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LAMPIRAN

Lampiran 1 Skrip program pengukuran metriks performance

Skrip program ini memakai Bahasa pemrograman python dan dijalankan pada visual studio code.

Skrip pengukuran YOLOv4 dengan *filter Pre-processing*

```
# Load YOLOv4 model using OpenCV

import os

import cv2

import numpy as np

from pycocotools.coco import COCO


# Path setup

coco_annotation_file = os.path.join('path', 'to', 'annotations', 'instances_val2017.json')

image_folder = os.path.join('path', 'to', 'images', 'val2017')

model_folder = os.path.dirname(os.path.abspath(__file__))


net = cv2.dnn.readNetFromDarknet(os.path.join(model_folder, 'yolov4.cfg'), os.path.join(model_folder, 'yolov4.weights'))

layer_names = net.getLayerNames()

output_layers = [layer_names[i - 1] for i in net.getUnconnectedOutLayers()]


# Preprocess image with optimized filters for YOLOv4

def preprocess_image_with_optimized_filters(image_path, target_size):

    if not os.path.exists(image_path):

        raise FileNotFoundError(f"File {image_path} tidak ditemukan.")


    image = cv2.imread(image_path)

    if image is None:

        raise IOError(f"Gagal membaca file gambar {image_path}. Periksa jalur file dan integritasnya.")
```

```
    # Calculate brightness
    hsv = cv2.cvtColor(image, cv2.COLOR_BGR2HSV)
    brightness = hsv[..., 2].mean()

    # Set filter parameters based on brightness
    if brightness < 50:
        blur_strength = int(np.interp(brightness, [0, 50], [15, 5]))
        CLAHE_limit = np.interp(brightness, [0, 50], [4.0, 2.0])
        tile_grid_size = int(np.interp(brightness, [0, 50], [16, 8]))

        # Ensure blur_strength is odd
        blur_strength = max(1, blur_strength | 1)

        image = cv2.GaussianBlur(image, (blur_strength, blur_strength), 0)
        image = cv2.medianBlur(image, blur_strength)

        gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
        equalized = cv2.equalizeHist(gray)

        CLAHE = cv2.createCLAHE(clipLimit=CLAHE_limit,
tileGridSize=(tile_grid_size, tile_grid_size))
        CLAHE_applied = CLAHE.apply(equalized)

        # Convert to grayscale if very dark
        if brightness < 20:
            image = cv2.cvtColor(CLAHE_applied, cv2.COLOR_GRAY2BGR)
        else:
            lab = cv2.cvtColor(image, cv2.COLOR_BGR2LAB)
            l, a, b = cv2.split(lab)
```

```
            l = CLAHE.apply(l)
            lab = cv2.merge((l, a, b))
            image = cv2.cvtColor(lab, cv2.COLOR_LAB2BGR)
    else:
        # Apply minimal filtering to maintain colors
        image = cv2.GaussianBlur(image, (3, 3), 0)
        image = cv2.medianBlur(image, 3)

    blob = cv2.dnn.blobFromImage(image, 1/255.0, target_size, swapRB=True, crop=False)
    return blob, image

# Perform detection using YOLOv4
def detect_objects(image, net, output_layers):
    net.setInput(image)
    outputs = net.forward(output_layers)
    return outputs

# Postprocess detections
def postprocess_detections(outputs, width, height, conf_threshold=0.5, nms_threshold=0.4):
    boxes = []
    confidences = []
    class_ids = []
    for output in outputs:
        for detection in output:
            scores = detection[5:]
            class_id = np.argmax(scores)
            confidence = scores[class_id]
            if confidence > conf_threshold:
```

```
            center_x = int(detection[0] * width)
            center_y = int(detection[1] * height)
            w = int(detection[2] * width)
            h = int(detection[3] * height)
            x = int(center_x - w / 2)
            y = int(center_y - h / 2)
            boxes.append([x, y, x + w, y + h])
            confidences.append(float(confidence))
            class_ids.append(class_id)
    indices = cv2.dnn.NMSBoxes(boxes, confidences, conf_threshold, nms_threshold)
    return [(boxes[i], class_ids[i]) for i in indices]


# Evaluate detections manually
def evaluate_detections(detections, ground_truths, iou_threshold=0.3):
    tp = 0
    fp = 0
    fn = len(ground_truths)

    for det in detections:
        detected = False
        for gt in ground_truths:
            iou = calculate_iou(gt, det[0])
            if iou > iou_threshold:
                detected = True
                tp += 1
                fn -= 1
                break
        if not detected:
            fp += 1
```

```
    precision = tp / (tp + fp) if (tp + fp) > 0 else 0
    recall = tp / (tp + fn) if (tp + fn) > 0 else 0
    f1_score = 2 * (precision * recall) / (precision + recall) if (precision + recall) > 0 else
0

    return precision, recall, f1_score

# Calculate IoU (Intersection over Union)
def calculate_iou(boxA, boxB):
    xA = max(boxA[0], boxB[0])
    yA = max(boxA[1], boxB[1])
    xB = min(boxA[2], boxB[2])
    yB = min(boxA[3], boxB[3])

    interArea = max(0, xB - xA) * max(0, yB - yA)
    boxAArea = (boxA[2] - boxA[0]) * (boxA[3] - boxA[1])
    boxBArea = (boxB[2] - boxB[0]) * (boxB[3] - boxB[1])

    iou = interArea / float(boxAArea + boxBArea - interArea)
    return iou
```

