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DATA ANALYTICS TOOLS USED FOR DATA ANALYSIS OF DATA GENERATED FROM SMART HOMES

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ABSTRACT

A new way of controlling and managing smart homes, built on the analysis of large amounts of data, is developed to boost their efficiency. In order to gather data from a smart house, visualise such data, and set off alarms with a buzzer, the fundamental hardware of control and management is created. This hardware includes smoke sensors, temperature and humidity sensors, and infrared sensors. Data acquired from smart homes are communicated over an indoor wireless network comprising gateway equipment, with data being stored using a distributed cache architecture informed by big data analysis. Scheduling the control and management chores of a smart home is accomplished with the help of a hybrid particle swarm optimization algorithm based on the necessary data. From our experiments, we can conclude that this approach improves upon the state-of-the-art in terms of device control and scenario management, as well as communication performance and usefulness in the real world. Many studies are being conducted to find the best way for an application to handle a large data set. This article provides an overview of the use of Big Data in Smart Homes and discusses the problems and solutions that have arisen throughout the introduction of Big Data ideas and technologies. The primary problems and obstacles are also mentioned, including things like slow or unreliable Internet, slow or unreliable sensors, high costs, a lack of reliable device maintenance or reliable vendors, and problems with converting data formats. A smart home framework is also proposed in this study, comprised of three parts: an application module, a device configuration module, and a big data module. This framework makes use of big data ideas and technologies in order to store and analyze data for more informed decisions and notifications.

KEYWORDS: Big Data, Smart Home, IoT, Hadoop, Cloud Computing.

INTRODUCTION

Big Data refers to a big amount of data, whether it's organized, semi-structured, or unstructured, that exceeds the capacity of traditional database and application systems and thus presents significant challenges when trying to process, analyze, and draw meaningful patterns from the data. Data volumes are typically too large, data transmission and update rates are too high, or data processing requirements exceed the capabilities of currently deployed IT infrastructure in businesses. Companies may streamline their operations and make better, more timely choices with the aid of Big Data. Capturing, formatting, manipulating, storing, and analyzing data may help a business get valuable knowledge that can be used to boost profits, attract and keep customers, and enhance the efficiency and effectiveness of daily operations. Since big data covers such a wide range of applications, it's reasonable for a user to assume that it's already being put to good use in a number of prominent domains. Among these are financial trading, Smart city and smart home implementation, understanding and targeting customers, understanding business trends, and optimizing business processes; improving healthcare services and public health support systems; enhancing science and research; bolstering security and law enforcement; enhancing and optimizing city and country e-governance services; and enhancing and optimizing e-governance services. In the last decade, the concept of the "smart city" has emerged as a means of harnessing the potential of information and communications technologies to enhance urban infrastructure and services, thereby boosting cities' efficiency, competitiveness, and the ability to alleviate issues such as poverty, health care access, social exclusion, environmental degradation, and more. To put it another way, a smart city is an urban development initiative whose primary goal is the safe and effective use of Internet of Things (IoT) and information and communication technology (ICT) to municipal infrastructure and administrative tasks. Transportation networks, water distribution systems, educational institutions, libraries, information hubs, trash management, healthcare facilities, energy generators, law enforcement, and social services are only some of the city's many available assets. Home automation systems in a smart city go far beyond the standard fare, with features like automatic door openers, object motion sensors, IP-enabled cameras, security alarms and safety notification systems, and intelligent door locks with biometrics, all contributing to the feeling of safety and security that residents of a smart city can take for granted. The internet of things (IoT) and similar technologies are necessary for these kinds of automated systems in smart homes because they allow for a constant and stable connection between the transmitters and sensors of various home appliances, allowing them to store, process, and analyze their data. Future homeowners will have smart houses. As a part of their efforts to modernize, several cities throughout the world are actively adopting smart homes. Many linked smart home gadgets and equipment in these "always on" homes provide vast amounts of useful information.

