MATLAB EXPO

Towards Safe Driving in Unstructured Environments

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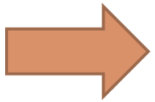
INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

MathWorks®

Structured to Unstructured Environments

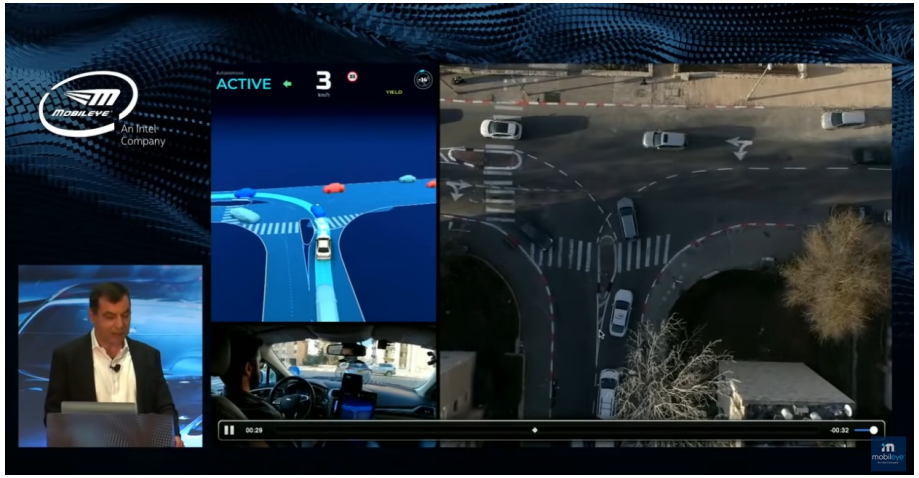


Challenges in Perception and Reasoning

- Density
- New Objects
- Diverse Objects
- Complex Movement Patterns
- Crowd/Poor-Visibility

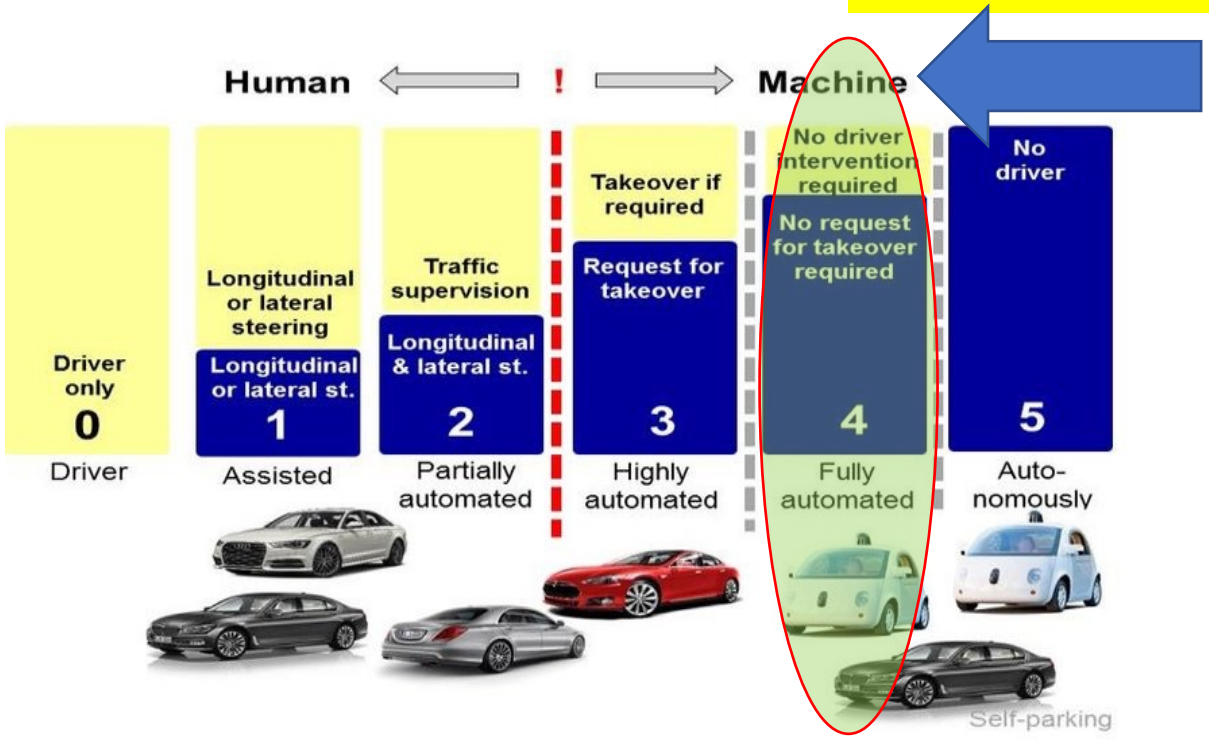
Future of Driving – Cars with Artificial Intelligence (AI)

Source: https://www.youtube.com/watch?v=S1DZi0x0Uhk



Source: https://www.youtube.com/watch?v=HPWGFzqd7pI

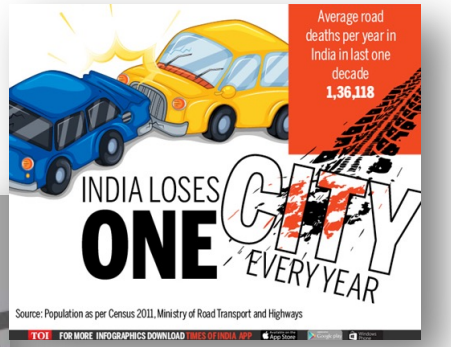
Self-driving cars



https://www.researchgate.net/figure/Levels-of-autonomous-driving-according-to-SAE-J3016_fig1_322368082

How Safe are Indian Roads ?

