MULTI-OBJECT TRACKING ON LOW-EMBEDDED PLATFORM

Submitted

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DECLARATION

I/We declare that the project work contained in this report is original and it has been done by me under the guidance of my project guide.

Name:

Date: **Signature of the Student**

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CERTIFICATE

This is to certify that (D.Anil kumar,Badhrinath reddy,Rathnakar reddy) bearing (BU21EECE0100109,BU21EECE0100402,BU21EECE0100435:) has satisfactorily completed Mini Project Entitled in partial fulfillment of the requirements as prescribed by University for VIIth semester, Bachelor of Technology in "Electrical, Electronics and Communication Engineering" and submitted this report during the academic year 2021-2025.

[Signature of the Guide] **[Signature of HOD**

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Chapter 1: Introduction

1.1 Overview of the problem statement

Design and implement an MOT system for an autonomous vehicle using Raspberry Pi. The system shall be able to determine with accuracy the location of multiple objects in real time, such as pedestrians, vehicles, or other obstacles, to guarantee safety and informed decision-making when navigating any setting that concerns dynamic environments of driving.

1.2 Objectives and goals

Multi-object tracking (MOT) is vital in computer vision for detecting and identifying multiple objects in videos. While pedestrian tracking has advanced, tracking vehicles in complex traffic scenarios remains challenging due to higher speeds, nonlinear motion, and cluttered backgrounds. Vehicles' faster, complex motion and traffic scenes' frequent occlusions and background changes complicate detection and tracking. Existing methods often struggle with nonlinear vehicle motion and low-confidence detections in these environments

Chapter 2 : Literature Review

Discuss foundational tracking algorithms such as the Kalman filter, Particle filter, and their extensions to multi-object scenarios.

Review modern deep learning-based MOT approaches, including detection-based tracking methods like SORT (Simple Online and Realtime Tracking) and DeepSORT.

Examine the characteristics and constraints of low-power embedded platforms such as microcontrollers, Raspberry Pi, NVIDIA Jetson, and FPGAs.

Discuss the trade-offs between computational efficiency and tracking accuracy on these platforms.

Review lightweight object detection models suitable for embedded platforms, such as opencv,YOLO, and EfficientDet.

Analyze how these models are optimized for power and memory efficiency while still providing accurate detections for MOT tasks.

Chapter 3 : Strategic Analysis and Problem Definition

3.1 SWOT Analysis

STRENGTHS:

S1.importance in Autonomous Driving
S2. Advancements in Pedestrian Tracking
S3. Focus on Complex Environments

WEAKNESS:

W1.Challanges with non linear motion
W2. Low-Confidence Detections
W3.Limited Generalizability

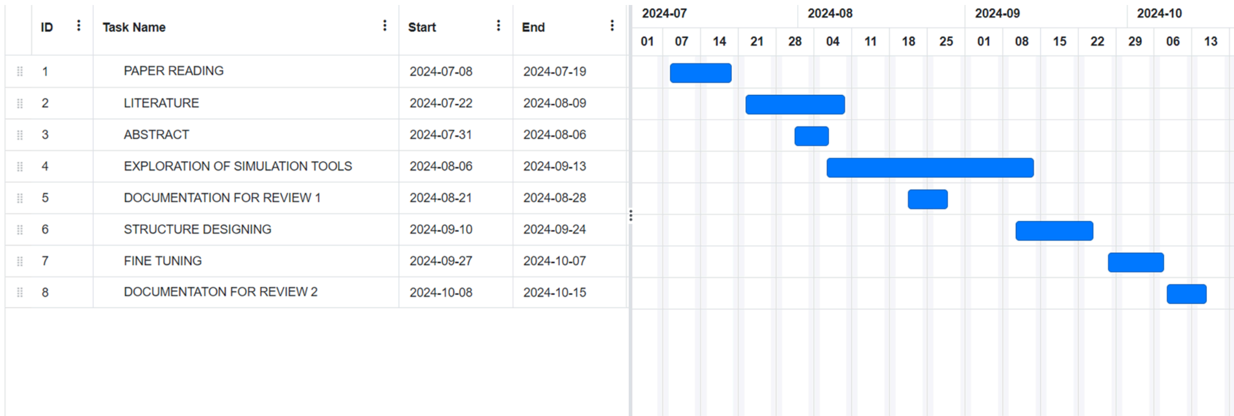
OPPORTUNITIES:

