PROJECT REPORT ON

APPLICATION OF OBJECT DETECTION FOR TRAFFIC MANAGEMENT

Submitted by

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CERTIFICATE OF PROJECT COMPLETION

“APPLICATION OF OBJECT DETECTION FOR TRAFFIC MANAGEMENT” submitted by M.RAJESH(R180757), J.SWETHA (O180409) ,S.LIVEENA GRACE(R180609), B.PRAVEENA KUMAR NAIK(R180607) under our guidance and supervision for the partial Fulfilment for the degree of Bachlor of Technology in Computer Science and Engineering during the academic session February 2023 – July 2023 at RGUKT – RK VALLEY.

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DECLARATION

We,M.RAJESH(R180757),J.SWETHA(O180409),S.LIVEENAGRACE(R180609) B.PRAVEEN KUMAR NAIK(R180607). Here by declare that the project report entitled "**APPLICATION OF OBJECT DETECTION FOR THE TRAFFIC MANAGEMENT**" done under the guidance of **RATNA KUMARI CHALLA** is submitted in partial fulfillment for the degree of Bachlor of Technology in Computer Science & Engineering during the academic session February 2023 – July 2023 at RGUKT, RK Valley. I also declare that this project is a result of our own efforts and has not been copied or imitated from any source. Citiations from any websites are mentioned in the references. To the best of my knowledge, the results embodied in this desertation work have not been submitted to any university or institute for the award of any degree or diploma.

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With Sincere Regards,

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ABSTRACT

Efficient traffic management in urban areas relies on accurate and timely information about vehicular movement. This paper presents an innovative application of the YOLO(YOU ONLY LOOK ONCE) object detection algorithm, in conjuction with the OPENCV computer vision library, for real-time vehicle detection and its integration into traffic management systems.The YOLO algorithm's unique architecture allows for simultaneous object detection and localization ina single pass, making it well-suited for real-time applications.Leveraging YOLO's capabilities, this research focuses on detecting vehicles within the live video feeds from surveillance cameras strategically placed across road networks.

Through the integration of YOLO and OPENCV, this research showcases the potential for advanced vehicle detection techniques to significantly improve traffic management strategies. The resulting system contributes to more efficient traffic flow, enhanced safety measures, and a data driven approach to urban mobility planning.

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PROBLEM STATEMENT

The challenge is to develop a robust and efficient object detection system that can accurately identify and classify various objects, such as vehicles, pedestrains,cyclists and potentially even emergency vehicles, at intersections. This system should then use the detected object information to dynamically adjust traffic signal timings in real time, optimizing traffic flow, reducing congestion and improving safety.

The key objectives of this project are as follows :

High-Accuracy Vehicle Detection : Create a real time vehicle detection system that employs YOLO to accurately and reliably detect various types of vehicles in diverse environments, accounting for varying lighting conditions, vehicle sizes and occlusions.

Performance Optimization & Scalability : Fine-tune the YOLO model to achieve optimal accuracy and processing speed, ensuring the system's viability for deployment across a wide range of urban road networks.

User-Friendly Visualization : Develop an intuitive user interface that displays real-time traffic data, vehicle detection results and actionable insights, enabling traffic management operators to make informed decisions and implement effective strategies.

INTRODUCTION

The ever-increasing urbanization and rapid growth of vehicular traffic have presented a pressig need for innovative solutions in traffic management. Traditional methods struggle to cope with the complexities of modern traffic petterns, resulting in congestion, longer commutes and heightened safety risks. In response, this paper introduces a novel approach that harnesses the capabilities of object detection through OPENCV and the YOLO algorithm, seamlessly integrated with an intelligent traffic signal control algorithm. This integrated system aims to revolutionize urban traffic management by leveraging real-time object detection and dynamic signal adjustments to optimize traffic flow and enhance safety.

Object detection, a core component of this approach involves the automatic identification and localization of objects within visual data. OPEN CV, a robustand versatile and computer vision library, serves as the foundation for developing object detection systems. The YOLO algorithm, known for its efficiency and accuracy, enhances this process by enabling real-time, comprehensive object recognition. By combining OPEN CV and YOLO our system achieves precise and timely detection of vehicles, pededtrains and other objects critical for traffic management.

