Beyond Things: A Systematic Study of Internet of Everything

K. Sravanthi Reddy[1], Kavita Agarwal[2], and Amit Kumar Tyagi[3(✉)]

[1] Department of Computer Science and Engineering, Malla Reddy Engineering College, Hyderabad, India
sravanthireddy.k8@gmail.com

[2] Department of Computer Science and Engineering, Lingaya's Vidyapeeth, Faridabad, Haryana, India
goel.kavita15@gmail.com

[3] School of Computer Science and Engineering, Vellore Institute of Technology, Chennai Campus, Chennai 600127, Tamilnadu, India
amitkrtyagi025@gmail.com

Abstract. Increasing necessity/needs of human have a large impact on development of technology. If we look in 1950, we were far behind than current scenarios. Today Human has made several great innovations which make human being life easier to live. Among such development, sensing of devices is great one. Sensing technologies are being everywhere, i.e., in each applications. A best example is Internet of Things. Internet of Things are communicating together and doing work efficiently (using sensing functions). Further, several upcoming technologies are also in trend like internet of everything, internet of nano-thing, etc. Internet of Things (IoTs) is still in developing phase, so internet of everything is also far from development. Today approximately 0.6% devices are connected only to internet (total 50 billion internet-connected devices), but this number will increase in near future, i.e., 25 billion devices will be connected till 2025. Increasing integration of devices with internet creates several challenges like security, privacy, huge data, etc. Several researchers are making serious attempts with IoTs but with IoE no more have been done/taken care, i.e., no article provides research gaps such issues or challenges (in IoE) on a single place. Hence, this article provides systematic study with significant current and future challenges (including possible future expansion of their applications).

Keywords: Internet of Things · Internet of Objects · Internet Connected Things · Internet of Everything

1 Introduction

Today's several emerging technologies are in trend like Internet of Things (IoT), Internet of Nano-Things (IoNT) and Internet of Everything (IoE) in various sectors/applications for providing convenient and reliable communication/services to users. Internet of

A. Abraham et al. (Eds.): IBICA 2019, AISC 1180, pp. 226–242, 2021.
https://doi.org/10.1007/978-3-030-49339-4_23

Things (IoTs) is the extension of Internet with providing a full-time connectivity to physical devices and everyday objects, for example, electronics items are getting embedded with internet connectivity for monitoring environment/activities and controlling these smart devices remotely. Further, Internet of Nano-Things (IoNT) concept also has been evolved in the past decade. IoTs variants can be many applications like Medical IoT, Human IoT, Industrial IoT, Consumer IoT, etc. Next, Internet of Everything (IoE) is integration of many Internet of Things, machine to machine, etc., together to do some tasks (like industrial Internet or industry 4.0) in automated form and smart way. Here, accepted definition (worldwide) for IoE is "the Internet of Everything (IoE) is bringing together people, process, data, and things to make networked connections more relevant and valuable than ever before-turning information into actions that create new capabilities, richer experiences, and unprecedented economic opportunity for businesses, individuals, and countries [1]". Information Technology (IT) company 'Cisco' claims that IoE brings people, systems, data and stuff together to make networked communications more important and meaningful than ever before turning knowledge into behavior that create new technologies, richer interactions, and unprecedented economic opportunities for enterprises, individuals, and countries. Hence, we need to put more focus on/study of IoE (also IoT) is more helpful in identifying dangers of criminal and other malicious activities, also hardware and software errors, which produce serious concerns, challenges, which can be considered for future (further) research. In last, after evaluating the current trends of advancement in the fields of IoT, IoNT and IoE, we reached to a decision that we need to identify many challenges/complex tasks in IoE environment/ecosystem which are required to be taken over by IoT/smart devices (and by research community).

1.1 Internet of Everything: Connecting the Unconnected Things and People

Internet of Everything (IoE) is a network of networks where billions of devices are connected together and sharing information among each other (for performing any task or solving a problem). These devices generated and share a lot of information among each other for providing efficient services to users (learning by itself). This collected information creates many opportunities including new risks. In general, IoE comprises of these concepts as well as connecting people, objects and systems. The integration of IoTs (create IoE ecosystem) provide automated decision-making industries or machines or environment like industries 4.0 or I4.0 or simply I4. I4 uses Industrial internet as the commercial, not consumer or individual application, i.e., towards digital transformation of manufacturing. Connecting devices together via internet, Internet has solution to cure (overcome) most of challenges whatever we face today. Now days, Internet of Things are being used in many popular sectors like smart healthcare, defence, smart cyber infrastructure, etc. Internet of Everything (IoE) can rectify and has ability to solve all raised challenges/problems (by device/human). For example, internet is solving several problems like by Improving education through the democratization of information, enabling economic growth through electronic commerce, and enabling greater collaboration or improving business possibilities with reaching to each and every consumer (in a region). As another example, internet is changing the face of aerospace industry via using cloud computing for its storage-purpose (string data virtually, can be accessed anytime, anywhere). But, having a lot of changing capabilities in IoT (or sectors like

science, medicine, communications, and other disciplines), still we have several critical problems like hunger, access to potable water, and various diseases, for such issues we are still in way of finding a solution.

- The human population today has almost tripled, while the overall water supply has been reduced by industrial pollution, unsustainable agriculture, and poor civic planning.
- The raising energy cost is causing instability between countries, growing business expenses, and adding to the consumer's financial burden.

