M2Smart NewsLetter

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OVERALL SUMMARY & SPECIAL TOPICS

Overall Summary

Since there is big impact by COVID-19 from March 2020. We had virtual on-line meeting among teams. It is quite difficult for our research especially for field test in Hyderabad and Ahmedabad. Our traffic monitoring system is able to collect big data through internet, therefore we are able to continue for traffic flow rsearch indivisually. This is one of our M2Smart project advantage. At the same time, we are able to communicate with regional government organization such as Ahmedabad Municipal Corporation (AMC), Smart City Ahmedabad Development Ltd. (SCADL) for our program. And we communicate with Indian Embassy of Tokyo three times for reporting our program status and request strong support from the government. And Inidan embassy supported to communicate with AMC, SCAL and CEPT University for field test support in this year. This kind of severe situation COVID-19 makes limited research activies but makes establsishing strong collaboration with Indian coverement.

Special Topics: Indian Embassy Minister's Visit to Nihon University!

On 21 March 2021, Ms. Mona Khandhar of Indian Embassy of Tokyo visited Nihon University. Ms. Kahdhar is the Minister of Economic & Commerce and she has lot of experience for Smart City development in Ahmedabad Gujarat state. At her visiting at Nihon University, we exchanged M2Msrat research acitivies among project members (refer top piture). She stated to provide strong support. The following picture shows discussion at Nihon Univweersity and visiting facility of Nihon University.

Discussion with Indian Embassy Minister

Visiting facility of Nihon University

GROUP REPORTS

Group 1: Image dehazing to improve scene sensing performance

by C. Krishna Mohan (Group 1 Leader), K Naveen Kumar, Pabbathi Uday Kumar, Sai Harsha Yelleni and Jaya Sharma

Group1 worked on restoring clear visible images from the hazy outdoor scenarios by reducing or removing interference due to haze using the deep learning methods.

Due to smoke, dust, fumes, mist, and other floating particles in the atmosphere, images taken in such an atmosphere are often subject to color distortion, blurring, low contrast, and further visible quality degradation. The hazy image input will make it difficult to solve the visual tasks such as **vehicle detection, vehicle count, and tracking**.

Image dehazing is a pre-processing step for all tasks involving visual appearance as a piece of critical information for analysis. Using image dehazing to the existing deep learning models during adverse weather conditions helps to improve the quality of results and the model performance.

We have used publicly available datasets on various road scenarios in foggy and haze conditions to train a deep learning model to recover haze and unclear images. When given as the input to the **vehicle detection** or **vehicle counting** module performs better with more reliable and accurate results.

Open Source Dehaze Image Datasets Used:

Datasets	Images	Description
NYUv2	1399	Indoor and outdoor synthetic haze dataset
FRIDA2	330	Images of 66 diverse foggy road scenes
Dense_Haze	66	Real haze and haze free indoor and outdoor images
O-Haze	90	Real hazy and haze free outdoor scene images

We have used publicly available datasets on various road scenarios in foggy and haze conditions to train a deep learning model to recover haze and unclear images. When given as the input to the **vehicle detection** or **vehicle counting** module performs better with more reliable and accurate results.

Methodology of Proposed Approach

1. We built a novel fusion architecture to restore haze-free images
2. We use local residual learning, which allows the less critical information such as thin haze region or low-frequency to be bypassed through multiple local residual connections and letting the main network architecture focus on more practical information
3. Feature attention module with pixel-wise and channel-wise attention is used to focus on thick haze pixels and more critical channel information
4. We adopt feature fusion techniques to retain shallow layer information, pass into deep layers, and restore haze-free images.

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Outcome

Given a hazy video captured by autonomous vehicle or surveillance cameras at various outdoor locations, our model would process each frame in the video and provide real-time high quality dehaze images for further analysis to any road scene analysis task, providing better assistance to capture the scene information.

Original haze image

Image after dehazing

→

→

References:

Qin, Xu, Zhilin Wang, Yuanchao Bai, Xiaodong Xie, and Huizhu Jia. "Ffa-net: Feature fusion attention network for single image dehazing," in proceedings of the AAAI Conference on Artificial Intelligence, vol. 34, no. 07, pp. 11908-11915. 2020.