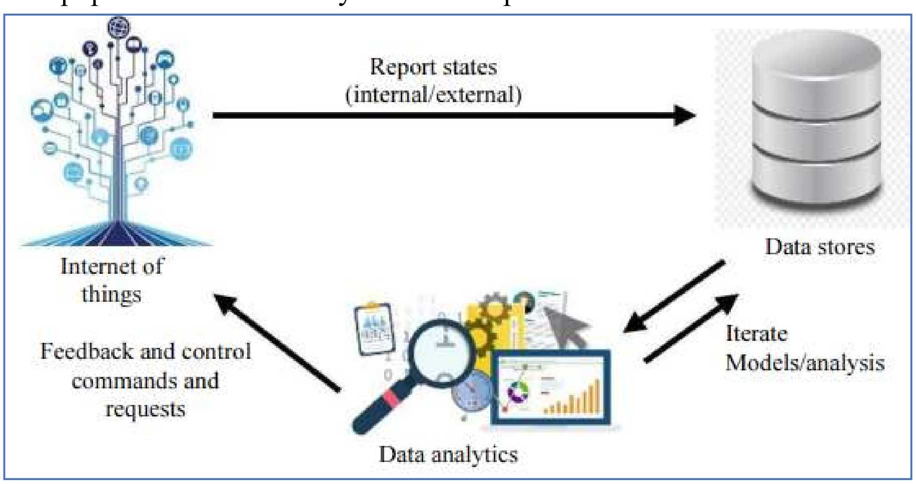

Figure1 . Interactions between the IoT and Big Data Analysis

The capacity to examine this data in near real-time and offline paves the way for the discovery of a wide range of information with far-reaching implications for the security, health, and prosperity of modern societies. The health care system of a smart city, for instance, may ascertain a patient's condition by tracking their appliance use and looking for any out-of-theordinary patterns that would signal an illness. A utility provider can get insight into homeowner behavior by analyzing extensive energy consumption data from in-home appliances, and then tailoring recommendations for lowering power bills to individual customers. Utilities and homeowners alike can save money in this circumstance. As a result of the Internet of Things (IoT) and its real-time applications, manufacturers may continually analyze data to establish or forecast a maintenance schedule for appliances or quickly swap out broken machinery. These Internet of Things (IoT) applications illustrate the value of studying IoT data collected from smart homes. While this information may be used to gain insight into the inner workings of a smart home and the habits of its inhabitants, it also poses a formidable obstacle in terms of data management, storage, and analytics. Smart city applications necessitate immediate actions with precise specifications, thus users must have access to systems capable of organizing, analyzing, and translating this volume of data into actionable insights. Both offline and near real-time decision making require systems that can scale to accommodate increasing amounts of data. A smart house may employ several automated and cutting-edge systems, each of which can create its own unique data. The data that each device creates and stores need not be in the same file format or be accessed in the same way. Big data technologies, such as Hadoop and its file system HDFS, and cloud-based analytics, can offer substantial savings. Comparing big data technology to more conventional methods (data warehouses and data marts in particular) is challenging due to the inherent differences between the two in terms of how they deal with schema-less data, semi-structured data, and the operations and functionalities related to these types of data. Hadoop and the tools that accompany it enable the efficient, distributed processing (Map reduce operations) of massive sets of data without respect to their structure, and at a low cost. Since almost all of the big data toolset is freely available and offers cloud-based analytics services, it has become more cost-effective than older methods of data processing. To better inform and execute on choices, big data analytics is ubiquitous. Smart homes, like huge corporations, are constantly on the lookout for faster and much better judgments for matters of safety, security, access controls, food processing, visual reports, and notifications, and they often turn to analytics scripts and tools to do so. Many businesses, smart cities, and smart homes are investing in in-memory analytics and Hadoop for its fast processing, security, and data replication characteristics.

LITERATURE REVIEW

Abhay Kumar Ray et al (2016), There are a number of active studies aimed at finding better ways for applications to handle massive amounts of data. The focus of this article is on the difficulties that have arisen as a result of trying to apply the principles and methods of big data analytics to the smart home. Major concerns and obstacles are covered, including those related to data format conversion, Internet availability and speed, sensor speed and quality, device maintenance, and vendor issues. As part of its research, the paper proposes a framework for smart homes, comprised of the following three parts: an application module, a device configuration module, and a big data module that makes use of big data concepts and tools in order to store and analyze data for more informed decisions and notifications.

