Smart Cities and Smart Homes: From Realization to Reality*

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***Abstract*— There is a buzz around the world about building smart cities and smart homes. Smart cities in brief can be defined as a city which uses digital technologies or information-communication technologies to make life of living beings more efficient and comfortable. Smart Home, comprising smart devices in the home context, promises enormous possibilities to our future life. At the same time, it might have its own influence to change our living habits.This paper sets to provide a way-out on how can a city and a home aspiring to become smart can really achieve it with putting up challenges that will be encountered in the path of achieving the goal.**

I. INTRODUCTION

It is hard enough to find a true definition for Smart City, but it is even harder to find a reliable description on how to make a smart city? and how does the city administration be affected from this? [1] This paper presents different areas that needs to be looked upon for realizing the dream of smart city. The different areas are : Energy Management, Pollution Prevention, Smart Transportation, E-Health Facility, Traffic Monitoring, Video Surveillance, Fire Detection, Smartphone Detection, Water Management, Water Leakage, Waste Management, Safety and Security, Home Area Network. Along side of this we will discuss the key challenges that will be encountered in making a city "smart".

II. MULTIPLE AREAS OF SMART CITIES

A. Energy Management

Whenever we think of Energy Management in terms of Smart cities what strikes our mind at first instance is "Smart Grid". Smart Grid can be broadly looked as collection of Micro-grid, Smart Appliances, Renewable Energy, PEVs (Plug-in Electric Vehicles) and Storage Devices.

1) Micro-grid: Micro-grid provides us centralized and distributed energy sources that serves a community as whole (for example, a metropolitan city) which can be operated in both connected and isolated modes. But there are some challenges associated with it as:

1. When to operate on connected mode ?
2. When to operate on isolated mode ?
3. Which one will be better proactive or reactive ?
4. What should be the pricing policy ?
5. How multiple entities can be operated together ?

Fig. 1. A typical scenario of smart city [2]

2) Renewable Energy: There are multiple options which can be adopted in view of renewable energy such as Solar Energy, Wind Energy, Hydro Energy, Biomass Energy etc. but the main issue with them is they are highly uncertain and fluctuated.

3) PEVs: A Plug-in Electric Vehicle is any motor vehicle that can be recharged from an external source of electrcity such as wall sockets, and the electricity stored in the rechargeable battery packs drives or contributes to drive the wheels. PEVs also provides V2G (Vehicle to Grid) and G2V (Grid to Vehicle) facility for energy storage which will lead to low pollution level.

B. Smart Transportation

There are some objectives associated with smart transportation such as Congestion control on roads because of heavy traffic,Incident detection mechanism,Road condition monitoring ,Information dissemination in case of any accident,Coordinated transport modes for effective and efficient life and Reduce energy consumption. These objectives requires smart sensing, short and long range communication technology,computation technology and a well connected infrastructure which can be done as :

1. Collect the generated information from Senors, Weather Monitoring tools, Incident detection tools and location services.
2. Received the information in the form of delay, congestion,

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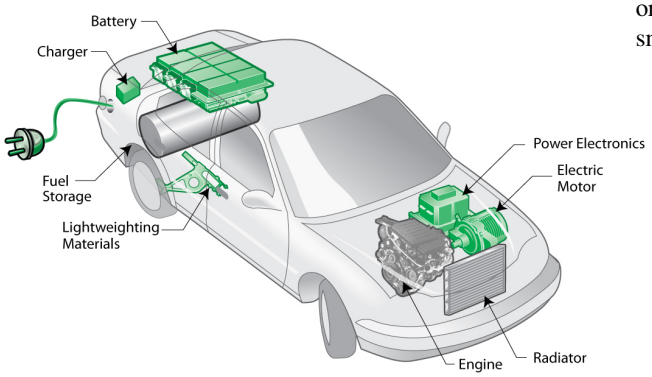

Fig. 2. A Plug-in Hybrid Electric Vehicle [3]

emergency alerts, alternate routes.
3. Take action to change mode,location, speed and broadcast the information.
A data cycle for better and smart transportation is already proposed as Data sensing, Data gathering Data fusion, Data processing, Data aggregation, Data exploitation and Service delivery.

