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# Applications of Big Data on IOT

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ABSTRACT

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## Keywords

Big Data, Internet of Things (IOT), Heterogeneous information, IOT Design, IOT Applications. Internet of Things (IOT) is a significant idea of another innovation era. It is a dream that allows the sensors or implanted gadgets to be interconnected over the Internet. The up and coming IOT will be significantly exhibited by the tremendous amount of heterogeneous organized installed gadgets that create seriously "Huge information". Immensely a lot of information is being gathered today by numerous associations and in a persistent raise. It ends up being computationally wasteful to break down such gigantic information. The amount of the accessible crude information has been developing an exponential scale. In an enormous database, the important data is covered up. The new grew Big information methods can deal with numerous difficulties that face information investigation and can remove profitable data. This study demonstrates the investigation of IoT and Big information. The study talks about Big information on IoT and how it is made. Numerous IoT existing, future application and an assortment of IoT advances whether wired or remote are seen. Difficulties and procedures that fathom these issues are talked about and the design of IoT is watched.

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## 1. Introduction

The brilliant world ideas, for example, savvy gadgets, PDAs, shrewd autos, keen homes, and brilliant urban areas have been received for quite a long while. Comparing to the flow assessment of scientists, the five extraordinary social explorations are Internet of Things (IOT), portable processing (MC), pervasive registering (PC), remote sensor systems (WSNs), and digital physical frameworks (CPS) [1].

The IOT is a thought that relies on upon interconnected physical items It makes a lattice of gadgets that can ready to create data. Sensors are around us like in autos, structures, and cell phones that can gather information about our surroundings [2]. IOT empowers us to know things that need supplanting, repairing or reviewing [3]. These things can contact and interrelate with their neighbors to achieve brought together objectives [4]. Numerous implanted in "things" gathered together and what is alluded to as a keen world is made [1].

Li et al. [5] recommended that we can diminish the cost, waste and misfortune, in the event that we had PCs that know everything and can gather information without client help. IOT can coordinate without human impedance.

The advancement of the IOT depends on specialized developments in numerous fields, from remote sensors to Nanotechnology. These advancements permit thoughts to transforms into particular items or applications. Existing examination on IOT underscores on the most proficient method to empower wide questions see, listen, and notice the physical world without anyone else. It makes them associated with offer the perceptions [6].

The immense presence of assortments of things, for example, sensors, actuators, and cell telephones, result in the considerable nearness of the IOT thought. Behind all desires, IOT upgrades the expectations for everyday comforts. The favorable circumstances identified with connection sensor information or systems administration between sensors is broadly conveyed in numerous fields. It contains ecological

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checking, calamity administration, human movements, wellbeing, savvy urban areas, and comprehension social marvel [7].

IOT produces various measure of information accordingly called "Huge information," that gives progressed logical methods and offers a dream that makes machine utilization simpler and effective. The Big information investigation is required to exploit its potential for abnormal state displaying and learning designing. The likelihood of the information stream from physical assets to future Internet offices is the thing that we have to an investigation by utilizing Big information logical strategies. The Big information test is the means by which to comprehend the communication amongst human and savvy objects. The premise of the Internet was human to human collaboration when the human decides the substance to be utilized by another human; however with the IOT the items decide the substance. Consequently, the effect on our lives is an open issue that necessities seeing how IOT assumes a vital part in a shrewd situation and brilliant world [8].

Whatever is left of this paper is sorted out as takes after. Area II presents making learning and Big information. Segment III talks about various sorts of utilizations of IOT. Area VI demonstrates the innovations of IOT. Area V examines systems and philosophies. Area VI demonstrates IOT Architecture. Area VII clarifies the already related work. At long last, difficulties and future Directions of IOT are talked about.

## **II. Creating Knowledge and Big Data**

The thought of the Big information is identified with the software engineering following the most punctual registering days. The information volume that goes past the preparing limit of the standard database and can't be taken care of by customary database strategies is called, "Enormous information."

However, in the event that we have a lot of information, it requires diverse methodologies like procedures, instruments, and engineering with the expect to tackle new issues or old issue in better ways [9].

