Building a New Smart City:
Integrating Local Culture and Technology

Keebaik Sim[1], Woo-Sung Hwang[2], Myung-Ryul Choi[3*]
[1]Master, Master in Design Studies, Harvard University
[2]The doctor's course, Department of Electronic, Electrical, Control & Instrumentation Engineering, Hanyang University
[3]Professor, Division of Electronics Engineering, Hanyang University

지역문화와 기술이 융합된 새로운 스마트시티 구축

심기백[1], 황우성[2], 최명렬[3*]
[1]하버드대학교 디자인연구과 석사, [2]한양대학교 전기전자제어계측공학과 박사과정,
[3]한양대학교 전자공학부 교수

Abstract In smart cities around the world, urban environments have become more convenient due to information and communication technology(ICT). However, extant studies reveal that the level of life satisfaction of citizens has not improved compared to that of the pre-smart city and citizens are skeptical about the role of the smart city. This is largely because local culture and needs were neglected during the planing and development of the smart city. The research was conducted on Cambodia as a pilot site and our findings indicate that middle age group's population is significantly small and the society is at risk of losing its culture. Therefore, this paper opens up various ways of embedding cultural programs using technology in order to pass down cultural heritage to young generation, provide an emotional attachment to the inhabitants and further build up a new phase of cultural legacy. This will engender cultural uniqueness to the city and intrigue tourists around the world resulting in the growth of the tourist industry. This research will contribute locally by providing a sense of community to the public and globally by suggesting applicable methodology to other cities that are under the similar context.

Key Words : smart city, AI, Big data, local culture, integration

요 약 스마트시티의 도시 환경은 최신 기술로 인해 더욱 편리해지고 있지만, 삶의 만족도는 기존 도시보다 향상되지 못하고 있다. 이는 스마트시티를 건설할 때 기술에만 집중할 뿐 지역 문화의 중요성을 간과했기 때문이다. 본 논문은 캄보디아에서 스마트시티에 적용되는 기술로 지역 문화를 활성화 할 수 있는 가능성을 모색하기 위한 연구를 진행한다. ICT, IoT 기술 등을 사용하여 다양한 문화 프로그램을 연계하는 방법 및 문화유산의 효과적 계승을 돕기 위한 플랫폼을 제안한다. 그러므로, 스마트 시티와 문화와의 융합은 지역 고유의 콘텐츠를 발전시키고 도시의 시민과 관광객의 방문을 유도하여 경제적 이익을 창출할 것이다. 또한, 사회 구성원으로서의 정체성 확립을 돕고, 첨단 기술과 지역 문화가 통합된 스마트시티 구축의 방법론은 유사한 다른 도시에 적용을 가능케 함으로 지역사회와 국제사회에 기여한다.

주제어 : 스마트시티, 인공지능, 빅데이터, 지역 문화, 융합

1. Introduction

Smart cities are emerging in famous cities around the world[1]. In most of smart cities cultural aspects are often neglected while other qualities such as energy efficiency, safety, uncongested and convenient transportation system are highly considered[2]. In regards to the fact that the cultural heritage is a collection of past's creativities and a crucial element which fuels our society, smart cities can provide more comfort and emotional security to the citizens with the integration of the communities' culture[3].

This research uses an area nearby Phnom Penh, Cambodia as a case study in order to illustrate how technologies can be implemented in multiple nodes of the smart city. Researching history, climate, economy, demographic, and culture: art, music, dance, ritual, cooking, clothing, and shelter revealed various sectors of community where technologies can fulfill the society's cultural needs by resolving social problems[4].

Further research on the integration of culture and smart city will also analyze ways to apply electronic identification(e-ID), electronic currency (e-Currency), and blockchain certificate(BC-certificate) at a national level.

2. Research

This research paper will put its primary focus on designing a smart city in consideration of the site's specific historical background and cultural aspects. However, this is not to argue that providing a convenient life for the urban dwellers is insignificant but to address the importance of integrating the community's culture in order to evoke the citizens' emotional attachment to the city[5]. Therefore, Cambodia's in-depth historical and cultural research on the site is essential.