One of the primary challenges in traffic management lies in the efficient control of traffic signals at intersections. Traditional fixed-time plans often lead to congestion and inefficient vehicle movement. To adress this, our approach incorporates a dynamic traffic signal management algorithm that responds to real-time traffic conditions. This algorithm continuously processes the object detection data and adjusts signal timings in a way that minimizes angestion, reduces waiting times and optimizes the overall traffic flow.

EXISTING SYSTEM

Video-based vehicle detection systems harness the capabilities of OPEN CV and YOLO algorithm to automatically identify vehicles within realtime video streams.These systems find applications in traffic management, surveillance and smart city intiatives by offering instantaneous insights into traffic patterns and vehicle movements.

The process involves recieving a continuous video feed from strategically positioned cameras, followed by real-time analysis of each frame using YOLO through OPENCV. YOLO predicts vehicle presence by outlining them with bouding boxes and assigning class probabilities. Object tracking methods may be employed to ensure seamless vehicle tracking acress frames, while vehicle conts are recorded as they traverse specific areas of interest.

This approach offers several advantages, including timely insights into traffic conditions, accurate vehicle identification owning to YOLO;s capabilities, adaptability for flexible deployment and the potential to yield comprehensive traffic behaviour data.

However, challenges include the need for proper infrastructure setup, sensitivity to environmental factors like weater and lighting, and addressing potential privacy concerns arising from captured video data.

In essence, video-based vehicle detection systems that utilize OPENCV and YOLO offer a dynamic means of real-time traffic analysis, enabling improved traffic management startegies and contributing to enhanced urban mobility.

APPLICATION

Our alternating process algorithm for traffic signal management sounds intresting. It's a classic approach used in traffic control to efficiently manage the flow of vehicles from different directions.Here is a summary of our developed algorithm based on our description :

Alternating Process Algorithm for Traffic Signal Management :

Our algorithm focuses on optimizing traffic signal management at intersections by employing an alternating process strategy. This strategy involves two primary processes, labeled as Process 1 (for the east direction, dor instance) and Process 2 (for the west direction). The algorithm alternates between these processes to control the traffic signals effectively. The red and green variables are used manage the duration of the respective signal states.

Process Flow :

Initialization : Begin with an initial state, often chosen based on predefined conditions or the current traffic situation.

Activate Process 1 : Start process 1 and set the red variable to control the duration of the red signal in the direction. Simultaneously, set the green variable to control the duration of the green signal in the east direction.

Traffic Direction : Allow traffic flow from the east direction (green signal) while the west direction waits (red signal).

Process 1 Timeout : Once the red variable times out, deactivate Process 1. The west direction (Process 2) will be given priority in the next step.

Activate Process 2 : Start Process 2 and set the red variable to control the duration of the red signal in the east direction. Set the green variable to control the of the green signal in the west direction.

Traffic Direction : Allow traffic to flow from the west direction (green signal) while the east direction direction waits (red signal).

Process 2 Timeout : Once the red variable times out, deactivate Process 2. The cycle returns to Process 1, and the alternating pattern continues.

Advantages :

Efficient Traffic Flow : The alternating process strategy ensures that traffic from both directions is given a fair chance to move, minimizing waiting times and congestion.

Simplicity : The algorithm can be adapted to handle different traffic volumes and patterns by adjusting the red and green durations.

Considerations :

Variable Timing : Optimizing the duration of the red and green signals based on traffic volume and historical data can enhance the algorithm's effectiveness.

In conclusion, our alternating process algorithm presents a practical approach to traffic signal management, ensuring efficient traffic flow and minimizing congestion by fairly distributing green signal time between opposing directions. The integration of vehicle detection techniques, such as YOLO could further elevate the algorithm's capabilities and responsiveness.

ALGORITHM AND ITS EXPLAINATION

The algorithm consisting of alternating processes, effectively manages traffic signals based on real-time vehicle counts to optimize traffic flow.

Here's a simplified overview :

Alternating Process Algorithm for Traffic Signal Management :

Green Signal Activation (East Side): The algorithm begins with the activation of green signal for eastbound traffic. Vehicles on the east side are allowed to proceed through the intersection.

