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A review on Visualization Approaches of Data mining in heavy spatial databases

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Abstract: *Data mining is the phenomenon to extract and recognized the new required pattern or types from the large data seta or data bases and whatever required data is being extracted and separated from large data bases then it is stored and that needs to give some sort of briefing via visualization and its techniques and then it is being recognized it important pattern and analysis identifications. And which is having a very common methodology of displaying the spatial data bases or data sets to search for the required pattern. no doubt its quit typical to search and browse the spatial data bases for human beings to browse and identify from a such huge collection of data bases. There for data mining algorithmic techniques is applied to filter and sort out the spatial data sets as per the requirements .A new web based visualization application is being devolved for supervising of spatial patterns and temporal, Data mining algorithm for sorting and searching from large spatial data sets also being presenting and that algorithm is tested on real time experienced. Hence in this paper a review is being presented on visualization approaches of data mining in large spatial data sets.*
Keywords: *Data Mining, Data Visualization; Visualization techniques; visual data mining*

I. Introduction

1.1 Concept And Background

Data mining is a process to extract implicit, nontrivial, previously unknown and potentially useful information (such as knowledge rules, constraints, regularities) from data in databases [1,2]. The explosive growth in data and databases used in business management, government administration, and scientific data analysis has created a need for tools that can automatically transform the processed data into useful information and knowledge. Data mining allows organizations and companies to extract useful information from the vast amount of data they have gathered, thus helping them make more effective decisions. Spatial data mining [3, 4, 5, 6, 7], a subfield of data mining, is concerned with the discovery of interesting and This work is partially supported by the Army High Performance Computing Research Center under the auspices of the Department of the Army, Army Research Laboratory cooperative agreement number DAAD19-01-2-0014,the content of which does not necessarily reflect the position or the policy of the government, and no official endorsement should be inferred. Chang-Tine Lu is currently with the Department of Computer Science, Northern Virginia Center, Virginia Tech. useful but implicit knowledge in spatial databases. With the huge amount of spatial data obtained from satellite images, medical images, and geographical information systems (GIS), it is a non-trivial task for humans to explore spatial data in detail. Spatial datasets and patterns are abundant in many application domains related to NASA, the Environmental Protection Agency, the National Institute of Standards and Technology, and the Department of Transportation. A key goal of spatial data mining is to partially automate knowledge discovery, i.e., search for "nuggets" of information embedded in very large quantities of spatial data. Challenges in spatial data mining arise from the following issues. First, classical data mining is designed to process numbers and categories. In contrast, spatial data is more complex and includes extended objects such as points, lines, and polygons. Second, classical data mining works with explicit inputs, whereas spatial predicates and attributes are often implicit. Third, classical data mining treats each input independently of other inputs, while spatial patterns often exhibit continuity and high autocorrelation among nearby features.

1.2 Data mining Architecture

Data mining is a knowledge discovery process; it is the analysis step of knowledge discovery in databases or KDD for short. As an interdisciplinary field of computer science, it involves techniques from fields such as artificial intelligence AI, machine learning, probability and statistics theory, and business intelligence.

As in actual mining, where useful substance is mined out of large deposits hidden deep with mine. Data mining mines meaningful and hidden patterns, and it's highly related to mathematical statistics. Though utilizing pattern recognition techniques, AI techniques, and even socio-economic aspects are taken into consideration. Data mining is used in today's ever-growing databases to achieve business superiority, finding genome sequences, automated decision making, monitoring and diagnosing engineering processes, and for drug discovery and diagnosis in medical and health care [8]. Data Mining, as with other Business Intelligence tools, efficiency is affected by the Data Warehousing solution used [9, 10].

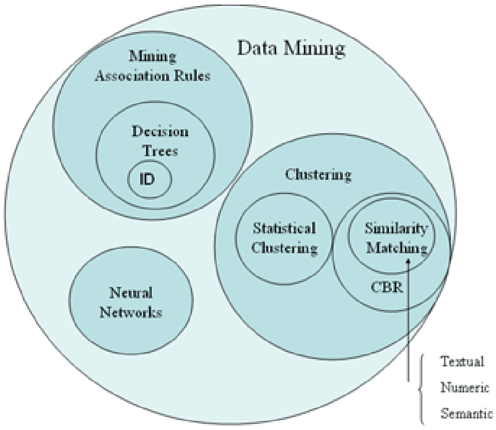

Fig:1 Data mining concept

1.3 Concept Of Visualization

Visualization is a mental image or a visual representation of an object or scene or person or abstraction that is similar to visual perception [11]. Visualization has many definition but the most referred one, which is found in literature is "the use of computer-supported, interactive, visual representations of data to amplify cognition", where cognition means the power of human perception or in simple words the acquisition or use of knowledge [12] [13]. Visualization is a graphical representation that best conveys the complicated ideas clearly, precisely, and efficiently. These graphical depictions are easily understood and interpret effectively [14] The main goal of Visualization is to find out what insight. Visualization is the transformation of Symbolic representation to geometric representation. The goal of visualization is to analyze, explore The visualization is a powerful tool that can be use for different cognitive processes like exploratory, analytical and descriptive [15].