A report discharged by Gartner [10] says going into an associated gadgets world; IOT is assessed to quicken and reach to 26 billion associated gadgets by 2020.

It has been watched four principle Big information challenges (the four Vs.):

• Expanding information volume.

• Expanding speed of information as in/out and change of information.

• Expanding assortment of information sorts and structures.

• Expanding information veracity.

The fifth V is proposed as the worth [11], which is the commitment of Big information and ready to decide. IOT will quickly expand the volume, assortment, and speed of information. Hence, undertakings start to hang on current Big information challenges. Obviously, taking care of the issues of information stockpiling, coordination, and IOT investigation is the obligation of IT.

In IOT, a gigantic measure of crude information is gathered on a continuous premise. In this manner, it is vital to grow new methods ready to change crude information into significant learning. Case in point, in the therapeutic area, huge activities done by human-like eating, drinking, breathing, and signs can be distinguished by changing significant sensor crude streams to it. The gathered information will be concentrated. It is required to be a tremendous measure of sensor information streams. These surges of information might be utilized as a part of various routes for various purposes. Along these lines, the assets of information and how it was prepared must be known, and the protection and security must be given [1]. The coming IOT will be incredibly displayed by the colossal amount of heterogeneous arranged installed gadgets that produce serious or "Enormous information". The gathered Big information might not have any quality unless dissecting, elucidation, and comprehension. The information mining systems are the for the most part prescribed techniques to be utilized as a part of extricating learning from crude information [1], [6].

#### **III. Uses OF IOT**

The IOT is not a good hypothesis. It is an application innovation that is helpful to our life. The estimation of IOT originates from numerous applications. Applying answers for these applications will be the essential guideline development motor. There exist some fruitful applications officially created in various fields like transportation, keen situations space, medicinal services area, sustenance maintainability, and modern applications [5], [12].

#### A. Transportation

#### 1. Savvy stopping

The savvy stopping offers answers for administration of stopping that can help drivers to spare time and fuel. By giving exact data about vehicles parking spots, it will be valuable for improving movement stream and diminish car influx [13].

#### 2. 3D Assisted driving

Vehicles like autos, transports and prepares that are fitted with sensors can give valuable data to the driver to spare better route and security. By utilizing 3D helped driving, the drivers can decide the right way in light of earlier learning about road turned parking lot and accidents[13].

## B. Shrewd situations area

#### 1. Shrewd water supply

Water supply in shrewd urban communities ought to be followed to ensure that the water sum is adequate forever needs. The brilliant urban communities can have the capacity to identify water misfortune issue before it happens, thus it can fundamentally save money on the financial plan. It helps the keen urban communities to recognize the water spill destinations and distinguish change need to keep much measure of water from misfortune [13].

### 2. Smart homes and workplaces

Sensors, actuators, and controllers can be added to a few home and office gadgets as a fan, refrigerator, clothes washer, aeration and cooling system, and microwave. For instance in Turkey, they apply an application for a home that is an answer for some issues. This application can screen home remotely, recognize fires, shield home from robberies, and control gadgets as a warmer and aeration and cooling systems from remote gadgets as a tablet, PC or telephone [13], [14].

#### C. Human services area

#### 1. Health following

Radio Frequency Identification (RFID) innovation is helpful for screen individual's wellbeing. The patient's therapeutic information can be measured by detecting gadgets and sent remotely to his to seek after his wellbeing [13],[15]. IOT applications include associating the sensor to a man that can track the client's heart rate or weight of blood ceaselessly, for examination by means of programming or versatile applications [16].

#### 2. Pharmaceutical items

Savvy drug store is a flawless application that helps simple gets to cure. Sensors appended gadgets can screen the condition of the medications. On account of discovering lapsed medications, it will keep it from gets to the patient. Case in point, brilliant pharmaceuticals is a South African endeavor that offers an arrangement of high components, minimal effort pharmaceuticals to drug stores, specialists, and other medicinal services social orders [13], [17].