Green Signal Duration (East Side) : The green signal remains active for the specified green signal duration (green variable) for the eastbound traffic.

Decrementing Vehicle Count (East Side) : As vehicles pass through the intersection from the east side, the vehicle count is decremented.

Green Signal Transition (West Side) : The algorithm transitions to the activation of the green signal for the westbound traffic once the vehicle count for the east side reaches zero.

Green Signal Duration (West Side) : The green signal remains active for the same green signal duration (green variable) for the westbound traffic.

Decrementing Vehicle Count (wesr Side) : As vehicles pass through the intersetion from the west side the vehicle is decremented.

Continuous Alternation : The algorithm continues to alternate between activating the green signal for the east and west sides.

Traffic Optimization : By allowing the green signal to remain active until the vehicle count is decremented to zero, the algorithm optimizes for both directions.

Continue Monitoring and Adjustment : The algorithm operates in a continual loop, fine-tuning green signal durations and maintaining the alternating process.Our alternating process algorithm, where the green signal remains active until the vehicle count reaches zero for eacg side, demonstrates an intelligent approach to traffic signal management. By dynamically adjusting the green signal duration based on real-time vehicle counts from an existing system using OPENCV and YOLO could further refine and optimize this algorithm, providing more accurate inputs for signal adjustments and leading to a more efficient traffic signal management strategy. We're contributing to a traffic management system that aims to efficiently accommodate traffic flows and enhamce urban mobility.

SAMPLE CODE

```
from ultralytics import YOLO
import numpy as np import
cv2 import math import
cvzone from sort import*
#cap.set(3,1280)
#cap.set(4,720)
max_vehicles=3
frameWidth=1000
frameHeight=500 cap
cv2.VideoCapture("/home/student/Downloads/production_id_3727445
(1080p).mp4")      model      =
YOLO("yolov8n.pt")
```

ALGORITHM FOR TRAFFIC SIGNAL MANAGEMENT

```
import java.util.concurrent.Semaphore; import
java.util.concurrent.atomic.AtomicBoolean;
import java.util.concurrent.locks.Lock; import
java.util.concurrent.locks.ReentrantLock;
17import java.util.Random; class Main
{ public static void main(String[] args)
{
Semaphore semaphore = new Semaphore(0);
AtomicBoolean sharedVar = new AtomicBoolean(false);
Lock lock = new ReentrantLock();
Thread process1 = new Thread(() -> {
// Initialize red to 0
int count = 0; // Initialize count to 0 initially
int red = 0; int green=30; while (true) {
lock.lock(); try { if (!sharedVar.get()) { if
(count == 0) {
count = new Random().nextInt(10) + 1; // Generate initial count green
= 30; // Initialize green to 30
}
18System.out.println("East---> Red: " + red + ", Green: " + green + ",
Count: " + count);
// Decrement green and count
simultaneously green--; count--; if (count ==
0) {
System.out.println("Count is zero. Switching to west");
sharedVar.set(true); semaphore.release();
semaphore.acquire();
}
Thread.sleep(1000);
} else {
System.out.println("Switching to west");
sharedVar.set(false);
```

```
semaphore.release();
semaphore.acquire();
}
} catch (InterruptedException e) {
Thread.currentThread().interrupt();
break;
} finally {
19lock.unlock();
}
}
});
Thread process2 = new Thread(() -> {
// Initialize red to 0
int count = 0; // Initialize count to 0 initially
int red = 0; int green=30; while (true) {
lock.lock(); try { if (sharedVar.get()) { if
(count == 0) {
count = new Random().nextInt(10) + 1; // Generate initial count green
= 30; // Initialize green to 30
}
System.out.println("west--> Red: " + red + ", Green: " + green + ",
Count: " + count);
// Decrement green and count
simultaneously green--; 20count--; if (count
== 0) {
System.out.println("Count is zero. Switching to west");
sharedVar.set(false); semaphore.release();



semaphore.acquire();



}
```

