Bridging the Physical and the Virtual: Creating a Social Network via Media-Enhanced Street Furniture

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1 ABSTRACT

The U-Streetlight is a 5-year R&D project aiming to develop an intelligent street light system and its applications to provide urban living information services as well as media service to the residents. This paper presents some of its outcomes which are more related to the applications of the system rather than the hardware itself. This research starts from the development of a game-engine based simulator for the U-Streetlight system, focusing on the function of orchestrating collective lighting observable from specific viewpoints. Thus, it is possible to predict and design the deployment as well as its media content before physically installing expensive hardware units. The role of intelligent street furniture as infotainment device, however, soon becomes in question as citizens are already enjoying numerous information services through cell phones with so much ease. Beyond just simulating the U-Streetlight system, we try to expand the realm of its service both on physical and virtual world. Here, the U-Streetlight becomes a connecting bridge between two worlds. The virtual world is called USL World, (U-Streetlight World), a Google Earth-based interactive 3D environment. Camera-equipped or bluetooth-enabled cell phone users can use the visual marker generated on the streetlamp display, to instantly get connected to the USL World Network. The users then have a choice of selecting available locations such as shops, event spaces, and facilities. Using popular social networking tools such as Twitter, or its own media blogging tools, users can create social networks anchored in specific urban places existing on in both worlds. They can also enjoy location-based entertainment services such as free coupons, free Wi-Fi access, instant MP3 music download, and so on. This paper illustrates the development of these systems from the simulator to the USL World, and discusses how a smart space can be implemented via this type of intelligent street furniture.

2 INTRODUCTION TO THE USL PROJECT

The intelligent streetlight is not an alien term anymore when it comes to implementing smart space scenarios on the street. Free Wi-Fi access and LED art are among the common functions we benefit from this new breed of urban facility. The U-Streetlight (USL) is a 5-year R&D project sponsored by Seoul city government, aiming to develop a multi-purpose intelligent streetlight system and applied business models. A USL unit is an LED-lamp equipped streetlight with information kiosk and emotive light functions in its basic form. It can also host modularized device units such as surveillance camera, Wi-Fi Access Point, and air pollution sensor. The information kiosk module provides everyday living information such as realtime bus schedule, taxi call, and weather information to the residents through touchscreen interface (Fig. 1 & Fig. 2). A few hardware prototypes have been fabricated and installed experimentally, and we are looking forward to deploying a set of USL units in months to the places like U-Eco City test bed site in Korea.

Fig. 1: A typical urban life support with the USL

This paper presents some of outcomes in this project more related to the software applications of the system rather than the implementation of the hardware itself. It is interesting to see the transition of research focuses as it reflects the common paradigm shift in the effort of implementing such intelligent urban facilities. We will briefly introduce the use of USL as urban sensor node, and move to the game-engine based simulator for the U-Streetlight system which was developed at the beginning of the project. This tool focuses on the function of orchestrating collective lighting event in which the USL works as an actuator to the urban media environment. Then, we will introduce the latest USL development. It incorporates three components: Physical USL, USL mobile, and USL World which is virtual USL. Here, social networking issue is presented on the street via intelligent street furniture. In this sequence, the role of USL is transforming from Sensor, Actuator, then to Mediator in the intelligent urban system.

