

Internet of Things (IOT): Analysis Challenges and Future Applications

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ABSTRACT

With the web of Things (IOT) bit by bit evolving because the future part of the evolution of the web, it becomes crucial to acknowledge the assorted potential domains for application of IOT, and therefore the analysis challenges that square measure related to these applications. starting from good cities, to health care, good agriculture, supplying and retail, to even good living and good environments IOT is anticipated to infiltrate into nearly all aspects of existence. even if the present IOT facultative technologies have greatly improved within the recent years, there square measure still various issues that need attention. Since the IOT thought ensues from heterogeneous technologies, several analysis challenges square measure guaranteed to arise. the very fact that IOT is thus expansive and affects much all areas of our lives, makes it a big analysis topic for studies in numerous connected fields like info technology and engineering. Thus, IOT is paving the approach for brand spanking new dimensions of analysis to be meted out. This paper presents the recent development of IOT technologies and discusses future applications and analysis challenges.

Keywords—Internet of Things; IOT applications; IOT challenges; future technologies; good cities; good environment; good agriculture; good living

1.INTRODUCTION

The Internet is delineated because the communication network that connects people to info whereas the net of Things (IoT) is AN interconnected system of distinctively address ready physical things with numerous degrees of process, sensing, and propulsion capabilities that share the aptitude to interoperate and communicate through the net as their joint platform [1]. Thus, the most objective of the net of Things is to form it doable for objects to be connected with alternative objects, people, at any time or anyplace victimization any network, path or service. the net of Things (IoT) is bit by bit being considered the next introduce the net evolution. IoT can build it doable for normal devices to be connected to the net so as to realize uncounted disparate goals. Currently, AN calculable range of solely zero.6% of devices which will be a part of IoT has been connected up to now [2]. However, by the year 2020, it's doubtless that over fifty billion devices can have an online affiliation.

As the net continues to evolve, it's become over an easy network of computers, however rather a network of assorted devices, whereas IoT is a network of assorted “connected” devices a network of networks [3]. Nowadays, devices like smartphones, vehicles, industrial systems, cameras, toys, buildings, home appliances, industrial systems and uncounted others will all share info over the net. despite their sizes and

functions, these devices will accomplish good reorganizations, tracing, positioning, control, real-time observance and method management. within the past years, there has been a very important propagation of net capable devices. although its most vital industrial impact has been determined within the client physical science field;

i.e. significantly the revolution of smartphones and also the interest in wearable devices (watches, headsets, etc.), connecting folks has become just a fraction of an even bigger movement towards the association of the digital and physical worlds.

With all this in mind, the net of Things (IoT) is anticipated to continue increasing its reach as pertains the amount of devices and functions, that it will run. this can be evident from the anomaly within the expression of “Things” that makes it tough to stipulate the ever-growing limits of the IoT [4]. whereas industrial success continues to pass off, the IoT perpetually offers a nearly limitless offer of opportunities, not simply in businesses however conjointly in analysis.

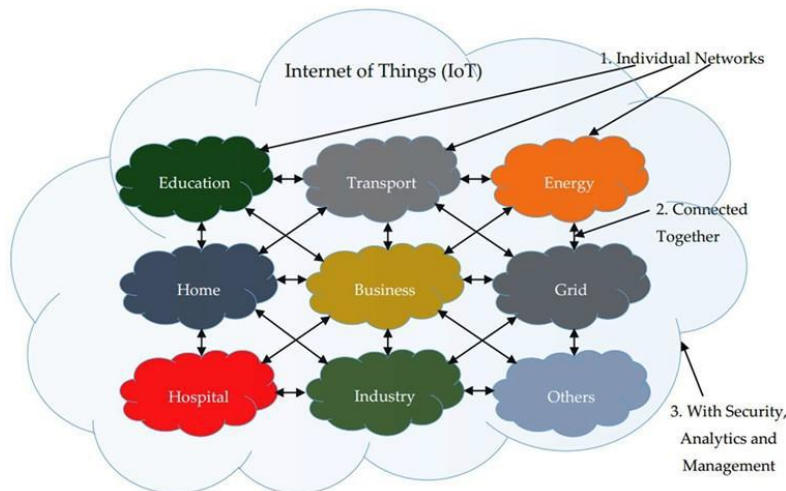


Fig. 1. IoT can be viewed as a Network of Networks[3]