## D. Sustenance manageability

There are a few stages that sustenance crosses from it before putting into the cooler. These stages are generation, gathering, transportation, and appropriation. The sustenance can be spared from harm by utilizing sensors that ready to screen the status of the nourishment and track temperature, dampness, and light to ensure sustenance. Viable nourishment checking helps in plant security from harm and control water sum [13].

## E. Modern applications space

The applications said in the past segments are reasonable as they either have been as of now conveyed or can be actualized in a short or medium period since the required advancements are as of now accessible. The following specified applications are not actualized; it will apply in the future[4].

#### 1. Robot Taxi

Brilliant robot taxis in shrewd urban communities can treat with each other and give administrations when asked for by individuals. Robot taxis can treat effortlessly with movement clog. It can move without the drive. It can maintain a strategic distance from mishap happening. Utilizing sensors and GPS, it can recognize the position of individuals who ask for the robot taxi. On account of ceasing when sensors informed that actuators set off reviving batteries, it can make basic upkeep and clean the auto [4].

# 2. City data model

The City Information Model (CIM) is relying upon the thought that proposes all structures is followed by the administration and permitted to the outsider. Keen economy, brilliant individuals, savvy gadgets, shrewd portability, savvy administration, and so forth can just interconnect with each other. Savvy urban communities models ought to be incorporated to enhance execution and proficiency of the framework [4].

## **IV. Innovations**

The IOT includes gadgets to get innovation from the physical world and change them into information. Advances in IOT can be partitioned into information procurement and system obtaining innovations.

Information Acquisition Technologies: In light of the quick development in PC equipment, programming, the Internet, and sensors, the versatile correspondences have created to improve administrations. Also, they have stretched out into new application ranges, with better administrations and elements with minor expenses.

## a) Two-dimensional code

It is a scanner tag that speaks to the information that the machine can read it. The one-dimensional code can read characters and numbers just and can't read Chinese letters and pictures. The two-dimensional code was developed to comprehend the one - dimensional code issues. The two-dimensional code handles high contrast pixels that are spoken to on a 2D plane to spare data. In the two-dimensional code, (0) communicates white, and

(1) communicates dark. The benefit of the two-dimensional code is the capacity to express an assortment of data as sounds, pictures, messages, and numbers. The Two-dimensional standardized identification was developed by calculations. The standard structure of pictures is monochrome BMP that outcome in the base volume in bytes [18].

## b) **RFID** Technology

RFID innovation can read remote source at a long separation. The distinguishing proof code identified with a label so that, the subsequent label code can be sent to one or more peruses. RFID includes of information correspondence between gadgets' peruses and RFID labels, and it is a standard innovation that can be utilized by numerous constructors. In this way, exact norms jump out at affirm suitable execution. These benchmarks are the EPC Global UHF v.1.2.0 and ISO 18000-6C. Numerous bank cards and move labels are utilizing uninvolved labels [18],[19]. Interchanges can be made by dynamic labels that have locally available battery procurement. The principle use of dynamic labels is observing payload in the part compartment. By contrasting RFID and two-dimensional standardized tags, the fundamental preferred standpoint of RFID than two-dimensional scanner tags is the capacity of non-contact operation without client mediation [20].

## c)Sensor

We can utilize sensors to portray items or gadgets. There are assortments of sensor sorts as dynamic pixel sensors, advanced sensors, and biosensors.

• Active pixel sensor (APS) is a picture sensor including of a coordinated circuit including an accumulation of pixel sensors; every pixel has a photograph pointer and a working speaker. A crucial advantage of CMOS APS engineering is its high productivity [21].

• Digital sensors an advanced sensor that is a mechanized or electrochemical sensor, wherever change and transmission of information are finished digitally. The necessity of advanced estimation and remote transmission oversee remote PC-based sensor diagnostics, following, and investigation. Applying the monstrous working limit, result in hard simple gadgets necessities improvement [22].

• The biosensor is an investigative gadget utilized for deciding expository that incorporate natural segments and physicochemical identifier. Biosensors rely on upon screen printed, so it is utilized for a huge degree development. In spite of the biosensors formed from bio-segments, numerous difficulties face biosensors as long reaction time, short steadiness, and poor era.

