
Dr.Usha Dixit Visit Nihon univ on 2nd Mar

M2Smart NewsLetter

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SPECIAL TOPICS

It's been an eventful period(JCC#6, Co-symposium,Ahmedabad trip)!

by Misa Kitagawa (M2Smart Residential Coordinator)

6th JCC conducted online

The 6th Joint Coordination Committee (JCC) meeting was heldd online on 17th January 2022.

Prof B S Murty, Director of Indian Institute of Technology Hyderabad (IITH), gave an encouraging opening remark that this project is very important not only for bilateral corporation but also interdisciplinary endeavour to apply technologies to real city. He pointed out that it is neede to bring in change in culture and discipline is required at all levels of society (citizens, service provider such as bus drivers, and administarions),introducing the examples of Indore and Surat.

Dr.Tsutomu Tsuboi(M2Smart Project Leader) introduced the progress in activities by SCADL (Smart City Ahmedabad Development Limited) , which was one of the destinations of his trip to Delhi & Ahmedabad (**→See page. 2 for details**).

Group activities and the situation of "Handbook" writing was shared with an efforts of each group and some remarkable results. The momentum of dissemination and publication of "Handbook" was also confirmed.

Lastly, Mr. Kenichi Kono, Japan International Cooperation Agency (JICA) , and Mr.Masayuki Kamimoto, Japan Science and Technology Agency (JST) expressed their high expectation as the project is in the phase of finalization.

Co-Symposium with Friend in Thailand was held

On 25th Jan, the Co-Symposium with "SmarTran4T4 (Smart Transport Strategy for Realizing Thailand 4.0)", another SATREPS project was held online.
(**→See page.4 for details**).

Dr. Dixit visit the Nihon University

On 2nd March, Dr. Usha Dixit, a counsellor (S&T) from the Embassy of India, Tokyo, visited Nihon university, requested through JST. It was very fruitful as M2Smart project activities were introduced and insight were exchanged among us. She gave us encouraging comments on support in the dessimination of handbook and possibly in workshops in Ahmedabad and Hyderabad. In Ahmedabad in particular, she also commented that it might be better to collaborate with Ahmedabad University, IIT-Gandhinagar and IIMA (Indian Institute Of Management – Ahmedabad).

SPECIAL TOPICS

Trip to Delhi & Ahmedabad

by Dr.Tsutomu Tsuboi (M2Smart Project Leader)

I would like to report the activities of my trip to India from 1st to 10th December 2021, the first time in almost two years due to COVID 19 pandemic. What was impressive about this trip was the steady progress made towards smart cities in India over the last two years.

SCADL (Smart City Ahmedabad Development Limited)

The most impactful part of the visit was the visit to the Smart City Corporation promoted by the local administration in Ahmedabad and the presentation given there. Some of the highlights are as follows

1. 7,200 surveillance cameras have been installed in the city to check citizens' compliance with traffic rules and to charge violators with "Challan(fines)" via their personal smartphones.
2. More than 180 free Wi-Fi hotspots have been set up in key spots in the city, giving citizens unlimited access to high speeds of 2 megabits per second.
3. More than 1,120 buses are equipped with GPS and used for fleet management.
4. 16,000 LED street lights have been installed on major roads, enabling automatic brightness control and contributing to the safety of citizens at night.
5. The early morning refuse collection vehicles are equipped with IoT (Internet of Things) devices to control whether they are properly operating to the designated refuse collection points in the city.
6. Smart public toilets have been set up at 120 locations in the city with a fee (Rs. 1) to provide sanitation services.

At SCADL- A monitor screen at the front of the building constantly shows video from surveillance cameras installed in the city, and about 50 staff members work behind the screen in three shifts.

What I learned here is the importance of shifting from "MONO(products)" to "KOTO(experience) ", which has become a popular phrase in Japanese business scene in recent years. On the hardware side, it was obvious from this visit that the major cities in India are making steady progress.

SPECIAL TOPICS

CEPT university

Since it has been difficult to conduct the series experiments in City of Ahmedabad due to Covid 19 situation for the past two years, we asked CEPT University (formerly the Centre for Environmental Planning and Technology) to undertake part of the work, the discussion about which was one of the main purpose of this trip.

At CEPT Research & Development Foundation (CRDF)

The visit to CEPT University was made possible by a professor who was introduced to us by Ms.Mona Khandhar, Minister of the Indian Embassy in Japan. The Minister, who happens to be from Gujarat, was very knowledgeable about the city of Ahmedabad in minute detail and helped us to arrange a visit. The professor kindly welcomed and hosted us for two days, on 6th and 9th December.

Part of the experiments involves the use of VMS(The variable message signs) installed around the city, with the aim of improving the habits of city bus drivers passing through the boards by displaying information on traffic manners (e.g. keeping a safe distance between vehicles) on half of the boards. 75 drivers on city bus routes passing by 9 information boards were interviewed about their opinions of the boards and whether they had led to a change in behaviour, as is the current fashion. We asked for the cooperation of CEPT University in translating the local Gujarati language as well as English shown in VMS.