Moreover this, due to increasing population around the world, we are facing rapid change in climate, through that we face serious threatens to our way of life (by impacting the weather, agriculture, etc.) in various forms like Tsunami, Flood etc. For solving such critical problems, author in [2, 3] introduced the concept of IoE, i.e., using smart devices in every possible applications, i.e., providing intelligence everywhere (in each application).

1.2 Internet of Everything Ecosystem: Role of Big Data and Cloud

In above section, we discussed that IoE is future of next century, containing IoT devices. An IoE ecosystem consists billions of sensors and millions of apps gather information from energy consumption, plant growth, blood pressure, etc. IoE ecosystem uses many smart devices together to change the environment of industry. Using IoT in IoE applications make emerging technologies best performer of the previous decade. In these emerging technologies, cloud computing and big data are two best innovations of the decade. These two services cloud services and big data help other technologies to emerge (with respect to IoE). The cloud can store and secure generated data that can be analyzed and turned into actionable information (i.e., data analytics). Cloud computing provides users with a computing environment, i.e. it offers dynamically distributed and virtualized services as an Internet service. Cloud computing is increasingly being used in many sectors, bringing many benefits to societies and industries. Cloud computing systems allow data to be stored remotely and accessed via secure login technologies. For instance, healthcare providers, can easily scale cloud storage to handle that patient data, i.e. patients can also access their medical records on mobile apps.

Moreover this, Big Data is most important component for big data analytics to provide effective decisions or to deliver predictive insights to other sectors/applications. Here the term "big data" refers to more diverse and ever-larger data sets that are updated in real-time. This generated data (by connected devices used in respective applications) is present in various forms like unstructured (e-mails, videos, audio formats), structured (any data that presents in a fixed field within a record or file), semi-structured, numerical from traditional databases [4]. Big data's different characteristics [5] are volume, variety, and speed, etc. Big data is crucial to IoE as it enables the efficient and productive handling of large amounts of data (generated by IoT, industrial internet, and Machine to Machine (M2M) technologies). IoE ecosystem includes more knowledge about this planet than we have ever gathered/accessed before and this interconnectivity produces large quantities and varieties of data from many devices, objects, people and systems at

the highest volume and speed. In summary, we discover that the IoE ecosystem (through all smart devices interconnected) needs to be securely integrated, function together and interact seamlessly with all connected systems (or phones) and networks (efficiently). Therefore, data generated from these multiple interactions must be properly secured, analyzed, incorporated and actionable with modern tools.

1.3 Role of Internet of Things in Internet of Everything Ecosystem

As discussed above, Internet of things are smart objects/devices which are used to create smart environment and perform task or solve problem efficiently and smartly. IoT devices working infrastructure is created by combination of sensors, actuators and internet. When these devices are connected together through Internet, then these devices/machines create smart environment. Smart environment is being implemented perfectly via Machine to Machine (M2M) communication. Note that till date nearly 0.6 billion devices have been connected globally and total 75 billion devices will be connected till 2025 [6]. As discussed above and in [11], integration of such devices are generating a lot of data, i.e., at a huge rate which is difficult to handle and have lot of importance for solving future/real world's problems. For that, we require several innovative solutions and efficient tools (also algorithms) to solve problems raised in these applications. For that, we need to define the role of internet of things, smart objects, sensors, etc., in IoE ecosystem clearly for next generation.

Internet of Things: Internet of Things (IoT) is a network of physical objects, linked and accessed (making communication) data via the Internet. Such objects involve embedded software to communicate with internal or external states. In other words, when entities can feel and interact, i.e., how and where to make decisions, and who, for example, makes them, Nest thermostat. IoT consists of networks of sensors and actuators connected to objects/devices, providing data that can be processed in order to make valuable decisions (such as predictions/projections) for the future (with automated actions initiated). The data also generates vital intelligence for planning, management, policy and decision-making. But, when these smart devices are being used everywhere then intelligence (generation of useful information) is initiated everywhere. Then, this scenario or ecosystem is called Internet of Everything. IoE reinvents the three-level (current) industries, i.e. business system, business model, and business moment. IoT will therefore produce tens of millions of new devices and sensors, all of which will generate real-time data. Today data is the new oil in 21st century, and it creates money to industries [7]. In near future, we will require big data and storage technologies to collect, analyse and store large amount of information.

Each component mentioned in Fig. 1, discussed in details as:

- People: In IoE, people can connect in many ways to the Internet. Many people today connect to the Internet through their interest in computers (e.g. PCs, laptops, TVs, smartphones, etc.) and social networks (e.g. Facebook, Twitter, LinkedIn, etc.). We will be linking more IoT devices in more appropriate and useful ways, as the Internet position is too central and necessary for IoE. For example, in the future, people will be able to use a pill over a safe Internet connection to a doctor to feel and document the safety of their digestive tract. Therefore, sensors mounted on the skin or sewn into

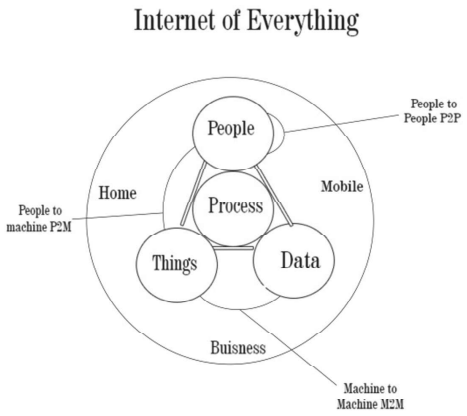

Fig. 1. Components of Internet of Everything [8]

clothing will provide data on the vital signs of a human. Individuals themselves will therefore become nodes on the Internet, with both static data and an activity process continuously emitting [9].

