



UNDERSTANDING USAGE OF BIG DATA FOR SMART CITIES

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ABSTRACT

Organizations across the world are thinking about incorporating the Smart City idea in their urban communities and executing big data applications that bolster smart city parts to achieve the required level of maintainability and enhance the expectations for everyday comforts. Keen urban communities use various innovations to enhance the execution of wellbeing, transportation, vitality, instruction, and water administrations prompting larger amounts of solace of their subjects. This includes lessening expenses and asset utilization notwithstanding all the more adequately and effectively captivating with their residents. One of the late advancements that has a tremendous potential to upgrade smart city administrations is enormous information investigation. As digitization has turned into a basic piece of regular life, information gathering has brought about the amassing of enormous measures of information that can be utilized as a part of different advantageous application areas. Compelling investigation and use of enormous information is a key variable for achievement in numerous business and administration areas, including the brilliant city space. This paper examines the uses of big data to bolster smart cities. It examines and analyzes distinctive meanings of the smart city and enormous information aka big data and investigates the open doors, difficulties and advantages of joining big data applications for smart cities.

Keywords - Big data Applications, Challenges, ICT, Smart city.

I. Introduction: what is a Smart City?

A city which is able to ‘think’ by combining intelligent technology together with human wisdom is a **Smart City**. Smart City uses digital technologies to **enhance the standard** of public **and personal** services thereby reducing **prices** and resource consumption.

Smart city integrates multiple information & communication technology (ICT) solutions to manage a city’s resources which include, but not restricted to, local departments, schools, libraries, transportation systems, hospitals, power plants, law enforcement, and other community services.

The goal of building a smart city is to improve quality of life by using technology to improve the efficiency of services and meet residents’ needs. ICT allows city officials to interact directly with the community and the city infrastructure and to tell what is happening in the city, how the city is evolving, and how to enable a better quality of life. Through the use

of real-time systems and sensors, data are collected from citizens and objects termed as **Big Data**, which is then analysed from multiple dimensions for intelligent decision making to make the optimal use of available resources. The information and knowledge gathered are keys leading to intelligent decisions.

Cities in world are thriving fast to become ‘smart’ by achieving above specified goals. ‘Smartification’ of cities is being achieved by decreasing dependency on fossil fuel by encouraging use of solar energy, encouraging organisations to become paper-less, using e-payment methods, using more and more of sensor based automation and authorization technologies and many more. Public as well as private organizations should emphasize on implementing smart measures to improve quality of life.

II. Smart cities are producing BIG DATA!

Enormous data is being generated by humans as well as all the electronic devices including personal computers, sensors, GPS Systems, mobile phones, etc, and this enormous data is collectively termed as Big Data. Various applications like social media sites, digital pictures and videos, commercial transactions, advertising applications, games and many more have contributed to this data generation in the past few years.

Thus Big Data can be defined as mentioned in [3]:

“Big Data is a term defining data that has three characteristics. First is the great volume of data, second the data cannot be structured into tables and third is velocity which means data is generated rapidly and thus is need to be processed and analyzed fast.”

Fig.2 [1] shows the employment of big data applications in smart cities. Smart city applications generate huge amounts of data while big data systems utilize this data to provide information to enhance smart cities applications. The big data systems store, process, and mine smart cities applications information in an efficient manner to produce information to enhance various services a smart city has to offer. In addition, the big data will help decision-makers to plan for any expansion in smart city services, resources, or areas.

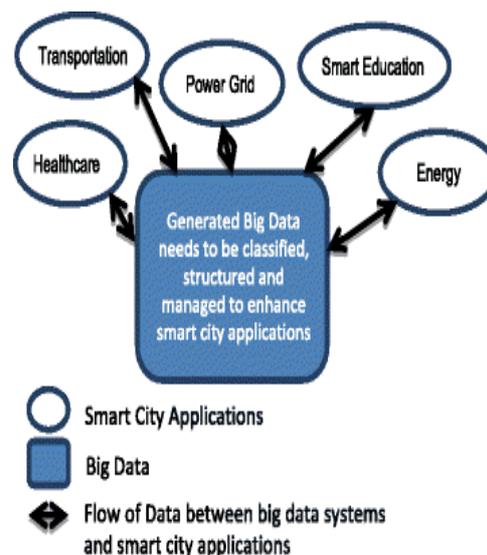


Fig.2: Smart city & Big Data

2.1 Characteristic features of Big Data

Big data possess various characteristics as explained in [2] are:

- a. Variety: It includes the data coming from heterogeneous sources from all the three categorizations i.e. structured, semi structured and unstructured sources
- b. Volume: By volume it means the enormous amount of data which is been generated every day.
- c. Velocity: The extremely fast rate at which the data is generated is termed as velocity, one of the characteristic of Big Data
- d. Value: The relevance of the important information which is taken out by applying queries over data, means the value
- e. Variability: The inconsistencies which arise during the data flow

In order to accomplish the objectives of Big Data, the administrations in smart cities requires the usage of right instruments and strategies to examine and arrange the data viably and proficiently.

