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# REVIEW PAPER ON IOT WITH HOME AUTOMATION

[1]Mithilesh kumar Singh, Research Scholar, Department of CSE, CBS Group Of Istitution Jhajjar
[2]Nishant Anand(Assistant Professor), Department of CSE, CBS Group Of Istitution Jhajjar

**Abstract:** *It is IoT which allows objects to be sensed & controlled remotely across existing network[13] infrastructure, creating opportunities for more direct integration of physical world into computer-based systems, & resulting in improved efficiency, accuracy & economic benefit. IoT is expected to offer advanced connectivity of devices, systems, & services that goes beyond machine-to-machine (M2M) communications & covers a variety of protocols, domains, & applications. End-to-end health monitoring IoT platforms are coming up for antenatal & chronic patients, helping one manage health vitals & recurring medication requirements[11]. The IoT could assist in integration of communications, control, & information processing across various transportation systems[9]. In the IoT, things are expected to become active participants where they are able to interact and communicate among themselves by exchanging data and information sensed about the environment. For that they react autonomously to the real world events and provide services with or without direct human intervention. In this paper we use IOT for energy efficient Environmental Conditions sensing and in Home Automation[3].*

**Keywords:** IOT, Home automation, Machine to Machine, Auto ID Center, Auto ID Labs

## [I] Introduction

There are several planned or ongoing large-scale deployments of IoT, to enable better management of cities & systems. For example, Songdo, South Korea, first of its kind fully equipped & wired smart city, is near completion. Ambient intelligence[8] & autonomous control are not part of original concept of Internet of Things. Ambient intelligence & autonomous control do not necessarily require Internet structures, either.

In future Internet of Things may be a non-deterministic & open network in which auto-organized or intelligent entities Web services, SOA components, virtual objects also known as avatars will be interoperable & able to act independently pursuing their own objectives or shared ones depending on context, circumstances or environments. Environmental monitoring applications[1] of IoT typically use sensors to assist in environmental protection by monitoring air or water quality, atmospheric or soil conditions,and could even include areas like monitoring movements of wildlife & their habitats. Usage of IoT devices for monitoring & operating infrastructure is likely to improve incident management & emergency response coordination, & quality of service, up-times & reduce costs of operation in all infrastructure related areas[23].


The objective of research is Home automation[3] using IOT with integration of Solar based energy system. Integration of sensing & actuation systems, connected to Internet, is likely to optimize energy consumption[17] as a whole. It is expected that IoT devices will be integrated into all forms of energy consuming devices (switches, power outlets, bulbs, televisions, etc.) & be able to communicate with utility supply company in order to effectively balance power generation & energy usage. Solar Energy System that is properly installed & adequately sized will not really require much in way of management. To make this relationship clear, & for those who might think solar energy is complicated, I designed & wrote this simulation to demonstrate basic operation of a solar energy electric power system. Only 3 things need to be considered first is level of charge on battery bank. (AmpHour Meter), Second is Amount of charging power coming in. (Solar Amps Meter), Third is Amount of power being used. (AC Amps Meter)

IoT is especially relevant to Smart Grid since this provides systems to gather & act on energy & power-related information in an automated fashion with goal to improve efficiency, reliability, economics, & sustainability of production & distribution of electricity. The Internet of Things (IoT) is network of physical objects—devices, vehicles, buildings & other items—embedded with electronics, software, sensors, & network connectivity that enables these objects to collect & exchange data.The IoT allows objects to be sensed & controlled remotely across existing network infrastructure, creating opportunities for more direct integration of physical world into computer-based systems, & resulting in improved efficiency, accuracy & economic benefit;when IoT is augmented with sensors & actuators, technology becomes an instance of more general class of cyber-physical systems, which also encompasses technologies such as smart grids, smart homes, intelligent transportation & smart cities. Each thing is uniquely identifiable through its embedded computing system but is able to interoperate within existing Internet infrastructure. Experts estimate that IoT will consist of almost 50 billion objects by 2020. British entrepreneur Kevin Ashton first coined term in 1999 while working at Auto-ID Labs (originally called Auto-ID centers, referring

