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Title: Bigdata challenges in health monitoring

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ABTSRACT

The use of sensor networks with long-term monitoring capabilities such as structural health monitoring (SHM) has become a part of the everyday routine in ageing societies. For that matter the huge amount of data coming from these solutions require novel bigdata analyses strategies. Not only because the continuously increasing records in the database pose processing challenges but also with the appearance of a new device that generates new types of attributes, the data storage structure changes. A significant amount time is spent by bigdata experts developing a common structure for the data coming from different sources and not on the analysing processes themselves. Modern database management systems fall into two broad classes: Relational Database Management System (RDBMS) and Not Only Structured Query Language (NoSQL). NoSQL models give room for bigdata storage and management but with the introduction of a new type of entity-attribute, a new application becomes mandatory. Maintaining a NoSQL model based database requires continuous system development. We designed a database management logic that provides an opportunity to store and interpret each data in only one data table (like in NoSQL databases) while the data handling processes can be completed by SQL commands. This logic contributes to the interoperability between the relational and non-relational systems where converting application usage is unnecessary. Using a coding mechanism developed by us, each attribute needs only one index for indexing in the database. Using this logic the bigdata management become possible without changing the data storage structure when introducing new entity-attributes.

OBJECTIVES

Our main objective was to develop a data storage logic that is able to:

- decrease the developing processes in SHM systems
- store each data in a single datable
- manage the stored data by SQL commands
- accelerate queries in the cloud
- index each attribute in the database
- determine virtual tables in the single big data table (user friendly operations)

METHODS

The technical environment is Oracle Application Express (Apex) 5.0 cloud-based technology. Workstation: OS (which is indifferent) + internet browser (Chrome). Specification of the physical data table structure was determined with 4 fours columns -ID (num), -ATTRIBUTE (num) is the identifier of the attribute; -VALUE (VARCHAR2) and Primary_ID (num) determined by Oracle. Firstly, basic relationships are stored which help to describe the names of attributes (columns), type of relationships (belonging to the structure) and virtual data tables (belonging to the virtual data table). In the second step, the records witch form virtual records (records having the same ID numbers) are displayed. The physical records with the same ID values mean a virtual record (entity) in the current logic based databases. These identifiers can be any natural number that has not already been used in the ID column. In the third step, records witch form new attributes are also displayed. The values of these identifiers can be any natural number that has not already been used in the Attribute column. Each attributes are identified in the Attribute column. In the fourth step, the attributes are assigned to each virtual data table using a previously introduced attribute called "belonging to the virtual data table".

ID	Attribute	Value	Primary ID
x1	y1	z1	1
x1	y2	z2	2
x1	y3	z3	3
x2	y1	z4	4
x2	y2	z5	5
x2	y3	z3	6
x3	y3	z9	7

Figure 1 : NoSQL data storage concept integrated into SQL environment

Records with the same ID value identify an entity in this concept. The codes which are stored in the Attribute column are also defined, sooner or later, in the ID column. At that time the attribute becomes an entity. In every case, the subjectivity determines the depth of entity-attribute definition in the physical data table.

RESULTS

This novel logic-based databases can be defined using primitive relation scheme known as a three-tuple according to Paredaens (1989) concept: PRS = (ω,δ, dom) where ω is a finite set of attributes, in our case, it is the set of entities from the ATTRIBUTES virtual data table. δ is a finite set of entities, in our case, it is a set of virtual records. dom : ω → δ is a function that associates each attribute to an entity; it can be interpreted as a predefined set of attributes called "1:N registry hive". This function is used to maintain the entities in the virtual data tables. A relation scheme (or briefly a relation) is a three-tuple RS=(PRS,M,SC) where PRS is a primitive relation scheme; M is the meaning of the relation. This is an informal component of the definition, since it refers to the real world and since we will describe it using a natural language. SC is a set of relation constraints.

