

Applications of Internet of Things

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Abstract

The internet of things is emerging as the third wave in the development of the internet. Internet of things (IoT) is expected to have a massive impact on consumer products, business and wider culture, but these are still early days. Given its potential for very wide applicability to almost all verticals and aspects of business, industries, manufacturing, consumer goods, supply chain, etc. IoT is having wide area of the applications this paper focuses specifically to its adoption to our Home Applications. Importantly, based on the analysis of current consumer sentiment about the new smart devices, carves out the potential opportunities to bring down the barriers. The Internet of Things is facing on its own way to mainstream adoption and who has potential to win in this segment..

Keywords- Internet of Things (IoT)

I. INTRODUCTION

The Internet of Things (IoT) provides a notion of sensors or “things” being connected anytime, anywhere. It is an extension of the Internet to the real world. It is consisting of physical objects and is often associated with terms such as “ubiquitous network,” and “cyber physical system” [1].

All future advancements in the field of IoT are contingent on the developments in microelectronics, embedded systems and network protocols.

Some of the fields that IoT can potentially revolutionize in the years to come are

- Intelligent Transportation
- Smart clothing
- Education
- Environment forecasting
- Smart Agriculture
- Health Care
- Smart Buildings

II. APPLICATIONS OF IOT

The applications of IoT are many and varied and the field has witnessed rapid growth in recent times. In order to ease the development process of IoT applications, developers should move beyond low-level cloud programming models. In order to address this problem, [2] proposes a framework that is mapped to cloud application program interfaces (APIs) provided by platforms like Aneka. The framework not only reads data from both the sensors and online databases but also passes messages in case an event of interest is observed. The design is summarized in Fig.1.

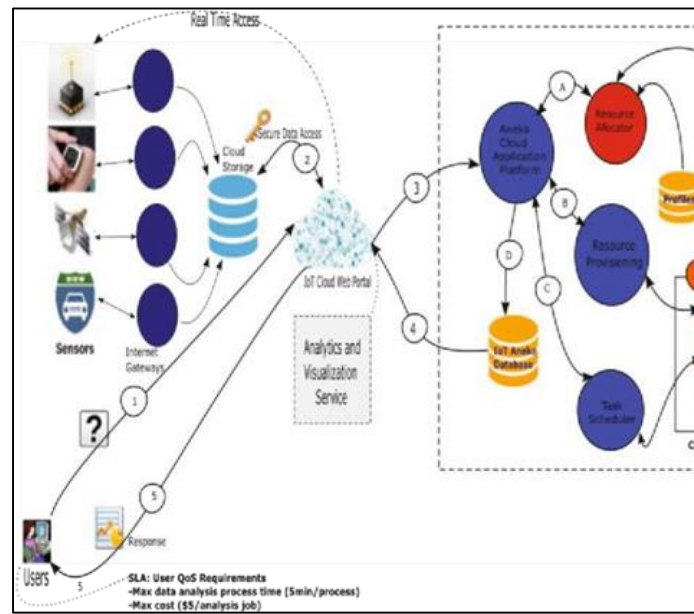


Fig. 1: Possible framework for developing future IoT applications

A. Intelligent Transportation

It is expected that soon the principle of IoT could be applied to vehicles to set up car networks aimed at exchanging high rate multimedia information for entertainment purposes [4]. Such networks are called Vehicular Ad-Hoc Networks (VANETs). Device-to-device (D2D) communication is one of the promising applications of network control over communication sessions, whereby the devices discover each other and directly communicate with minimal involvement of the network. This strategy can help to overcome latency issues in scenarios where vehicles communicate directly with one other, i.e., vehicle-to-vehicle (V2V) communication [5]. The resulting VANET converts the participating vehicle into a wireless router or node, allowing other cars within a proximity of 100–300m of each other to connect and create a network. This will be a very effective way of operating vehicles.

There have already been other major developments towards achieving “smartness” on the road. Multi-national enterprises around the world have made locating the parking slots easier through sensors (ParkSight [6]). This is allow the users to summon cabs through a single tap of a smartphone (Uber [7]) and designed a mechanism for volunteers to collect road traffic data for visualization (Streetbump[8]).



