Improvement in Operation Efficiency for Chip Mounter Using Web Server

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ABSTRACT

The number of the enterprises which utilize network technology has been increasing for solving problems such as productivity improvement, market trend analysis, and material collection for making decision. Especially, the management of equipment and the recovery time reduction when machines break down are very important factors in productivity improvement of the enterprise.

Currently, most of the remote trouble diagnosis of equipment using the internet have just one function of transmitting the trouble information to the user. Therefore it does not directly reflect the user's recovery experience or the developer's new recovery methods. If the user's experienced recovery methods or the developer's recovery methods as well as the basic recovery methods are reflected online or on the internet, it makes it possible to recover faster than before.

In this paper, we develop a Remote Monitoring Server (RMS) for chip mounters, and make it possible to reduce the recovery time by reflecting the user's experience and developer's new methods in addition to presenting the basic recovery methods. For this, trouble recovery concept will be defined. Based on this, many functions(trouble diagnosis, the presentation of the basic recovery methods, user's and developer's recovery method, counting function of the trouble number of each code, and presentation of usage number of each recovery methods) were developed. By utilizing the reports of the actual results of chip mounter and the notice function of the parts change time, the rate of operation of the chip mounter can be improved.

Key Words : Web Server, Chip Mounter, TCP/IP, Trouble Diagnosis, Trouble Recovery, E-mail Service, Service Alarm

1. Introduction

Due to the wide distribution of the rapidly rising ADSL and the development of related technology, the number of enterprises which use network technology [1,2] is increasing. Network technology is used for productivity improvement, market trend analysis and material collection for making decision. Remote monitoring [3] is used to improve the productivity of production facilities and network technology is utilized in diagnosis. However most of the remote trouble diagnosis using the internet have only simple functions that transmit the trouble to the user. The user only knows the existence of the trouble and the basic recovery methods transmitted from the production facility. However, if it provide not only the basic recovery methods but also the user's experience and the developer's new methods when the machine brokes down, the recovery time might be reduced in the case of identical trouble.

Today, the PCB (Printed Circuit Board) assembly industry is transferring from electric home appliances to computers and communication equipment. These products have a short life cycle in the market. Therefore it is important to change the equipment for making

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Accepted: May 24, 2003
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products into a small production system. In addition, the network technology applications are increasing because it is important to improve the rate of operation.

In this paper, we will develop a Remote Monitoring Server (RMS) for chip mounters, and make it possible to reduce the recovery time by reflecting the user's experience and developer's new methods in addition to presenting the basic recovery methods. For this, trouble recovery concept is defined. Based on this, the trouble diagnosis function, the presentation function of the basic recovery method, the user's and developer's recovery method, the counting function of the trouble number of each code, and the presentation function of usage number of each recovery method were developed. By utilizing the reports of the actual results of chip mounter and the notice function of the parts change time, the rate of operation of the chip mounter can be improved.

2. System Configuration

2.1 Hardware base

The chip mounter performs the function for PCB supply, part insertion, inspection and heating parts for adhesion.

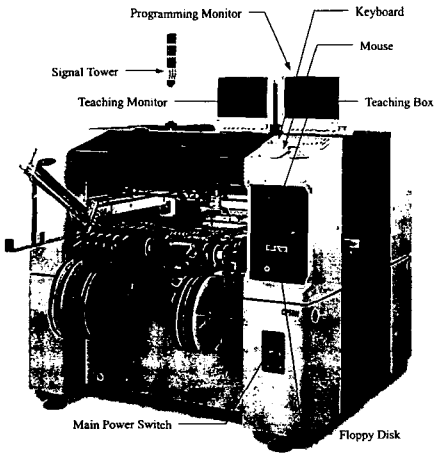

Fig. 1 Chip mounter

This system has the capability to install 104 feeders. The head assembly consists of 3 spindle units and has a spindle module for fast motion. The system [3] can attach chips with height of 0.3 ~ 15.0 mm, width of 1.0 × 0.5 mm and lead pitch of 0.5 mm. The OS is Microsoft Windows 95. The fixed camera for vision system can recognize QFP of 0.5 mm lead pitch. Fig. 1 [4] shows the chip mounter.