Skrip pengukuran YOLOv4 tanpa *filter Pre-processing*

```
# Load YOLOv4 model using OpenCV
import os
import cv2
import numpy as np
import pandas as pd
import tkinter as tk
from tkinter import ttk, messagebox
from pycocotools.coco import COCO
```

```
# Path setup
coco_annotation_file = os.path.join('path', 'to', 'annotations', 'instances_val2017.json')
image_folder = os.path.join('path', 'to', 'images', 'val2017')
model_folder = os.path.dirname(os.path.abspath(__file__))

# Load YOLOv4 model using OpenCV
net = cv2.dnn.readNetFromDarknet(os.path.join(model_folder, 'yolov4.cfg'), os.path.join(model_folder, 'yolov4.weights'))
layer_names = net.getLayerNames()
output_layers = [layer_names[i - 1] for i in net.getUnconnectedOutLayers()]

# Load COCO annotations
coco = COCO(coco_annotation_file)

# Load class names
def load_class_names(file_path):
    with open(file_path, 'r') as f:
        class_names = f.read().strip().split('\n')
    return class_names

# Preprocess image for YOLOv4 (without additional filters)
def preprocess_image(image_path, target_size):
    image = cv2.imread(image_path)
    blob = cv2.dnn.blobFromImage(image, 1/255.0, target_size, swapRB=True, crop=False)
    return blob, image

# Perform detection using YOLOv4
def detect_objects(image, net, output_layers):
```

```
    net.setInput(image)
    outputs = net.forward(output_layers)
    return outputs


# Postprocess detections
def postprocess_detections(outputs, width, height, conf_threshold=0.5, nms_threshold=0.4):
    boxes = []
    confidences = []
    class_ids = []
    for output in outputs:
        for detection in output:
            scores = detection[5:]
            class_id = np.argmax(scores)
            confidence = scores[class_id]
            if confidence > conf_threshold:
                center_x = int(detection[0] * width)
                center_y = int(detection[1] * height)
                w = int(detection[2] * width)
                h = int(detection[3] * height)
                x = int(center_x - w / 2)
                y = int(center_y - h / 2)
                boxes.append([x, y, x + w, y + h])
                confidences.append(float(confidence))
                class_ids.append(class_id)
    indices = cv2.dnn.NMSBoxes(boxes, confidences, conf_threshold, nms_threshold)
    return [(boxes[i], class_ids[i]) for i in indices]


# Evaluate detections manually
```

```
def evaluate_detections(detections, ground_truths, iou_threshold=0.3):
    tp = 0
    fp = 0
    fn = len(ground_truths)

    for det in detections:
        detected = False
        for gt in ground_truths:
            iou = calculate_iou(gt, det[0])
            if iou > iou_threshold:
                detected = True
                tp += 1
                fn -= 1
                break
        if not detected:
            fp += 1

    precision = tp / (tp + fp) if (tp + fp) > 0 else 0
    recall = tp / (tp + fn) if (tp + fn) > 0 else 0
    f1_score = 2 * (precision * recall) / (precision + recall) if (precision + recall) > 0 else
0

    return precision, recall, f1_score

# Calculate IoU (Intersection over Union)
def calculate_iou(boxA, boxB):
    xA = max(boxA[0], boxB[0])
    yA = max(boxA[1], boxB[1])
    xB = min(boxA[2], boxB[2])
    yB = min(boxA[3], boxB[3])
```

```
    interArea = max(0, xB - xA) * max(0, yB - yA)
    boxAArea = (boxA[2] - boxA[0]) * (boxA[3] - boxA[1])
    boxBArea = (boxB[2] - boxB[0]) * (boxB[3] - boxB[1])

    iou = interArea / float(boxAArea + boxBArea - interArea)
    return iou
```