Fig. 2: Communication techniques expected to be used in VANETs comprising vehicles equipped with on-board sensors and electronic control unit (ECU); vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-road side unit (V2R) and vehicle to sensors (V2S)(https://ece.uwaterloo.ca/~kan.yang/securit_ybbr/vanet.html)

IoT is expected to continue playing a major role in determining how drivers interact with the environment, including the traffic, around them.

B. Smart Clothing

The state-of-the-art technique for clothing is restricted to special purpose, low-volume fabrics that are embedded with electronics. However, projects that use IoT in future garments by incorporating sensing layers like as a conductive coating or a mesh of conductive threads, into a cloth during production. Especially, [9] lays down three requirements for achieving this:

- The sensor layers got to be tailored counting on what variables they aim to sense and therefore the body location they are alleged to perform their job on.
- There should be connectivity between the sensor layers to furnish an influence and communication infrastructure for the sensory components.
- There should be an interface to line up to be embedded with electronic circuitry.

In conjunction to the features, a separate OS could also be added to the electronic control modules.

IoT can find application in product inspection and internal control. For instance, Wong, y., & Ip (2010) [10], proposes the planning of a garment hanger that not only checks how the material looks like (such as colour and fitting) in order that it meets predetermined standards, this also determine its lastingness that is strength as well as its response to being worn by an individual several times.

Researchers have also looked into the various possibility of developing a sensor system to figure out the optimal temperature for a building's heating or cooling system relying on the clothing insulation of the occupants [11]. The work was undertaken to prevent wastage of energy as well as reduce the feelings of discomfort experienced by people. This may be considered inside the building owing to inordinately high or low temperature settings. A smart sensor system for clothing insulation inference (SiCILIA) may be a platform that addresses these challenges by obtaining the private and physical variables of the inhabitant's thermal environment to deduce their clothing insulation.

1) Education

Global education with the vast proliferation of internet access, students and researchers now feel the urge to not only access the work of experts in their field but also their peers. The Internet has thus become a platform for sharing ideas and ongoing research. It is expected that in the future experts in a particular area will be requested to teach classes anywhere in the world through streaming or live video [16].

With the world's leading universities are providing access to their professors free of charge, the idea of "flipped classrooms" is gaining strength, whereby students would be expected to learn the subject matter outside the classroom, leaving the course instructor to discuss problems and ideas during class time. By providing an opportunity for students in the developing world to learn beyond basic education (which is often limited by the economic status), MOOCs and other online resources like the Khan Academy [17] can, in time, help to improve the quality of life for people who cannot afford higher education.

Another major group of beneficiaries would be home-bound individuals who are capable of learning and participate in classroom courses.

In the future, MOOCs may take the transformation into vehicles for two-way information which can prove vital for the universities and teachers engaged in furthering these initiatives. MOOCs can generate data-sets outlining the number of registrations and drop-outs, online attendance per course and the students' internet protocol (IP) address of the students. The universities can thus gauge the time that people spend on course materials and narrow down the content and topics that might be popular among specific demographics. This would allow course instructors to streamline their teaching methods to reduce drop-out rates and to align the curriculum to the students' needs.

C. Environment Observation, Forecasting and Protection

With the environment under constant stress due to extensive urbanization and adverse human activities such as hunting for sport, IoT is projected to play a part in preserving natural resources and endangered species. In order to achieve the latter objective, organizations around the world are using GPS-enabled devices to track the habits and health of endangered. In fact, Cisco is using long range radio (LoRa)-based connectivity to track the movement of anyone entering the reserve grounds for rhinos. In case of Trespassing, precautionary measures may be taken for the well-being of the animals.

Furthermore, IoT can potentially help alleviate waste management issues particularly in countries like the USA where the daily per capita trash was estimated to be 4.6 pounds in 2013 [18]. By determining the optimum time for waste collection and the best routes for the trucks to follow, IoT can redress the problems associated with waste build-up in neighbourhoods.

