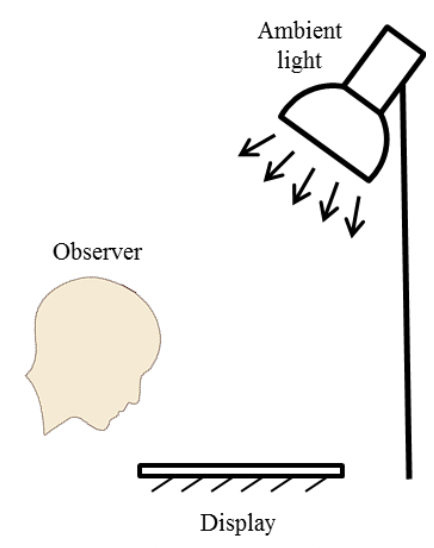
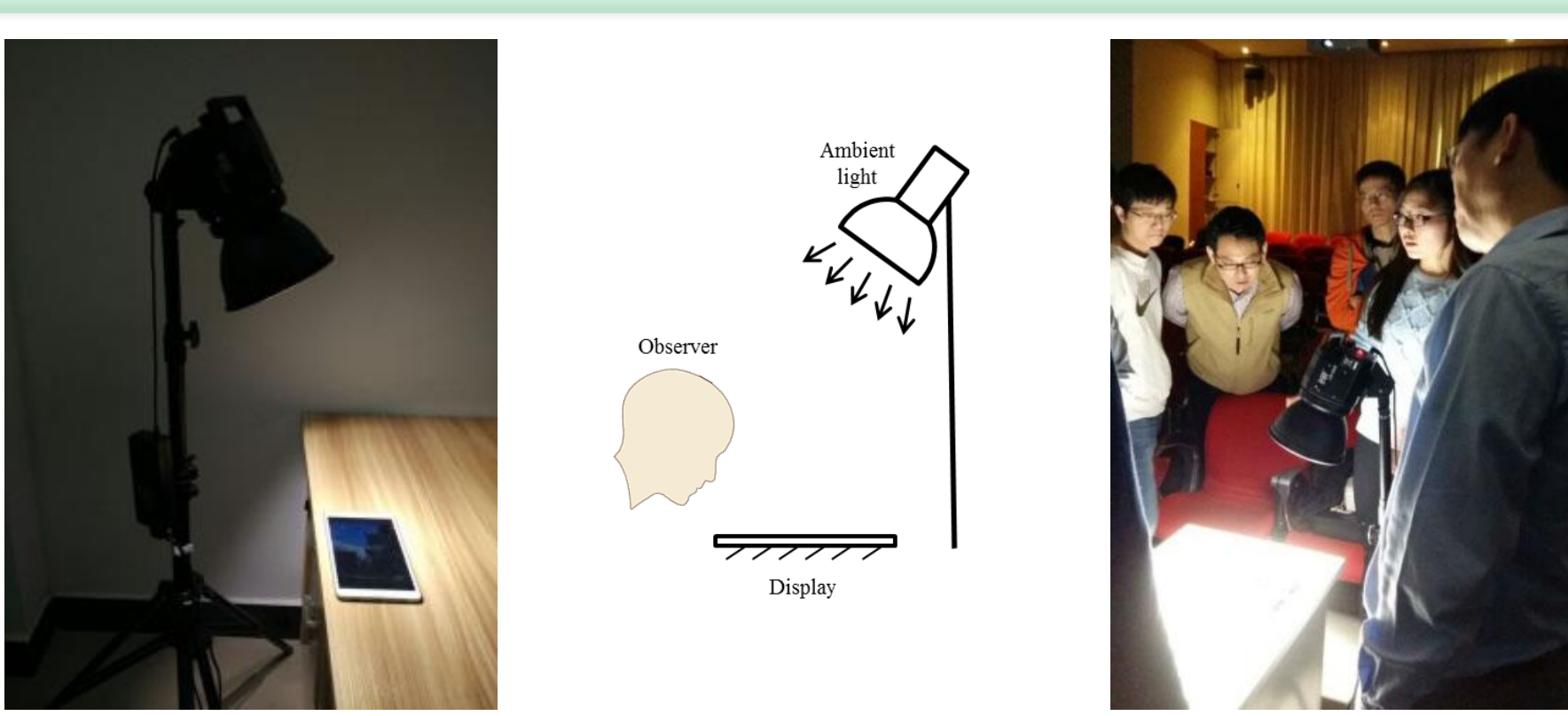