Lampiran 2 Skrip program parameter kualitas gambar

```
import os
import cv2
import numpy as np
import pandas as pd
from skimage.metrics import structural_similarity as ssim
from math import log10, sqrt
import warnings

# Image processing parameters
blur_strength_low = 3
blur_strength_high = 15
CLAHE_limit_low = 2.0
CLAHE_limit_high = 4.0
tile_grid_size_low = 8
tile_grid_size_high = 16

# Folder containing images
image_folder = os.path.join('path', 'to', 'images', 'val2017')

# Function to apply pre-processing filters
def apply_filters(image):
    hsv = cv2.cvtColor(image, cv2.COLOR_BGR2HSV)
```

```
    brightness = hsv[..., 2].mean()


    if brightness < 50:
        blur_strength = int(np.interp(brightness, [0, 50], [blur_strength_high,
blur_strength_low]))
        CLAHE_limit = np.interp(brightness, [0, 50], [CLAHE_limit_high,
CLAHE_limit_low])
        tile_grid_size = int(np.interp(brightness, [0, 50], [tile_grid_size_high,
tile_grid_size_low]))
        blur_strength = max(1, blur_strength | 1)


        image = cv2.GaussianBlur(image, (blur_strength, blur_strength), 0)
        image = cv2.medianBlur(image, blur_strength)


        gray = cv2.cvtColor(image, cv2.COLOR_BGR2GRAY)
        equalized = cv2.equalizeHist(gray)


        CLAHE = cv2.createCLAHE(clipLimit=CLAHE_limit,
tileGridSize=(tile_grid_size, tile_grid_size))
        CLAHE_applied = CLAHE.apply(equalized)


        if brightness < 20:
            image = cv2.cvtColor(CLAHE_applied, cv2.COLOR_GRAY2BGR)
        else:
            lab = cv2.cvtColor(image, cv2.COLOR_BGR2LAB)
            l, a, b = cv2.split(lab)
            l = CLAHE.apply(l)
            lab = cv2.merge((l, a, b))
            image = cv2.cvtColor(lab, cv2.COLOR_LAB2BGR)
    else:
        image = cv2.GaussianBlur(image, (blur_strength_low, blur_strength_low), 0)
        image = cv2.medianBlur(image, blur_strength_low)
```

```
    return image

# Function to calculate SNR
def calculate_snr(image, noise):
    signal_power = np.mean(image ** 2)
    noise_power = np.mean(noise ** 2)
    if noise_power == 0:
        return float('inf')
    snr_value = 10 * log10(signal_power / noise_power)
    return snr_value

# Function to calculate PSNR
def calculate_psnr(original, processed):
    mse_value = np.mean((original - processed) ** 2)
    if mse_value == 0:
        return float('inf')
    max_pixel = 255.0
    psnr_value = 20 * log10(max_pixel / sqrt(mse_value))
    return psnr_value

# Function to calculate MSE
def calculate_mse(original, processed):
    mse_value = np.mean((original - processed) ** 2)
    return mse_value

# Function to calculate SSIM
def calculate_ssim(original, processed):
    min_side = min(original.shape[0], original.shape[1])
    win_size = min(7, min_side)
    ssim_value = ssim(original, processed, channel_axis=-1, win_size=win_size)
```

```
    return ssim_value
```

Lampiran 3 Skrip program untuk menjalankan pengujian secara *realtime*

```
import cv2
import numpy as np
import URLlib.request
import requests
import time
from telegram import Bot

# YOLO Model Configuration
whT = 320
confThreshold = 0.15  # Lowering confidence threshold
nmsThreshold = 0.05  # Lowering NMS threshold
classesfile = 'path/to/coco.names'
classNames = []

with open(classesfile, 'rt') as f:
    classNames = f.read().rstrip('\n').split('\n')

modelConfig = 'path/to/yolov4.cfg'
modelWeights = 'path/to/yolov4.weights'
net = cv2.dnn.readNetFromDarknet(modelConfig, modelWeights)
net.setPreferableBackend(cv2.dnn.DNN_BACKEND_OPENCV)
net.setPreferableTarget(cv2.dnn.DNN_TARGET_CPU)

# Telegram Bot Configuration
telegram_bot_token = 'YOUR_TELEGRAM_BOT_TOKEN'
telegram_chat_id = 'YOUR_TELEGRAM_CHAT_ID'
bot = Bot(token=telegram_bot_token)

# Camera URL Configuration
```

```
camera_URL = 'http://path/to/camera_feed.jpg'

# Set up a session with retry strategy
session = requests.Session()

# Function to calculate brightness
def calculate_brightness(im):
    hsv = cv2.cvtColor(im, cv2.COLOR_BGR2HSV)
    brightness = hsv[..., 2].mean()
    return brightness

# Function to apply dynamic filters
def apply_dynamic_filters(im):
    brightness = calculate_brightness(im)
    if brightness < 20:
        blur_strength = int(np.interp(brightness, [0, 20], [15, 5]))
        CLAHE_limit = np.interp(brightness, [0, 20], [4.0, 2.0])
        tile_grid_size = int(np.interp(brightness, [0, 20], [16, 8]))

        if blur_strength % 2 == 0:
            blur_strength += 1
        if blur_strength < 1:
            blur_strength = 1

        im = cv2.GaussianBlur(im, (blur_strength, blur_strength), 0)
        im = cv2.medianBlur(im, blur_strength)

        gray = cv2.cvtColor(im, cv2.COLOR_BGR2GRAY)
        equalized = cv2.equalizeHist(gray)
```

```
        CLAHE = cv2.createCLAHE(clipLimit=CLAHE_limit,
tileGridSize=(tile_grid_size, tile_grid_size))
        CLAHE_applied = CLAHE.apply(equalized)


        im = cv2.cvtColor(CLAHE_applied, cv2.COLOR_GRAY2BGR)
    else:
        im = cv2.GaussianBlur(im, (3, 3), 0)
        im = cv2.medianBlur(im, 3)


    return im, brightness


# Function to find objects using YOLOv4
def findObject(outputs, im, with_filter):
    hT, wT, cT = im.shape
    bbox = []
    classIds = []
    confs = []
    found_person = False
    for output in outputs:
        for det in output:
            scores = det[5:]
            classId = np.argmax(scores)
            confidence = scores[classId]
            if confidence > confThreshold:
                w, h = int(det[2] * wT), int(det[3] * hT)
                x, y = int((det[0] * wT) - w / 2), int((det[1] * hT) - h / 2)
                bbox.append([x, y, w, h])
                classIds.append(classId)
                confs.append(float(confidence))


    indices = cv2.dnn.NMSBoxes(bbox, confs, confThreshold, nmsThreshold)
```

```
    if len(indices) > 0:
        for i in indices.flatten():
            box = bbox[i]
            x, y, w, h = box[0], box[1], box[2], box[3]
            if classNames[classIds[i]] == 'person':
                found_person = True
            cv2.rectangle(im, (x, y), (x + w, y + h), (255, 0, 255), 1)
            text = f'{classNames[classIds[i]].upper()} {int(confs[i] * 100)}%'
            cv2.putText(im, text, (x, y - 10 if y - 10 > 10 else y + h + 10),
cv2.FONT_HERSHEY_SIMPLEX, 0.6, (255, 0, 255), 1)
        return found_person
    return False


# Main Loop to Capture Image and Perform Detection
while True:
    try:
        img_resp = URLlib.request.URLopen(camera_URL)
        imgnp = np.array(bytearray(img_resp.read()), dtype=np.uint8)
        im = cv2.imdecode(imgnp, -1)


        # Resize image for faster processing
        im_small = cv2.resize(im, (whT, whT))


        # Apply dynamic filters
        im_with_filter, brightness_with_filter = apply_dynamic_filters(im_small.copy())


        blob_with_filter = cv2.dnn.blobFromImage(im_with_filter, 1/255, (whT, whT),
[0, 0, 0], 1, crop=False)
        net.setInput(blob_with_filter)
        outputs_with_filter = net.forward([net.getLayerNames()[i - 1] for i in
net.getUnconnectedOutLayers()])
```

```
        detected_with_filter = findObject(outputs_with_filter, im_with_filter,
with_filter=True)
        if detected_with_filter:
            print("Person detected with filter")
            # Additional actions can be added here (e.g., send notification)
        # Show the processed image
        cv2.imshow('Image with Filter', im_with_filter
        key = cv2.waitKey(1) & 0xFF
        if key == ord('q'):
            break
    except Exception as e:
        print(f"Error: {e}")
        break
cv2.destroyAllWindows()
```

