

Exploring Role and Associated Challenges of Data Mining Technique and it's Implementation in E-Governance

Krishna Kumar Verma, Navita Shrivastava

ABSTRACT- Data Mining techniques may play pivotal role in effective and efficient management of E-Governance. In this paper an attempt has been made to review and compare the work done by various researchers in this field. It has been concluded that there is a strong need to discover knowledge from historical data, daily being generated through various E-Governance application at exponential rate, specially in Indian context. Authors also felt the need to develop strategies to cope of the challenges of processing of theses data and transforming into a compatible homogeneous and clean e repository of data, which can be directly used for analysis purpose. Application of Big Data Analytics techniques may further improve the quality of data analysis.

KEYWORDS- E-Governance, Data Mining, Challenges, Knowledge Management

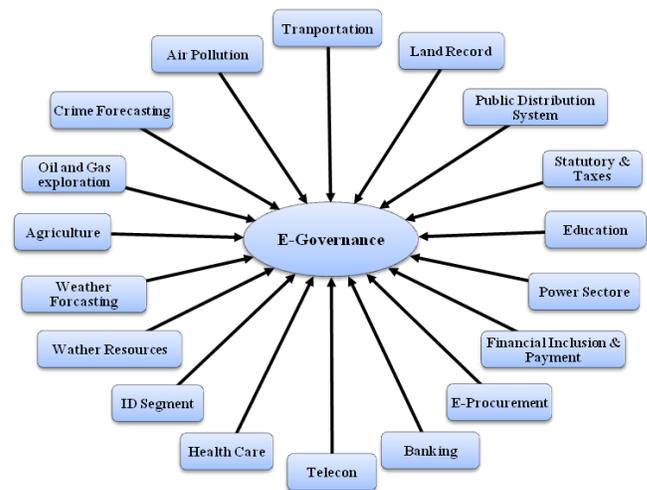


Fig. 1. Services of E-Governance

I. INTRODUCTION

E-government can be defined as a function of four variables: governance (G), information and communication technology (ICT), business process re-engineering (BPR) and e-citizen (EC) [22]. It also refers to the delivery of national & state government information and services through the digital media to citizens or business or other governmental agencies. According to UNESCO definition (www.unesco.org) " E-governance is the public sector's use of ICT with the aim of improving information and service delivery, encouraging citizen participation in the decision making process". E-governance, meaning 'electronic governance' is using ICT at various levels of the government, semi government and public sector, for the purpose of enhancing governance and use of internet to execute their functions of supervising, planning, organizing, coordinating and staffing effectively [32].

Big data refers to data sets that are large in size and complex in nature. The traditional data processing tools and technologies can not be useful on these data sets. Because data is growing at a high speed in exponential rate it is necessary to uncover hidden patterns for improvement purpose and it is possible by data mining techniques referred to as Big Data Analytics [27], [34].

The e-taal (Electronic Transaction Aggregation & Analysis Layer) is the government web portal that provides statistics on transaction done electronically by citizens with various e-Governance projects and gives the live statistical information. It shows that Indians have done over 2 billion e-transactions in last one year. The main thing is, in 2012 only 21 million e-transactions were registered comparing to whopping 2 billion in 2013 [1].

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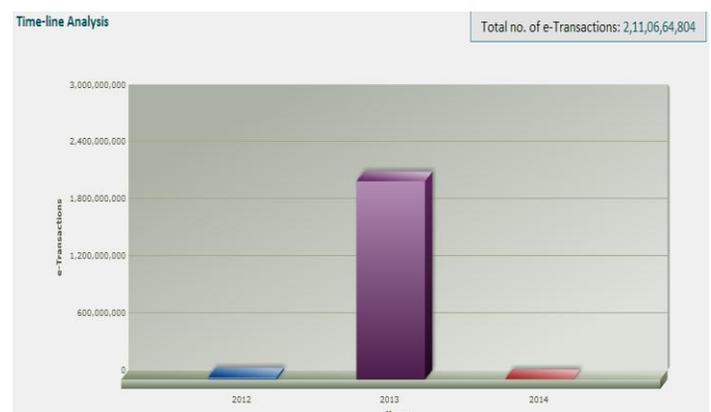


Fig. 2. E-Transaction in India [1]

This count is based on National e-Governance Plan (NeGP) that comprises 31 mission mode projects (MMPs), which are further classified as state, central or integrated projects. Mission Mode Projects (MMPs) are individual projects within the NeGP that focus on one aspect

of electronic governance such as banking, land records or commercial taxes etc [1].

