SPEED ESTIMATION USING LUCAS KANADE OPTICAL FLOW

San Jose State University | Artificial Intelligence | 2023

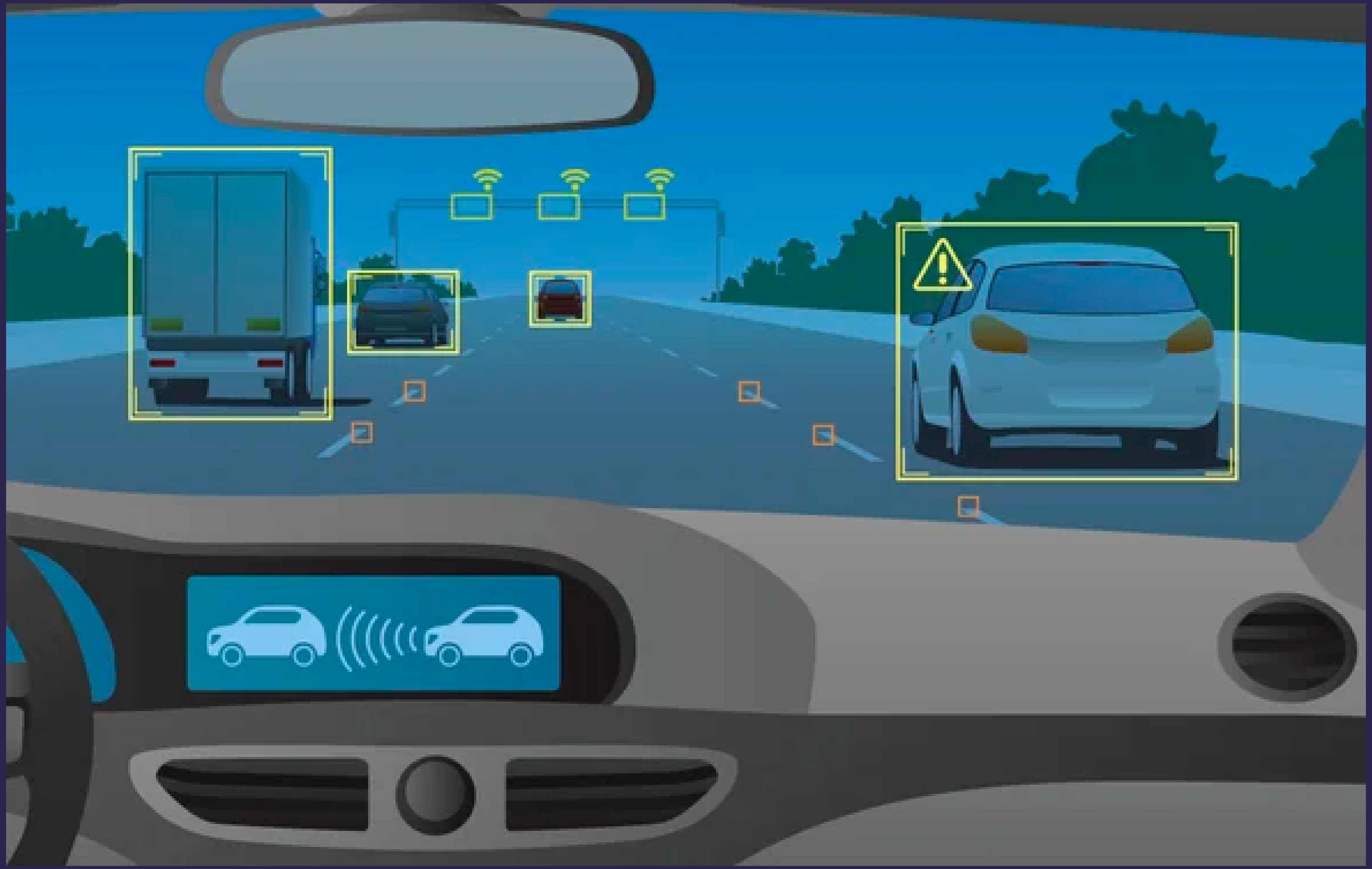
Presented by ROHITH PUVVALA SUBRAMANYAM

OVERVIEW

- Introduction
- Hypothesis
- Implementation
- YoLov5
- Lucas Kanade optical flow
- Results

INTRODUCTION

The problem addressed in this project is real-time object detection and speed estimation using the YOLOv5 model and Lucas-Kanade optical flow. Object detection is a fundamental task in computer vision, aimed at identifying and localizing objects of interest within an image or video stream. Additionally, accurately estimating the speed of moving objects in a video sequence is crucial for various applications, such as traffic monitoring, autonomous vehicles, and surveillance systems.