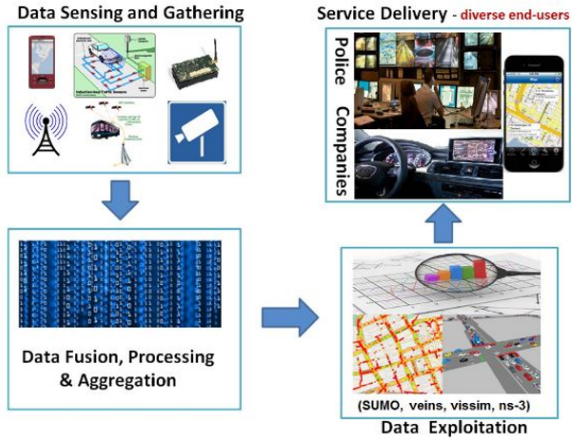

Fig. 3. Data life cycle in smart transportation [4]

C. Smart E-Health

The Government of each country aspire to provide a better health for its citizens and E-healthcare solutions is a approach in this context. There are some basic requirements that needs to met for developing Smart E-health system :
1. It should operate on low power so that it does not need to be looked upon 24X7.
2. An integrated precision-analog technology needs to be implemented.
3. Wireless networking is a huge plus.
A smart e-health system comprises clinical care, remote monitoring, early intervention, prevention and emergency responses. With the help of wireless sensors either on the body or embedded into it is a typical solution for implementing smart e-health scenario.

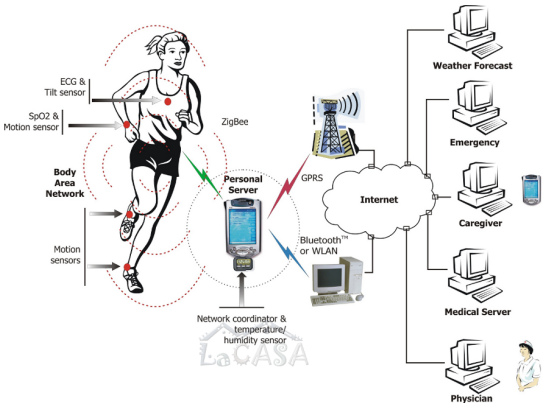

Fig. 4. Sensors on the body to with connected network [5]

D. Video Surveillance

Video Surveillance is monitoring of people's action on roads,railway stations, bus stations, airport etc. so that any unwanted activity can be avoided. Also, they are important in proper functioning of the management in the city.
Video Surveillance requires high amount of bandwidth and mobile environment however there is always a delay constraint even of nanoseconds attached to it. A typical demonstration of video surveillance is referred in Figure 5.

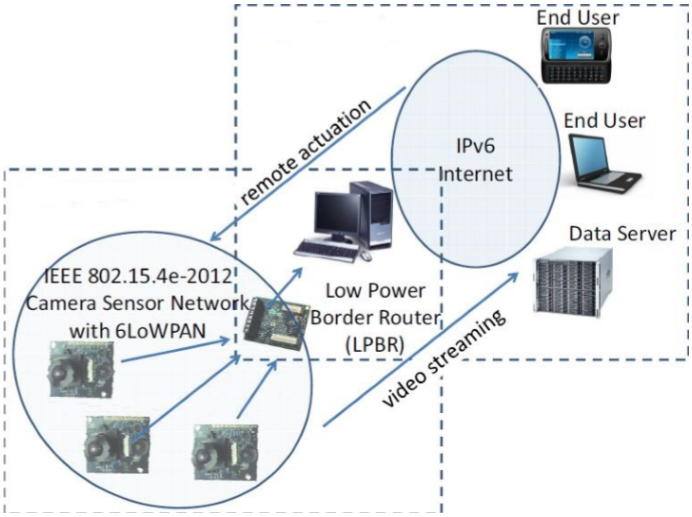

Fig. 5. Video streaming over IoT-oriented standards [6]

E. Waste Management

A smart city is developed upon numerous distinct elements and solid waste management is one of these vital aspects. For instance, today, to address the rising concern of carbon emissions in construction process contractors are mandatorily asked to utilize equipments as per Euro-IV standards. Hence, for employing such operational standards we need to have

active participation and acceptance from the contractors in utilizing equipments as per the prescribed technologies [7]. With the use of cloud computing and proper waste management infrastructure effective waste management can be reached. The use of RFID tags, Check Posts, Log Sheets etc. adds up the advantage to it.