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to a global network of objects connected to radio-frequency identification, or RFID). Typically, IoT is expected to offer advanced connectivity of devices, systems, & services that goes beyond machine-to-machine (M2M) communications & covers a variety of protocols, domains, & applications. The interconnection of these embedded devices (including smart objects), is expected to usher in automation in nearly all fields, while also enabling advanced applications like a smart grid, & expanding to areas such as smart cities. "Things," in IoT sense, could refer to a wide variety of devices such as heart monitoring[11] implants, biochip transponders on farm animals, electric clams in coastal waters, automobiles with built-in sensors, DNA analysis devices for environmental/food/pathogen monitoring or field operation devices that assist firefighters in search & rescue operations. Legal scholars suggest to look at "Things" as an "inextricable mixture of hardware, software, data & service". These devices collect useful data with help of various existing technologies & then autonomously flow data between other devices. Current market examples include smart thermostat systems & washer/dryers that use Wi-Fi for remote monitoring [25]. As well as expansion of Internet-connected automation into a plethora of new application areas, IoT is also expected to generate large amounts of data from diverse locations, with consequent necessity for quick aggregation of data, & an increase in need to index, store, & process such data more effectively. IoT is one of platforms of today's Smart City, & Smart Energy Management Systems [17].

## [II] LITERATURE REVIEW

| | |
|---|---|
| Author | John A. Stankovic |
| Title | Life Fellow, IEEE wrote research on "Research Directions for the Internet of Things"[23] |
| Description | Many technical communities are vigorously pursuing research topics that contribute to the Internet of Things (IoT). Today, as sensing, actuation, communication, and control become ever more sophisticated and ubiquitous, there is significant overlap in these communities, sometimes from slightly different perspectives. Then, eight key research topics are enumerated and research problems within those topics are discussed. |
| Author | Chirag M. Shah, Vamil B. Sangoi and Raj M. Visharia |
| | |
| Title | Smart Security Solutions based on Internet of Things (IoT) [26] |
| Description | With increasing popularity of the IoT (Internet of Things) and devices getting smarter day by day, this paper presents an idea to reform the existing access control systems. This approach of enhancing the access control system ensures that the system is wireless thereby reducing wiring issues. The prototype described in this paper has the provision of accepting inputs from a smart card reader (RFID reader) or a biometric sensor. |
| Author | Armando Roy Delgado, Rich Picking and Vic Grout |
| Title | Remote-Controlled Home Automation Systems with Different Network Technologies[25] |
| Description | This paper describes an investigation into the potential for remote controlled operation of home automation systems. It considers problems with their implementation, discusses possible solutions through various network technologies and indicates how to optimize the use of such systems. |
| Author | V. Sathya Narayanan1 , S. Gayathri |
| Title | Design of Wireless Home automation and security system using PIC Microcontroller [24] |
| Description | The development of the new technologies in the field of electronics has brought tremendous changes in the day to day life of every human being. The proposed system gives the overall framework of hardware and software design, and describes ways to implement the system. |

## [III]ARCHITECTURE AND DIAGRAM OF ARCHITECTURE

There has been and still is much hype about the "Internet of Things". The idea of a globally interconnected

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continuum of devices, objects and things in general emerged with the RFID technology[26], and this concept has considerably been extended to the current vision that envisages a plethora of heterogeneous objects interacting with the physical environment. Today, a large number of different means are used to enable communication between heterogeneous devices. We see these as "Intranet of Things", representing vertical silos that do not support interoperability. However, this balkanisation of efforts will lead to a predictable slowdown in devising a viable global solution. Furthermore, existing solutions do not address the scalability requirements for a future Internet of Things, they provide inappropriate models of governance and fundamentally neglect privacy and security in their design. IoT-A, the European Lighthouse Integrated Project has addressed for three years the Internet-of-Things Architecture, and created the proposed architectural reference model together with the definition of an initial set of key building blocks. Together they are envisioned as foundations for fostering the emerging Internet of Things. Using an experimental paradigm, IoT-A combined top-down reasoning about architectural principles and design guidelines with simulation and prototyping in exploring the technical consequences of architectural design choices.

