Development of Nuclide Recognizing Prompt Radiation Distribution Monitoring System

Uk Jae. Lee*, Dong Han. Yoo, Hee Reyoung. Kim
Ulsan National Institute of Science and Technology, Banyeon-ri, Eonyang-eup, Ulju-gun, Ulsan, Korea
Corresponding author:dnrwpwkd@unist.ac.kr

1. Introduction

As unexpected disastrous accident can always occur, understanding of rapid radiation distribution is essential for measuring on the public protection in the area other than emergency planning zone. Then the 2D and 3D mapping program to measure the distribution of natural radiation, major artificial radiation (^{137}Cs, ^{131}I) and total radiation is devised. This program is based on the information which is auto-recognized and interpolated [1]. The geographic data such as latitude, longitude and map image can be obtained by using GPS and digital map [3]. Radiation data can be acquired by detector. Finally simultaneous visibility system can be operated by using CDMA.

2. Methods and Results

This section includes the component and concept of nuclide recognizing prompt radiation distribution monitoring system. Then, the process of making 2D & 3D contour mapping program based on real detected data will be explained. The process is consisted of CDMA algorithm, image matching, contour code and changing file type.

2.1 Components and concept

This system consists of detector with GPS, digital map, CDMA, Laptop and Server PC. Fig.1. shows the components of this system [2].

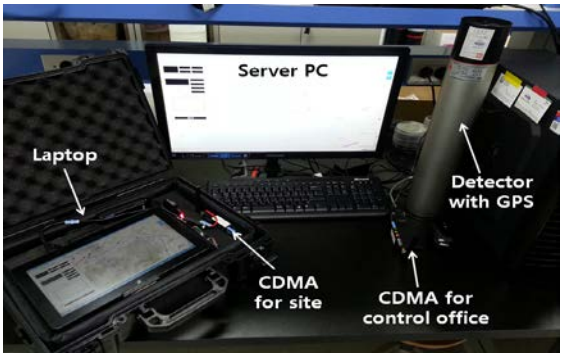

Fig. 1. Components of Radiation Distribution Monitoring System

The concept of Radiation Distribution Monitoring System is shown in Fig.2

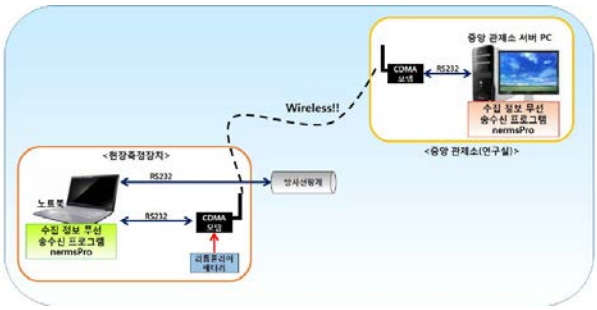

Fig. 2. Concept of Radiation Distribution Monitoring System

The concept of the system is as follows

1. Detector and Laptop which are located in a site place communicate with each other using Bluetooth. If detector and laptop are connected, current position and radiation dose rate can be shown in laptop.
2. Laptop in a site and Server PC in the control office communicate with each other using CDMA. Data which is acquired in a site is transmitted to a server PC. So both laptop and server PC can check distribution of radiation dose rate.
3. Finally contour map with geographic information, which shows distribution of radiation dose rate by using MATLAB code.

2.2 CDMA algorithm

Connection between a site and the control office is essential for making a simultaneous visibility system. There are many kinds of wireless communication such as WIFI, WIBRO and HSDPA and so on. CDMA has high quality of communication and high security. So CDMA is suitable for connecting between laptop in a site place and server PC in the control office. CDMA connection algorithm is consisted of three steps. First CDMA in a site place sends SMS which requires Server PC's IP address. Second Server PC sends SMS which includes server PC's IP address, and then CDMA in site place access to Server PC's IP. Finally CDMA in a site place and CDMA in the control office can connect each other.

2.3 Image matching

To visualize specific place's distribution of radiation dose rate, some processes are need such as acquiring map image and image matching between contour map and map image. Image matching process is as follows: Digital map has to be adjusted before detecting. It

should be set at the place want to detect. Map image file and text file which contain geographic data and radiation data can be acquired after detecting. In the text file, there are four meaningful numbers, maximum and minimum values of latitude and longitude. These numbers are used in matching map image with contour map.

2.4 Contour code using MATLAB

Based on real detected data, the 2D and 3D contour mapping code by using MATLAB is devised. Fig.2 shows the concept of MATLAB code.

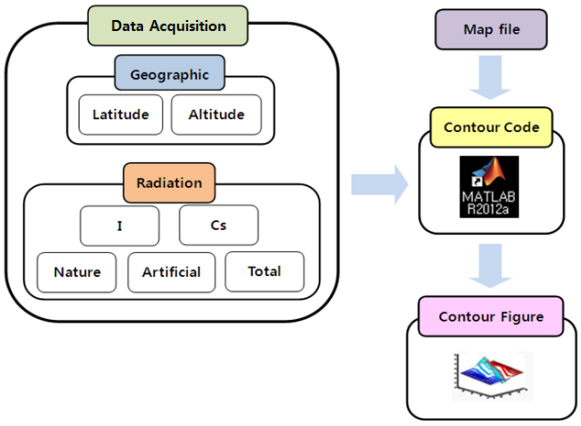

Fig. 2. Concept of the MATLAB code in nuclide recognizing prompt environmental radiation distribution monitoring system.

Before making the contour mapping code, there are some considerations. First is the noise elimination. In real detected data, not only radiological data caused by the radiation source (meaningful data) but also electrical noise or statistical fluctuation (meaningless data) can exist. The meaningless data distorts the distribution of radiation. So the process to eliminate noise or fluctuation must be required. Second is number and thickness of contour line [4]. If there are too many contour lines or if contour lines are too think, then the map image would not be clear. If contour lines are too little and thin, checking distribution of radiation would be hard. According to these considerations, MATLAB contour mapping code is made by using function of plot, linear, quadratic interpolation and so on. If contour mapping code is operated, 5 figures (^{137}Cs, ^{131}I, Nature, Artificial, Total) which show distribution of radiation can be shown.

2.5 Changing file type

Contour mapping code can only operate in the MATLAB installed condition. By changing the file type to “exe” format, contour mapping code can be used without the MATLAB. Therefore contour mapping program is operated by one-click.

3. Conclusions

Existing radiation distribution monitoring system is based on random generated data. However the radiation distribution monitoring system is developed. It is based on real detected data. Connection between the detector and laptop which are located at a site place is operated by using Bluetooth. CDMA is used to simulate visibility system between laptop in a site place and server PC in the control office. Real map image is taken from digital map. Finally radiation distribution contour map on the real map image can be shown by using MATLAB. 5 figures appear which shows natural, ^{137}Cs, ^{131}I, artificial and total radiation dose rate. So this system can be used in everywhere to check the distribution of radiation with geographic information.

REFERENCES

[1] Hee Reyoung Kim, et al, "The Establishment of an In-Situ Real Time Radiation Contour Mapping Technique", Journal of Nuclear Science and Technology, 5, p. 662-665 2008.
[2] Wendy Peters, "Radiation monitoring and local authorities", ATOM 378, 1988.
[3] Thermo Electron Corporation, FHT 1376 Mobile Radioactivity and GPS Detection System, Operation Manual, 2004.
[4] The MathWorks, Image Processing Toolbox, User’s Guide, Natick, 2005.