- Enhancing road safety is an important mission for India
  - One death every 4 minutes
  - 17 deaths every hour in India
  - India loses 3% GDP every year to road deaths

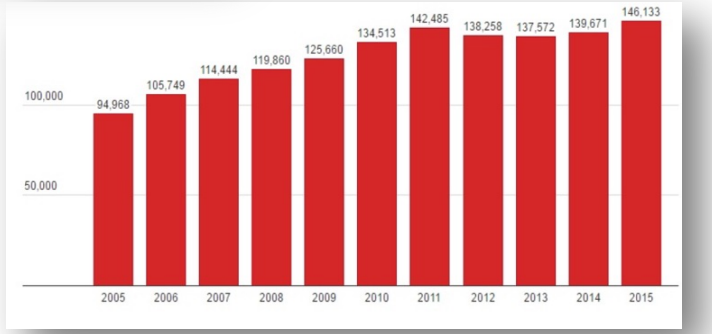


India way behind 2020 target, road accidents still kill over a lakh a year

Priya Kapoor | TIMESOFINDIA.COM | Updated: Oct 4, 2018, 20:55 IST A- A+

India tops in road deaths; Globally fatalities increase by 1 lakh in 3 years: WHO report

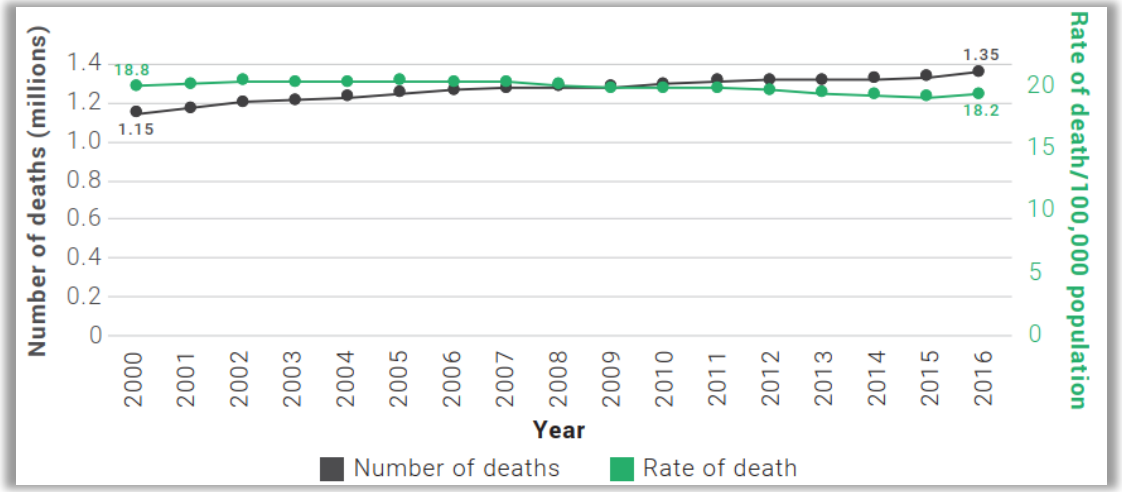
Dipak K Dash | TNN | Dec 7, 2018, 13:07 IST A- A+



Source: https://timesofindia.indiatimes.com/india/india-way-off-road-safety-targets-for-2020-road-accidents-still-kill-over-a-lakh-a-year/articleshowprint/65765549.cms

Road Safety – Big Societal Problem

- Worldwide
  - 1.35 million deaths per year
  - Leading killer in age group 5-29

