A Review Paper on Internet of Nano Things

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Abstract- The Internet of Nano Things taking IoT to next level. Nanotechnology is science technology in which size of devices are much smaller which contributed greatly in computing and electronics, leading to faster ,smaller and more profitable system that can be use for communication and storing of large data. It is also use of creating devices, machines in nano size by integrating molecules or atoms. Nanotechnology is a building block of Internet of Nano Things(IoNT) which include basic unit called as Nano machines which perform simple task like sensing and actuating. The interconnection of nano devices with existing internet called as "Internet of Nano Things". Nanotechnology has provide new solution to benefit society in different sector like information technology, medicines, transportation, military field , as well as industrial purpose. In this paper we are showing the architecture of Nano machines, network architecture ,application field, challenges in Internet of Nano Things (IoNT) and help to researchers to find solution for challenges and increase the use of Internet of nano Things (IoNT) in future in different field.

Keywords— Internet of Things (IoT), Internet of Nano Things(IoNT), Nanotechnology, Nano Machines , Nano Sensor ,Nano communication.

I.   INTRODUCTION

The revolution of technology which brought us by amazing concept called –Internet of Things (IoT).The Internet of Things (IoT) is regarded as new revolution that is picking up popularity in the world of modern wireless telecommunications. This technology help to transform ordinary object or thing into smart object or things. Internet of Things (IoT) concept was purposed by Ashton in 1999 and link to new concept of RFID. The concept of IoT marks high impact on various aspects of everyone's life as wide range of devices and communication protocols are under rapid development process by industries and researchers in diverse fields like e-health, e-agriculture, e-industry, smart cities, e-military etc. Internet of Things (IoT) change the use of internet and also brought communication between devices which involve interaction of sensor,device and object and also create a zone like Wireless Body Sensor Networks (WBSN) and lead to new concept called Internet of Everything(IoE) [1] . The two main technologies in IoT are, RFID tags and wireless Sensor Networks (WSNs).RFID tags can be easily embedded in all categories of things due to their small size and their battery less operation. But , RFID tags do not generally have processing, data stroring or sensing capabilities . On other hand WSNs can enable IoT with necessary computing, data storing, and sensing functionalities, but the size, complexity limit the usefulness of this approach . But since IoT requires the feature of both the technologies, there is need for a new technology for IoT.

Now-a-day things are moving fast so as our need to get more comfortable with the help of technology, that's why we are talking about technology called –Internet of Nano Things [8].   The basic definition of nanotechnology is "Nanotechnology is engineering of function system at the molecular scale" [1]. Nanotechnology is enabling the development of devices in scale ranging from one to few hundred nanometer [2]. At this scale, a Nano machines is defined as the most basic function unit, integrated by nano-components and able to perform simple task such as sensing and actuation. Nanotechnology has providing various solution to real world application like medical, agriculture, industry, military. Nano technology is not only for detection molecules but also for creating devices, system which is in nano size. The integration of nano devices with existing high speed internet referred to as- Internet of Nano Things [2] The concept of Internet of Nano Things (IoNT) was proposed by Ian Akyildiz and Josep Jornet in the paper of "The Internet of Nano-Things ". In contrast to Internet of Things (IoT) , more number of sensor are deployed in IoNT because the size of sensor is considerably reduced to nano scale .Hence, IoNT will give more precise and detailed information about a particular object. In future, we would find ourselves surrounded by billions of nano sensors providing us useful information [3]. Since there are many paper on IoNT but still have confusion about how the nano devices will communicate with each other. But after a few year two methods are recognize namely as Molecular Communication and Nano Electromagnetic Communication.

In Molecular communication transmission and reception occur by encoding information in molecules. In Electromagnetic communication transmission and reception placed by electromagnetic radiation [2]. The common example of IoNT is, sensor implanted in a patient's heart, call the doctor when the organ shows signs of failing ; the sensor deployed in the door opens the door automatically when it identifies that owner of the house arrived in.

In this paper we are discussing new technologies related to Internet of Things (IoT), Internet of Nano Things (IoNT) and nano communication and their application area, architecture, challenges in term of nano devices.

II. LITERATURE REVIEW

The term of IoT is 16 year old. But actual idea of connected devices had been around at longer at least since the 70's back then the idea was often called" embedded internal" or "pervasive computing". But actual term "IoT was coined by Kevin Ashton in 1999 during his work at Procter and Gamble. Ashton who was working in supply chain optimization waned to attract senior management's attention to new exciting technology called RFID .the concept of IoT started to gain some popularity in the summer of 2010[5].
The concept of Nanotechnology was stated by" Richard Feynman"- A physicist noble laureate in 1959 in his famous speech titled "There's Plenty of Room at the Bottom". He focus on the Miniaturization field and create a powerful and nano devices.

