Digital Image Processing

Term Project

2025 Fall Semester

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Your task is **to improve the image quality and to develop new functionalities** of a USB camera by leveraging techniques learned from classes and literature. Use the images generated by the camera as the input of your algorithm(s).

Device information:

Feature	Built-in Functions
Auto Gain / Exposure / White Balance	Automatic (AGC / AEC / AWB)
Supported Video Formats	MJPG, YUV
Resolution	640×480
Supported Platforms	Windows, iOS, Android, Linux
Link	Taiwan IoT Shop

Suggested Areas of Work

Students are suggested to work on the following:

1. Analyze the problems or deficiency of the USB camera in geometric distortion, color distortion, resolution, noise, etc.
2. Design and implement efficient algorithms to address the identified problems
3. Extend the functionality of the USB camera

Category	Examples
Image Enhancement	• Brightness • Color appearance • Distortion correction
Computational efficiency	• Real-time performance • Frame rate
Functionality	• Video stabilization • Backlight compensation • 3-D reconstruction • Face recognition • Gaze tracking

Deliverables

- Live Demo — 10 minutes
- Presentation — 10 minutes
- Written Report — at least 10 pages, single space, excluding figures and tables

Grading Criteria

- Image quality
- Scope
- Computational performance
- Creativity

Example Code

Example code for image acquisition from the USB camera can be found in

- Python: OpenCV
- MATLAB: Acquire Images from Webcams

```python
import cv2
# Create a VideoCapture object.
# The argument '0' typically refers to the default webcam.
# If you have multiple webcams, you can try '1', '2', etc.
cap = cv2.VideoCapture(1)
# Check if the webcam was opened successfully
if not cap.isOpened():
    print("Error: Could not open webcam.")
    exit()
while True:
    # Read a frame from the webcam
    ret, frame = cap.read()
    # If the frame was not read successfully, break the loop
    if not ret:
        print("Error: Could not read frame.")
        break
    # Display the captured frame
    cv2.imshow('Webcam Feed', frame)
    # Wait for a key press. If 'q' is pressed, break the loop.
    if cv2.waitKey(1) & 0xFF == ord('q'):
        break
# Release the VideoCapture object and destroy all OpenCV windows
cap.release()
cv2.destroyAllWindows()
```