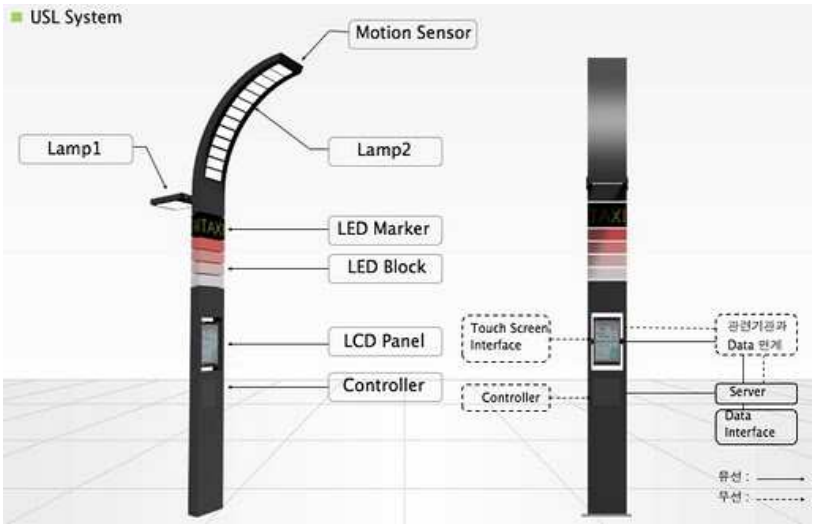

Fig. 2: Basic components of the USL Unit

2.1 Urban Sensor

Being able to host modularized sensor devices like surveillance camera or air pollution sensor, the USL has been considered a powerful sensor node of the ubiquitous sensor network. Crowd counting was one of the major sensing functions implemented at the early stage of the project (Fig. 3). It utilizes the surveillance camera unit built into the USL unit. The number of passers-by could be automatically calculated, by sending the image stream to a vision-based crowd counting software on the server. Although it needs a sophisticated algorithm to organize the collaborative counting with the network of USLs, we can effectively grasp the traffic amount, and thereby reason about the marketing potentials of a commercial district. We have also recently implemented the software so that we can count the number of people trying to contact with the USL by bluetooth or visual marker, or download some information from specific USL. This sensing function can provide more meaningful data out of the numbers of people with specific intents along with their profiles and spatiotemporal information. As more sensing devices become available due to the recent outcomes by other related research groups the role of USL as a urban sensor continues to be promising in this project.

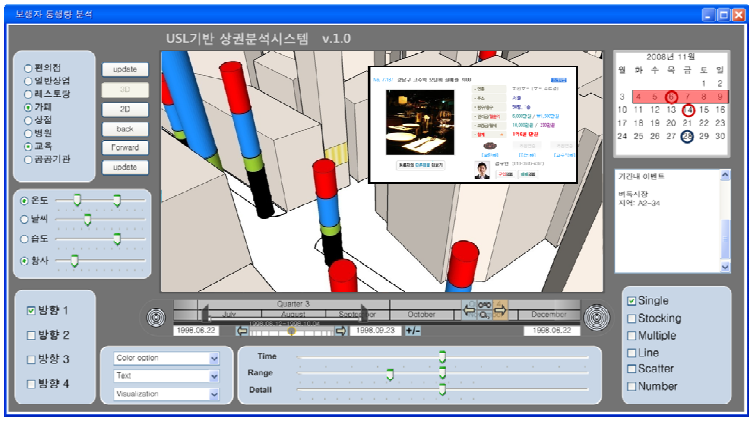

Fig. 3: Crowd counting application (adopted from SONG & JANG 2009)

2.2 Urban Actuator

The USL becomes an actuator as a urban media, providing emotional entertainment the residents. By using this type of urban object harnessed with sensors and display devices connected with the communication network, it is possible to transform the urban space into a digital media player. Urban media in such a scale allows unforeseen emotional service for the public. Each USL unit operates as a kind of image pixel constructing a bitmap of media screen in this scenario. The media screen generates a sparse image which transforms an urban district into a display panel observable from a distance. The patterns can be recognized as just an abstract lighting pattern from the street level viewpoint, but the result may be better recognized as a meaningful imagery from a certain point of observation in the city.

It requires huge investment to realize and physical result may be irreversible. We developed a simulator-cum-controller of the USL media fabric for this reason. The simulator lets us preview the USL patterns in an interactive 3D environment. The USL designers can import the 3D digital model, layout the virtual USL units, and simulate lighting patterns from various media using the simulator. It is possible to predict and design the deployment as well as its media content before physically installing expensive USLs using this simulator. The system also allows the access from mobile contents senders to respond to the collaborative mobile art scenario. Eventually, the system will be developed into a control platform of the physical city and USL network (Fig. 4 & Fig. 5). The simulator was developed based on a game-engine, and it has networking ability. The simulator or the actual USL unit is manipulated through the USL server. Any authorized user is allowed to send data (text, image, movie) to the server using a mobile device and the the fabric becomes a media board displaying a collaborative media art.