The term of "Nanotechnology" was first use by Japanese scientist called "Norio Taniguchi" at Tokyo University of Science in 1974 conference, to describe semiconductor processes such as thin film deposition and ion beam milling exhibiting characteristic control on the order of nanometer. His definition was, "Nanotechnology" mainly consist of the processing of ,separation , consolidation and deformation of material by one atom or one molecule [5].

k.Eric Drexler encountered Feynman's provocative 1965 talk "There's Plenty of Room at the Bottom" in 1980 his was preparing paper on ,"Molecular Engineering : an approach to the development of general capabilities for molecular manipulation ,"published in the proceeding of National Academy of Science in 1981. The term " nanotechnology " was independently applied by Drexler in his book Engines of Creation :The Coming Era of Nanotechnology ,which proposed the idea of nanoscale "assembler "which would be able to build a copy of itself and of other items of arbitrary complexity [5].

III. RELATED WORK

Anand Nayyar, Vikram Puri, Dac-Nhuong Le published paper on IoNT named as "Internet of Nano Things (IoNT):Next Evolutionary Step in Nanotechnology" in 2017 . In this paper researcher give depth view with regard to Internet of Nano Things (IoNT) is presented which is regarded as next evolutionary step in world of nanotechnology in addition to nano machines application and research areas.

Ian F. Akyildiz ‚Josep Miquel Jornet ,published paper named as "The Internet of Nano Things" in 2010. In this paper researcher introduced the reference architecture for this new paradigm and discussed the state of research on electromagnetic nanonetworks and bring attention toward nanoscale channel models, information encoding and modulation for nanoscale network based on IoNT.

Karan Agarwal,Kunal Agarwal, Shalini Agarwal, published a paper "Evolution of Internet Of Nano Things(IoNT)" in 2017.In his paper he stated that IoNT change the use of internet as well as the way devices are connected together. In this paper researcher focus on challenges based on frequency band, channel modeling ,bandwidth constraint and channel capacity.

Kaushal Dabhi, Ashish Maheta, published paper "Interent of Nano Things –The Next Big Thing" in 2017. In this paper researcher show Internet of Nano Things view as next development stride in universe of Nanotechnology not withstanding nano machnices, application and research ranges.

IV. SYSTEM ARCHITECTURE

IoT working:
An IoT system comprised of sensor or devices which collect all information from user. Sometime a sensor is part of device which use to sense the things. This device communicate to cloud through some connectivity like cellular, satellite, Wi-Fi, Bluetooth, Low Power Wide Area Networks or connecting directly to the internet . picking up correct connectivity depend on which IoT application is being accomplished the task of getting data or information to cloud .Once the information get into cloud,some kind of processing on it and then might have to perform some task,such as sending alert or automatically adjusting the sensor without the need the user interface.But if user wants to check on the system, user interface allw them to do so. Any action by user as sent in the opposite direction of through the system from user interface to cloud and make a change back to sensor or devices. IoNT isn't different from IoT the only change the size of devices which is ranging from one to few hundred nano-meter.

Architecture of Internet of Nano Things:
 Nano Machines Architecture
 Nano Machines architecture consist of various component. To build a simple nano device to high developed nano robots

this component are used. Nano machines comprise of following components.[1]

- Control Unit: Control unit does all work required to execute instructions to perform desired operations. It is use to control all component of Nano Machines and act as storage for saving data of Nano Machines used by user to perform desired tasks. Control unit is main component of Nano Machines which function as heart for Nano Machines.
- Communication Unit: This unit perform task like sending and receiving information between nano devices at nano meter scale.
- Reproduction Unit: Reproduction Unit used for designing nano machines by comprising external element and collect them beneficially to create a Nano Machines. So we can create a powerful Nano Machines which can use for various computation.
- Power Unit: Power Unit get together all energy from external sources like light, heat etc for utilizations and distributions tasks. Power Unit does task of charging or powering all component of Nano Machines.

Introducing architecture for Internet of Nano Things in two different applications, namely intrabody nanonetwork for healthcare and the interconnected office. Architecture of Internet of Nano Things consist of following component based on final application area.[2]

Nano-nodes:
These is smallest and simplest component of architecture. It is use for storage but in limited capacity, perform simple computations, and help for transmit over a short distance because of their limited energy and interchange capacity. Considered Body Sensor Networks, biological sensor fitted in human body are considered as Nano-nodes and also fitted in physical object like book, keys, paper folder etc.

