Sensor Data Mining System with Multiagent Approach for Metrological Data and Pachinko System

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Abstract

In this paper, we proposes the technique of the sensor data mining with multiagent approach. In the sensor data mining by multiagent approach, we define the source to which sends sensor data as agent, and sensor data analyze system including sensors and mining programs is defined as multiagent sensor data mining system. We discuss proposed multiagent system which is applied to the meteorological observation data and the data of the store system of pachinko. The meteorological observation data contains a large amount of the numerical data. The meteorological observation data also contains both of data only before and after the data observed at the regular time and the time at which special event is occurred. The purpose of the data analysis is defined as to extract the observation data of the regular time when the relation is strong to the event of thunder or lightning. The pachinko data composed the stream data of the number of pachinko bolls used to play a game with each pachinko machine and the number of balls at jackpot, etc. It is used to investigate prevention of the user from illegal using and a popular pachinko machine model.

Keyword:

Sensor Data Mining System, Multiagent Approach, Metrological Data, Pachinko Data

1 Introduction

Recently, we can obtain various data easily by a high performance of computer and the Internet. Data mining that extracted significant knowledge from a large amount of data become popular. The technique for applying data mining to text information such as Web page is developed recently though the data stored in databases was targeted in normal data mining. In the Internet, various time series data can be obtained. For instance, the image data of the weather satellite and the data of various sensors can be obtained. The feature of these data is continuous data in the time series.

The techniques which applied data mining from databases are used for time series data, but some techniques were improved for time series data.

In this paper, we proposes the technique of the sensor data mining with multiagent approach. In the sensor data mining by multiagent approach, we define the source to which sends sensor data as agent, and sensor data analyze system including sensors and mining programs is defined as multiagent sensor data mining system. The advantage of multiagent system is scalavirity of the number of sensors. It becomes to be able to correspond to the change in the number of sensors easily by constructing the multiagent system.

We discuss proposed multiagent system which is applied to the meteorological observation data and the data of the store system of pachinko. The meteorological observation data contains a large amount of the numerical data. The meteorological observation data also contains both of data only before and after the data observed at the regular time and the time at which special event is occurred. The purpose of the data analysis is defined as to extract the observation data of the regular time when the relation is strong to the event of thunder or lightning.

The pachinko is Japanese pinball. The pachinko data composed the stream data of the number of pachinko machine and the number of balls at jackpot, etc. It is used to investigate prevention of the user from illegal using and a popular pachinko machine model.

The advantage of the proposal approach is that it is easy to correspond to the change in the number of data sources. The change of the system is not to hard even when the composition of the sensor changes. Moreover, the data acquisition system from the sensor in the remote place can be easily constructed by constructing the system on the Internet.

2 Sensor Data Mining using Multiagent

In KES2003, the multiagent technology is defined as a technology that processed information by cooperatively operating two or more independent programs (agent). [1]

Generally, multiagent technology is discuss with an autonomous control of an individual agent, but in this paper, we do not discuss it mainly.

A communication between agents between one to one, one to multi, multi to multi. In this paper, we use one to one communication by UNIX process communication, one to multi by Black board model.

2.1 Agent Definitions

The definition of agent which is used for data mining in this paper is defined as follows.

Query agent: Query agent receives used the database and the data mining algorithm from a user, and generates other agents. Query agent is generated at each demand of a user.

Mining agent: Mining agent generates DB-access agent, acquires data from DB-access agent, and applies data mining algorithm. Mining agent is generated of each applied mining algorithm.

DB-access agent: DB-access agent acquires data from the database, and sends it to mining agent. DB-access agent is generated of each database and of each mining agent.

Result agent: Result agent observes a movement of mining agents, and obtains result from mining agents. When result agent obtains all results, result agent arrangement/integrates, and shows it to a user.

Black board(BB): Place where results from data mining agent is written.

2.2 Flow of System

A flow of proposed system is defined as follows. (Fig. 1 shows flowchart of proposed system.)

1. A user generates Query agent, with setting the used database and the used data mining algorithm as its parameter.

2. The place of black board(BB) is set with Query agent.

3. Query agent generates Mining agent, and the place of BB is transmitted.

4. Query agent generates Result agent, and the place of BB is transmitted.

5. DB-access agent is generated, and Mining agent is accessed to the database.

6. DB-access agent gets data from the database.

7. Mining agent receives data from DB-access agent, and applies the data mining algorithm.

8. Mining agent writes the result of data mining on BB.

9. Result agent checks BB, and if all results are written, arranges the results and presents to the user.

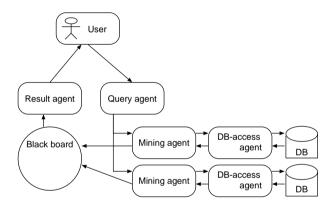10. All agents are eliminated.