- Data: Devices collect data with IoT and stream it to a central source over the Internet, where it is analyzed and processed. Through transforming data into more useful information, they will become more knowledgeable as the capabilities of devices/things connected to the Internet continue to advance and improve. Instead of merely collecting raw data, Internet Connected Things (ICT) will soon return higher-level information to machines, computers, and individuals for further evaluation and decision-making. This transition from data to IoE information is important because it will allow us to make quicker, smarter decisions (also more successful in managing our environment).
- Things: This group is constructed using physical things like sensors, consumer devices, and **enterprise assets** that are connected to both the Internet and each other. In IoE, these things will sense more data become context-aware and provide more experiential information to help people and machines make more relevant and valuable decisions. For example, "things" in IoE include smart sensors built into structures like bridges, and disposable sensors, can be placed on everyday items like milk cartons, dustbins, etc.
- Process: Process plays an important role in how each of these organizations interacts with others (to provide quality products to the IoE world), i.e. people, information, and items. Connections are meaningful with the correct process and add value because the right information is provided in the appropriate way to the right person at the right time.

Now, this paper evaluates the benefits and risks caused by their application (with considering the governance models and industry practices), emerging in support of IoE. In near future, IoE will provide relevant and valuable connections to machine or devices to make human life easier or work efficiently. IoE has to work efficiently with machines and machine must perform efficient communication with other systems/machines (M2M

communication). By CISCO [10] it is predicted that *M2M (non-human mediated application of IoT), industrial Internet and IoT (all) are components of the Internet of everything (IoE) and there will be $14.4 trillion (USD) worth of "value at stake" over the next decade in the IoE economy, driven by "connecting the unconnected. Which is good sign for a nation" growth as in contribution in a nation's GDP.* It shows the value of IoE for many sectors, and for this century.

Hence, the remaining paper is organised as: Sect. 2 discusses related work related to internet of things, internet of everything. Also, several other components like cloud, big data, sensing devices are being discussed in this respective section. Further, motivation behind toward this work/paper is being discussed in Sect. 4. Further, importance or scope of IoE is discussed in Sect. 5. Section 6 discusses several relevant and valuable connections of Internet of Everything in near future. Further, Sect. 6 discusses several issues, opportunities and challenges in IoE (in detail). Section 7 discusses essential part of this article, i.e., an open discussion as argument between uses of IoE over IoT in near future (with considering all possible advantages and disadvantages). Finally, this work is being concluded in Sect. 8 with some future enhancement (including some research gaps). Note that the terms "Internet of Things" or "Internet of Objects" or "Smart devices" or "Smart things", or "Internet Connected Things will be used interchangeably throughout this work.

2 Related Work

As we discussed in Sect. 1, four pillars of Internet of Everything are people, data, process and things. Internet of Things (IoT) is the networked connection of physical Objects, whereas, Internet of Everything means "Intelligence Everywhere". In 19^{th} century, internet have launched/shared with introduction of Advanced Research Projects Agency Network (ARPANET). Today Internet has occupied every possible sectors or applications for increasing productivity or making communication easier. Mobile devices or smart devices are best ever innovation of the recent (past) century. Human can communication to other in minimum time (without having movement) with such smart devices. These smart are being used in many sectors to do effective work or increase productivity of an industry/organisation. For example, many smart devices or internet connected objects are being used in satellite or in aerospace sectors. Such sectors or satellite are being used to look over the boundary of nation and protect humanity against any natural hazards. These satellites provide live status of earth from space, which is very useful in shifting higher density of people (in an area) to different area/locations (to face minimum losses). Such solution can save millions of lives irrespective of repeated natural hazards. For example, Japan faces maximum earthquake in a year, so we can use IoE in smart home to alert user in critical situations and protect them. In summary, the pillars of the Internet of Everything (IoE) are:

- People: People getting connected in more valuable and appropriate way
- Data: Conversion of information into intelligence in order to make better decisions
- Process: Providing the right information at the right time to the right person (or machine)

- Things: Intelligent decision taking by physical devices and objects connected to the Internet and each other; also called the Internet of Things (IoT).

Hence, this section discusses work related to internet of everything and its related components/terms like cloud, big data, sensing devices, etc. It also discusses several works/attempts done in the previous decade in enhancement of Internet of everything. Now next section will discuss motivation behind/towards writing this work/area of internet of everything.

