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A Study on the Concurrency Control Model using BIRDT

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Abstract

Recently, the RFID (Radio-Frequency Identification) transaction model research concerning the processing of the RFID transaction has been actively carried out in the wireless communication environment.However, relatively insufficient amount of researches have been done on the concurrency control model from the RF communications.When communication is disconnected in this RF (radio frequency) communication environment, a data inconsistency problem arises as a result of data damage.The RFID transaction reprocessing technique is extremely important in order to maintain data consistency.In the existing RFID transaction reprocessing technique, an overhead occurs due to the sequential reprocessing.In order to improve the problem of log analysis time overhead, the proposed technique constitutes an index using a B-tree, hence is a concurrency model that works faster than the existing technique. Performance assessment results show that the proposed BIRDT technique significantly decreased the amount of overhead when reprocessing transactions, compared to the existing RFID transaction reprocessing technique.

Keywords: B-tree, Concurrency, RFID, Transaction

1 Introduction

With the recent advancement in high-speed wireless internet technology and ubiquitous technology, the RFID, which uses wireless communication technology, is being applied in various areas. Especially with the development of low-cost compact nodes, it is being applied in diverse areas such as circulation, distribution, manufacturing factories, and etc. As a result, the need for accurate and speedy processing of the RFID transactions is being called for in the RF communication. The previous studies on the RFID reported that there is a connection between transaction reprocessing and multi-level marketing routing protocol, SCM, hybrid tag, etc. [1-11]

As opposed to the existing barcode system, a more accurate and practical product identification has become possible among the readers, who use the RFID wireless communication that uses the RF signals that are more convenient, have faster recognition, and have individual tag codes [4]. However there are problems related to the tag information exposure, security holes, and tag identifier code standardization. Furthermore, problems with communication consistency occur as a result of irregular communication disruptions [7, 8]. In this paper,the consistency problems of the RF communication are addressed.

Reading/writing operations are executed incompletely as a result of inaccurate and disrupted communication.Consequently, a data inconsistency problem occurs, in which the tag memory data is only partially recorded [8]. In addition, the overlapping of the data stored on the RFID middleware via several virtual readers cause efficiency problems [5, 6].

In order to improve the efficiency problem with the existing overlapping storage problem, a tag-touch operation has been modelled with the RFID transaction. The RFID transaction guarantees consistency in the tag memory data and proposes a solution to the inconsistency problem. In order to guarantee data consistency, the Asynchronous Reprocessing RFID Transaction Model was proposed as the RFID transaction model. It guarantees transaction completion by executing the reprocessing transaction model in case of an incomplete transaction. Furthermore, the RFID data consistency is ensured with the concurrency control based on the continuous inquiring [8]. However, this technique [8] may not operate completely due to the intermittence and inaccuracy of the RFID communication. At this point the reprocessing (reading/writing operations) transactions need to be analysed for the unclear processes. It is either the incomplete reprocessing transaction or a sub-transaction that includes the unprocessed operation. If the RFID transaction process results are confirmed to be incomplete, the reprocessing operation and the reprocessing transaction will be generated. The domain of the reprocessing operation is in the unprocessed data of incomplete operations, and the reprocessing transaction includes the operations after which were not processed. At this point it sequentially analyses reprocessing operations in order to ensure consistency. As a result, a lot of analysis overheads are produced [8].

A problem with the existing technique is that it takes a long time to recover, because the generation of reprocessing transactions of the existing technique is done in a similar way as that of the sequential files. Thus, this paper proposes a new reprocessing transaction technique that eliminates overhead when generating a reprocessing transaction.

The technique proposed in this paper is called the B-tree Index Reprocessing Directory Transaction Model (hereinafter referred to as BIRDT) technique, which shows improvement compared to the Asynchronous Reprocessing RFID Transaction Model technique. Consisting of the index, which uses the B-tree, this technique proposes a faster concurrency control model than the existing Asynchronous Reprocessing RFID Transaction Model technique.

2 Related Studies

2.1 Asynchronous Reprocessing RFID Transaction Model

The Asynchronous Reprocessing RFID Transaction Model is a model that guarantees consistency and atomicity in transactions by generating a reprocessing transaction in the event of an incomplete RFID transaction. A detailed generating process of the reprocessing transaction is as follows. First, as soon as the processed RFID transaction result is verified as incomplete, it generates reprocessing operation and reprocessing transaction. Second, those incomplete transactions are recorded as complete in the server application. Third, the middleware suspends the transaction and runs the reprocessing transaction. The RFID transaction controls concurrency by processing the reprocessing transactions before other transactions. The concurrency control is achieved by separating and sequentially processing the reprocessing transaction inquiries and the user transaction inquiries. In the case of an incomplete reprocessing transaction, the reprocessing transaction of the incomplete reprocessing transaction generates an overlap. Consequently, the unprocessed transaction is assumed to be concluded in a way that enables the subsequent reprocessing. The problem with this technique is that the processing of the reprocessing transaction is done in a similar order as that of the sequential files, hence resulting in a long processing time [8].

3Concurrency Control Model using the BIRDT

This chapter proposes the B-tree reprocessing directory transaction model that uses a B-tree in order to improve the overhead that occurs when reprocessing transactions using the Asynchronous Reprocessing RFID Transaction Model.