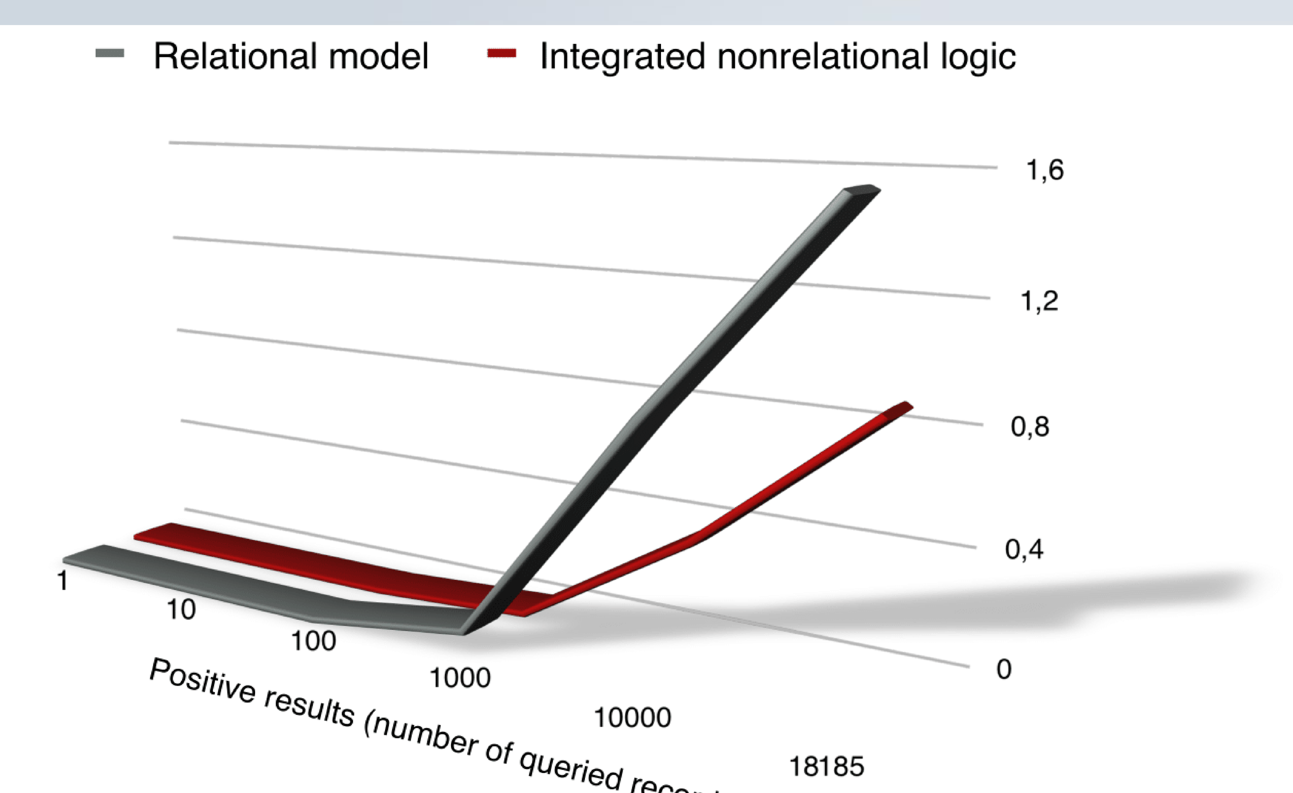

Figure 2 : Differences between query times (sec)

Similarly to most NoSQL models, the speed of our system lies in vertical data expansion, and sequential search is not used as it slows queries. A database was created in Oracle APEX environment based on our model which ensures faster queries than the usual-relational data models. The faster queries prevailed on every attribute that could be indexed in our system which is not usual in a relational environment where generally 2-3 (in the presented example 3) attributes are indexed.

CONCLUSIONS

With the developed logic, one data table data storage is ensured in SQL database systems for the storage and management of long term scientific information.
The developed model contributes to building a universal platform where the data and their relationships from different databases can support each others systems. With the further development of the logic there is a significant chance to make software compatibility.

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