Review on CCD Camera Images

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Abstract - There are some deficiencies in the traditional daytime visibility calculation method using CCD digital camera. The visibility observation value is accurate while using the artificial objects, but expensive at the same time, a non-zero internal reflection coefficient of the target leads to an inaccurate visibility observation results while using natural objects as the target. A new daytime visibility algorithm based on colour CCD digital cameras has been proposed in this paper. We used the coloured images obtained by the CCD digital camera, then estimated the transmission of coloured digital images by using the knowledge of dark channel prior, and obtain the atmospheric attenuation coefficient from transmission to calculate the visibility value. The experimental data show that the maximum error of the proposed algorithm is less than 20% which confirms the error provisions of WMO on the meteorological visibility instrument, and simple operation, without artificial target, low cost.

Keywords: *Colour digital camera, Daytime visibility, a new visibility Algorithm, Estimated transmissio*n.

I. INTRODUCTION

Recently, with the development of computer technology and CCD camera technology, design and research of CCD digital camera visibility meter rapid development. Basically, A charge-coupled device (CCD) [1] is used for the movement of electrical charge, usually from inner part of the device to an area where the charge could be manipulated, i.e. Conversion into a Digital entity. This is acquired by "shifting" the signals between levels within the device one at a time. In CCD charge moves between capacitive bins in the device, with the shift allowing for the transfer of charge between bins. The CCD is the major part of technology in digital imaging. In CCD Image sensor, P-Doped MOS Capacitors are used to represent the pixels. When the image acquisition begins, for inversions these MOS Capacitors are biased above the threshold. This permits the conversion of incoming photons into electron charges at the semiconductor-oxide interface. These Charges are read out by the CCD and these image sensors are widely used in Avionics, medical, professional, and scientific applications where image data with high quality is required.

II. BASICS OF OPERATION

In CCD there is a proactive region (upper layer is made up of silicon) and a transmitting region mode out of the CCD. The image is projected onto the capacitor array through a lens; this causes each capacitor to assemble electric charge which is directly proportional to the intensity of light on the exact same location. In line-scan cameras a one-dimensional array is used that captures the single slice of the data i.e. .image, while on the other hand for video and still cameras a two-dimensional array is used [5][6]. It captures pictures (two-dimensional) which corresponds to the projected scene on the focal plane of the sensor. Once the array is exposed to the image, the control circuit causes to transfer the contents of each capacitor to its neighbour. The last capacitor in the array disposes its charge into the charge amplifier which is used for the conversion of charge into voltage. The entire contents of the array are converted into the sequences of voltage by repeating this process with help of the controlling circuits [7]. These voltages are stored in memory of a digital device after being sampled and digitized on the other hand in an analogue device ,they are processed into a continues analogue signal after that the signal is fed out to the other circuits for transmission recording and other processing.

III. ALGORITHM DESIGN

A. Visibility calculation model

The atmospheric visibility dropped in the atmosphere mainly due to three reasons: The light of object (including self-luminous and reflective) absorbed by the atmosphere before it reaching at the detector; the light of object scattered by all kinds of atmospheric particulate matter so that it cannot reaching at the detector; other background light is scattered into the detector because of the atmospheric particulate matter on the path from the object to the detector. Atmospheric absorption and scattering result in light attenuation jointly. We ignore atmospheric absorption to achieve the proposed algorithm because most of the atmospheric optical attenuation mainly roots in atmospheric scattering [9][10]. The selection of target area the selection of target area in the image needs to according to different situations in this paper. Generally, for obtaining accurate results of choosing target area, two steps judgment should be done: (1) selecting dark objects or surfaces as the target area; (2) judging if there is a bright single channel in target areas. The dark objects or surfaces mean that a channel of the target area will have very low intensity value, which accord with the application conditions of using the dark channel prior. Exiting a bright single channel in target areas means that position of the target area is far, and the baseline is long, so that the range of visibility observable is far. Fig. 1 shows the selection process of target area

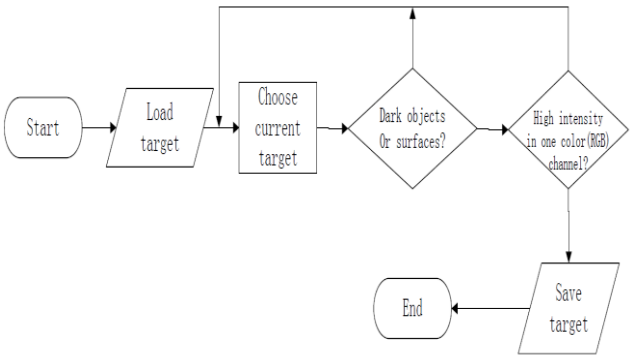

Fig.1: Selection process of target area

Who need a specification is, condition 2 is not established when visibility is poor. Either channel intensity may be not very high in the situation of poor visibility [8]. And this means that the current visibility range is low. In this case, if we cannot find the target area which can satisfy the two conditions at the same time, we abandon condition 2, and only judge condition 1 to discover the optimal target object.

