Department of
Computer Science & Engineering

Tentative Title:

Integrative Trajectory Forecasting for Autonomous Vehicles in Mixed Traffic Environments

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Topic Outline

- Introduction
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Introduction

- Trajectory refers to a path that a vehicle moves through space over time.
- For of an autonomous vehicle, trajectory not only the route but also it's motion—speed, acceleration, and direction etc.

Fig – 1: Some trajectories of various vehicle [5]

Introduction (CONT'D)

- Mixed traffic environment consists of different types of road users, such as pedestrians, bicycles, motorcycles, cars, and buses, share the same space and interact with each other.

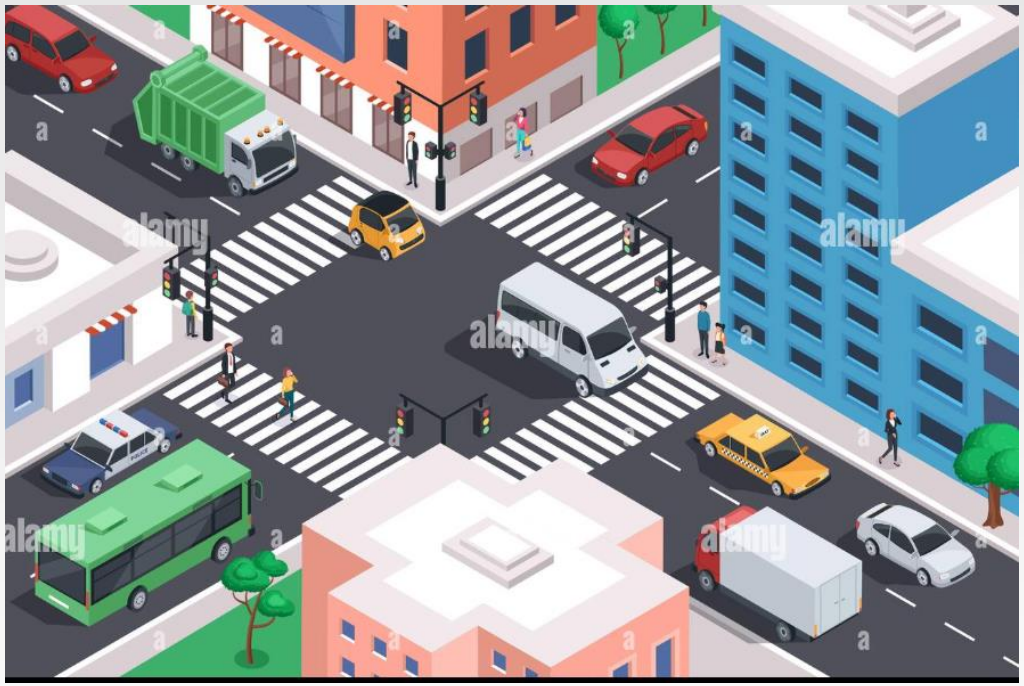


Fig – 2: Mixed Traffic Environment [1]

Literature Review

TrafficPredict: Trajectory Prediction for Heterogeneous Traffic-Agents [2]

Performances:

- Using previous state-of-the-art approaches in accuracy for trajectory prediction in heterogeneous traffic
- Offer real-time performance without assumptions about traffic conditions or the number of agents.

Limitations:

- The accuracy varies with traffic conditions and the historical data available.
- Future improvements will consider additional constraints such as lane directions, traffic signals, and rules.

Literature Review (CONT'D)

Interactive Trajectory Prediction for Autonomous Driving via Recurrent Meta Program Induction Network [3]

Performances :

- Use traditional kernel methods in predicting the trajectory of human-driven cars, achieving lower mean error rates in trajectory prediction for both longitudinal and lateral directions.

Limitations:

- Future developments are needed for a more advanced generator and observer structure to further reduce prediction errors and to extend the framework to more general scenarios, such as turns at intersections and highway merging.