Lampiran 4 Dokumentasi pengujian secara *realtime*

Dokumentasi Pengkalibrasian Kamera *ESP32*-CAM Dalam Ruangan

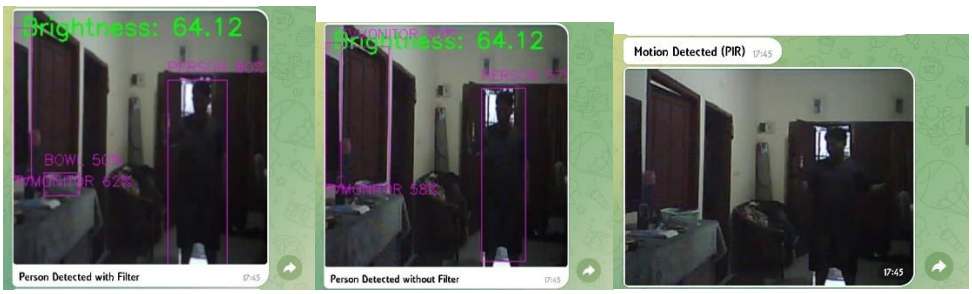
Dokumentasi Pengkalibrasian Kamera *ESP32*-CAM Luar Ruangan

Pemasangan Alat Untuk Pengujian Dalam Ruangan

Pemasangan Alat Untuk Pengujian Luar Ruangan

Pengujian Pemakaian Secara Real Time Dalam Ruangan

(Dok. Percobaan Jarak 2 Meter Dalam Ruangan Objek 1 Orang)



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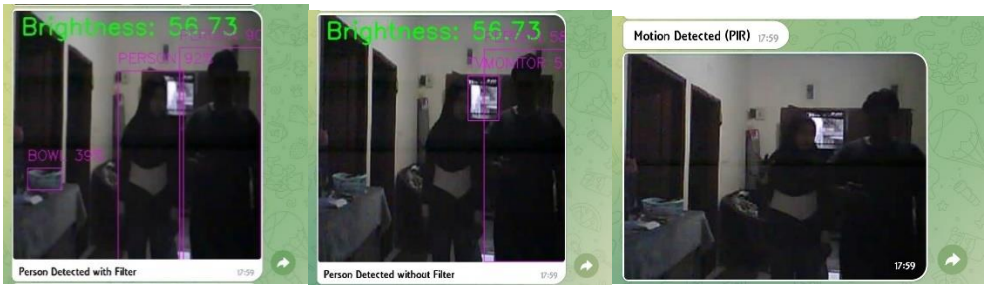

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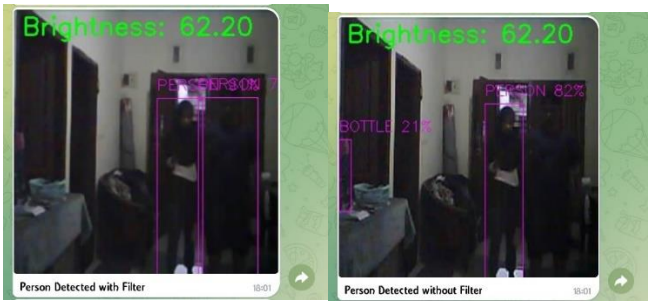