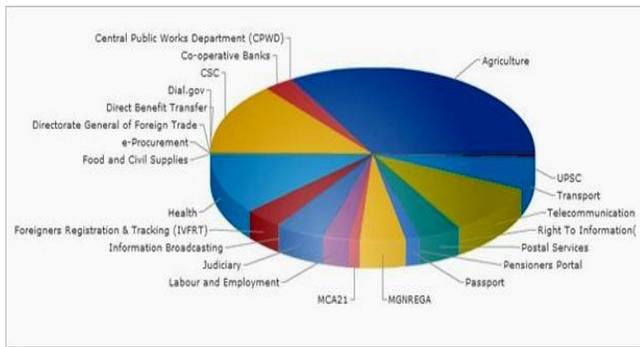


Fig. 3. E-Transaction based on services [1]

On the basis of this figure we can analyzed that Agriculture tops the chart as biggest one utilized service by the Indians.

II. DATA MINING

The Data Mining techniques are extensively used by government/ private organizations and research communities to uncover hidden trends and knowledge from historical data. The Data Mining concepts are successfully implemented in several areas like “Banking”, “Credit Card Business”, “Insurance”, “Customer Relationship Management”, “Super Store Sales data analysis”, “Stock Market”, “Gaming”, “Network and Security”, “Financial Market”, “Telecommunication”, “Oil and Gas exploration”, “Weather Forecasting”, “Water Resource”, “Agriculture”, Healthcare etc...In recent past, the government organizations have also realized the potential use of Data Mining on e-governance data [16]. The Data Mining algorithms can be applied on e-governance data to find hidden trends and knowledge from historical data.

Data mining is one of the most important steps of the knowledge discovery in databases process and is considered as significant subfield in knowledge management. Research in data mining continues growing in business and in learning organization over coming decades. The field combines tools from statistics and artificial intelligence (such as neural networks and machine learning) with database management to analyze large digital collections, known as data sets [37].

III. BRIEF LITERATURE REVIEW

Kaur, H., & Wasan, S. K. (2006) examined the potential use of classification based data mining techniques such as Rule based decision tree and Artificial Neural Network to healthcare data. In particular they consider a case study using classification techniques on a medical data set of diabetic patients. There is a wealth of data available within the healthcare systems. However, there is a need of effective

analysis tools to discover hidden pattern and relationships in data. This hidden data may be valuable knowledge that needs to be discovered from application of data mining techniques in healthcare system [12].

Tomar, D., & Agarwal, S. (2013) presented a survey on challenges and future issues of Data Mining in healthcare and gives his recommendation regarding the suitable choice of available data mining technique. This survey explores the utility of various Data Mining techniques (with its advantages and disadvantages) such as classification, clustering, association, regression in health domain and also highlights applications of Data Mining techniques in healthcare. In this paper they use hybrid or integrated Data Mining technique such as combination of different classifiers, combination of clustering with classification or association with clustering etc. for producing better knowledge. They observed that GA with clustering or classification, PSO-SVM, Fuzzy KNN, AR-PSO-SVM etc. can produce good results as compare to single traditional approach [5].

Dave, M., & Dadhich, P. (2013) also presents a systematic approach of data mining techniques in healthcare industry and a survey of current techniques of knowledge discovery in databases using data mining techniques that are in use today in medical research and healthcare sector. This paper focuses on some critical issues and challenges associated with the application of data mining in the profession of healthcare practices [21].

Bhanti, P., Kaushal, U., & Pandey, A. (2011) discussed E-governance implementation for higher education system with the use of data warehousing and data mining techniques. For this purpose they propose a logical architecture of data warehouse for university system. This architecture is divided into several layer these are: data layer, data & services integration layer, services layer, service integration layer, application layer, user interfaces layer and security services layer. The users of this architecture are applicants, students, staff, faculty etc. and the information likes student data, research data, library data, finance data etc. are the major output. This architecture also helps out for developing the logical design of databases [29].

Guan, G., Zhou, L., & Tang, P. (2009) discussed how data mining technique can provide the better results for government decision making. In this research they discussed three steps methodology; these steps are establishing public opinion collection mechanism, user the information architecture way to carry on the investigation & analysis, and data warehouse and data mining technology. In this methodology the main techniques used by researcher was multidimensional cross table analysis and correlation analysis method. This paper applied data mining technique in e-government construction. Firstly investigates the populace opinion, then process the collected data by SPSS cross tab and correlation analysis, find the immanent rule of people real need, then can provide the better support for government decision [8].

