



IIT MADRAS

Indian Institute of Technology Madras

Technology Transfer Office TTO - IPM Cell



Industrial Consultancy & Sponsored Research (IC&SR)

Method and System for Real-Time Restoration of Images captured in Extreme Low-Light Condition

IITM Technology Available for Licensing

PROBLEM STATEMENT

- Eventhough a practical low-light enhancement solution must be computationally fast, memory-efficient, & achieve a visually appealing restoration, existing methods target mostly restoration quality whilst compromising on **speed** & **memory** requirements & this raises concerns about the implementation & deployment in real world applications.
- Moreover, even if the computational aspect is set aside & computational efficiency is not a concern, it is still very **challenging** to restore images captured in extremely dark conditions.
- Hence, present invention addresses the problems & can restore an ultrahigh-definition **4K** resolution image in real time applications including efficient restoration quality.

INTELLECTUAL PROPERTY

IITM IDF Ref. 2176; IN Patent No:462334

TECHNOLOGY CATEGORY/ MARKET

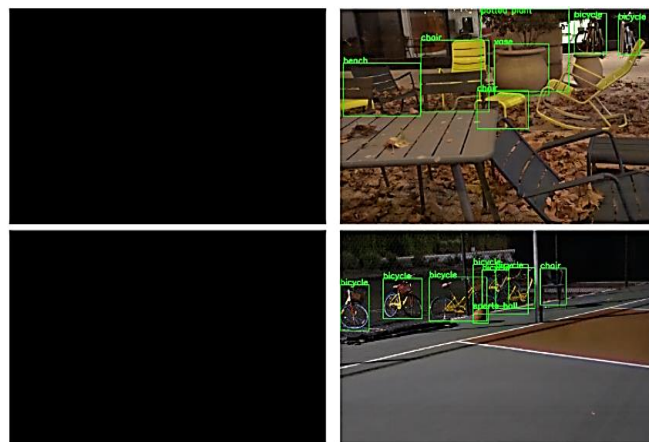
Technology: Real-Time Restoration of Images captured;

Industry/Applications: Computer Technology, Computer Software, Photoshop;

Market: The global **image capture** market is projected to grow at a **CAGR of 12.8%** during **2023-2030**.

TECHNOLOGY

- The present invention describes a **method & an apparatus** of **real time restoration of images captured in extreme low-light condition**. (Refer Fig.1 & Fig.3)
- Said method comprises a few steps explained and illustrated in figures:
- In **First step** explains about **capturing** at least one **image** in an **extreme low-light condition**.
- The following step describes about the **computing an amplification factor** based on one or more parameters.



Captured Extremely Dark Image

Our Restoration + Object Detection

FIG.1

- Yet further step explains about the **amplifying at least one image** based on the computed amplification factor.
- Still next step describes about **selecting** one or more scale levels from an image scale space, wherein each scale level has a respective high, medium, and/or low resolution with respect to one another, wherein said selection is performed by a **scale selection unit**, and selecting the one or more scale levels from image scale space comprises **skipping one or more intermediate scale levels** of the image scale space.
- Further step describes about the **parallely encoding**, by one or more encoders, the at least one amplified image at the one or more selected scale levels to **restore the captured image with enhanced quality**.

TRL (TECHNOLOGY READINESS LEVEL)