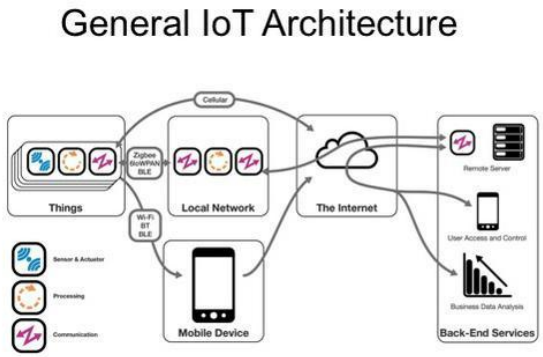


Fig. 1 Architecture of IOT [29]

## [IV] APPLICATIONS OF IOT

### Medical & healthcare systems

IoT devices could be used to enable remote health monitoring & emergency notification systems[11]. These health monitoring devices could range from blood pressure & heart rate monitors to advanced devices capable of monitoring specialized implants, such as pacemakers, Fitbit electronic wristbands or advanced hearing aids. Specialized sensors could also be equipped within living spaces to monitor health & general well-being of senior citizens, while also ensuring that proper treatment is being administered & assisting people regain lost mobility via therapy as well. Other consumer devices to encourage healthy living, such as, connected scales or wearable heart monitors, are also a possibility with IoT. More & more end-to-end health monitoring IoT platforms are coming up for antenatal & chronic patients, helping one manage health vitals & recurring medication requirements. [11]

### Building & home automation

IoT devices could be used to monitor & control mechanical, electrical & electronic systems used in various types of buildings (e.g., public & private, industrial, institutions, or residential) in home automation & building automation systems[3].

### Transportation

The IoT could assist in integration of communications, control, & information processing across various transportation systems. Application of IoT extends to all aspects of transportation systems (i.e. vehicle, infrastructure, & driver or user). Dynamic interaction between these components of a transport system enables inter & intra vehicular communication, smart traffic control, smart parking, electronic toll collection systems, logistic & fleet management, vehicle control, & safety & road assistance[23].

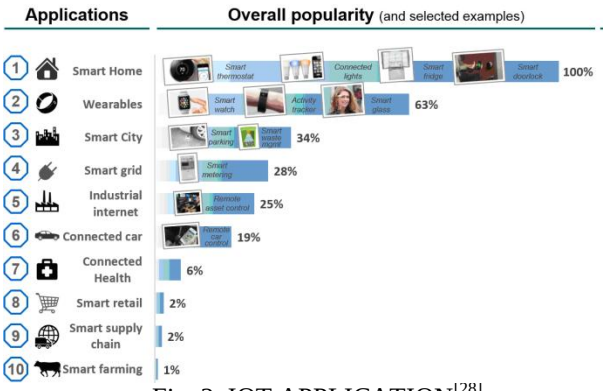


Fig. 2 IOT APPLICATION[28]

### Large scale deployments

There are several planned or ongoing large-scale deployments of IoT, to enable better management of cities & systems. For example, Songdo, South Korea, first of its kind fully equipped & wired smart city, is near completion. Nearly everything in this city is planned to be wired, connected & turned into a constant stream of data that would be monitored & analyzed by an array of computers with little, or no human intervention.Another application is a currently undergoing project in Santander, Spain. For this deployment, two approaches have been adopted. This city of 180,000 inhabitants, has already seen 18,000 city application downloads for their smartphones. This application is connected to 10,000 sensors that enable services like parking search, environmental monitoring, digital city agenda among others. City context information is used in this deployment so as to benefit merchants

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through a spark deals mechanism based on city behavior that aims at maximizing impact of each notification.

With wireless network in place, NY Waterway is able to take control of its fleet & passengers in a way that was not previously possible. New applications could include security, energy & fleet management, digital signage, public Wi-Fi, paperless ticketing & others[24].

**Unique addressability of things**

The original idea of Auto-ID Center is based on RFID-tags[26] & unique identification through Electronic Product Code however this has evolved into objects having an IP address or URI.

An alternative view, from world of Semantic Web focuses instead on making all things (not just those electronic, smart, or RFID-enabled) addressable by existing naming protocols, such as URI. The objects themselves do not converse, but they may now be referred to by other agents, such as powerful centralized servers acting for their human owners.

