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A Survey on Sustainable Smart City Applications Based on Complete End-to-End IOT Architecture

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Abstract
Fundamental objective of smart city is to accommodate mechanical advancements with the economic, social and environmental difficulties of the city of tomorrow. Smart city expects to improve the nature of urban administrations or reduces its expenses by using Technological concepts. Staying up with digital innovation is essential for smart city success. Cloud-based technology, mobile apps, citywide data platforms, IoT, sensors, biometrics recognition, and geospatial technology are now used by more than half of the surveyed cities. Within next few years, these technologies likely to become an important component in smart city technology. Smart city is generating considerable interest in terms urbanization, industrialization, consumption grow, environmental sustainability. While innovation is just a single choice for address the challenges. This paper proposes an architecture for the interaction of smart city applications. Though this is a survey paper, the discussions are made on the proposed system and survey is made on IoT and Sustainable smart city applications to enhance the working of smart city applications in the future.

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1. Introduction

The use of the Internet as a global platform for letting devices, machines and smart objects to communicate (we are allowing existing internet to use objects communicate each other), dialogue (keep exchange information between the devices), compute (compute over cloud) and coordinate (two or more IoT devices share the information and coordinate certain activities) is unleashing a new world order. IoT builds on three supports, related to ability of smart objects to be Identifiable (When we add need sensor, there must be addressing mechanisms to identify in the network using

IP address anything identifies itself),

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Communicate (As part of IoT device, any things can able to communicate with another device anything Communicates), Interact (when two devices are connected in the internet, they must be talk each other). The objective of IoT is represented in the figure.1. It is predictable that in the coming decade, the internet will exist as flawless fabric of classic networks (network mean to connect PCs and other devices) and networked objects. Two types of network can be formed using existing networks. The technology enabling person-to-object and object-to-object communications. Class networks-Networks of PCs. Networked Objects-IoT (Anything can be worked as smart objectified). The key thought behind the Internet of Things idea lives in the huge capability of embedding, computing and communication capacities into objects of regular use. Henceforth we have to represent the add-on Identification, Sensing and activation.

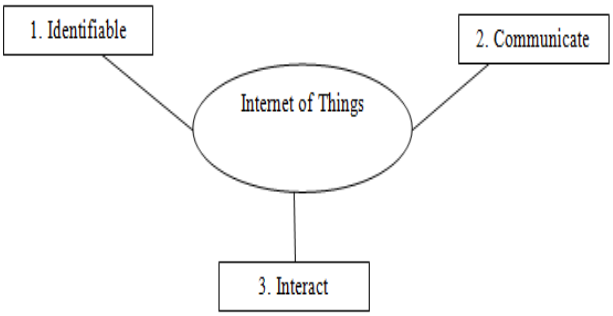

Figure 1: Objective of IoT

2. Literature Review

Smart City contains the whole human biological system. It centers on providing social advantages, economic development and creating new opportunities. Hence, Smart city deals with different domains such as Natural resources and energy (smart grids, lighting, renewable energies, waste management, water management, foog and agriculture), Transport and mobility (city logistics, mobility information, mobility of people), Smart building (facilities management, construction service, housing quality), Daily life (entertainment, hospilitality, pollution control, public security, health), Government (e-governance-democracy, transparency), as it provides intelligence decision making in the smart city.

Pablo Chamosoet al [1] proposed set of software components that can be reused by other urban communities and permits the formation of index of services that urban community can clone exploiting improvement, without programming basic functionalities. When we use bicycle sharing system, transportation of a town are going to be a lot of green and convenient. Thus IoT might become a very important role in sustainable and smart city. Limin LIU et al [2], proposed Bicycle sharing system is to look for sharing bicycle through GPS with mobile phone. The sharing bicycle in china build considerable contribution for green transportation, energy conservation and environment protection. It plays necessary role in sustainable and smart cities.

