Glimpses of Smart Cities using Internet of Things

Manish Shrivastava

Abstract: ***IoT will solve main problems faced by the people living in cities like pollution, traffic congestion and shortage of energy supplies etc. Products like cellular communication enabled Smart Belly trash will send alerts to municipal services when a bin needs to be emptied. Smart city is another powerful application of IoT generating curiosity among world's population. Smart surveillance, automated transportation, smarter energy management systems, water distribution, urban security and environmental monitoring all are examples of internet of things applications for smart cities. We know IoT applications cover wide range of domain but in this paper we cover IoT application related to smart city like Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring etc.***

Index Terms: About four key words or phrases in alphabetical order, separated by commas.

I. INTRODUCTION

IoT is fast growing technology, its cover every aspect of society IoT is spreading like a forest fire. IoT is revolution of internet and sensor, by the advancement in sensor network, mobile devices, wireless communication and cloud technologies, expert forecast that by year 2020 there will be a total of 50 billion devices/things connected to the internet.
Smart city is another powerful application of IoT generating curiosity among world's population. Smart surveillance, automated transportation, smarter energy management systems, water distribution, urban security and environmental monitoring all are examples of internet of things applications for smart cities.

IoT will solve main problems faced by the people living in cities like pollution, traffic congestion and shortage of energy supplies etc. Products like cellular communication enabled Smart Belly trash will send alerts to municipal services when a bin needs to be emptied [5].

By installing sensors and using web applications, citizens can find free available parking slots across the city. Also, the sensors can detect meter tampering issues, general malfunctions and any installation issues in the electricity system.

We know IoT applications cover wide range of domain but in this paper we cover IoT application related to smart city like Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring etc.

II. IOT TECHNOLOGIES

Internets of Things consist of things that have unique identities and are connected to the internet. the range of IoT is not limited to just connecting things (devices, appliances, machines) to the internet.

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IoT allows these things to communicate and exchange data while executing meaningful applications towards a common user or machine goal. It can be define as A vibrant network infrastructure with self-configuring ability based on standard communication protocols where physical and virtual 'things' have identities, physical attributes, and virtual personalities and use intelligent interfaces are faultlessly integrated into the information network, often communicate data associated with user and their environments. IoT is enabled by various technologies including wireless sensor networks, cloud computing, big data analytics, embedded system etc.

A. Wireless Sensor Network

A wireless sensor network is a cluster of dedicated transducers with a communications infrastructure for monitoring and recording conditions at different locations . Commonly monitored parameters are temperature, humidity, pressure, wind direction and speed, illumination
intensity, vibration intensity, sound intensity, power-line voltage, chemical concentrations, impurity levels. A Wireless Sensor Network is one kind of wireless network includes a large number of circulating, self-directed, minute, low powered devices named sensor nodes. These networks surely cover a huge number of spatially distributed, little, battery-operated, embedded devices that are networked to delicately collect, process, and transfer data to the operators, and it has controlled the capabilities of computing & processing. Nodes are the tiny computers, which work jointly to form the networks [1].

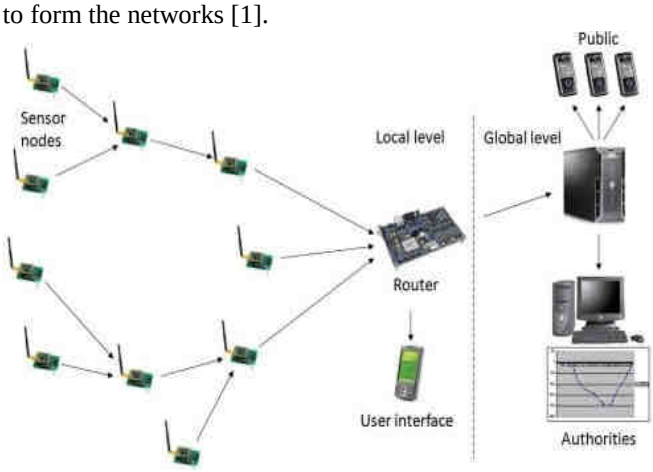

Figure 1 Wireless Sensor Netwok

B. Cloud Computing

In the simple language, cloud computing means storing and retrieving data and programs over the Internet as an substitute of your computer's hard drive [2]. Cloud computing relies on sharing a pool of physical and/or virtual resources, rather than deploying local or personal hardware and software.

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It is somewhat equal with the term 'utility computing', as users are able to tap into a supply of computing resource rather than manage the equipment needed to generate it themselves. Cloud computing have several smart benefits for businesses and end users. Three of the main profit of cloud computing are:

- Self-service provisioning: End users can spin up compute resources for almost any type of workload on demand. This removes the traditional need for IT administrators to manage computer resources.
- Elasticity: Companies can scale up as computing needs increase and scale down again as demands decrease. This removes the need for huge investments in local infrastructure which may or may not remain active.
- Pay per use: Computer resources are measured at a rough level, allowing users to pay only for the resources and workloads they use [3].

