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THE SPECIFIC WAY OF THE DATA STORAGE IMPLEMENTATION IN THE ROBOT SOCCER GAME

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Abstract: This paper is focused on application of in-memory database system in a project game of robot soccer. It will provide an account of reasons why we are using database system to store data. It will present features of database system with strict time responses. We will describe benefits and disadvantages of the concrete solution. Plans for future work will be mentioned in the following text. *Copyright © 2005 IFAC*

Keywords: real time, database systems, database structure.

1. INTRODUCTION

Application data is stored in certain representations in the most of information systems. We distinguish one specific type of systems, which we call the database systems. These systems contain only functions for data operations. This includes the next four basic operations – insert, update, select, delete. Two main benefits of using of these systems are separation of the application logic and of the data part, thus we do not deal with the data storage. Data part defines data structures that are available to your program. Application programmer does not have to create several representations when he uses database systems.

1.1 Particular database systems with strict time responses

There exists a small group of database systems which must allow to work with stored data with pre-prepared, well-known and defined responses. If we get required information after predefined time intervals then the acquired information is obsolete. This group of systems is named *real time database systems* (RTDBS). Real time database systems are similar to the conventional databases in the way they encapsulate data as a resource, provide a central control of data and efficient algorithms for data storing, searching and manipulation. Though, real time systems are developed mostly on individual basis for particular applications because the standard database systems are not suitable for real-time applications.

1.2 Data Storage Component of the Database System

It is possible to use a special type of storage in the database system. Databases with all data stored in the RAM memory are called *in-memory* database systems (it may or may not be subset of the group of real time database systems).

In the classical database system, the algorithms of query processing are optimized to reduce the number of accesses to the data structure on the hard disk and to improve performance by means of the binary blocks transfer.

While using in-memory resident database systems these principles are less important and primary effort is to reduce CPU's workload.

Conventional access methods and database structures are inconvenient in this case. Data structures in memory may be organized in other way than hard drive data. For example it is possible to save memory space. If data item occurs in database more than once we can simply store only one copy of the data item and create pointers to it. Also indexing schema used in the in-memory database may be different. The general index schemata in database systems based on the hard drive principle are called B-trees. Because the index is stored on the drive block-by-block, these blocks must be low-level. Search operations in multilevel trees are much faster in the main memory. For this reason it is possible to use more complex multilevel trees while using the main memory compared to the hard drive solution.

This is why certain modifications of the B-tree have been made and so-called T-tree was designed. The T-tree is a binary tree with more elements for one node.

2. UNIVERSAL DESCRIPTION OF THE ROBOT SOCCER GAME

The Robot Soccer game is the project in which we use database system. A match is played by two teams, each consisting of three (small league) or five (middle league) robots, one of which may be the goalkeeper. Only three human team members, a "manager", a "coach" and a "trainer", will be allowed on the stage. One host computer per team is allowed, mainly dedicated to vision processing and other location identifying tasks. Team which scores more goals is the winner.

The goal in the robot soccer game is valid in the same way as in the classical soccer, but rules of the game alone are specific and formulated in the way that allows technical requirements to be met.
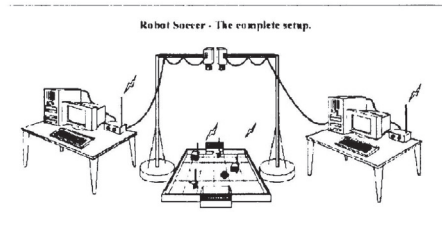

Fig. 1. This figure displayes basic components which are necessary to play the game.

The overall Robot Football system comprises of four main components:
1. the robots
2. host computer
3. vision system
4. communications

Of course, there must exist an information channel to share data between parts described above.

2.1 Each step of the game

What is happening within one step of the game? First of all, one step takes about ~20ms. During this time all tasks that are necessary to change actual state of robots are performed. We will now provide more detailed description of all operations. First of all, a picture of the actual state is obtained from the camera. Next step is processing of the captured picture that consists of position recognition of our robot team members and of the ball. This is managed by the host computer and it is not processed in the robot. We try to utilize optical sensor on the robot to provide us by another source of the position information. New instructions are assigned according to previous positions. Next operation is computing closest strategy step for the each robot. These strategies are called high-level strategies and as they provide us with information what the robot must do in the actual state, they do not have to specify exactly how this activity has to be done. The next step is the search for low-level strategies that contain the information necessary for realization of steps assigned by the high-level strategy. Processing of the low-level strategy output follows. The speed of each wheel is set accordingly to this output. Last step is sending these configuration parameters over wireless network to the robot.

We use robots which do not have any part of "intelligence" themselves now, but it will be changed soon. Vision processing and strategy selection will be moved to robots.

3. PART OF THE DATABASE SYSTEM OF THE ROBOT SOCCER SYSTEM

We are developing the database system that provides the fastest access to data. It is not a separate application. It means that we do not have to provide

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