A Relational Database Machine
for Very Large Information Retrieval Systems

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Abstract

An overview is presented of a new advanced relational database machine (ADAM) for very large information retrieval systems. Novel features of ADAM are as follows.

(1) A relation is divided into several parts and stored in general purpose magnetic disks. A parallel access method and a clustering technique based on the extended K-d tree are employed to shorten data transfer time from disks to the main memory.

(2) Selection operations are performed at the time of the data transfer by specialized hardware attached to a disk controller. A table based on the finite state machine is used to perform text search of selection operations.

(3) The three-phase (filtering, sorting and comparing) join method is used to accelerate join operations. Each phase is performed in parallel by specialized hardware.

The performance of ADAM is two orders higher than that of conventional general purpose computers when applied to very large information retrieval systems. The cost performance is also one order of magnitude better.

1. Introduction

Many information retrieval systems storing a variety of databases are now available. Most of these systems provide secondary data which are converted from original data for the purpose of computer retrieval. In document retrieval systems, for example, databases consist of bibliography
lists, abstracts and keywords which are appended to the bibliography lists by specialists. Problems that arise with systems providing secondary rather than original data are the following.

(1) Enormous specialist manpower is needed to convert original data into secondary data. Extracting abstracts and keywords from the original data is an especially painstaking task.

(2) The use of data can change as time passes. Flexible response to the change is difficult when access paths to the data are restricted by indexed keywords.

(3) Special techniques for specifying keywords are necessary because retrieval results depend on these keywords.

On the other hand, systems which provide original data have the great advantage that the data can be utilized for a variety of purposes. Development of such systems has tended recently to become easier, as the cost of data storage continues to drop dramatically and as efficient devices for inputting or outputting large quantities of data become available. It is presently, however, impossible to develop online systems which provide large amounts of original data, because general purpose computers do not yet have sufficient power to handle original data.

Many relational database machines (RDBM) have been proposed owing to rapid hardware cost reductions with LSI technology (e.g.[1],[2],[3]). The relational database model is suitable for handling original data because of its flexible data manipulation facilities. Conventional RDBMs have, however, been organized to handle databases of small or medium size (on the order of several gigabytes) and have not yet been able to handle very large (on the order of several hundred gigabytes) databases of original data at a reasonable cost. This is because some of them use special content addressable storage devices and some of their main processors are small microprocessors which work alone.

This paper outlines the overall architecture of a new relational database machine (ADAM: Advanced Database Machine) for very large database systems. ADAM includes mechanisms for high speed disk access, high speed searching, and high speed join operations.

ADAM constructed using the state-of-the-art technology can retrieve data from very large databases two orders of magnitude faster than general purpose computers. The cost performance for the system has also been