Beyond ADAS-CAS, through Grey Spot Mapping

Digital Transformation

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CONTENTS

ABSTRACT

India has several challenges and has a tremendous opportunities and potential to address the same through latest technologies. One such challenge is reduce number of accidents happening in India and the impact it has on the society. Studies show that there are 17 deaths every hour in India. At this rate India loses 3.2 million people and loss of 3 % of GDP every year besides the social impact.

Installation of the ADAS (Advanced Driver-Assistance Systems)-CAS (collision avoidance systems) devices has tremendous impact by reducing # of accidents by 50 % to 60 % in globally on an average. This paper talks about how we can extended the alerts from the CAS devices and that helped in identifying the potential accidents zone (Grey Spots) through crowd sourced data and further enable better traffic management and city planning. Note: Black spot is where accidents have already occurred. Aggregating the basic CAS information as a data and correlation with other information opens up a different paradigm with next level of insights to enhance road safety.

This pilot was deployed in a controlled environment and has enabled to us to get more insights and has further confirmed the hypothesis.

INTRODUCTION

It is known fact worldwide that the major reason for accidents are because of distractions. With the penetration of mobile phones and the smart devices, it is contributing further distraction and hence increase the accident number further. CAS is a good Active ADAS device that acts as a third eye on the road and provide auditory, visual and haptic alerts to the drivers to respond for any possible collision. Some of the CAS devices like Mobileye 630 that are highly reliable are used for actuation as well lie for AEB (Automatic Emergency Breaking) and ACC (Adaptive Cruise Control).

There is huge opportunity to aggregate these alerts from the CAS devices and derive a meaning using the same. One such attempt is Grey Spot detection and mapping. This paper talks about taking the collision warning meta digital data aggregated over time for bringing transformational insights in curbing the accidents and by increasing the safety on the roads.

Grey spots are the potential accidents locations if not controlled may soon be a Black spot. Grey Spots will further help in realizing the commitment to reduce number of accidents by the Government and make road safer. Grey Spot mapping is one such initiative together with Govt. of Karnataka Intel India (along with Mobileye an Intel company) initiated a pilot to identify Grey Spots in the Pilot areas. Initial success from the stage-1 was also press released jointly by Intel/Mobileye and Govt. Karnataka.

DETAILS OF THE PAPER

1. About CAS device Mobileye 630.

Mobileye 630 is a Collision Avoidance System with EQ2 chip and has established its global presence as one of reliable systems. The reliability is because of least or nil false positives. False positives means, to avoid any

mishaps, system provides more alerts or over cautious. This has a negative impact. The driver may ignore the true situation by not responding and may result in mishap. The Mobileye 630's reliability have made its EQ2 chip in the car OEMs to use for the actuation of AEBs and ACCs.

The Mobileye 630 provides various alerts and meaning of the same is as below.

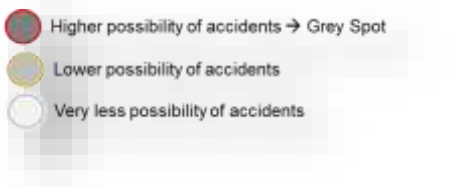
a. PCW – [Pedestrian Collision Warning] Indicates near-miss with pedestrian or cyclist (vulnerable road users)
b. FCW – [Forward Collision Warning] Indicates near-miss with vehicle
c. SLI – [Speed Limit Indicator] Indicates need for either enforcement of speed limit, or modification (raising) of speed limit to suit road conditions.
d. LDW – [Lane Departure Warning (Left & Right)] Indicates curves that have a high incidence of vehicles leaving the lane unintentionally on cornering (danger of overturning, running off the road or running into oncoming traffic).

e. HMW - Headway Monitor Warning & Urban Forward Collision Warning
f. PDZ – Indicates high concentration of pedestrians and cyclists. If an area has HIGH PDZ but LOW PCW then it may be regarded as a White Area. i.e. The infrastructure provides necessary protection to the vulnerable road users.

2. Grey Spot mapping Hypothesis

If we have multiple vehicles that are fitted with CAS device like Mobileye 630 and these provide the alerts based on the real situation on the road then these alerts can be aggregated in a common location / cloud storage. If the similar events occur around the same spot multiple times over a period and from multiple vehicles then it enables a different insight to the situation. Example: If there are multiple PCW (i.e. Pedestrian Collision Warning), it clearly hints the possibility of collision of vehicles with Pedestrians in that spot.

Aggregation of the Key alerts like PCW, FCW and PDZ can help in identifying the near misses with Pedestrians or other vehicles. Higher the # of these events, means probability of the collision is high and may become '1', which means mishap happened. Multiple mishap in a spot results it as a Black Spot. Grey Spot is where there is higher possibility of accidents.