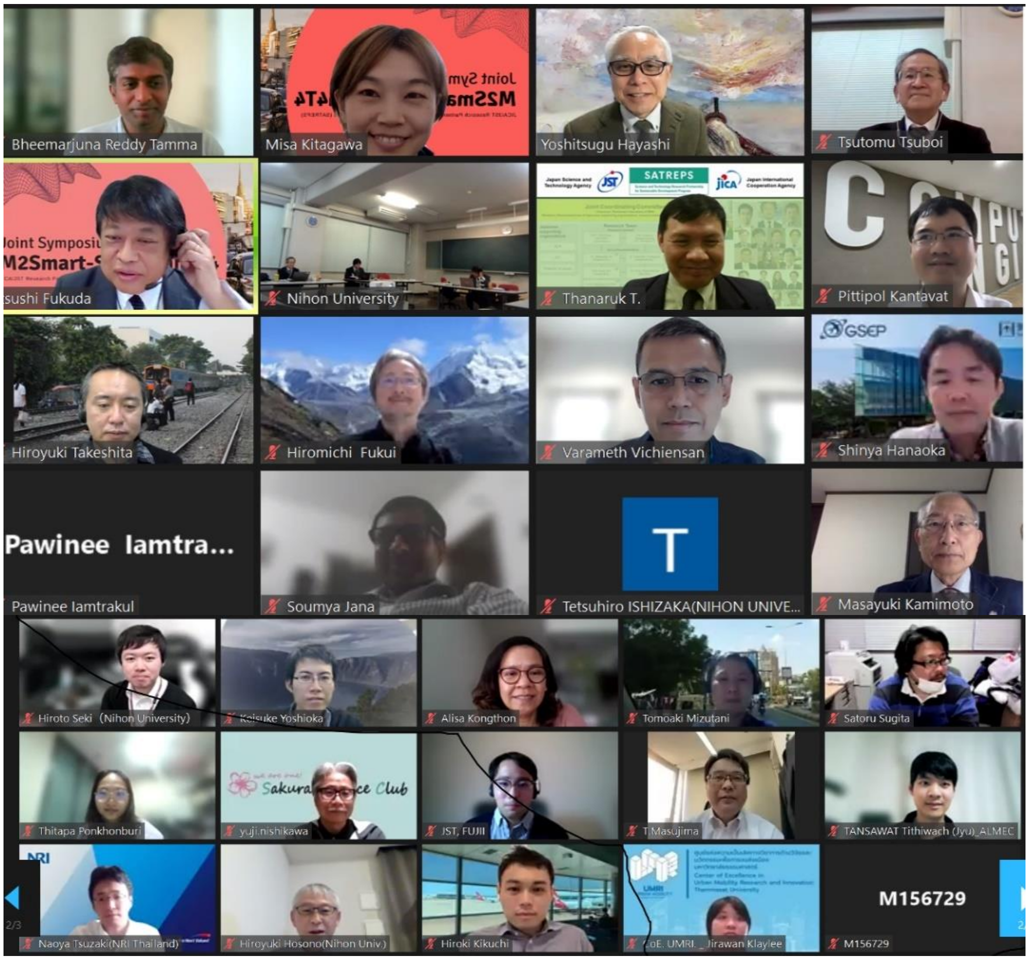
METRO construction site at NIPPON SIGNAL

Visiting Metro construction site operated by Nippon Signal was another excitement. At the moment, Metro is operating between 6 stations, at the edge of the city, with an interval of 20 mins. When we visited the actual station "Apparel park", as it we could see a few passengers actually using the metro, although it was sparse because service time still remains short(10am - 6pm). At Nippon Signal, we could clearly saw how the

passengers and the train operator are monitored with the sit uations of train cars, platform, and ticket gates with high resolution screen . So far, the entire line is expected to open between June and August, which will possibly contribute multi-modalization in the city.

CO-SYMPOSIUM WITH SMARTRAN4T4

Co-Symposium with "SmarTran4T4 (Smart Transport Strategy for Realizing Thailand 4.0)"



Co-symposium with like-minded friends in Thailand

by Misa Kitagawa (M2Smart Residential Coordinator)

On 25th Jan, the Co-Symposium with "**SmarTran4T4 (Smart Transport Strategy for Realizing Thailand 4.0)**", another SATREPS project was held online.

The aim of the symposium was to exchange insights and views among of each other, to explore future challenge and to strengthen research networks.

We are happy to announce that it ended successfully, with the audience of as many as 114 at maximum, including both project members and young researchers from 3 countries, JICA, JST and the relevant public and private sectors.

2 projects have a lot in common in the goal, to create a sustainable and eco & people-friendly city by smart transportation to address the common issues which emerging countries are facing.

We will keep in touch with for future challenge!

https://youtu.be/Gai6zdt6zdE

Introduction of the day's presentations

Estimation of Traffic State by Image Processing in Ahmedabad

by Prof.C. Krishna Mohan (Group 1 Leader), K Naveen Kumar, Sai Harsha Yelleni

Intersections are one of the main sources of congestion and hence, it is important to understand traffic behavior at intersections. Particularly, in developing countries with high vehicle density, mixed traffic type, and lane-less driving behavior, it is difficult to distinguish between congested and normal traffic behavior. We worked on traffic congestion state detection and prediction using image processing[3] and deep learning methods[1].

Congestion state is modeled as:

1. (OF)Open flow (low congestion),
2. Mild congestion (medium),
3. High congestion.

We performed experiments on traffic congestion state modeling based on vehicle queue length [2] and capacity/density-based modeling. Capacity is the percentage of roads occupied by vehicles. In a Capacity based model, users should give the area of interest (AOI), and based on blurring and thresholding, we obtain the binary (black/white) pixels. White pixels represent the area of the road segment and black pixels are the vehicles.
AOI in our case is half part of the road. It is characterized as a polygon with (x,y) coordinates on the image. The advantage of the polygon is we can choose the AOI as precisely as possible. For the input video, we have to fix the AOI according to the camera angle. Outputs are video with capacity displayed and a graph for time (of the day) vs capacity. The higher the capacity of the road is occupied the higher the congestion. Capacity and Level of Service (LOS) are for obtaining quantitative measures of traffic congestion.