Surrounding Adaptive Tone Mapping in Displayed Images under Ambient Light

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Ambient Light Adaptive Display Enhancement (ALADE)

• **Two types of light** in this work:

- 1) Surrounding light in an image;
- 2) Ambient light in outdoor environment;

• **Ambient light:** Visibility reduction, dark perception in HVS

• **Our approach**

- 1) Brightness compensation in dark regions (surrounding light)
- 2) Adaptive tone mapping using TVI function (ambient light)

Proposed Method

• **Low level enhancement** by Bartleson-Breneman equation
: Enhance dark regions caused by surrounding light[1]

$$L_a = I_{gain} f + I_{offset}$$

$$f = \left| \frac{L - L_{min}}{L_{max} - L_{min}} \right|^{\gamma} \quad I_{gain} = \frac{100}{f_{max} - f_{min}} \quad I_{offset} = -\frac{100 f_{min}}{f_{max} - f_{min}}$$



• **Adaptive Tone Mapping** to Ambient Light

: Combine **cone and rod TVI function**[2] with **tone mapping**[3] considering HVS perception under ambient light

$$L_d = mL \quad m = t(L_a + ref) / t(L)$$

m : tone mapping operator

$T()$: TVI function

k : reflectivity

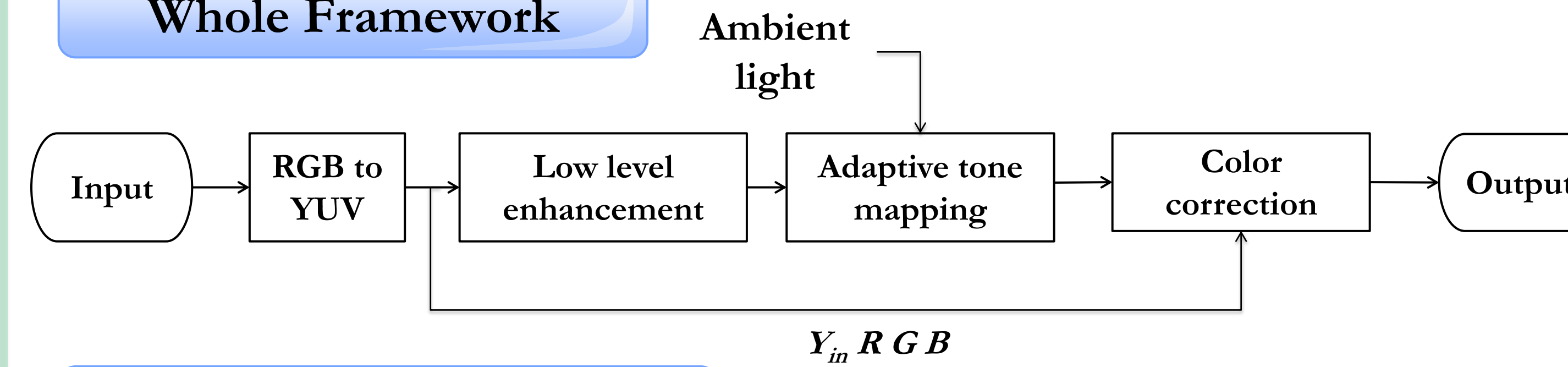
$$ref = k \cdot \frac{M}{\pi}$$

M : ambient light intensity

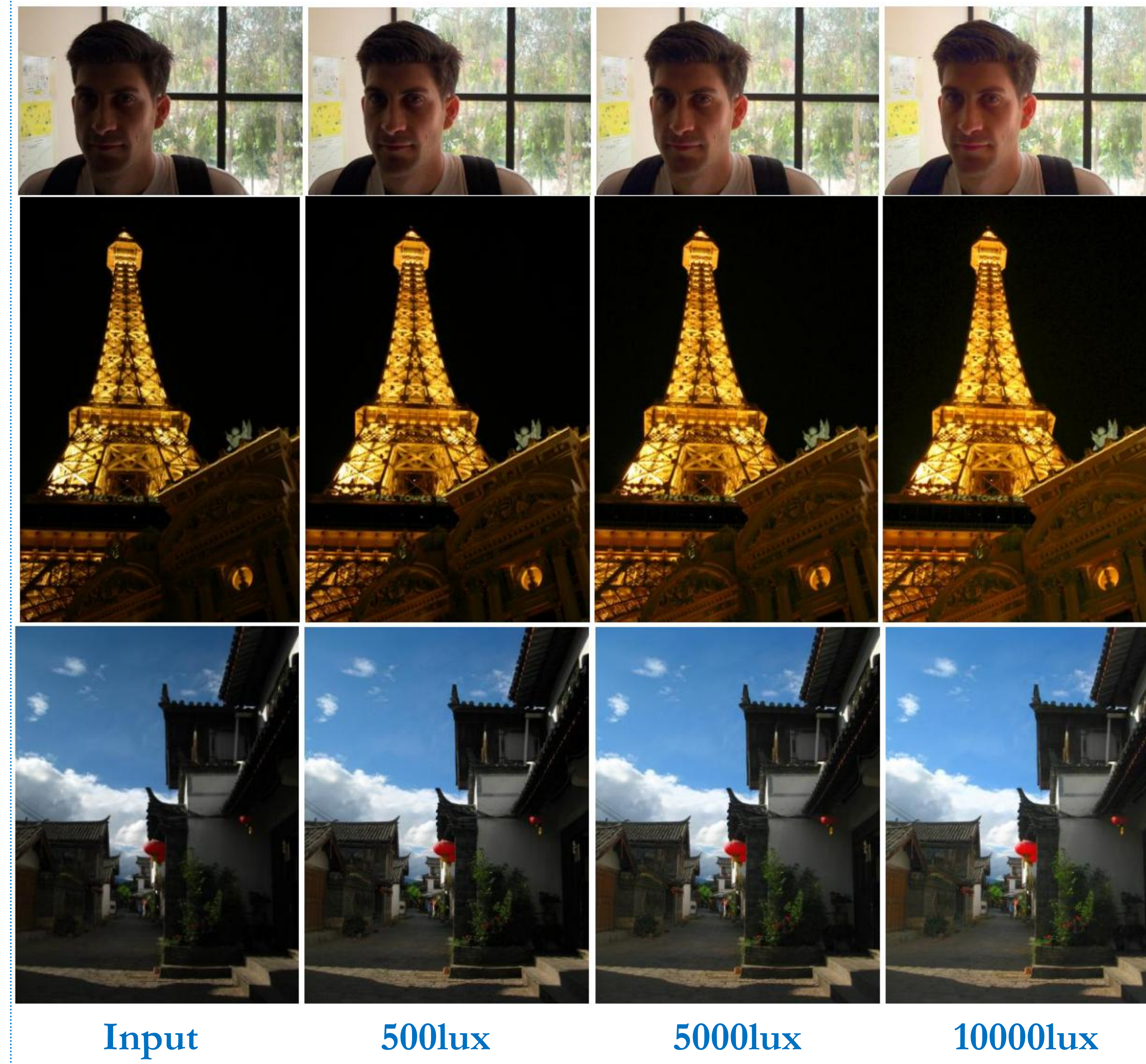
• **Color Correction**

$$\begin{bmatrix} R' \\ G' \\ B' \end{bmatrix} = \begin{bmatrix} ratio & 0 & 0 \\ 0 & ratio & 0 \\ 0 & 0 & ratio \end{bmatrix} \begin{bmatrix} R \\ G \\ B \end{bmatrix} \quad ratio = \frac{L_d}{L}$$

Whole Framework



Experimental Results



Conclusions

- Surrounding adaptive tone mapping under ambient light
- Brightness compensation in dark regions by low-level enhancement
- Ambient light adaptive tone mapping considering HVS perception by TVI function
- Successfully improve **readability of displayed images** under various ambient light conditions

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Acknowledgement

This work was supported by the National Natural Science Foundation of China (No. 61271298) and the International S&T Cooperation Program of China (No. 2014DFG12780).