3 Motivation

Now days IoT are being used in every sectors/applications to increase productivity and fulfil need of society. IoT is the infrastructure that allows all types of devices (also machines) to communicate with each other, for example, cyber infrastructure, medical cyber physical systems, etc. This (IoT) links physical systems around the world such as power meters, cars, containers, pipes, wind turbines, sales devices, personal accessories, etc. Today's IoT technologies are used in all fields (or industries) possible, as well as providing many possibilities for other sectors such as fleet management, energy management, connected vehicle, health monitoring, and cargo management. Internet of Everything is the enhance version of Internet of Things (or Internet connected things) which consist intelligence everywhere via using smart objects (in real world's applications). For example, a daily life example has been discussed in [11] in detail. As another real world example, such devices are very much useful in decreasing total number of accidents over the road via continuous sensing nearby objects and responding to users (e.g., autonomous car). In near future, IoE will be everywhere and each object have intelligence and able to respond immediately with the help of IoTs. On another side, with (using) such devices we are facing many serious concerns like security of our personal information (or data), privacy of our identity (or location/information), trust in devices (or smart things), and lack of standardization of tools, etc. Serious vulnerability is getting traced by these smart devices/things, which is a serious issue (because via hacking or threats an attacker can try to steal user's information and can use for its financial gain/purpose). Finally, we should not forget that in the future we will be able to use IoT and IoE tools for sustainable development and to take urgent action to combat climate change and its effects on nature.

Hence, this section discusses motivation behind writing articles regarding to this emerging area. In that, we found that IoE is need for next decade and will be implemented with every system/ devices (to make people life easier). Now next section will discuss importance of IoE over IoT in 21st century (in detail).

4 Importance of Internet of Everything (Over Internet of Things) in 21st century

In general, terms IoE and IoT are being used interchangeably in this work (also in general-use), but IoT is not a synonym for IoE, it is an essential component of IoE. For

example, IoE includes people, artifacts, and system interactions in which IoT is one of the components. Internet Connected Things make environment for IoE and crate communications like (for) Machine to Machine (M2M) communication, Industrial Internet, industry 4.0, etc., for many industries. These smart technologies are being used in several critical applications like healthcare, defence, or aerospace, etc. Then, they have very essential role in making effective decision or predict accurate results (with respect to respective application), saving maximum human lives (around the world). Using IoE in different industry increase the productivity, reduce production cost and save time for completing any task. Hence, keeping importance of IoE in our mind, we are explaining several essential terms here, which are:

Machine to Machine (M2M) Communication Today and in Future: Machine-to-Machine (M2M) communication is made by integrating of many devices (called IoT or smart devices). There are several key components of an M2M system that include sensors, including radio frequency identification (RFID) tags, a Wi-Fi or cellular communications connection, and (programmed) autonomous computing software, used to communicate between devices and make effective decisions (without human assistance), i.e. only connected via internet/other networks. Even today's M2M is an important aspect of warehouse management, remote control, automation, traffic control, logistics, supply chain management, fleet management and telemedicine.). M2M communication have a lot of importance in several business models which include video-based security, in-vehicle information services, assisted living and mobile health solutions, energy solutions, manufacturing solutions, and the creation of smart cities. Several industries or organizations can collect revenue via using M2M technology, or via providing new opportunities to customer choice and service. For example, operational costs in manufacturing, automation and logistics are decreasing day by day, also M2M communication are increasing in various applications/sectors like healthcare, automotive, and consumer electronics. M2M development is also allowing businesses to focus on providing end to end global solutions. Transportation companies are saving millions by reducing fuel consumption using data captured, transmitted, and analysed (in real-time via efficient tools).

Industrial Internet: Industrial Internet provides enhanced visibility and deeper insight into equipment and resource quality. Responses on which equipment is most relevant, how it should be maintained and how unexpected failures can be prevented can be given by asset performance management. By using data and analytics in new ways to drive efficiency gains, increase performance and achieve overall operational excellence, the digital Internet improves the way people and machines communicate. The digital internet provides valuable new insights through the integration of machines with powerful (best) analytics. Industrial Internet's popular feature is that it consists of/installs knowledge above the level of individual machines. Internet-connected smart devices (IoT, Internet of Services and cyber-physical systems) can automatically improve performance, security, reliability, and energy efficiency by collecting data/information, interpreting data, and taking appropriate information action and transmitting it to the respective user. Industrial Internet solutions enable sustainable development through enhanced resource efficiency, resulting in savings in energy and water, increased performance, and higher output rates

of industrial machines. Simply put, by internet convergence of smart devices, M2M interaction maximizes the use of all industrial tools. For instance, street lighting (i.e. improving traffic congestion), energy-efficient initiatives (in larger cities) use Wireless Control Systems (WCS) to enable remote operation and monitoring of lighting fixtures through a web-enabled central management system. This not only saves energy and money, but also enables controllers to switch off or dim streetlights when required, i.e. to provide unique versatility and utilization of resources. Remember that street light can also feel vibrations that can help identify structural integrity problems while placed on bridges. *With similar examples, IoE can use useful a lot and provide different experience to users/citizens.*

Industry 4.0: Near future technology belongs to centralised structure with explaining or telling machines "what to do". For example, we can connect embedded system production technologies to other business industries (for smart production processes) which create a new technological age, also change/transform industry (also business models), etc., and work as smart factory. Automation (increased by interaction with M2M) would mean advanced robotics that will make automation more efficient and cheaper. Through such technologies as sensors and actuators, wireless networks, high-performance cloud computing and big data analytics, this interaction or automation phase is allowed. Virtual industrial transition is Industry 4.0 (emerged in 2011), which is the industry's new revolution. Industry 4.0 innovation, for example, helps farmers in developing countries keep pace with increasing demand for milk products, which has been a factor in improving quality of life and boosting rural economic growth. Automation also calculates the percentage of milk, cream fat and non-fat solids, while queue management ensures prompt refilling of silos without delay to maintain continuity. Note that M2M communication/automation ensures *sustainable consumption and production patterns of an organisation.* The next phase of digitization of industry 4.0/manufacturing sector include four trends:

- Increased data volumes, computational power and connectivity, particularly new wide-ranging low-power networks,
- The growth of skills in analytics and business intelligence,
- New forms of communication between human and machine, such as touch interfaces and augmented reality systems, and,
- Improvements in transferring digital instructions to the physical world, such as advanced robotics and 3-D printing.