1.4 Spatial Data Warehouse

A data ware house (DW) [16, 17, 18] is a repository of subject oriented, integrated, and non-volatile information whose aim is to support knowledge workers (executives, managers, analysts) to make better and faster decisions. Data warehouses contain large amounts of information collected from a variety of independent sources and are often maintained separately from the operational databases. Spatial data warehouses contain geographic data, e.g., satellite images, aerial photographs [19, 20, 21, 22], in addition to non-spatial data. Examples of spatial data ware houses include the US Census dataset [23], Earth Observation System archives of satellite imagery [24], and Sequoia 2000 [25], and highway traffic measurement archives. The research on spatial data warehouses has focused on case studies [26, 27] and on the per-dimension concept hierarchy [28]. A major difference between conventional and spatial data warehouses lies in the visualization of the results. Conventional data warehouse OLAP results are often shown as summary tables or spread sheets of text and numbers, whereas in the case of spatial data warehouses the results may be albums of maps.

1.5 Spatial Data Mining

Spatial data mining is a process of discovering interesting and useful but implicit spatial patterns. With the huge amount of spatial data obtained from satellite images, medical images, GIS, etc., it is a non-trivial task for humans to explore spatial data in detail. Spatial datasets and patterns are abundant in many application domains related to NASA, EPA, NIST, and USDOT. A key goal of spatial data mining

is to partially 'automate' knowledge discovery, i.e. search for "nuggets" of information embedded in very large quantities of spatial data. Efficient tools for extracting information [28] from spatial data sets can be of importance to organizations which own, generate, and manage large geo-spatial data sets [28].

II. Literature Review

2.1 Process Of Visualization

The approach of designing well disciplined visualization the process can be divided into different steps. The literature [29] "Chittaro, 2006" contains a list of six different steps i.e. mapping, selection, presentation, interactivity, usability, and evaluation, which identifies major activities involving visualization, to aim precise and error less design. The following subsection explains briefly these six activities:

1) First step of visualization process is known is Mapping. Mapping means how to visualize information or how to encode information into visual form
2) Second step of visualization process is called Selection. Selection means to select data among those data which is available according to the given task or job.
3) Third phase of the process is Presentation. In visualization perspective presentation means how to manage, organize information in the available space on the screen effectively. After intuitive mapping, clear and precise selection of data items it is really important to present it in more meaningful and understandable form [30]
4) After creating usable visualization interface, the last step is to evaluate the created visual form. Evaluation is equally important, to find out whether the visualization method has effectiveness or not, the goal is achieved or not. The challenges confront visualization evaluation is proposed by Pleasant [31].

2.2 Challenges In Visualization

The creation or production of a perfect visualization method is a big challenge in order to fulfill all the requirement of users. Visualization is suffering through many problems. In this perspective Chaomei Chen introduce a very comprehensive document with the title "Top 10 Unsolved Information Visualization Problems" [32]. When someone wants to produce as effective visualization technique, he/she should try to consider all the discussed aspects. Usability issues are critical issues for visualization, which means how to make it easy to use and efficient. The visualization should offer enough information and satisfied user. Understanding elementary perceptual–cognitive tasks is the basic step regarding information visualization engineering, providing it according to human perception capability. Requires Prior knowledge about method, how to operate and use it, it should make it more generic, means the users have common understanding about techniques. Education and Training is requires for the researchers and practitioners to share the basic principles and skills about information visualization methods. The lack of intrinsic quality measures means there is no common evaluation and selection mechanism plus the unavailability of bench marks undermine advances in visualization methods. One of the long lasting problem is Scalability, how to manage huge visualization in available space, example [33]. Researchers are much focus on scalability problem in data streams, which is explain by Wong et al, 2003 [34].

