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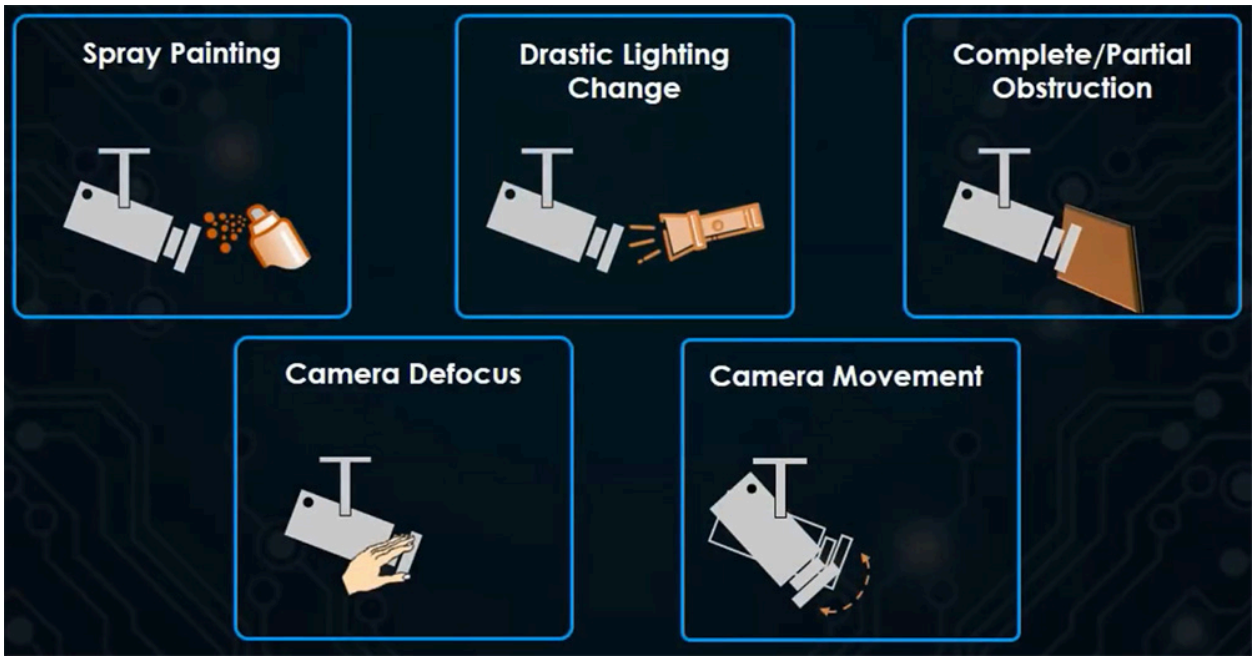
Tampering Detection System:

Objective:

Tampering detection system aims at ensuring the integrity of the traffic images. Camera images can be tempered due to many means such as environmental changes such fog, dust, fire, excessive light, man made manipulation to camera such as occluding the camera with some object or cloth, blurring due to defocusing the camera, motion blur etc.



There are many causes of getting the tempered image, Let us list down the cause and effects :

Cause of Tempering	**Effect of Tempering**
Camera tempered with cloth partially or fully	Significant region of image is blackened
Overexposure of Light	Very bright or Complete white image or glare in specific region of image
Fog	Foggy Image
Dust	Some region of image has dust and particles or soiled

Camera Defocusing	Blurr
Unknown cause	Blurr
Camera position tempering	Change in the Image Perspective

Dataset collection:

We can collect the dataset for following cases:

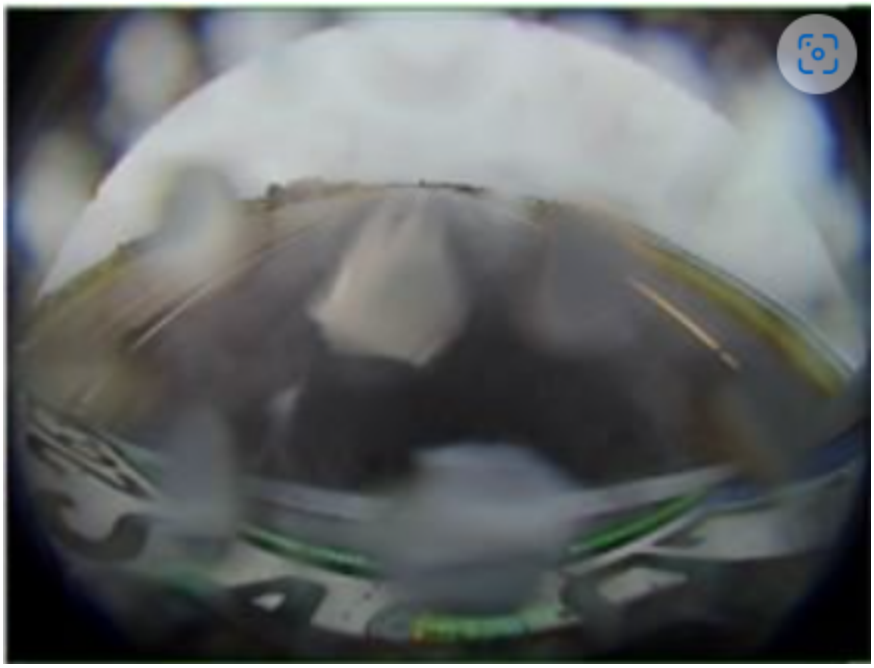
1) Foggy Images
2) Dust/soiled Images
3) Images with glare
4) Blurr images

Annotation strategy:

Per-pixel annotate the segments of fog/rain drop, dust/soiling , glare, blurr

Examples images of these cases :

Soiled Image



Foggy Image Tempered due to water droplets or fog

Image with glare

Methodologies:

Before even discussing the possible methodologies. What possible ways do we have to formulate the problem?

1) Do we want to only know whether camera is tempered or not i.e., is image quality degraded or not ?
2) Do we want to know the cause of tempering i.e., category Blur, Fog, Glare, Soiling, etc.
3) Do we want categories as well as localize the spatial regions which are tempered ?

Problem Statement:

Classify the category of temporing as well as segment the tempered spatial region of the image. Segment the regions of image affected by dust/soiling, Fog and Glare.

Assumptions:

1) The location where the camera is installed is under constant surveillance, ensuring there is always some level of ambient light in the area. This ensures that the images captured are not completely black.
2) Camera has an inbuilt gyroscope and oscilloscope sensors.

Pseudo code:

```
# Initialize thresholds
threshold1
threshold2

# Initialize Flags
pose_tempered = False
image_degraded = False

# Calculate delta change in position and orientation of gyroscope and oscilloscope sensor
# reading
delta_change = cal_delta_change_in_pose(gyroscope_reading, oscilloscope_reading)

# if delta change is larger than acceptable
if delta_change > threshold1 :
        pose_tempered = True
        result = “Camera Tempered due to change in position and orientation”

# if camera position is not tempered
if not pose_tempered :
    iqs = cal_image_quality_score(image)
```

```
        if iqs < threshold2:
            image_degraded = True
        else:
          result = “Camera is all OK - Image quality up to the mark”

# if image quality is degraded
if image_degraded:
    mean_intensity = cal_mean_intensity(image)
    if mean_intensity < 50 :
        result = “ Camera Tempered : Highly blackened Image \n
                Possible reasons: Camera obstructed by an Object or cloth”
    elif mean_intensity > 200:
        result = “ Camera Tempered : Highly Whitened Image \n
                Possible reasons: Due to Overexposure of Light”
    else:
        results = semantic_segmentation_model(image)
```

Explanation of the Proposed approach:

Camera position tempering is difficult to detect via images because we cannot have a reference image to compare with since the reference image might change with location as well as in case of changes of objects and infrastructure in the view camera on site.

Nowadays smart cameras have advanced sensors like gyroscope and oscilloscope inbuilt. We can keep track of the delta changes and if it is abnormal we can say that camera position is tempered.

If the camera position is not tempered we can calculate the Image Quality Score using Neural Image Assessment Algorithm an open-source no-reference image quality assessment tool
If the image score is greater than some threshold we can say that the camera is all ok and there are no signs of camera tempering.

If the image quality is degraded then we can calculate the mean intensity of grayscale image to know if the image is abnormally blackened or whitened. If it is abnormally blackened we can say that it might have happened due to an obstructing object or a cloth. If it is abnormally whitened then we can say that it is overexposed with light i.e., tempered.

If the image is not abnormally blackened or whitened then it still has some useful information. In that case we can run a per pixel semantic segmentation model to segment the tempered regions for the classes blurr, dust or soiling , fog or rain drops, glare.

Based on the segmented regions we can decide what action to take for the downstream task of Object detection and anything else till the camera is manually fixed or clean.

References:

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