Singh, Ayush, Ajay Bhave, and Dilip K. Prasad. "Single image dehazing for a variety of haze scenarios using back projected pyramid network," in European Conference on Computer Vision, pp. 166-181. Springer, Cham, 2020.

Datasets : https://github.com/youngguncho/awesome-dehazing

GROUP REPORTS

Group 3 – A : Vehicular exhaust emission under real-world driving conditions / Role of electric-vehicles on reducing pollutant emission

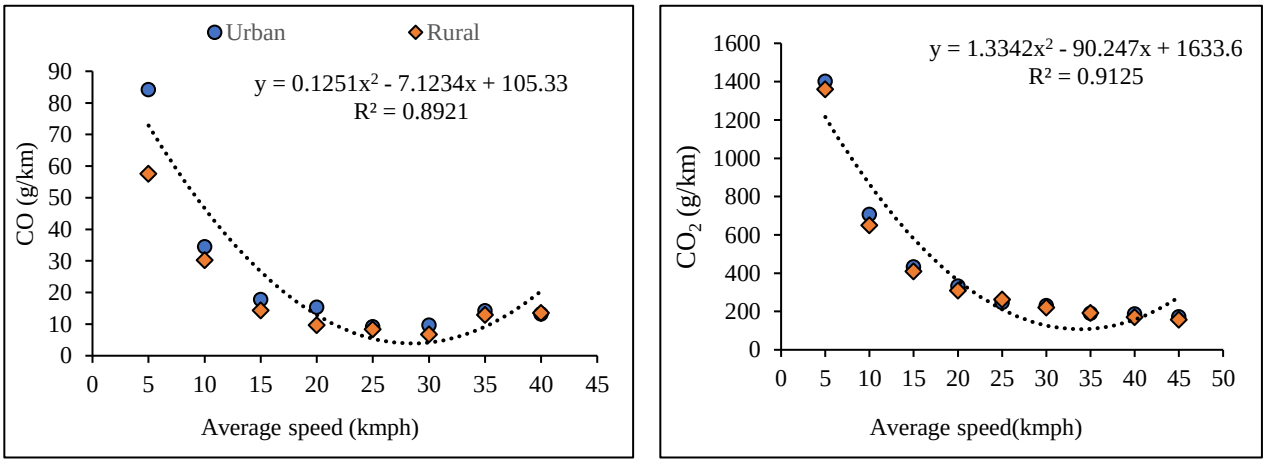
by Digvijay S. Pawar (Group 3 Leader) and Chandrashker. C

The current study mainly focuses on the direct measurement of **emissions from diesel auto-rickshaws** for India's urban and rural traffic conditions. A test route of 14 km stretch comprised of urban and rural traffic in Sangareddy city was selected for the study.

The instantaneous emissions and speeds were measured by integrating the auto gas analyzer and Hd-VBox device. Two test vehicles of different emission standards were chosen for the 10 trips data collection. **The relationship between emission factors and average speeds** were developed for urban and rural traffic in this study. The speed- emission factor models, were fitted with quadratic polynomial function with a good R2 value. From the result, the emission factors from urban traffic were found to be substantial than rural traffic. The result showed that the lowest driving speed contributed to a significant portion of total CO2 and CO emissions over a trip, as shown in Figure 1.

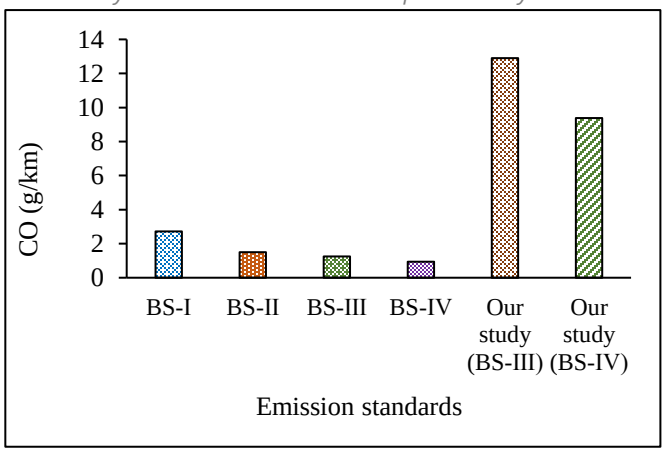
The emission factors of CO obtained from our study were found to be approximately 10 times higher than prescribed Bharat stage -Ⅲ (BS-Ⅲ) and Bharat stage - Ⅳ (BS-Ⅳ) emission standards values. **The lowest emission factors were observed at a speed range of 25-30 kmph for rural and urban traffic conditions**. The emission factors obtained from our model does not meet Bharat stage Ⅲ and Ⅳ emission values at any speed band.

