International Journal of Information, Control and Computer Sciences
ISSN: 2517-9942
Vol:10, No:11, 2016

A Proposal for U-City (Smart City) Service Method Using Real-Time Digital Map

SangWon Han, MuWook Pyeon, Sujung Moon, DaeKyo Seo

***Abstract*—**Recently, technologies based on three-dimensional (3D) space information are being developed and quality of life is improving as a result. Research on real-time digital map (RDM) is being conducted now to provide 3D space information. RDM is a service that creates and supplies 3D space information in real time based on location/shape detection. Research subjects on RDM include the construction of 3D space information with matching image data, complementing the weaknesses of image acquisition using multi-source data, and data collection methods using big data. Using RDM will be effective for space analysis using 3D space information in a U-City and for other space information utilization technologies.

***Keywords*—**RDM, multi-source data, big data, U-City.

I. Introduction

RECENTLY, RDM is being researched to provide space information in real time. RDM research aims to build the foundation for national land information through the development of multidimensional and real-time space information creation technology based on location/shape detection, to develop technology to provide RDM service contents by merging multidimensional space information, sensor information, multimedia, and network information, and to implement a model for providing such services in real time. With the development of the information age, entertainment and building information modeling (BIM) technologies are being developed through augmented reality based on 3D space information.

The Ubiquitous City (U-City) applying such services to a city is evolving to Smart City with innovative developments in the Internet of things (IoT) and information and communication technology (ICT). This paper proposes services that can be applied to U-City using this RDM.

II. RDM and U-City

RDM can be implemented by acquiring images from many directions and by constructing 3D space information using images. Images are acquired through multi-source data and multi-sources include CCTV, smart phone, and digital camera.

The reference images must be selected to use the data obtained from multi-sources. For reference data, CCTVs that acquire data from fixed areas in real time are appropriate. For areas whose images cannot be acquired through CCTVs, the images from smart phones and digital cameras can be used [1].

However, the images of smart phones and digital cameras are very limited; thus, big data can be used for more efficient data collection. Big data refers to data produced in the digital world which is enormous and has a short life cycle. Big data architecture is being designed and researched to store more efficiently, manage, and analyze the big data [2].

For cloud point data, the final cloud point file, origin file, texturing file, and target area name are sent [2]. For digital camera image data, the target file, area name, the left and right image file for sending stereo image data acquired with CCTV, as well as the area name, are sent [2].

In addition, the access information (IP, port, etc.) for the data interface is set and the data are searched. The type of data to search (cloud point, digital camera image, CCTV stereo image, or control point) is selected and resolution, camera name, photographed area, etc. are searched [2].

From the images acquired from many directions, the matching points of images are extracted through the SIFT and PATCH techniques. Then, 3D data is constructed using the direct linear transformation (DLT) technique [3]. The matching points extracted through the SIFT method in each image are overlapped to increase their number. The decomposed images use the same coordinates, and the extracted matching points can be overlapped on the same position [3].

The characteristics of stereo images, disparity takes place for patch-based matching on a similar position, therefore, the right image was moved by 37 pixels from the center, and matching research was conducted. After creating a patch in 200x60 pixels and another patch in 160x50 pixels on the left and right images, respectively, the most similar patch was found by allowing the small patch on the right image to retrieve the big patch on the left image [3].

U-City or Ubiquitous City refers to a city where you can access the network anytime, anywhere. The U-City is a model of future cities, which is implemented on the basis of broadband, mobile, geographic information system (GIS), radio frequency identification (RFID), and Internet Protocol version 6 (IPv6) technologies [4]. For the future city model U-City, a standard platform for handling ground facilities data based on 3D space modeling must be specified and maintained through a database.

For this purpose, the urban information system (UIS) must be constructed and operated [5]. Real-time 3D space modeling can be obtained by connecting 3D space modeling with RDM. However, during the construction of U-City, U-City-related

SangWon Han and MuWook Pyeon are with the Department of Civil Engineering, Konkuk University, Republic of South Korea (e-mail: hsw721@naver.com, neptune@konkuk.ac.kr).

Sujung Moon is with the Department of Advanced Technology Fusion, Konkuk University, Republic of South Korea (e-mail: msujung@konkuk.ac.kr).

DaeKyo Seo is with the Department of Smart ICT Convergence, Konkuk University, Republic of South Korea (e-mail: ckekaqheocnf@naver.com).

infrastructures were installed with no planning through housing land development profits, and the spatial characteristics were not considered because the space plan was weakened due to planning centered on information and communication [6].

Excessive infrastructure installations and thoughtless land planning can be prevented if space planning is performed through RDM.

