

Issues, Challenges and Application of Big Data in Smart Home

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ABSTRACT

There are various research is going on for efficiently manage the huge amount of data by the application. This paper describes the application of Big Data in Smart Home, it focus on the issues and challenges in implementation of big data concepts and tools in the smart home. The major issues and challenges in like availability/speed of Internet, Speed and quality of sensors, Cost aspects, device maintenance issue and vendors issues, Data format conversion etc also discussed . This paper also proposes a framework of smart homes which contains three module like Application Module, Device configuration module and Big data module this framework uses big data concepts tools for the storage and analysis to take the effective decision and notifications in the smart home.

Keywords

Big Data, Smart Home, IoT, Hadoop

1. INTRODUCTION

The term Big Data is a phrase which means a massive volume of structured, semi structured and unstructured data that is so large in volume what is why it is difficult to process, analyzes and draws a meaningful pattern using conventional database and applications. In most cases the volume of data is too big or it transmits and update very fast or it goes beyond processing capacity of the available computer systems of the enterprises. Big Data has the capability to help enterprises to improve operation activities and make more relevant, faster decisions. The data, when it captured, formatted, manipulated, stored, and analyzed can assist an enterprise to gain useful insight to increase revenue, get or retain consumers or customers, and improve quality of operational activities.

The scope of Big data is so much deeper and broader than that a user believes there are many major areas in which this technology is currently being used to take more advantage in practice. These major areas are such as understanding and targeting the customers, understanding the business trends and optimizing business processes, personal quantification and performance optimization, improving healthcare services and public health support systems, improving science and research, improving security systems and law enforcement, improving and optimizing cities and countries e-governance services , financial trading, Smart city and smart homes implementation.

The idea of the smart city come into sight during the last decade as implementation the power of information and communications technologies to improve the operations and functionality of cities, improving their efficiency, enhancing their competitiveness, and find out new ways in which problems of poverty, problems of health care services, social deprivation, poor environment etc. might be addressed [1]. In other words smart city is an urban development focus to

integrate multiple aspects of information and communication technology (ICT) and application of Internet of Things (IoT) technology in a secured manner to manage a city's resources – the city's resources include, but are not limited to, transportation systems local administrative departments', water supply networks, schools, libraries, information systems, waste management, hospitals, power plants, law enforcement, and other social services. A smart city must have smart homes which have highly advanced automated systems beyond the basic functionality like light control system to provide benefits in terms energy efficiency, automatic door openers, object motion sensors, IP-enabled cameras, security alarms and safety notification systems and intelligent door locks with biometrics provide better safety and security. This kind of automated systems in the smart homes, must require a revolutionary technology which must provides seamless and reliable internet connection among the transmitters and sensors of different home appliances so that they can store, process and analyzes their data this may happened efficiently in use of is internet of Things (IOT) [2] and its related technology in smart homes.

2. APPLICATION OF BIG DATA IN SMART HOMES

A smart home can generate different kinds of data and may use different kinds of automated and advance systems. It is not necessary that all devices generate and store their data in same file format or use of same accessing method. The major kinds of data generated by a smart home are as given below.

- Security and access control of doors or main gate of home and logs of its entries and exits.
- Streams of footage of IP- Enable cameras
- Data about electricity consumption, availability and power backup
- Data of home appliances like intelligent air conditioners, Air purifiers, Washing machines etc
- Data about sanitation
- Data of security alarms and safety notifications

Above all are the major source of data of the smart homes and it is an approximation that a smart home can generate minimum 1GB data in a week [3]. So if taking consideration of time period of five year it will become huge amount of data and probably not suitable for conventional data database system. So these kinds of systems should go for Big data concepts and its supporting tools. The major advantages of Big data are as given below.