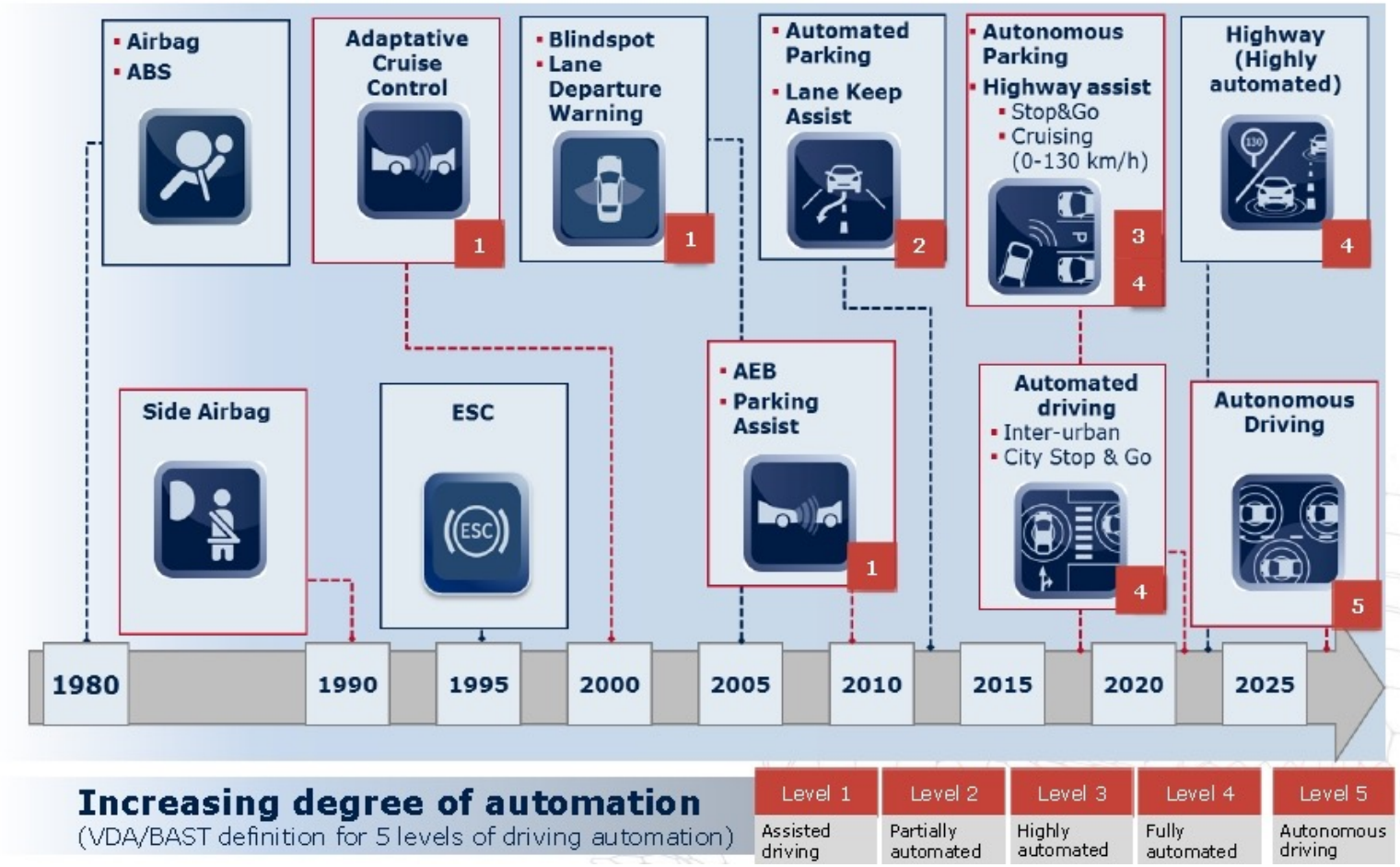


- India
  - 150,000 people killed every year, 450,000 crippled every year
    - 70% of death in age group 18-45
  - Cost: Rs. 91 lakhs/death, Rs. 3.64 lakhs/injured person
    - 3.14% of GDP (Rs. 4.3 lakh crores)
  - 1% of world vehicles but 11% of all road deaths

Source: WHO, Business Today

Automobile Safety – Evolution

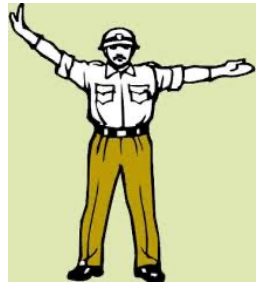
Safety evolves towards automated and autonomous driving



Source: Infineon

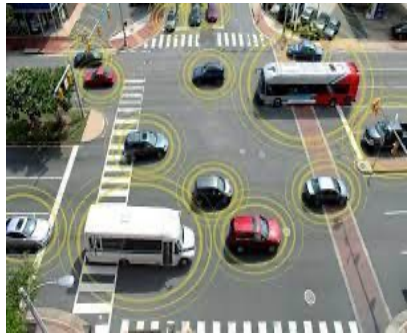
What Makes Indian Situation Different/Challenging?

Density, Diversity, Unstructured Movement Patterns



Traffic Signs, Enforcement, Regulating large population

Road Surface: Diversity, Quality, Cost in Establishing



Lack of Technology, Cost of Technology, Adoption

AD in India – First Brainstorming Meet

- Organized at IIIT-Hyderabad (December 2017)
- 30+ attendees
  - Academia
  - Industry