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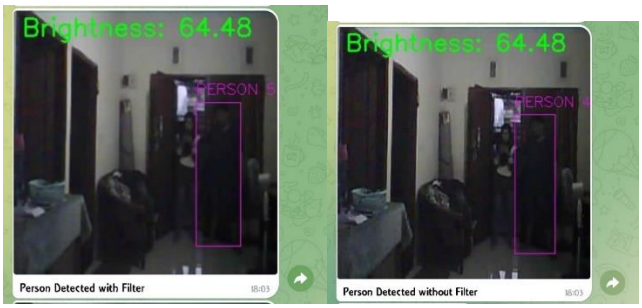

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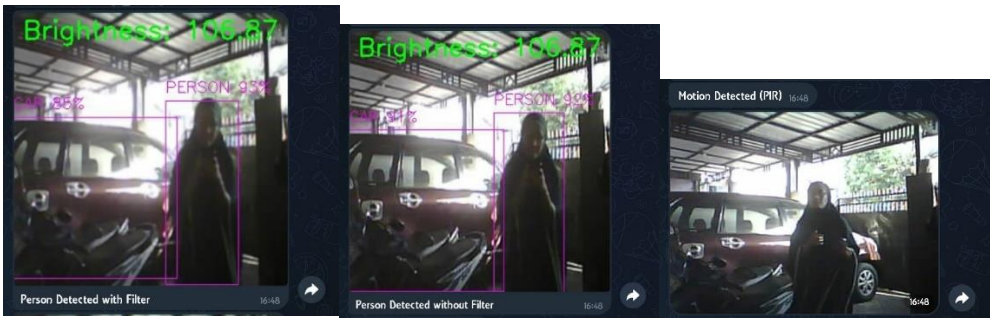
Pengujian Pemakaian Secara Real Time Diluar Ruangan (Kondisi Siang-Sore)



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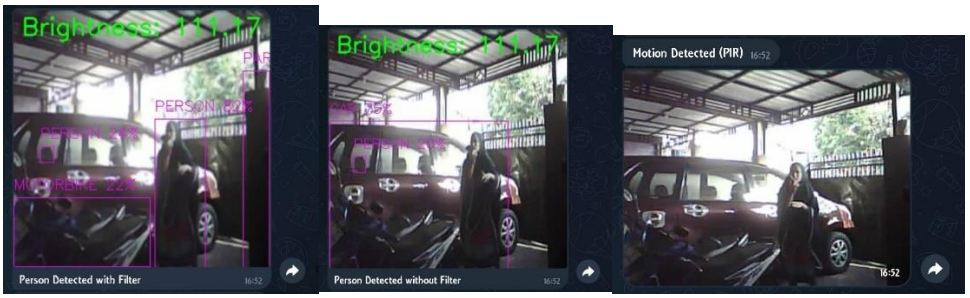

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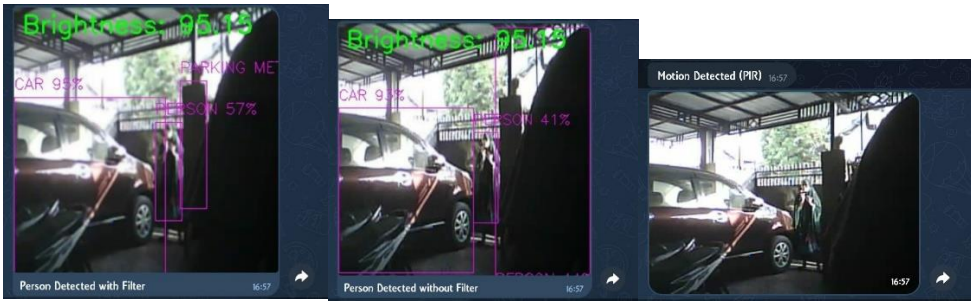

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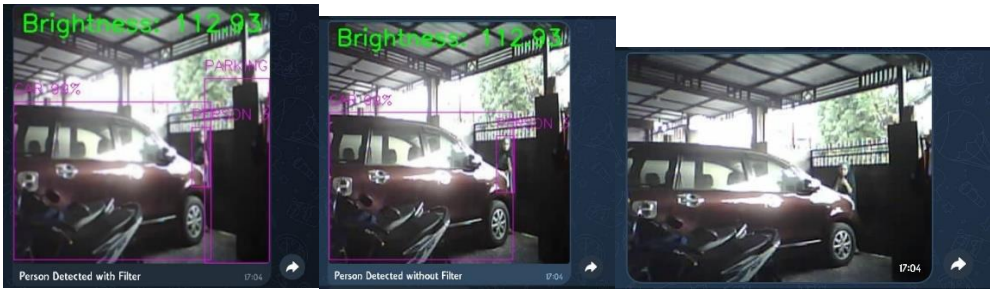

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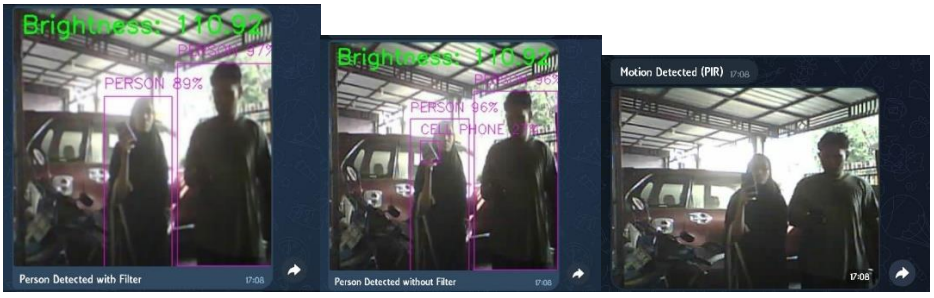