C. Big Data Analytics

Big data is a term useful to data sets whose size or type is outside the capability of conventional relational databases to capture, handle, and process the data with low-latency. And it has one or more of the following features – high volume, high velocity, or high variety. Big data comes from sensors, devices, video/audio, networks, log files, transactional applications, web, and social media - much of it produced in real time and in a very large scale.

Analyzing big data allows analysts, researchers, and business users to make superior and quicker decisions using data that was before unreachable or impractical. Using advanced analytics techniques such as text analytics, machine learning, predictive analytics, data mining, statistics, and natural language processing, businesses can analyze in the past unused data sources independent or together with their existing enterprise data to gain new insights resulting in significantly superior and quicker decisions.

D. Embedded Systems

Embedded means something that is attached to another thing. An embedded system can be idea of as a computer hardware system having software embedded in it. An embedded system can be an autonomous system or it can be a part of a large system. An embedded system is a microcontroller or microprocessor based system which is designed to achieve a definite job. For example, a fire alarm is an embedded system; it will sense only smoke.

An embedded system has three components −

- It has hardware.
- It has application software.
- It has Real Time Operating system (RTOS) that controls the application software and give mechanism to let the processor run a process as per scheduling by following a plan to manage the latencies. RTOS defines the way the system works. It sets the rules during the execution of application program. A small scale embedded system may not have RTOS.

So we can define an embedded system as a Microcontroller based, software driven, reliable, real-time control system [4].

III. SMART CITY AND IOT SERVICES

we outline some of the services that might be enabled by an city IoT standard because they can increasing the quality and enhancing the services offered to the citizens while bringing an economical advantage for the city administration in terms of reduction of the operational costs . IoT includes a variety of elements like communication technologies, communication protocols, identification technologies, sensing, computation, services and semantics. In the smart city application several heterogeneous devices needs to be connected through the internet for communication. In the smart city application we will have large amount of data to be collected from different applications and database which needs to be classified and analyzed. We know IoT applications cover wide range of domain but in this paper we cover IoT application related to smart city like Smart Parking, Smart Lighting, Smart Roads, and Structural Health Monitoring etc.

A. Smart Parking

Searching a parking space in crowed city during rush hours is big problem, its is not only time consuming and frustrating but these also increase CO2 emission, searching parking space blindly increase additional traffic congestion, we need system that make the search for parking space easier and convenient using IoT technologies we can solve this problem. Smart parking powered by IoT system that finds the number of empty parking space and send the information through smart parking application to driver. These application can be accessed by drivers through smart mobile, tablets and in-car navigation. A smart parking application help driver to check the availability of parking space and book a parking space accordingly, Instead of driving to the lot and then finding parking space, driver will be able to reserve parking from their home, even before start driving. In smart parking, sensors are used for each parking space, to find whether the space is vacant or in use. This information is combined by a local controller and sent to a server. Each sensor is read in regular intervals and the status of parking space is updated in a server (database).

B. Smart Lighting

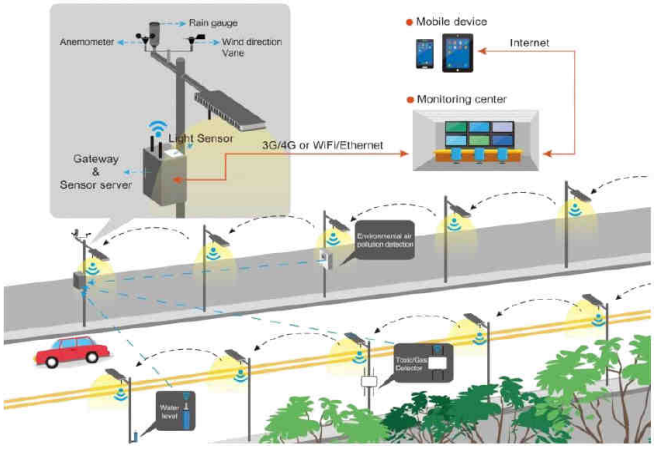

Figure 2 Smart Lighting

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As street lighting continue to be operated and maintained manually by local municipalities in India, power expenditure and transmission losses are getting too high to ignore. lighting will play a significant role in the development of smart cities of the future as it passes through every area of an individual's life–home, work, on the road and in public places. touching beyond its efficient role of lighting, connected LED lighting has the potential to improve quality of life, transform everyday experiences and services, and ensure sustainability in our ever expanding cities. Smart lighting for homes helps in saving energy by adapting the lighting to the ambient conditions and switching on/off or dimming the lights when needed. Key enabling technologies for smart lighting include LED and IP-enabled lights. Connected LED street lights provide highly energy efficient, quality light with sensor nodes. It could stream data between millions of devices, collect and distribute data and improve city services such as light, traffic, air quality, public safety, parking and other location based services.