With an increasing number of water stressed countries around the world, the installation of smart water sensors in buildings can also to help limit domestic water consumption. Through these devices and data analytics, users will be able to keep track of how much water was used in a given period, allowing them to cut down on excessive usage.

Another major environmental crisis that the world faces is deforestation. In addition to fighting forest fires, drones are now part of an initiative by Biocarbon Engineering to replant one billion trees [19]. The organization aims to achieve its goals through precision agriculture techniques, the use of technology to reduce manpower requirements and cost and the deployment of drones to determine the landscape of the area affected by deforestation. Finally, IoT can also assist in predicting and mitigating the effects of natural disasters. In particular, Zizmo [20] uses cloud connected sensors that detect motion near earthquake epicentres

to issue a warning to residents in the surrounding areas. Similarly, Avatech [21] uses pressure sensors to predict the likelihood of an avalanche.

D. Smart Agriculture

The world's water reservoirs are fast depleting and there is an urgent need to conserve this precious resource. According to an estimate, farmers use 70% of earth's freshwater, 60% of which is lost due to faulty irrigation systems, inefficient agricultural techniques and the cultivation of thirsty crops. Sensors and actuators can provide growers with a better visibility over their operation and thus allow them to minimize water wastage by monitoring metrics such as temperature and water pressure. In this respect, Microstrain [22] has developed a system of wireless sensors to gauge key conditions during the growing season in vineyards. The sensors measure variables such as temperature, soil moisture and solar radiation and alert the farmers in case of extreme conditions. Figure 3 spells out the possible applications of IoT in farming.



Fig. 3: Applications of IoT in agriculture

E. Health Care

Given the vast number of future applications of IoT, it is little wonder that IoT is expected to revolutionize health care as well. IoT can allow physicians to constantly monitor the physiological parameters of their patients. Owing to the recent advances in wireless sensor networks (WSNs) and embedded systems, miniaturized health monitoring devices have become a reality. These sensors can form a body sensor network (BSN) which not only monitors the patients' health indicators but also incorporates context aware sensing for improved sensitivity. In this connection, [23] proposes the design of a hardware development platform.

The diagnosis of cardiac diseases by constantly monitoring the patient's electrocardiogram (ECG) signals is a common application of BSNs. These sensor networks have also been used for monitoring patients with Parkinson's disease as they offer credible data collected over a larger period of time, compared to the inferences made through clinical observation. For example, in [24], the authors used wearable sensors to identify the movement characteristics of patients suffering from Parkinson's disease and attained real-time monitoring with high accuracy. Similarly BSNs have also been used for the treatment of respiratory diseases. In such a scenario, the network comprises a respiratory sensor for determining the depth and frequency of breathing. The collected data might then be used for patients to undergo breathing training which is instrumental in respiratory disease rehabilitation. The setup includes It utilizes a respiratory sensor for monitoring depth and frequency of breathing, to guide patients to take correct breathing training, which plays a very important role in respiratory disease rehabilitation [25, 26].

F. Smart Buildings

Sensors can prove useful in preventing possible health hazards at home. For instance, environmental sensors can now monitor air quality, barometric pressure, carbon monoxide concentration, colour, gas leaks, humidity, hydrogen sulphide levels and temperature, with upcoming start-ups offering users to access these details remotely. Netatmo [27] is one such venture. Other

enterprises have tried to incorporate IoT principles to household lighting. Meethue [28], for example, is a bulb that can be controlled by mobile devices that is sensitive not only to the weather but also to user preferences, time and room activity. Additionally, some smart home solutions have also focused on facilitating the activities of the elderly. For instance, Ubi [29] a voice- activated computer allows access to an audio calendar, podcast and voice memos, and can also make lighting based notifications to indicate the occurrence of certain events [30].

III. CONCLUSION

IoT devices are changing the way people live and interact with the physical world. As IoT networks become increasingly complex and widespread, businesses around the world would have to rethink the process of value creation. Despite lingering concerns such as information security, it is safe to state that IoT can potentially bring about economic development which could be at par with that witnessed during the Industrial Revolution.

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