Note that here digitalisation of the industry means is ability of real-time data (by machines) by efficient analytics tools. In the production environment, for example, cyber-physical systems (CPSs) include smart machines, storage systems, and production facilities that exchange information autonomously, trigger actions, and independently control each other. This improves the manufacturing, engineering, material use and supply chain and life cycle management processes involved in industrial processes. On the other hand, data generated from Global Positioning Systems (GPS) and agricultural sensors (and using big data analytics) will allow farmers to improve or increase their crop productivity through proper (field) water utilization. Farmers can also benefit from reliable

guidance on the seeds to be planted, time to harvest, and estimated yield using data and analysis. Monitoring crops and weather patterns can be tracked in the near future to specific regions to issue early warnings of drought or protect crops from extreme natural disasters. Such attempts may be useful for government to take preventive measures in risk areas. Industrie 4.0 therefore offers new tools for smarter energy consumption, greater storage of information in products and pallets (so-called smart lots), and optimization of real-time yields. Industrial Internet and Industry 4.0 can be used to improve health, resource efficiency and sustainable development in the near future.

IoE Today: Through describing the current and evolving elements of IoE: IoT, M2M, Industrial Web, Industry 4.0, and the environment they work in (i.e., cloud and Big Data Analytics), we discuss several benefits and risks caused by the respective application. Today internet has changed various application/sectors in terms of efficiency. What's next, then? How is the Internet going to evolve and keep changing and improving the world? Such things are discussed here or things are in supporting the IoE today are discussed here as.

Transforming the World's Largest Cities via Providing Smart Solutions to Transportation Sector
On nearby smartphones, tablets and laptops along the highway/road, smart screens can be accessed via Wi-Fi. The aim of smart Screens (in cities) are to:

- By connecting people immediately with information relevant to their immediate proximity, notify them.
- Secure by providing local police and fire departments with a citywide network of sensing, communications and response capable of directing required staff and assets precisely where and when necessary
- Revitalize by increasing levels of commerce, investment, and tourism

We need to create innovative solutions to the major environmental, social and health challenges facing cities, i.e., [12] skill. Smart traffic can also solve several critical problems like traffic management, etc. Mazhar Rathore et al. [13] explained the application of IoT devices/IoE in providing real time data to help urban drivers find parking more quickly and efficiently *(*technology can help drivers find parking more quickly and avoid unnecessary driving*). Also,* logistics companies are able to use similar initiatives to obtain traffic footprints of urban centres to help define cost- and time-efficient routes for the delivery of vehicles.

Resource Efficiency: The key area where IoT can bring significant benefits is energy management. The control of water is a good example. Usually, large-scale water systems could lose around 20% to leakage before reaching the end-customer. Such a system would bring a whole new level of efficiency to water consumption around the world. Better optimization of capacity and demand, better management of the network and leakage, lower unbilled volume of water are some advantages of resource efficiency. The new reality has many connected devices rapidly improving computing power and economies of scope and scale (also increasing the use of cloud computing and big data

analytics). The technology transition provides multiple opportunities (which we have not seen before) for both the public and private sectors to develop new technologies, enhance productivity and efficiency, enhance real-time decision-making, solve issues relevant to critical society, and develop new and innovative user experiences. IoE covers a wide range of items, including M2M and the digital Internet. This chapter addresses the nature and significance of the IoE age and the near future for different applications. Now, the next segment will be addressing important and useful IoE interfaces/connections in the near future with other smart devices/objects.

5 Relevant and Valuable Connections of Internet of Everything to Other Applications in Near Future

IoE will impact individuals, businesses, and countries in various ways, i.e. by bringing people, processes, data, and things together, it will bring several benefits to humanity. Each term can be defined as:

- Individuals: Through their senses, people experience the world (hears, touch, sight, taste and smell). IoE becomes an exponential proxy in this context for sensing, understanding and managing our world. Something that was silent now has a voice with IoE.
- Businesses: Success in business is about making a profit. IoE should help businesses achieve this goal by creating new automation and improvement opportunities.
- Countries: While there are many forms of government, accountability is essential for countries to provide their people with services. If properly applied to protect confidentiality, safety and security, IoE would allow all levels of government to increase transparency in order to benefit everyone.

For example, billions of devices helps manufacturing sector via tracking of materials efficiently. For healthcare, smart slippers and other wearable devices for the elderly include sensors that detect falls and different medical conditions. If something is wrong, the system will alert a doctor via email or text message, avoiding a fall and a costly ride to the emergency room. Another example is the installation of sensors in cars offering a pay-as-you-drive policy that ties the insurance premium to the risk profile of the patient. This will lead to increased health, protection and avoidance of losses in the insurance industry. IoE will also facilitate new business models like usage-based insurance, calculated based on real-time driving data. IoE will also improve its ecosystem capabilities and provide sustainable development, as well as expand applications in areas such as healthcare, elderly care, medical research, urban planning, logistics, environmental protection, resource management, education, strategic planning and effectiveness assessment across all disciplines [12]. Now, what are the applications may/will support IoE are discussed here (with some examples):

IoE Tomorrow: Several decisions are need to be made in the coming decade by IoE. Some changes in near future will be or included here as:

Conquering Climate Change: Using IoE, we can assess our limited resources' best by enhancing how we think, perceive, and even control our climate. As billions of sensors are connected around the world (or in the atmosphere), we're going to get to know about the "heartbeat" of our world. Indeed, we're going to know when our planet is healthy or ill. With this intimate understanding, we will start to eliminate some of our most pressing problems, including hunger and drinking water availability.