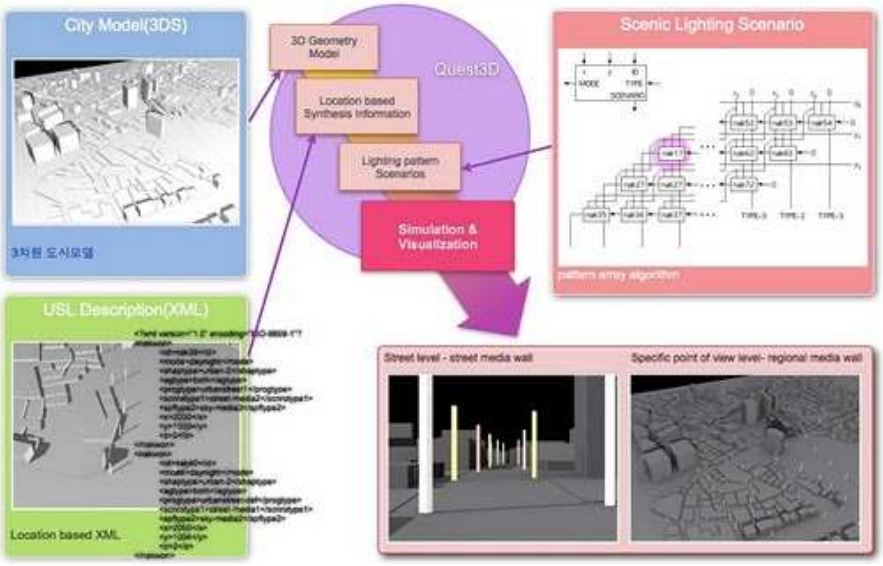

Fig. 4: Application structure of the USL Simulator

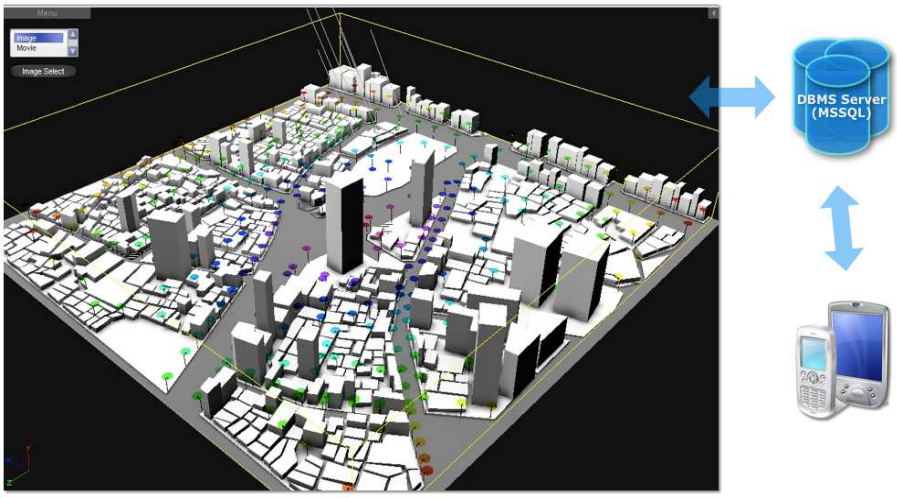

Fig. 5: Screetshot of the USL Simulator

2.3 Urban Mediator

The role of intelligent streetlight as infotainment device, however, soon becomes in question as people are already enjoying numerous information services through cell phones with so much ease. For example, any mobile phone users can acquire the weather information or find out nearby restaurants suitable to their tastes. Accordingly, most of information services by fixed facilities seem to become as obsolete as public phone booths nowadays which suffer from its raison d'etre. Our immediate answer was that public information service should still respond to the needs by digitally lesser people even if the mobile ubiquity is available. Furthermore indoor LBS is still not accurate enough. USL can be transformed into indoor facility similar to information kiosk, and provides accurate location based information. While keeping these reasons for maintaining the kisosk function, we came up with the idea of using USL as an urban mediator which enables communication between people both in real and virtual world. Camera-equipped or bluetooth-enabled cell phone users can use the visual marker generated on the USL display, to instantly get connected to the USL World Network. The users then have a choice of selecting available locations such as shops, event spaces, and facilities. Using popular social networking tools such as Twitter, or its own media blogging tools, users can create social networks anchored in specific urban places existing on in both worlds. They can also enjoy location-based entertainment services such as free coupons, free information access, instant MP3 download and so on. The USL Mobile Application lets people use their mobile phones to leave media notes at points of interest and share their experiences with other people in real time through the USL World (Fig. 6).