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RELATED WORK

Literary Review 01

[1]explores two promising approaches - pruning and quantization - to improve inference time with a little compromise on the performance. We explore the impact of each of these methods independently and introduce a hybrid method that performs pruning followed by quantization.

Literary Review 02

[2] mainly focuses on improving the accuracy and speed of vehicle detection on the road by improving the YoLov5s model, enumerating “an attention mechanism model”, and changing the activation function

RELATED WORK

Literary Review 03

[3]discusses the difference in performance between the standalone Lucas Kanade algorithm and when it is combined with the number of iterations and smoothing from the Horn Schnuck algorithm and filtering.

Literary Review 04

[4] explains about detection of objects from a whole image by considering it as a regression problem, each object has a separate bounding box and class probabilities.

These are the hypothesis took into consideration for the research work

HYPOTHESIS

Hypothesis 1

1. We can use object detection and assume the real-world size of vehicles to estimate depth and motion so we assumed the width of the car as 3 metres approximately.

Hypothesis 2

2. Depth estimation, and speed estimation, are all approximate. It is enough for a human rider to interpret the results.

IMPLEMENTATION

Phase 01

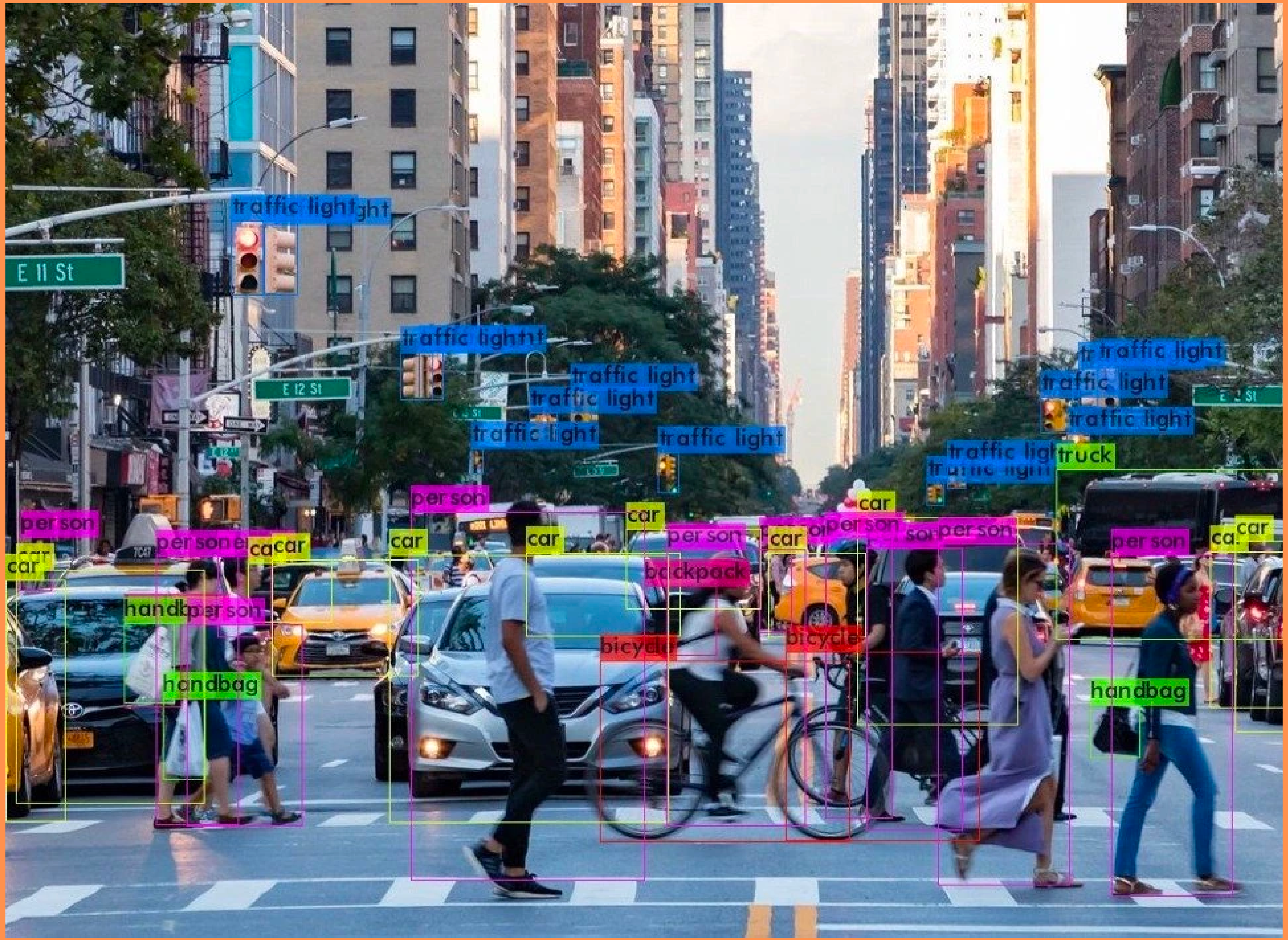
Object detection using YoLov5 algorithm

Phase 02

Tracking the flow of objects and distance moved by the object per frame using Lucas Kanade optical flow, which helps in calculating the relative speed of the obstacle with respect to the camera.

YoLov5

THE YOLOV5 ALGORITHM USES A CONVOLUTIONAL NEURAL NETWORK (CNN) TO PERFORM OBJECT DETECTION. THE CNN IS TRAINED ON A LARGE DATASET OF LABELED IMAGES, ALLOWING IT TO LEARN TO DETECT OBJECTS BASED ON THEIR VISUAL FEATURES. THE NETWORK IS TRAINED USING A TECHNIQUE CALLED BACKPROPAGATION, WHICH ADJUSTS THE WEIGHTS AND BIASES OF THE NETWORK TO MINIMIZE THE DIFFERENCE BETWEEN THE PREDICTED OUTPUT AND THE GROUND TRUTH LABELS.