Literature Review (CONT'D)

Probabilistic Trajectory Prediction for Autonomous Vehicles with Attentive Recurrent Neural Process [4]

Performances :

- The Attentive Recurrent Neural Process (ARNP) proposed in the paper effectively captures sequential information traffic scenarios.
- ARNP outperforms several previous approaches in terms of prediction accuracy, variance, and probability expressiveness by predicting an explicit distribution.

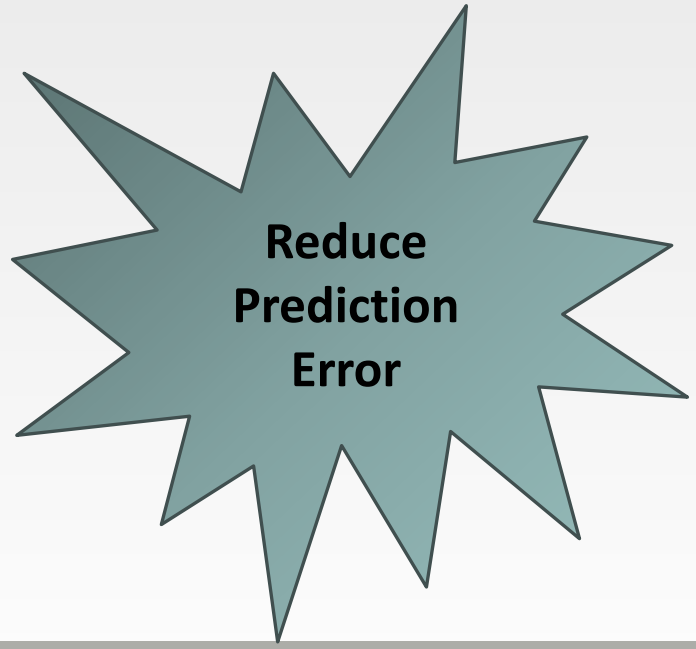
Limitations:

- Future developments are needed for better recognize and adapt to poorly understood traffic.

