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Recommendation

ITU-T F.740.5 (09/2023)

SERIES F: Non-telephone telecommunication services

Multimedia services

Data collection and annotation requirements for automatic white balance (AWB) enhancement in mobile terminals for digital culture

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Recommendation ITU-T F.740.5

Data collection and annotation requirements for automatic white balance (AWB) enhancement in mobile terminals for digital culture

Summary

Recommendation ITU-T F.740.5 provides the collection procedure of data for automatic white balance (AWB) enhancement and describes the requirements for all steps, which includes the requirements for scene selecting, shooting setting, data capturing and illumination uniformity detecting. The requirements of data annotation are also described in this Recommendation, including the illumination colour, illumination indicator and device. The goal of this Recommendation is to improve the user experience during image data transmission, which is the most popular cultural behaviour.

History [*]

Edition	Recommendation	Approval	Study Group	Unique ID
1.0	ITU-T F.740.5	2023-09-13	16	11.1002/1000/15615

Keywords

Annotation metadata, automatic white balance, computational photography, data collection, digital culture.

[*] To access the Recommendation, type the URL https://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID.

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NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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Recommendation ITU-T F.740.5

Data collection and annotation requirements for automatic white balance (AWB) enhancement in mobile terminals for digital culture

1 Scope

This Recommendation describes the procedure and the requirement for data collection and annotation for automatic white balance (AWB) enhancement under uniform illumination conditions in mobile terminals, which includes:

– Requirements of the data collection procedure.

– Requirements of the data annotation.

This Recommendation is intended to make the digital culture and social media related contents on mobile terminals more uniform and accurate during transmission.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

None.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 automatic white balance [b-ISO/IEC 30118-4]: A technology of normalizing the effect of the captured scene's illumination such that all objects appear as if they were captured under ideal "white light".

3.1.2 metadata [b-ITU-T X.1255]: Structured information that pertains to the identity of users, systems, services, processes, resources, information or other entities.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 illumination uniformity: The colour of illumination is the same across an entire raw image. This specific condition serves as the fundamental data requirement for existing automatic white balance (AWB) enhancement techniques.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AWB Automatic White Balance

CV Coefficient of Variation

ISP Image Signal Processing

MTCPS Mobile Terminal Computational Photography System

RGB Red Green Blue

5 Conventions

In this Recommendation:

– The keywords "**is recommended**" indicate a requirement that is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

– The keywords "**is required to**" indicate a requirement that must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed.

6 Overview

The sharing of photography works on social networks has become one of the main contents and plays an important role as a cultural dissemination medium. By sharing photography works, users can convey their visual concepts, values, and cultural backgrounds, thus promoting the dissemination of cultural diversity. Accurate automatic white balance (AWB) can present photography works with true colours, enhancing the audience's understanding and resonance with the cultural connotations conveyed in the works. As the enhancement of the AWB module is data-driven, the large and correct data (with uniform illumination) has a great impact on its training effect. Thus, it is necessary to standardize data collection and annotation.

This Recommendation standardizes a data collection procedure for AWB module enhancement for digital culture. It provides the requirements for four parts: scene selecting, shooting setting, data capturing and illumination uniformity detecting. Moreover, the requirements for the metadata of illumination colour, and the illumination indicator device are also described in this Recommendation. By standardizing the collection procedure and annotation metadata, it is beneficial to the improvement of training data consistency and validity for AWB module enhancement, and will ultimately benefit the user experience on digital culture data transmission under different mobile terminals.

7 Requirements of data collection

7.1 Data collection procedure and requirements

This Recommendation provides a data collection procedure for AWB module training to ensure the uniformity of illumination. Figure 1 shows the data collection procedure.

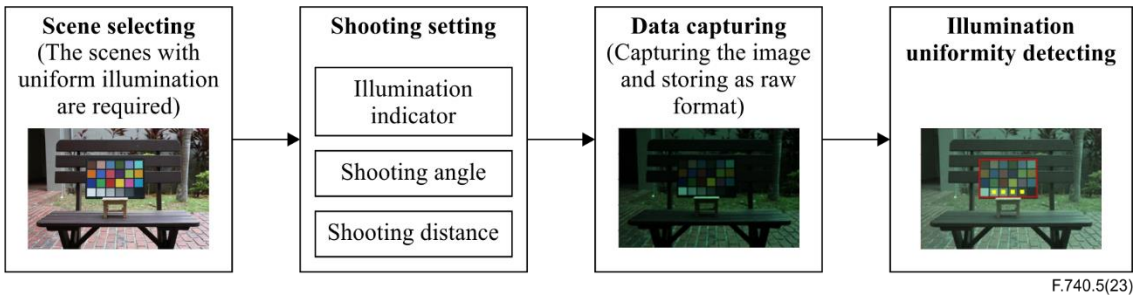

Figure 1 – Data collection procedure

The data collection procedure follows the following requirements:

1) **Scene selecting.** This part is required to select scenes with uniform illumination. It is recommended to select open outdoor scenes, indoor scenes with uniform light sources, etc.