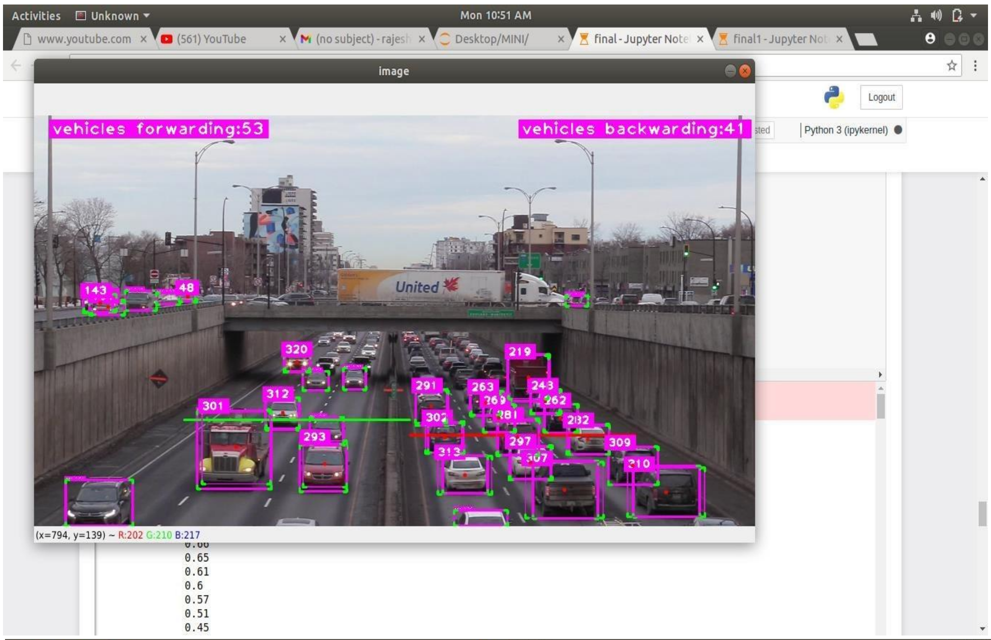
```
Thread.sleep(1000);
} else {
System.out.println("Switching to East");
sharedVar.set(true);
semaphore.release();
semaphore.acquire();
}
} catch (InterruptedException e) {
Thread.currentThread().interrupt(
); break; } finally {
lock.unlock();
}
}
});
21process1.start();
process2.start();
Runtime.getRuntime().addShutdownHook(new Thread(() -> {
process1.interrupt(); process2.interrupt();
}));
}
}
```

