Applications of IoT and IoT: Vision 2020

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Abstract: The Internet of Things (IoT) is considered as a part of the Internet of the future and will comprise billions of intelligent communicating 'things'. The future of the Internet will consist of heterogeneously connected devices that will further extend the borders of the world with physical entities and virtual components. It is expected that IoT will become a reality over the next 5 years. This section illustrates potential of IoT as an emerging technology in day to day life. The potentialities offered by the IoT make it possible to develop numerous applications based on it. In future, there will be intelligent applications for smarter homes and offices, smarter transportation systems, smarter hospitals, smarter enterprises and factories. Out of the few applications deployed like smart devices communicating wirelessly over hybrid and ad-hoc networks of devices or the sensors and actuators working in synergy, almost all of them are leading towards improvement in the quality of our daily lives. Moreover such advancements are consistently reducing the ecological impact of mankind on the planet.

Keywords: Internet of Things (IOT), Applications of IoT, Future of IoT.

I. INTRODUCTION

Internet has drastically changed the ways of communication over the years. We can communicate with anyone at any time, irrespective of any geographical or chronological constraints. This would have not been possible without the parallel and simultaneous advancements in the fields of hardware such as processors, sensors, transmitters and receivers. During the recent few years, in the area of wireless communication and networking, an emerging technology called the Internet of Things (IoT), has gained a lot of attention. This is primarily because IoT broadens the range of communication by expanding the interaction to anything and everything around us. The expression is composed by two words and concepts: "Internet" and "Thing", where "Internet" can be defined as "The world-wide network of interconnected computer networks, based on a standard communication protocol", while "Thing" is "a virtual, real, mobile or steady object that continuously relays information to other objects" Therefore, semantically, "Internet of Things" means "a world-wide network of interconnected objects uniquely addressable, based on standard communication protocols". Another reason to include IoT in our day to day lives is its easy implementation. With the help of few mobile transceivers one can easily establish an interconnected network and lay down the foundation for interaction between people and things, and between things themselves.

   The main strength of the IoT vision is the tremendous impact it will have on several aspects of every-day life as well as the behaviour of its potential users. For a Private user, IoT can prove to be most useful in working and domestic fields. This involves smart homes and offices, e-health and assisted living. However in the context of Business users, the most apparent implementation can be witnessed in the fields of automation and industrial manufacturing, logistics and intelligent transportation of goods and people.

   The population of the world is continuously increasing and similarly the number of devices connected to internet is also increasing at a steep rate. As of now 7.2 billion is the world's population and surprisingly the number of connected devices in today's world is over 10 billion. Saying so the projected world population in 2020 is 7.8 billion while the estimated number of connected devices will be over 50 billion i.e. almost 6.5 times the population. This tells us about the importance of IoT in the near future.
The objective of this paper is to provide the reader a comprehensive discussion on the possible applications of IoT in various fields and the ways in which it can improve the daily lives of the people in coming few years.

II. APPLICATIONS OF IOT

The possibilities that IoT offers have made it possible to develop numerous applications based on it. In future, there will be intelligent applications for smarter homes and offices, smarter transportation systems, smarter hospitals, smarter enterprises and factories. In the following subsections, some of the important example applications of IoT are briefly discussed. Some of these applications exist in the present age while some are a few years short of implementation.

2.1 RETAIL AND LOGISTICS
The largest application of the IoT technology can be witnessed in the replacement of bar code in retail. This replacement began a couple of years ago and is still growing and developing. The main barriers so far have been the

much higher cost of the tag over the bar code. Nonetheless, the replacement has already started in various projects and although they might co-existence right now, advances in the electronics industry will render the Radio-Frequency Identification (RFID) tag ever cheaper and easily accessible to the retailers.

The electronic tags offer multiple benefits over the bar code for both the retailers and the consumers. Furthermore, IoT can help making the data from the retail store available for optimizing the logistics of the whole supply chain. Manufacturers can avoid the situation of over-production or under-production if they know the stock and sales data from retailers and hence produce and ship the right quantities of products.[2] The shelves can be intelligent issuing a refill order automatically to the storage as items are sold, offering precise delivery from the wholesaler directly to the shelf. Furthermore, the history of any item from production to the shelf can be stored offering increased quality management along the supply chain.

Today almost every mobile phone sold is equipped with some kind of short range radio communication like Bluetooth, or more specifically near field communication (NFC) specifically designed for reading RFID tags. Predictions indicate that the NFC market will be worth 21.8 billion USD by 2020 which gives us a rough idea of billions of NFC enabled mobile devices around the world. [5]This technique can be seen implemented in automated warehouses where the shopping list is transmitted when the customer leaves the house to collect a ready-made shopping bag already checked upon arrival to the warehouse. With the ability of directly reading the tags, the inventory of your belongings may be stored in you mobile phone making insurance claims easier.