Rita Yi Man Li et al (2016), Information technology's rising profile not only alters the outward appearance of data management but also fuels the smart home and city revolution. Though there are various variants of smart home electronics, many are aimed towards the same end goal of greener living. A lot of these gadgets help generate more energy, while others help save it. Some of them undeniably reach the trifecta of environmental, social, and economic co-development, where all parties involved benefit. We begin this study by comparing and contrasting the first three generations of smart homes: Smart technologies, such as those enabled by Bluetooth and Zigbee, include (2) an artificially intelligent smart home and (3) a robot that can roam freely around the house. Then, using the big data analytics technique, we look at Google search trends for "smart house" and "home automation" between the years 2004 and 2016. When all else fails, we look for cutting-edge smart home technology that can help us reach sustainable development. These findings demonstrate that interest in smart homes and other forms of home automation is not limited to the world's wealthiest nations. Over the past ten years, three Indian towns have dominated Google searches for home automation. They are widely recognised as centres of information technology (IT) and are home to a sizable number of specialists in this field. We hypothesise that an individual's level of computer literacy, rather than their financial status, is connected to their level of interest in smart home / home automation. And studies have shown that many eco-friendly household appliances are primarily concerned with cutting energy costs. Rare as a blue moon are smart home gadgets that conserve water. That may explain why power is so much more expensive than water in many locations across the globe. In a nutshell, the study has implications for theory, practise, and policy.

RESEARCH METHODOLOGY

There are three main parts to the suggested smart house framework that makes use of big data technologies for storing, processing, and taking swift and efficient designs for smart homes. The accompanying figure illustrates these levels. Often referred to as "domotics" or "smart homes," domotic buildings automate the functions of a household. Automation and management of the home's lighting, heating (through smart thermostats), cooling (via HVAC systems), and security (via smart locks) systems. Remote monitoring and control through Wi-Fi is commonplace. When appliances in the home are connected to the internet and can be monitored and controlled from afar, they become a vital part of the IoT. The switches and sensors in a modern system are often networked together through a gateway, and the user interface is typically a wall-mounted terminal, tablet computer, or web interface. When the house's infrastructure is upgraded with the help of modern information and communication technologies, we get what is known as a "smart home" (ICT). Numerous distinct protocols for exchanging information with commercial devices that employ a variety of data representations have emerged thanks to the IoT paradigm.

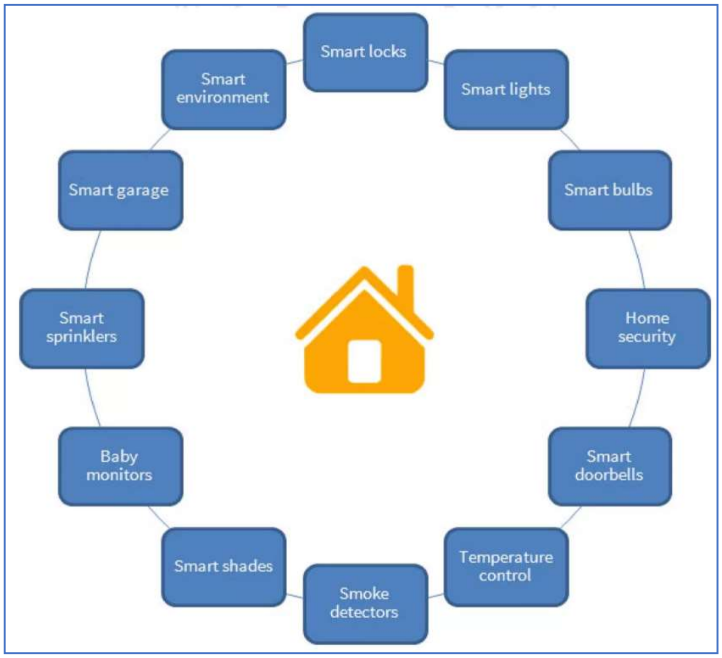

Figure 2. A Smart Home's Point of View

An Internet-of-Things (IoT) platform is required to manage all interoperability elements and to enable the incorporation of optimal Artificial Intelligence (AI) algorithms for modeling contextual connections. In this paper, we suggest architecture for the smart home that makes use of big data approaches.