Methodology of Proposed Approach:

1. From the input video, get the edges of the frame.
2. Blur the frames to get the area that is more filled.
3. Blur the image by binary thresholding.
4. Overlap the thresholded image with AOI and count black pixels/white pixels which give you traffic capacity

Outcome

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

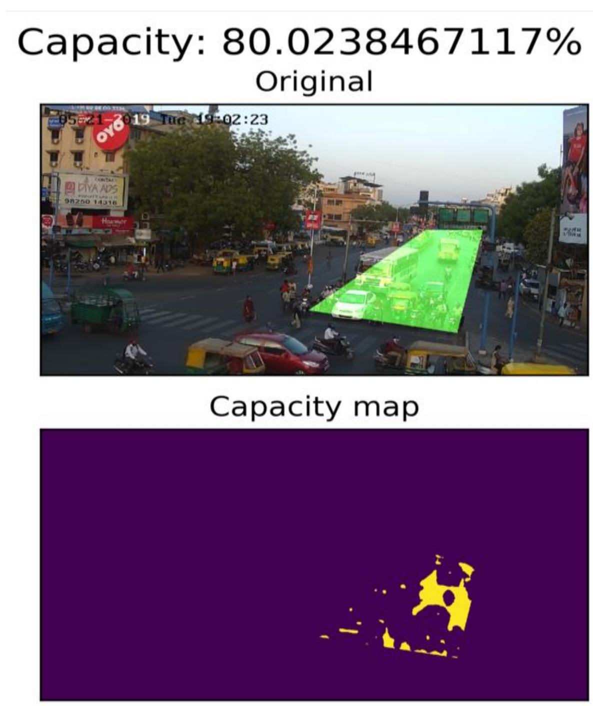


Figure 1: Capacity model input

Time vs Capacity Graph

This Big data of time vs capacity is generated and stored in CSV format, which helps in traffic congestion prediction using time series analysis.

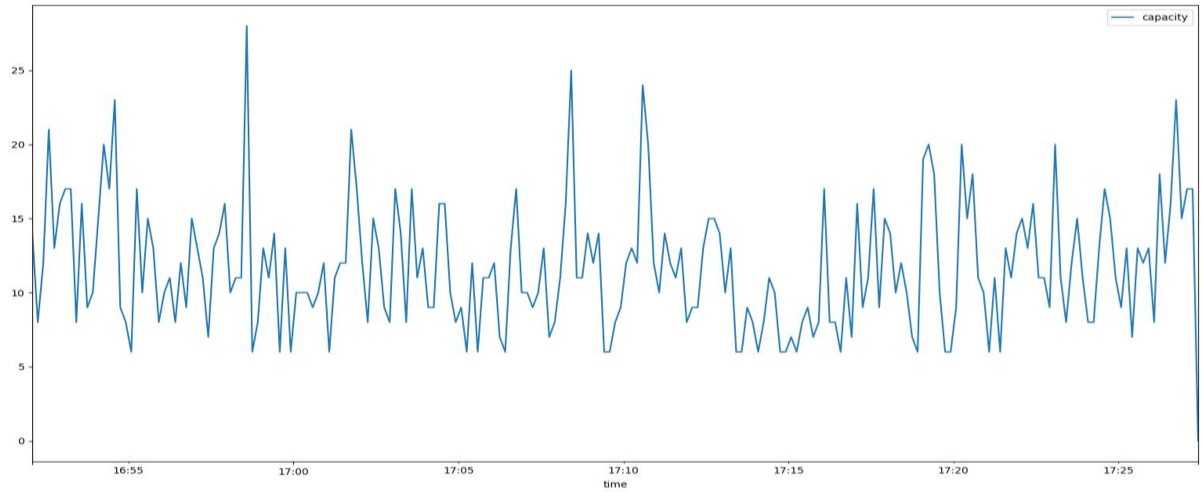


Figure 2: Real-time graph of capacity at Ahmedabad

Observations

- With the capacity based approach, we can analyze traffic in a particular region.
- Real-time capacity measures help in monitoring traffic congestion and help in congestion prediction.

With the help of traffic congestion detection, we can get traffic states in real-time, and with the help of big data of capacity stored, we get traffic congestion prediction estimates. By doing traffic congestion detection at multiple junctions, we can do traffic optimization to reduce congestion. In the future, we would like to improve the performance of models during nighttime using image enhancement techniques.

References

1. Chakraborty, Pranamesh, et al. "Traffic congestion detection from camera images using deep convolutional neural networks." Transportation Research Record 2672.45 (2018): 222-231.
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3. Wei, Li, and Dai Hong-ying. "Real-time road congestion detection based on image texture analysis." Procedia engineering 137 (2016): 196-201.

CO-SYMPOSIUM WITH "SMARTRAN4T4"

Group 2 – Assessment of Mobility and Traffic Emission by Controlling the Speed at the Intersection under Heterogeneous Traffic Flow

by Aditya BETHALA , Prof. Tetsuhiro Ishizaka (Group 2 Leader), Shaik Mohammed Asif Nawaz

One of the Goals of Group 2 has been to study and test the implications of smart applications of traffic control systems, due to lack of signal timing information and lengthy signal cycle, vehicles wait at the intersection for extended period which result in unnecessary idling cause inturn resulting in huge amount of fuel wastage

Objectives

The main objective of this study is to evaluate the traffic delay, fuel consumption, and traffic emissions at the intersection by providing upcoming traffic signal information and required speed to cross the intersection in the green phase under heterogeneous traffic flow and indiscipline lane behavior. The secondary objective is to evaluate the speed control under different speeds (nothing but different road types like urban streets, arterial roads, rural roads, and Highways/motorways). To conduct this study PTV Vissim microscopic traffic simulation was employed as an effective and flexible tool to simulate the speed controlling rule.