Darker the Grey towards black, higher are the chances of collisions and mishaps. Black spots is a known vocabulary, which is identified post the accident occurrence.

The alerts will have to be tagged with Location, where the collision identified, along with the time info. The alerts from each vehicle are identified by a device ID. Four basic parameters required for Grey Spot are

i. Collision event
ii. Geo coordinates (Location/GPS)
iii. Timestamp
iv. Device ID

Parameters 'i' is provided by CAS device and rest of the parameters 'ii', 'iii' & 'iv' are provided by Telematics devices.

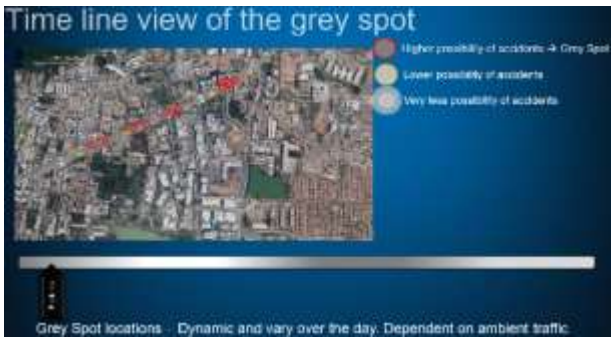
3. PoC and System Overview for Grey Spot data capture

First challenge is to identify a mechanism to aggregation of the alerts/warning from the Mobileye 630 (CAS) device. This is possible by pumping the data over the network with all the 4 basic parameters packed together and stored in the cloud. All the vehicles fitted with these devices will have to pump to the common location for inferencing.

To validate the Hypothesis, started with a single vehicle that was connected with Mobileye 630 device. The CAS was connected with a Telematics device that provide GPS, timestamp and device id. The telematics device provided the connectivity to transfer the data to the backend cloud. The data were aggregated in the cloud.

It was identified, during the trails with single vehicle, the driver was driving cautiously so that the FCW and PCW were not coming. With this we were not in a position to identify the Grey Spots. This enabled us switch off the both auditory and visual warning to the drivers, while scaling for the actual PoC.

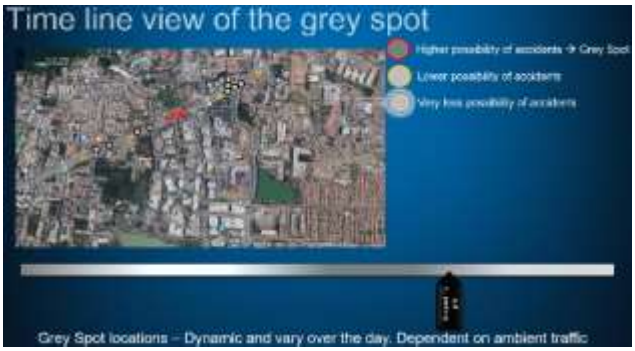
The Web based UI provided some insight and on a time line view and is as shown below snap shots during the initial with single vehicle.



Peak time view highlighted the Red Grey Spot (Darker Grey) in the heat map.

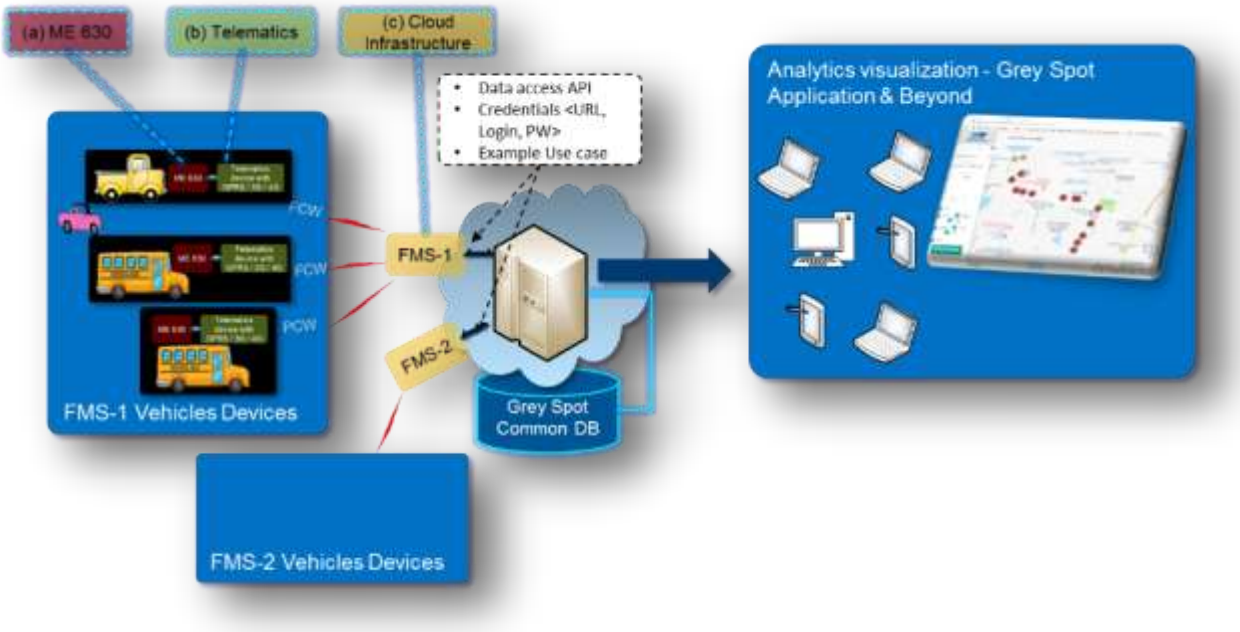
Noon had lighter grey making less probality