# System Acquisition Technologies

WSN is a guideline system that licenses things to shape correspondence with each other. Remote radio interfaces have little assortments, and subsequently middle of the road hubs are utilized for the spread of information. One, a few or all hubs in the sensor system can carry on as entryways to the Internet. The key advantage of WSN is that the likelihood of shared interchanges among the hubs exists. The variability of short degree access systems is converged with a wide range system like the Internet to outline a colossal knowledge system. In this way, the things are associated with each other in their little system, and the little system can be associated with extensive systems to finish the IOT [18], [19]. a)Zigbee

Zigbee is a remote system innovation built for little sensor degree. This convention incorporates the system layer, the framework layer, and the application layer. These layers are characterized in its ideas [18].

b) Z-Wave

Z-Wave is a remote interconnection innovation that approves spread from an administration element to one or more elements in the system. It comprises in its engineering of the system, framework, and application layers[18]. c)6LoWPAN

Low-control Wireless Personal Area Networks (LoWPANs) are remote systems that constituted of an immeasurable amount of minimal effort gadgets. They are measured with comparable remote systems. LoWPAN incorporates challenges as little bundle sizes, low data transfer capacity, low power, and extensive volumes of gadgets, battery section, and shakiness from radio network challenges. When they are converged with the Internet Protocol (IP), the imperatives of LoWPAN are suited. In this way, there is 6LoWPAN [18].

## V. Strategies and Methodologies

There are a few strategies and devices for tackling numerous IOT information administration challenges like Big information, distributed computing, semantic sensor Internet, information combination methods, and middleware.

• Big Data Analytics and Tools

There are numerous strategies or techniques that can fathom IOT information preparing and investigation issues in numerous ideas, fig.1 demonstrated the Apache Hadoop biological system.

#### 42265



## Figure 1. Apache Hadoop ecosystem.

#### a) Hadoop

Hadoop is an open source mission that managed by the Apache Software Foundation. Big data can be collected and handled by Hadoop. Hadoop is proposed to parallelize data processing through computing nodes to hurry computations and hide latency. There are two main components for Hadoop: Hadoop Distributed File System (HDFS) and Map Reduce engine. HDFS stores enormous data constantly set and reproduce it to the user application at high bandwidth. MapReduce is a framework that is used for processing massive data sets in a distributed fashion through numerous machines.

#### b) Map Reduce

MapReduce was constructed as a broad programming paradigm. Some of the original employments offered all the key needs of parallel execution, fault tolerance, load balancing, and data manipulation. The Map Reduce named with this name because it includes two abilities from existing functional computer languages: map and reduce. The MapReduce framework gathers all sets with the common key from all records and joins them together. Therefore, it acquires forming one group for each one of the different produced keys. MapReduce is one of the new technologies, but it is just an algorithm, a technique for how to fit all the data. To acquire the best from MapReduce, we need more than just an algorithm. We need a collection of products and technologies created to manage the challenges of Big data.

## c)HBase

HBase is a database model inside the Hadoop framework that looks like the original system of Big Table. The HBase has a column that operates as the key and is the only index that can be used to get back the rows. The data in HBase is also saved as (key, value) sets, where the subject in the non-key columns can be represented by the values [19].

#### d) Hive

The already deployed tools for data warehousing are not able to be suitable especially in the situation wherever, data is accessible everywhere; they are costly and often privatelyoperated. Such as the notion like MapReduce is there, it requests for the ability to write job procedures. Map Reduce jobs are difficult to track the characteristics of reusable code as some jobs are business particular some of the time. Hive may be thought as the necessary portion of Hadoop system and views at the top that principally is the organization for the data warehouse. Hive cannot treat with applications and transactions of the real time those are achieved online. The motivation behind it is a complicated technique. **e)Pig** 

The Pig implementation designed within the Hadoop framework to offer additional database as functionality. A table in Pig is a group of tuples, and every field is a value or a set of tuples. So, this framework permits for nested tables, which is a great notion. Pig also provides a scripting language called PigLatin that offers all the common concepts of SQL, such as projections, joins, sorting, and grouping. PigLatin differs from SQL as scripts are procedural and are simple for programmers to be understood. The PigLatin language offers a higher extraction level to the MapReduce framework, as a query in PigLatin may be converted into a sequence of MapReduce tasks [19].