Figure 1. Emission factors v/s speed for diesel – auto-rickshaws in urban and rural traffic conditions



As shown in Figure 2, the standard emissions factors varied significantly compared to our study. This may be because, standard emission factors were obtained from a laboratory test using the standard Indian driving cycle (IDC) by the Automotive Research Association of India (ARAI). The variation in emission factors may be due to vehicle age, vehicle type under consideration, vehicle kilometer traveled, vehicle maintenance, etc. **Therefore, emission factors obtained from a laboratory test for emission inventories may underestimate the real-world emissions.** Thus, the acquired real-world emission factors from the study for a particular region/city may help policymakers implement traffic management systems and urban policy interventions to improve air quality.

Figure 2. Comparison of emission factor of CO obtained from our study with the emission standards prescribed by ARAI



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References:

1.Climate and clean air coalition, 'Three wheels united '2018 https://www.ccacoalition.org/en/news-media

2. Olivier, J.G.J., & Peters, J. A. H. W. (2020). Trends in Global CO2 and Total Greenhouse Gas Emissions: Report 2019. PBL Netherlands Environmental Assessment Agency.

3. Singh, N., Mishra, T., & Banerjee, R. (2019). Greenhouse gas emissions in India's road transport sector. In Climate change signals and response (pp. 197-209). Springer, Singapore.

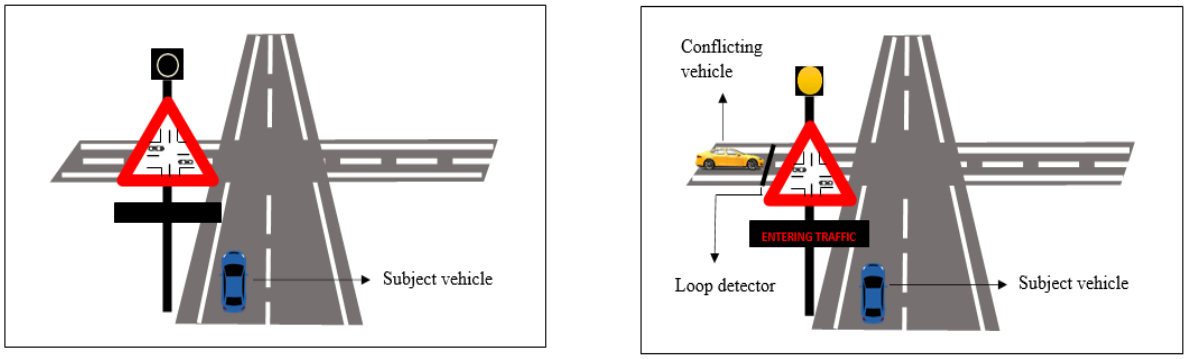
Group 3 – B: Evaluation of major road driver response towards intersection conflict warning system at an uncontrolled intersection

by Dr. Digvijay S. Pawar (Group 3 Leader), Rachakonda. Y

Intersection Conflict Warning System (ICWS) is one of the applications of ITS technology that acts as the best solution to reduce crashes at uncontrolled intersections. It consists of activated LED warning signs and sensors that detect the vehicle approaching and send warning sign to the adjacent approaching vehicles.

This study evaluates the performance of ICWS installed at typical four-legged uncontrolled intersection by examining the responses of major road drivers towards the installed warning system. The ICWS performance is evaluated for three different scenarios.

Figure 1: Experiment design with different scenarios



(a) Scenario 1: No conflicting vehicle on minor approach and warning sign not activated

(b) Scenario 2: Conflicting vehicle present on minor approach and warning sign is activated

In scenario 1, no vehicle was present on the minor road therefore warning sign was not activated on the major road (see figure 1(a)).

In scenario 2, crossing vehicle was present on the minor road and entering traffic warning signal was given to the major road approach (see figure 1(b)).