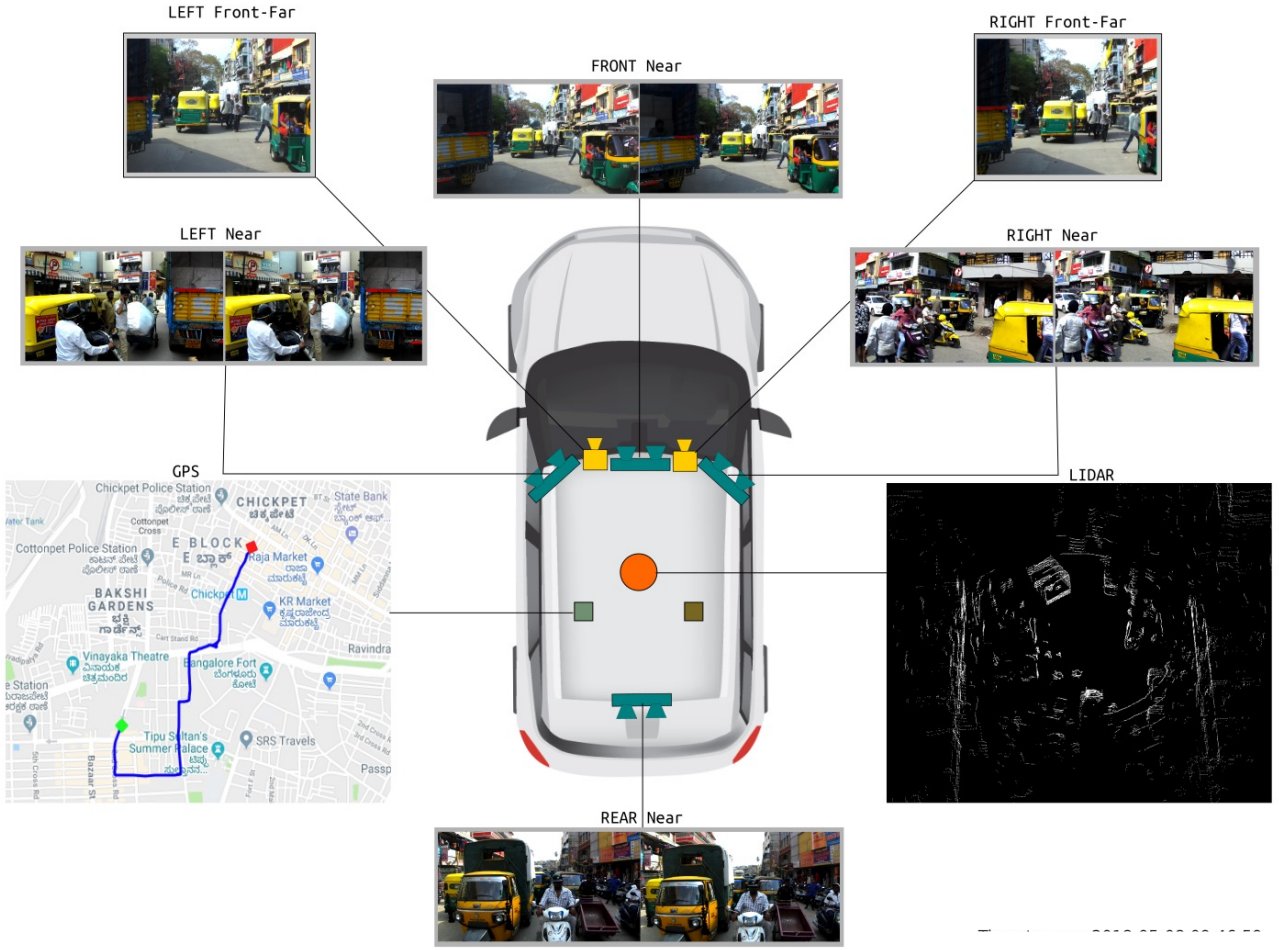
Brainstorming on Autonomous Navigation and Indian Setting
20th December 2017
Venue: KCIS Meeting Room, IIIT Hyderabad

Program Schedule

Time	Event	
08:30 – 09:30	**Breakfast & Informal interaction**	
09:30 - 10:15	Session 1: **Setting the Context** Introduction & Background : *C.V. Jawahar, IIIT- H* Opening Remark : *Manmohan Chandraker, UCSD/NEC*	
10:15 – 10:30	**Tea Break**	
0:30 - 12:00	Session 2: **Panel on Problems and Challenges** Moderator: *Vineeth Balasubramanian, IIT-H* Discussions: • What are the challenging and emerging technical problems in autonomous navigation? • What are the secondary benefits that the society looks forward (eg. Safety of people)? • What are the India specific challenges in this broad space? (Specially Technical, Social and Cultural) • Other related topics.	Panelists: • Amit Kale, Bosch • Anoop Namboodiri, IIIT H • Chetan Arora, IIIT D • Natraj J, Intel • Shanti Swarup, Mathworks • Dipindar, Kritikal
2:00 - 13:00	Session 3: **Experience Sharing** Experience on automated navigation, driver assistance and related areas. Discussions: • Brief presentation (5 - 10 Mins) from different groups/activities.	Presenters: • Akshay Uttamanambi , MSR • Gaurav Aggarwal, Ola • Madhava Krishna and IIIT H team • Prabhavathy Adavikolanu, Intel • Saket Anand and IIIT D Team • Vinoth Ponnuswamy, Mahindra • Presentations from other participants

Multi-Sensor Data Collection for IDD

- 4 stereo cameras
  - 1920 x 1080 pixels each
  - 15 frames per second
- LIDAR (16-channel)
- GPS



IDD – A Snapshot of First Release (2018)

Annotated dataset – 50,000 frames (2x Cityscapes dataset)

- 10,000 fine annotations
- 40,000 coarse annotations
- 30 classes
- 4-level class hierarchy

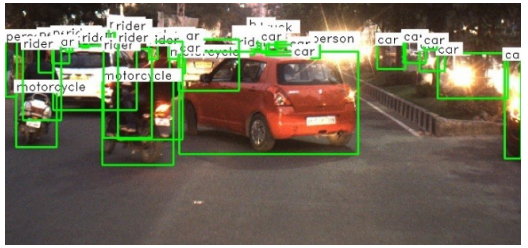
	Image	Drive sequences
Full	10,003	182
Train	6993	120
Val	981	22
Test	2029	40

Dataset	Calibration	Nearby frames / Video	Distortion /Night	#Images/ #Sequences	#Labels Train/Total	Average Resolution
Cityscapes [5]	✓	✓		5K / 50	19/34	2048x1024
IDD	✓	✓		10K / 180	30/34	1678x968
BDD100K [26]		✓	✓	10K / 10K	19/30	1280x720
MVD [16]				25K / -	65/66	>1920x1080

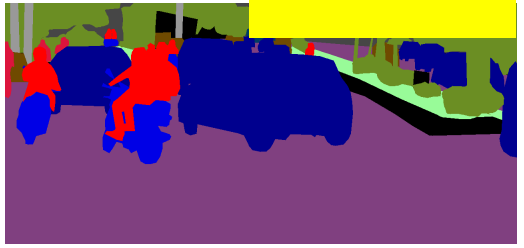
Table 1. Comparison of semantic segmentation datasets for autonomous navigation.