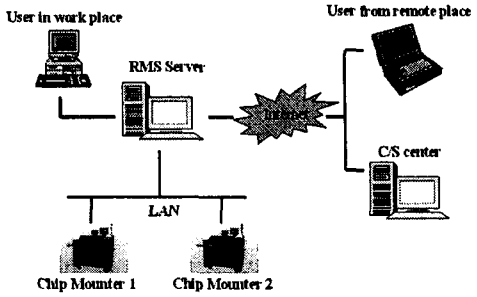

Fig. 2 Hardware configuration of RMS

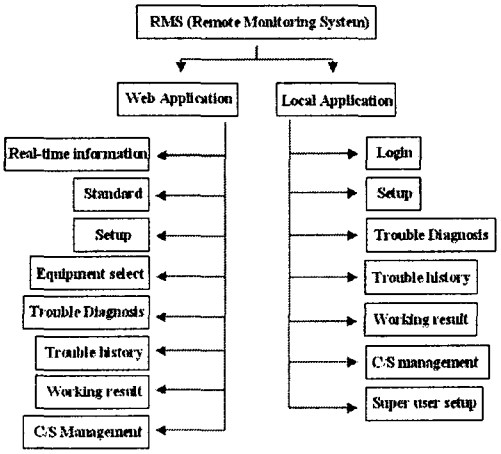

Fig. 3 Software configuration of RMS

Fig. 2 shows the hardware configuration of RMS [6,7]. RMS communicates with the chip mounter through TCP/IP, receives the Real Time Information (RTInfor) from the chip mounter by its own request, classifies it and saves it in a DB. Because each one of the chip mounters has an IP address, the RMS can select any of the chip mounters when necessary. In a workshop, the user can connect the RMS through a network or a direct connection.

Fig. 3 shows the software configuration of the RMS. The software consists of local application and web application [5]. Local application consists of Login, Setup, Trouble Diagnosis, Trouble history, Working result, C/S management and Super user setup. The DB contains the trouble history information, real-time data and the user information. Therefore, access to the local application is limited to the registered users.

In addition, users who want to get the data in the RMS in a remote place can connect the RMS through a web browser. Remote users can get the contents about Real-Time Information, Standard, Setup, Equipment selection, Trouble Diagnosis, Working result, C/S Management from the web browser.

3. Remote Monitoring Server (RMS)

3.1 Real Time Information (RTInfo)

The chip mounter transmits the RTInfo through TCP/IP at the request of the RMS. The RMS utilizes it to manage the actual result control and to improve the operation efficiency. The RTInfo is 40 bytes and is made up of Status, InCount, OutCount, WorkCount, TroubleCode, StopCode, PlacementTime and WaitTime. Table 1 shows the size and contents of the RTInfo.

Table 1 The contents and size of RTInfo

Contents	Size	Contents	Size
Status	4	TroubleCode	4
InCount	4	PlaceTime	4
OutCounts	4	WaitTime	4
WorkCount	4	StopCode	4

Status means the condition of the chip mounter which indicates stop, idle and operation. InCount means the number of new PCB which is put into the RMS and OutCount the accumulated number of PCB that has been finished. WorkCount means the number of PCB that are working or on standby. The TroubleCode represents the cause of trouble. StopCode means the cause of the stop. PlaceTime means the time that is spent on putting the previous PCB, and WaitTime is the waiting time of the previous PCB. Fig. 4 indicates the usage of RTInfo that is stored in the DB of RMS.

InCount, OutCount and WorkCount are used to manage the actual results such as counting the chip mounter's actual output. Status, PlaceTime and WaitTime are used to analyze the process time to know the time spent to produce the finished PCB. Troublecode, StopCode, Recovery methods, Trouble History and Changing parts are used to manage the operation efficiency such as the content of trouble, showing recovery method, trouble history and informing the change time of the expendables. The used DB engine is Oracle 8i. Table 2 is the content of DB designed for improvement of operator rate.