Figure 1: Flowchart of Proposed System

2.3 Feature of Proposed Method

The proposal method has the following features.

The result of data mining can be made for more meaning result by building in the thesaurus agent as Mining agent, and making it can access the thesaurus database.

Query agent generates two or more Mining agent, it becomes possible to execute data mining algorithms in parallel. Moreover, it becomes possible that constructing the system and the access to the database and the processing of data are divided by separating

DB-access agent accessed the database with Mining agent that processes data.

It becomes possible that the processing of each data mining algorithm and its arrangement/integration are separately thought by setting the agent which arranges the result. Moreover, it becomes easy to build arrangement/integration according to user's purpose into the system.

The system user comes to be able to construct the system corresponding to the purpose by recycling DB Agent and Mining Agent, and do tuning of Query agent and Result agent.

In this paper, the black board model with the file was handled with the interprocess communication on UNIX, but it can be easily enhanced to the communication on TCP/IP. Then, it is possible to enhance proposed approach to application to database that has been distributed on Internet. The problem of proposed approach is not using interprocess communication on UNIX but using black board model. Writing in the black board becomes a problem when the number of databases and data mining algorithm used increase, then the entire operation is influenced from the operation of the slowest agent. Therefore, the access to database and the processing of the data mining algorithm can be run parallel, but processing stops when checking results in the blackboard. It is necessary to consider that the maximum time is set to the black board writing check, and the system can show the result after each agent process.

2.4 Adapt for Sensor Data Mining

The proposed multiagent system was for database system. Then, we expanded the proposed system for sensor data mining. In this expansion, sensor units which are data sources treat as databases, and sensor units have both sensor part which measurement system and send part which send measurement data. If the sensor units can send data for the Internet, the expanded multiagent system can easy to construct. A lot of recent sensor units can make network and send measurement data for the network. So, the proposed multiagent sensor data mining system can build into an existing sensor network system.

3 Metrological Data Mining System

We construct the meteorological data analysis system as one of the examples of applying the proposal technique, and verify the effectiveness of the proposal technique. We construct the data mining system that does data mining collecting data on the network by using the sensor network where the fixed point observation data has been disclosed on the Internet named Teiten2000.[3, 4]

In Teiten2000, the information such as temperature, humidity, and the fixed point image are collected with each sensor unit, and sensor unit preserves data in local database. In the Teiten2000 sensor network, the data of each local database ties on the network. The system by which the meteorological data analysis system that proposes it collects data from a local database of each sensor unit, and does data mining from this network. Data mining that uses the data of Teiten2000 has already been evaluated.[4]

The agent which collect data from the sensor unit and the agent which chooses two or more sensor data are being constructed now. It is scheduled that data mining from the Teiten2000 network is done after the agents are constructed, and an effective output is evaluated.

4 Pachinko Data Mining System

We construct the data mining system of the pachinko(Japanese pinball) data as an example of applying the proposal technique, and verify the effectiveness of the proposal technique.

The data mining system of the pachinko data is a system that analyzes the movement of the ball of the pachinko stand in the pachinko parlor by data mining. The sensor that examines the opening and shutting door of pachinko stand and number of output balls, the big hit(jackpot) frequency, etc. is built in and it is called stand computer("DaiCom") in each pachinko stand. Data is collected by the computer that is called island computer("ShimaCom") brings several stand computer together. In addition, the computer that is called hall computer("HallCom") collects the data of the pachinko stand of the parlor.

We build multiagent sensor mining system into this system, and construct the system that in real time moves the number of ball in data mining. It aims to detect illegal play by the outlier analysis of the movement of the number of ball, to examine the model of a popular pachinko stand, and to analyze how for the customer to play by using the constructed system.

While with the data mining system as a system that collects data from the pachinko stand by the network the system that collects the data of several stand computer("DaiCom") directly is constructed under the present situation. It is scheduled that the network

where island computer("ShimaCom") and hall computer("HallCom") were used for the pachinko stand of an actual parlor to correspond is constructed, and the multiagent sensor data mining system is built into the system.

5   Conclusion and Future Works

In this paper, we proposes the technique of the sensor data mining with multiagent approach. In the sensor data mining by multiagent approach, we define the source to which sends sensor data as agent, and sensor data analyze system including sensors and mining programs is defined as multiagent sensor data mining system. The advantage of multiagent system is scalavirity of the number of sensors. It becomes to be able to correspond to the change in the number of sensors easily by constructing the multiagent system.

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The advantage of the proposal approach is that it is easy to correspond to the change in the number of data sources. The change of the system is not to hard even when the composition of the sensor changes. Moreover, the data acquisition system from the sensor in the remote place can be easily constructed by constructing the system on the Internet.

Each system is being constructed now. The effectiveness of the system is scheduled to be verified by constructing the multiagent sensor mining system, and using actual data in the future.

Acknowledgements

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