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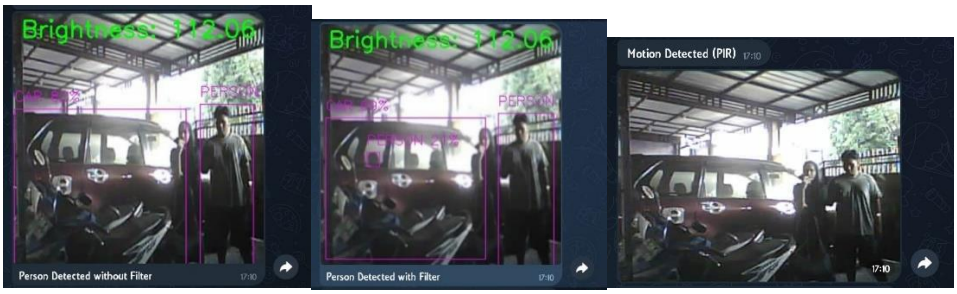

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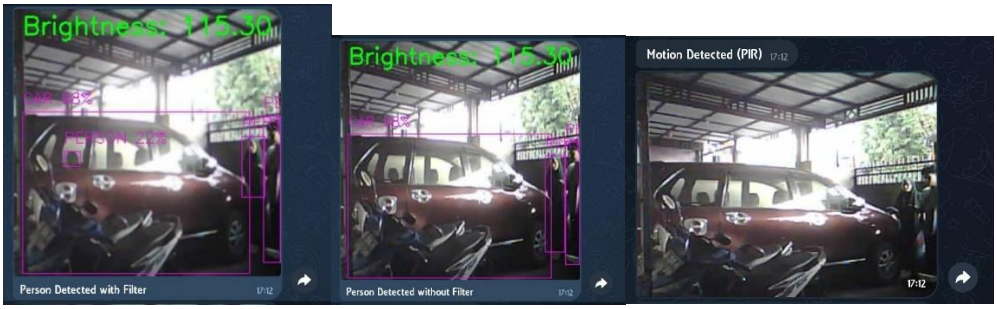

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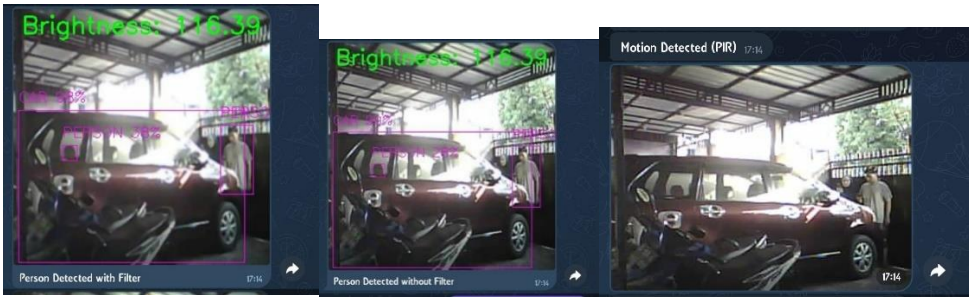

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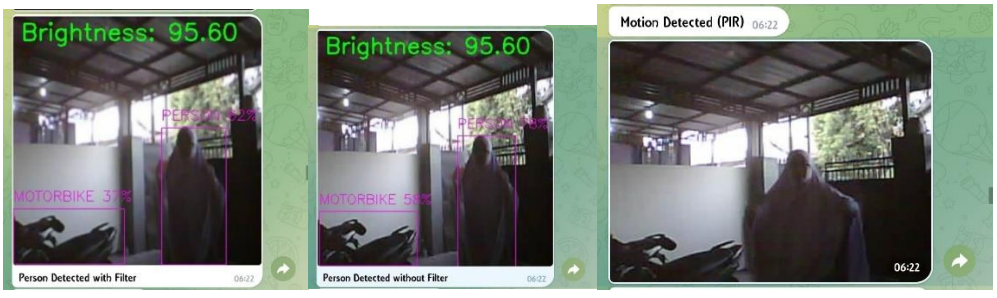
Pengujian Pemakaian Secara Real Time Diluar Ruangan (Kondisi Pagi)



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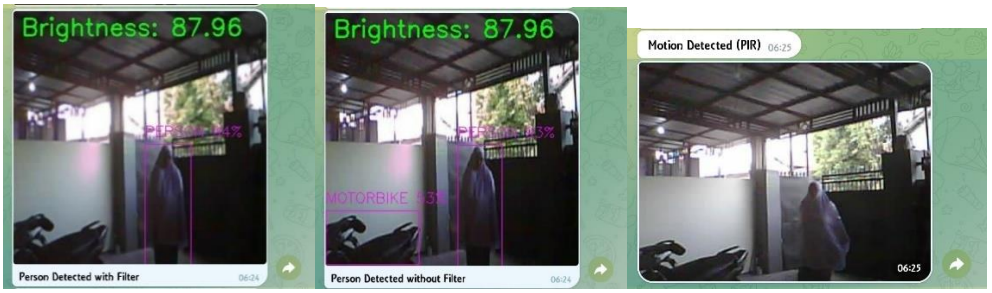