The warehouses will become completely automatic with items being checked in and out and orders automatically passed to the suppliers. This allows better management of the assets. Goods may be transported without human intervention from producer to consumer and the manufacturers will have a direct feedback on the market's needs. In this way the production and transportation can be adapted dynamically thus saving time, energy, and the environment. Executable code in the tags enable the *thing* in transit to make intelligent decisions on its routing based on information received either via readers or positioning systems.

Present day IoT based logistics can be seen established in various recognized supply chains. It is possible to envision that the things in transit form a marketplace and that a consumer could place a request on the Internet of Things, receive and accept an offer from a thing fulfilling the request.

For example, Pizza takeaway company Domino's has released the ultimate device for the connected home – a physical button that you can press to instantly order your favorite pizza. A single press of a button and the pizza gets delivered. All such mechanisms involve complex logistics implemented with simple 'things'. [4]

2.2 INTELLIGENT HOME

Intelligent Home means the house/home which can respond to nearby changes and actions. The devices in the network must be accessible to the user irrespective of his/her location. That means the user should be able to control and monitor settings as he/she wishes from wherever he/she wishes. Though thought of as a fantasy it can now be realized due to IOT.

Moreover, intelligent home systems can help in reducing the carbon footprint by conserving energy. Maintaining a comfort temperature and heating of water are the most energy consuming tasks of the house with huge potentials for energy conservation, and as a consequence a significant positive impact on the environment. There can be robots taking care of the house, performing routine works such as cleaning or maintenance. These will collaborate autonomously with the house sensors, and the house control. The intelligent appliances will collaborate to conserve energy, and to signal need for new supplies of food, detergents, maintenance, etc. Some of which may be satisfied automatically by the maintenance robot. This will take away some of today's tedious housekeeping activities.

The house will also jointly try to maximise the comfort of each of its inhabitants by learning the individual preference profiles. The coffee will be ready at the right time in the morning, surround sound system will broadcast and adapt to the right media (television, phone, radio or computer), and record the stream if the user is unavailable, the bathtub will be filled with water at the right temperature. Elderly and people with disabilities will find the house capable of taking charge of activities that today may require excessive effort or manual assistance.

Fig 2.2.1 Communication using IoT in Smart home

2.3 MEDICAL AND HEALTH CARE INDUSTRY

New efficient diagnostics combined with nanotechnology enabled lab-on-a-chip technologies opens a complete range of novel opportunities for new treatments and prevention of serious deceases. IoT can provide a large savings potential in a retail store, since it has been found that 3.9% of sales loss happens worldwide when shelves go empty and customers return with getting the desired products [3]. Furthermore, IoT can help making the data from the retail store available for optimizing the logistics of the whole supply chain. In-vivo equipment will assist in drug dosage closer to the affected organs thus reducing the amount of reagents needed and diminish the risk of adverse effects. It is an established fact that several serious common illnesses like cardio-vascular diseases and Alzheimer's disease have genetic components. It is also known that successful treatment depends on early detection. Thus, in-vivo laboratories may test persons at risk providing a sufficiently frequent sampling to allow early detection and improved recovery possibilities.

Biodegradable materials will offer the possibility to place temporary sensors and lab-on-a-chip equipment on the patient, or in the patient. Temperature and humidity can be measured inside a cast to prevent skin problems. Antigens may be detected on transplanted organs to help prevent rejection. Intelligent micro-robots may be guided to bring drugs to the infected areas by ex-vivo remote guidance, and assist in the diagnosis providing located measurements of vital parameters.

Furthermore, this new sort personal medical equipment will enable the patient to stay longer and safer at home since the equipment itself can alarm the hospital in case of critical situations, or the patient can be relieved from the hassle of routine checks when there is nothing wrong.

2.4 TRANSPORTATION INDUSTRY

IoT offers various fare collection and toll system solutions along with solutions for screening of passengers and bags boarding commercial carriers and the goods moved during the travel. The public transport sector may be radically changed by using IoT in this field. Ticketing based on RFID is already widely available. One may easily envision that this system not only permit the user access to the stations, but that readers in the doors of the trains and busses enable an accurate tracking of every connection and route of every traveller. This will provide the operating company with perfect traffic data to optimize the network and service level, and to decide on the establishment of new lines. In the case of an emergency, the rescue workers could know the number of travellers in a certain station, and the name of the subscribers of the rechargeable ticket.

In private sector, the cars will be able to communicate and autonomously start gathering ambient information. For instance when there is a queue, the first cars may tell the cars behind if there is an accident or just too much traffic, and this will eventually make intelligent navigation systems re-plan the route of cars programmed to go down already saturated roads. The cars may help the driver to keep safe distance to the car in front, and may refuse dangerous actions like speeding if the weather conditions are unsafe or overtaking if the oncoming car goes too fast. The cars can go by autopilot on highways reducing the risk of fatigue related accidents.

Cars will also be able to maintain themselves, calling for the appropriate service based on the self-diagnosis of the problem and ensuring that the right replacement parts are in stock.