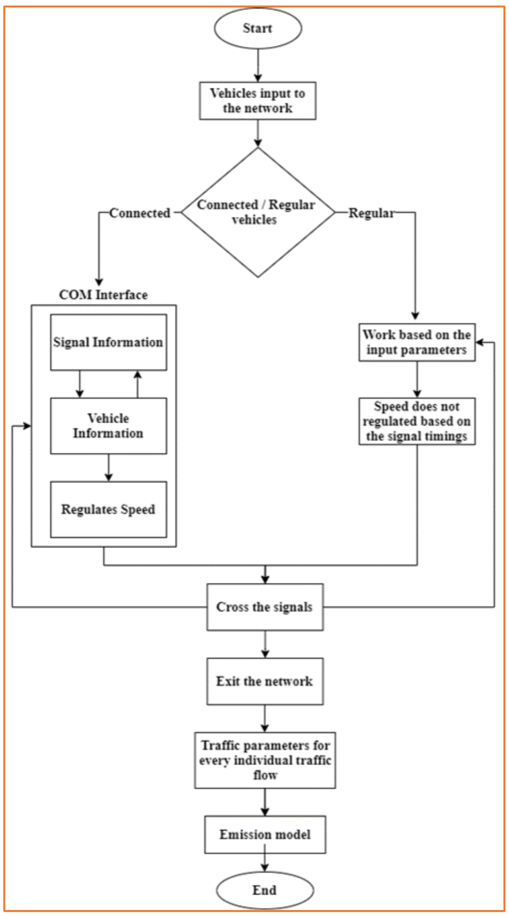
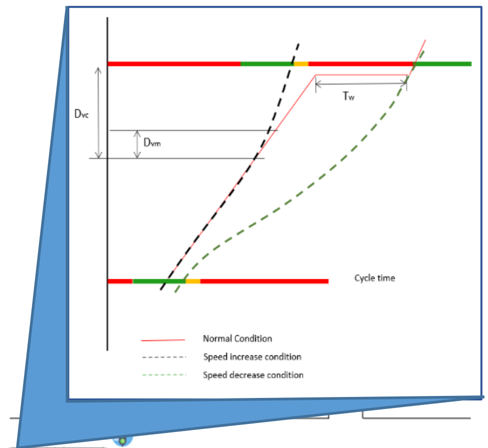


Fig 1 : Working model flow chart for simulation



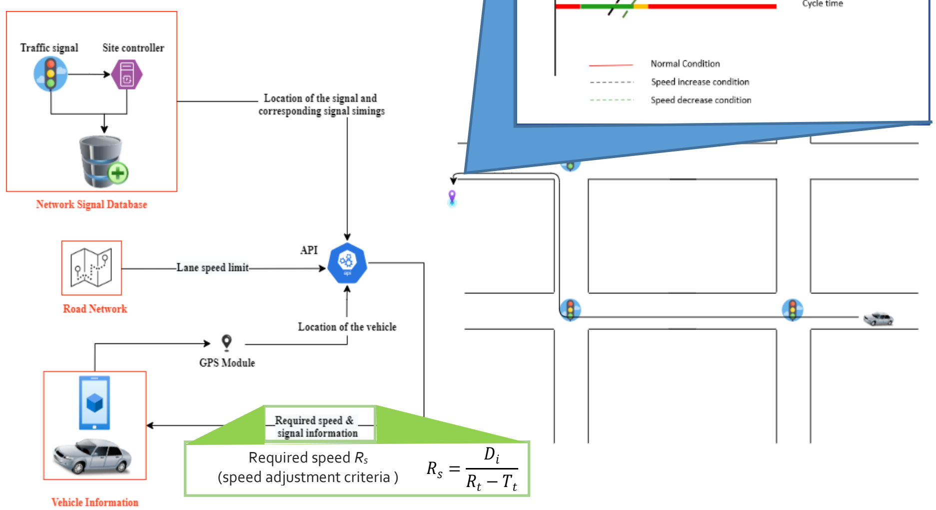


Fig2 : Conceptual realization of a working system

Speed Control and Carbon dioxide emission

It is difficult to control the vehicle in the real world and genereate such quality data. So, in this study, to estimate the impact of the speed control at the upcoming intersection on flow and environment under heterogeneous traffic flow a PTV VISSIM simulation-based traffic model is used. In the simulation speed controlling and estimation of CO_2 are done by using user-defined attributes and a COM interface following the steps shown in Fig.1 and Fig.2

Results and inferences

The purpose is to evaluate the efficiency of the speed adjusting by proving the upcoming signal information to improve mobility and reducing CO_2 emission. The results indicated that the speed control has a significant change in CO_2. There is a significant impact in both scenarios if all the vehicles use the speed controlling option.