2.POTENTIAL APPLICATION DOMAINS OF IOT

Potential applications of the net of Things aren't solely various however conjointly quite numerous as they permeate into nearly all aspects of way of life of people, establishments, and society. per [5], the applications of IoT cowl broad areas together with producing or the economic sector, health sector, agriculture, good cities, security and emergencies among several others.

2.1 GOOD CITIES

According to [6], the IoT plays an important role in rising the smartness of cities and enhancing general infrastructure. a number of IoT application areas in making good cities include; intelligent transportation

systems [7], good building, tie up [7, 8] waste management [9], good lighting, good parking, and concrete maps. this could embrace completely different functionalities such as; observance obtainable parking areas among the town, observance vibrations furthermore as material conditions of bridges and buildings, fitting place sound observance devices in sensitive elements of cities, furthermore as observance the amount of pedestrians and vehicles. computer science (AI) enabled IoT is utilised to watch, management and scale back traffic congestions in good Cities [6]. Moreover, IoT permits installation of intelligent and weather adaptative street lighting and detection waste and waste containers by keeping tabs of garbage pickup schedules. Intelligent highways will offer warning messages and necessary info, like access to diversions looking on the climate or sudden occurrences like traffic jams and accidents.

Application of IoT to realize good cities would need victimization frequency identification and sensors. a number of the already developed applications during this space are the Aware home and also the good Santander functionalities. within the u. s., some major cities like capital of Massachusetts have plans on the way to implement the net of Things in most of their systems starting from their parking meters, streetlights, mechanical device systems, and sewerage grates are all scheduled to be interlinked and connected to the net. Such applications can supply important break throughs in terms of saving cash and energy.

2.2 HEALTHCARE

Most tending systems in several countries area unit inefficient, slow and inevitably at risk of error. this may simply be modified since the tending sector depends on various activities and devices which will be machine-driven and increased through technology. further technology which will facilitate varied operations like report sharing to multiple people and locations, record keeping and dispensing medications would go a protracted means in dynamic the tending sector [10].

A lot of advantages that IoT application offers within the health-care sector is most classified into trailing of patients, staff, and objects, distinguishing, likewise as authenticating, people, and therefore the automatic gathering of information and sensing. Hospital progress are often considerably improved once patients flow is half-track. in addition, authentication and identification scale back incidents that will be harmful to patients, record maintenance and fewer cases of mismatching infants. additionally, automatic information assortment and transmission is significant in method automation, reduction of kind process timelines, machine-driven procedure auditing likewise as medical inventory management. device devices permit functions focused on patients, notably, in diagnosis conditions and availing time period info regarding patients' health indicators [6].

Application domains during this sector include; having the ability to watch a patient's compliance with prescriptions, telemedicine solutions, and alerts for patients' well-being. Thereby, sensors are often applied to patient and patient patients, dental Bluetooth devices and toothbrushes which will offer info once they're used and patient's police work. different parts of IoT during this capability include; RFID, Bluetooth, and Wi-Fi among others. These can greatly enhance measuring and observance techniques of important functions like vital sign, temperature, heart rate, blood sugar, sterol levels, and plenty of others.

The applications of web of Things (IoT) and web of Everything (IoE) area unit any being extended through the materialization of the web of Nano-things (IoNT) [3]. The notion of IoNT, because the name implies, is being designed by desegregation Nano-sensors in numerous objects (things) exploitation Nano networks. Medical

application, as shown in Fig. 2, is one in all the main focuses of IoNT implementations. Application of IoNT in anatomy, for treatment functions, facilitates access to information from in place elements of the body that were so far in accessible to sense from or by exploitation those medical instruments incorporated with large device size. Thus, IoNT can modify new medical information to be collected, resulting in new discoveries and higher nosology.