The cars will also be able to manage better the energy needed, by harvesting it in much higher quantities, by storing it with novel storage techniques, and by producing it more efficiently thanks to engines based fully or partly on new

sources of energy. Optimal route planning will reduce the number of kilometres driven, and better control systems for the car will make the ride more energy efficient. All of these individual factors will contribute to reduced emissions and less pollution.
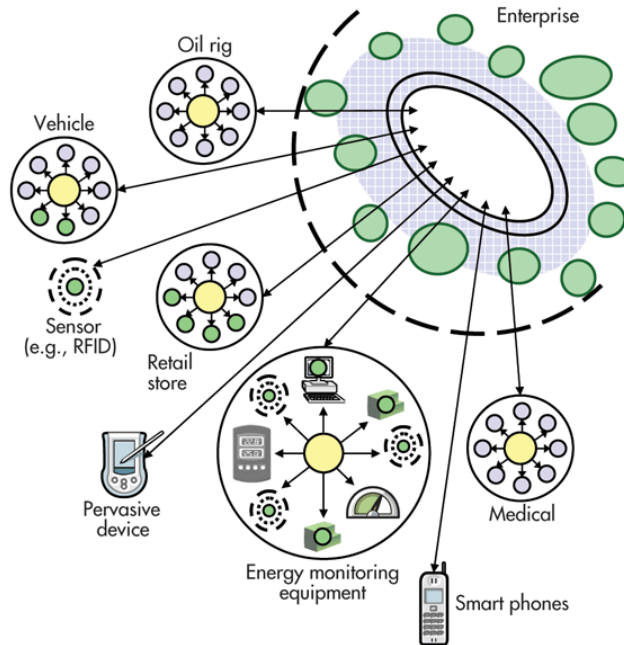

Fig. 2.4.1 Communication in Transport System using IoT.

2.5 ENVIRONMENTAL ASPECTS

IoT technologies can be used to achieve efficiency and effectiveness of numerous environmental assets, by using devices that monitor vehicle emissions to help supervise air quality, the collection of recyclable materials, and the disposal of electronic waste. [2] Combining sensory information will also allow early warnings and prevention of catastrophes. An open gas valve on a stove may be detected by comparing the gas flow measurement with the lack of increased temperature in the room. Accidental emissions polluting water may be stopped by a sensor in the drain detecting the emission and communicating with the next valve in the sewer to block the pollutant to progress. The advance over today's situation is that the control is distributed hence offering faster and more cost efficient responses than what is achievable with centralised monitoring and control.

III.VISION 2020

When looking at today's state of the art technologies, they should give a clear indication of how the Internet of things will be implemented on a universal level in the years to come as well as indicate important aspects that need to be further studied and developed in the coming years.

It is widely expected that RFID technology will become mainstream in the retail industry around 2020. As this scenario will evolve, a vast amount of objects will be addressable, and could be connected to IP-based networks, to constitute the very first wave of the "Internet of Things". There will be two major challenges in order to guarantee seamless network access: the first issue relates to the fact that today different networks coexist; the other issue is related to the sheer size of the "IoT". The IT industry has no experience in developing a system in which hundreds of millions of objects are connected to IP networks. Other current issues, such as authentication and encryption, and multicast functions to deliver voice and video signals efficiently will probably be overcome by on-going technological developments.

Another very important aspect that needs to be addressed at this early stage is the one related to legislation. Various consumer groups have expressed strong concerns about the numerous possibilities for this technology to be misused. A clear legislative framework ensuring the right of privacy and security level for all users must therefore be implemented by all member states. So we can think of a centralised body that will govern the legal laws and clauses that one must abide by in order to use an IoT based environment. In the coming years food traceability will be a piece of cake and assisted living or more secure healthcare will no longer remain a fantasy.

Traditionally, the retail and logistics industry require very low cost tags with limited features; such as an ID number and some extra user memory area, while other applications and industries will require tags that will contain a much higher quantity of data and more interactive and intelligent functions. "Data", in this context, can be seen as an "object" and under this vision a tag carries not only its own characteristics, but also the operations it can handle. The amount of intelligence that the objects in the IoT will need to have and if, how and in which cases this intelligence is distributed or centralised becomes a key factor of development in the future. As the "IQ" of "things" will grow, the pace of the development and study of behavioural requirements will also grow and benefit from it.

We can clearly see a future where everything around us is smart from our trash cans to our cars. Everything will respond to some action. For instance, curtains respond to excessive light, robot cleaners to dust and dirt while cars to bad weather.

With various promising companies like Samsung, Microsoft and Intel taking tons of efforts to make IoT a reality, it becomes clear that IoT will soon be implemented in our lives. It is only a matter of few years before we can interact with everything around us and everything around us will interact with us as well as among themselves.

IV.CONCLUSION

There is a huge potential in IoT based systems and it is evident from already implemented applications. There are many other applications that still require development and analysis. The future of IoT is very bright. In the next few years, everything from our coffee to transport mode will be governed by IoT. There are various opportunities for IoT in day to day lives of people due to current socio-economic conditions. IoT based applications also help in reducing the ecological impact of mankind. Moreover, IoT is not a fantasy anymore. It is under implementation and within the next few years will be seen implemented all across the world.

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