As shown in above Fig.3, the average delay is improved by an average of 80% in the case of scenario ‘A’ and 30% in the case

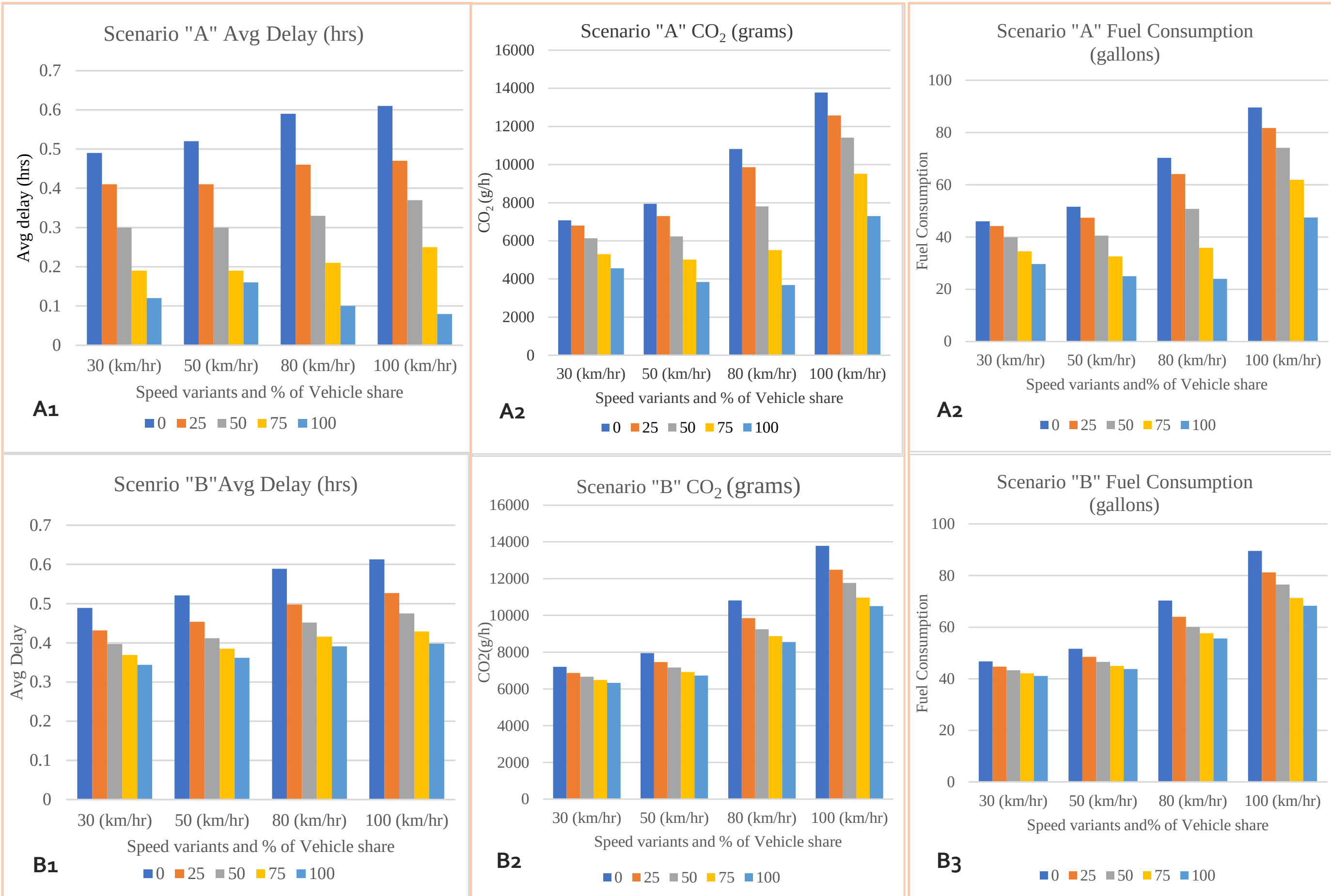


Fig3 : Scenario comparison - Average delay (Scenario AvB), Emissions (Scenario AvB) and Fuel Consumption (Scenario AvB)

of scenario ‘B’. Similarly, 50% change in the fuel consumption and CO2 in the case of scenario ‘A’ and 18% change in case of scenario ‘B’ when compared with the base scenario. In addition, speed control has a positive impact on the other traffic parameters like Vehicle Kilometres Travelled, Vehicles Hours Travelled, Queue length, the average number of stops, and speed inside the network. The results of this study shows that signal control has significant impact in both the scenarios on mobility, fuel consumption, and CO2-emissions.It is evident that even partial application of speed control shows improvement but also if all vehicles use only speeding condition there is significant positive impact when compared with base scenario.

Application of study

As the conception of smart cities is evident, adoption of autonomous traffic control measures can be a stepping stone to more smart measures to alleviate congestion problem. The real world application tests can be gradually performed to investigate other possible influencing factors such as Vehicle2Vehicle and Vechicle2Infrastructure connectivity to understand the the study in the real world context.

CO-SYMPOSIUM WITH "SMARTRAN4T4"

Data Acquisition by Various Sensing Devices and its Utilization

by Dr.Tsutomu Tsuboi(M2Smart Project Leader)

Traffic flow analysis

For these years, we have been accumulating traffic data through various sensing devices installed in Ahmedabad City, which enable us to understand and summarize the traffic situations.

- Traffic monitor camera … 29 locations
- CCTV … 1 location (Paldi junction)
- Monitor camera … 4 locations (Paldi junction)
- VMS … 10 locations

By utilizing the obtained data, we could analyze and estimate when will the congestion occurs, and what is the mechanism of congestion.

First, we conducted time-zone analysis and could understand congestion is always occurring in evening, 5-10pm.

Secondly, we focused on the location where congestion were occurring and a closer look at the sight through monitoring camera led us to the insight that a possible cause of the congestion is the appearance of many small stalls in the evening, where there was space and cars were flowing during the day.