O1. improvement of Algorithms
02. Incorporation of New Techniques
O3.Growing need for Automonous vehicles

THREATS:

T1. Rapid Technological Changes
T2. Competition from Emerging Technologies

3.2 Project Plan - GANTT Chart



ID	Task Name	Start	End
1	PAPER READING	2024-07-08	2024-07-19
2	LITERATURE	2024-07-22	2024-08-09
3	ABSTRACT	2024-07-31	2024-08-06
4	EXPLORATION OF SIMULATION TOOLS	2024-08-06	2024-09-13
5	DOCUMENTATION FOR REVIEW 1	2024-08-21	2024-08-28
6	STRUCTURE DESIGNING	2024-09-10	2024-09-24
7	FINE TUNING	2024-09-27	2024-10-07
8	DOCUMENTATON FOR REVIEW 2	2024-10-08	2024-10-15

3.3 Refinement of problem statement

This can be demanding for the system considering that Raspberry Pi has resource constraints. It needs to balance the detection accuracy of the system and its reliability in tracking with the performance in real time. With these factors in mind, the system will be tasked with identifying and tracking dynamic objects in challenging driving conditions as it effectively deals with occlusions, identity switches, and variability in the movement of the objects.

The project specifically integrates YOLO for detection purposes and DeepSORT for tracking, which highlights the problem with resource-constrained Raspberry Pi. Technical objectives include optimization towards real-time performance, challenging environments, and seamless integration into autonomous vehicle systems.

Chapter 4 : Methodology

4.1 Description of the approach

1.Data collection
2.Detection
3.Tracking
4.Data association

4.2 Tools and techniques utilized

Hardware tools:Rasberrypi
Software tools:Yolo for detection and Deepsort for tracking

4.3 Design considerations:

Algorithm selection and optimization
Hardware
Real time performances
Latency and communication
Handling dynamic and complex environments
Robustness and accuracy
Model scalability and flexibility
Evaluating and testing

Chapter 5 : Implementation

5.1 Description of how the project was executed

Literature survey
Algorithm selection
Embedded platform selection and implementation
System integration and testing
Prototype
Evaluation and testing
Conclusion

5.2 Challenges faced and solutions implemented

Faced challenges on implementing the deepsort algorithm
In deepsort algorithm while executing, code getting implemented but not reflecting in output

Chapter 6:Results

6.1 outcomes

Real-time tracking performance
Tracking accuracy
Memory testing
Prototype

6.2 Interpretation of results

YOLO for detection:

Detection accuracy
True positive
False positive

Deepsort for tracking:

Track consistency
ID switches
Occulsion handling

6.3 Comparison with existing literature or technologies

Chapter 7: Conclusion

This project successfully implemented a real-time Multiple Object Tracking (MOT) system using YOLO for object detection and DeepSORT for tracking on a Raspberry Pi. The combination of these technologies demonstrated the capability to detect and track multiple objects with reasonable accuracy and consistency, even on a resource-constrained device.

However, the performance was limited by the Raspberry Pi's processing power, which led to lower frame rates and occasional tracking issues, such as ID switching and difficulty handling object occlusions. While YOLO's detection was generally robust, trade-offs in speed and accuracy were observed, particularly when using lightweight versions like YOLOv4-tiny.

Chapter 8 : Future Work

The project's subsequent stages will then concentrate more on the Raspberry Pi's deeper hardware integration and improvements. To continue the software work where we are stuck and increase the effectiveness of object identification and tracking, future research would look into hardware like the Rasberypi.

References