Nano-Routers:
Nano-routers have high energy of computations then Nano-nodes. It is use to gather all information coming from Nano-nodes. It is also control of Nano-nodes actins by interchanging simple control commands like off, on, sleep, read etc.

Nano-micro interface devices:
These component is use for integrate all information from Nano-router and able to communicate between the microscale devices. They behave as hybrid device to communicate in nanoscale using Nano communication techniques and also with traditional communication network with classical network protocols

Gateway:
These device are enable to remote control all nano network over internet. For example in intrabody network the

information received from nano-micro interface device to our healthcare provider and interconnected office a router can able to provided this functionality.
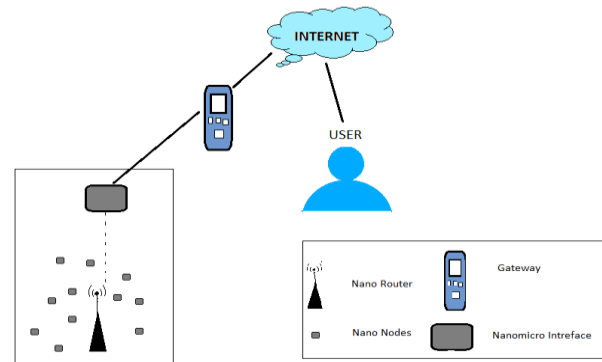

Figure 1. Architecture of Internet of Nano Things

V.   APPLICATIONS

For future generation there are various application areas of Internet of Nano Thingsas follows:

Healthcare Monitoring through Nano-Technology Based Body Sensor Networks:
Now-a-days for healthcare this IoNT application is mostly used in digital word. If Doctor is present some distance from patient this IoNT technology is help for treating patient. The Nano-technology Based Body Sensor are embedded in the patient body and all the activity happen in body are inform to doctor and proper treatment is provided by doctor. Nano sensor being used in BSN provides real tme data on a wearable device being used by the doctor for getting timely information regarding patient's health.

Environmental Monitoring:
In this real time application Nano sensor are placed in public places like railway stations ,Bus stop, Hotels, School etc. This is use to monitoring Temperature, Traffic, Air Pollutions is done more efficiently [1].

Agriculture:
For development in agriculture field IoNT technology make major changes in farming techniques. By fitting nano device with nano sensor in farm help to monitor activity in field by sitting long distance. The activities like Grass Monitoring, Animals Health and Feed Management, Agriculture Field Condition, Effective monitoring of usage of pesticides and insecticides in the Agriculture field can be controlled and monitored.

Other Possible Applications:
IoNT can be also used in various field by considering Military foe battle field Monitoring, Development of Nano-Robot, Nano-drones, smart cities and Industry production and many more **[1].**
ADVANTAGES

- In security field many devices uses like camera, mobile phone etc. IoT concept is use security purpose to control or monitor the moment.
- As in Internet of Nano Things Contain Nanoscale devices so it easy to carry any where as well as fitted or embedded anywhere and process easily.
- Nanotechnology can be used to create powerful processors and supercomputers that collect, analyze and report on the data IoT devices create.[7]
- IoT nanotechnology is also useful for creating battery systems that can sustain IoT devices without the need to charge them often, or even at all -- passive nano-IoT devices, for example, may never need charging [7].
- Nanotechnology in IoT will also be critical in designing networking systems that enable IoT devices to communicate with each other. For example, sophisticated nanoscale embedded antenna technologies -- telephones, televisions and health tracking devices -- all use nanoscale antennas and receivers to facilitate communications.[6,7]

LIMITATIONS
Compatibility and Data Integration
A huge number of interconnected devices and hundreds of service provider companies. Having hundreds of standards worsen the condition. As of now, it is not decided whether the devices would have single set of standards or these standards vary according to the service providers. Thus, questions are raised over the compatibility of the information obtained from various devices and their integration for completing a certain assigned task.

Privacy Concerns
Millions of devices interconnected and concerns over privacy increased more than ever. Data encryption is very much necessary for maintaining the privacy of the data that is shared over the internet. No one would like their colleagues in the office to know how much milk you consume or what time do you wake up[7].

Threat to Security
When you are using IoT based devices, a large amount of information flows through them. Such huge flow is prone to security issues. Managing a large number of security checks itself a challenges.

More probabilities for complexity
With the emergence of devices, there are possibilities of complexity arising and giving to more complexes in processes.

VI. CONCLUSION

The various use of Nano-Machines, Nanotechnology in different field using Internet of Things(IoT) make big change in daily life. It reduce the work, time required for particular task and easy to carry anywhere. In this paper we have proposed it's architecture ,real time application area, challenges of Internet of Nano Things(IoNT) and learn how the nano devices communicate with each other and use of sensor in various area.

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