2.3 GOOD AGRICULTURE AND WATER MANAGEMENT

According to [11], the IoT has the capability to strengthen and enhance the agriculture sector through examining soil wetness and within the case of vineyards, observance the trunk diameter. IoT would permit to regulate and preserve the number of vitamins found in agricultural merchandise, and regulate microclimate conditions so as to form the foremost of the assembly of vegetables and fruits and their quality. what is more, finding out climatic conditions permits statement of ice info, drought, wind changes, rain or snow, so dominant temperature and wetness levels to forestall plant life likewise as different microorganism contaminants.

When it involves cows, IoT will assist in distinguishing animals that graze in open locations, police work prejudicious gases from animal excrements in farms, likewise as dominant growth conditions in offspring to reinforce possibilities of health and survival so on. Moreover, through IoT application in agriculture, heaps of wastage and spoilage are often avoided through correct observance techniques and management of the complete agriculture field. It conjointly ends up in higher electricity and water management.

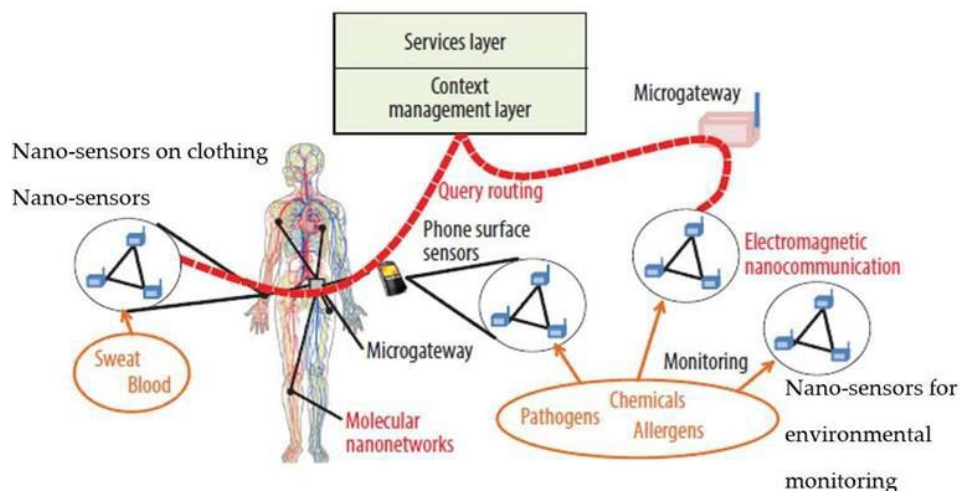


Fig. 2. The Internet of Nano-Things[3]

As [11] make a case for, in water management, the role of IoT includes finding out water quality in seas and rivers for each drinking and agriculture use, police work pressure variations in pipes, and liquid presence outside tanks similarly as observation levels of water variation in dams, rivers and reservoirs. These IoT applications utilize Wireless detector networks. samples of existing IoT applications during this domain include; SISVIA, GBROOS, and SEMAT.

2.4 RETAIL AND SUPPLY

Executing the IoT in offer Chain or retail Management has several advantages. Some include; perceptive storage conditions throughout the availability chain, product chase to modify trace ability functions, payment process betting on the placement or activity amount publicly transport, theme parks, gyms, and others. within the retail premises, IoT is applied to numerous applications like direction within the look supported a preselected list, quick payment processes like mechanically searching for with the help of bioscience, police work potential substance merchandise and dominant the rotation of merchandise on shelves and warehouses so as to automatise restocking procedures [12].

The IoT components principally employed in this setting include; wireless detector networks and frequency identification. In retail, there's a current use of SAP (Systems Applications and Products), whereas in supply various examples embody quality consignment conditions, item location, police work storage incompatibility problems, fleet chase among others. within the business domain, IoT helps in police work levels of gas and leakages at intervals the business and its environment, keeping track of deadly gases similarly because the element levels at intervals the scope of chemical plants to make sure the protection of products and employees and perceptive levels of oil, gases and water in cisterns and storage tanks. Application of IoT conjointly assists in maintenance and repair as a result of systems is place in situ to predict instrumentation malfunctions and at identical mechanically schedule periodic maintenance services before there's a failure within the instrumentation. this will be achieved through the installation of sensors within instrumentation or machinery to watch their practicality and infrequently send reports.