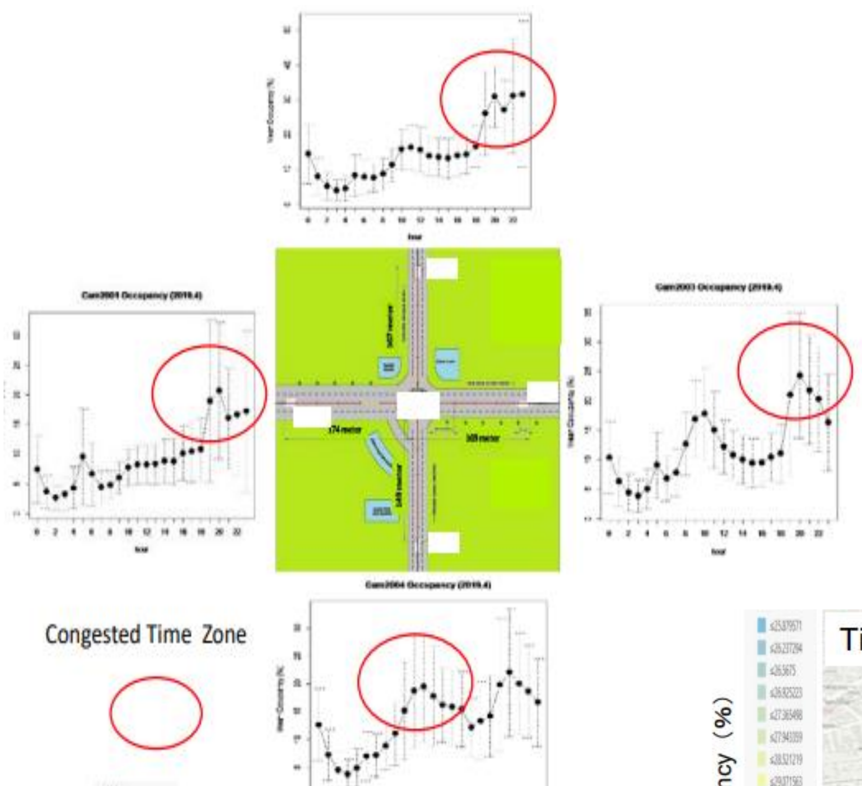


Fig1 : Time zone analysis

These kind of analysis of traffic situation may be beneficial for the local government who tries to address the issue.

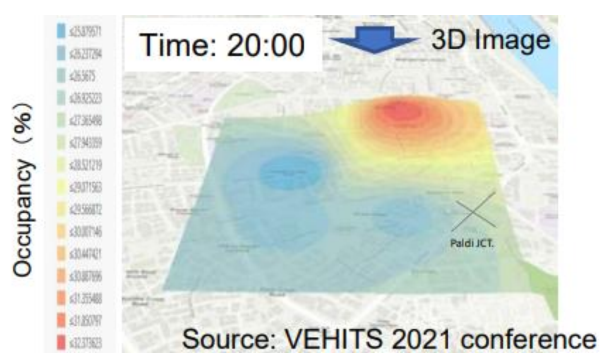


Image1 : 3D visualization of traffic situation

CO-SYMPOSIUM WITH "SMARTRAN4T4"

Travel activity analysis and Urban Trip modeling

Meanwhile, personal travel activity data obtained through smartphone App carried by each resident can be utilized to clarify the actual travel route, when and how citizen choose the travel route.

Moreover by combining several different types of data(actural travel route, Origin and Destination travel route, traffic spatial analysis, traffic mesh analysis, and census data), it is possible to bring to light a multi-layered picture of the real situation in the city, which may lead more advanced congestion forecasting and urban trip modeling. There was field trail test in December 2021. The detal analysis is under going. It will be informed at the next NewsLetter.

Driver's behaviour analysis by VMS

From October to December 2021, survey of driver's behaviour was conducted in Ahmedabad city with the support of CEPT university. Main purpose of this survey is to verify the effects of utilizing VMS as a communication tool, and Key question was "How VMS influence drivers mind and how mind change leading to the travel behaviour?".
75 bus drivers were divided into 4 groups according to with/without pre-learning and on/off bus route where VMS was installed. During the survey, various messeages in different languages were displayed on VMS, then bus driver's behavioural change in each group was monitored and compared quantitatively.
In conclusion, the observation strongly supports the effect of learning and VMS messaging to improve driver' s behavior, although it is now at the preliminary phase of study and subject to further analysis.

Impact on greenhouse gases/roadside air pollution

by Prof. Soumya Jana(Group 4 Leader), Anand Kakarla

Developing nations have been witnessing accelerated economic growth and technological advancements in recent years and contributed to increase in resource usage and depletion. In this backdrop, several such nations have taken smart cities initiative in an attempt at sustaining the environment while providing desirable citizen services. In this paper, we focus on an essential service, namely, urban mobility, and develop tools to measure its environmental impact, so that the traffic can be managed in real time subject to appropriate locallyenforced emission limits [1].

At present, desired high-resolution spatio-temporal maps of vehicular pollution are not available. In practice, local traffic agencies set real-time mobility targets at streets and junctions, while a pollution monitoring agency independently looks at city-scale contribution of vehicular emission over a much longer time horizon [2]. In particular, the latter usually obtains aggregate data on fuel consumption, vehicle kilometers travelled and similar quantities over a period, and makes estimation of gross emission levels. Such coarse estimates are clearly inadequate for the present purpose. Indeed, we need alternatives to gross source modeling because of heterogeneous traffic characteristics in developing cities exhibit high spatiotemporal variability. In addition, non-traffic sources, such as garbage burning and cooking in close proximity, contribute to on-road air quality.