Currently more than the half of the population in Cambodia are younger than 22 due to vicious civil wars throughout the history. The country is at risk of losing its cultural legacy from the past. This research leads to a significantly important role of the smart city which is a platform for community members to create a sense of community by bridging cultural legacy through designing and planning the city structure and implementing various programs in multiple nodes of society Fig. 1.
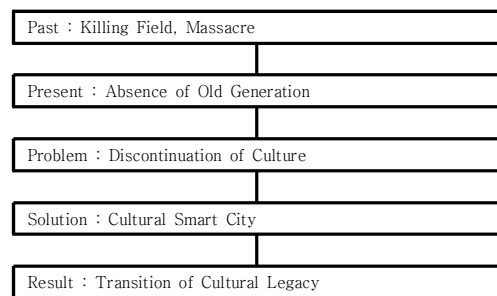
Past : Killing Field, Massacre

Present : Absence of Old Generation

Problem : Discontinuation of Culture

Solution : Cultural Smart City

Result : Transition of Cultural Legacy

Fig. 1. Basic process

2.1 Pilot Site Analysis

An area nearby Phnom Penh has a potential to be developed as a smart city. Geographically, Mekong River and Bassac River, both leading to Ho Chi Minh City, Vietnam run on the north and the south of the area respectively. Ferry Terminal on the Mekong River side facilitates water transport in this area. Two major highways surround the area, and the Phnom Penh International Airport is located near by. Also, there is a middle and low-class residential area adjacent to the Mekong River and a mid to high-class groups located near to the Bassac River. Such condition drew stakeholders to build facilities like hospital, mall, and broadcasting station Fig. 2.

In sum, the area has a potential as a future smart city in regards to three significant aspects; various economic class of residents; potential influx of groups of local and international tourists; a strategic geographical location for importing and exporting goods.

Fig. 2. Pilot site planning

3. Methodology

3.1 Cultural Smart City

What does it mean to integrate local culture and technology creating "cultural smart city." Cultural smart city seeks to consider the cultural context when planning, building and maintaining the smart city. In large scale, cultural aspect can be integrated among urban elements by connecting transport, buildings, and urban agriculture using Information and Communication Technology(ICT)[6-8]. Also, in small scale, each urban element provides relevant cultural programs by using various technologies creating a strong bond among community members and the city.

Moreover, these connections would not only be limited within their own boundary of scales but network over different scales as well as blurring the borderline between physical and digital spaces in the city, dispersed in multiple nodes of society[9] Fig. 3. For example, an autonomous vehicle, a type of transport carries a passenger while displaying augmented reality(AR) about the most preferable cuisine to the user by analyzing the appetite and dietary information based on the data accumulated on apps. As soon

as the user selects the cuisine the vehicle will drive the user to the street food vendor. After eating the food, the user can obtain more information on food on the display at the food vendor.
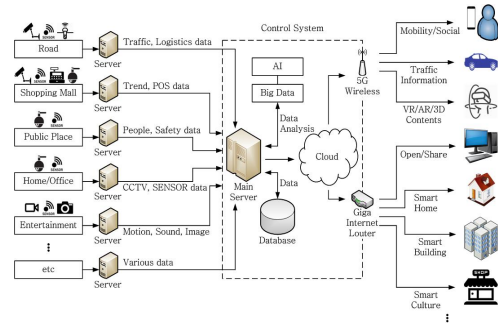

Fig. 3. Cambodia's cultural smart city system diagram

Cambodia Smart City						
Goverment	Mobility	Living	Environment	Economy	People	Culture
Intelligent Operations Center Smart Public Service Open Data	Smart Traffic & Logistics	Smart Safety & Emergency Service Smart Education / Healthcare Smart Home & Building	Smart Energy Smart Water Smart Waste Management	Smart Tourism Smart Agriculture Smart Commerce	Smart Citizen Generation Connection	Experience Traditional Culture Integration of Local Culture Traditional / Cultural Inheritance
Information Communication Technologies						
Big Data	Mobile	Social	Cloud	AI	AR/VR	Open /Share

Fig. 4. Cambodia's cultural smart city framework

It will offer information about ingredients and provide a delivery service to their home. Based on this idea of the networked system[10] the paper will further explain more specific ways to configure smart city in regards to the cultural context in multiple levels[11] Fig. 4.

3.2 Town Planning

Public space as a form of a park is located in the center of the smart city in order to resolve the current city's problems — the economic disparities among citizens and disconnected cultural legacy from the past. The center location increases an accessibility for diverse groups of

people creating a more equitable city[12]. Also, the park's programs in the interactive media dome establish a sense of community among the participants through collaborative practices[13]. These cultural programs are created based on traditional, contemporary cultural elements or a mixture of the two elements and not confined to a specific methodology but cross disciplinary.