In scenario 3, participants were educated about the deployed conflict warning system and were asked to drive the intersection with the entering traffic warning signal on.

GROUP REPORTS

A total of 18 drivers data were collected using a high end GPS data logger. Speed and acceleration are the driving performances measures considered for evaluation. ANOVA test was employed to study the statistical differences in driving performance against three scenarios. **Results indicate that a statistical significance difference among three scenarios for mean speed and mean acceleration was observed.**

Figure 2: Boxplots of mean speed and mean acceleration for three ICWS scenarios

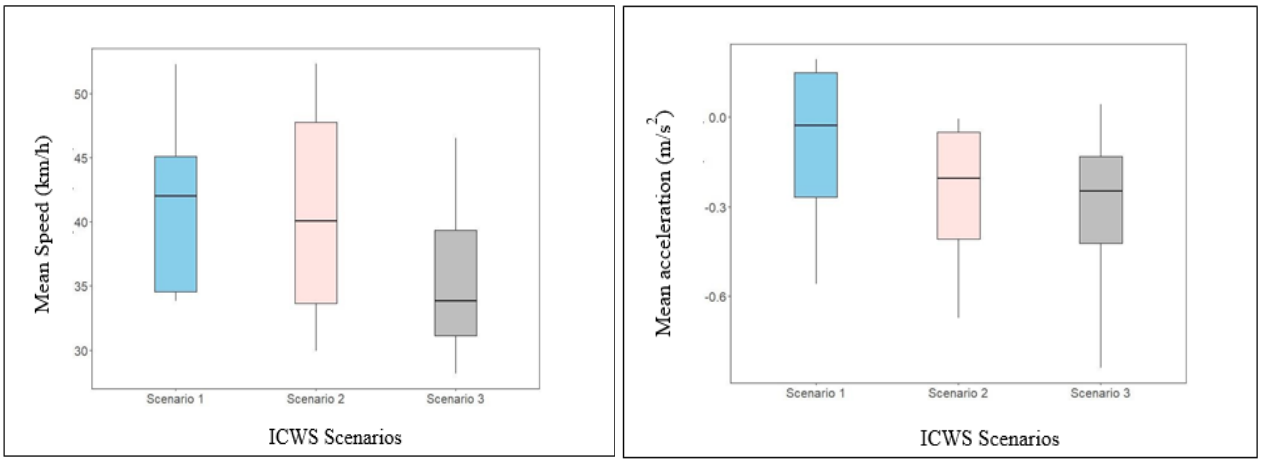


Figure 2 represents the boxplot of mean speed and mean acceleration of drivers for three ICWS scenarios. It was observed that the average mean speed of drivers for scenario 3 was lowered by 6.52 km/h compared with scenario 1 and the average mean acceleration of drivers for scenario 3 was reduced by 0.33 m/s2 than scenario 1.

This implies that **the drivers after being educated by the warning system result in lower mean speed because drivers were alert about the approaching vehicle and responded before they approached the intersection**. Further study will be carried out by considering more drivers for evaluating ICWS performance, and the reaction time of drivers will be considered as another driving performance measure.

OTHERS

Leaving of Haruka Katarao, M2smart Residential Coordinator

Hello everyone, I'm Misa, the new face in M2smart

by Misa Kitagawa (M2Smart Resident Coordinator)

A very warm greeting to all of you. I am Misa Kitagawa, successor of Haruka Katarao, who had been M2smart Residential Coorinator. As you may already know, she has left the project in April, and I am taking over her job, such as RA agreement, payment request, and issue of the newsletter. Since my arrival to Hyderabad, originally scheduled for May, has been delayed due to Covid-19 pandemic, I am waiting the day that I will be able to get there and fully carry out my mission.

For a self introduction, I had been worked as a project manager integrating the field of asset management and data science as a new business consultant. I am very happy to be a part of this project, as I have been deeply interested in both of India as a promising country, and SDGs. I am very excited about this research that will lead to smart cities in the country.

I'm looking forward to seeing you all in face-to-face soon!