2.1 Cost reduction

Big data technologies like Hadoop and its file system HDFS and cloud-based analytics can provide significant cost advantages. While comparisons between big data technology and traditional approaches (Data warehouses and Data marts specially), the traditional approaches are difficult because of

differences of handling schema less data, semi structure data and related operations and functionalities. Hadoop and its supported tools provide a cost effective, distributed processing (Map reduce operations) ability of large set of data regard less of its structure. The approximate all tools used by Big data are open source and also provide cloud base analytics services so it become cheaper than traditional technologies.

2.2 Faster, better decision making

Big data analytics is always involved try to improve decision making and make effective decisions. Not only large organization but Smart homes are always seeking both quicker and much better decisions for the safety, security, access controls, food processing, visual reports, notifications through analytics scripts and tools. Due to good processing capability, security features , data replication feature of Hadoop and in-memory analytics, many companies ,smart cities and smart homes are focused on speeding up their decision making capability.

2.3 Integration and development of new applications and services

Most powerful use of big data analytics is to develop and integration of new applications and services for customers. An owner of smart home can access his data from any remote location through a secure channel (if available) in his desirable format by use of analytics tools. The service provider company can easily integrate develop application for the smart home owner on his demand in latter stage.

Keeping mind of above advantages of Big data vendors can use Big data in the implementation of smart home to keep their data secure, reliability and fast and effective design making.

Application of Big Data in different area

2.4 Smart Grid

Large amount of data is generated from different resources in the Smart Grid such as the habits of power utilization by consumer, Phasor measurement of Data for situational awareness and data of energy consumption by Smart Meters. The efficient use of Big data in the data collected by the Smart Grid environment, which can be used for decision making in terms of supply and demand.

2.5 Smart Healthcare

In the past, huge amount of data is collected in the healthcare sector also. The rapid rate of increasing population also increases the data in the healthcare sector. The data of one person about their health for one day are approximately 1 GB (Text, Images and Video etc),[4] so imagine what will be the size of data for a month and year. Here Big data play a vital role, the data can be analyzed through the Big Data technology and decision will be easily taken by doctor.

2.6 Smart Transportation

Analyze of the data taken from the day to day traffic will improve the future transportation system of the city. Smart Parking will also be the part of Smart Transportation. So, the big data collected from the traffic, parking and road condition for every day will give the efficient system for the transportation.

2.7 Smart Governance

In Smart Governance, Big data analytics can play an important role. The organization or Companies with common domain can easily be selected via data analysis that can lead

toward collaboration with them. This collaboration can be the cause of development of the country. Big data analytics can help the governments to establish and implement holistic policies which are the need of people. In addition to above, the unemployment can also be reduced by analyzing the big data of different educational institutes.

3. ISSUES

The smart and connected home concept has been come for a few years now, but aside from a relatively small community of family of do it yourself enthusiasts and luxury or rich home owners, home automation hasn't the cup of tea for general public.

The successful Smart Home requires High speed Wi-Fi , Broadband Connection, High quality sensors and HD Camera and problem is also for compatibility because of the rapid development of the technologies.

A huge number of connected devices, each sharing and analyzing streams of informal data in real time, seem like a big data story. And, in fact, it is, says Greg Roberts, marketing chief for iControl Networks, a venture-backed software company that builds a connected home platform for unifying data, applications or apps, and devices. Its software powers several major home control and security services in North America, including Comcast Xfinity Home, Time Warner Cable Intelligent Home, and ADT Pulse.

Consumer acceptance of Smart-home services and devices would likely enable a host of additional services, including health-related uses such as the aforementioned data-sharing weight scale. "When a scale starts generating data, you have something that is tracking your weight on a daily basis," said Roberts [4]. A dramatic weight change in a short period of time could advise a serious medical issue -- information the scale could pass along to other health-oriented services.

4. CHALLENGES

There are lots of challenges to implement the Smart Home using Big data. Some of the challenges for implementing the Smart homes using Big-Data are:

4.1 Scope of Application is limited

Most of the smart home projects are very limited in their scope and only cover special purpose. The service offered in home are remote control and monitored the home appliances like refrigerator, lights, invertors, washing machines, dish washers, taps , automatic beds etc.