Most of the prevailing frameworks either lack service programming models or define a programming model solely supported their own private model and interfaces. Therefore as a smart city platform, they're quite restricted in terms of openness and interoperability. To resolve these issues [3], proposed standard based approach to design and implement new fog computing based framework specifically Fog Flow, for IoT smart city platforms. Fog Flow's programming model permits IoT service developers to program elastic IoT services easily over cloud and edge. It supports standard interfaces to share and reuse contextual knowledge across services. Centralized system carries out existing data analytics and higher decision making process from our current

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extremely virtualized platform of wireless networks and Internet of Things (IoT) applications. It's possible that existing methodology can encounter additional challenges and problems in respect to network dynamics and high overhead within the network response time. It's resulting in latency and traffic. To avoid these issues within the network and deliver the goods optimum level of resource utilization, new methodology known as edge computing (EC) is proposed for evolution of latest age applications and services. Many IoT applications like smart grid, smart traffic lights, and smart vehicles are unit upgrading with EC.El-Sayed et al [4] proposed validate efficiency and resourcefulness of edge computing. When analyzing different network properties, the results shows that edge computing performs better than cloud computing systems.

Smart city gives an intelligent method to oversee components, for example, transport, health, energy, homes and buildings and environment. The data created by these parts are primarily by remote sensor systems have sent in numerous modern and consumer applications, for example, health monitoring, smart home, water checking and condition monitoring. Aditya Gaur et al [5] proposed design can help Alzheimer's patients and old people with their day by day living exercises. For instance by sending caution and warnings to end clients on the off chance that they forget or unable to finish, day by day living exercises. The framework also provides intelligent way for individuals living in smart society.

Sustainability is a method of advancement that guarantees a coherent, continuing balance among supply and demand. A feasible advancement should contribute to a healthy not only natural but also from affordable viewpoint. Real difficulties when utilizing IOT technology to upgrade urban sustainability Zhang et al [6] proposed enhanced urban sustainability using IOT applications, for example, 1) Urban sustainability is waste management, Intelligent waste containers are introduced to track waste load levels to advance waste preparing and decrease potential contaminations In the event that the component of waste following can be joined with different capacities, for example, toxic substance detection, system can have more commitment to urban sustainability.

2) Smart streetlights- smart light poles are furnished with numerous sensors that recognize environmental, data such as humidity, carbon dioxide emissions and noise, such adaptive framework can be viewed as a significant advance forward in city sustainability. 3) Smart home-This incorporates optimization of lights, temperature and humidity to reduce energy cost from urban planning. Zhang et al[7] focus on a sustainable development has to have plan that protect balance among all groups. A sustainable innovation should provide not only natural environment but also from and social perspectives. Theodoratos [8] et al, reviewed the smart city applications include city administration, transportation, education, healthcare, public safety, housing infrastructure and utilities. To maintain sustainable manner in smart city applications need to coordinated and maintained by local bodies of the government. Tremendous management effort is required to monitor, report, and intervene the systems of smart cities [9] et al, mentioned that these systems are essential for urban living and uninterruptible services.

3. Motivation for this research - The best approach to turn into a Smart Sustainable City

Its everything about development of sustainability in smart city to help or improvement of reuse, recycle, recharge. It is

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support nature and its components. Sustainability refers to keen city, it is in a perfect world about ventures which actualize green structure ideas inside a current city. Being eco-friendly and sustainable township is tied in with recycling garbage to compost manure for greenhouse to make methane gas to control utilities. To harness wind and solar to provide a part of power requirements, its additionally about charging the water through downpour water harvesting.

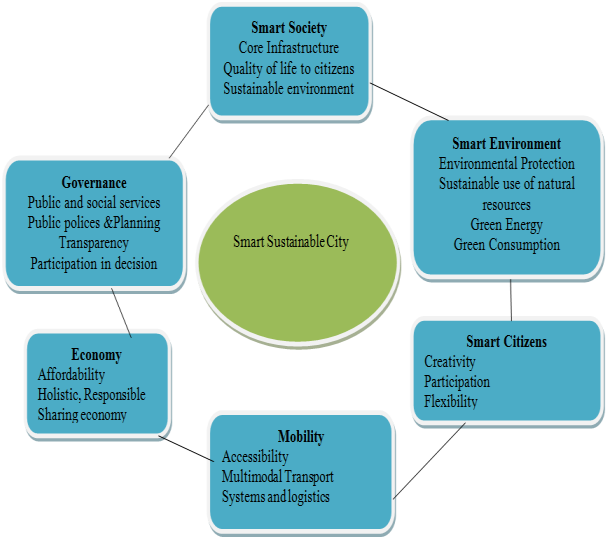

Figure 2: Smart sustainable city

The smart sustainable city utilizing the incorporated methodology tunes itself, improves the efficiencies of various components of city.

