

Smart City and Smart-Health Framework, Challenges and Opportunities

Majed Kamel Al-Azzam¹
Business Administration Department
Yarmouk University Irbid, Jordan

Malik Bader Alazzam²
Software engineering Department
Jadara University Irbid, Jordan

Abstract—The new age of mobile health is accompanied with wider implementation of ubiquitous and pervasive mobile communication and computing, that in turn, has brought enormous opportunities for organizations and governments to reconsider their healthcare concept. Alongside, the global process of urbanization signifies a daunting test and attracts the expert concentration towards towns that can obtain significant high populations and service people in a human and efficient approach. The consistent need of these two trends led to evolution of the concept of smart cities plus mobile healthcare. The given article is intended to provide an overview of smart health, explained to be context-aware that is accompanied by mobile health within the smart cities. The purpose of the article is to offer a standpoint on the main fields of research and knowledge explained in the procedure of establishment of the new idea. Furthermore, the article will also focus on major opportunities and challenges that are implied by s-health and will offer a common opportunity for future research.

Keywords—Smart city; challenges; opportunities; smart health

I. INTRODUCTION

Electronic health (e-health) is the contribution of (ICT) implementation in the healthcare industry. This e-health concept further helps in increasing efficiency and cost reduction [1]. The e-health consolidation is followed by the widespread preference of mobile devices with abilities such as smart phones, which led to evolution of mobile health (m-health) concept. One can understand m-health as delivering healthcare services using mobile communication devices [2]. m-health offers astonishing opportunities being an addition to the already existing of e-health that are associated with the ubiquity of mobile devices, which includes immediacy, wider availability, and global monitoring capabilities [3][4]. Even when substantial innovations have been made in the field of m-health, but the concept is still in its early phases and is consistently developing alongside another opportunistic and promising idea of smart cities based on ICT and target to handle local concerns ranging, transportation and local economy to e-governance plus quality of life.

Local authorities, nowadays, invest hefty amounts in ICT for equipping their smart cities with all needed technological infrastructures that can foster social responsibility, support ambient intelligence, and can enhance appreciation for the environment. Hence, this indicates boundless potentials for the smart cities plus organizations. Example, Intel and IBM are partnering in a way to consolidate or merge their leadership in the given industry. They have recognized various relevant

fields in which smart cities can play a crucial roles and these include energy and public utilities, public safety, education, trade and industry development, healthcare, and social services, etc. The sensors are the basis of the smart cities that offer updated information regarding distinct variables that entail humidity, temperature, pollution, concentration of allergens, traffic conditions and many more. Explored the framework as the ecological settings plus states that also help in determining behavior of an application or in which event of an application happens and is of interest to the user. These variables offered by the infrastructure of smart city are the context that can help in understanding the citizens' living environment at any time. Hence, by using this information in a proper way can help in providing patients and citizens with the healthcare services and applications with active awareness of the context (i.e., services and applications that inevitably adjust to discovered context) by making changes in the behavior of services and applications.

The prime objective of the given work is to evaluate the idea of Smart Health (s-Health) like an outcome of the natural effort or collaboration of smart cities and m-health, from the viewpoint of ICT, society, and that of individuals. The article will then focus on advantages and challenges that are explored by this new perception of health in the smart cities and analyze its practical viability.

The remaining editorial is prearranged as follows. The first segment recapitulates major and prime research field that explains a primary role in the s-health development. After this, the article will explain the idea of s-health and focus on its importance, impact, feasibility, and timeliness. Following this, the emphasis of the article will be the elaboration on the major opportunities and challenges implied by s-health. Finally, the article will be concluded by providing a summary of overall contribution of the researcher to the article and some final opinions and viewpoints about it [5].

II. SMART CITY

Smart city is still considered as vague concept that has not been defined strictly. Caragliu in offered a definition of the concept, which was further explained in Pérez-Martínez et al. as: these are the cities that are powerfully created on ICTs investing in social plus human capital enhancing the quality lifestyle of their citizens by promoting economic growth, wiser resource organization, engaging governance, efficient mobility, and sustainability, while they assure the security and privacy of the citizens [12].

is very new, there is an increasing requirement for collaboration, cooperation and interaction among diverse actors including researchers, practitioners, governments, physicians, etc. for defining a common mutual ground from the beginning, and hence, preventing redundant redesigns as well as over-spending.

2) *Security and privacy:* Even when s-health approach can help in mitigating various health related concerns, but its capability to obtain unparalleled amount of data can jeopardize the citizens' privacy. Protection of privacy and security of the infrastructure is an inevitable issue that research community is still trying to redress. Privacy protection and security is foremost in around every facet of human life. Nevertheless, in smart city context, it is even of greater importance and the reason is because the information that is obtained is very personal. From the data or information that is collected in a smart city, it is possible to get knowledge about the habits of citizens, their social status, other personal information, and even the information related to their religion. All these personal information variables are extremely delicate in nature, and when they are integrated with the health information of an individual, the outcome is even more sensitive. Hence, it infers a great difficulty and several challenges that are still required to be studied. Certain efforts have been conducted to explain the concept of the privacy of citizens and to offer possible solution to protect that privacy [10][8]. In addition, various attempts are contributed towards the privacy protection in health, Trust- worthy Health and Wellness (THaW) is one of the representative projects in this context [7][13]. The concept of THaW aims to resolve diverse challenges and difficulties to offer trustworthy and reliable information systems for wellness and health. In a similar way, the Strategic Healthcare IT Advanced Research Projects on Security (SHARPS) is another project that aims in making improvements in the foundations, requirements, development, design, and deployment of security, as well as on privacy methods and tools that are used for m-health. Such projects are the research priorities and difficulties with them are daunting [14][15].