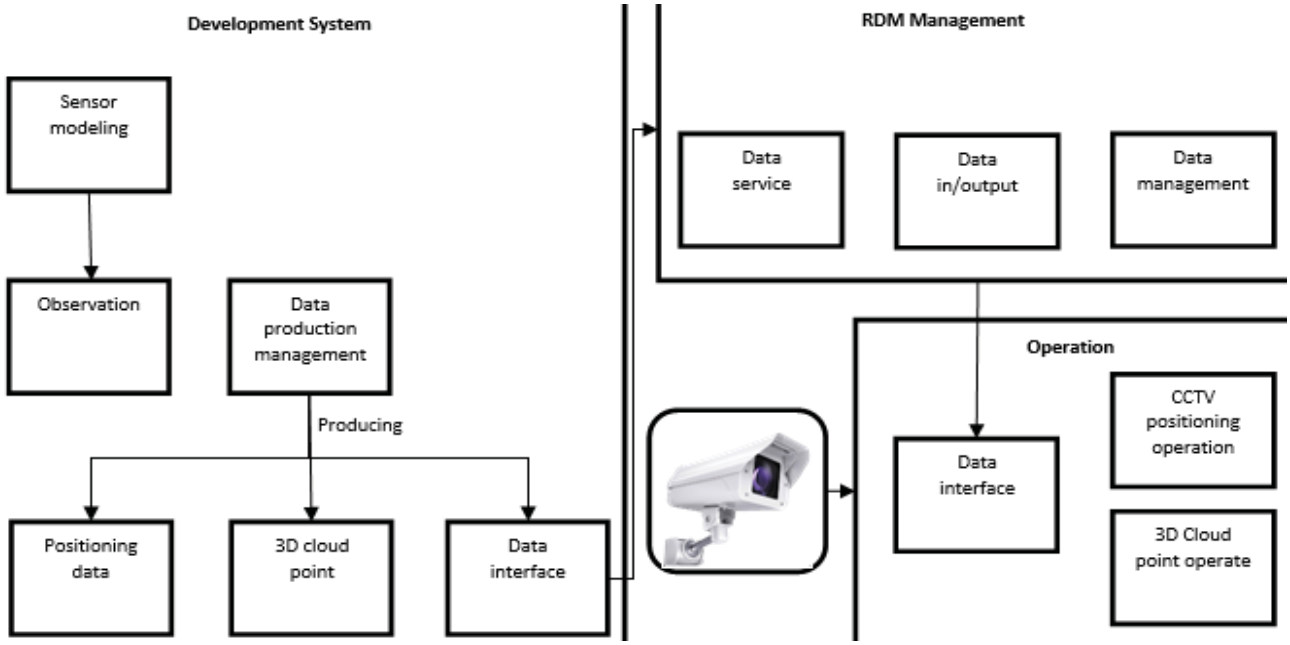

Fig. 1 Big Data Architecture

III. Utilization of RDM in U-City

With the development of high-performance image acquisition devices and social media and the opening of public data, and based on the space information created as a result of such developments, we can effectively respond to real-time maps, augmented reality (AR), and automatic driving markets.

The AR and automatic driving markets are researching an AR vehicle navigation system [7] which helps vehicle driving by creating virtual information images on the images of real world according to the location of the user with an AR image creation module; this system has become a major issue the field of automobile engineering. However, this system cannot process images with cameras during the night. This problem can be improved by using 3D data constructed with multi-source data by applying RDM. Furthermore, during the day when the driving is helped by virtual data added to the images of the real world captured through cameras, the RDM image processing method can be applied to reduce error matching points and construct a model like the real-world data.

The entire city is constructed in 3D through 3D city simulation that is similar to the real world, and the 3D city modeling is connected with GIS so that each object has space information. Furthermore, the administration, public services, and urban planning of the city can be effectively carried out through the phase structures of the objects. In addition, faster modeling is possible using the CCTVs of construction sites for 3D shape production of BIM during the construction stage, and the drawing inspection time can be shortened through this process.