IV. DATA PROCESSING AND A SHORT TIME EXPERIMENT

The experimental results are compared with the forward scatter visibility meter (FD12). In order to ensure the accuracy of the experiment, CCD digital camera and forward scatter visibility meter keep consistent direction and angle of view in the experiment. i.e. the image was taken at 9:00 am. Fig. 2 shows an original image.

Fig.2: Original Image

The yellow area is the target area, and the area in the red box is enlarged the target details.

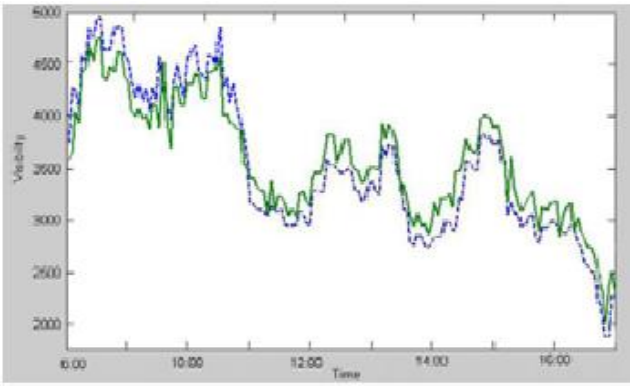

Fig.3: Estimated transmission map from an input image

Fig.3 show the estimated transmission map from an input image [12]. The experimental procedure as follows: capturing the image by the CCD digital camera, choosing a target area, estimating transmission of the target area, and then calculating the visibility value.

V. LONG TIME EXPERIMENT IN THE NATURAL

In order to verify the effect of the proposed algorithm further, a long time experiment was done from November 24 to November 26 in Beijing. The site we chosen is in the south of Beijing with very few human building, and the comparison of visibility between the proposed algorithm and the forward scatter visibility meter is shown in following figures :-

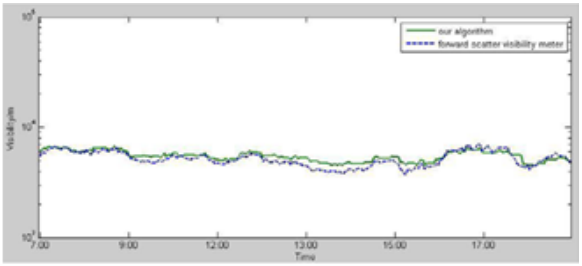

Fig.4: The comparison visibility on November 24

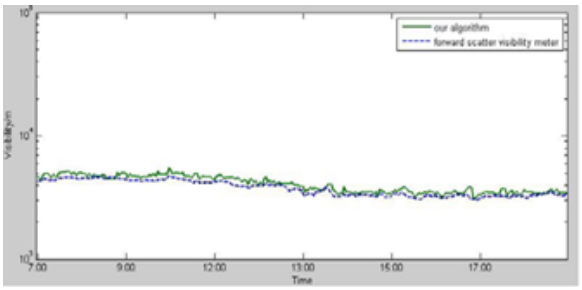

Fig.5: The comparison visibility on November 25

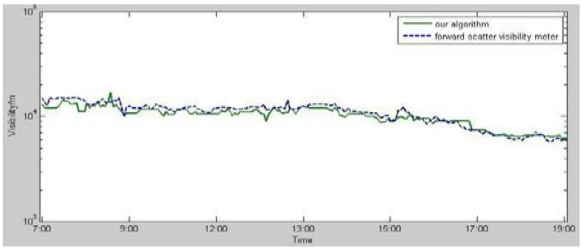

Fig.6: The comparison visibility on November 26

The correlation coefficient and relative RMSE between the proposed algorithm and the forward scatter visibility meter is shown in Table 1

Table 1 The correlation coefficient and relative RMSE

Date	Correlation Coefficient	Relative RMSE
2012.12.24	0.7942	7.62%
2012.12.25	0.8120	7.93%
2012.12.26	0.8432	8.18%

According to the experimental results we can know, we known the correlation coefficient the proposed algorithm and the forward scatter visibility meter is less than 0.85, and the difference of distribution between two results is less than 8.2% [11]. Therefore the distribution of the proposed algorithm has good consistency with forward projection instrument results. Cause the error range parameter of FD12 is 10%, so the maximum error of the proposed algorithm is less than 20% which satisfied the error provisions of WMO on the meteorological visibility instrument [2,3], and It proves that the proposed algorithm is feasible.

VI. CONCLUSION AND FUTURE WORK

A new daytime visibility algorithm based on colour CCD digital camera is proposed in this paper. The proposed algorithm can deal natural images directly to gain visibility value, without artificial object and low cost. The proposed algorithm eliminates the error which caused by the no-blackbody characteristics of the target, and obtains good experimental results in visibility observation range 1500-3000m. It's worth to discuss some questions for this algorithm: 1.The atmospheric light we chosen cannot accurately reflect the really atmospheric light. How to gain the accurate atmospheric light from the colour image is a problem which is worth studying. 2. In acquiring images with a CCD camera, light levels and sensor temperature are major factors affecting the amount of noise in the resulting image [4]. We further research work is how to de-noise for a more accurate visibility value.

VII. REFERENCES

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