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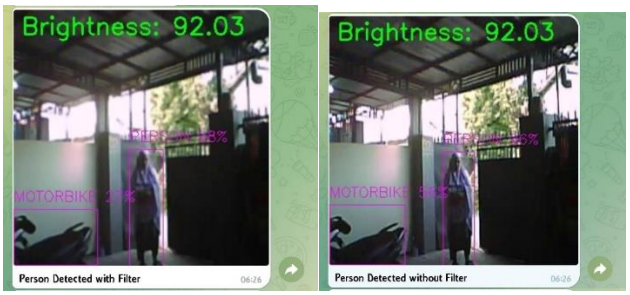

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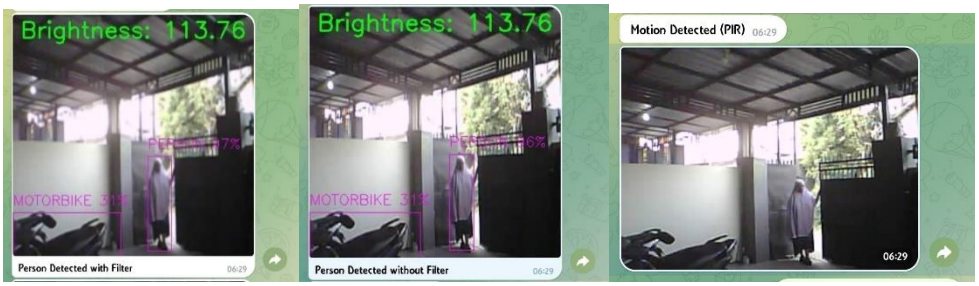

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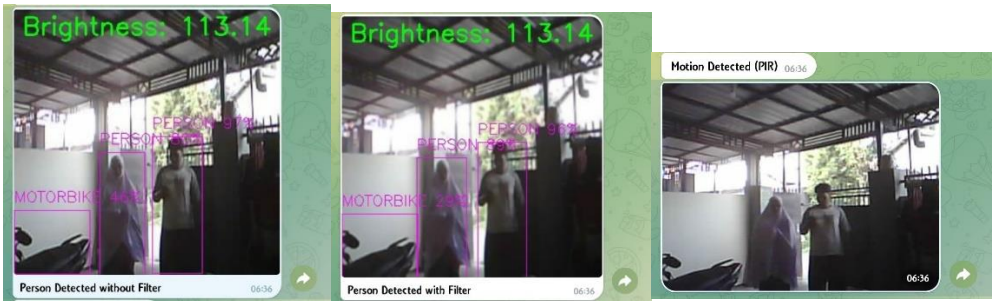

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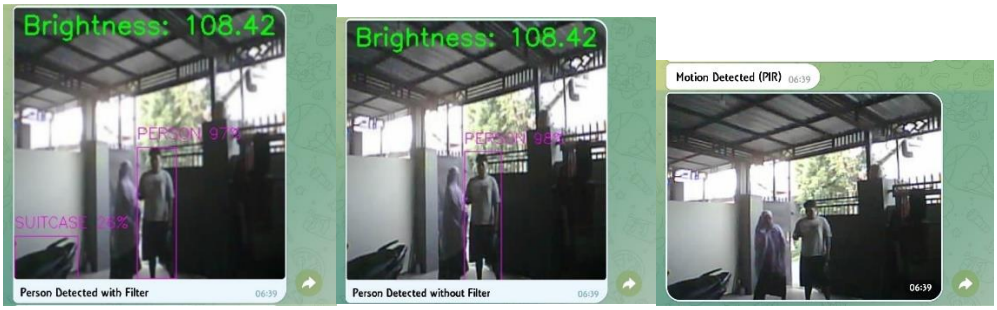

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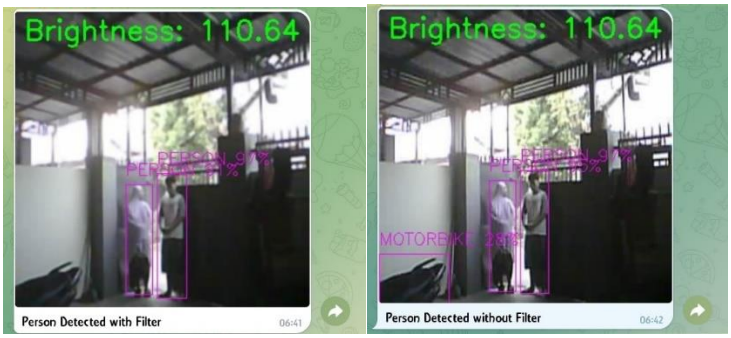