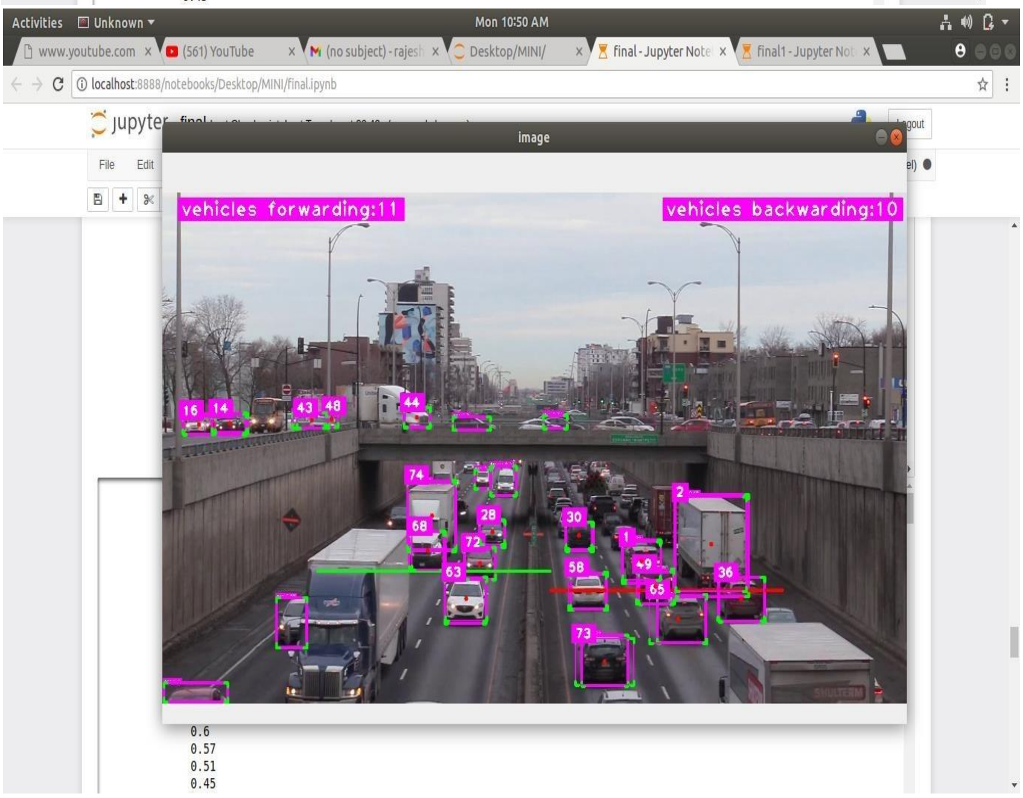
OUTPUT

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

```
Switching to west
East---> Red: 0, Green: 30, Count: 9
East---> Red: 0, Green: 29, Count: 8
East---> Red: 0, Green: 28, Count: 7
East---> Red: 0, Green: 27, Count: 6
East---> Red: 0, Green: 26, Count: 5
East---> Red: 0, Green: 25, Count: 4
East---> Red: 0, Green: 24, Count: 3
East---> Red: 0, Green: 23, Count: 2
East---> Red: 0, Green: 22, Count: 1
Count is zero. Switching to west
Switching to west
East---> Red: 0, Green: 30, Count: 2
East---> Red: 0, Green: 29, Count: 1
Count is zero. Switching to west
Switching to west
East---> Red: 0, Green: 30, Count: 2
East---> Red: 0, Green: 29, Count: 1
Count is zero. Switching to west
west---> Red: 0, Green: 28, Count: 3
west---> Red: 0, Green: 27, Count: 2
west---> Red: 0, Green: 26, Count: 1
Count is zero. Switching to west
Switching to East
west---> Red: 0, Green: 30, Count: 7
west---> Red: 0, Green: 29, Count: 6
west---> Red: 0, Green: 28, Count: 5
west---> Red: 0, Green: 27, Count: 4
west---> Red: 0, Green: 26, Count: 3
west---> Red: 0, Green: 25, Count: 2
west---> Red: 0, Green: 24, Count: 1
Count is zero. Switching to west
Switching to East
west---> Red: 0, Green: 30, Count: 2
```

RESULTS


Activities
Unknown
Mon 10:51 AM
www.youtube.com
(561) YouTube
(no subject) - rajesh
Desktop/MINI/
final - Jupyter Note
final1 - Jupyter Not
image
Logout
Python 3 (ipykernel)
vehicles forwarding:53
vehicles backwarding:41
United
(x=794, y=139) ~ R:202 G:210 B:217
0.65
0.61
0.6
0.57
0.51
0.45


Activities
Unknown
Mon 10:50 AM
www.youtube.com
(561) YouTube
(no subject) - rajesh
Desktop/MINI/
final - Jupyter Note
final1 - Jupyter Not
localhost:8888/notebooks/Desktop/MINI/final.ipynb
jupyter
File
Edit
image
vehicles forwarding:11
vehicles backwarding:10
0.6
0.57
0.51
0.45

CONCLUSION

In conclusion, this project has successfully demonstrated the potential of integrating advanced object detection techniques, specifically the YOLO algorithm in conjuction with OPEN CV, with an adaptive traffic signal control algorithm to enhance traffic management and optimize urban mobility. The goal was to adress the challenges of increasing vehicular congestion, inefficient traffic flow, and safety concerns in urban environments.

Through the implementation of the integrated system, we have showcased the following key outcomes :

Accurate Object Detection : The YOLO algorithm, in combination with OPEN CV, proved to be a powerful tool for real-time and accurate detection of various objects, including vehicles and pedestrains in environmental conditions.

Real-time Traffic Insights : By continuously analyzing the object detection data, the system generated real-time insights into traffic flow patterns, congestion points and vehicukar density, enabling informed decision-making.

Dynamic Signal Control : The adaptive traffic signal control algorithm responded dynamically to changes in traffic volume by adjusting signal timings. This led to reduced congestion, minimized waiting times, and improved traffic flow at intersections.

REFERENCES :

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