Challenges


Work on Urban Areas


Deals with Mixed Traffic Agents

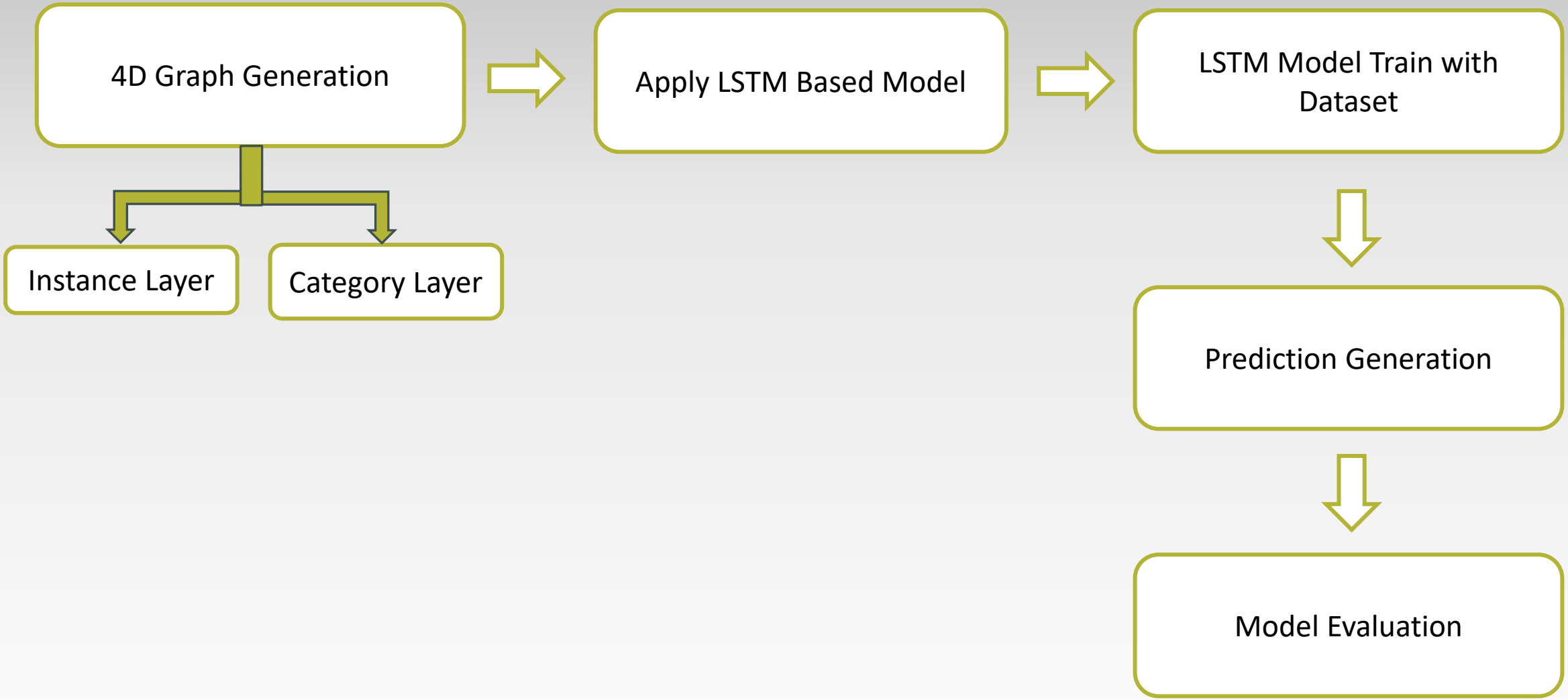

Reduce Prediction Error

Objectives

