VISUAL OBJECT TRACKING REPORT

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1. Introduction

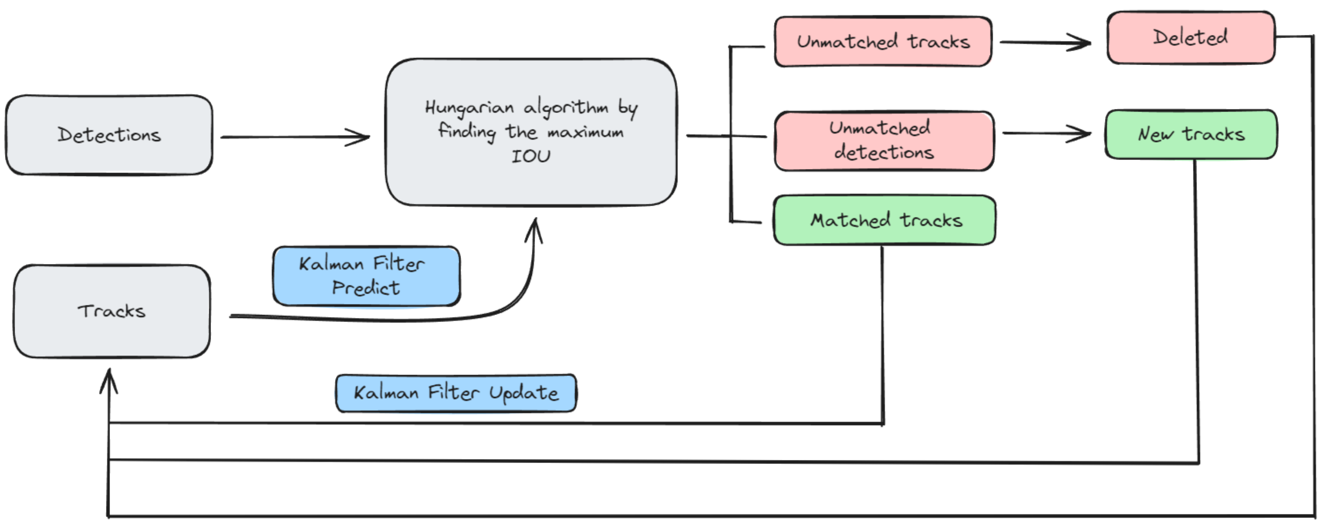
Object tracking is a fundamental task in computer vision with applications ranging from surveillance to autonomous vehicles. In this report, we present an object tracking system that integrates multiple techniques for robust and accurate tracking. Our approach progressively enhances tracking performance by incorporating the Hungarian algorithm, Kalman filter, and MobileNet model.

2. Methodology

Our object tracking system consists of the following components:

1. **Multiple Object Tracking (MOT)**: Initially, we implement a multiple object tracking system to detect and track objects in a video stream. This forms the baseline for our tracking pipeline.
2. **Hungarian Algorithm**: We integrate the Hungarian algorithm to optimize the assignment of detected objects to existing tracks. By minimizing the overall assignment cost, the Hungarian algorithm improves the accuracy and reliability of object association.
3. **Kalman Filter**: To account for prediction uncertainty and noisy measurements, we employ a Kalman filter for state estimation. The Kalman filter predicts the future state of each tracked object based on its previous state and the dynamics of the system, resulting in smoother trajectories and better object localization.
4. **MobileNet Model**: Finally, we introduce a MobileNet model for object detection. The MobileNet model is lightweight and well-suited for real-time applications, enabling efficient object detection even on resource-constrained devices.

Here we can see the final architecture of the visual object tracker:



3. Results and Comparison

The following table summarizes the performance of our object tracking system:

	HOTA	CLEAR	Identity
MOT + Hungarian + Kalman	18.8	25.4	24.6
MOT + Hungarian + Kalman + MobileNet	17	25	21.0

We can here see that the MobileNet model did not add any value to the object tracking system. This could be due to the poor optimization I have done on it or due to bad usage of it. I did not have enough time to analyze why.

4. Challenges Faced

Throughout the development and implementation of our object tracking system, we encountered several challenges that required careful consideration and innovative solutions:

1. **Complexity of Environments**: Real-world environments are often dynamic and complex, with varying lighting conditions, occlusions, and object interactions. Designing a robust object tracking system that can adapt to these complexities posed a significant challenge.

2. **Optimization for Real-Time Performance**: Achieving real-time performance while maintaining tracking accuracy was another challenge. Each additional component, such as the Hungarian algorithm, Kalman filter, and MobileNet model, added computational overhead, requiring careful optimization to ensure efficient operation.

3. **Parameter Tuning**: Many of the algorithms and models used in our object tracking system have various parameters that require careful tuning for optimal performance. Finding the right balance between sensitivity, robustness, and computational efficiency was a challenge that required iterative experimentation.

4. **Handling Occlusions and Object Interactions**: Occlusions and object interactions present significant challenges for object tracking systems, as they can lead to identity switches and track fragmentation. Developing strategies to handle occlusions and accurately track objects in crowded scenes required innovative approaches and careful algorithm design.

5. Conclusion

In conclusion, our object tracking system demonstrates significant improvements in tracking accuracy and efficiency through the integration of the Hungarian algorithm, Kalman filter, and MobileNet model. The progressive enhancement of our tracking pipeline enables robust performance across diverse real-world scenarios.