These advantages to be accomplished require large amounts of complexity and contribution as far as the applications, assets and individuals are included. The chances to accomplish these advantages are accessible; be that as it may, they require putting resources into more innovation, better improvement endeavours and compelling utilization of enormous information. There is likewise the need to set strategies to guarantee information exactness, top notch, high security, protection, and control of the information and in addition utilizing information documentation guidelines to give direction on the substance and utilization of the datasets. What's more, innovation can be exceptionally helpful while considering the administration and assurance of ecological assets and foundations, and common assets with a definitive objective of expanding manageability.

III. Big Data for Smart Cities

Big data supports applications in a wide spectrum of area ranging from healthcare to transportation, improving customer experience by providing 'intelligent information' to business houses using data mining ,helps environmentalists to monitor pollution levels and so on. The list is large and growing rapidly. Some of the big data applications are summed up in the list provided below as mentioned in [4]

- a. Healthcare
- b. Public sector administration
- c. Retail
- d. Manufacturing
- e. Personal location data
- f. Fact based decision making
- g. Improved customer experience
- h. Improved sales
- i. New product innovation
- j. Reduced risk
- k. Higher quality product and services
- l. Most efficient operations

3.1 The Methodology

In order to use big data services mentioned in [3], big data applications are being developed but using big data applications require an underlying support of a good information and communication technology (ICT) infrastructure. A smart city can be made smarter when utilizing ICT and big data for many of its applications and services but using big data applications has its own issues and challenges which need to be taken care of.

3.1.1 Challenges

Implementing big data applications has its own set of issues and challenges which need to be taken care of when using it for making a city 'Smart'. Smart cities are considered very dynamic and evolving environments, thus it is important to avoid or at least reduce the challenges involved in smart applications design and development for smart cities.

Following are some of the issues concerning big data based applications:

- **Data sources and characteristics:** Data is generated by numerous sources in many different formats varying from unstructured (e.g. images, audio, tweets, video, server logs, etc.) which needs to be transformed to a structured format using techniques provided by advance database systems [2]. While trying to encompass different attributes of big data, what we get is a very complex models and approaches thereby making it hard to manage. This is simply because the current methodologies or data mining software tools cannot handle the ever growing large size and complexity. In addition, there are some challenges that may be faced in the future, such as analytics design, evaluation, distributed mining, time evolving information, compression, visualization, and hidden big data. When considering smart city applications utilizing big data, challenges arise in various areas. Data Collection is complicated by the existence of numerous sources with different formats and types and varying usage and access policies. In addition, the unstructured nature of the data makes it even more difficult to categorize and organize and make it easily accessible for applications to use.
- **Data and information Sharing:** Sharing information and data among various city offices is another test. Each of the city office has its own stockroom or storehouse of private or open data. The majority of which are frequently hesitant to share what may be viewed as exclusive information. Moreover, a few information might be administered by certain protection conditions that make them difficult to share crosswise over various substances. The test here is to make a point not to cross the scarcely discernible difference amongst gathering and utilizing enormous information and guaranteeing residents' privileges of protection. This is relevant inside any keen city since there are numerous divisions and businesses included. Shrewd city applications should discover approaches to avoid or diminish the obstructions to accomplish consistent data sharing and trade among various substances. Moreover, with different assorted information sources circulated among related offices, a few information sorts, for example, spatial-worldly information can be redesigned rapidly . Accordingly, it is hard to make a brought together comprehension of information semantics, and concentrate new learning in view of particular cycle information and continuous information. As result, it will be hard to make an information base for a smart city.

