

Benefits of using Big Data Sentiment Analysis and Soft Computing Techniques in E-Governance



Akhilesh Dwivedi, R P Pant, Senam Pandey, Martand Pande, Atul Kumar Mittal

Abstract: In the current digital world, we tend to use electronic media to complete, each process and every work on time and quickly. In governance, we are benefited in a significant way from the use of sentiment posted electronically, called big data sentiment for e-governance. In this paper, we discuss the benefits of big data sentiment analysis and soft computing techniques for e-government with advancements of using big data. And its featured faster sentiment analysis using soft computing techniques and its framework. It helps to improve the goals of e-Governance that are Transparent, Trustworthy and Corruption free and quick action Governance as well as more citizen involvement in the country's development.

Keywords: Big data; Sentiment Analysis; e-Governance; Transparency in Governance; Growth in e-Governance; Hadoop; Map-Reduce

I. INTRODUCTION

Nowadays, Big Data and e-governance are closely associated with each other undoubtedly. More and more people want to connect themselves to the government. And many people are already connected to the government electronically. They can get all the information from the internet. All information accessible by every citizen of the country. And according to the variety of users and their accessibility rights. It is also essential to know about the citizens' sentiments for their government actions and policies and future planning's. Therefore, in this regard, a massive amount of data located on the server which need a significant bigdata infrastructure to manage and handle multinational data. In this paper, we discuss the e-governance fundamentals in section II. And section III describes the challenges of e-governance. In part IV, we define the use of big data sentiment analysis and soft computing techniques in e-governance. Section V establishes

the role of bigdata in e-Governance. Section VI establishes the framework for e-Governance. And section VII defines bigdata Framework for e-government. Section VIII describes the benefits of using big data sentiment analysis in soft computing techniques in e-Governance. Finally, we conclude the topic in section IX. This paper proposes a new framework for e-governance. It focuses on the use of sentiment analysis and soft computing techniques which may be more beneficial than current e-governance model.

II. E-GOVERNANCE FUNDAMENTALS

The first question is to define e-governance. According to World Bank [1] and [2], "e-governance is the use of information and communication technology (ICT) such as Wide Area Network, internet and mobile computing to deliver government services to Citizens, Businesses and government's internal organisations." The focus of e-governance is to make government more responsible, more efficient, and more available towards its citizens [4] [8]. According to Late Dr APJ Abdul Kalam, former President of India [4] [8], "Delivery of services to citizens is considered a primary function of the government. In a democratic nation of over one billion people like India, e-governance should enable seamless access to information and seamless flow of information across the state and central government in the federal set up. No country has so far implemented an e-governance system for one billion people. It is a big challenge for us". There are various models of e-governance the simple integrated model for e-government in Fig.1 [2].

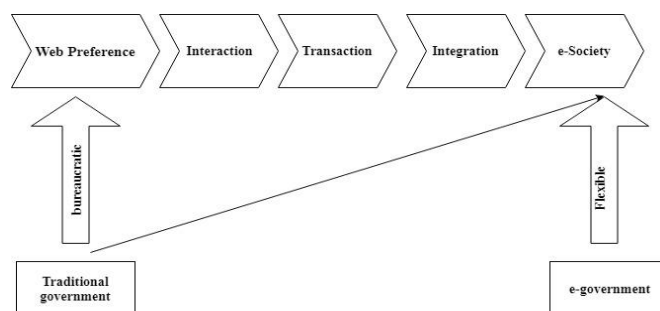


Fig. 1.A simple integrated model for e-government

The stages between traditional Governments to Electronic Government as the flexibility increases the complexity also increase to manage the enormous amount of multidimensional, structured and unstructured data with the conventional database system.

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In the web presence, the flow of information is half-duplex because the citizen can't send data to the government. They can only access the information available on the internet. In the Interaction stage, the citizen can interact with the dynamic version of websites.

In the Transaction Phase, the citizens of the country can perform the online transaction with the government such as paying income tax, obtaining license etc. In the Integration Phase, all separate e-services integrated to access from single government portal. When all the communicating body such as citizen, business and government's internal department uses the integrated e-services, it becomes the e-society.

III. CHALLENGES OF E-GOVERNANCE

The e-governance is providing benefits to every citizen of the nation. But facing the many challenges in its implementation and management of implemented applications at the state level. And as a separate application for a specific service to the citizens. So, there are two types of challenges in e-governance, the very first is Implementation Challenges and second the Management Challenges.