2) **Shooting setting.** This part is required to include the following three parts:
   - Illumination indicator. This part is required to have a standard neutral grey area, which can reflect actual illumination colour.
   - Shooting angle. This part is required to avoid light sources appearing in the shooting range to keep the illumination uniform.
   - Shooting distance. This part is required to ensure the standard neutral grey area in the captured image can be positioned.
3) **Data capturing.** This part is required to capture the image as the raw format.
4) **Illumination uniformity detecting.** This part is required to verify the illumination uniformity of captured images. The specific procedure and requirements of this part are further elaborated in clause 7.2.

7.2 Procedure and requirement of illumination uniformity detecting

To complete the fourth part of the data collection procedure, this Recommendation further provides a procedure for illumination uniformity detection. It is recommended to include five parts: preprocessing, illumination indicator locating, grey pixel locating, illumination uniformity detecting, and illumination uniformity judging. Figure 2 describes the procedure of illumination uniformity detection.

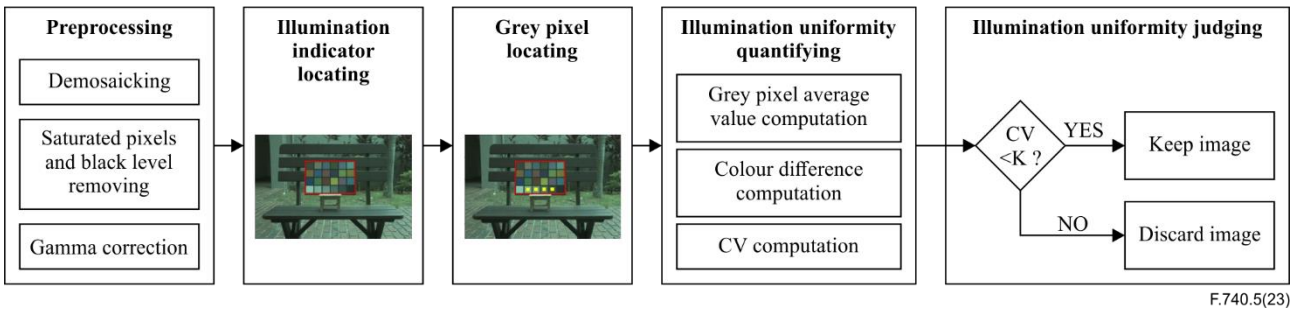

Figure 2 – Illumination uniformity detecting procedure

The illumination uniformity detecting procedure follows the following requirements:

1) **Preprocessing.** This part is required to convert raw image into a processed version. It is recommended to include three steps: demosaicking, saturated pixels and black level removal, and gamma correction.
2) **Illumination indicator locating.** This part is required to locate the illumination indicator that has standard neutral grey pixels in captured raw image. Note that the illumination indicator is recommended to be the Macbeth colour checker.
3) **Grey pixel locating.** This part is required to locate standard neutral grey pixels in the illumination indicator and return corresponding colour values.
4) **Illumination uniformity quantifying.** This part is required to quantify the illumination uniformity. It is recommended to compute the coefficient of variation (CV) for grey pixel values, which includes three parts: grey pixel average value computation, colour difference computation and CV computation.
5) **Illumination uniformity judging.** This part is required to recommend an approach to determine whether the captured illumination is uniform. It is recommended to judge with a threshold. In detail, if the CV value is below the threshold K indicating uniform illumination, the raw image will be retained and annotated; otherwise, if the CV value exceeds K indicating non-uniform illumination, the raw image will be discarded.

8 Requirements of data annotation

This Recommendation provides the requirements for the illumination colour annotation, illumination indicator annotation and shooting device annotation. The first two annotations are used to support the training of AWB module enhancement, and the third annotation is used to support the generalization training of AWB module enhancement.

8.1 Requirements of illumination colour annotation

The illumination colour information is required to calculate by averaging the red green blue (RGB) values of grey pixels in the illumination indicator of the collected raw image.

Metadata of illumination colour information annotation is required as presented in Table 1.

