Smart City Experimentation through Internet of Things and Cloud

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Abstract- *A smart city is a place where traditional networks and services are made more flexible, efficient, and sustainable with the use of information, digital, and telecommunication technologies to improve the city's operations for the benefit of its inhabitants. Smart cities are cleaner, greener, safer, faster, and friendlier. The different components of a smart city include smart infrastructure, smart transportation, smart energy, smart health care, and smart technology. These components are what make the cities smart and efficient. Information and communication technology (ICT) are enabling keys for transforming traditional cities into smart cities. Two closely related emerging technology frameworks, the Internet of Things (IoT) and Cloud computing, make smart cities efficient and responsive. This paper, focus specifically to a metropolitan city, which aims at exploiting the most advanced communication technologies to make city cleaner and safer for the citizens. The paper addressed towards the experimentation of environment parameters such as temperature, air, noise etc. for pollution detection.*

Keywords- Arduino board, IoT System, ICT, Smart City, Smart components.

I. INTRODUCTION

The concept of smart city originated at the time when entire world was facing one of the worst economic crises. In 2008, IBM began to work on a smarter cities concept as a part of its smaller planet initiative. By the beginning of 2009 the concept had captivated the imagination of various nations across the globe. The smart city is the Information and Communications Technology (ICT) and also embeds the future technologies. Main vision of the smart city is to provide cleaner, smarter and safer city for the citizens [4]. The different components of the smart city includes smart environment, smart education, smart technology, smart home, smart people, smart security etc.[1].

India-A smart vision:

India is considered as one of the developing countries from past 10 to 20 years. It is still lagging behind in the development since increase in the population. Now the population in India is approximately 120 crores and it gets increase in the future. Also a research study says that for every minute an average of 30 people moving towards the cities to fulfill their demand, it may lead population elevate in the cities [7]. Increase in population may direct to enormous of waste generation and this causes different sort of health problems to the citizens. Most of the Indian cities are suffering from different sort of problems like poverty, unemployment, pollutions such as air pollution, noise pollution, global warming and so on. Hence, there is a need of future city called smart city should reach the user demand in all the paths. Smart city must be pollution free and will provide plethora of services using information, digital and communication technology. In 2016, 100 cities in India are selected for smart city concept and it is a good move to make India towards a Smart India [7] [8].

Smart City Components:

Associated components of smart city defined as follows:

A. Smart Environment: The smart environment concept is a form of ubiquitous computing that promotes the ideas of a physical world that is richly and invisibly interwoven with sensors, actuators, display and computational elements, embedded seamlessly in the everyday objects of our lives and connected through a continuous network [2]. The area is well formed to provide plethora of services which are healthy and innocuous for the citizen of the city.

B. Smart Education: It is an educational technology which encompasses several domains including learning theory, computer based training, online leaning, mobile learning, and is the system describes the intellectual and technical development of education technology [1].

C. Smart Technology: Incorporating IT into an object to make it capable of communicating autonomously and becoming a node in a network [1] [3].

D. Smart People: Smart city equally driven by its citizens, who in the developed economies are may be well educated, well informed, well connected, secure financial position and well known towards the smart systems.

E. Smart Home: Smart home or a building is equipped with special structures enables the occupants to remotely control or program an array of automated home electronic devices.

F. Smart Security: Smart Digital and Information Technology make the city secure in all the domains such as cyber security, digital certificates and signatures, business and transactions, public safety and licensing [6].
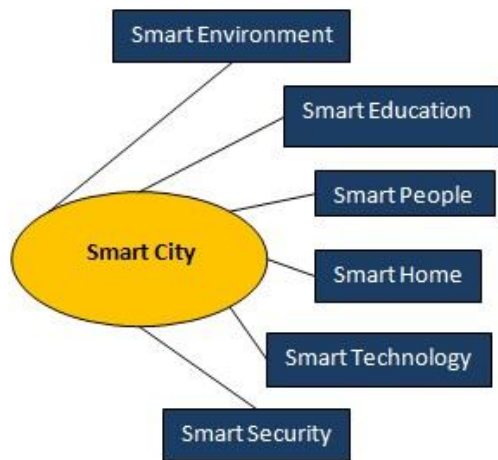

Figure 1. Smart City Components.

