Potential of ICT in the Evolution of Smart Healthcare

Abstract

Smart city services are used by many organizations for large cities around the world to significantly enhance and improve the quality of life of the inhabitants, improve the utilization of city resources, and reduce operational costs. With the rapid development of information technology, Geographic Information System (GIS), Internet of things, big data, and cloud computing, smart management of infrastructure is becoming a trend, including smart grid cities, smart home/building waste management, modelling, smart simulation, urban mobility and transportation, hospital Healthcare and wellness and control systems. Smart services need reliable and robust networking and communication infrastructures to enable efficient communication. Smart cities generally refer to the use of technology-based solutions to enhance the quality of life for citizens, improve interaction with the government and promote sustainable development. Research aims are to present the potential of the smart service, exploring its characteristics, perspectives, and fields of application. Smart cities are predominantly composed of Information Technology and Communication Technologies to deploy, develop, and promote sustainable development practices to growing urbanization challenges. The Paper makes an overview of the infrastructure and smart services infrastructure features and concepts, then determines smart services perspectives, and finally presents outcomes.

Introduction

Since the development of science, technology, and knowledge in the last two decades has increased rapidly, most of the population is moving towards urban areas. Recently, research reports show that the scale of urban residents is rising in modern cities because of the rapid development in the economy [1]. More than 50% of the global population is now urbanized (United Nations Report 2012) [2]. This speedy transition in cities and urban areas caused the cities to become overpopulated, which caused cities to have difficulty in planning and running the city's basic operations. The crowded population has affected each segment of cities, where education institutions, business areas, and healthcare organizations face problems such as city management, governance, equal distribution of resources among the population; also, the city areas' ecosystem has been damaged by overpopulation. Therefore, the need for sustainable development and planning increased for urban areas.

Regarding the increasing expansion, there has been much development taken in the theoretical and practical field. This consideration is based on a search performed in Google Scholar on 1st April 2016 using the search string «smart city» OR «smart cities» (the baseline year 1980). The search found that the number of publications related to smart cities increased by 120 times over 20 years, rising from 138 in 1996 to 16,500 in 2015.[3] There is no exact definition of smart cities that fully explain the smart cities concept; Smart cities are developed in a way that they can smartly and efficiently manage the operations of cities in which governance, education, and business, people health care all work smoothly and efficiently through the use of the latest smart practices and use

of Internet of Things(IoT), and Information Communication Technologies, for providing sustainable development and peaceful environment. There are many segments involved in smart cities; our focus will be on smart health care, which is the most crucial requirement of people and one of the important sections of smart cities development.

Smart health care hospitals in smart cities are required to plan and build to handle heavy population needs effectively. In smart health care systems, utilization of smart infrastructure and technology is common, and Patients use User-friendly Mobile Apps for remote treatments; mobile hospitals for providing fast medical services such as first aid and basic report generation for heartbeat rate, blood pressure, body temperature checking are done in advance in any emergency before reaching hospital to save the time of checking basic report, city-wide dedicated hospital wireless network is used for communication to patients from any corner of the city at any time, patient digital data privacy and security, sharing data to only concerned doctor and patient, also critical data can be sent to another doctor with encryption so the third party cannot read the patient data; uses of simulation for remote diagnosis by the world's best specialist. These types of technological utilization are the best practices required for better health care systems. In this paper, we will focus on developing such sustainable development plans, which smart hospitals use to manage the increasing urbanization of the cities; how a patient will get the fast and efficient services of health care, and in any emergency how the patient reaches the hospital instantly without being delay, what are the new technological trends and best health care practices are followed, through that smart cities health care systems work effectively and efficiently and play a role for the sustainable development and planning of smart cities to provide smooth services to the heavy population of the cities.