2.3 Types of Visualization Methods

Visualization techniques or methods are categorized differently by different authors. There is three categories of visualization i.e. information visualization, software visualization, and Scientific visualization. **Scientific visualization** helps to understand physical phenomena in data, mathematical models, in isosurfaces, volume rendering, and glyphs etc.

2.3.1 Software Visualization

Helps people to learn the use of computer software, program visualization helps programmers to handle complex software, and similarly algorithm animation support, encourage, and motivate student to learn the computation capability of an algorithm.

2.3.2 Information Visualization is "the depiction of information using spatial or graphical representations to facilitate comparison, pattern recognition, change detection, and other cognitive skills by making use of visual system". In periodic table of visualization six main categories are mentioned, i.e. it **visually** represents quantitative data with or without axes in schematic or diagrammatic forms e.g. Table, Line chart, Pie chart, Histogram, and Scatter plot etc. it is an interactive interface of data to increase cognition or perception ability. Transform data into a changeable image, through which users can interact during manipulation, e.g. Data map, Tree map, Clustering, Semantic network, Time line, and Venn/ Euler diagram etc. there are various types of Information visualization are as follows

2.3.2.1 Parallel Coordinates
2.3.2.2 Tree Map
2.3.2.3Entity Relationship Diagram

2.3.2.4 Cone Tree
2.3.2.5 Time Line example of Flow Chart
2.3.2.6 Data Flow Diagram
2.3.2.7 Venn Diagram
2.3.2.8 Semantic Network