Frame

Coarse



Fine (semantic)



IDD – A Long Journey

2017

Dec
- First brain-storming at IIIT-H
- Autorickshaw detection challenge at **NCVPRIPG 2017**

2018

Aug
- IDD in **Govt. of India's (NITI Aayog)** - Global Move Hackathon

Sep
- **IDD** released
- AutoNUE @ **ECCV**
- 2 data challenges

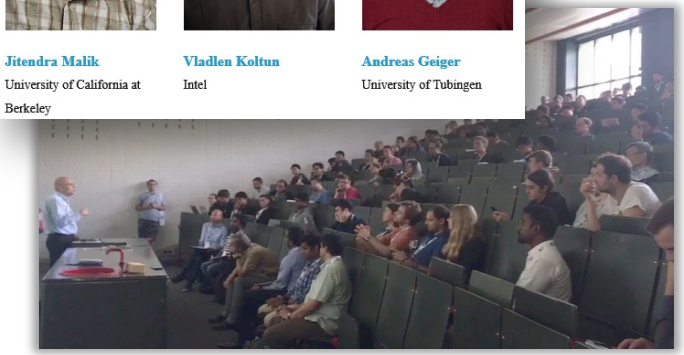
AutoNUE@ ECCV 2018

Keynote Speakers

Jitendra Malik
University of California at Berkeley

Vladlen Koltun
Intel

Andreas Geiger
University of Tubingen

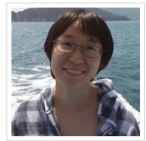


2019

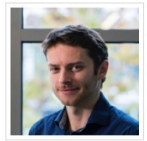
Nov
- IDD website launched
- ICTAI mobility workshop

Nov
- AutoNUE 2 @ **ICCV**
- Released **IDD-2, IDD-Muitmodal, IDD-Temporal**
- 4 data challenges

ICCV 2019 Seoul, Korea



Ayoung Kim
Korea Advanced Institute of Science Technology (KAIST)



Adrien Gaidon
Machine Learning Lead at Toyota Research Institute(TRI

Kai Yu
CEO Horizon Robotics, Founder of Baidu IDL

Li Erran Li
Head of Machine Learning, Scale AI

Raquel Urtasun
University of Toronto

Torsten Sattler
Chalmers University of Technology

2020

Dec
- Data challenge at ICVGIP 2020

Dec
- **IDD-Lite** released
- Data challenge at NCVPRIPG 2019

2021

Jun
- AutoNUE 3 @CVPR
- 5 data challenges

CVPR VIRTUAL JUNE 19-25

AutoNue@ CVPR 2021 - Nashville, USA

INVITED SPEAKERS

Henrik I. Christensen
University of California San Diego, USA

Ang Marcelo H. Jr
National University of Singapore

Kate Saenko
Boston University, USA

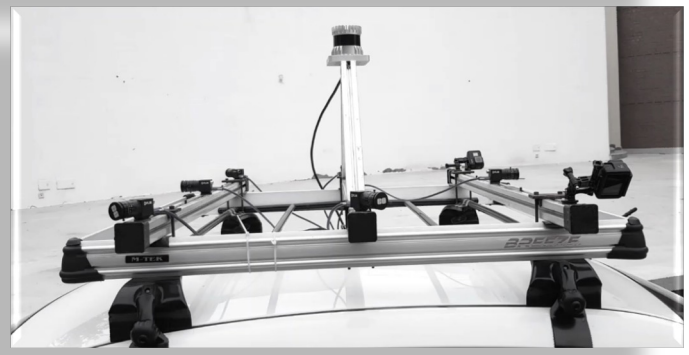
Alexandre Massoud Alahi
EPFL, Switzerland