To understand the concept of smart city, we begin with understanding the conceptual relatives of the model papers. During 2015, both academicians and professional researchers attribute an interest to the future of cities. They conclude that the technological leap wills influence the both architecture and infrastructure, which will give birth to the smart cities vision. This essay aims to provide a comprehensive understanding of the movement towards smartness by providing a study on divers smart city definitions which depend on geographical, environmental, economical and social constraints of each city, It gives an overview of smart city characteristics: Smart Economy, Smart Environment, Smart Hospitality, Smart Governance, Smart Mobility, Smart Living and Smart Human Level and shows some big pictures of the components of each paradigm and how they been illustrated. Smart city represents a new future framework which integrates multiple information and communication technology (ICT), which provides solution to cope with urban challenges and at the same time to improve the quality of life of the citizens. [4] Based on the review, it is identified that 11 dimensions contributes to the development of smart cities; smart economy, smart governance, smart people, smart environment, smart infrastructure, smart technology, smart living, smart mobility, smart water and waste, smart security and smart agriculture. In context of the recent COVID-19 pandemic, smart hospitals' contributions to pre-medical, remote diagnosis, and social distancing has been further vetted. Smart hospital management evolves with new technology and knowledge management, which needs an evaluation system to prioritize its associated criteria and sub-criteria. The global effect of the

COVID-19 pandemic further necessitates a comprehensive research of smart hospital management. [5]

Since early 2020, the COVID-19 pandemic's rapid spread globally has further hit the healthcare industry, increasing the demand for hospitals' particular treatment facilities. Unfortunately, the conventional hospitals' physical building structures have imposed barriers such as pressure to ensure or convert to negative influence inpatient isolation wards and up-to-date medical information systems to address the needs of particular pandemic patients; this extraordinary time of COVID-19 calls for the adoption of a comprehensive evaluation system for smart hospital management and building up the infrastructure. Hospitals are being forced for making changes by increased expenditures, demographic issues in population and environmental changes. These changes are generally defined under the smart hospital concept. Digitalized hospitals that are taken advantage of developing technology offer a more efficient healthcare service. However smart hospital concept is not only described as the digitalized hospital, yet focused on resolution and efficiency, but also safe and green. [6] In this research, characteristics of efficiency and effectiveness at smart hospital environments, realized in smart hospital environments, enhance efficiency on administrative issues and data management. Development of such technologies and awareness, training and attitude of medical staff and patients in regards to smart technologies has caused creating a new concept called "smart hospital". Digital hospital" was first introduced to transfer paper-based systems and patient files to electronic health records.[7] The combination of people, processes and places require an interdisciplinary approach between medical sciences, information technology, and architecture. The goal is to (re)design and simulates clinical processes and hospital architecture in a virtual environment (Building Information Model) to increase professionals' productivity but also the way patients experience the quality of care. [8] We analyzed papers qualitatively to identify how the papers conceptualize smart cities, smart governance, the drivers of smart cities and the outcomes. Deciding the perfect location is the first step in hospital infrastructure planning. A smart city integrates several physical, institutional, and digital components to create a holistic definition of what smart planning would look like. [9]