Fig. 1. Preliminary setup at IIT Hyderabad

TABLE I CLASS-DIFFERENTIATED TVC AND EMISSION ESTIMATES IN A SPECIFIC HOUR BASED ON BSIV STANDARD

Vehicle Class	2W	3W	4W	Bus	Truck
Total Count	595	113	717	39	100
Emission Rate (g/km)	0.1	1.2	2.3	5.2	4.7

In such circumstances, we propose to complement source measurements and models with emission measurements and dispersion models towards obtaining reliable high-resolution profiles. In this vein, we shall specifically obtain fine-scale data on (i) class-differentiated traffic alongside suitable driving cycle and emission factor, and (ii) on-road pollution levels. Thus, we shall rely on not only traffic information collected by the traffic management system, but also pollution information of the air quality management system.

As the vehicular traffic significantly contributes to the on-road air quality, we assume that estimating the said contribution, can improve the reliability of the estimating pollution profiles. Specifically, if the emission information is known along with the ambient meteorology, one can estimate the on-road pollution profiles using dispersion models. Here, the total emissions on a particular road segment can be obtained from traffic volume estimates which includes total count of different types of vehicles such as two-wheelers and three-wheelers and the emission rates of each vehicle type.

For this small scale demonstration, we selected a road segment of National Highway (NH) 65 near Indian Institute of Technology Hyderabad (IITH) main-gate. With the main objective of obtaining the on-road pollution profile, we placed two alphasense CO sensors known for their low minimum detection limit, one on road (S2) and one off road (S1) as shown in Figure 1. The sensors were calibrated against known concentrations of CO at five different levels. For this, we setup The Infra-Red Traffic Logger (TIRTL) that provides TVC including vehicle flow rate (VFR) and speed of various vehicle types such as motorised two-wheelers, threewheelers, cars, buses and trucks.

For the generation of spatial CO profile, we only considered the time between 17:00 PM and 18:00 PM and obtained the corresponding TVC. And, emission limits were set according to Bharat Stage (BS IV) and source emission rate (E_s) was calculated. And, to create a pollution profile, AERMOD dispersion model [6] was adopted. Certain meteorological parameters necessary for AERMOD were obtained from the IITH weather station. Further, the emission release height was set to 1 m and line area source with a width of 5 m and length of 600 m was considered. Next, we found the source emission rate (E_m) based on CO measurements as follows. Framing an optimization problem, we found the emission rate that minimizes the mismatch between simulated profile and the measurements made at the corresponding locations of S1 and S2. Next, we took the average of E_s and E_m and simulated the corresponding AERMOD profile.

Within the selected hour, obtained TVC from TIRTL and the corresponding emissions set based on BS-IV standard are given in Table I. Using these values Es was obtained as $5.42 \times 10^{-4}\ g/sec/m^2$. On the other hand, the average value of measurements within the selected hour at S1 and S2 were found to be 1.1 ppm and 3.58 ppm. After obtaining all the necessary parameters for AERMOD dispersion, Em was back caliculated as $2.89 \times 10^{-3}\ g/sec/m^2$. Consequently, we obtained a fused average value of $1.7 \times 10^{-3}\ g/sec/m^2$. Next, AERMOD profile was simulated based on the rate estimate. This profile shows that mean concentration was about 1 ppm along the road and decreased as we go far away from the the road as expected. Finally we employed a CO to CO2 correlation factor of 212 (based on emperical data) to obtain CO2 profile.

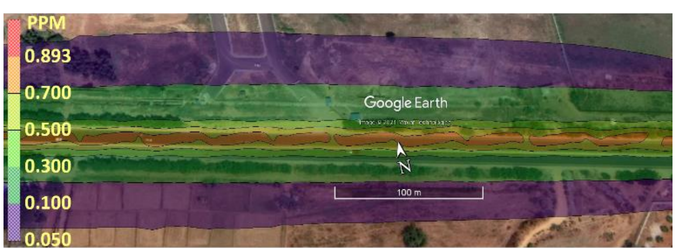


Fig. 2. Source-based pollution profile around NH-65 near IIT Hyderabad.

INFORMATION

ACKNOWLEDGEMENT FOR RESEACH ASSISTANTS

by Prof. Bheemarjuna Reddy Tamma (M2Smart Co-Project Leader)

The research and development activities of M2Smart project are carried out by passionate research assistants (RAs) under the guidance of faculty members at IIT Hyderabad and other researchers from Japan. Being interdisplinary nature of work, we put together 20 RAs from various disciplines to work together as part of this project.

They created novel solutions and technologies for collecting, processing, and providing traffic information in the IITH campus and Ahmedabad city using various sensing technologies, wireless communication technologies and big data processing techniques,some of which came to fruition in the form of 34 publications(20 conferences, 7 journals, 5 workshop papers, 2 posters).

I would like to congratlaute all the scholars for making their research outcomes visible by publishing them in reputed conferences and journals. I would like to place on record my sincere thanks for the key role that they played in shaping the handbook of the project and wish them all the best in their future.