Ruigang Yang
University of Kentucky, USA

Kris Kitani
Carnegie Mellon University, USA

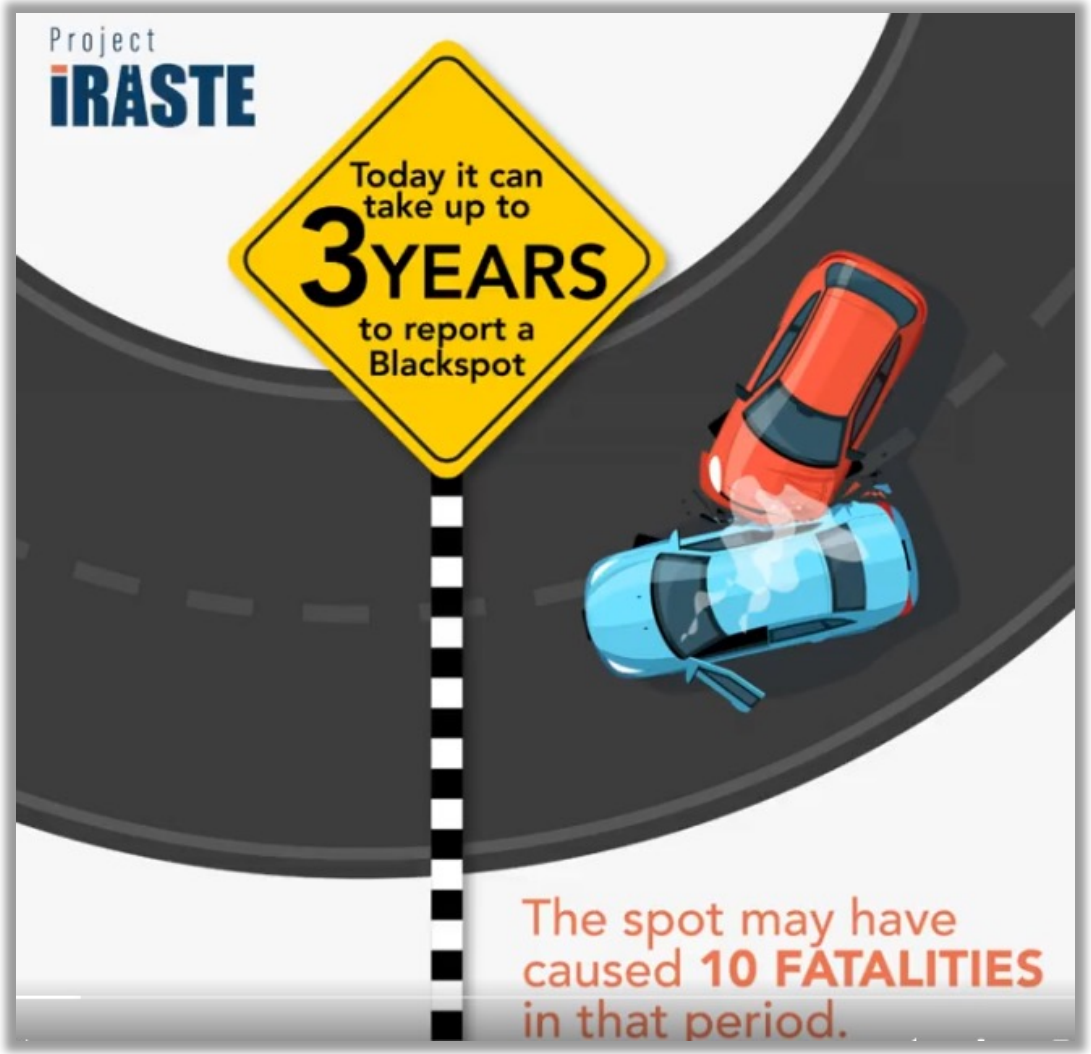
IDD Journey (Continues in 2023)

- Driver Gaze
  - Where does the driver look?
- IDD 3D (2022)
- More Challenges
  - Eg. Detect Missing Road Signs (2023)
- Platforms that can be shared
  - Students, Researchers, Startups, NGOs
- Movement Logs, Sensor Logs
- Data for bad weather
- Synthetic Data, Algorithms, Simulations for rare situations



Can we predict potential accidents before they happen?

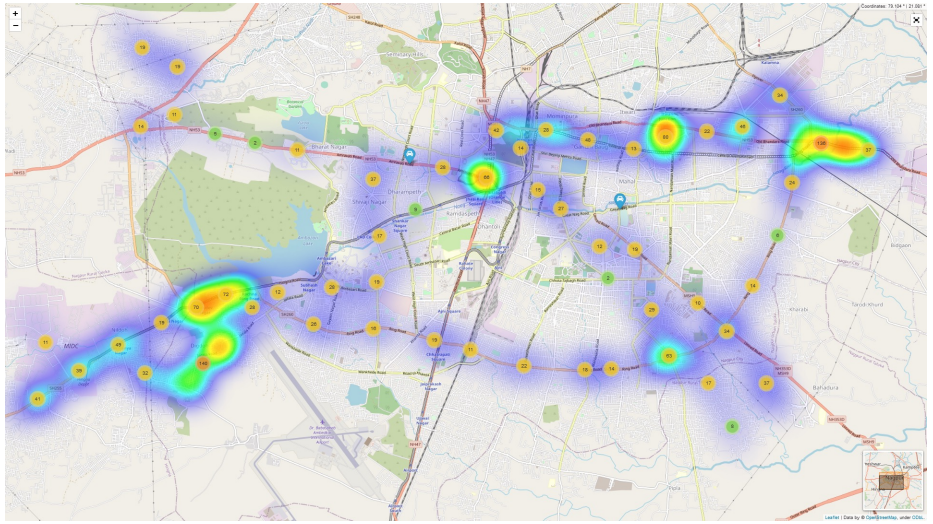
- Blacksports: Ministry of Road Transport & Highways (MoRTH) definition
- Locations on road network, which had 5 accidents or 10 fatalities, in the last 3 calendar years
- Today: It takes 3 years or more