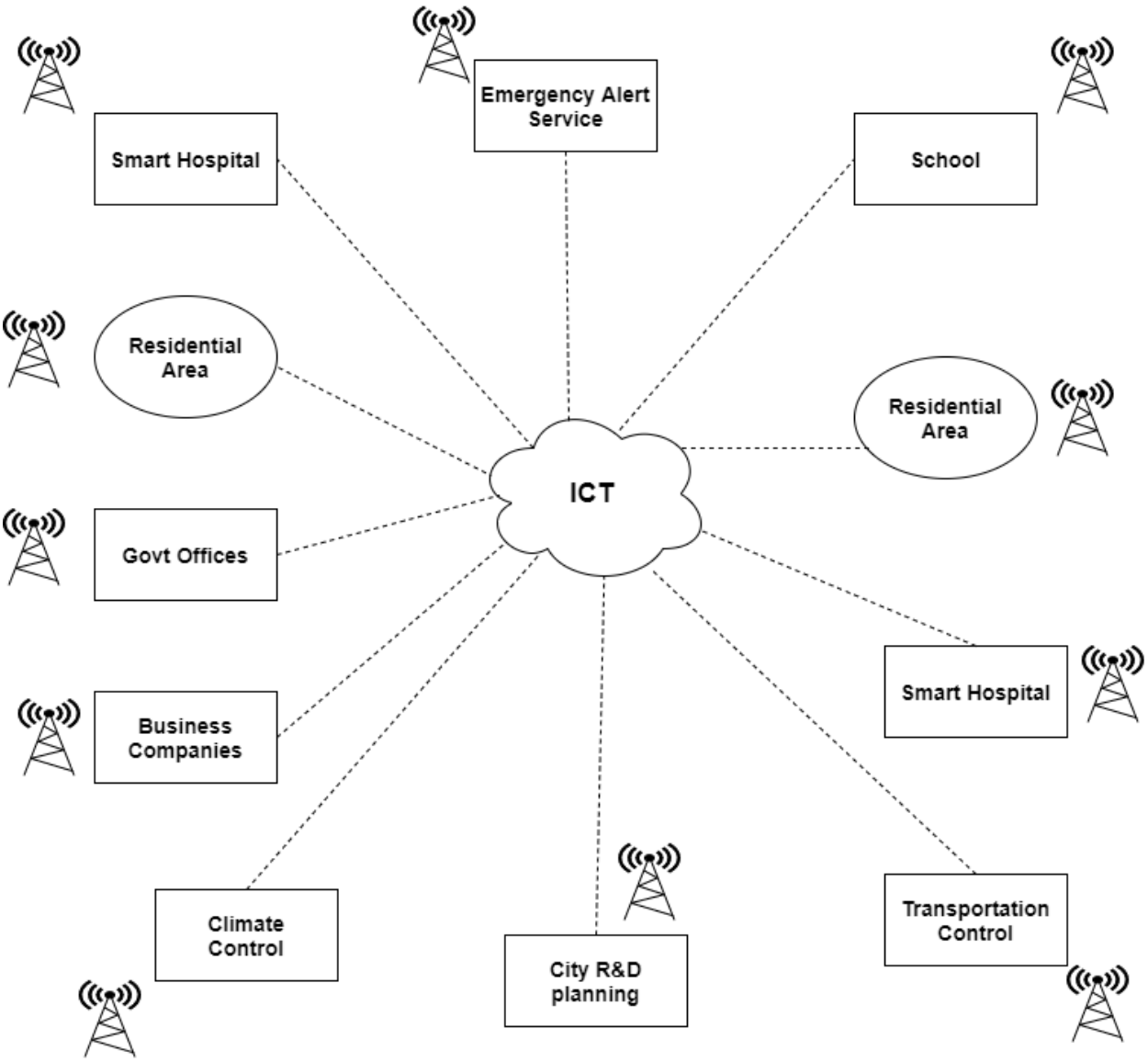

Figure 1

Holistic Approach to Data Management

Methodology:

Smart Hospital:

A society is developed by its people. A healthy society creates equal balance in every sphere of life. Over the years, advancements in medical technology created effective diagnoses and solutions for many diseases. But the increasing population and changing lifestyle demand a smart healthcare network that can look after its people more quickly and efficiently.

The architectural design of healthcare institutions has evolved and undergone many changes since the second half of the twentieth century. Smart cities are evolving, and there will be a need for smart hospitals which could offer fast services through the help of fast technology. Smart hospitals

have an important role in a smart city. IoT devices will be used in smart hospitals for fast execution and permanent connection and sharing of information. The IoT revolution, which has expanded itself in the energy, transport, security and infrastructure segment, will have sweeping results in health care.

Ongoing population growth, inefficient patient flow, limited staffing, lengthy hospital stays, high re-admission rates and subpar communication methods are rampant. These issues cause problems, along with growing threats of climate change, diminishing natural resources and increased life expectancies [10].

In order to provide better healthcare-related services, medical organizations, health care professionals, researchers are working on solutions and IoT devices that can minimize response time, offer quick emergency services, reduce overcrowding in hospitals, give remote treatment and collaborate with doctors around the globe.

The smart hospital must contain the overall record of each and every patient in a fast, accessible database which can be viewed in an emergency and that will help to perform quick diagnosis and treatment.

The smart city focuses on easiness and quick solutions, so location matters in this regard. Location of the hospital shouldn't be a cause for the patient to wait or suffer. The location must be flexible, which avoids traffic congestion, and anyone can easily reach the hospital.