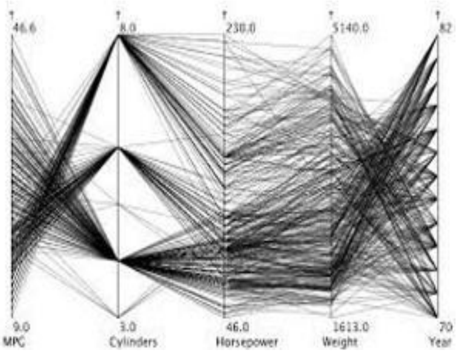

Fig: 2.3.2.1 Parallel Coordinates

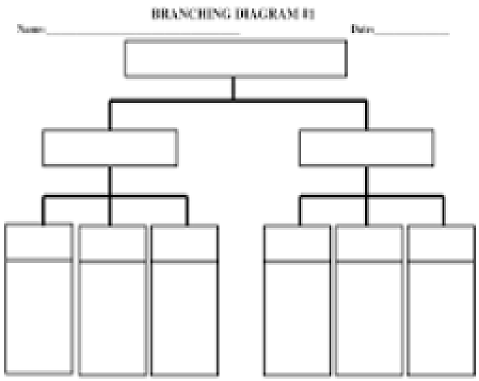

Fig:2.3.2.2 Tree Map

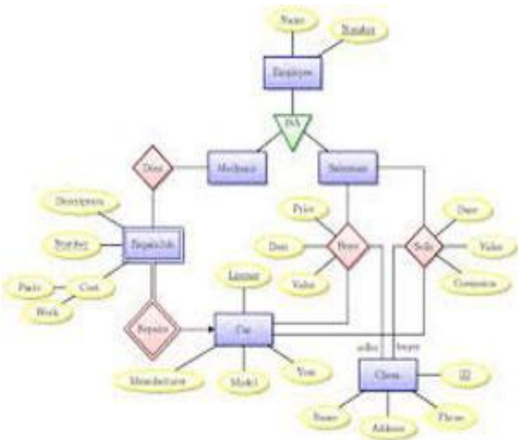

Fig:2.3.2.3 Entity Relationship Diagram

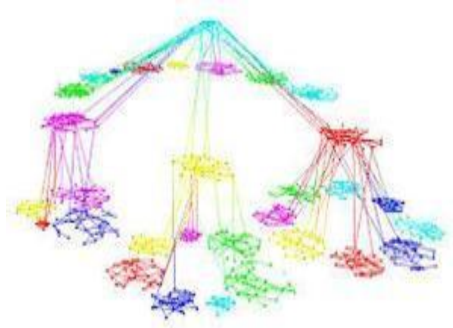

Fig:2.3.2.4 Cone Tree

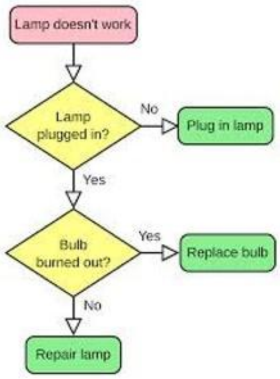

Fig:2.3.2.5 Time Line example of Flow Chart

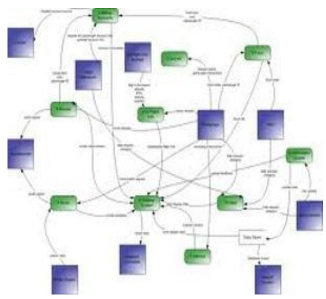

Fig: 2.3.2.6 Data Flow Diagram

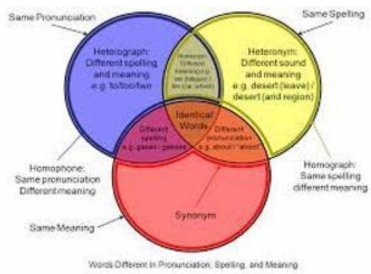

Fig: 2.3.2.7 Venn Diagram

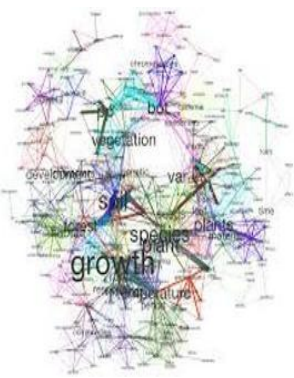

Fig: 2.3.2.8 Semantic Network

2.3.3 Concept Visualizations are methods use to elaborate ideas, plan, concepts, and analyze it easily, e.g. Mind map, Layer chart, Concentric circle, Decision tree, Pert chart etc.

2.3.4 Strategic Visualization is a systematic approach in which an organization visually represent it strategies of development, formulation, communication, implementation, and some time its analysis, e.g. Organizational chart, Strategy map, Failure tree, and Portfolio diagram etc.

2.3.5 Metaphor Visualization

Organizes and structure information graphically. They convey insight of information through key characteristics of metaphor that is employed, e.g. Metro map, Story template, Funnel, and Tree etc. **Compound visualization** is the complementary use of different graphic representation formats in one single schema or frame, e.g. Cartoon, Rich picture, Knowledge map, and Learning map etc

2.3.6 Data Visualization

Visually represents quantitative data with or without axes in schematic or diagrammatic forms e.g. Table, Line chart, Pie chart, Histogram, and Scatter plot etc
[35] [36]. There are various types of data visualization are as follows

2.3.6.1 Table
2.3.6.2 Pie Chart
2.3.6.3 Bar Chart
2.3.6.4 Histogram
2.3.6.5 Line Chart
2.3.6.6 Area Chart
2.3.6.7 Scatter Plot
2.3.6.8 Bubble Chart
2.3.6.9 Multiple Data Series

	eERM	IE Data model	SAP SERM	SeDaM model	eERM attribute allocation diagram
Relationship type	x	(x)			x
Cluster/Data model	x	x	x	x	
Entity type	x	x	x	x	x
ERM attribute	x	x	x	x	x
ERM domain	x				x
Generalization type	x	x	x	x	x
Attribute type group	x			x	x
Enumeration occurrence	x				x
Enumeration	x				x
Measurement unit	x				x
Measurement unit number	x				x