- Hunger: Farmers will be able to plant crops that have the greatest chance of success by understanding and predicting long-term weather patterns. And, once the fields are harvested, more efficient (and therefore less expensive) transport systems will enable food to be distributed and delivered from abundant places to scarce places.
- Drinkable Water: Although IoE may not be able to create water where it is most necessary, it will be able to address many of the issues that limit our clean water supply, such as industrial waste, wasteful farming, and poor urban planning. For example, when a leak occurs, smart sensors installed throughout the water system of a city can detect and automatically divert water to avoid unnecessary waste. The same sensor would warn the service workers so that as long as resources are available the problem can be solved.

In IoT based Cloud infrastructure, all types of devices and machines communicate with each other to solve complex or difficult problem/to do difficult task (like in healthcare, etc.). New heart monitoring devices can be worn at home for extended periods of time giving physicians much more visibility in the function of the heart (including times and activities). Such test in a hospital are every costly, so in near future efficient medical care are an alternative option for patients (using smart devices). Different systems move to households, allowing the remote and continuous control of essential information from patients. Such medical information is wirelessly connected to a regional monitoring center (i.e., from a phone to a router) in the patient's home, which then sends the information to the broadband network, forwarding it to the cloud where sensors constantly monitor a patient's condition, i.e. reminding a health care provider of any problems/problems. However, the telehealth field [14] holds the potential to expand healthcare practitioners' scope to rural, underserved and high-risk areas. IoT improves the quality of life and integration of elderly people, improving safety and lifestyle for elderly people (i.e., supported by home sensors). In summary, IoT technology can collect, analyze and automate appropriate responses and actions to real-time data from sensors and other devices in homes or other properties in a secure manner.

In near future, this technology can identify and send alerts on an emergency, i.e., requiring urgent care (with identifying, tracking and monitoring of patient's health, e.g., mental – disorder patients). Similarly, in case of an accident, IoTs devices can send alert message to nearby hospitals, and can help in saving many lives. Network can also host live video conferences between doctors and patients, and share pictures and medical records (or reviews, etc.). In another example, traffic-use software can use virtual real-time maps and autonomous driving to help solve simple real-world problems. This is a serious issue and can be solved by implementation of IoT devices in IoE environment. Hence, this section discusses several relevant and useful interconnections with other

devices/systems/objects in near future (to do work efficiently). Now, next section will discuss several issues, challenges and essential opportunities for future researchers.

6 Issues, Opportunities and Challenges in Internet of Everything in Near Future

As discussed above, Machine to Machine (M2M) communication, industrial Internet and IoT are all components of the Internet of everything (IoE) and it is predicted that the uses of IoE will be existed in every sector in next decade. Some popular issues and challenges in IoE are:

- Identification of each devices or proving address to each device is a challenging issue (for finding attacker when any attack happened). For example, IPv6 must become a reality as the number of connections moves from billions to trillions. Also, efficient network protocols, storage mechanism, and analytics process or tools push several challenges towards IoE.
- Preserving privacy in IoE is an essential issue. Here, because of its often imperceptible collection of information, there is a privacy issue. In the environment (i.e., indoors and outdoors), for example, it becomes more computer-aware with sensors that are not managed by any person and for which data collection or use is not apparent.
- IoE also raises (equal) security challenges with confidentiality. Computer protection and the potential to break into the computer or data flow that comes from the system are serious issues that arise. Security and privacy are serious concerns for health devices/medical care applications [19] or those involved in critical systems.
- Finding energy sources to fuel the huge number of miniature (even microscopic) devices is another problem.

In summary, we notice that privacy, security, trust, addressing, etc., are the main challenges or issues in IoE. Suppose IoE is part of a larger system and used by many users every-day. For example, Self-monitoring, analysis, reporting or 'smart' house may include a number of enabled devices, smart appliances, outlets and cables, all of which can be controlled through a centralized house system. In such applications, leaking of personal information by internet of things or security of IoT against many popular threats is a serious issue. For example, in Hollywood movie "Die Hard or Live Free", villain tries to control on each and every systems of a country and use all devices according to his plans. Also, one more movie name I.T released 2016, attacker tries to breach and take control on one man's house and use collected information for blackmailing him/against owner's wish. Hence, issues in IoE (in the next 10 years) will be security, privacy and reliability would allow us to have open social and political discussions. However, note that government plays an important role in embracing every emerging technology through eliminating policy obstacles, increasing excessive costs, and mitigating unintended consequences where they are critical factors. Government's role is to promote and encourage the use of emerging technologies in a number of ways and as an early adopter will help create trust and confidence in new technologies. Overall, a policy issue of serious concern provides sufficient rules and regulations to protect it (personal

data) from attackers and provide privacy assurances. The industries/organizations of today are data driven and data that contain information about the preferences, networks, habits and behaviors of individuals (e.g., mobile apps, etc.). The concern is dependent on the nature of the information being collected and used. Like, de-identified data can be used in healthcare for the good of all people for certain research purposes and for big data purposes.