The primary objective of this sustainability is to improve the prosperity of residents. The smart sustainable city establishes an economical methodology that addresses the issues of today without relinquishing the capacity to address the needs of future generations.

4. Proposed Architecture - Complete End-To-End Iot Architecture- Iot or Next Generation Devices

Next generation devices that can sense the real world like temperature, lighting, the pressure or absence of people or objects, etc and report real world data or act on it.

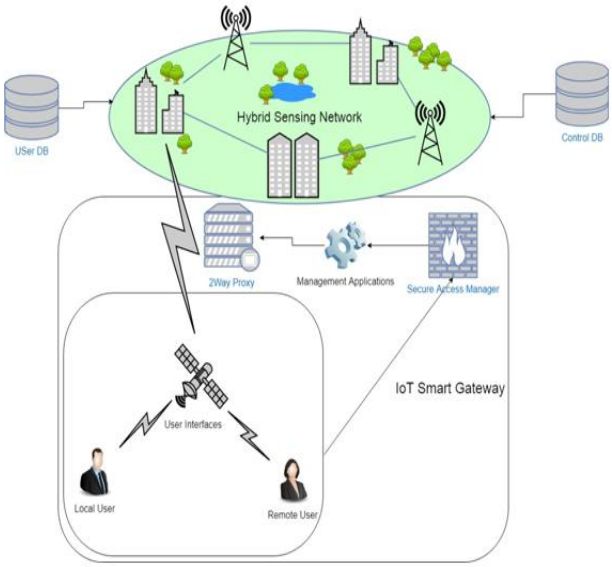

Figure 3: Proposed Smart City System Architecture

The figure.3. depicts the architecture of the proposed smart city System. The architecture comprises the Hybrid sensing network operated in cloud, IoT smart gateway comprising 2 way proxy server one for sender and another for receiver, Secure access manager and management applications, two databases one acts as control DB and another one acts as user DB. The user interface allows the local user and the remote user to interact with the proposed smart city system architecture. The proposed smart city architecture contains the structure of the complete end to end IOT devices.

4.1 Complete end-to-end IOT Devices

We have considered gateway as center point, IoT Gateway which is an actual hardware device as central point where it will be getting relevant information from the sensors. The input to this gateway and then process this sensor information on the gateway itself or if

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we want to store this information on gateway home and then i will forward it to the IoT cloud platform. The input to this gateway and afterward process this sensor data on the gateway or on the off chance that we need to store this data on gateway home and, at that point I will advance it to the IoT cloud stage. From the cloud we will advance same data which I have taken from the gateway to any front end customer that can be mobile application or any powerful page so if front end client need to give order dependent on this data which you got from the sensor then he will almost certainly give explicit command to the actuators.