Li, B. et al. (2012) discussed application of Spatial Data Mining based on E-Government Information System. As we know that there are large amounts of data stored in the database of E-Government Information System and from these databases, 80% of the data is concerned with spatial location. Authors emphasized that Spatial Data Mining, i.e. SDM, is a kind of important and useful tool in the practical application of E-Government Information System database, and is very useful to find and describe a hidden mode in the particular multi-dimensional data aggregation. Especially, authors presented a useful example on land utilization and land classification in a certain county of Guizhou Province, China. A derived star-type model was used to organize the raster data form multi dimension data set and these conditions follow the clustering method for utilizing the raster data. This clustering method follow analysis methods (Likes diversity of data, great amount of data, temporal data etc.). Some useful information and knowledge were extracted like which types of vegetation were suitable for being cultivated in specific region by using related knowledge in a macroscopic view. It was convenient for the departments of different level to make aided decision-making on the basis of these results [18].

Shen, Y. et al. proposed e-government evaluation model named SCISS which stands for standardization (including specification, administration...), communication (including communicate, net fried...), informationization (including information, news, network...), service (including service, policy...) and security (including safe, guard, ensure...). To acquiring data from websites, the author proposed a information extraction model. They assume that the data acquired from the meta search engine may be complex and pluralistic, so they proposed "adaptive text segmentation and co-occurrence algorithm" to achieve effective analysis on the data. Then based on the proposed model, the author did content mining and semantic analysis on the Web data of five big cities (Beijing, Shanghai, Wuhan, Guangzhou, and Chengdu) with the help of self-made ROST Content Mining System, to get first 30 high-frequency e-government words respectively. On the basis of empirical analysis, the author comes up with some countermeasures; they gave advice for the development/ improvement of e-government in china [36].

Liu, X., & Luo, X. proposed a DW architecture which include open source business intelligence technologies for E-Government, The construction of this data warehouse is to store the benchmarking e-Government services results in four observatories: *Accessibility, Transparency, Efficiency and Impact* (ATEI). This project is also the continuous work of the other project - European Internet Accessibility Observatory (EIAO), which evaluates the accessibility of European websites. In this architecture PostgreSQL was used as DBMS, e-Government operational system used as the data source, and a right-time ETL tool used for populate the data [19].

Desai P. (2014) presented a methodology for knowledge discovery from birth registration e-governance data. This

methodology includes basic three important phases of data mining: In first phase data preprocessing tasks on birth registration or source data are performed, In second phase multi dimensional schema for Data Warehouse implementation is designed and In third phase, Clustering algorithms is used to identify important clusters from e-governance data, after these phases Association Rules Mining algorithm is applied on important data clusters. This method provides novel relationship among important attributes like Zone, Religion, Name, Delivery Attention and Delivery Method, and these results can be utilized by the corporation for better planning and service to the citizens [30].

In the above same manner Desai, P. (2014) again proposed a data mining model and its implementation on Vehicle e-governance data. In this paper, multi dimensional schema, data cube and OLAP operations on Vehicle e-governance data is discussed. Desai, P. had presented his work in three phases: In the first phase, Clustering algorithm is used to identify important clusters from the Vehicle data. In the second phase, Association Rules Mining algorithm is applied to explore the relationships from the important clusters of data that are observed in the first phase. In the third phase we get the results, these results are unique in sense that e-governance data can be utilized by private companies to increase their sales, improve marketing of the product and analyze the vehicle purchase trend of the citizens [31].

Data mining in e-government is the process of translating data from government web site in useful knowledge that can be used in decision making. Milić, P., Veljković, N., & Stoimenov, L, proposed a framework for open data mining on open government data. This framework includes four tasks: data collection, data processing, pattern discovery and pattern analysis. They had chosen the dataset from U.S. government website and the data was on earthquakes around the world that occurred in the last 7 days. They applied steps of framework following with Apriori Algorithm and produced a result as "areas in which most earthquakes occur" etc. The researcher concluded that this type of knowledge can be used in support of efficient decision making [25].

Rao V.R. (2014) proposed a framework for e-government data mining application and presented a case study on common and department's specific applications of e-government. The eGDMA is divided into two category first is common application that include grievance management, citizens ID, HRM & project management and second is department's specific that include agriculture, health, law transport, education and police. In this research Rao V.R. also examined various issues and challenges using data mining techniques for decision making within the government organization and concluded that data mining techniques can help in not only to detect fraud and security threats, but also it can be used for measuring influence facts like citizen's behavior, desire and need, that affect on improving e-government services such Government to

Citizen (G2C), Government to Government (G2G), Business (G2B) [38].
Government to Employee (G2E) and Government to