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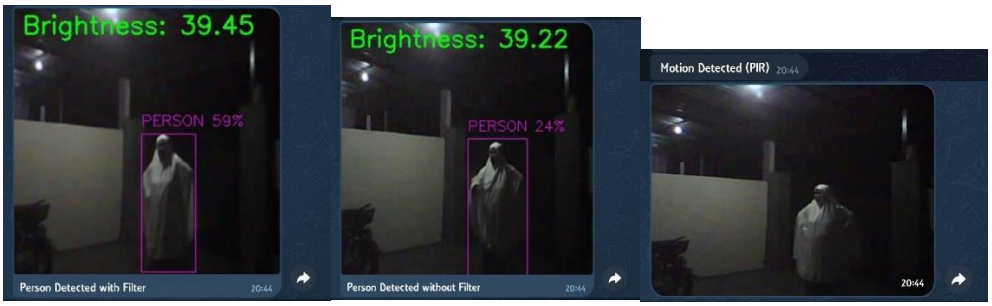
Pengujian Pemakaian Secara Real Time Diluar Ruangan (Kondisi Malam)

(Dok. Percobaan Jarak 2 Meter Diluar Ruangan Objek 1 Orang)



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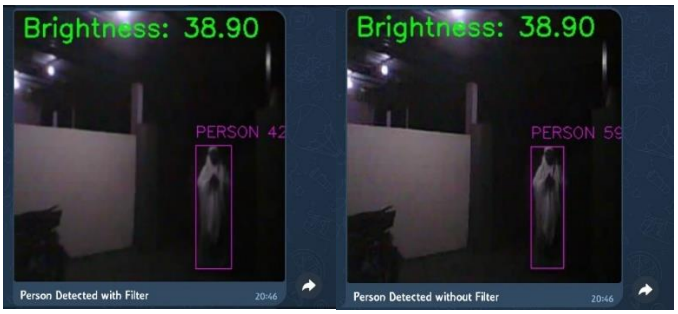

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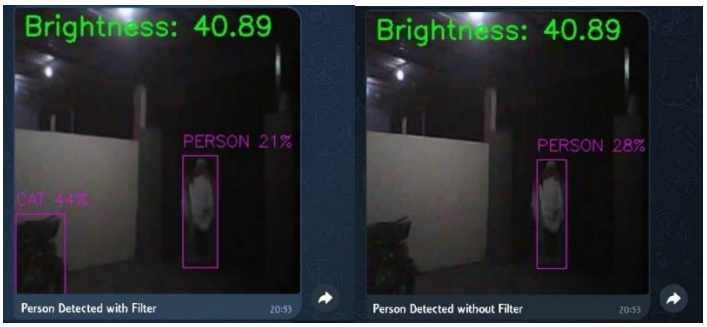

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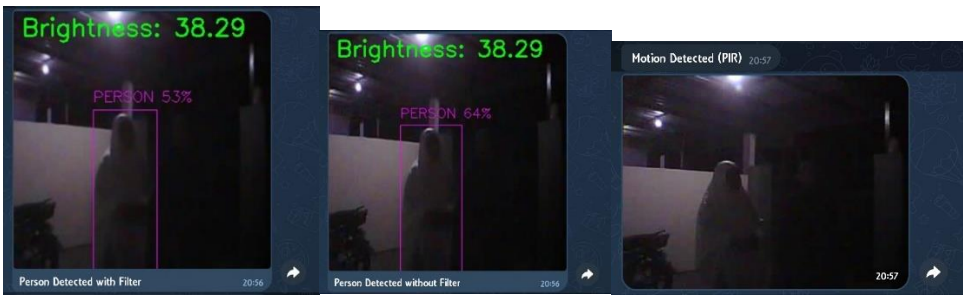

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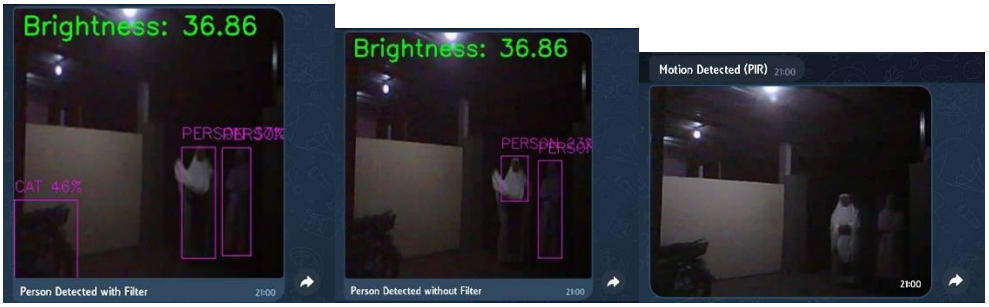

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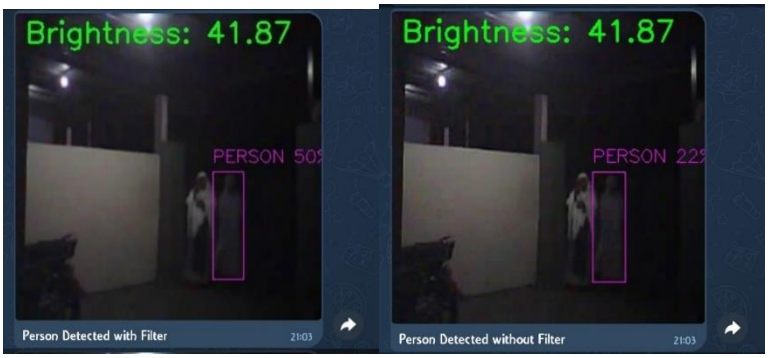

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