https://twitter.com/inai_ai/status/1642850954025267208

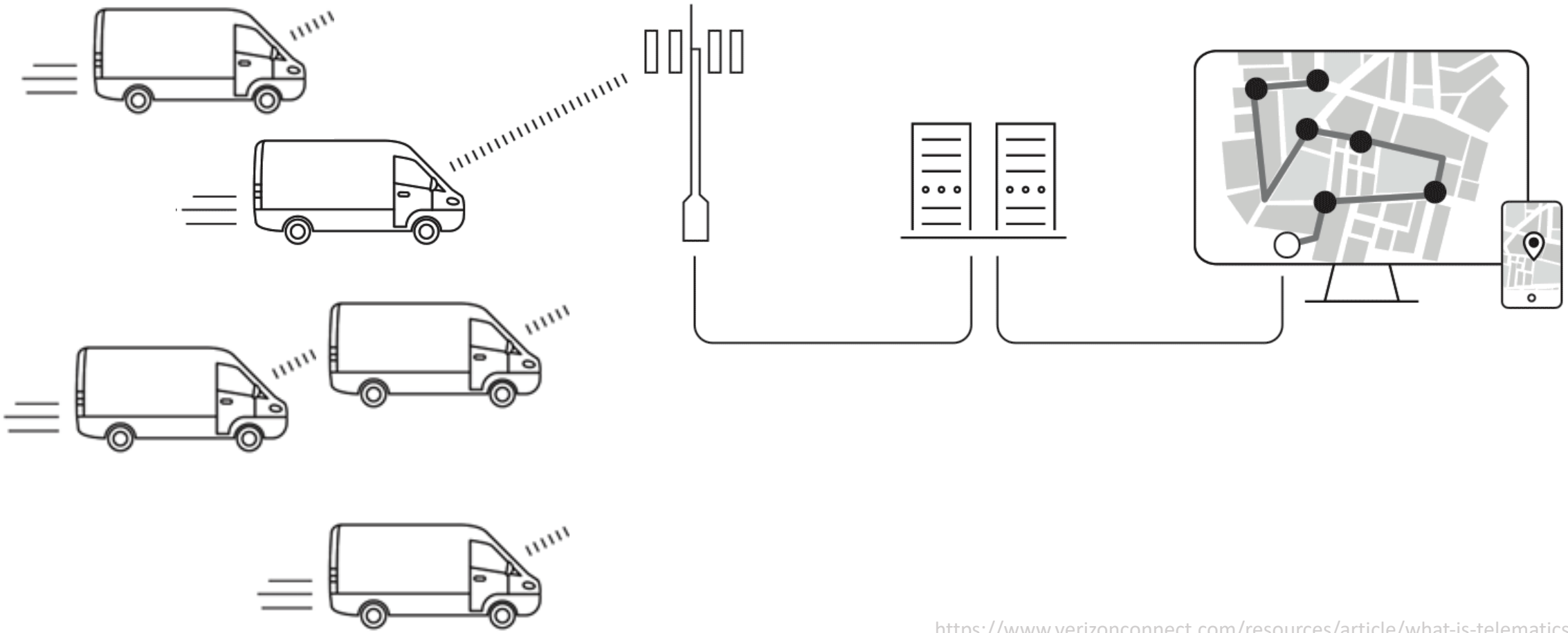
Grey spots: predict before it become black – Help Prevent Accidents

Source: https://twitter.com/inai_ai/status/1655924802731876352



- Locations on road network, which have a potential to become Blackspots sometime in future, if no corrective road-safety measures are taken at these locations to prevent accidents