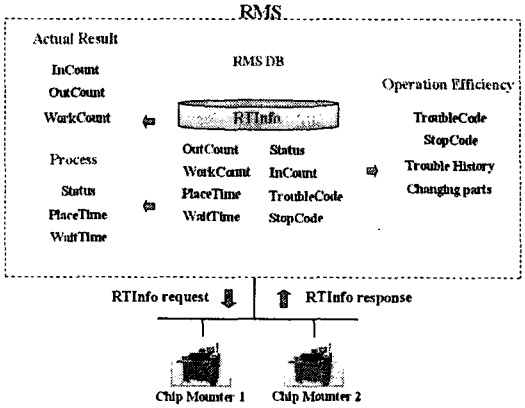

Fig. 4 The usage of RTInfo in RMS

Table 2 DB used for improving operation efficiency

Trouble_Code	VARCHAR(20)	NOT NULL
Stop_Code	VARCHAR(10)	NOT NULL
Trouble_History	NUMBER(10)	NOT NULL
Changing_Parts	VARCHAR(50)	NOT NULL

Table 3 is the contents of DB designed for actual results management.

Table 3 DB table used for managing the actual results.

InCount	DATE	NULL
OutCount	DATE	NULL
WorkCount	DATE	NULL

3.2 Reporting of actual results and process

InCount, OutCount and WorkCount are used to analyze the actual results of the chip mounter. InCount presents the entire number of new PCB moved from PCB loader to the chip mounter. OutCount presents the entire number of PCBs except the inferior ones that are caused by trouble or error while they are being operated. We can find the number of inferior ones from the difference between InCount and OutCount. WorkCount presents the number of PCBs being operated in the chip mounter. PlaceTime, which indicates the time spent on setting up the previous goods, and WaitTime are used to calculate the process time. Status indicates the condition of the chip mounter as stop, idle or operation. Fig. 5 shows the

local applications for the working results. Fig. 6 shows the working results in the web browser.

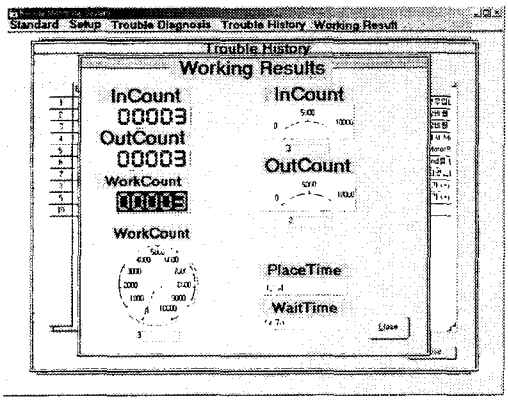

Fig. 5 Local application for working results

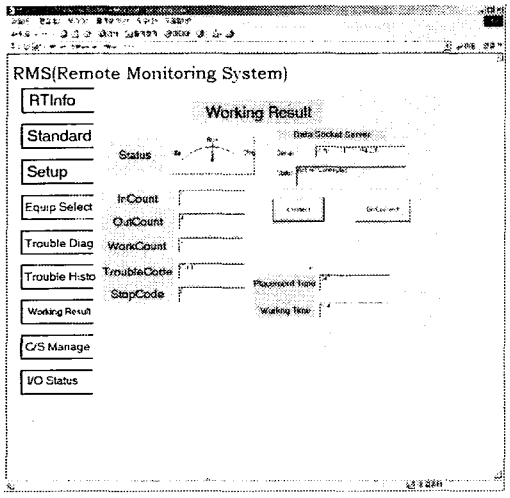

Fig. 6 Working result in web browser

3.3 Trouble Treatment

The chip mounter user should reduce the stop time caused by trouble to improve operation efficiency. Also, the developer of the chip mounter should support the fast recovery methods when there is trouble. However it's not easy to recover it quickly because of the distance between user and developer. To solve this problem, the concept of a trouble treatment that involves the functions presenting the three recovery methods(basic recovery method, the user's and the developer's recovery method) of the RMS, the trouble number of each code and inputting the user's experienced recovery methods and developer's recovery methods, and representing the usage number of each recovery methods is defined. Fig. 7 shows the development concept about trouble treatment of the RMS and the details are as follows.