Table 1 – Metadata of illumination colour annotation

Fields	Description	Data type
Illumination colour information	A three-dimensional vector where each component is a floating-point number representing the value of red (R), green (G) and blue (B) respectively. The value range for each component if from 0.0 to 1.0.	<float, float, float>

8.2 Requirements of illumination indicator annotation

The illumination indicator is used to capture the illumination colour. Because the illumination indicator contains grey pixels that affect the AWB enhancement effect, it is required be masked in the training processing of AWB module enhancement. Therefore, the location information of the illumination indicator is required to be annotated.

Metadata of illumination indicator annotation is required as presented in Table 2.

Table 2 – Metadata of illumination indicator annotation

Fields	Description	Data type
Illumination indicator information	A four-dimensional vector, where each component is a floating-point number representing the horizontal position of the top two vertices, the horizontal position of the bottom two vertices, the vertical position of the left two vertices, and the vertical position of the right two vertices of the illumination indicator, respectively.	<float, float, float, float>

8.3 Requirements of device annotation

The information of the device is required to include the device brand and image signal processing (ISP) model.

Metadata of device information annotation is required as presented in Table 3.

Table 3 – Metadata of device annotation

Fields	Description	Data type
Device information	A two-dimensional vector, where each component is a string representing the brand of device and the model of ISP respectively.	<string, string>

Appendix I

Supplements for illumination uniformity quantifying and illumination uniformity judging

(This appendix does not form an integral part of this Recommendation.)

I.1 Illumination uniformity quantifying: colour difference computation

Regarding the average value G_{avg} as the base pixel, this step is suggested to compute the offset degree of each grey pixel for the illumination uniformity detection, which is the angle between the pixel vectors and their average vector G_{avg} and is denoted as colour difference A_i.

$$A_i = \frac{180}{\pi}\arccos\left(\mathrm{G_i} \cdot \mathrm{G_{avg}}\right)$$

I.2 Illumination uniformity quantifying: coefficient of variation computation

For uniform illumination, the colour difference of each grey pixel should be as similar as possible. It is suggested to regard the coefficient of variation (CV) as an index to quantify the degree of dispersion for colour difference. The lower value of CV refers to more uniform illumination.

$$CV = \frac{std\{A_1, A_2, \ldots\ldots, A_n\}}{mean\{A_1, A_2, \ldots\ldots, A_n\}}$$

I.3 Illumination uniformity judging

It is suggested to collect a small-scale raw dataset under controlled standard illumination conditions to determine threshold K. Figure I.1 shows examples for the data with controlled standard uniform illuminations. It is suggested to acquire threshold K by taking the maximum value for most CVs, as in Figure I.2.

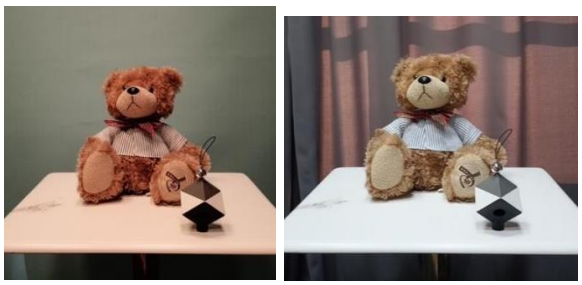

Figure I.1 – Examples for the captured images with uniform illuminations

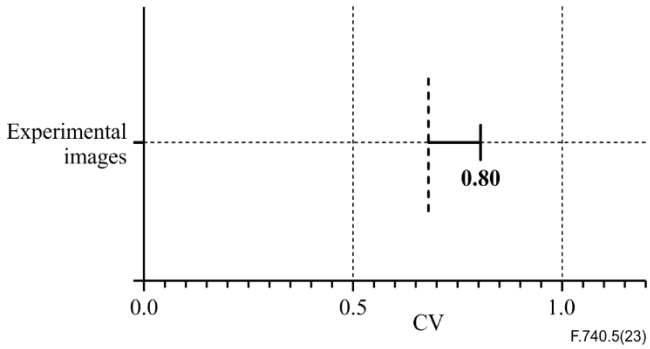

Figure I.2 – Distributions of threshold K for the raw images with uniform illuminations

Bibliography

[b-ITU-T X.1255] Recommendation ITU-T X.1255 (2013), *Framework for discovery of identity management information.*

[b-ISO/IEC 30118-4] Recommendation ISO/CIE 30118-4, *Information technology – Open Connectivity Foundation (OCF) Specification – Part 4: Resource type specifications*.

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