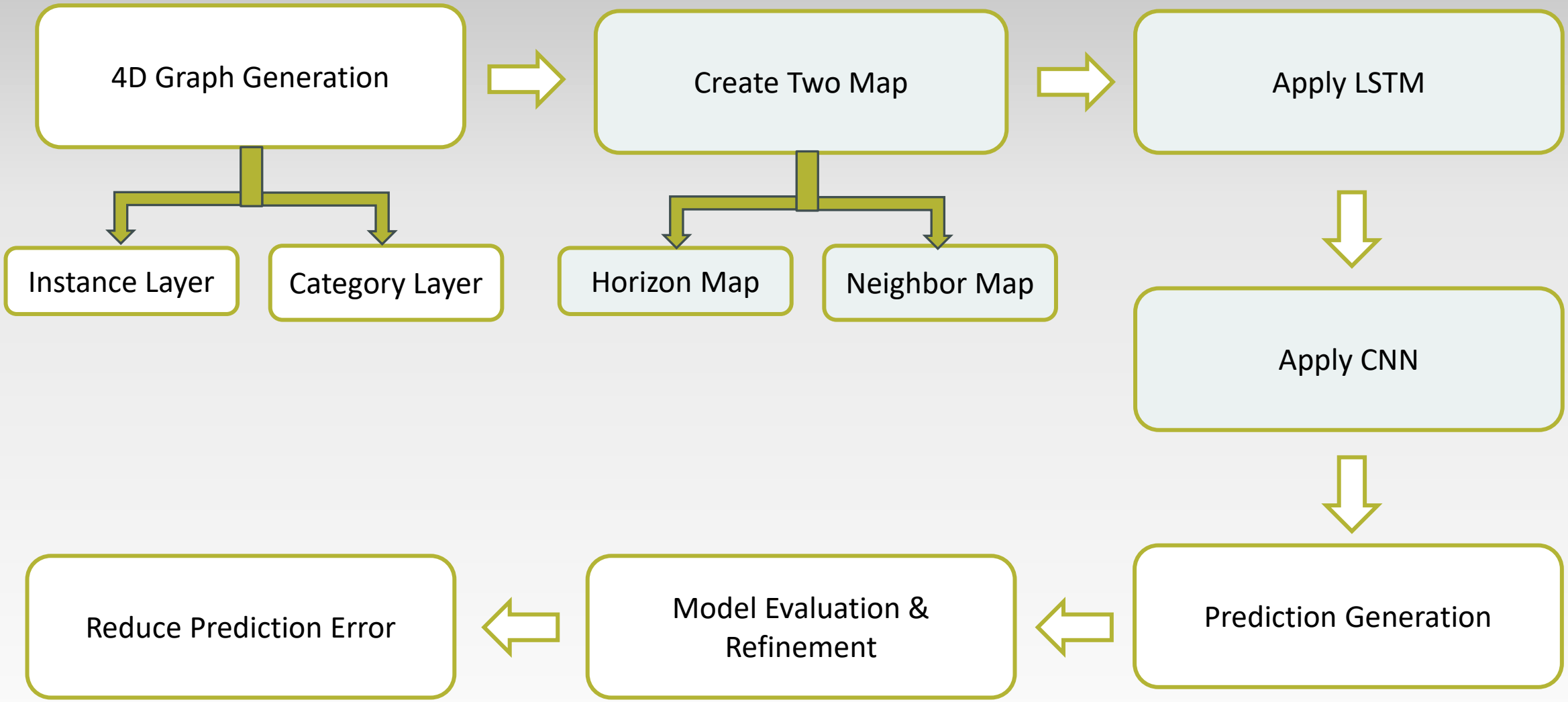
- Deals with mixed traffic environment consists of various cars, bicycles, bikes, buses, pedestrians, traffic lights etc in an urban areas.

