PA57) Evaluation of Visual Range in Incheon Area Using Image Analysis Technique

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1. Introduction

Visibility impairment is the complex phenomenon influenced by air quality and a number of natural factors such as temperature, humidity, wind speed etc. It is also shown that the size, chemical composition and concentration of airborne particle heavily affect visibility. The aggravation of visual range directly and indirectly affect on different sectors such as transportation, aviation, security, tourism, etc., therefore many efforts have been done to monitor and alleviate visual range.

There are various visibility monitoring instruments and techniques are developed. Horvath(1995) used telephotometer for monitoring visibility in central Europe that predicted visibility in terms of spectral extinction coefficient. Likewise the extinction due to the scattering and absorption property of aerosol was calculated by using an integrated nephelometer and athelometer respectively. Subsequently, the corresponding visual range was estimated in terms of scattering and absorption coefficient. Transmissometer is known as the most accurate instrument which has a function of calculating total extinction coefficient. The visual range is estimated in terms of total extinction coefficient. In addition, human-eye observation is another popular visibility monitoring technique which is applicable for observing the perceptual visibility.

Although several techniques are available for visibility estimation, those have several limitations such as bulkiness, costing, accuracy measure etc. To overcome such limitations and evaluation of perceptual visual range, we introduced the image analysis technique in this study.

2. Material and Method

First of all an empirical model as in eqn. (1) was developed based on the monitored visual ranges and RMS indices of digital images which were monitored in Incheon area(Pokhrel, 2007). Figure 1(a) shows the monitoring procedure to produce the empirical model. In this study we are introducing the model to estimate visual range in Incheon University area.

$$VR = 2.364e^{0.5\times(RMS)} \qquad (1)$$

A digital camera (IMI_TECH:IMC_80FF:1700018); control by software, air quality monitoring system (OSIRIS) were setup on the top of University building as shown in figure 1(b) and figure 1(c). A temporary shadow was built to protect the camera lens from direct sunlight and all the functions were set as default conditions. The images with resolution(768×1024) were continuously captured based on the set time interval 30 minutes. Similarly OSIRIS was also setup with time interval 30 minutes which continuously monitored TSP, PM10, PM2.5, PM1, temperature, relative humidity, wind speed and wind direction. At the end, statistical analysis will be done to evaluate the variation of visual range and relation of visibility with atmospheric parameters.

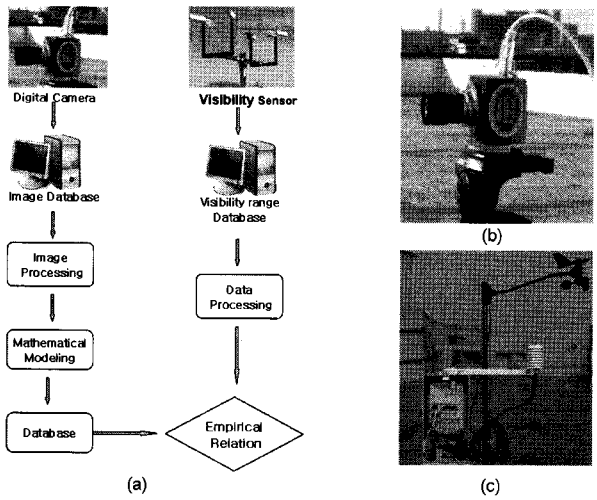

Fig. 1. Visibility monitoring technique (a) Flow chart for the development of empirical model, (b) Digital camera (c) Air quality monitoring system(OSIRIS).

3. Result and Discussion

Image data and air quality data were monitored during different climatic conditions. The contrast of the digital image rapidly decreases during hazier environmental condition than normal environmental condition which can evaluate from Figure 2.

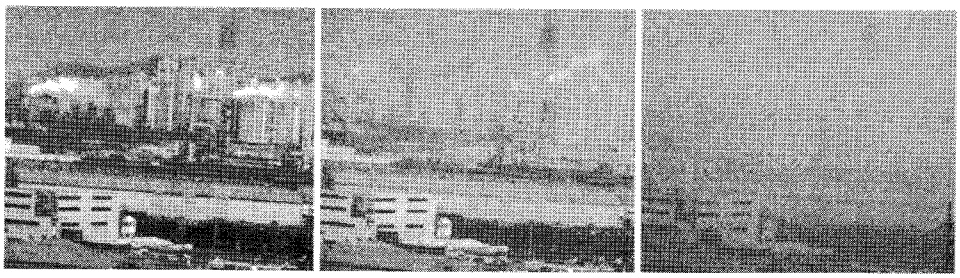

Fig. 2. Digital image captured during different atmospheric condition (a) Clear condition. (b) Normal condition and (c) Hazy condition.

Figure 2(a) shows the very clear atmospheric condition where the PM10 concentration was less than 50$\mu g/m^3$. Similarly Figure 2(b) and (c) are normal and hazy atmospheric conditions in Incheon area where PM10 concentration was approximately 80$\mu g/m^3$ and 1500$\mu g/m^3$ respectively. The hazy condition occurred during the yellow dust period. Further computation visual range and its aggravation will be presented in this paper.

References

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