TRL-2/3, Proof of Concept ready

RESEARCH LAB

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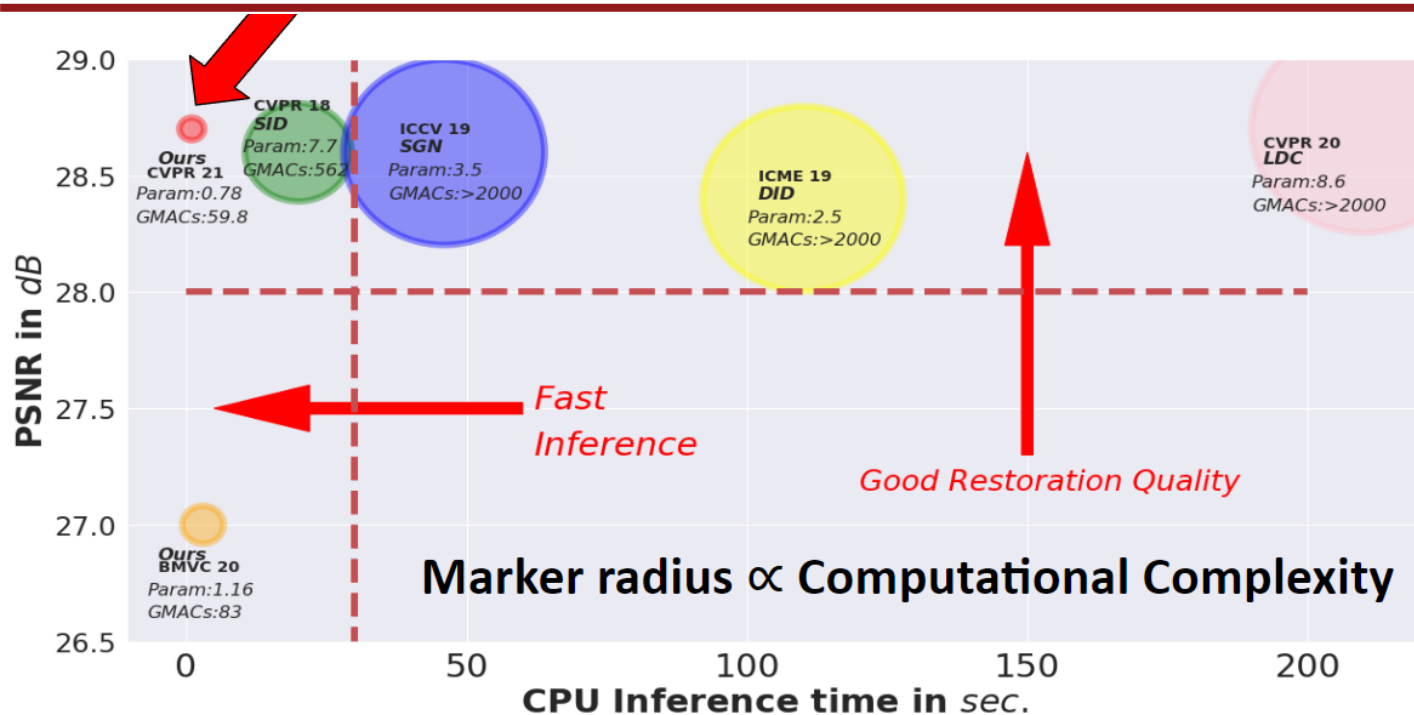


FIG.2: Illustrates drastic improvement in inference speed and computational efficiency while maintaining a competitive restoration

TECHNOLOGY (Contd.)

- The **encoding** the at least one amplified image at higher scale levels comprises **simultaneously processing** a **rectified output** and a **non-rectified output** of convolutional layers present in **modified Residual Dense Blocks (RDBs)**.
- The **modified RDB** facilitates **better restoration** & **maintains** time-memory complexity **efficiently**.

APPLICATIONS

Proposed invention is applicable in the areas of below and related sectors:

- Smart phone cameras,**
- DSLR cameras,**
- ADAS and automobiles,**

- Image Editing/Enhancement software,**
- Photoshop,**
- Computer Technology**

KEY FEATURES / VALUE PROPOSITION

❖ Technical Perspective:

- Disclosed invention saves a **large amount of time** and **computational overhead**, which is necessary for real-world applications, but **also enables accurate low-light image recovery with enhanced image quality.** (Refer Fig.2)
- Especially, said invention can restore an **ultrahigh-definition 4K resolution image at 32 fps on a GPU.**