Smart Home Control and Management

The Internet of Things (IoT) is a network of gadgets, automobiles, household appliances, and other items that may connect to one another and share data thanks to built-in electronics, software, sensors, actuators, and connections. Everything has a unique identifier thanks to its built-in computer system, yet they can all work together because to the Internet. Convergence of wireless technology, micro electromechanical systems (MEMS), and the Internet gave rise to IoT. The term "Internet of Everything" can also be used to describe this idea. The term "internet of things" (IoT) refers to the interconnection of devices, cars, buildings, and other inanimate objects equipped with electronics, software, sensors, actuators, and network connections for the purpose of collecting and exchanging data. In the context of the Internet of Things, "a thing" can be anything from a human being implanted with a heart monitor to a farm animal fitted with a biochip transponder to a car outfitted with sensors to notify the driver of low tyre pressure. Without the need for human-to-human or human-to-computer contact, the Internet of Things (IoT) allows for the identification and tracking of virtually any physical object, animal, or person over any network. The Internet of Things (IoT) paves the way for the remote sensing and/or controlling of items through preexisting network infrastructure, allowing for more direct integration of the physical world into computer-based systems and bringing about increased efficiency, accuracy, and economic advantage. The SIM900 GPRS modem on an IoT board enables an online connection, and a controller converts data received through UART into GPRS-based online information. It's possible to update data in a way that makes it accessible to users of a certain site or social network.

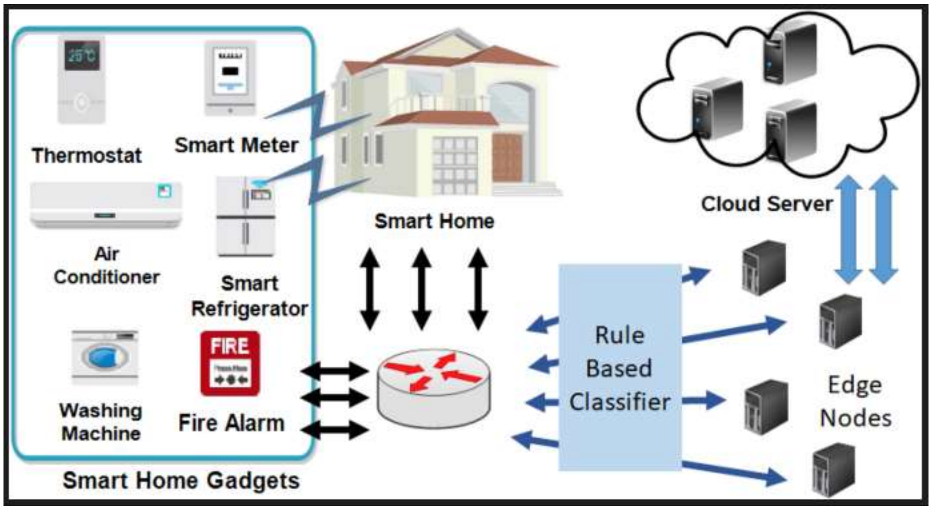

Figure 3 Applying Big Data Analysis to Create Smart Homes

Many years have passed since the introduction of the notion of the "smart and connected house," but outside of a select group of do-it-yourself enthusiasts and the ultra-wealthy, home automation hasn't caught on with the masses. High-speed Wi-Fi, a broadband connection, high-quality sensors, and a high-definition camera are all necessary components of a functional smart home, but compatibility is a concern due to the quick pace at which technologies are evolving. It seems like a big data tale when a large number of interconnected devices are exchanging and analysing streams of unstructured data in real time. And it is, according to Greg Roberts, head of marketing at venture-backed software startup iControl Networks, which develops a connected home platform for integrating data, applications, and devices. Comcast Xfinity Home, Time Warner Cable Intelligent Home, and ADT Pulse are just a few of the main home control and security systems that are powered by its software in North America. The widespread adoption of Smart-home services and gadgets is anticipated to pave the way for a variety of new services, many of which would be beneficial to the user's health, like the data-sharing scale discussed before. According to Roberts, daily weight tracking becomes possible once a scale begins producing data. If your weight suddenly and significantly changes, the scale can alert your doctor or other medical professionals to potential health problems. A smart house is a dwelling in which many systems, including the HVAC, lighting, security, and others, are operated by an automated process. Sensing devices, actuators, and microchips are all used in a smart home's data management system. Building owners, operators, and managers may increase asset dependability and performance, decrease energy consumption, maximize space use, and lessen the building's environmental impact with the help of this infrastructure. With a smart home system, you can control your lights, fans, and other electrical home fixtures from anywhere in the house. With its help, home appliances may be managed and operated with simplicity. After looking at how other systems work, we came up with this innovative method to enhance human contact and make greater use of android and Arduino. Home automation systems allow for the effective management of smart homes that are both affordable and adaptable.