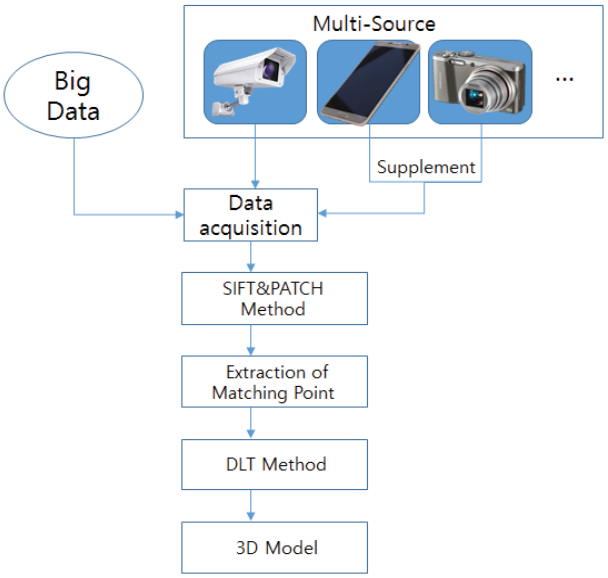

Fig. 2 RDM Image Processing Structure

Fig. 3 U-city Diagram

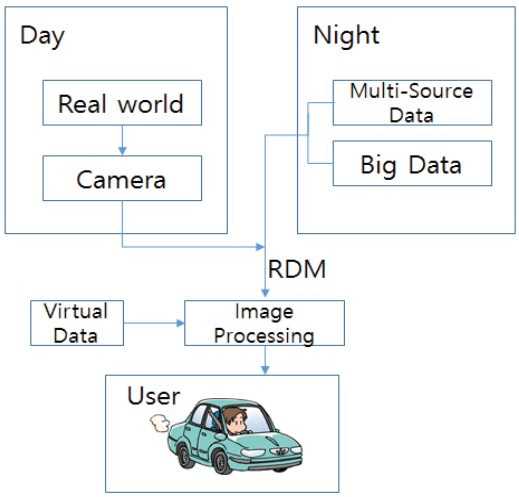

Fig. 4 AR Vehicle Navigation System Using RDM

Fig. 5 User Participation Schematic Diagram

Thus, the use of RDM saves the location acquisition cost and new businesses can be derived from the location identification process based on images. Furthermore, people can identify their location with one photograph and this can be applied to various location based services (LBS). In particular, RDM can be used for AR and pedestrian navigation to cope with the increasing large indoor spaces. Besides, with the operation of CCTVs in the expanding smart cities and the omnipresence of various image recording devices, RDM can be applied to the construction of 3D space information in partnership with local governments and large-scale project developers.

The multi-source data in RDM can utilize numerous image data produced every moment, and users can acquire more data than they do now through participatory multi-source information. Furthermore, the demand for real-time image-based space information is expected to explosively increase with the expansion of big data market.

IV. Conclusion

RDM is a service that creates and supplies 3D space information in real time on the basis of location/shape detection. The development of a vehicle navigation system through AR using RDM during the night can enable more efficient traffic services of U-City. The use of RDM in 3D urban modeling can shorten the modeling process. Furthermore, land planning considering space characteristics is possible for the detailed planning of U-City.

RDM can be used for LBS through image-based location identification process in the U-City. It will be also used in AR and pedestrian navigation to cope with the increasing indoor spaces, enhance spatial capacity and improve the quality of life by being applied to service areas.

Furthermore, RDM is anticipated to create temporal and economical profits with the construction of space information through the use of user-participatory multi-source information with big data and multi-source data acquired from diverse directions during the data collection process.

Acknowledgment

This work is financially supported by Korea Ministry of Land, Infrastructure and Transport (MOLIT) as “U-City Master and Doctor Course Grant Program” and this research was supported by a grant (15CHUD-C061156-05) from National Spatial Information Research Program funded by Ministry of Land, Infrastructure and Transport of Korean government.

References

[1] S.J. Moon, M.W. Pyeon and S.W. Han (2016), “A Study on the Physical Configuration Plan of the RDM (Realtime Digital Map) Construction Multi-source Devices (EO sensor) for U-city Service” in Engineering & Technology, Computer, Basic& Applied Sciences(ECBA), Vol. 241, Issue. 17

[2] S.J. Moon, M.W. Pyeon, S.W Bae, D.R Lee and S.W. Han (2016), “Big Data Architecture Design for the Development of Hyper Live Map (HLM)” in Journal of the Korean Society of Surveying, Geodesy, Photogrammetry and Cartography, Vol. 34. No. 2, pp. 207-215

[3] K.I. Moon, M.W. Pyeon, J.H. Kim, S.J. Moon and K.S. Kim (2015), “DLT Positioning Technology Experiment for the RDM Production” in The Korean Society for Geospatial Information Science, pp. 103-104.

[4] T.J. Kim (2006), “A Study on the Provision of Public Service in Ubiquitous Government” in The Korea Spatial Planning Review, pp. 185-204.
[5] T.H. Kim and C. H. Hong (2008), “A Study on Construction of Urban Ground Facilities Management Model in U-City” in Journal of Korean Society for Geo-Spatial Information System, Vol. 16, No. 2, pp. 17-21.
[6] S.H. Han, Y.M. Lim and J.Y. Lee (2014), “A Study on Necessity of Construct and Altitude at Existing City” in The Journal of the Korean Institute of Communication Sciences, Vol. 31, No. 8, pp. 3-9.
[7] K.J. Byun, D.C. Lee, J.W. Kim, C.Y. Park and B.T. Jang (2001), “A Study on Car Navigation System Based on Augmented Reality Technology” in Korea Information Science Society, Vol. 28, No. 2, pp. 493-495