- Remote monitoring: A street lighting automation system must allow supervisors to view streetlight statuses from the Internet. Important data such as operational hours, energy consumption, and faulty equipment must be made available at the click of a button
- Sensor integration: Automation systems would be more efficient if they could sense the intensity of surrounding light. For example, in foggy, stormy or smoggy conditions, it would be necessary for the streetlights to activate, regardless of the time of day. Thus, automation systems should include sensor integration
- Wireless nature: An automated street lighting solution should avoid extra wiring, digging and re-paving of roads to enable monitoring and control. Instead, the solution must be wireless, plug and play, and low cost in nature.

Smart lighting solutions for achieve energy savings by sensing the human movement and controlling the lights accordingly. Wireless-enabled and internet connected lights can be controlled remotely from IoT applications such as a mobile or web applications [6].

C. Smart Roads

The road lighting will be connected to light, weight or motion based sensors that will only illuminate the lighting in that area when there is passing traffic. The concept of using motion-sensor lighting on the roads will work very well, because when a car approaches a stretch of road, the embedded sensors will light up only that particular section of the road, with the lights gradually getting brighter as the car approaches and eventually diming as it passes by. IoT road sensors can provide real-time data from roads to help divert the flow of traffic away from areas of vulnerability. "Road sensors can be easily embedded under the roads so that they can effectively measure the changes in temperature, traffic volume and humidity, among other weather and traffic constraints."

The data collected by the sensors is collected in servers, where it is analyzed to give concerned authorities with real-time information about traffic and road conditions in the IoT-equipped regions. The analyzed information can help in a number of scenarios, including optimizing the use of limited maintenance resources and equipment, as well as predicting and alerting about possible hazards and accidents that may take place because of poor road and weather conditions [7].

D. Structural Health Monitoring

Structural Health Monitoring (SHM) enables engineers to improve the safety and maintainability of critical structures. SHM combines multiple sensing technologies with an embedded measurement controller to capture, log, and analyze real-time data. Structural Health Monitoring (SHM) is the process of implementing a damage detection and characterization strategy for engineering structures in order to maintain the system's performance. The SHM process involves the observation of a system over time using periodically sampled response measurements from an array of sensors, extracting damage-sensitive features from these measurements, and performing statistical analysis of these features to determine the current state of system health.

Structural health monitoring (SHM) systems provide automated assessments of structural health by processing data from sensors fastened to a structure. The scope of the project is high rise buildings where there are many factors affecting the strength of the building. We consider three main parameters. They are (i) Vibration (ii) Tilt and (iii) Sag. Accelerometers and piezoelectric sensors can be used for measuring vibrations in building. Accelerometers are also used for measuring the tilt of the building. The data are acquired using a wireless sensor network and the status of the building can be observed and saved periodically which helps in further learning. The damage in the building can be due to various reasons such as environmental reasons or human activities or improper construction of building etc. Why SHM?

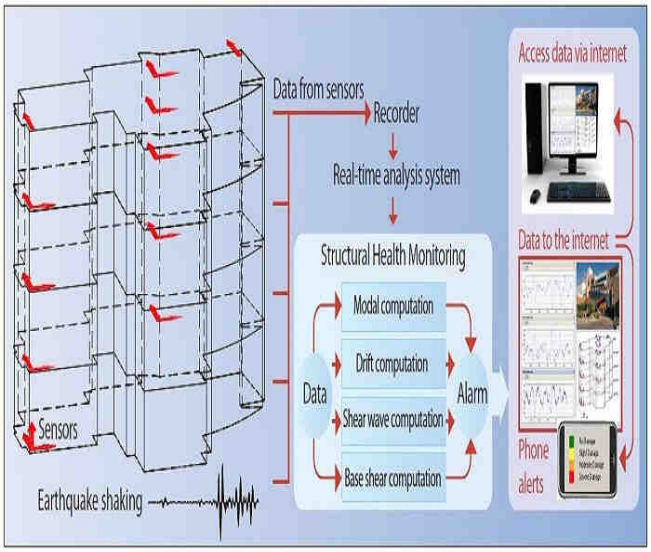

Figure 3 Structural Health Monitoring

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1) Detecting the existence of the damage on the structure
2) Locating the damage
3) Identifying the types of damage
4) Quantifying the severity of the damage

IV. CONCLUSION

IoT based Smart City enhance performance and happiness, reduce costs and resource consumption. Improve the quality of life. To make better use of public resource Smart cities are enabled by the information and communication technologies which play a main role in providing a variety of services. The various applications of the smart city has been discussed in this paper. The challenges existing in the traditional smart city environment needs to make the city smarter.

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