RESEARCH RESULTS

This graphic shows the evolution of google interest in smart home and home automation from 2004-2016 by illuminating keyword search. This demonstrates that smart homes have been increasingly popular while home automation has fallen out of favour. Phoenix (USA), Quezon City (Philippines), and Austin (USA) dominate Google search results for "smart house," with the Philippines, the USA, and Germany accounting for the majority of total nation queries (the US). South Africans, Indians, and Emiratis conduct the most searches for information about home automation. The highest volumes of keyword searches originate in the Indian cities of Bangalore, Hyderabad, and Chennai. Located in different parts of India, these three cities are internationally recognized for their contributions to the field of information technology. Hyderabad is home to Google, Apple, Face book, and Microsoft India, whereas Bangalore is sometimes referred to as "India's Silicon Valley." The findings partially disprove common beliefs that home automation and smart homes are elitist topics of interest primarily to the wealthy and powerful. The findings indicate that familiarity with computers is more strongly correlated with enthusiasm for smart home technology than is economic growth.

Figure 4. Searches for "Home Automation Country" Most Popular Country

The second half of the study will examine the many smart home technologies now on the market and discuss how they may contribute to the objective of sustainable development (smart home robots are not included in this study yet as many of them which include Zenbo are not yet available for sale in the market till late 2016). Sustainable development is "development that satisfies the demands of the present without jeopardizing the ability of future generations to satisfy their own needs," according to the World Wildlife Fund. It emphasizes the importance of economic, environmental, and social progress all occurring simultaneously. Many of the already available smart home gadgets help reduce energy consumption or improve the reliability of the power grid. Using EIB-I Bus, we may, for instance, manage items remotely and adjust the amount of artificial light coming into a room or building. As a result, it contributes to environmental progress (through decreased power consumption), economic progress (by consumer cost savings), and social progress (can be controlled everywhere). Some of these gadgets even conserve water in addition to reducing or preventing the use of electricity. One such product is Whirlpool's optical water senor, which measures water and energy use and provides adjustments to both. Zone check residential delivers flow-switch tests, which eliminate the requirement for and cost of hiring contractors to conserve water during fire testing. However, there is a far smaller selection of water-saving smart home gadgets than there is for electricity-saving ones. The products displayed are some examples of smart home technology that might be used for environmental good.

CONCLUSION

In this paper, we explored the concept of smart houses, as well as how and why Big Data may be used in the smart home ecosystem. Concepts from the Internet of Things are used to the creation of "smart" houses by linking together electronic devices and sensors to improve the quality of our daily lives. However, this data may be simply stored, processed, and analyzed to yield some helpful insights for the homeowner, even if the total amount of data generated by all the linked devices each day is enormous. Smart houses that use Big Data not only save money, but also provide their owners access to the tools and capabilities of Hadoop. Safety and access controls, optimal energy use, storing and analyzing data from smart air purifiers, lighting systems, etc. are just some of the ways in which Big Data is being put to use in smart home designs. The quality of sensors, the cost issue, vendor-related concerns, device compatibility issues, servers for the data storage, and security challenges are all discussed in this article as well as their significance in the context of using Big Data technology in a smart home. And last, a basic framework for incorporating big data instruments into smart homes was provided at the paper's conclusion. Using the Internet of Things (IoT) and its many components, such as home access control, power management control, climate control, etc., this facilitates operation of the various gadgets that make up a Smart Home. The framework is divided into three main sections: the "Application" section, the "Big Data" section, and the "Home Appliances and Devices" section. Connect and set up your smart home appliances with the help of this module. Big Data file systems are utilized by these gadgets to store the data, which is then analysed with the help of big data analysis tools and application data analysis tools. Concerns addressed in this study might guide the design of a private cloud for storing smart home data in big data file systems, the deployment of in-house analytic tools to prevent data breaches, and the provision of an encrypted remote connection to the service provider.