D. Opportunities

The perception of s-health is created on a ground that it can use the smart cities' infrastructure that in turn can open an array of opportunities or potentials for the expansion and growth of new applications identified and explored services that are associated with health. Some of the opportunities that s-health can offer include:

1) *Data collection, presentation, and analysis:* It can help in practical redesigning of data related to health, because certain information that seems irrelevant can be of utmost importance for healthcare services [16][17]. S-health makes it possible to collect data from healthy people and patients in real-time and can further be combined with the data or information of city. Main routes, signs, as well as records of every citizen could be seamlessly integrated or combined with

the data that is derived using pervasive cameras, sensors, forecasts, and weather reports. Hence, proper use of all the data can then become the prime pillar and basis for the s-health applications [18].

2) *Prevention as well as administration of critical incidents:* s-Health expected to also provide the precise techniques for avoidance as well as proficient management of acute plus chronic ailments plus accidents. Comprehensive s-health expected to be helpful in identifying the circumstance that needs intervention such as falls, cardiovascular events, accidents, and can offer optimized and automated management of such incidents such as providing the guidance as well as notifications to the establishment (Example 5) [19][20]. In the event, when there is a small and not very acute event, the patient can easily be guided to reach immediately at bordering health provider or pharmacy by using s-health. On the other hand, during the life-threatening circumstances, the traffic information can also be used to guide and dispatch the ambulance so that it can reach patient as early possible. Comprehensive and proper data or information analysis can also offer various techniques for more efficient prevention of disease, early detection of chronic ailments and diseases, and even recognizing the new risks and threats related to health [1][21][22].

3) *Effectiveness and environmental assessment:* Patient expected monitor information also used for identification of non-optimally managed situations or non-responsive patients to offer them treatments as well as to provide them efficient and effective healthcare assistance. As an example, s-health systems can help in recognizing the patients with chronic diseases with major signs that are inconsistent to the medicines prescribed to them such as abnormal heart rate, blood pressures, blood glucose, etc. Example of such data can be combined with the location, status, and current actions of patient for the sake of reducing false positives and recognize bona fide actions that needs interference [23][24]. Such application may also impose substantial influence on the new interventions' assessment in case of clinical trials. S-Health systems can seamlessly integrate patient's medical records, long-term patient monitor system, and efficient assessment methodologies with the data provided by city sensors. Such integration act as an ideal setting for providing high-quality personalized medicine. Environmental conditions including pollution, temperature, humidity, etc. and daily routes and activities of patients can also be used in order their dosing at an unprecedented level of detail, while the capability of the system to routinely and actively measure each intervention's effectiveness [10][25].

4) *Engaging patients and families in managing their health:* In s-health approach, the citizens are substantially empowered as well as assisted in an efficient manner for participating actively in the management of their health. S-health systems can make use of medical records data as well as important signs for providing optimal and best guidance for everyday activities, habits, and tasks within the city [15]. For

example, an s-health application can also offer the heart patients and those with respiratory diseases, with a best route by preventing the areas with high level of pollution [9][26][27].

5) *Improving policy decisions*: s-Health systems can also enable health management of public. Laws and preferences can also be “modified” to evaluate every district or city, on the basis of the data that is resulting from health hazard, population, weather, environment, and accessible infrastructure. There are boundless or limitless potential that arise from mining such data for the sake of optimizing decision making related to public health.

6) *Epidemic control*: s-health data as well as methodologies also radically enhance the competence of the state in detection and control of epidemics. The vital signs, activities, and locations of citizens can be utilized for detection of possibly the new cases during an epidemic, effectively recognizing the fields of enhanced risk, and managing a ranging outbreak in an effective manner. Such methods also be implemented in the detection as well as organization of other widespread risks related to health such as radiation or pollution from an trade incident [28].

7) *Cost saving*: Identified sectors that are exploited previously may impose a substantial impact on reducing the cost of health care [29][30][31]. Such reduction of cost will also be included with simultaneous boost in the efficiency of scheme and enhancement in the provision of services. Timely [7][32], optimization of the prevention and management of disease can further lead to decrease in unnecessary visits to hospitals and the development of acute events due to poor management of the patients with chronic conditions. Additionally, reduction in the action time and effective public health management can also offer optimal outcomes while offering reduction in costs on a national scale [33][34][35][36].

III. CONCLUSION

The extensive ICT adoption in the cities’ context led to the evolution of smart cities. In a similar manner, using mobile technologies and ICT for issues related to health will led to appearance of monitoring of patient and health care in a ubiquitous way using e-health and m-health. Whilst researchers are already focusing on the further development of the ideology of m-health plus smart cities, it can further believed that there is an increasing requirement for a new concept that can be known as *smart health (s-health)*, which emerges by amalgamating the identified smart cities with mobile and electronic health services.

Upon introducing this new ideology of s-health plus by providing clarification of the scope of this concept, the research is trying to pave the way for prospect explore to have a clarified plus better concentration as well as a common explanation to enhance healthcare. The given editorial provided overview of the s-health concept, and help in analyzing most of the research fields related to it. The article

also helped in discussing the major challenges that are generally faced during the development and implementation of s-health, and it also focuses on highlighting all the opportunities possible to implement the concept and the future potentials of s-health, which according to the researchers are boundless.

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