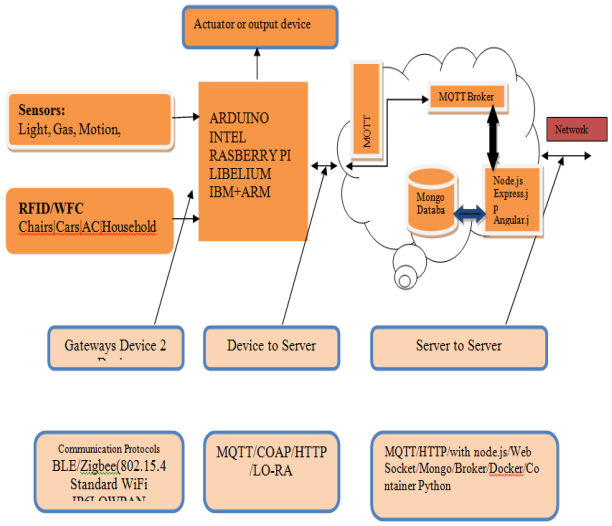

Figure 4: Complete End-to-End IoT architecture

5. Discussions to Understand the Complete End-To-End Iot Operations

In this model, we consider about concerned, home automation is example. we have essential temperature sensor at my home which is sending is real data persistently to the cloud or might be within an interval of some threshold if temperature goes beyond 35 or 40, at that point it should send its data to the cloud and afterward fronting client will get some data from the cloud as a receiver in his mobile application or website page. User will not only be monitoring the temperature he can give order on back to the actuators. For example: he can turn on or off AC or fan from a same mobile application over cloud from any remote area.

The complete end-to-end architecture comprise of the basic IoT phrasings, for example, sensors, actuators, microcontrollers, gateways or networking platforms or protocols, API's, database and frameworks. These devices and frameworks are useful for making any IOT Applications. Sensor will be one of our inputs for IoT technology and RFID will be second input. Sensor is the only input for IOT technology. We can use different sensor for different applications. This sensor information will go towards the Gateway. The most prevalent gateways are ARDUNIO, Intel, or Raspberry Pi, Libelium, IBM or ARM. The listed gateways are all open source gateways.

This sensor data will make progresses on the gateway and after that from this gateway information will go to cloud via network. Network plays significant job between integration of hardware gateway and IoT cloud platform. The IOT cloud providers, for example, IBM bluemix Watson or AWS IOT or Microsoft Azure used to coordinate with any hardware devices in the cloud platforms. Message protocol on each and every layer same from the cloud. This data can be sent to front end and this front can be your mobile application or website page where one can monitor information and after that in reverse same user can give the command to the devices or actuator. From the above end-to-end architecture, divided this technology into three major communication levels. One is Device to Device, second is device to server, third one is server to server. We have to understand opportunities on each and every layer of communication protocol.

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5.1 Device-to-device Communication level

To integrate or communicate any sensor data with the gateway we need to make it wireless. In the wireless network we need to use different connectivity protocols. Wireless protocols such as ZigBee, IPV6Loopen, WiFibluetooth, and RF modules or sub 1 and 0.

5.2 Device to server communication

To integrate any gateway with the cloud or IoT cloud platform. Network plays very important role to integrate gateway with the IoT cloud platform. In network there are messaging protocols through, which data can be sent to the cloud but while sending the data hardware to cloud, there may be lot of issues or major IoT concerns such as security, power consumption, and interoperability. These issues can be reduced by right selection of these messaging protocols for specific to the IoT application.

5.3 Server to server Technology

We need to have the device information on any IoT specific server. Server side scripting language, for example, ASP.net, PHP, Python or node.js. are utilized to incorporate server and cloud stage. Device information can be directed from once more into front end MVC with the REST API. Front end can be mobile application or that can be any website page. Device information can stored NOSQL database like MONGODB.

5.3.1 Sustainable Real smart city applications

1) Garbage collection- For instance it is possible to monitor level of garbage in the bins in container. It is important that they will be able to save a lot of money and fuel if there is really sign the collection routed before that the correction truck leaves their facilities.

2) Water Quality-we can recognize physical parameters and chemical particles in the water upstream a city and downstream. We make early cautioning frameworks. At the point when there is a contamination issue in a city or in a waterway. We see that the issue like a 16hours later yet on the off chance that we have system of device monitoring water quality each five kilometers, at regular intervals, we will probably figure out where the contamination event occurred and where and we can search for capable and in those five minutes on the off chance that we recognize that something isn't right.

6. Conclusion and Future Work

City population is growing much faster than resource which exists in the city. We need sustainable ways to manage resource such as water, Electricity, Housing for city living. This paper presents a new approach to enhance sustainable smart city applications with sustainable real smart city applications. To further proceed our research we are planning to implement sustainable smart city applications in IoT environment.

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