A. Implementation challenges

The implementation challenges [5] include basic categories which are environmental and Social Challenges, Economic Challenges and Technical Challenges. The common Environmental and Social challenge contains the use of different language over geographical locations; Illiteracy; accessibility in the rural areas where network problem exists, trust and awareness on services. Economic Challenges are the high cost of implementation and maintenance cost of projects. But this is not a big deal if it provides good governance. But the most economic challenges may be poverty in the country that one poor person can't afford the electronic device to use the e-governance services.

B. Management challenges

We are more focused on the management of e-governance at a higher level after the integration of all small, separate, and various types of e-services. The experience of using e-governance services should be positive for the citizens only then it can be trustworthy [11]. There are the following challenges in e-governance-

- 1) Dealing with security and privacy issue.
- 2) It needs good internet speed and accessibility.
- 3) Use of Information and Communication Technology (ICT) for removing Illiteracy.
- 4) Not proper access control over the online data.
- 5) Unable to manage data with the traditional database system.
- 6) Reliability.
- 7) Application Integration.

IV. USE OF BIG DATA SENTIMENT ANALYSIS AND SOFT COMPUTING TECHNIQUES FOR E-GOVERNANCE

E-Governance is the use of ICT (Information Communication and Technology) for delivering government services to their public. The main aim of the government is to make more available towards their citizens. Transparency and communication between government and citizens become complicated when the number of citizens is in a million. With

the use of ICT, the government can easily communicate with their citizens, and every citizen easily accesses any information about any new plan of government. There are lots of government policies which require citizen information from their stored databases. Day by day, the database of information becomes so large such that it cannot handle with traditional methods of the database system. Therefore, by applying the concept of big data technology one can reduce many challenges of e-governance. Hadoop is the standard and highly used framework for analysing big data. And It works in master-slave architecture, and stores data in Hadoop Distributed File System known as the HDFS file system. HDFS file system is a distributed file system which can analyse the big data stored in the government's distributed data centres. Big data framework is essential for effective e-governance policies [1]. For a further enhancement to deliver government policies, there is another term called Sentiment Analysis. It is the process of mining text and analyses personal information of writing or any other material. It tests underlying text and analyses whether the statement is positive or negative. Based on this test, one can improve their services. With the use of Big Data and Sentiment analysis government can compare the work of past government with the current government and enhance their services according to citizen's feedback [2].

V. ROLE OF BIG DATA IN E-GOVERNANCE

The e-governance needs to collect all the information related to the citizens, businesses and internal government bodies which combined become the Big Data. The E-governance can only become more useful if it can manage a massive amount of data, current data as well as historical data. There is a need to store the past data to analyse the growth over the years in the governance. And decide according to the data or information stored from the public. There are four components of e-government includes G2C (e.g. Passport Services), G2E (employee, e-training), G2G (e.g. Intra-governmental communication), and G2B (e.g. e-tender box system). According to the TCS [3], government-issued 71.7 lakh passports, and 3.6 lakh miscellaneous passport services were created under the new system in India. There is a need for a big data framework to store user information. E-governance is like a growing plant. It will give us multiple types of fruits after becoming a tree. But the infrastructure for the tree should be there at the time of plantation. Because if it becomes a tree but not a suitable platform, then it will burden citizens and unmanageable. The platform for the plant of e-governance is the big data framework which will provide it with a healthy environment to grow and work for its whole lifetime. In every country, there are many types of e-services implemented by the government to deliver the fast, convenient, transparent, and accessible governance. But if we think at a higher level when all applications are integrated into a single e-governance service so that the data becomes enormous and challenging to process, manage and analyse. The paper [13] proposes cloud computing as an ideal solution to these challenges, including maintaining Green ICT. But to analyse multidimensional semi-structured and unstructured data, big data framework is the real solution of the problem.

VI. FRAMEWORK OF E-GOVERNANCE

Before discussing the big data framework for e-governance, we need to think about the flow of data in the e-government, as shown in fig.3.