#### f) Mahout

Mahout is mainly built on an Apache open-source library which able to be scaled and managed for the massive volume of data. These segments rely on three significant machine learning missions that Mahout presently operates.

Collaborative filtering

# Clustering

•Categorization/Classification

#### g) NoSQL

It is an abbreviation to Not only SQL, and the most usual notion for non-relational databases. These databases are appealed to operate better than SQL databases. Various types of NoSQL databases, which are key-value pair document, databases, column-oriented, and graph that permit programmers to display the data suitable to the structure of their used applications. Because of the growth of the Internet usability and the accessibility of low-cost storage, a massive quantity of structured, semi-structured and unstructured data are acquired and saved for different types of applications. This data is usually denoted to as Big data. Google, Facebook, Amazon, and several other enterprises use NoSQL databases.

## •Cloud Computing

Google's cloud computing is the most used cloud computing. Data storage technology is the Google File System(GFS). Data management technology is the BigTable, in addition to the Map-Reduce that discussed in the previous section as a programming model, used in cloud computing. a) GFS

## GFS is a distributed file system established by Google Inc. GFS is enhanced for Google's main data storage and usage requirements that can produce massive quantities of data that requires recalling. GFS has many purposes, such as performance, scalability, reliability, and availability of the distributed file system manipulated by application workloads and technological environment of Google.

#### b) BigTable

A Big Table development is initiated in 2004 and is now used by a much of Google applications, such as MapReduce. It is often used for producing and altering data stored in BigTable, Google Reader, Google Maps, Google Book Search, Google Earth, Blogger.com, Google Code hosting, Orkut, YouTube, and Gmail. Google's motivation for evolving its specific database contain scalability, and better control of performance features. BigTable is augmented for data read processes, by distributed data storage management model, which is based on column storage to enhance data retrieving effectiveness. The main components of BigTable are a row, column, record tablet, and timestamp. Amongst them, there cord tablet is a link to the set of row.

#### •Semantic Sensor Internet

The quantity of existing sensors will be enormous, and the gathered data will be intensive. If we have the ability to put the collections of data into a homogeneous and heterogeneous form, then the interoperability problems of understanding the data will rely on the semantic technologies to process the data. There are many aspects of semantic sensor Internet as

#### 42267 Ontology

Ontology is the core of any semantic technology as semantic sensor Internet. It is a tool for knowledge allocations and usage. Semantic Ontologies can be divided into some formats as OWL and RDF [19].

OWL: OWL stands for Internet Ontology Language. It defines discrete data substitution format. The great benefit of this ontology format is that there is no limitation to represent constraints as domain or range constraints.

RDF: RDF is an abbreviation for description research framework. It is a research description language. This language determines the way that resources can interconnect with each other and perform interpretations [19].

Data Fusion -It is a multidisciplinary extent that includes numerous fields, and it is difficult to launch a clear and precise classification. The developed methods and techniques can be divided as said by the following principles - According to the associations between the input data sources. These associations can be described as:

(a)complementary, (b) redundant, or (c) cooperative data. According to the input/output data types and their nature. According to an abstraction level of the employed data:

(a)raw measurement, (b) signals, and (c) characteristics or decisions. According to the different data fusion levels stated by the JDL. According to the architecture type: (a) centralized, (b) decentralized, or (c) distributed

## Conclusion

The IOT denotes to spreading the Internet of physical objects as a room, table, or another human sensing objects as collections of features. They can be detected, determined, and accessed by devices like actuators, sensors or other smart devices. As the vast increasing of existing devices, sensors, actuators and network communications, a massive amount of data has been generated. There are many problems result in the increasing of data volume as massive, heterogeneous, noisy data, privacy, and security. Applications of IOT have been presented. Technologies have been surveyed from the perspective of data acquisition and network based. Finally, challenges and future direction have been discussed. We intend to find new techniques and tools to solve Massive–Heterogeneous issues that are found in related work.

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### 42267

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