Table 1: Object types in ER diagrams

Fig: 2.3.6.1 Table

Fig: 2.3.6.2 Pie Chart

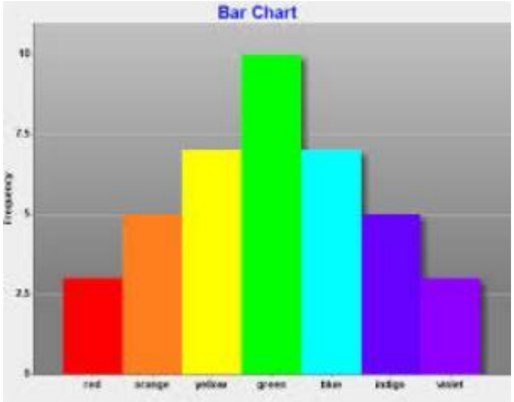

Fig: 2.3.6.3 Bar Chart

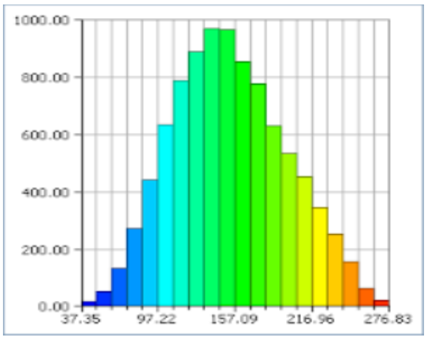

Fig: 2.3.6.4 Histogram

Fig: 2.3.6.5 Line Chart

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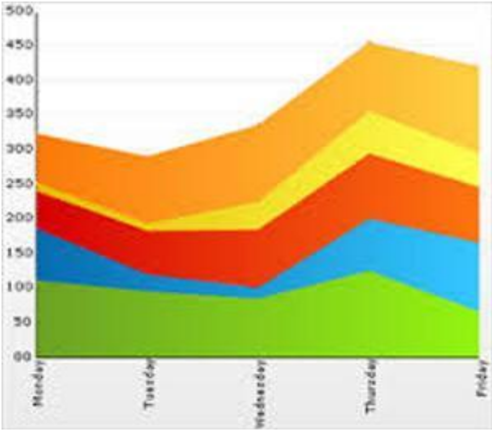

Fig: 2.3.6.6 Area Chart

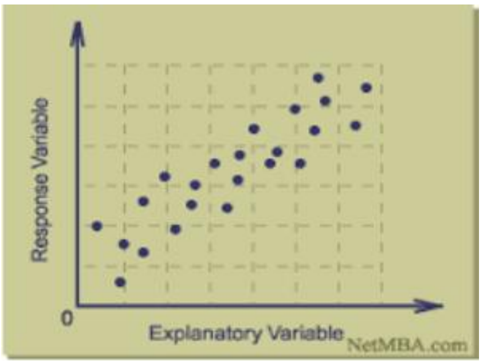

Fig: 2.3.6.7 Scatter Plot

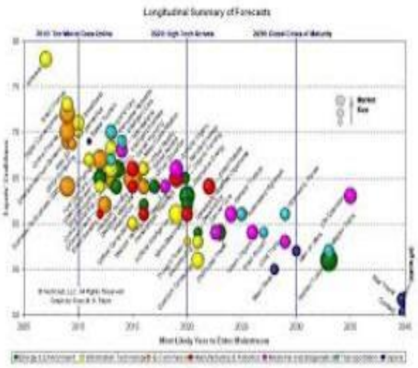

Fig: 2.3.6.8 Bubble Chart

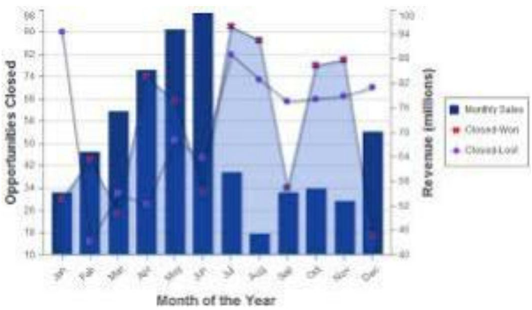

Fig: 2.3.6.9 Multiple Data Series

2.4 Applications Of Data Mining

Applications of data mining vary, depending on the nature of the data to be mined. Since its inception data mining was used in various other fields. The classical application of data mining encompasses statistical and probabilistic applications. These classical applications included for example, population census studies, biosphere analysis, and marine life and oceanography.

2.4.1 Spatial Data Mining

Spatial databases are databases that have unique data; this data is about space and geometry, such as the coordinates of earth, maps, and satellite data. This data is in the form of geological or geographical data. Such databases are extremely large and the data seems for the most part unrelated, and without any signs or correlations. Data mining is a natural candidate to find logic and make sense of such data. Data visualization, which was discussed earlier, is another tool of data mining heavily used in spatial databases. Spatial databases are also used in geographical for marketing, traffic control and analysis, and GIS systems [37].

2.4.2 Business Intelligence

Data mining help business intelligence in many ways and for that, it is one of the fundamental tools of business intelligence. Business intelligence's (BI) goals are to gain a competitive advantage over competitors, increase productivity and effectiveness of current business operations, and to maintain a balance and control of risk management. Business intelligence is a usual task of any Enterprise Resource Planning ERP solution [38]

2.4.3 Text Mining

Another widely used application of data mining is text mining. Text mining deals with textual data rather than records stored in a regular database. It is defined as an automated discovery of hidden patterns, knowledge, or unknown information from textual data [39]. Most of data found on the World Wide Web WWW is text, after distilling the multimedia elements; most of knowledge out there is text. Text mining utilizes different techniques and methodologies, mostly linguistic and grammatical techniques, such as the Natural Language Processing NLP.