Today protecting privacy of patient and protecting sensitive or non-personal information is a critical issue. A successful implementation strategy is always necessary for IoE for overcoming above serious concern 'privacy'. Privacy is preserved with some rules, regulations or restrictions. Nonetheless, higher constraints are blocking successful implementation of innovative technologies, causing confusion and often legal ambiguity. To achieve a successful IoE ecosystem (or systems of systems), we need to provide solutions like

- Globally recognized market-driven, consensus-based standards can accelerate adoption, drive competition, and enable new technologies to be introduced cost-effectively (i.e., cost-effectiveness).
- Sensitivity and confidentiality of the data, improve the security of the devices
- Distributed edge system and data center analytics solutions,
- Capacity to categorize and manage data as public or private (i.e., providing robust and appropriate data protection with involving trusted environments)

Therefore, in order to overcome these obstacles, government agencies, standards bodies, companies, and even individuals will need to come together with a spirit of cooperation. Through integrating people, systems, information, and stuff (IoE's pillars), the internet allows us to do something fantastic and seek innovative solutions to individuals, companies, and countries' problems/challenges. Hence, this section discusses several issues, challenges and provides opportunities (list-wise) in Internet of Everything in next decade. Now next section will discuss/provide an open discussion or argument among both emerging technologies (with every possible user's or industry perspective).

7 Argument Between Internet of Thing and Internet of Everything

In above discussion, we have seen the growth/rapid change in internet of things and internet of everything today and in upcoming decade. IoT is a component of IoE, of a smart infrastructure. We found that privacy and security are critical building blocks for the IoE ecosystem and capabilities to be designed by design methodologies into IoT systems from the outset. Security solutions will also be an essential component of personal data protection; and both security and privacy should be considered as basic elements in the design of IoT systems [18]. Note that trust also can be improved by improving privacy in a computing environment.

Considering IoT devices use in IoE, have the ability to connect the physical world and human activity with sensors and networks (with the Internet) and attracting high attention from citizens, governments and transforming people lives/daily routines, etc. These smart devices are being used in e-healthcare applications/bio-medical imaging area on a large

scale. Electronic Health Records (EHR) lead to greater and more streamlined flow of information within an electronic health care system and can transform the way care is delivered. For electronic health records, information is available whenever and wherever it is facilitating; enhanced patient care and coordination; better treatment and patient outcomes; and significant cost savings and efficiencies. Patient information is readily available to store patient information directly on the cloud through devices/machines to improve efficiency and minimize paperwork and costs. Through mobile applications, patients can also access their medical records. Big data is important for IoE because it allows the efficient and productive handling of the vast amount of data produced by IoT, industrial Internet and M2M technologies.

Now coming IoE part, in many applications, a variety of sensors (embedded IoE Ecosystem) from connected environments (like cloud and big data analytics) provide a continuously updated stock of conditions in real time across a number of variables. IoE include components big data, cloud and IoT together to make communication or predict decision early and efficient. Big data, cloud and IoT can be used in the human body through sensor inputs, as well as through the senses, the internet, communications systems, and the cloud can be represented by the human nervous system carrying the impulses. Therefore, analytics and big data processing can be linked to some of the brain functions that process data for decision making. Big data analysis has a significant impact on medical quality and personalized medicine. Predictive analytics [15] plays a key role in early disease identification and ensuring that patients receive personalized and efficient treatment. It predicts diseases from suturing processes, assessing the risk of illness, assisting a physician with a diagnosis, and predicting future health. Data analytics, forecasting models to identify useful trends from raw data often play a similar role.

Today's Big Data helps to use large quantities of IoE resources, whether through data, processes or facilities, thus improving service quality. As discussed in [16], big data present in structured and unstructured form. Both structured and unstructured type of data increases the efficiency (with improving service efficiency and effectiveness of outcomes) of analytics process with discovering and communication of meaningful correlations in data. The Nano-Thing Internet uses multiple sensors to ensure proper timing and dosage of medicine support doctors during clinical trials; in-flight data collection from jet engines is used in real-time to recognize and plan required and preventive maintenance; embedded sensors and related analytics help enhance the independence of the elderly and visually impaired, and improve the quality of life in cities and rural areas. In addition, the information produced (through D2D/M2M communication) enables scientists, politicians, developers and residents to collaborate and make cities safer, more productive and more livable, i.e. to save costs by predicting and proactively solving potential problems such as urban floods.

Hence, in summary IoE will be more popular and useful than IoT in very possible applications. Also, remember without IoT, IoE is nothing, i.e., IoE is depending on internet connected devices/objects (completely). Because, emerging technologies like IoE have major impact on economy of a nation. According to McKinsey's estimation [17] The Internet of Things (IoT) can have a total potential economic impact of $3.9 trillion to $11.1 trillion a year by 2025 and at the high end that rate of value, i.e., including

the consumer surplus, would amount to about 11% of the world economy. In the near future, we need to develop new business models that accelerate economic growth and maximize societal benefits. To solve many real world's problems, we require robust data exchange solutions with IoE in many sectors/applications with ensuring scalability and sustainability of infrastructure and technological innovation (for a long time). If we care about this technology (Internet of Everything) to our best level, it will solve many of challenges (or problems) whatever we face in current. Hence, this section discusses an open discussion or argument between IoT and IoE and provide answer to several questions like "Which one technology will be popular in near future", "Which technology have maximum challenges or bad impacts on society", etc. Now next section will conclude this work in brief with some future research works (enhancements).