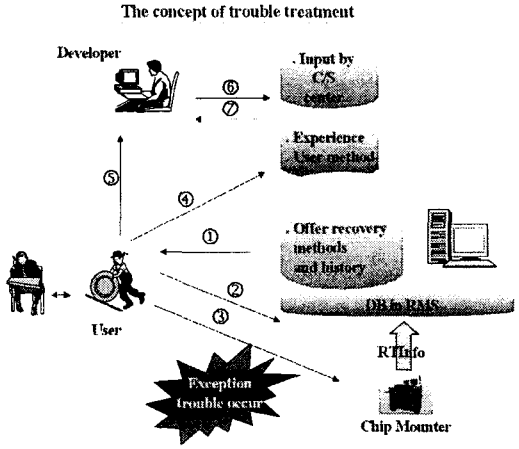

Fig. 7 The concept of trouble treatment

(1) The RMS receives the trouble code from the chip mounter through communication. The RMS shows the contents of the trouble, its cause and basic recovery methods.

(2) The user tries to recover by using the basic recovery methods that the RMS offers.

(3) When the trouble that can't be solved by basic recovery methods occurs, users recover it by themselves or with the help of other experienced users.

(4) If the recovery is performed by the user's or the experienced user's methods, that method is inputted to the RMS. The RMS saves the new inputted methods and presents it later when the same trouble occurs. This result is used for the user to choose the proper methods.

(5) If the methods that are presented from now on, don't work, the user tells the nature of the problem to developer by e-mail, chatting or telephone.

(6) After accessing the RMS, developers input the new developed recovery methods and directions. These are offered with the basic recovery method and the user's recovery methods later.

(7) Later, developers refer to the methods that are inputted by the user and use them when they develop the new version of trouble treatment methods. This has an important role as the data that is performed on the actual spot.

Fig. 8 shows the number of trouble numbers of each

code in local application.

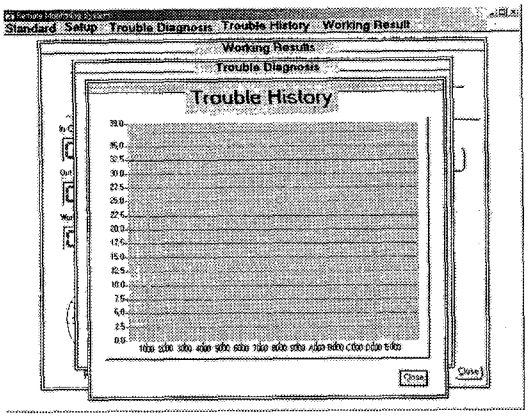

Fig. 8 Trouble history in local application

Fig. 9 shows the recovery methods that are used in web applications.

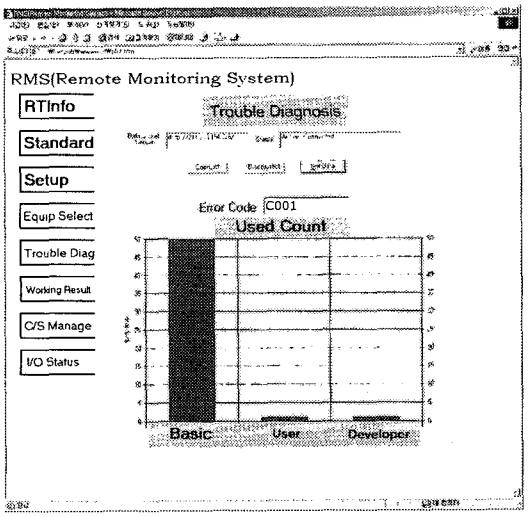

Fig. 9 The used number of each methods

Fig. 10 shows the basic recovery methods and inputting methods of the users and developers. Some parts of the chip mounter are expendable and should be changed periodically.

The RMS sends an e-mail to the users to inform them of the change time in advance. That can be helpful for the user to prepare the replacement parts. Thus, the stop time caused by lack of parts can be reduced. Fig. 11 shows the list that needs to be notified through e-mail.

The RMS can observe the I/O status of peripheral devices through the web browser. The RMS can use a total of 4 boards for I/O check. Each board has 12 ports.