2.5 GOOD LIVING

In this domain, IoT is applied in device devices whereby one will remotely switch appliances on and off thus preventing accidents similarly as saving energy [1, 3]. alternative good home appliances embody refrigerators fitted with alphanumeric display (Liquid Crystal Display) screens, sanctionative one to grasp what's offered within, what has over stayed and is nearly expiring similarly as what has to be restocked. This data may be joined to a smartphone application sanctionative one to access it once outside the house and so purchase what's required. moreover, laundry machines will permit one to remotely monitor laundry. additionally, a good vary of room devices is interfaced through a smartphone, thus creating it doable to regulate temperature, like within the case of associate kitchen appliance. Some ovens that have a self-cleaning feature is simply monitored similarly. In terms of safety within the home, IoT is applied through alarm systems and cameras is put in to watch and observe window or door openings thus preventing intruders [3].

3. ANALYSIS CHALLENGES

For all the higher than potential applications of IoT, there should be correct feasibleness into the various domains to determine the success of some applications and their practicality. like the other sort of technology or innovation, IoT has its challenges and implications that has to be sorted dead set modify mass adoption. even supposing this IoT sanctionative technologies have greatly improved within the recent years, there area unit still various issues that need attention, thus paving the manner for brand new dimensions of analysis to be disbursed.

Since the IoT idea ensues from heterogeneous technologies that area unit employed in sensing, collecting, action, processing, inferring, transmittal, notifying, managing, and storing of information, tons of analysis challenges area unit guaranteed to arise. These analysis challenges that need attention have consequently spanned totally different analysis areas [14].

3.1 PRIVACY AND SECURITY

Owing to the actual fact that IoT has become a significant part as regards the longer term of the web with its inflated usage, it necessitates a necessity to adequately address security and trust functions. Researchers area unit alert to the weaknesses that presently exist in several IoT devices. moreover, the inspiration of IoT is arranged on the prevailing wireless detector networks (WSN), IoT therefore architecturally inherits identical privacy and security problems WSN possesses [3, 15]. varied attacks and weaknesses on IoT systems prove that there's so a necessity for wide locomote security styles which is able to shield knowledge and systems from finish to finish. several attacks typically exploit weaknesses in specific devices thereby gaining access into their systems and consequently creating secure devices vulnerable [16, 17] . This security gap any motivates comprehensive security solutions that include analysis that's economical in applied cryptography for knowledge and system security, non-cryptographic security techniques similarly as frameworks that assist developers to come back up with safe systems on devices that area unit heterogeneous.

There is a necessity for additional analysis to be conducted on cryptographical security services that have the potential to control on resource unnatural IoT devices. this could modify totally different ball-hawking users to firmly use and deploy IoT systems regardless of the inadequate user interfaces that area unit offered with most IoT devices. additionally to the protection and security aspects of the IoT, further areas like confidentiality in communication, trustiness, and legitimacy of communication parties, and message integrity, and supplementary safety needs ought to even be incorporated. These could embody options like having the ability to stop communication of assorted parties. As associate example, in business transactions, smart objects must be prevented from facilitating competitors' access to confidential information in the devices and thus using this information maliciously.

3.2 PROCESSING, ANALYSIS AND MANAGEMENT OF INFORMATION

The procedure for process, analysis and knowledge management is staggeringly difficult due to the heterogeneous nature of IoT, and therefore the massive scale of information collected, notably during this era of massive knowledge [18]. Currently, most systems utilize centralized systems in offloading knowledge and concluding computationally intensive tasks on a global cloud platform. nonetheless, there's a continuing concern concerning standard cloud architectures not being effective in terms of transferring the huge volumes of information that area unit created and consumed by IoT enabled devices and to be in a position any support the related to machine load and at the same time meet temporal arrangement constraints [13]. Most systems area unit so looking forward to current solutions like mobile cloud computing and fog computing that area unit each supported edge process, to mitigate this challenge.