8 Conclusion and Future Scope

Today's emerging technologies like IoT, IoE are currently utilised in several sectors/ways for benefit of society and are providing strength to the network day by day. As we have seen many of the applications are being transferred to IoT (a network of objects/smart devices connected to the internet). Further, IoE (networks of networks of IoTs or intelligence using IoT) built upon billions and someday trillions of connections create the opportunities which were never done before. With opportunities, it may also face some serious like security of devices, privacy of data (in motion/communication time), addressing of each unique smart devices, etc. There are exponential changes in technology which create many opportunities for near future. Hence, rapid pace of change in technologies require a lot of attention from research communities to look in respective issues, challenges and research gaps. To overcome these challenges, we (citizens), government organizations, standards bodies, and businesses need to come together with a lot of energy and cooperation to face such issues/challenges.

Acknowledgment. Parts of this work have been funded by the Ministry of Science, Education, and Culture of the German State of Rhineland-Palatinate in the context of the project MInD and the Observatory for Artificial Intelligence in Work and Society (KIO) of the Denkfabrik Digitale Arbeitsgesellschaft in the project "KI Testing & Auditing"

References

1. http://www.cisco.com/web/about/ac79/innov/IoE.html
2. Weissberger, A.: TiECon 2014 Summary-Part I: Qualcomm Keynote & loT Track Overview. IEEE Com Soc (2014)
3. Evans, D.: The Internet of Everything: How More Relevant and Valuable Connections Will Change the World. Cisco Internet Business Solutions Group (TBSG), Cisco Systems, Inc., San Jose, CA, USA, White Paper (2012)
4. Han, J., Haihong, E., Le, G., Du, J.: Survey on NoSQL database. In: 6th International Conference on Pervasive Computing and Applications (2011)
5. Oguntimilehin, A., Ademola, E.O.: A review of Big Data management, benefits and challenges. J. Emerg. Trends Comput. Inf. Sci. **5**, 433–437 (2014)

6. Alam, T.: A reliable communication framework and its use in internet of things (IoT). Int. J. Sci. Res. Comput. Sci. Eng. Inf. Technol. (IJSRCSEIT) **3**(5), 450–456 (2018)
7. Azencott, C.-A.: Machine learning and genomics: precision medicine versus patient privacy. Phil. Trans. R. Soc. A **376**, 20170350 (2018)
8. Evans, D.: How the Internet of Everything Will Change the World. Cisco Blog (November 2012)
9. Gubbi, J., Buyya, R., Marusic, S., Palaniswami, M.: Internet of things (IoT): a vision, architectural elements, and future directions. Fut. Gener. Comput. Syst. **29**(7), 1645–1660 (2013)
10. Bradley, J., Loucks, J., Macaulay, J., Noronha, A.: Internet of Everything (IoE) Value Index: How Much Value Are Private-Sector Firms Capturing from IoE in 2013? Cisco Internet Business Solutions Group (TBSG), Cisco Systems, Inc., San Jose, CA, USA, White Paper (2013)
11. Tyagi, A.K., Shamila, M.: Spy in the crowd: how user's privacy is getting affected with the integration of internet of thing's devices. In: Proceedings of International Conference on Sustainable Computing in Science, Technology and Management (SUSCOM), 26–28 February 2019. Amity University Rajasthan, Jaipur, India. http://dx.doi.org/10.2139/ssrn.3356268. https://ssrn.com/abstract=3356268
12. https://cdn.iccwbo.org/content/uploads/sites/3/2016/10/ICC-Policy-Primer-on-the-Internet-of-Everything.pdf
13. Mazhar Rathore, M., Ahamed, A., et al.: Urban planning and building smart cities based on the internet of things using big data analytics. Comput. Netw. **101**, 63–80 (2016)
14. Al-Majeed, S.S., Al-Mejibli, I.S., et al.: Home telehealth by internet of things (IoT). IEEE (2015)
15. Ghosh, R., Naik, V.K.: Biting off safely more than you can chew: predictive analytics for resource over-commit in IaaS cloud. IEEE (2012)
16. Raghupathi, W., Raghupathi, V.: Big data analytics in healthcare: promise and potential. Health Inf. Sci. Syst. **2**(1), 3 (2014)
17. https://www.mckinsey.com/business-functions/digital-mckinsey
18. Tyagi, A.K., Rekha, G., Sreenath, N.: Beyond the hype: internet of things concepts, security and privacy concerns. In: Satapathy, S.C., Raju, K.S., Shyamala, K., Krishna, D.R., Favorskaya, M.N. (eds.) ICETE 2019. LAIS, vol. 3, pp. 393–407. Springer, Cham (2020). https://doi.org/10.1007/978-3-030-24322-7_50
19. Shamila, M., Vinuthna, K., Amit Kumar, T.: A review on several critical issues and challenges in IoT based e-healthcare system. In: International Conference on Intelligent Computing and Control Systems, ICICCS 2019. IEEE (2019)