Farewell and hope our paths cross again in the near future!

by Haruka Katarao (ex-M2Smart Resident Coordinator)

It has been a great pleasure working with M2Smart Project team for the last 3 years. Due to the continuous Covid-19 pandemic, it was pity that I could not meet you all in person but it was nice meeting with Director Murty, Prof. Arjun and few RAs at IITH in April 2021. I also appreciate all the thoughtful messages from each of you. The intecutual situmilations and warm friendships are my lifetime treasure.

This Covid-19 pandemic made huge impact on each one of us and it made us re-think about our common future. In that sense, I truly wish the success of the M2Smart Project, which contributes to the low carbon society. Now I have started to work on another area of environmental project, marine plastic waste issues, together with ASEAN countries.

All the best on the M2Smart Project and over to you Misa!

Last IITH M2Smart Lab visit, April 2021

OTHERS

Message from Graduating RA

Traffic Aware V2X Solutions for Intelligent Transport Systems

by Anshika Chourasia

I would like to thank Dr. Bheemarjuna Reddy Tamma and Dr. Antony Franklin for giving me this opportunity and their guidance. I would also like to thank "M2Smart: Smart Cities for Emerging Countries based on Sensing, Network and Big Data Analysis of Multimodal Regional Transport System", JST/JICA SATREPS, Japan" project for their support.

I've explored the Wi-Fi and Cellular-based V2X technology for improving road safety and traffic efficiency. Intelligent Transport System (ITS) performance is improved by proposing two traffic-aware solutions, first exploiting Wi-Fi technology for traffic monitoring and then introducing a traffic-aware semi-persistent resource selection scheme for C-V2X networks. To ease traffic congestion and keep a smooth traffic flow, the Wi-Fi-based road traffic monitoring system with channel hopping functionality is studied, which helps estimate traffic stats (travel time, average speed, and traffic flow) of road segments. Moreover, to increase the safety performance of decentralised C-V2X Mode 4 networks a Traffic-Aware Semi-Persistent Scheduling (SPS), an enhancement to the traditional SPS scheme is introduced, which enhances the transmission reliability of C-V2X Mode 4 networks.

Road traffic detection using Social Media & M2Smart Bot

by Priyambada Ambastha

I express my deepest gratitude to Dr. Maunendra Sankar Desarkar for giving me the opportunity to be a part of the M2Smart family as a Research Assistant. My work at M2Smart revolved around "Road traffic detection using Social Media" and "M2Smart Bot: A transport domain chatbot for commuters". This work would never have been successful without his excellent guidance, constant support, encouragement and sincere advice.
I am thankful to "M2Smart: Smart Cities for Emerging Countries based on Sensing, Network and Big Data Analysis of Multimodal Regional Transport System", supported by JST/JICA SATREPS, Japan project for supporting my work in all possible ways throughout my journey.
My sincere thanks to all the faculty members for their invaluable guidance and insightful comments. Lastly, I would like to thank all my fellow team members for all the fun moments we had in the lab and virtually.

Travel time and traffic incident duration prediction

by Prashansa Agrawal

I would like to express my deepest gratitude to Dr. Antony Franklin and Dr. Bheemarjun Reddy Tamma for selecting me as a part of this project. The completion of my dissertation would not have been possible without their consistent support and guidance. I would also like to show my deepest appreciation to Dr. Digvijay Pawar for his constant mentoring and support. I am also extremely greatful to Dr. Srijith PK for guiding me with invaluable suggestions and warm encouragement. My sincere thanks to JST/JICA SATREPS, Japan for their support. I had great pleasure working with IITH M2Smart team. A special mention to Chandrashekhar C for the collaborative work.

I have worked extensively on traffic related datasets with respect to travel time and traffic incident duration prediction. The work included data analysis using various Machine Learning models in combination with Natural Language Processing. I was also involved in the collaborative work with respect to E-Rikshaw Driving Cycle Development.

Publications

Journals

- Tsutomu Tsuboi, Tomoaki Mizutani, "Traffic Congestion "Gap" Analysis in India", 6th International Conference on Vehicle Technology and Intelligent Transport Systems April 2021 (VEHITS)

Conference presentations

- Prashansa Agrawal, Jahnavi Yarlagadda, Antony Franklin, Dr. Digvijay Pawar, "Bus Travel Time Prediction using Extreme Gradient Boosting" ASCE ICTD 2021 (Virtual Event). (Virtual presentation date : 8th June 2021)

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