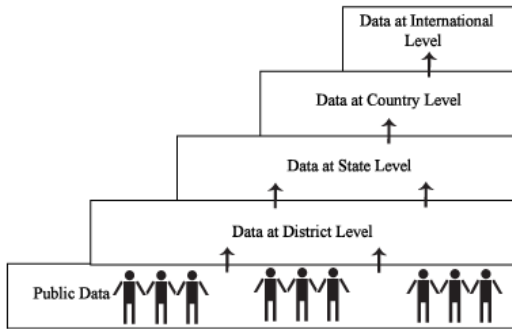


Fig. 2.Data Generation in e-governance

As the e-governance can interact with G2C, G2B and G2G, at each level there is massive data which is mostly unstructured or semi-structured type. Hence at every level (e.g. District Level, State Level, Country Level and International Level) in the governance, there is needed to have big data tools to make use of big data present at each level. At each level in the fig.3, there are own data centres for their particular e-governance application. But as we go to the lower level (public data) to a higher level (International standard) the types of data and size of data increases. And there is a tree-like structure in the data node present in the e-governance. And a top-level node maybe works as the master node and can analyse the data present at the current node and another child node (at lower level). In India [7] the NIC (National Informatics and Communication) has established the state and national level data centres over the NICNET, which is operated up to district level. For the large-scale service delivery, there are using the State Wide Area Network (SWAN).

VII. BIG DATA FRAMEWORK FOR E-GOVERNANCE

The big data framework for e-governance is essential to implement effective governance [15]. Here we focus on the government’s data centres and servers those containing the big data framework for the e-governance. It applies to all e-governance applications. Hadoop is a common and highly used framework for analysing big data. And It works in master-slave architecture. And It stores data in the Hadoop Distributed File System known as the HDFS file system. HDFS file system is a distributed file system which is capable of analysing the big data stored in the government’s distributed data centres. So, it will work on the master-slave architecture in which the data processed locally on the slave node, and the output of the process goes to the master node.

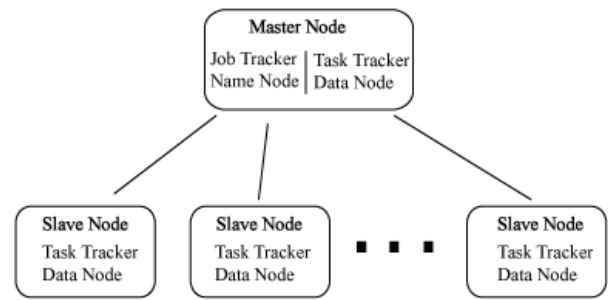


Fig. 3.Master-Slave Architecture of nodes in e-governance

As shown in fig 3. Each data node which works on data of e-government can work in the master-slave architecture. And it makes it as a tree structure where the root node is the highest level of a government body. And it is connected to the lower level server. The root node will work as a master node and child node work as a slave. The master node will have its Hadoop Distributed File System (HDFS) to store data. So at each level, there is the same scenario to use big data tools in e-governance. The bigdata framework for e-Governance includes the Hadoop components, and the working of each element describe below.

A. Sqoop

Sqoop is a tool which uses for efficient transfer of bulk data between Hadoop database (HDFS, HBase and Hive) and traditional RDBMS systems [15]. Sqoop can be used to import and export of the structured data from the government data centres to the HDFS.

B. Flume

Flume is a tool to collect the unstructured and semi-structured data from the data centres of various e-governance applications and webs. Flume uses for efficiently collecting, aggregating and moving large amounts of data.

C. Zookeeper

It is a centralised service for maintaining configuration information, naming, Synchronisation, and provides group services. And provides HPCC (High-Performance Computing Cluster) Systems, distributed data-intensive, open-source computing platform and provides significant bigdata workflow management services [18].

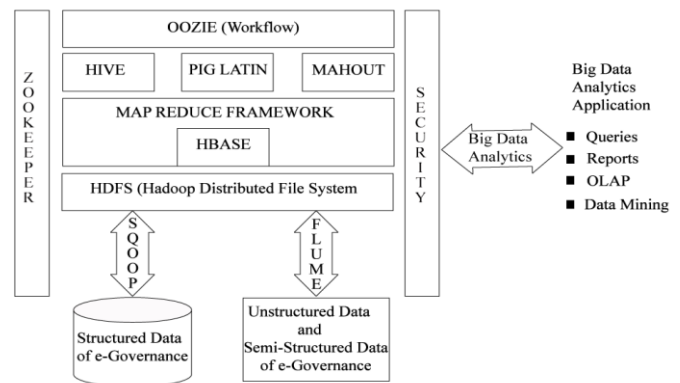


Fig. 4. Big Data Framework for e-governance

D. Oozie

It is a server-based workflow engine to manage Hadoop jobs. It is used to maintain the workflow among the Hadoop components. It also coordinates, executes, and manages job flow. It combines actions and arranges Hadoop tasks using a directed acyclic graph (DAG) [20].