Some may question why dome has to be built since technology can make the participants to feel like they are among the crowds through a virtual experience. This experience may simulate the crowd, but there are many limitations to the emotional effect compared to that of the physical interaction can provide[14]. In this case, a physical structure combined with the digital technology can evoke physical interaction resulting social cohesion, improve people's mental and physical well-being and nurture people to become more democratic[3].

Moreover, networks of technologies (immersive display, AR/VR, and haptic display) with narratives are embedded in multiple nodes of community — local stores, transport, kiosks, and other recreation sites — by breaking down the boundary between body, machine, and urban space[15]. These technologies embedded in various places of the city play an essential role in presenting historical events in a new perspective and provide information for people to experience their cultural legacy and build cultural identity. The scenario below illustrates in detail on how technologies are operating and interacting one another in a pilot site.

4. Future Scenario

Crafting Peace, a dome for collaborative community events promotes community participation through traditional, contemporary, and a mixture of both cultural activities. It was a dance session when I arrived and many people

were dancing together. I realized the projection on the dome was a dancing live stream of Cambodian diasporas in different countries. The order of steps was displayed on the floor and the belts that I was wearing moved x, y, and z-axes in space guiding me where to move and how to rotate my body according to the music. The next song's beat became a bit faster and sounded very Cambodian but contemporary. As the song had changed, it seemed my outfit's pattern and style changing according to the music.

Nearby the park there is a local coffee shop, Us Coffee. As I have entered the coffee shop, I learned that Cambodia has its authentic way of roasting coffee beans and unique coffee drinking culture through different interfaces. When I was ordering coffee, the waitress asked me if I would like to experience Cambodian coffee roasting and drinking culture and I said, "Yes!" The waitress guided me to sit on a specific table and it started to play an immersive video about Cambodian coffee. The vision explained about the history of coffee farm laborers and the uniqueness of Cambodia's coffee drinking culture. Then the seating arrangement suddenly changed and virtual people sat next to me in a circle and started drinking coffee while sharing a conversation.

As I stepped out of the coffee shop an autonomous vehicle came and asked me to choose where to go first among Place for Grieve, Crafting Peace, and Feed One Another. I chose to explore the Place for Grieve since I wanted to know more about the history. The vehicle started to move very slowly with a narration, and a background sound delivered the terrifying events happened in the past.

After the tour the vehicle dropped me off in front of a Ferris wheel. The whole interiors were covered with screens and provided amore immersive effect than VR. The passenger can decide whether to enjoy the outside scenery or the various programs provided by the Ferris wheel. The programs were composed of diverse

topics to explore such as traditional textile fabrication, local climate experience, and rice wine drinking.

The vehicle remotely sensed my metabolism and came near me to provide a ride to an urban farming area, Feed One Another. The vehicle has a mini built in kitchen for people to cook their own meal after collecting vegetables and fruits. As I had decided to try traditional Cambodian cuisine, Amok and the vehicle drove me to several locations of vertical gardens and I picked up fresh bamboo shoots, eggs, and algae. I wanted to add a fish to Amok and a drone delivered the fresh fish from a nearby seaport area. Other ingredients such as spices and seasonings were readily available in the vehicle. The display led step by step procedure of cooking the cuisine. The display not only showed how to make the food but also the history and the socio-cultural story behind it.

After the lunch, I decided to try making my own t-shirt using Cambodian traditional craftsmanship. The vehicle dropped me off in front of Crafting Peace, a pavilion for textile making and clothes fabrication. The interface explained the history of textile making and started to scan my body and skin tone for the perfect fit and color tone. The AR interface has guided me how to make the clothes while I was surrounded by many people who are making fabric and joined their conversation during the process. After a certain point, I have chosen an automation mode to fasten the process.

5. Conclusion

Many of the cities have started or already changed into a smart city and it became a familiar term. However, the definition and direction of smart city has not been clearly defined. While previous studies only focus on building a convenient city with cutting edge technology, this research raise awareness to engineers and planners by arguing the importance of 'cultural smart city' ─ a smart city that has integrated local culture and technology.

The cultural smart city with its cultural uniqueness will intrigue more tourists contributing to tourist industry. Also, the methodologies, models, and technologies will be registered as intellectual property and these can be applied to other cities that are willing to develop in consideration of the local culture.

The cultural smart city can increase satisfaction of the citizens by designing and building the programs and city by collecting citizens' opinions through deliberative planning. The city will be sustainable by implementing a network system that continuously reacts and manages the city by analyzing data collected from the public.

The cultural smart city will further evolve as a platform and include other functions such as requirements analysis and operational strategies when applying e-ID, e-Currency, and BC-certificate.