4.2 Complex to build, use and maintain

Special training is required to operate the Smart Homes. Very complex to build and lots of challenges in inter operational. The key challenge to consumer acceptance (besides price) is usability. An interface has to be as simple as the classic light switch, but of course more powerful. Within an extendible system the connected user interface can quickly become inherently complex, especially if the user should be able to control everything. An example where specifically tailored solutions can have higher usability than general ones is multimedia control. Multi-room media streaming solutions, e.g. from SunOS, Philips, or Apple, are optimized for their purpose, although they cannot control other devices such as lights. One key factor for usability is responsiveness. Commands must have immediate effects and immediate feedback on the interaction device. System architectures that involve several layers of marshalling, converting and dispatching events in a distributed network are at a challenge here.

The more device types are included and the more a system is capable of, the more heavyweight it will become. The architecture of such a generic system becomes increasingly difficult for developers, making systems hard to build. Also, such generic systems consume more resources (production cost, electricity) than specialized ones. There is also a complex task to maintain the Smart homes.

4.3 Lots of Investment

Smart Homes cannot be afforded by the general persons. It requires lots of investment in the projects. For a system to be successful (not too simplistic), it has to be extensible. But up-front investment in system architecture for this and creating standards is expensive. Companies (both manufacturers and operators) will shy away from this investment until their own prospective market share is promising enough. But business models are still unclear at the moment, and these determine

how a system has to be designed with regard to its extensibility and its ability to integrate further crafts or services.

4.4 Data Storage from the sensors

Data storage from the sensors is also the challenges and Analysis of those data through Big Data to take the effective decision in future or emergency condition.

5. POPOSED FRAMEWORK OF SMART HOME USING BIG DATA TECHNOLOGY

The proposed framework of smart home which uses the big data tools for the store, process and take quick and efficient designs for smart homes have three basic layers these layers are show in below diagram.