Fig. 6: USL World Main User Interface

3 IMPLEMENTATION OF THE USL WORLD

3.1 Spatially mediated social networking

Beyond just simulating the USL system, we are trying to expand the realm of its service both on physical and virtual world. Here, the USL becomes a connecting bridge between two worlds. The virtual world is called USL World. USL World is a web-based application hosting a 3D city viewer within its frame. It utilizes the Google Earth plug-in module as the viewer, which basically displays one of major business districts of Seoul. We built a city model using SketchUp program and loaded the model data as KML format. Major landmark buildings and main street facades are texture mapped with photos. This static modelling process wirll be replaced by the dynamic model generation method i ncorporation with GIS database towards the end of the project.

The user can freely navigate through the city model as in google earth viewer. The sidebar menu provides a named street viewpoint list. Viewpoint items can be bookmarked by the user. A volumetric marker shows up to indicate the target area when the mouse cursor rolls over each viewpoint item so that the user can grasp what to see.

Utilizing available open APIs, we also added some living information services such as bus stop information to the USL world. Virtual USL units are also deployed. The USL World is a replica of the physical world with USLs embedded twitter API. Each USL has unique twitter ID. As someone writes to the USL ID on the twitter, a 3d text column appears reflecting the most recent message (Fig. 7), creating a dext-based datascape.

Fig. 7: Text colums appear on the street of USL World linked with Twitter communication

3.2 Interaction with visual markers

The QR-code based 2D visual marker system was introduced to facilitate the interactions with the physical USL world as well as the virtual USL world. For example, when a person uses a cameraphone to match with the QR-code displayed on the USL unit, she can instantly get connected to the USL server. Then, she is able to use the media blog or twitter connected to that specific USL post. She can use infotainment menu interface on her smarphone which appears as AR object over the USL scene. QR-code match also guides the person to the equivalent location on the USL World. Both physical and virtual USL world provide sharable social networking tools and media blogs where users can create spontaneous online community.

Compared with the the anonymous and sometimes intrusive LBS services, this visual contact-mediated social networking ensures the quality of the community, and generates more meaningful data as it deals the specific user groups with specific intents and user profiles. It is a realitvely easy to connect both worlds by this method, and enhaces the space-mediated social networking in term of business models. We are trying to develop more business-oriented scenarios using this model. (Fig. 8).

Fig. 8: A QR Code-based USL World Scenario

4 CONCLUSION

Experimenting with various street event scenarios now, we expect the integration of a semantic engine in the long run so it is possible to find out meaning correlations between messages and places, and also between various factors such as activities and time. AR based application is being developed to provide more exciting interface to the user. These scenarios may not work as expected when deployed in mass scale, and new emerging technologies may call for fundamental changes of the concept. The sensor-autuator-mediator roles, howerver, seem to be still effective in general for this kind of intelligent street system development.

5 ACKNOWLEDGEMENT

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6 REFERENCES

SHIN, Dong Yoon & KIM, Sung Ah: Designing through Simulation: Integration of Ubiquitous Street Facilities into the Urban Media Fabric, Fourth International Conf. on Networked Computing and Advanced Information Management (NCM '08), , vol.1. pp. 311-317, 2008, Gyeongju

SONG, Kyu-Man & JANG, Ji-Young: A Study on the Data Collection and Application of the Pedestrian Volumn using the Ubiquitous Streetlight, Journal of Architectural Institute of Korea, Vol.25, No.9, pp 205-213 2009 (in Korean).

CHO, Yunjung & KIM, Sung Ah: A Study on the Ubiquitous Street Light as Social Media, Proc. of Architectual Institute of Korea 2009 Conference, pp. 301-304, 2009 (in Korean).