ICT:

ICT Information and Communication Technology is the broad term that uses different communication technologies, including the internet, cell phone, wireless network, and software for transmitting and manipulate information in digital form. In the smart city, we use ICT to connect every segment of the city to one system, through which every segment works collaborate, and all sections have the information of other plans. It will help the city work parallel and rapidly and save time in working and planning the city's current and future goals. It will help the city suggest new technological trends and practices for every crucial department—using new IoT devices, analyzing the history, and knowing people's current requirements. Hence the utilization of ICT is essential for smart healthcare for improving the overall health segments requirement.

Transportation Control:

Transportation System is a crucial segment of the smart city. Infrastructure’s road traffic control is scalable, load-balanced, and uses correction decisions for the route adjustment based on local areas. Smart transport systems inherently use complex networks to deliver their services. Traffic signal control systems and Satellite navigation will ensure vehicles know when to stop, slow down and speed up, and classify hazards in real time. This information will result in better traffic management. It will significantly reduce the number of accidents. Roads ultimately beneath us will communicate with smart cars, most likely through indestructible sensors embedded within the street. ICT is an important part of a smart city; without it, a smart city can’t exist because it is the central zone to provide real-time information across the smart city. ICT could disseminate information on the locations of electric vehicle charging stations in order to optimize flows of traffic and energy usage of electric vehicles. So, the transportation to the hospital becomes smooth in every situation.

Emergency alert service:
Smart cities' potential to implement their security systems is reasonably best guessed by expanding our metaphor for the living, being city as a 'digital immune system.' With the help of advanced, intelligent technologies and blanket coverage of sensors, the future city will identify potential warnings and react to them in real-time. The city that is used daily by thousands, if not millions of people, will maintain creeping harm to its infrastructure, which can be challenging to measure. Faster emergency response saves lives. Cities of the tomorrow are primed to do more than give us places to live, and they may even be able to stretch our lives, saving us from threat, assuring we receive necessary medical cooperation more quickly in times of need and advancing the quality of that healthcare with real-time, digitized medical information at the fingertips of medical professionals. Emergency vehicles require a clear-cut track to sites of accidents to save lives. Smart Response solutions enable cameras and internet of things IoT systems that analyze assets and citizen behaviours.
Further, by police, fire department, and paramedic GPS and many others. ICT keep the historical information and current as well. Quick decisions could be made according to the available data in ICT in case of an emergency which will help hospital to make the important decision to avoid the effect on the city residents.

Smart Schools:
The objective of smart cities is to produce, develop and validate a methodology supported by an online, collaborative, city-development simulation engine that stimulates the integration and continuous exploitation of Problem-Based Learning in engineering, science and other schools. Innovative education is a critical ingredient in smart city development. Strengths in primary education, high-level training and certification, academies and community colleges, e-learning infrastructure, lifelong knowledge and innovation in education technologies are all components of what determines a smart city. For the residents of a smart city to flourish, we must first set education at its centre. ICT has carried about many dramatic transformations in how educators teach and how learners learn. Teachers use ICT to produce and assess learning activities, to communicate with students and community members and to produce awareness in society about healthcare in the people.

City R&D planning:
Research and Development is a component of any company's strategy, either big or small. Always there have been actions aimed at discovering what no one ever thought could be found or build what nobody in their right intellect would believe could be built. Growing the region's share of R&D investment from public and as well as private sources depends more on the joint action of regional stakeholders and our ability to showcase the region's excellent growth potential. Information comes in huge forms and needs to be managed using highly efficient databases to manage and make decisions and Information sharing allows better operational decisions to be made.

Government offices:
The administration is a crucial component of "Smart Cities". It will include collaborations to help local communities tackle key hurdles such as reducing in healthcare, traffic congestion, fighting crime, fostering economic growth, managing the effects of a changing climate, and improving the delivery of city services. Government offices are mainly to monitor the social and economic

activities of the private sector. To maintain and develop action for improving the overall health ratio in the population, and warm relationships with concern departments and provide different types of administrative services to be the individuals and corporations.