- Also increasing the accuracy of the model is an obligatory part of my work.

Methodology



Proposed Methodology



Methodology (CONT'D)

4D Graph Generation

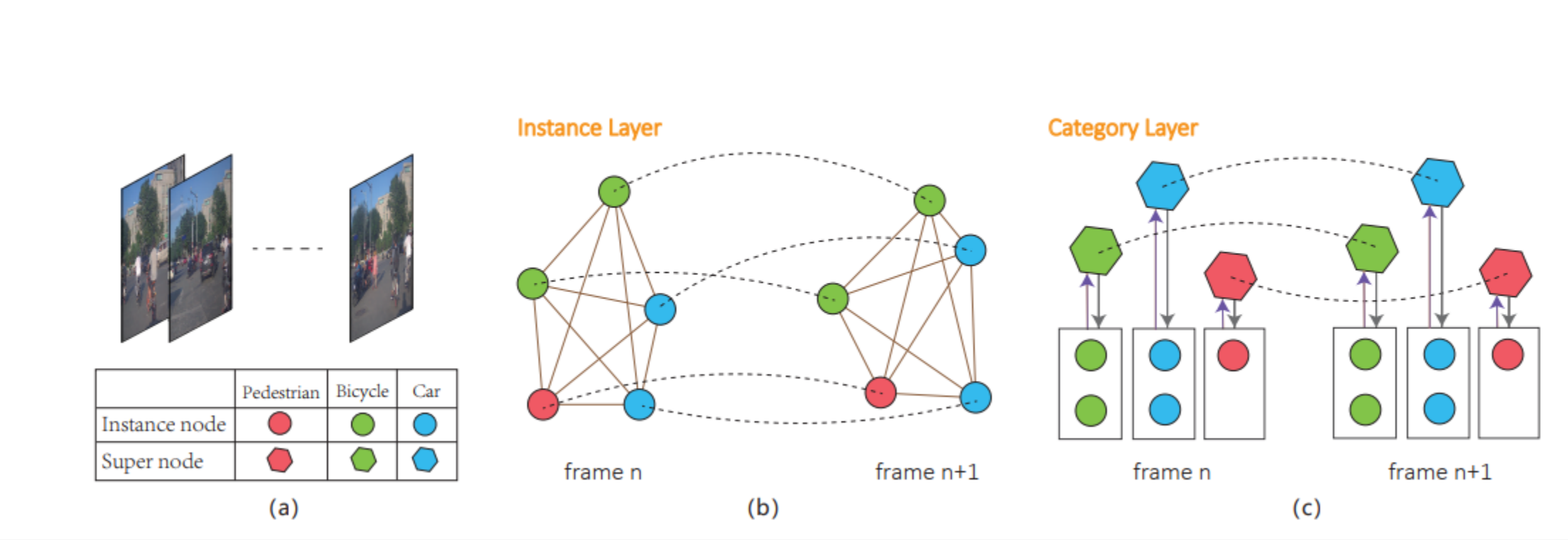
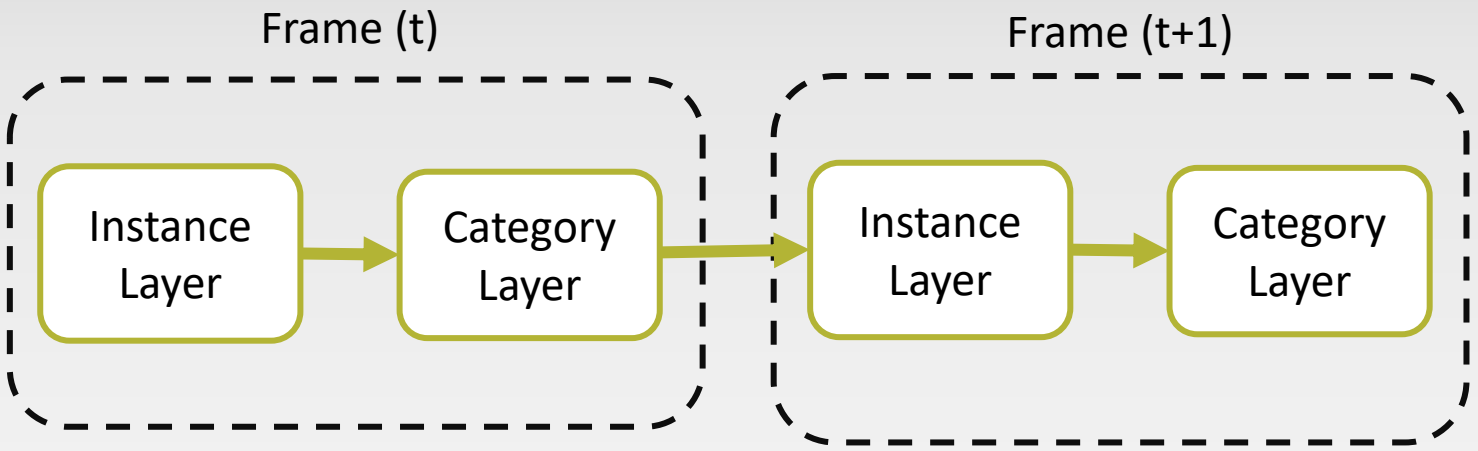