- **Data Quality:** Another concern towards big data applications isn't right information or low quality of information. Numerous Data Sources have distinctive sorts of issues connected with it like information gained from legacy information sources don't have the metadata to depict them. A source that offers any sort of unsecured access can get to be untrustworthy and at last adds to poor information quality. The attributes that are in responsible for poor data quality as mentioned in[5] are as follows :
 1. Entry quality: Relates to whether the data enters the framework effectively at the purpose of cause. Entry quality is likely the least demanding issue to distinguish yet is regularly the most hard to revise. These issues are normally brought about by personnel entering information into a framework. The issue might be a mistake or a wilful choice, for example, giving a spurious telephone number or address. Distinguishing these anomalies or missing information is effortlessly refined with profiling instruments or straightforward questions
 2. Process quality: Was the uprightness of the data kept up amid preparing through the framework?
 3. Identification quality: Are two comparative data objects recognized accurately to be the same or diverse?
 4. Integration quality: Is all the known data around an object coordinated to the point of giving an exact representation of the item?
 5. Usage quality: Is the data utilized and translated effectively at the purpose of access?
 6. Aging quality: Has enough time passed that the legitimacy of the data can never again be trusted?
 7. Organizational quality: Can the same data be accommodated between two frameworks taking into account the way the association develops and sees the information? An arrangement of activity must record for each of these wellsprings of blunder. Every case varies in its simplicity of identification and simplicity of redress. An examination of each of these sources uncovers a changing measure of costs connected with each and conflicting measures of trouble to address the issue.
- **Security and privacy:** Another of the significant difficulties in a smart city and with utilizing enormous information is the security and protection issues. In fundamental terms this imply databases may incorporate classified data identified with the administration and individuals, so they require elevated amounts of security arrangements and components to ensure this information against unapproved use and malignant assaults. Likewise, keen applications coordinated together crosswise over offices additionally require high security since the information will move over different sorts of systems, some of which might be pen or unsecure . What makes such an issue more mind boggling is that most huge information advancements today, including Cassandra and Hadoop, experience the ill effects of an absence of adequate security . Notwithstanding the need to secure information as it ventures and as it is being utilized by the distinctive segments of keen city applications, there is additionally the need to unmistakably recognize and ensure protection privileges of associations and people this information speaks to. Albeit particular keen city elements can guarantee responsibility for huge information, a considerable measure of it incorporates individual and private data about people. Wellbeing and restorative

records, monetary and bank records, retail history, and a great deal all the more all give personal perspectives of the general population they speak to. Numerous perspective accesses to this sort of information as an infringement of a man's legitimate rights for security. Ensuring that stringent security strategies are set up and legitimately implemented speaks to a noteworthy test for enormous information savvy city applications designers and clients.

- **Cost:** Cost is another vital factor that involving the ways government organizations may affect people when they use ICT solutions. For example, using an energy usage reduction system, this forces the government to use new systems, components or features to watch consumption and record data. This results in making a sensible energy management system; however, it is also costly to implement. In addition if such a project is not implemented correctly from the beginning, it might cause a big problem, result in very high pricing, and the city in turn may be negatively affected. For example, testing of a sensible light and signal system includes a terribly high cost as it needs to cover additional costs of physically deploying hardware and software for monitoring traffic in a real time environment.
- **Smart City Population:** Individuals influence and are influenced by the brilliant applications. Especially the city's populace size greatly affects the measure of huge information. As the populace develops, the measure of created information likewise quickly develops and can get to be enormous. This is one of the primary difficulties in light of the fact that the quick development will create activity clog, contamination, and expanding social disparity other than expanded urbanization, which raises an assortment of specialized, social, monetary, and authoritative issues that have a tendency to endanger the financial and ecological supportability of smart cities . Thus, keen city applications need to develop rapidly and stretch out proficiently to handle the developing volume and assortment of huge information to keep away from such issues. At last, the objective is to create and send keen city applications that are sufficiently shrewd to advance and brilliantly handle the quick development of huge information to produce better result.

As discussed above, different applications have varying necessities for data usage. For example, traffic control requires immediate responses from the underlying application to monitor and control real time traffic; while environmental sustainability applications are being developed keeping in mind their ability of handling a lot of delayed responses as selections are usually remodelled over different periods of time. Therefore, real-time transfer, discovery, analysis, decision-making, and responses is an issue. More over achieving real-time responses depends heavily on how well the challenges are addressed and resolved.

IV. Conclusion

Big Data and Smart City are two present day vital ideas. A large number of organizations are incorporating them to create smart city applications that will achieve maintainability, better flexibility, compelling administration, improved personal satisfaction, and wise administration of keen city assets. Our study investigated both ideas and their diverse

definitions and we came to distinguish some basic characteristics for each. Notwithstanding the changing definitions every idea has various attributes that interestingly characterizes it. Depending on these normal qualities, we could recognize the general advantages of utilizing big data to plan and bolster smart city applications.

Then we discussed about various issues and challenges. We likewise talked about the different difficulties in this area and recognized a few issues that may block huge information applications improvement endeavours. In view of that discourse, we recommended a rundown of general prerequisites for enormous information brilliant city applications. These prerequisites are important to plan and actualize powerful and proficient applications. Likewise, these prerequisites additionally attempt to address the difficulties and propose diverse approaches to determine a portion of the issues and produce better results. At long last we talked about a portion of the fundamental open issues that should be further examined and tended to achieve a more exhaustive perspective of brilliant urban communities and create sew in a comprehensive well thoroughly considered model.

Fabricating and conveying effective smart city applications will require tending to the difficulties and open issues, taking after thorough configuration and advancement models, having all around prepared HR, using re-enactment models and being ell arranged and all around upheld by the administering elements. With all achievement variables set up and better comprehension of the ideas, making a city shrewd will be conceivable and further upgrading it for more astute models and administrations will be a feasible and practical objective.

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