AI for Road Safety – Large Data Analysis

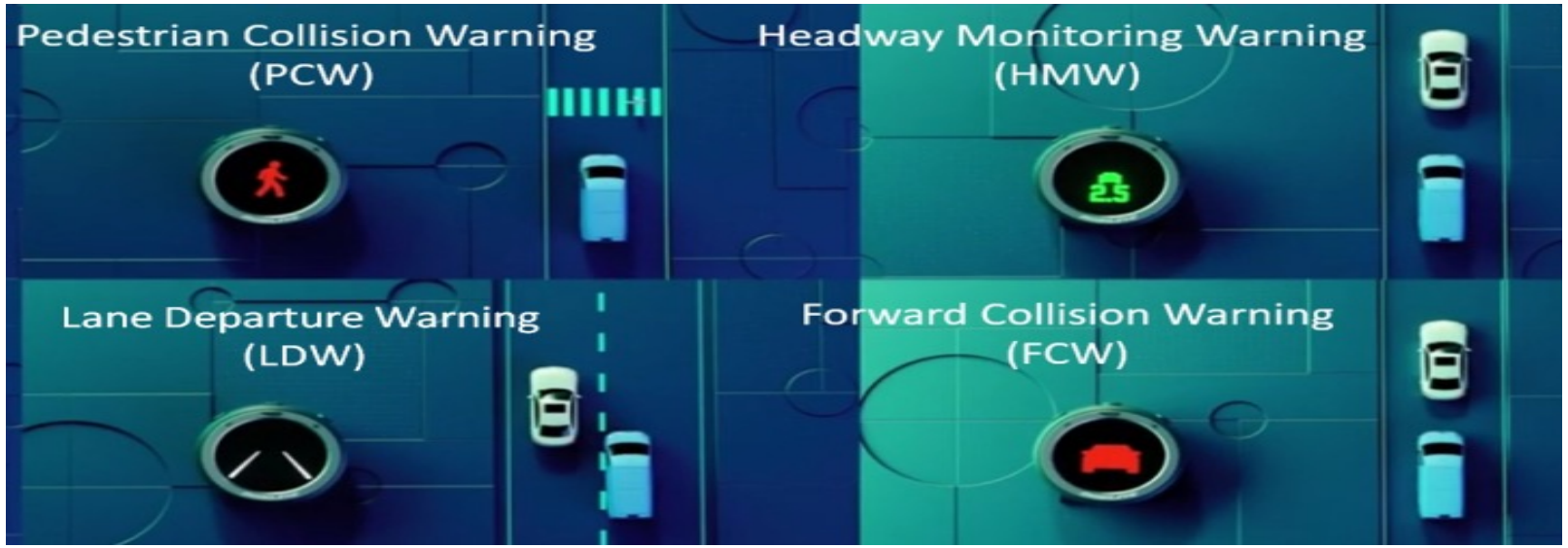


https://www.verizonconnect.com/resources/article/what-is-telematics/

Participatory Road Safety

Camera focused on road

Display unit ***(audio + visual alerts)***



Road Safety

↑

ADAS

↑

Autonomous Driving

Project: iRASTE

Project iRASTE

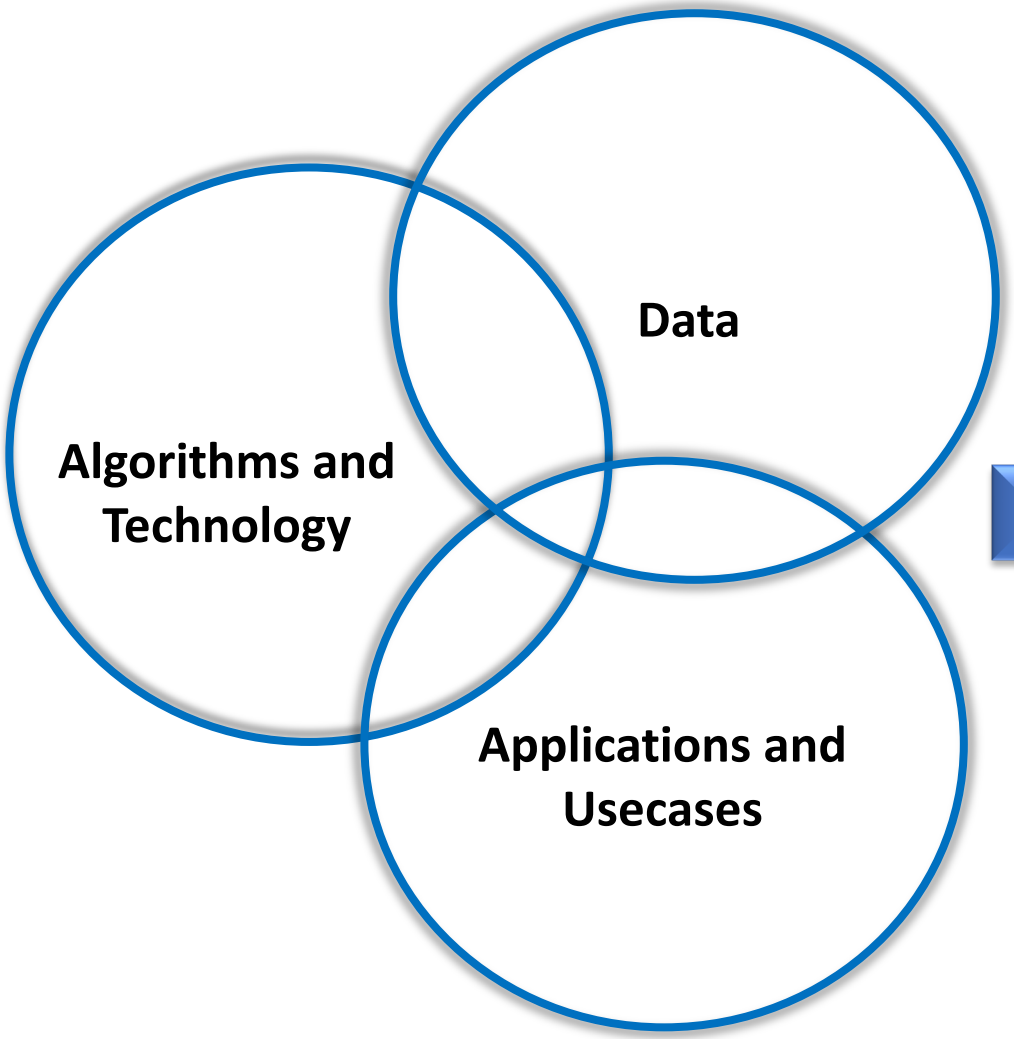
Re-imagine Road Safety with the predictive power of AI

NAGPUR | CSIR | Mahindra Rise | inai | International Institute of Information Technology Hyderabad | intel

- Academia and Industry partnership in solving real world problems
- Project getting extended to Telangana
  - Focus on Highways
- A working example of how can technology (AI, Data, Algorithms) work with engineering.

https://twitter.com/inai_ai/status/1621451089592881153

Summary and Directions



- Government
- Vehicle Manufacturers
- Vehicle Owners
- Citizens
- Start ups

- Road Safety
- Cost Effective Technologies
- Sustainability
- Meeting Local Needs

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