ARCHITECTURE OF YOLOV5

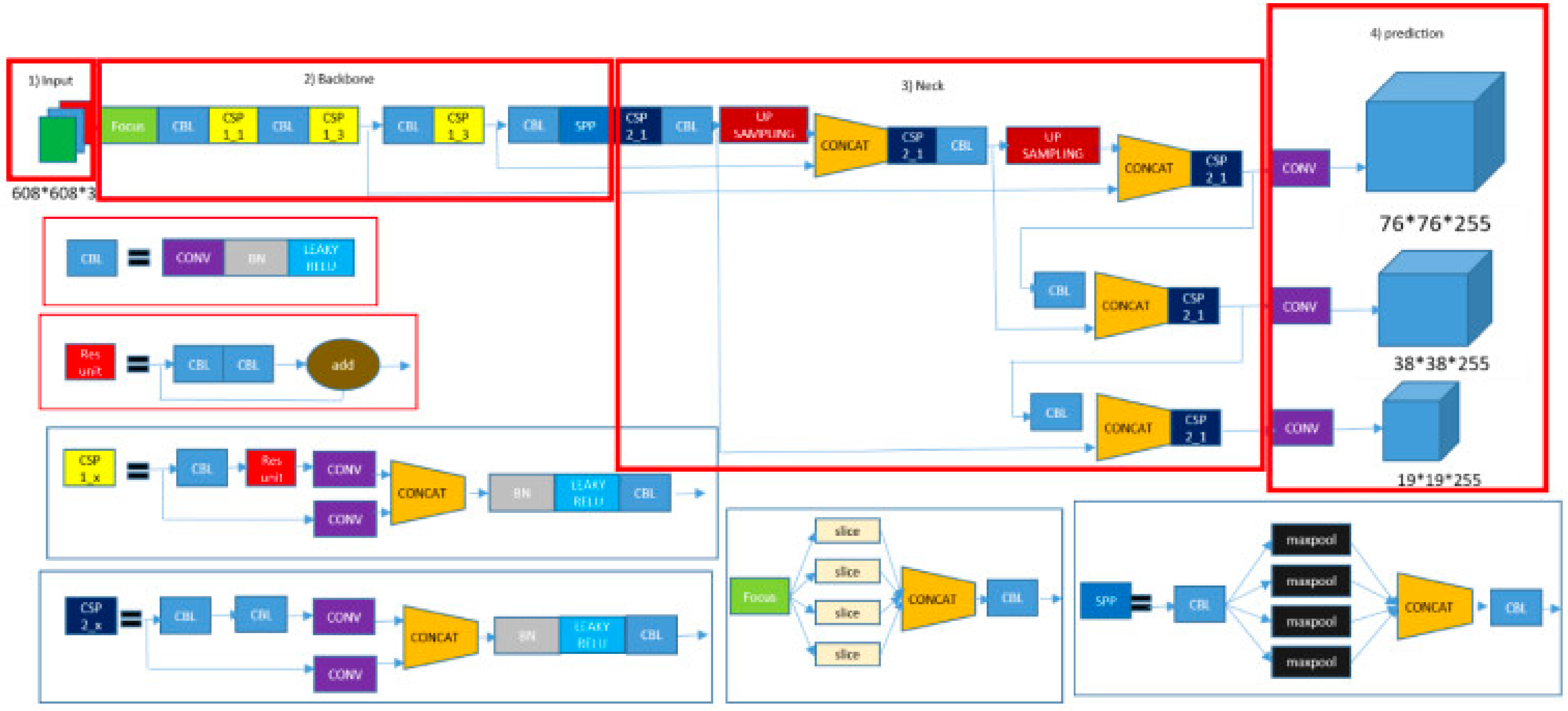


Figure 2. Structure of YOLO-v5.

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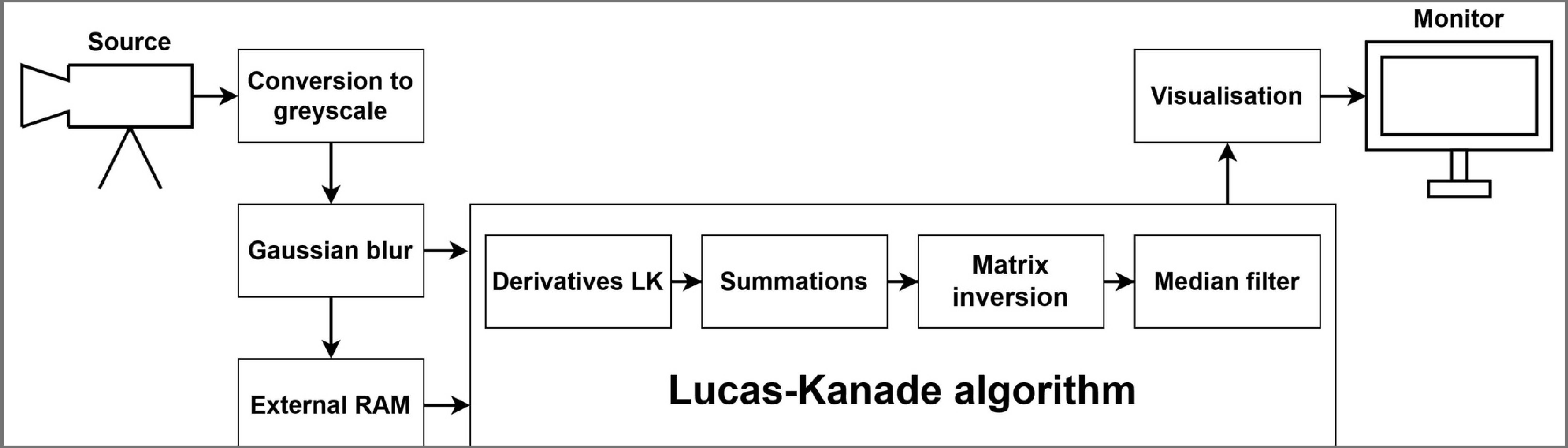
Output for object detection using YoLov5

Lucas Kanade Algorithm

Lucas Kanade assumes that the flow is essentially constant in a local neighborhood of the pixel under consideration, and solves the basic optical flow equations for all the pixels in that neighborhood. By combining information from several nearby pixels, the Lucas–Kanade method can often resolve the inherent ambiguity of the optical flow equation. It is also less sensitive to image noise than point-wise methods. On the other hand, since it is a purely local method, it cannot provide flow information in the interior of uniform regions of the image.

https://docs.opencv.org/3.4/d4/dee/tutorial_optical_flow.html

LUCAS KANADE OPTICAL FLOW ARCHITECTURE



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ROHITH PUVVALA
SUBRAMANYAM

DATASET USED FOR EVALUATION

- KITTI is the standard Computer Vision dataset used for evaluation purposes.
- The KITTI dataset is a widely used benchmark dataset for evaluating computer vision algorithms related to autonomous driving. It consists of high-resolution images and laser range data (lidar) collected from a car-mounted sensor suite while driving in urban environments.

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Output for speed estimation using Lucas Kanade algorithm

FUTURE WORK

Plan 01

This project can be still optimized to further improve precision and accuracy.

Plan 02

Can further implement the project in detecting intersections to monitor 360 degrees.

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THANK YOU!

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