The next generation of Internet applications using Internet Protocol Version 6 (IPv6) would be able to communicate with devices attached to virtually all human-made objects because of extremely large address space of IPv6 protocol. This system would therefore be able to scale to large numbers of objects envisaged.

A combination of these ideas could be found in current GS1/EPCglobal EPC Information Services (EPCIS) specifications. This system is being used to identify objects in industries ranging from aerospace to fast moving consumer products & transportation logistics.

### (i) Trends & characteristics

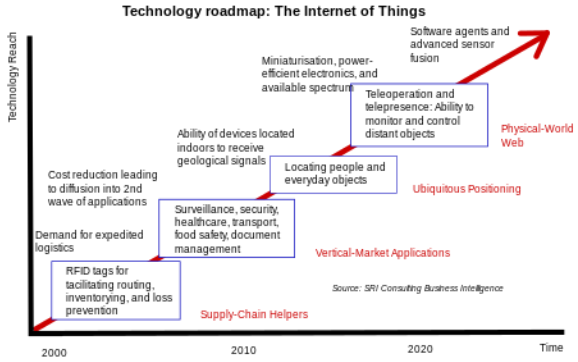


Fig 3 Technology Roadmap: Internet of Things[27]

### (ii) Intelligence

Ambient intelligence & autonomous control[8] are not part of original concept of Internet of Things. Ambient intelligence & autonomous control do not necessarily require Internet structures, either. However, there is a shift in research to integrate concepts of Internet of Things & autonomous control, with initial outcomes towards this direction considering objects as driving force for autonomous IoT.

In future Internet of Things may be a non-deterministic & open network in which auto-organized or intelligent entities (Web services, SOA components), virtual objects (avatars) will be interoperable & able to act independently (pursuing their own objectives or shared ones) depending on context, circumstances or environments. Autonomous behavior through collection & reasoning of context information as well as objects ability to detect changes in environment, faults affecting sensors & introduce suitable mitigation measures constitute a major research trend, clearly needed to provide credibility to IoT technology. Modern IoT products & solutions in marketplace use a variety of different technologies to support such context-aware automation but more sophisticated forms of intelligence are requested to permit sensor units to be deployed in real environments.

## [V] TECHNOLOGY BENEFITS AND DRAWBACKS

### (i) Advantages

There are many advantages of incorporating IoT into our lives, which can help individuals, businesses, and society on a daily basis. For individuals this new concept can come in many forms including health, safety, financially, and every day planning. The integration of IoT into the health care system could prove to be incredibly beneficial for both an individual and a society. A chip could be implemented into each individual, allowing for hospitals to monitor the vital signs of the patient. By tracking their vital signs, it could help indicate whether or not serious assessment is necessary. With all of the information that is available on the Internet, it can also scare people into believing they need more care than what is really needed. Hospitals already struggle to assess and take care of the patients that they have. By monitoring individual's health, it will allow them to judge who needs primary attention. The Internet of Things can also assist people with their personal safety. ADT, which is a home security system, allows individuals to monitor their security systems at home through their phones, with the ability to control it. Also, another technology that has already been released is GM OnStar. This is a system that is embedded in GM cars that can detect if a crash has occurred and it automatically calls 9-1-1. It can also track the movement of the car.[6]

IoT can also function as a tool that can save people money within their households. If their home appliances are able to communicate, they can operate in an energy efficient way. Finally, IoT can assist people with their everyday plans. A very interesting example that was given in a video was the communication between many devices that automatically adjusted to let an individual sleep in. Although this may sound unimportant, the misusage of time costs us "$135 billion a year" (Koreshoff, 2012). By allowing physical devices to communicate, it is taking the data that is individually collected, sharing it, and then translating the information into ways to make our current systems more efficient.