E. Pig and Pig Latin

Pig is a programming language to assimilate all kinds of data (structured and unstructured). Yahoo develops it. It enables the programmer to focus more on big data analytics, not on the mapper and the reducer code.

Writing the code recursively for the map-reduce job is a very complex task. So, there are tools for direct executing SQL-like query to the big data. The query language is called the Pig Latin used in Pig [21].

F. Mahout

Mahout is an open-source machine learning library developed by Apache written in java. It does the tasks like collective filtering, clustering, classification and mining of frequent parallel patterns [20].

G. Map Reduce Framework

Many countries (e.g. Australia, the US, Japan, Sweden and Taiwan) are spending lots of money on research and use of big data [15]. Map-reduce are the main component of big data analysis. The map-reduce framework contains mainly two programs written in java. The first is mapper which maps the values from the data nodes. And the second is reducer which reduces the result by collecting a similar type of effect in a single result.

H. HBase

It is non-relational (NoSQL) database of the Hadoop that runs on top of HDFS file system. HBase allows the random and real-time read/write access for big data, provides fault-tolerant storage and fast data access [19]. The fault-tolerant and high-speed data accesses are necessary for fast e-governance data services.

I. Hadoop Distributed File System (HDFS)

It is the main component of Hadoop. It stores the data in a distributed fashion to compute fast. It saves the data after splitting it into the logical size of 64MB or 128 MB in the data node. The name node stores all metadata about the data node, which is also the part of HDFS. Besides this, HDFS also provides rack awareness, fault tolerance, scalability, efficiency, reliability and minimal data motion [19].

J. Security

In the e-governance, there is the government's sensitive data which needs to be confidential. So, there is a need to secure the Big Data framework for unauthorised access. There should be an authentication interface to access the big data framework and to access the Hadoop ecosystem. Analysis of Big Data e-Governance makes the concept of quick and good governance. The data saved on the remote location or in the cloud secured by using the application of the Fully Homomorphic Encryption (FHE) scheme that could be used to enhance the security of the Big Data Analytics. We can

construct a security model based on the standard of modern cryptography [17].

VIII. BENEFITS OF USING BIG DATA SENTIMENT ANALYSIS AND SOFT COMPUTING TECHNIQUES IN E-GOVERNANCE

Sentiment analysis is a specialised version of opinion mining and to do fast sentiment processing, we may use soft computing techniques along with this. Public opinion is essential for the implementation of good e-governance based on people's sentiment. For quick actions and cumbersome decision making according to the feelings posted by the citizens, the soft computing techniques are essential. Soft computing covers the use of fuzzy sets, rough sets and hybrid sets. Fig 5 shows the progress of e-governance with BDSA.

The companies using big data get the 50% higher revenue growth rates than those who are not using big data approach. Comparison published in Dell's 2nd annual Global Technology Adoption Index (GTAI)[6]. We can reduce many challenges in implementing e-governance as well as provides more benefits to the citizens by applying big data framework. The government to manage many e-governance applications at a time. There are some achievements of e-Governance in India. The MSTC, a government of India Company, does [8] e-auction of Coal Mines, Global e-Tender cum e-Auction in Multi-Currency of Red Sander Wood, e-Auction of Timber in the State of Kerala, e-Auction of Fly Ash, e-Auction for disbursing Gas, e-Procurement services.

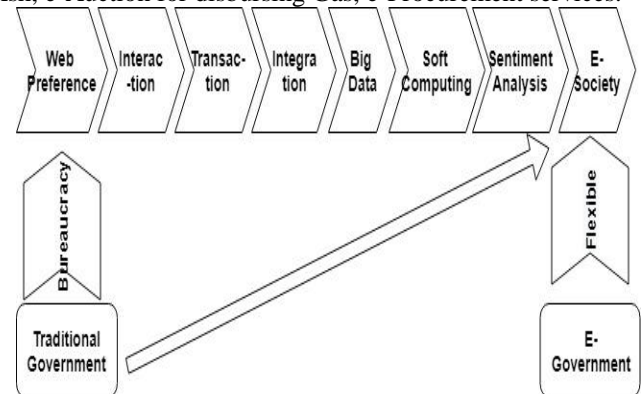
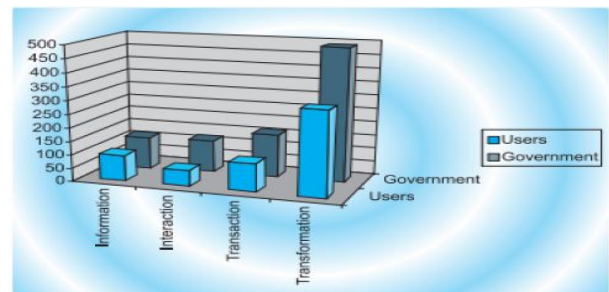


Fig. 5. Progress of e-governance with BDSA

The following fig.6 shows benefits from e-government projects at different levels of sophistication [9].