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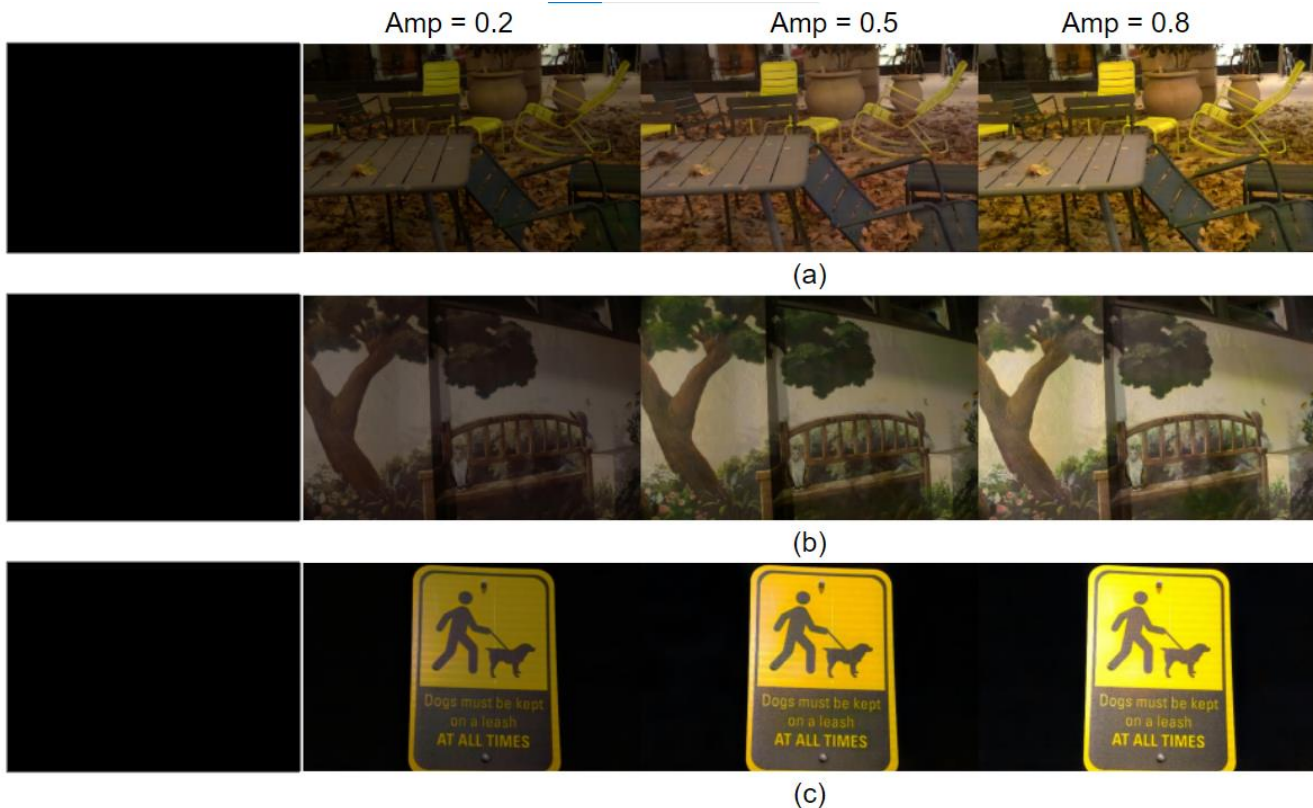


Fig. 3(a)-(c): Illustrates restored dark input images with different color brightness which can be adjusted by the user;

KEY FEATURES / VALUE PROPOSITION (Contd.)

- The enhanced restored image is generated by skipping the intermediate scale level processing and **by operating all the encoders (LSE, MSE and HSE) parallelly and independently** on the amplified image. (Refer Fig.4)

❖ **Industrial Perspective:**

- Claimed invention is not only **cost-effective, computationally fast, and memory-efficient** but also provides a **accurate restoration of image captured** in extreme low-light condition.

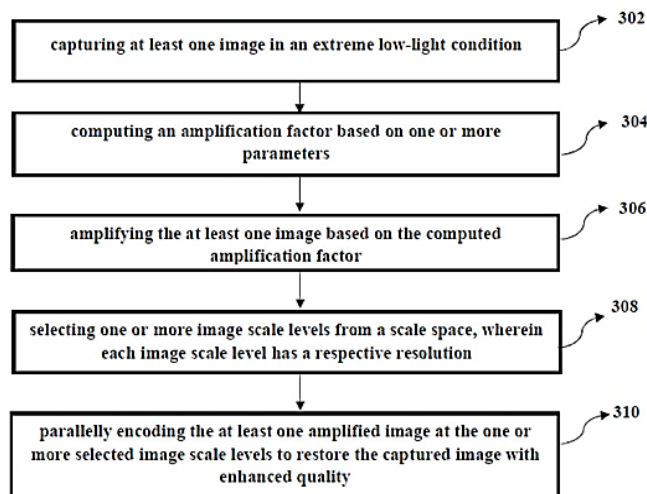


Fig.4: Illustrates the flowchart depicting a real-time image restoration method;

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