Work's Machining Center (MC).

Two test operations for document search were done: a document search from a 3-D model, and a document search from text information of monitoring for these test operations.

First, results of testing for document search from 3-D model were as follows. Names of machine tool parts in the document were obtained by mouse-clicking 3-D models of the parts of the 3-D Remote monitoring system. Moreover, documents related to the parts were searched using names of machine tools' parts as keywords for the document management system, as shown in Figure 4.

Results of testing for document searching from monitoring system text information were as follows. Prototype system testing was done using a manufacturing system emulator instead of MC because it was not easy to generate device errors intentionally in the real device. Test operation results show that error messages generated by the emulator were indicated by the 3-D Remote monitoring system. Figure 5 shows that documents were searched by mouse-clicking on the indication.

According to the results of these test operations, the document management system collaboration with 3-D Remote monitoring system based on the proposed method is useful as one component of the portal collaboration type operation and maintenance support system.

5. Conclusion

Document search methods by clicking text indications of production or device information from remote monitoring systems were developed as an additional function of the 3-D Remote monitoring system. A prototype system based on the proposed method was developed. Moreover, test operations of the prototype system were done. The proposed method was verified using test results.

According to these test results, the document management system collaboration with 3-D Remote monitoring system performed quite well as one component of the portal collaboration type operation and maintenance support system.

Functions based on the proposed method will more improve in the future. Moreover, development of the portal collaboration type operation and maintenance support system will be completed by development of a collaboration method with a TV conference system.

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