Another analysis direction as regards knowledge management is applying data central Network (ICN) within the IoT. Since these data central systems provide support within the economical content retrieval and access to services, they seem to be quite valuable not simply in accessing however conjointly transferring

similarly as managing generated content and its transmission. This resolution, however, brings concerning varied challenges such as; a way to extend the ICN paradigm with competence over the mounted network edge, a way to absorb IoTs static and mobile devices similarly as a way to apportion the practicality of ICN on resource unnatural devices [13].

Data analysis and its context not solely plays a vital role within the success of IoT, it conjointly poses major challenges. Once knowledge has been collected it's to be used showing intelligence so as to attain good IoT functions. consequently, the event of machine learning strategies and AI algorithms, resultant from neural works, genetic algorithms, organic process algorithms, and plenty of alternative artificial intelligence systems area unit essential in achieving automatic higher cognitive process.

3.3 OBSERVATION AND SENSING

Even if technologies involved with observation and sensing have created tremendous progress, they're perpetually evolving notably specializing in the energy potency and type facet. Sensors and tags area unit usually expected to move perpetually so as to get fast knowledge, this facet makes it essential for energy potency particularly in life extension. at the same time, new advances in nanotechnology/biotechnology and shrinking have allowed the event of actuators and sensors at the Nano-scale.

3.4 M2M (MACHINE TO MACHINE) COMMUNICATION AND COMMUNICATION PROTOCOLS

where as there area unit already existing IoT familiarised communication protocols like unnatural Application Protocol (CO)(AP) and Message Queuing Telemetry Transport (MQTT), there's still no customary for associate open IoT. though all objects need property, it's not necessary for each object to be created web capable since they solely ought to have a precise capability to put their knowledge on a specific entry. to boot, there area unit tons of choices in terms of appropriate wireless technologies like LORA, IEEE 802.15.4, and Bluetooth even supposing it's not clear whether or not these offered wireless technologies have the required capability to continue covering the intensive vary of IoT property henceforward.

The communication protocols for devices area unit the drive in actualizing IoT applications, and that they type the most support of information flow between sensors and therefore the physical objects or outer world. whereas varied raincoat protocols are projected for many domains with Frequency Division Multiple Access, Time Division Multiple Access and Carrier Sense Multiple Access (FDMA, TDMA and CSMA) for low traffic potency that's collision free, additional electronic equipment in nodes area unit needed severally. the most objectives of the transport layer embody guaranteeing associate end-to-end responsibility similarly as playing end-to-end management of congestion. during this facet, most protocols area unit unable to get together acceptable finish to finish responsibility [10].

4.CONCLUSION

The IoT will best be delineate as a CRS (Complex reconciling System) which will still evolve thus requiring new and innovative styles of code engineering, systems engineering, project management, similarly as various alternative disciplines to develop it any and manage it the approaching years. the appliance area unitas of IoT

are quite various to modify it to serve totally different users, United Nations agency successively have totally different wants. The technology serves 3 classes of users, people, the society or communities and establishments. As mentioned within the application section of this analysis paper, the IoT has while not a doubt a huge capability to be a staggeringly transformative force, which will, and to some extent will already, completely impact variant lives worldwide. in line with [4], this has become even additional evident, as totally different governments round the world have shown associate interest within the IoT idea by providing additional funding within the field that's meant to facilitate any analysis. a decent example is that the Chinese Government.

Countless analysis teams are, and still be, initiated from totally different components of the globe, and their main objective is to follow through IoT connected researches. As additional and additional analysis studies area unit conducted, new dimensions to the IoT processes, technologies concerned and therefore the objects that may be connected, still emerge, any paving manner for rather more application functionalities of IoT. the actual fact that IoT is thus expansive and affects much all areas of our lives, makes it a big analysis topic for studies in varied connected fields like data technology and technology. The paper highlights varied potential application domains of the web of things and therefore the connected analysis challenges.

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