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Businesses can also reap many benefits from the Internet of Things[23]. IoT can be useful in many different categories including asset tracking and inventory control, shipping and location, security, individual tracking, and energy conservation. As mentioned before, IoT allows for the communication between devices, commonly referred to as Machine-to-Machine (M2M) communication. With this being possible, physical devices are able to communicate to people letting them know their condition and where it is located. Devices such as trucks or ships allow for the maximum capacity to be filled by communication amongst devices and then relaying that information to a person to capitalize on the data supplied. All of these combined maximize revenue by cutting cost of inefficiencies within the business. A specific example from "A Successful 'Internet of Things' Hinges on M2M" article, is the operation of Nestles Nespresso Coffee Machine, which has "the ability to monitor factors such as temperature setting, vibration, and pressure helps ensure quality output, potentially leading to greater customer satisfaction and continued repeat business" (Frenzel, 2012). Although the idea seems quite simple, it can be very advantageous for a company to utilize the IoT to ensure quality service is given to their customers.

Another advantage of IoT is the ability to track individual consumers and targeting these consumers based on the information supplied by the devices. In a way, it provides a more "personalized" system that could potentially increase business sales and increases their demographic. Additionally, with the increased amount of devices connected to the Internet the Smart Grid expands, conserving more energy (Frenzel, 2012). Devices can make decisions and adapt without human guidance to reduce their energy usage. The IoT has many advantages to businesses, individuals, consumers, the environment, and society, but as with any technology, there are always repercussions and controversies that arise.

**(ii) Disadvantages**

Three of the main concerns that accompany the Internet of Things are the breach of privacy, over-reliance on technology, and the loss of jobs. When anything is put on the internet it will always be there. Of course there are security measures[1] that are taken to protect information, but there is always the possibility of hackers breaking into the system and stealing the data. For example, Anonymous is a group of individuals that hacked into federal sites and released confidential information to the public. Meanwhile the government is supposed to have the highest level of security, yet their system was easily breached. Therefore, if all of our information is stored on the internet, people could hack into it, finding out everything about individuals lives. Also, companies could misuse the information that they are given access to. This is a common mishap that occurs within companies all the time. Just recently Google got caught using information that was supposed to be private. Information, such as the data collected and stored by IoT, can be immensely beneficial to companies.

The privacy issues also leads to the question of who will control the Internet of Things. If there is only one company, that could potentially lead to a monopoly hurting consumers and other companies. If there are multiple companies that are given access to the information acquired, doesn't that breach consumers privacy? Also, where is the information going to be stored? Phone service suppliers such as Verizon and AT&T are no longer offering unlimited data usage for mobile phones because it is too costly, yet by 2020 it is expected that 50 billion devices will be connected, collecting and storing data (Evans, 2011). Another argument against IoT is the over-reliance on technology. As time has progressed, our current generation has grown up with the readily availability of the internet and technology in general. However, relying on technology on a day to day basis, making decisions by the information that it gives up could lead to devastation. No system is robust and fault-free. We see glitches that occur constantly in technology, specifically involving the internet. Depending on the amount that an individual relies on the information supplied could be detrimental if the system collapses. The more we entrust and the more dependent we are on the Internet could lead to a potentially catastrophic event if it crashes.

Finally the connecting of more and more devices to the Internet will result in the loss of jobs. The automation of IoT "will have a devastating impact on the employment prospects of less-educated workers" (Schumpeter, 2010). For example, people who evaluate inventory will lose their jobs because devices can not only communicate between each other, but transmit that information to the owner. We already are witnessing jobs being lost to automated machines, such as the checkout line in supermarkets and even ATM's. These disadvantages can be largely devastating to society as a whole, as well as individuals and consumers.

## [VI] FUTURE SCOPE AND CONCLUSION

The system will likely be an example of event-driven architecture bottom-up made (based on context of processes & operations, in real-time) & will consider any subsidiary level. Therefore, model driven & functional approaches will coexist with new ones able to treat exceptions & unusual evolution of processes (Multi-agent systems, B-ADSc, etc.).In an Internet of Things, meaning of an event will not necessarily be based on a deterministic or syntactic model but would instead be based on context of event itself: this will also be a semantic web. Consequently, this will not necessarily need common standards that would not be able to address every context or use: some actors (services, components, avatars) will

accordingly be self-referenced and, if ever needed, adaptive to existing common standards. Some researchers argue that sensor networks are most essential components of Internet of Things[23].

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