Climate Control:

In smart cities, there should be a climate control system that observes the current climate and follows such practices, reducing the greenhouse gas emission in the city, reducing fossils and electricity consumption and heat production. Many things affect the environment, such as transportation, industrial fossils, water wastage, and deforestation. The control system should make such an effort to counter climate change, such as in smart cities. Such as using climate-friendly electric vehicles, using renewable energy for houses, investing in energy-efficient appliances, and increasing their uses in every segment of smart cities.

Increasing forestation in the city, creating the bio-green environment and limiting the city population by avoiding congestion so that the climate keeps in control.

Smart Residential Areas:

In the smart city, the residential area should be well planned. It should cover all the requirements of cities; it should fairly distribute public service equally, provide groceries, medical stores, and make arrangements that provide fast provision to the areas where the necessities are lacking. There should be the main focus on administration operating in the city to increase the quality of city life. There should be rules developed for maintaining ethics and controlling law situations in towns with their punishment also be given in the case of violation. Another way an aspiring smart city can make life better for its residents is by striving for maximum cleanliness in the area, setting up garbage disposal bins at regular intervals, and enforcing civic sense in the citizens in question. Training on becoming a model citizen and awareness of civic responsibilities can teach civic importance in the community. Strict fines/punishment must be imposed upon regular offenders. It is necessary to produce a valuable method of changing the long-established civic mindset of people – either through rigorous education or a system of strict, unyielding governance. Spitting, urinating and defecating on the public streets must be strictly banned.

Business companies:

Cities worldwide are getting smarter, and that has everything to do with hyper-connectivity made possible by the ever-burgeoning Internet of Things. When these best innovations are done, they are often the result of the partnership between the government and the private sector. Business companies, including industrial and technology companies, can play a vital role in the development of the smart city.

Technology companies excel at getting data from one system to another. If you need to process a lot of banking transactions and analyze trends, you don't need an industrial company. But if you are a city leader that is going to deploy physical sensors all across your city to empower the next urban technology evolution, you definitely want the experience of an industrial company [2]

Several startup companies have very cool solutions. It is hoped that many of these startup companies can find a way to leverage the industrial digital infrastructure to solve interesting problems.

We require digital industrial companies to use and secure infrastructure; big technology companies will proceed to play a vital role in resolving urban problems. Their output will get even better, and

their capacity to help city directors will scale much quicker after a digital industrial company provides them with decent physical infrastructure.

Data Security in Smart Cities:

According to ABI Research, there will be an estimated 1.3 billion wide-area network smart city connections by 2024. The same report provided an investment forecast for cyber security infrastructure valued at $135 billion for the same year. [11]

Cities obtain a lot of information through the ICT system. Therefore more knowledge but more vulnerability to data security issues. The more extensive a system is, the higher the demand for cities to protect the data. Essential services requiring a high degree of security include energy, transportation, healthcare and other relevant infrastructure.

ICT in Healthcare:

Today, the new technology development is changing the world towards an advanced world. The role of ICT has brought a remarkable evolution in healthcare. It enhances the quality of health care, increases efficiency, and reduces operating & administrative costs.

The user-friendly devices used by many populations provide easiness to share the information to the health care; it also minimizes the communication gap between patients and healthcare workers. Also, the accessibility to information using ICT has become easy.

There are many challenges faced by health care, such as maintaining patients' diagnosis history, managing hospital information systems and using proper and advanced equipment, and monitoring medication error. With the help of ICT, the healthcare sector is efficiently minimizing these challenges.

Access to the rural areas becomes easy. Doctors get the information of the patients through the proper communication channel. The digitalization of the data makes it easy for the patients to access their data anywhere and anytime; thus, the ICT brings accurate information of the rural areas and urban areas with the help of better information communication.

ICT can be used in different healthcare segments, such as Health& education, Hospital Management systems, Health Research, and health data management. The usage of ICT helps people find the best hospital and approach the best doctor for treatment; it allows the hospital to manage and strengthen the healthcare; it has also eliminated the traditional healthcare system into digitalized e-healthcare systems. Hence, the healthcare field should work with ICT to shift healthcare towards a much higher level, essential for better healthcare.