F. Water Management

Water management is the key towards acheiving the goal of smart city. A proper and well maintained water management system needs to be implemented to be taken of.
Sensores are needed to be deployed at different levels such as Residential Areas, Factories, Farm Lands etc. and data from that can be sent to the server. Decision about the scenario are sent to the pump house in any form email/sms etc.

G. Structural Health Monitoring

Preventive actions are needed to be taken for maintaining and monitoring the structural health. It includes monitoring of bridges, buildings etc. in form of vibration monitoring, estimating the load capacity and condition monitoring of an old building so that if any renovation is required can be achieved in proper time. Increasing awareness among people is biggest challenge of this area.

H. Smart Agriculture

The biggest advantage of building a smart city is that even the poorer people will get handson with the technology. The sensors can be embedded in the soil to measure the temperature and moisture level. The collected data can be put on cloud from where many person can use it as sensing as a service.

III. SMART HOMES

Smart homes connects all the devices and appliances in your home so they can talk to each other. There are certain objectives which needs to be met :
There should be automatic control of appliances, Controlling of light and climate in an optimized manner is another vital task, Automating the alarm system, taking care of entertaining (media) systems etc. However these objectives are not easy to met because there are certain challenges attached to it namely:
1. All appliances needs to have in-built communication technology.
2. Designing and layout of the devices.
3. Sensor interfacing of each device.
4. Data processing of the incoming/outgoing data.
5. Who is the key decision maker?
6. Security and privacy issues.

A. Smart Home: In-home architecture

A typical in home architecture must have smart energy consumption, should have multiple appliance monitoring at a single time with keeping in view the security and privacy issues attached to it. The appliances send their demands and utility gateways schedules the appliances. The owner sitting anywhere in world can monitor/control his/her home appliances remotely.

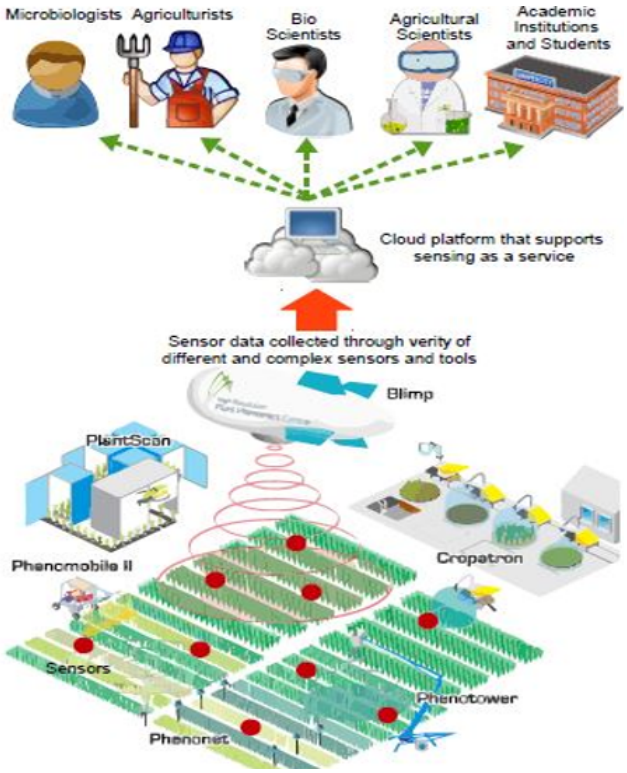

Fig. 6. Smart agriculture model [8]

B. Smart Home: Health Monitoring

Health is a critical issue related to any home. Regular health check-ups, Prediction of the disease based on symptoms only, proactive measurements to cure that and reporting of any emergency situation are tasks involved in health monitoring for smart homes.