IV. DATA MINING TECHNIQUES & IMPLEMENTATION OF E-GOVERNANCE

Authors	Year	Research Area	Country	Practical Implementation?	Remarks
Matjaž Gams et al. [22]	2008	demography, fertility	Multinational	YES	Analysis performed using decision Trees
EbrahimSahafizadeh et al. [35]	2009	Air Pollution	Iran	YES	Knowledge discovery using Clustering and decision trees
H. Aggarwal, et al. [11]	2009	E-voting	India	NO	Conceptual discussion
Behrouz Minaei-Bidgoli et al.[3]	2010	Customer complain system	Iran	YES	Knowledge discovery using Association rules
Wei Cheng et al.[4]	2010	Road Traffic	China	YES	Knowledge discovery using Association rules
Suh, J. H. et al.[15]	2010	online petition portal system (e-People)	Korea	YES	Text and data mining techniques
Hamidah, J. et al. [16]	2010	Employee Performance Prediction	UKM, MALAYSIA	NO	Classification techniques and prediction model
Neera Singh et al. [28]	2011	Healthcare	India	YES	Knowledge discovered using Association rules, Clustering, Decision Trees
Kishori Lal Bansal et al. [17]	2011	E-governance	India	NO	Conceptual discussion about use of data warehouse and data mining in e-governance
G. Knteswara Rao et al. [9]	2011	DSS	India	NO	Conceptual discussion about Text Mining
Malathi. A et al.[24]	2011	Crime Detection	India	YES	Enhance Data Mining algorithm for Crime Detection
Anjum Mujawar [26]	2012	Tax	India	YES	Better decision making in Tax department using Fuzzy Data Mining
Gözde Bakirli [10]	2012	Local Municipalities	Turkey	YES	Services Oriented Architecture for Knowledge discovery using Association Rules, Classification, Clustering
Hanmant N. Renuše et al. [13]	2012	Crime Forecasting	India	YES	Crime forecasting and prevention using data mining
R Sujatha et al. [33]	2013	Crime Detection	India	YES	Crime Detection using Classification
Adeyemo [2]	2013	Air Pollution	Nigeria	YES	Knowledge discovery using clustering and decision trees
Hana [20]	2013	Road Traffic	China	YES	Knowledge discovery using Association Rules
Trivedi, H., and Amit Dutta [14]	2014	Water Resource Data	India	NO	Analyze data base of water resources for different HDUG's (Hydrological data users group) and Classification method
Desai P. [31]	2014	Vehicle e-governance	India	NO	Knowledge discovery using Clustering and Association Rules
Desai P. [30]	2014	Birth Registration E-governance	India	NO	Knowledge discovery using Clustering and Association Rules

V. CHALLENGES IN E-GOVERNANCE

Though a lot of work has been done to analyze digitally generated E-Governance data, there are still many issues associated with data management as well as techniques to analyze these data, which needs to be addressed by the future researchers. One of such issue is lack of E-repository of data throughout India & lack of skilled human resources primarily due to lack of ICT penetration in remote areas of the country. This restricts in extending the reach of E-Governance services to 70% of Indian population that lives in rural areas. Some other challenges include [7] [6]:

- Assessment of local needs and customizing E-Governance solutions to meet those needs
- Connectivity
- Content (local content based on local language)
- Building Human Capacities
- E-Commerce
- Sustainability
- Interaction and integration
- Technical divide
- Infrastructure and Speed
- Security and technical changes
- Process and administrative inertia

The specific key challenges associated with applying data mining techniques for electronic governance implementation are as follows:

- Lack of global/ Universal original values & missing attributes in database
- Dynamic nature of database
- Huge size of databases generating in exponentially high speed
- Heterogeneous nature of databases
- Hidden datasets
- Selection of attributes

To conclude, lack of proper E-repositories of electronic data (clean, homogeneous, universal and effective data analytic techniques) are the major constraints & challenges. Development of new Data Mining algorithm & Big data Analytics may come as a solution to cope up these challenges and may help in better implementation of E-Governance. Big data Analytics may provide opportunities in generating business analytics to promote better utilization and improve personalization of E-Government services. It also addresses the data management challenges.

VI. CONCLUSION

E-governance is a new initiative to utilize ICT to improve public sector services, which definitely is going to effect the relationship between government & citizens. But such initiative have their own challenges such as need to develop efficient techniques to analyze flood of data, daily being

generated with exponential rate in digital world. These data are not only huge in size but also dirty, dynamic & heterogeneous in nature. It has been observed that though several researchers have used Data Mining technique to analyze and discover knowledge from these data but in view of the above challenges, it has been felt that there is a strong need to develop more efficient and robust data analytic techniques for better implementation of E-Governance. Big data Analytics come as a solution to cope up such challenges and may be a potential game changer in E-Governance. The authors recommended following for better & effective implementation of E-Governance project specially in Indian context.

1. In Indian context we do not have enough and proper E-repositories of data which leads to various data management related issues (Incomplete data, missing value, dirty data). The need is to develop strategies/ techniques that can address such issues.

2. Encourage use of Big data Analytics techniques as they can prove to be a game changer for further improvement, better planning and decision making of E-Governance applications.

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