The two main technologies in smart city are Internet of things and Cloud Computing. IoT: Internet of things is a computing terminology that describes the idea of everyday physical objects being connected to the internet and being able to identify themselves to other devices. It was invented in 1999 when there was an analysis on RFID technology. Cloud computing: Cloud computing is a type of Internet based computing that provides shared computer processing resources and data to computers and other devices on demand. The remainder of this paper is organized as follows: it reviews on related work, An IoT system for smart city and conclusion with some prospective on possible future work.

II. RELATED WORK

Smart city environment be obliged to toxic free in all the domains for the citizens and different papers were discussed to construct city cleaner and safer. Reliable damage detection system, solid waste management system, pervasive computing, traffic monitoring system, noise pollution and air pollution detection system, heterogeneous system connections, context aware services, usage of protocols were the highly related technologies in smart environment [1][4]. The services for which quality can be enhanced in a smart city are monitoring the above dimensions. Here, the paper is concentrated on temperature, noise and CO parameters of environment. Temperature, Noise and CO are the basic parameters for services like; (i) air quality management for reduction of pollution and healthy environment, (ii) weather monitoring for future agricultural actions and human comfort and (iii) automation of public buildings for reducing human effort and energy consumption[2][5][6]. To achieve this, a wireless sensor node is required to collect and monitor the data wirelessly. The following table shows the safe and unsafe ranges of parameters for the citizens.

Table 1. Range of parameters

Range Parameter	Safe Range	Unsafe
Temperature	22°C-38°C	<10°C >40°C
CO	0 PPM-Fresh air 9 PPM- Maximum recommended	>24 PPM -Health effect >70PPM- Leads to death
Noise	20db – 40db	>40db -Noise >95 db -Unpleasant noise or hear loss

III. AN IOT SYSTEM FOR SMART CITY

Study on smart city clearly depicts that heterogeneous systems communicates together and deployed over the urban area to generate overabundance of services [2]. Figure 2 shows the IoT system designed for the experimentation of environmental parameters like Temperature, CO, Nitrogen, Humidity, Light, CO2, Noise and so on. Here, we considered some of the parameters and are collected using sensors. Temperature sensor LM35 used to detect the temperature, MQ5 with voltage comparator is used for Carbon Monoxide (CO) and M213 with condenser MIC for noise detection.
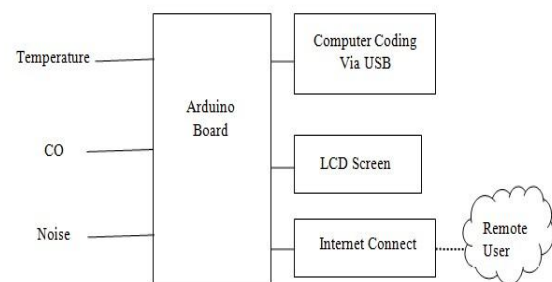

Figure 2. An IoT System.

An Arduino Uno board with ATMega328p microcontroller is used for the development of program. The microcontroller is already loaded with the bootloader software which supports for the direct communication with computer through USB and chains program development. The sensors connected to the digital or analog pins of the board based on the data supports. The functions such as digitalRead( ), analogRead( ), digitalWrite( ), analogWrite( ), TX, RX supports for data transmission between the devices and computer. A LCD (Liquid Crystal Display) screen is used for the local user to view the result. The experiment is supporting for the remote user to view the result as and when required either through serial communications or through cloud (long distance).

IV. CONCLUSION

Smart city is a future upcoming city and essential for worldwide nations. Varieties of technologies are developed or under development for smart cities, one approach is discussed in this paper. With the proper business model this approach can be deployed in the smart city technology, but it may require knowledge and time to adopt the technology. In future the performance, reliability issues can be considered. With proper p-p-p (public-private-participant) model involvement the city will reach towards the goal of smart city.

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