C. Appliance Monitoring

Appliances are triggered with sensors. Here are some key points associated with it:
1.How many sensors to build a smart home ?
2.Suitable sensor interfacing technology needed in action.
3.Operating mode: Active or passive
4.Motion detecting sensors for detection of any unwanted activity.
5.Temperature measurement sensors for recording the temperature in which appliance is functioning.
6.Light intensity measurement sensors.
7.Touch-activated sensors

IV. INTERFACING, SECURITY AND PRIVACY

Multiple devices are expected to work together that require a common interfacing technology and how does the existing devices can be interfaced with the new one ? are some keys points which are needed to be take in account while dealing with interfacing.
Security, Privacy and Trust are of foremost understanding in these circumstances. How the users data can be handled in a secured manner? Privacy of users need to be preserved, while

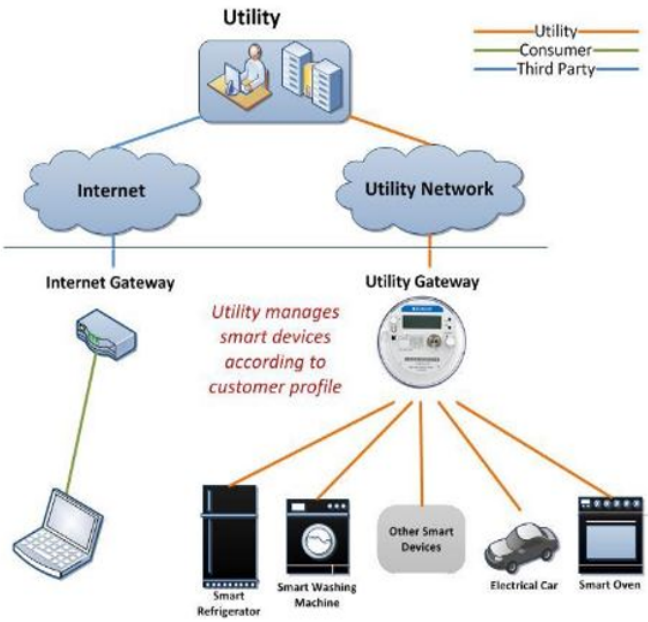

Fig. 7. Smart energy consumption architecture [9]

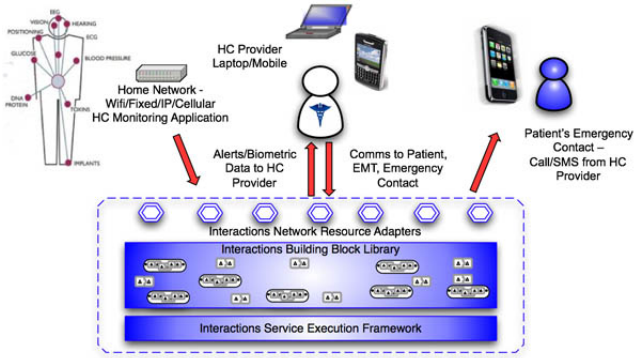

Fig. 8. Typical Scenario of a health monitoring system [10]

uploading the data to a cloud-based platform etc. Overall, how the appliance monitoring can be secured so that third party cannot access it is the key objective behind this. Most useful communication technologies that are used in IoT are Zig-bee, Bluetooth and Wi-fi.

V. CONCLUSION

In conclusion, the major stakeholders in any city or state must collaborate openly in order to decide how livable and sustainable their environment should be[11].Summarizing in terms of Technology we need better architectural designs, data collection methods, Sensor configuration in best effective and efficient manner and at last Interfacing technology with the real life. Economical issues will always prevail in this process such as Business practices, Licensing ,Market impact etc.Security, Privacy and Trust are some common challenges that propose the future work in this area.

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