REFERENCES

[1] K. B. Kim, G. C. Kim & H. J. Cho. (2018). Status and Prospect of Smart City in the Fourth Industrial Revolution Era. *Journal of the Korea Convergence Society, 9(9),* 191-197.

[2] K. Goh. (2015). Who's smart? Whose city? The Sociopolitics of Urban Intelligence. *Planning Support Systems and Smart Cities,* 169-187.
DOI : 10.1007/978-3-319-18368-8

[3] L. Charles & J. Hyams. (2012). *The Creative City Index.* Gloucestershire: Comedia.

[4] W. J. Mitchell. (1995). *City of bits: Space, place, and the infobahn.* (pp. 238-241) Cambridge, MA: MIT Press.
DOI : 10.1177/089443939601400217

[5] A. Loukaitou-Sideris. (2012). Addressing the Challenges of Urban Landscapes: Normative Goals for Urban Design. *Journal of Urban Design, 17(4),* 467-484.
DOI : 10.1080/13574809.2012.706601

[6] Y. K. Park, (2015), Analysis on Smart City Service Technology with IoT, *Korea Institute of Information*

Technology Magazine, 13(2), 31-37

[7] H. Chourabi. (2012), Understanding Smart Cities: An Integrative Framework, *45th Hawaii International Conference on System Sciences, IEEE*, 2289-2297

[8] M. Batty. (2012), Smart cities of the future, *The European Physical Journal Special Topics, 214(1)*, 481-518.

[9] S. H. Lee & D. W. Lee. (2016). Actual Cases for Smart Fusion Industrybased on Internet of Thing. *Journal of the Korea Convergence Society, 7(2)*, 1-6.

[10] K. Biswas, (2016), Securing Smart Cities Using Blockchain Technology, *18th international conference on high performance computing and communications; IEEE 14th international conference on smart city; IEEE 2nd international conference on data science and systems(HPCC/SmartCity/DSS). IEEE*, 1392-1393

[11] A. Gaur. (2015). Smart City Architecture and its Applications based on IoT, *Procedia computer science, 52*, 1089-1094.

[12] J. Parkinson. (2006). Holistic Democracy and Physical Public Space. *British Journal of Political Science Conference, British Academy,* 1-17

[13] A. Benedict R. O'G. (1983). *Imagined Communities: Reflections on the Origin and Spread of Nationalism.* London: Verso.

[14] M. Dobbins. (2009). *Urban Design for People.* Hoboken, N.J.: Wiley.

[15] W. J. Mitchell. (2003). *Me++: The cyborg self and the networked city.* (pp. 154-156). Cambridge, MA: MIT Press. .
DOI : 10.1007/s12130-005-1029-4

심 기 백(Keebaik Sim) [정회원]

· 2012년 5월 : Pratt Institute 산업디자인과 (학사)
· 2017년 5월 : Harvard University 디자인연구과 (석사)
· 관심분야 : 디자인, 커뮤니티, conflict resolution
· E-Mail : keebaiksim@gmail.com

황 우 성(Woo-Sung Hwang) [정회원]

· 2004년 2월 : 한양대학교 전자컴퓨터 공학과 (학사)
· 2006년 2월 : 한양대학교 전기전자제어계측공학과 (석사)
· 2006년 1월 ~ 2007년 7월 : 하이텍 반도체부문 연구원
· 2007년 9월 ~ 현재 : 한양대학교 전기전자제어계측공학과 박사과정
· 관심분야 : Image Processing, SoC/ASIC 설계, 2D/3D 및 VR/AR 영상처리, IoT/ICT 응용
· E-Mail : jokersir@gmail.com

최 명 렬(Myung-Ryul Choi) [정회원]

· 1983년 2월 : 한양대학교 전자공학과 (학사)
· 1985년 12월 : 미시간 주립대학교 컴퓨터공학과 (석사)
· 1991년 3월 : 미시간 주립대학교 컴퓨터공학과 (박사)
· 1991년 3월 ~ 1991년 10월 : 생산기술연구원 전자정보 실용화센터 조교수
· 1991년 11월 ~ 1992년 8월 : 생산기술연구원 산하 전자부품종합기술연구소 선임연구원
· 1992년 9월 ~ 현재 : 한양대학교 전자공학부 교수
· 관심분야 : SoC/ASIC/VLSI 설계, 신경회로망 설계, 2D/3D 및 VR/AR 영상처리, IoT/ICT 응용, Smartcard 응용
· E-Mail : choimy@hanyang.ac.kr