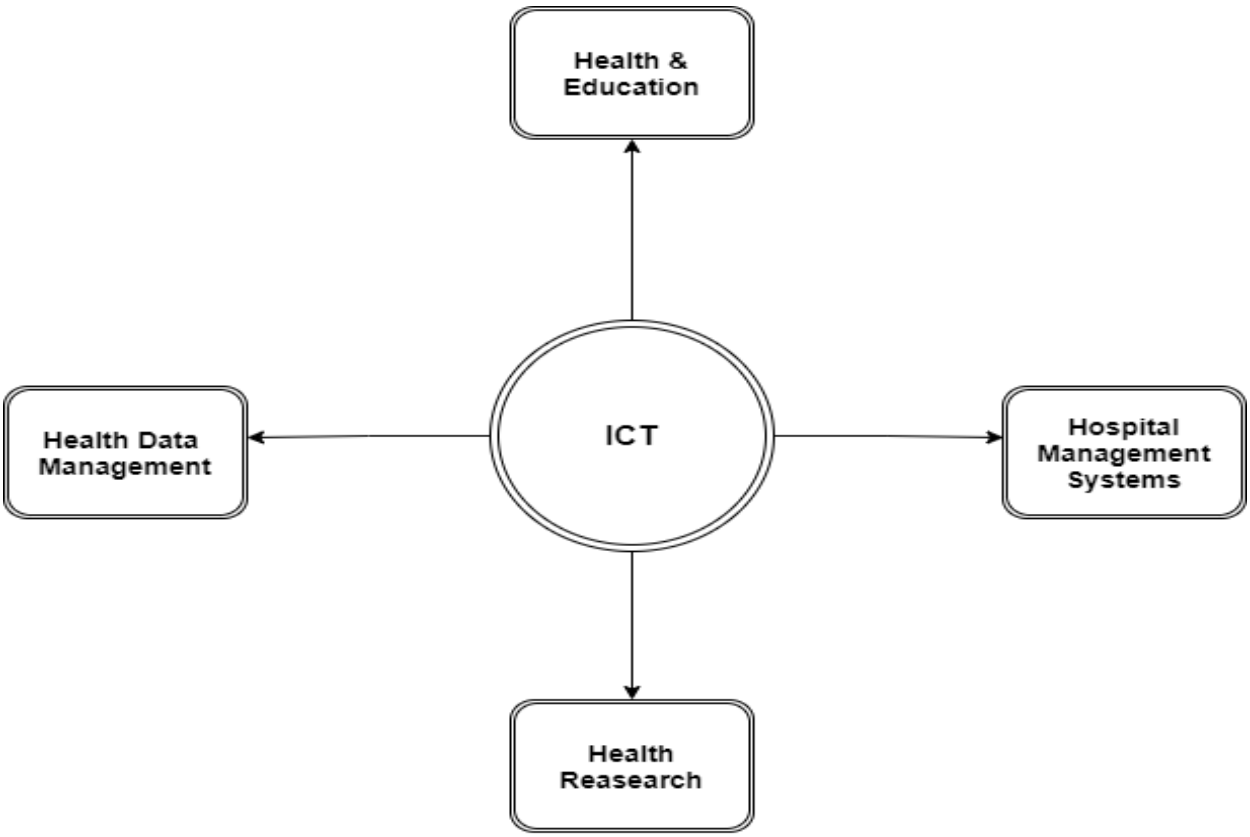

Figure 2. ICT In Healthcare

Conclusion:

In this paper, we have highlighted the vital feature of different smart cities segments, which are essential for managing smart healthcare systems in smart cities with the role of Information and communication technology and the link between them. We emphasized the theoretical idea of ICT as central information communication. ICT deals with each segment of the city, so that any step for the development and management of town should be taken according to ICT data. All other concerned departments of the city should be aware of the changes in the city.

The collaboration of different sectors with ICT will boost the city's performance and increase its efficiency in dealing with the main problem such as controlling the population, dealing with emergencies, providing better healthcare services, and managing climate change in the city. Also, the ICT will help the city to do better future planning for infrastructure and the adoption of advanced technology.

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