2.4.4 Web Mining

With the revolution of the Internet that have changed how databases are used, this revolution brought the term of web mining. Web mining is considered as a subfield of data mining, it's regarded as the vital web technology that is used heavily to monitor and regulate web traffic. Web mining is further divided into three main sub groups, web content mining, web structure mining, and web usage mining [40]. Web content mining is the mining of content found on the web, this include metadata, multimedia, hyperlinks and text. Web structure mining is considered with the Semantics and hyperlinks making up a website or a network

2.5 Tools

Data mining tools are basically software packages, whether integrated packages or individual packages. These sophisticated software tools often require special data analysts. Such analysts are trained to use such tools, as data mining itself is not a straightforward process

2.5.1 Data Mining Tools

Data mining tools are also called sift ware, for the sole reason that they 'sift' through the dataset. Data mining tools varies depending on level of their sophistication and projected level of accuracy. In 2008, the global market for business intelligence software, data mining centric software, reached over 7.8 billion USD, a vast amount. IBM SPSS is an example of business intelligence software package [41]; it is integrated data mining software with diverse business intelligence capabilities. IBM also provides online services for web mining, these services are called Surfaid Analytics; they provide sophisticated tools for web mining [42]. Other data mining with business intelligence capabilities is Oracle Data Mining [43], a part of the company's flagship RDBMS software suite.

2.5.2 Data Visualization Tools

For Data Visualization tools, we have checked IBM's *Parallel Visual Explorer*. This software package is used for market analysis, oil exploration, engineering and aerospace applications, and agriculture to name a few. For medical fields, Parallel Visual Explorer is used to analyze various effects of treatments on the immune system. It helps in visualizing many different diverse effects on the patients' immune system [44]. For manufacturing, this tool helps in monitoring the processing parameters. Process parameters are vital for effective streamlined production. For agricultural usages, this tool helps in

Determining which seed to plant by analyzing the soil parameters with taking in consideration the weather conditions. Finally, Parallel Visual Explorer is also used for market research such as providing visual aids to help market analyst find customers trends, habits, and buying sprees. Vis5D [45] is a visualization system used for 3D animated simulation of weather and geological data. Vis5D uses 5D arrays that contain the time sequences of the 3D spatial datasets. Vis5D was incorporated into Cave5D through its extendable PLI libraries. Cave5D and Vis5D have their limitations as only relatively medium to small datasets can be visualized and animated at the same time.

(A) (B)

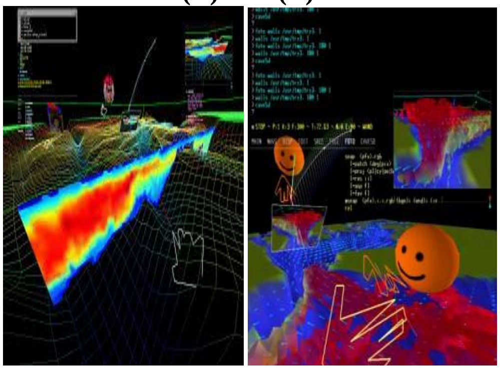

Fig:2 Cave5D(A),(B)

2.6 Data Mining In Future

Future trends for data mining lie in the hands of innovation and scientific breakthrough. As data mining is both a difficult problem, and a relatively new problem that incorporates many interdisciplinary fields. We shall see some new trends that will shape the way that data mining will be used in the upcoming future.

2.6.1 Data Mining Approach In Cloud Computing

A relatively new trend in utilizing and benefiting from data mining tools for middle-sized and small enterprises, incapable of supporting a full-fledged data mining solution, is *cloud computing* based data mining tools [46]. Because small and middle-sized enterprises usually lack the infrastructure and budget available for large enterprises, they tend to try this new cost effective trend. Cloud computing promises to provide data mining tools benefits at relatively lower costs form such small or middle sized enterprises. Cloud computing provides web data warehousing facilities, were the actual data warehouse [47] [48] application is outsourced and accessed entirely through the World Wide Web. Cloud based data mining also provides sophisticated mining analysis of the dataset, comparable to actual data mining software, as the enterprise specifies and demands[49].

III. Conclusion

Visualization in data mining is really emerging and developing field, which includes many of fields like text mining, machine learning, fuzzy logic having study area with many new innovational ideas and research approaches and many of applications, has been developed in this field. And new application is being developed for monitoring and summarizing the patterns of spatial data bases. Now a day's data mining and its approaches in visualization is quite capable to solving any problem in engineering and scientific and research And in this paper a brief review is taken over Visualization Approach of Data Mining in heavy spatial databases.

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