Many Thanks to

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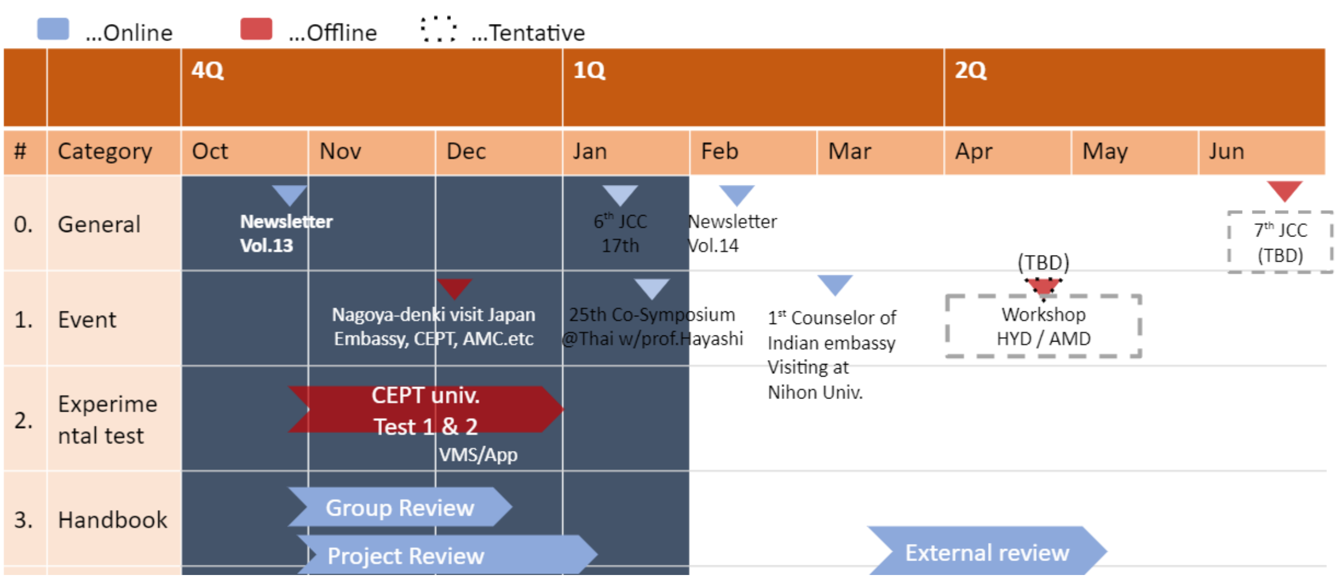
Mr. Chandrasekhar C,
Ms. Jaya Sharma,
Mr. Kummari Naveen Kumar,
Mr. Anand Kakarla,
Mr. Sai Harsha Yelleni,
Mr. Pabbathi Uday Kumar

and the students who has already graduated…

(listed in no particular order)

UPCOMING SCHEDULE



PUBLICATION

Journals

- Aditya BETHALA, Mohammed Asif Nawaz SHAIK, Tetsuhiro ISHIZAKA andDigvijay Sampatrao PAWAR (2021). Assessment of Mobility and Traffic Emission by Controlling the Speed at the Intersection under Heterogeneous Traffic Flow, The 14th International Conference of Eastern Asia Society for Transportation Studies
- Tetsuhiro ISHIZAKA, Debaditya Roy, Syo MATSUNOSHITA (2021). Detection and Evaluation of Running Condition under Mixed Traffic Flow using Social Force Model in India, The 64th Conference of Infrastructure Planning and Management, JSCE
- Kazu Fujieda,Kosuke Tanaka and Tetsuhiro ISHIZAKA (2021). Estimation of Satulation Flow rate under Mixed Traffic Flow and Analysis of Reduction Factor, The 49th Conference of Research and Technology, Kanto Branch, JSCE
- VR Naganaboina, SG Singh(2021). Graphene-CeO_2 based flexible gas sensor: Monitoring of low ppm CO gas with high selectivity at room temperature
- VR Naganaboina, SG Singh(2022). CdS based Chemiresistor with Schottky Contact: Toxic Gases Detection with Enhanced Sensitivity and Selectivity at Room Temperature, Sensors and Actuators B: Chemical vol. 357, April 2022, 131421
- VR Naganaboina, M Anandkumar, AS Deshpande, SG Singh(2022). Single-Phase High-Entropy Oxide-based Chemiresistor: Toward Selective and Sensitive Detection of Methane Gas for Real-time Applications, Sensors and Actuators B: Chemical vo. 357, April 2022, 131426

Conference

Workshop paper

- Priyambada Ambastha, Maunendra Sankar Desarkar(2022). mTransDial: Multilingual Dataset for Transport Domain Dialog Systems, AI for Transportation workshop at Thirty-Sixth AAAI Conference on Artificial Intelligence
- K Naveen Kumar, Digvijay S. Pawar, and C. Krishna Mohan(2022). Open-air Off-street Vehicle Parking Management System Using Deep Neural Networks: A Case Study

Conference Presentation

- Thamilselvam B, Subrahmanyam Kalyanasundaram, M. V. Panduranga Rao(2021). Statistical Model Checking for Traffic Models, SBMF2021 -24th Brazilian Symposium on Formal Methods
- Suhel Sajjan Magdum, Antony Franklin, Bheemarjuna Reddy Tamma(2022). A Cooperative Federated Learning Mechanism for Collision Avoidance using Cellular and 802.11p based Radios Opportunistically, ANTS 2021 IEEE International Conference on Advanced Networks and Telecommunications Systems
- Kakarla. A, V. S. K. R. Munagala, T. Ishizaka, A. Fukuda, and S. Jana, Spatio-temporal prediction of roadside PM2.5 based on sparse mobile sensing and traffic information, National Conference on Communications (NCC), 2021
- VR Naganaboina, SG Singh, Fabrication of highly selective NO_2 gas sensor for low ppm detection, IEEE Conference on Nanotechnology

M2Smart

NewsLetter

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