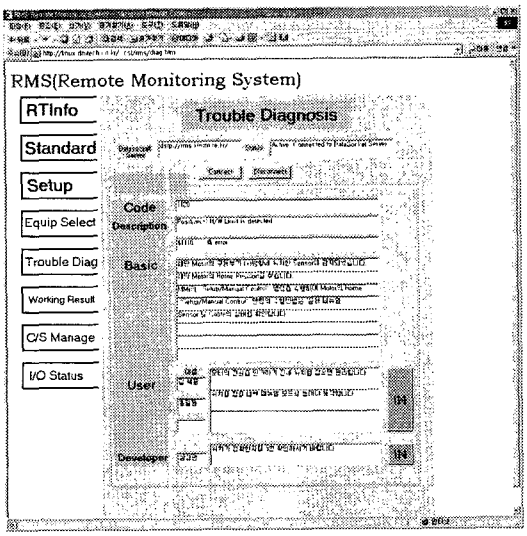

Fig. 10 Trouble diagnosis in web application

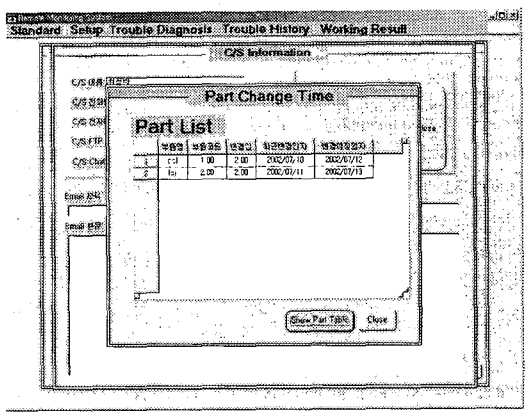

Fig. 11 expendable part list

Each port can be selected as input or output. Input and output ports are used for controlling or checking the peripheral equipment or devices of the chip mounter. However, control through the internet is not suitable for real time application because of the delay of command transmission and packet loss. The delay of command transmission and packet loss in internet control are common problems [8-11]. The RMS has an internet chatting function for wire or wireless communication obstacles in certain workshops. The chatting function is one of the communication methods. When troubles occur, the user can communicate with the A/S center to solve them it using this function.

4. Results

Most of the remote trouble diagnosis tools for equipment using the internet have just one function that transmits the breakdown to the user. Therefore it does not directly reflect the user's recovery experience or the developer's new recovery methods. If the user's or the developer's recovery method as well as the basic recovery methods are released online or on the internet, it makes the recovery faster than when only the basic methods are used. Moreover, experienced user's recovery methods are used as data to develop a more reliable equipment. The RMS offers the fast recovery methods by reflecting the user's and developer's methods as well as the basic recovery methods. This is the solution to the situation where the developer can't recover it directly because of the distance. For this, the RMS develops a trouble diagnosis and presents three recovery methods, the count function of the trouble number of each code and the presenting function of the usage number for each recovery methods. It contributes to the effective operation of the chip mounter by using the actual report of the results and the notice function of the parts replacement time. From the development of RMS, we get the results as follows:

(1)Through the RMS, we can see the operation condition of the chip mounter and its actual results. The basic methods and the user's or developer's methods are also presented when the trouble occurs. This makes it possible to reduce the recovery time. The usage number of each recovery method is used to reduce the recovery time. By counting the trouble number of each code, we can analyze the nature of the problem. The function of informing parts replacement time through e-mail contributes to reducing the stop time that can be caused by lack of parts. Through the actual results, we can check the operation condition of the chip mounter immediately.

(2) The information about actual output, work procedure, trouble management and operation rate is designed to be given only to the permitted users. However, in systems based on the internet, the following problems are significant: First, there is a case when a user without permission gets the data of the chip mounter by infiltration of the firewall. Second, private data to be saved in the server can be drained. Third, there can be DB damages and the obstacles of product management by writing false data in the DB. Fourth, the damage of the DB can occur by a computer virus [12].

(3) In remote control through the internet, if the chip mounter is directly, operated or stopped by a user without permission, the chip mounter or other devices can be damaged. This function is therefore limited to controlling the peripheral devices. Because of the traffic or packet dropout, real-time application through the internet has many difficult problems to solve.

5. Concluding Remarks

We reach the following conclusions through developing and applying the RMS

The RMS that is designed to reflect the user's and developer's methods can be used as methods to reduce the recovery time when problems occur. The RMS can also be used to improve the productivity of equipment after complementing the functions that reduce the recovery time. Because of security and safety problems, items that can be controlled through the internet require much more discussion. To protect the RMS from hacking, internet viruses and the outflow of data, security problems must continuously be studied.

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