(Source: Based on Economist, February 16th, 2008)

Fig. 6. Benefits from e-governance project different level of sophistication (million error)

Many benefits are using the big data sentiment analysis and soft computing techniques for e-governance as following:



A. Reduce Corruption

A case study discussed in paper [14] demonstrates e-governance as a useful tool to reduce corruption. It shows the positive impact of e-government using national-level data. In many countries across America, Asia and Europe have reduced corruption and crime through e-Governance. The loud and clear effect is seen in taxes and government contracts [10]. In the digital era, there are many techniques to prevent fraudulent activity.

Biometric verification, the unique ID number of each citizen (e.g. Aadhaar number in India) which contains all information about that city. There are massive data which is structured or unstructured data stored on the particular server. It is impossible to analyse them by the traditional data management system. So it needs a big data framework to manage a considerable amount of data and effectively investigated when any unwanted activity happens.

B. Transparency in Governance

Every government plans for the country's development is clear to the public. The public participates in governance and gives better ideas for the development and able to analyse the problems and challenges in the growth of the nation. Every benefit made by the government to the public can deliver directly to the audience.

C. Fast Delivery of services

The latest example of e-governance in India is "PAHAL" a direct benefit transfer project which directly transfers the subsidy into the customer's account. There are many projects in India to deliver fast service to citizens, businesses and Inter-governmental services. They not only offer services but also analyse the records of every task or action performed by the government. That can provide an explicit calculation of the government's income and expenditure in which any intermediate person can't interfere.

D. Generate trust in Good Governance

The e-governance elevates the political participation of citizens and also increases internal and external internet political efficacy. Political efficacy depends on the citizen's trust in politics [12]. In e-governance, the digital application should develop according to the Constitution in which each action will be correct. It will work as validation before the form submission on the web. We trust the information entered on the online form because there is a data validation process before the form submits to the server. So, in e-governance application under the big data platform, all the data (past and current information) is present on the server. These are reliable and feasible to analyse in less time due to map-reduce technique of big data framework.

E. Fast Decision Making

The use of big data framework gives us accurate and fast data for the right decision such as defence, research, government decisions [16]. If the integrated e-governance services run on a single big data environment, then it will be easy to manipulate all the data related to all services. And the government will be able to make the best decision based on the high-speed data processing system.

F. Efficient use of technology

The big data framework provides the parallel processing of data in a distributed environment with the fault tolerance

capability. Replicating multiple copies of data on different server achieves the fault tolerance that's why it does not require the backup of data.

G. Effective Interaction

The effective interaction is essential for good governance. By applying the significant bigdata technique in e-governance will make it more productive and decrease the response time. In the e-government if everything goes electronically, then the number of processing is done by the system hosted all e-governance applications, which results in the poor performance of the use.

H. Availability

The e-governance is available 24*7 for the citizen and seven days of the week. There is always essential to develop e-government in the big data environment to make it available ubiquitously every time. In a big data environment, there is the ability to handle the data which is continuously collecting to the government's website.

IX. CONCLUSION

The central government make an eye on all its departments' performance with the help HDFS. They can make a fast decision, based on the data of all e-governance schemes. It is possible with the help of Hadoop Distributed File System (HDFS) to store the data generated in e-governance and applying the map-reduce technology in master-slave architecture. So big data and its sentiment analysis can also see as the foundation of e-governance plans. It will provide better service to the government, and then the government will be able to provide better services to its citizens. There are many future scopes in enhancing the e-governance using hybrid soft computing techniques in the era of Big Data. Further, also more innovative techniques such as developing more secure algorithms to government's confidential data and user data for smart governance can be developed. Our proposed framework is the basic stack of Hadoop components which may be modified according to the real-time requirement for the more effective and enhanced model for future e-governance using Big Data [22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35,36, 37, 38, 39, 40,41,42,43, 44, 45,46, 47,48, 49].

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