REFERENCES

[1]. N. Komninos, Intelligent cities: variable geometries of spatial intelligence, Intelligent Buildings International, vol. 3, no. 3, pp. 172–188,2011.

[2]. L. Atzori, A. Iera, and G. Morabito, The internet of things: A survey, Computer networks, vol. 54, no. 15, pp. 2787–2805, 2010.

[3]. L. Da Xu, W. He, and S. Li, Internet of things in industries: a survey, Industrial Informatics, IEEE Transactions on, vol. 10, no. 4, pp. 2233–2243, 2014.

[4]. R. Iqbal, F. Doctor, B. More, S. Mahmud, and U. Yousuf, Big data analytics: Computational intelligence techniques and application areas, Int. J. Inf. Manage, pp. 10–15, 2016.

[5]. Z. Yan and D. Chakraborty, Semantics in mobile sensing, Synthesis Lectures on the Semantic Web: Theory and Technology, vol. 4, no. 1,pp. 1–143, 2014.

[6]. A. Carroll and G. Heiser, An analysis of power consumption in a Smartphone. in USENIX annual technical conference, 2010, pp. 1–14.

[7]. M. Kantardzic, Data mining: concepts, models, methods, and algorithms. John Wiley & Sons, 2011.

[8]. L. Daniele, F. den Hartog, and J. Roes, ―Created in close interaction with the industry: The smart appliances reference (saref) ontology, in Formal Ontologies Meet Industry. Springer, 2015, pp. 100–112.

[9]. K. Janowicz and M. Compton, The stimulus-sensor observation ontology design pattern and its integration into the semantic sensor network ontology, in Proceedings of the 3rd International Conference on Semantic Sensor Networks-Volume 668. 2010, pp.64–78.

[10]. M. Compton, P. Barnaghi, L. Bermudez, R. GarcíA-Castro, O. Corcho, S. Cox, J. Graybeal, M. Hauswirth, C. Henson, A. Herzog et al., The ssn ontology of the w3c semantic sensor network incubator group, Web Semantics: Science, Services and Agents on the World Wide Web, vol. 17,pp. 25–32, 2012.

[11]. O. Etzion and P. Niblett, Event Processing in Action, 1st ed. Greenwich, CT, USA: Manning Publications Co., 2010.

[12]. T. Maniak, C. Jayne, R. Iqbal, and F. Doctor, Automated intelligent system for sound signaling device quality assurance,‖ Information Sciences, vol. 294, pp. 600–611, 2015.

[13]. A. H. Neto and F. A. S. Fiorelli, Comparison between detailed model simulation and artificial neural network for forecasting building energy consumption,‖ Energy and Buildings, 2008.

[14]. H.-x. Zhao and F. Magoulès, A review on the prediction of building energy consumption,‖ Renewable and Sustainable Energy Reviews,vol. 16, no. 6, pp. 3586–3592, 2012.

[15]. B. B. Ekici and U. T. Aksoy, Prediction of building energy consumption by using artificial neural networks,‖ Advances in Engineering Software,vol. 40, no. 5, pp. 356–362, 2009.

[16]. F. Ascione, N. Bianco, C. De Stasio, G. M. Mauro, and G. P. Vanoli, Simulation-based model predictive control by the multi-objective optimization of building energy performance and thermal comfort,‖ Energy and Buildings, 2016.

[17]. W. Wang, J. P. Attanucci, and N. H. Wilson, Bus passenger origin destination estimation and related analyses using automated data collection systems,‖ Journal of Public Transportation, vol. 14, no. 4, p. 7,2011.

[18]. Z. Xu, Y. Wang, and X. Wang, "Research on Optimization of unstructured big data cloud storage combined with block chain," Computer Simulation,, 2021.

[19]. Y. U. Hao, Q. Wang, and Z. Wang, "Smart home remote control system based on Internet of things, Henan Science and Technology, 2020.

[20]. Verma P, Sood SK. Fog assisted-IoT enabled patient health monitoring in smart homes. IEEE Int Things J. 2018.