Fig – 3: (a) Sample image frames of various traffic agents, (b) Instance layer graph between two frames, (c) Category layer supernode creation and graph. [5]

Methodology (CONT'D)

Instance & Category Layer



Methodology (CONT'D)

Two Maps

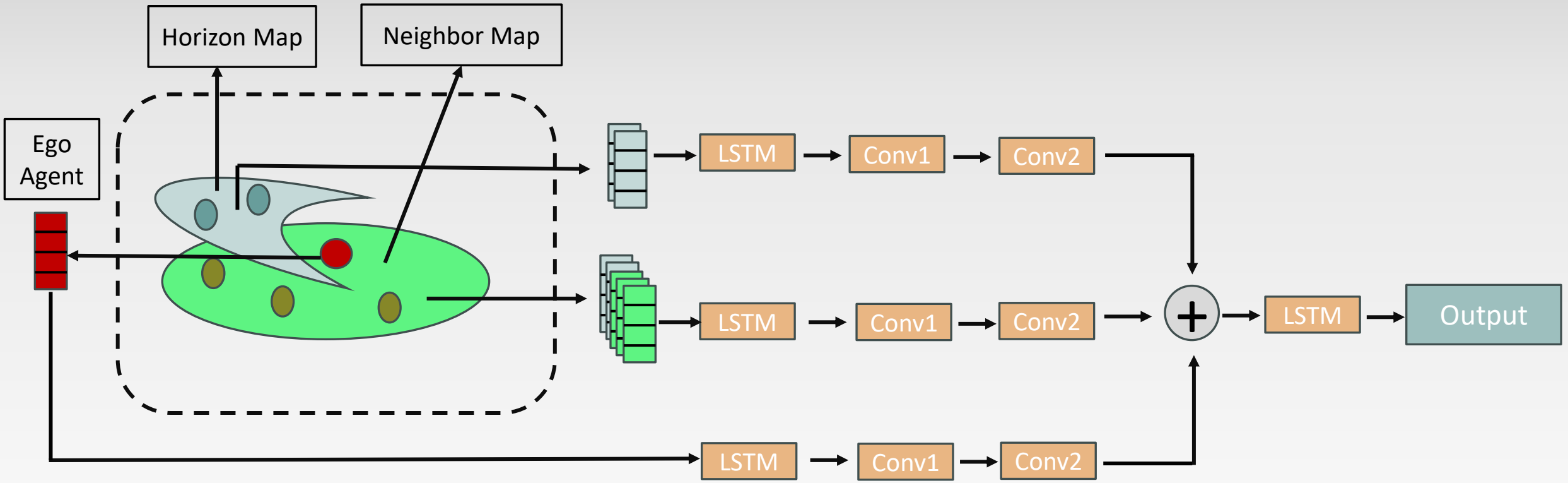


Fig – 4: LSTM-CNN Architecture

Dataset Details

Dataset Name: ApolloScape Dataset

It contains 53 file, each file for 1 min sequence with 2 fps (frame per second) rate.

Attribute	Description
Frame_id	It indicates a unique frame of a video stream which is captured on 2fps rate.
Object_id	It indicates the unique object.
Object_type	It indicates the type of an object such as vehicle, bicycle, pedestrian or other.
Position_x,y,z	The position x,y,z indicates the location of an object in world coordinate system.
Object_length	It indicates the length of an object.
Object_width	It indicates the width of an object.
Object_height	It indicates the height of an object.
Heading	The heading value is the steering radian with respect to the direction of the object.

[5]

Dataset Details

Dataset Name: TRAF Dataset

Attribute	Description
Frame_id	It indicates a unique frame of a video stream which is captured on 2fps rate.
Num_agent	It indicates the number of agents of this frame.
Position_x,y	The position x,y indicates the ground truth value of an agent in world coordinate system.
Agent_length	It indicates the length of an agent.
Agent_width	It indicates the width of an agent.
Agent_name_id	It indicates the type of an agent with an id.

[6]

Results

- I implement the model with the ApolloScape Dataset –

Traffic Agent	ADE	FDE
Pedestrian	1.1427719593048096	0.9647185802459717
Bicycle	1.0993574857711792	0.9176489114761353
Car	1.3722141981124878	1.3418755531311035

Average Displacement Error (ADE)	1.2047812938690186
Final Displacement Error (FDE)	1.0747476816177368

Conclusion

In conclusion, we have successfully implemented the existing model and evaluated the results. However, we have identified certain limitations in the existing approach, including the absence of considerations for dynamic motion, turning radius, and driver behavior. To address these shortcomings and enhance the model's capabilities, our proposed model incorporates these crucial characteristics, paving the way for a more comprehensive and accurate solution.

Future Work

Apply the Hybrid Model on another Dataset and Observe the result

Combine the prediction result of all existing traffic agent and try to give suggestion our vehicle trajectory

References

[1] https://c8.alamy.com/comp/2GDM3KX/isometric-city-crossroad-with-cars-road-intersection-traffic-jam-urban-downtown-street-with-transport-and-people-vector-illustration-public-and-private-transport-in-residential-area-2GDM3KX.jpg

[2] Yuexin Ma, Xinge Zhu, Sibo Zhang, Ruigang Yang, Wenping Wang, Dinesh Manocha4

[3] Chiyu Dong, Yilun Chen and John M. Dolan

[4] Jiacheng Zhu, Shenghao Qin, Wenshuo Wang, Member, IEEE, and Ding Zhao

[5] https://apolloscape.auto/trajectory.html

[6] https://gamma.umd.edu/researchdirections/autonomousdriving/trafdataset

Thank You

Q/A