3.1 BIRDT Model

The system architecture of the proposed model is consists of the database, RFID transaction table, redo log buffer, and BIRDT module.The detailed algorithm of the system architecture being proposed in this paper is as follows.

First, the RFID table is a table, in which the transaction information tag events are recorded.Second, the redo log consists of the entry block, where the information and log files are stored in the event of a transaction. Third, the B-tree index structure is used to perform a speedy search of log information, direct search, and range search. Also, in the B-tree index the redo log segment directory is indicated by a pointer.Fourth, the redo log segment directory retains redo log files for each individual segment, which are then used to reprocess the RFID transaction.Fifth, it records the reprocessing transaction log number concerning the RFID tag information. This information performs concurrency control via the RFID transaction table in order to resolve conflicting transactions.

The processing mechanism of the BIRDT begins with the re-recognition of the tag event, which has been suspended as a result of incomplete communication. At this point, it must first use the B-tree to find the relevant entry, in order to search the stored information of the re-recognized RFID transaction. With the pointer in the entry, it searches the directory in which the RFID transaction is stored and sequentially runs the tag operation. If an overflow occurs from the entry block at this time, it divides using the B-tree technique, which in turn leads to the increase and expansion in the new directory. The B-tree can process speedy transactions by implementing the node structure of the tree. Consequently, the BIRDT technique can speedily analyze log information by using a B-tree to form directory. As a result, the overhead in the processing time for reprocessing transaction during concurrency control can be decreased.

4 Performance Assessment

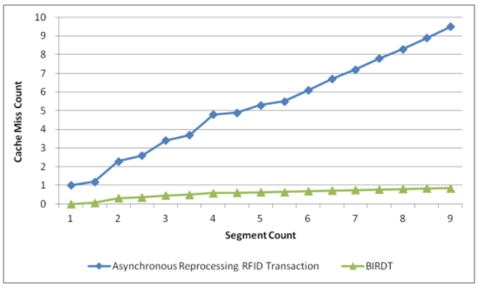
In this chapter, a performance assessment of the existing technique and the suggested technique are presented. The existing Asynchronous Reprocessing RFID Transaction Model technique is designed to process reprocessing transactions sequentially, and the proposed BIRDT technique consists of a B-tree index directory. The concurrency control modeling analysis was performed after modifying the proposed BIRDT to suit the research environment.

4.1 Experiment Performance Measurement

This experiment recorded the cache miss counts and the tree height of the Asynchronous Reprocessing RFID Transaction Model technique and the BIRDT technique, using Intel Core i7(2.50GHz), 8GB RAM.

4.2 Performance Comparison Analysis and Evaluation

Figure 1 indicates the cache miss count according to the segment numbers of the Asynchronous Reprocessing RFID Transaction Model technique and the BIRDT technique by generating random segment numbers from 1 to 10. The reason why the BIRDT technique has a lower cache miss count than the Asynchronous Reprocessing RFID Transaction Model technique is because the internal node block of the B-tree uses a node block that has the size of the cache memory block inside the cache memory.



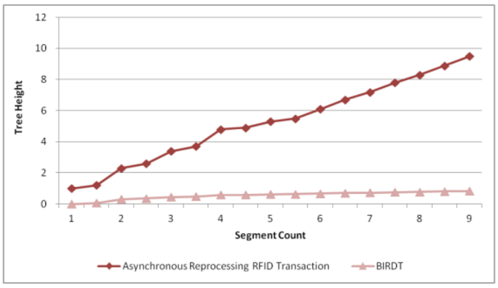


Fig 1. Cache Miss Count of Segment CountFig 2.Cache Miss Count of Segment Count

Figure 2 shows the tree height according to the segment numbers by generating random segment numbers as in figure 1. The reason why the tree height of the BIRDT technique is shorter than that of the Asynchronous Reprocessing RFID Transaction Model technique is because the B-tree, being a binary tree that produces up to 2 offspring nodes, has the redo entry information in the offspring node and therefore has a faster reprocessing speed than the existing technique, which reprocesses sequentially.

The experiment result analysis suggests that the proposed technique shows an improvement compared to the existing technique. Because the proposed technique has an increase in the segment numbers, hence produces less cache, compared to the existing technique, it also takes less time to perform concurrency control. The reason why the BIRDT technique is superior is because while the log directory of the Asynchronous Reprocessing RFID Transaction Model technique is made up of sequential files, requiring longer time to analyze log files, the BIRDT technique applies the B-tree and uses segments as data units, which in turn leads to maintain a consistent log file analysis time regardless of the amount of data.

5 Conclusion

The Asynchronous Reprocessing RFID Transaction Model was proposed as a solution to the data inconsistency problem caused by unclear communication in the RF Communication. However, since the Asynchronous Reprocessing RFID Transaction Model sequentially processes the reprocessing transaction, a lot of overheads occur in the concurrency control. To address this problem, the BIRDT technique was proposed, in which the overhead of the existing technique is found to have been improved. In order to evaluate the performance, the existing technique and the proposed BIRDT technique are compared and analyzed. Compared to the existing technique, the application of the B-index in the proposed technique reduced the log search time and resulted in a superior performance, in terms of the processing of aligned data and storage space efficiency. The performance assessment showed that the BIRDT technique shows a great improvement compared to the existing technique.

In the future, I wish to conduct research on a technique that can process the reprocessing transactions even faster and more effectively than the BIRDT technique.

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