Application

Data mining for customer service support

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Abstract

In traditional customer service support of a manufacturing environment, a customer service database usually stores two types of service information: (1) unstructured customer service reports record machine problems and its remedial actions and (2) structured data on sales, employees, and customers for day-to-day management operations. This paper investigates how to apply data mining techniques to extract knowledge from the database to support two kinds of customer service activities: decision support and machine fault diagnosis. A data mining process, based on the data mining tool DBMiner, was investigated to provide structured management data for decision support. In addition, a data mining technique that integrates neural network, case-based reasoning, and rule-based reasoning is proposed; it would search the unstructured customer service records for machine fault diagnosis. The proposed technique has been implemented to support intelligent fault diagnosis over the World Wide Web. © 2000 Elsevier Science B.V. All rights reserved.

Keywords: Data mining; Knowledge discovery in databases; Customer service support; Decision support; Machine fault diagnosis

1. Introduction

Customer service support is becoming an integral part of most multinational manufacturing companies that manufacture and market expensive machines and electronic equipment. Many companies have a customer service department that provides installation, inspection, and maintenance support for their worldwide customers. Although most of these have some engineers to handle day-to-day maintenance and small-scale troubleshooting, expert advice are often required from the manufacturing companies for more complex maintenance and repair jobs. Prompt response to a request is needed to maintain customer satisfaction. Therefore, a hot-line service centre (or help desk) is usually set up to answer frequently encountered problems from the customers.

Fig. 1 shows the workflow in a traditional hot-line service centre. The service centre is responsible for receiving reports on faulty machines or enquiries from customers via telephone calls. When a problem is reported, a service engineer will suggest a series of checkpoints for customers using the hot-line advisory system. Such suggestions are based on past experience. This has been extracted from a Customer Service Database, which contains previous service records that are identical or similar to the current problem. The customer can then try to solve the problem and subsequently confirm, with the service centre, if the problem is resolved. If the problem still persists, the centre will dispatch a service engineer to the customer's premise for an on-site repair. During such trips, the service engineer will take past records of the customer's machine, related manuals, and spare parts

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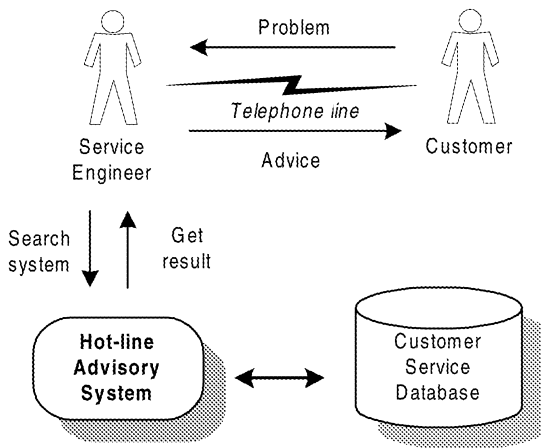*E-mail address*: asschui@ntuvax.ntu.ac.sg (S.C. Hui).

Fig. 1. Traditional hot-line service centre.

that may be required to carry out the repair. Such a process is inconvenient.

At the end of each service cycle, a customer service report is used to record the new problem and the proposed remedies or suggestions taken to rectify it. This database is used for billing purposes, as well as for maintaining a corporate knowledge base. The service centre stores the customer service report in the database.

Apart from maintaining a knowledge base on common faults and its remedies, the customer service database also stores data on sales, employees, customers and service reports. These data are not only used for day-to-day management operations, but help the company in decision making on job assignment and promotion of service engineers, and marketing, manufacturing, and maintenance of different machine models.

The customer service database serves as a repository of invaluable information and knowledge that can be utilized to assist the customer service department in supporting its activities. The objective of this paper is to discuss how to apply data mining techniques to extract knowledge from the customer service database to support two types of activities: decision support and machine fault diagnosis.

The work was carried out as a collaborative work between a multinational company and the School of Applied Science, Nanyang Technological University, Singapore. The company manufactures and supplies insertion and surface mount machines for use mainly in the electronics industry.

2. Data mining

Data mining, also known as knowledge discovery in databases (KDD) [7,9], is a rapidly emerging field. This technology is motivated by the need of new techniques to help analyze, understand or even visualize the huge amounts of stored data gathered from business and scientific applications. It is the process of discovering interesting knowledge, such as patterns, associations, changes, anomalies and significant structures from large amounts of data stored in databases, data warehouses, or other information repositories. It can be used to help companies to make better decision to stay competitive in the marketplace. The major data mining functions that are developed in commercial and research communities include summarization, association, classification, prediction and clustering. These functions can be implemented using a variety of technologies, such as database-oriented techniques, machine learning and statistical techniques [10].

Recently, a number of data mining applications and prototypes have been developed for a variety of domains [4] including marketing, banking, finance, manufacturing and health care. In addition, data mining has also been applied to other types of data such as time-series, spatial, telecommunications, web, and multimedia data. In general, the data mining process, and the data mining technique and function to be applied depend very much on the application domain and the nature of the data available.

3. Customer service support

Service records (or reports) are currently defined and stored in the customer service database. Each service record consists of customer account information and service details, which contain two types of information: *fault-condition* and *checkpoint information*. The former contains the service engineer's description of the machine fault, while the later indicates the suggested actions or services to be carried out to repair the machine, based on the actual fault-condition given by the customer. Checkpoint information contains checkpoint group name, and checkpoint description, with priority and an optional help file. The checkpoint group name is used to specify a list of group checkpoints. Each checkpoint is associated with