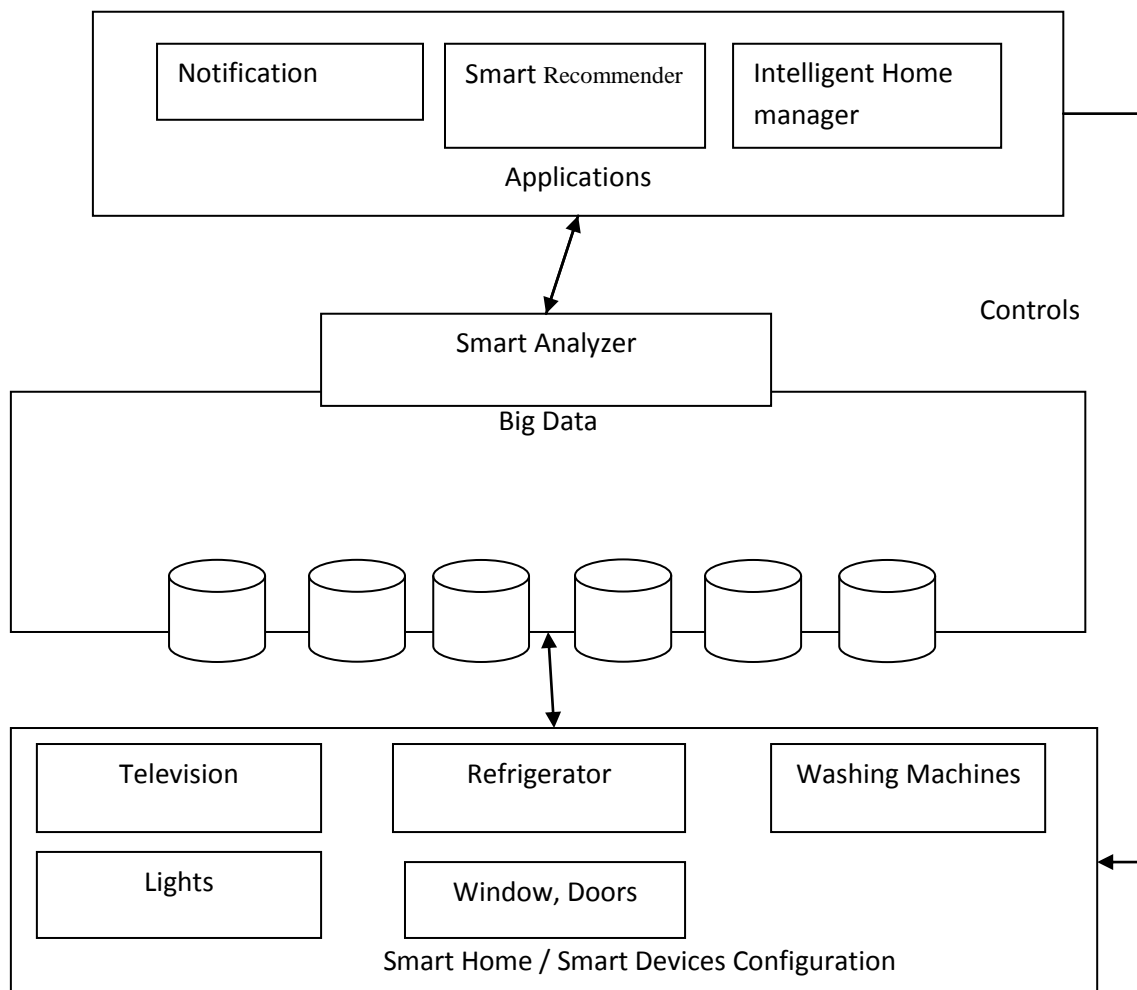


Figure 1: Proposed Framework of Smart Home Using Big Data Technology

5.1 Smart devices configuration module

it provides the services to connect and configure different smart devices like smart televisions, IP enable intelligent cameras, smart washing machines etc of home which basically contains the which pass their internal state data to the Big Data module and also read the data from the big data module in case of any reset situation. This module can also use the services of application module and controlled by the Application module which is directly accessible by the owner.

5.2 Big Data Module

This module provides the storage service to the smart devices in any form of data like none structured, semi structured and structured data. And provides different kinds of API for the application module like Data access API, Image analysis API, conversation of different kind's data format to and fro etc by which different apps of application module make take effective designs. This module is also capable to the read the data from different devices on the demand of Application module.

5.3 Application Module

It is collection of web based tools and apps which provide different kinds of services to the owner and the service provider for application administrations and data management. It also controls and provides the useful data and instructions to the smart devices for the optimization of their performance.

6. CONCLUSION

This paper discussed and explained about smart homes, application of Big Data and supporting tools in smart homes. Application of Internet of Things concepts in smart homes connects the home appliances and sensors to make our life more comfortable. But all the connected devices may generate huge amount of data day by day and this amount of data can easily store, process and analyze to get some useful information for the homeowner. The application of Big data in smart homes is not only cost saving, but also provide the powers of Hadoop and its supporting tools. The major applications of Big Data for smart designs in smart homes are safety & access controls , optimum utilization of electricity , storage and analysis of smart air purifiers ,lightning system etc this paper also focus on major issues and challenges for the implementation of Big Data technology in smart home, like quality of sensors, cost issue, vendors related issues, devices compatibility issues, servers for the data storage and security challenges etc and at the end of the paper , proposed a simple framework for the implementation of Big data tools in smart home. This works to control Smart Home’s devices using Internet of Things (IoT) and its different components like home access control, electricity management control, climate control etc. The framework contains basically three modules like Application module, big data module and home appliances/devices module. Home appliances/ devices module use to connect and configure smart devices. These devices stores the data into the file systems of Big Data these huge data further used by analyzers and tools of big data module and application data module. The issues raised in this paper may focus for the development of private cloud system to store the data of smart homes in Big data file systems, use of analytical tools locally to avoid the security breaches and provide a remote link to the service provider in a secured connection.

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