Evening slot again had Red (Darker Spots).



There are few Red (Darker) Grey pots in the night.

The system consisted of (a) Mobileye 630, (b) Telematics device & (c) Cloud Infrastructure. Each vehicle had 'a' & 'b' devices. To ensure the extendibility of System, the existing infrastructure FMS-1 was integrated into a common cloud infrastructure that pulled the data from the various FMS cloud infrastructure. As shown FMS-1, FMS-2 data are pulled into Grey Spot common data based. Grey Spot Common data base had a data analytics infrastructure that helped in analysing the Grey Spots, which was viewed over web based application.



4. Pilot in East part of Bangalore

PoC was done by deploying the setup in 25 school vehicles which takes defined path and runs multiple times in different time slots. The Auditory and Visual were muted to get the possible FCW and PCW. This was done in the Eastern part of Bangalore and it covered 150 kms of Arterial road running around 100+ times.

East part of Bangalore

Peak hour (Morning)

Non Peak hour (Noon)

Peak hour (Evening)

5. Top 3 Grey Spots → Insights to take actions

After a period of around 2 months we identified few interesting spots

Pedestrian Collision Warning

1) Loyal City Supermarket (Near ITPL)
2) ECC road whitefield: because of
    a. many apartment and cross road
    b. school and hotel nearby
3) Basvanagar Hoodi because of
    a. place of worship and school

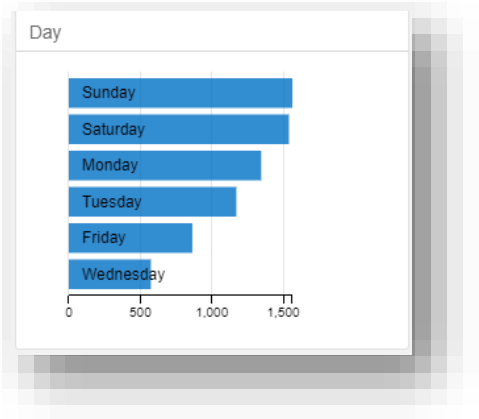
Forward Collision (vehicles)

1) Hoodi: Due to
    a. hospital and post office
2) ITPL: Due to
    a. hotel and Mall
    b. bank, apartment and big circle

6. Benefits

a) Grey Spots gives insight to city planner and traffic management team in planning the infrastructure and the traffic management. In case the Grey spot is because of aggregation of high # PCW, it triggers city planner to pin point the location for further analysis. Possible actions can be to install skywalk or a traffic signal. In case the Grey Spot has of high # FCW it calls to inspect for any 90 deg intersection of merging traffic. This will also enable in regulating traffic signals timings calibration to name a few.
b) Any action to on the Grey Spot can be easily evaluated when Grey spot become lighter in color.
c) Once the Grey spot are enabled, it also creates an opportunity to notify the new drivers with a warning that the driver is entering accident zone (Grey Spot) during that time. This can also help intelligent routing of carrying hazardous material by avoiding darker grey spot area during the time.
d) Fleet management team can also infer driver behaviour and profile the driver. It also provides insights to the area of improvements. Augmenting the collision warning with other vehicle parameters like braking enables reason for harsh breaking, say may be because of sudden Pedestrian.
e) When these collision warnings are analysed with other data like say holidays, festivals, events (cricket match, cinema release), weather, etc. provides insights and helps in taking precautionary measures.

Interesting to know that Bangalore Mysore road had interesting observation on week days.



- This means week end traffic causes more FCWs
- Wednesdays seem to be a Safe drive.
- These data observed over year one year would help in identifying the reason for any pattern. Example: These data was collected during the May June time frame. Which means end of summer vacations. It will be interesting to know during entire summer, which month is high.

The Experiment is extended to map the Bangalore Mysore Highway. 100 trips are already done and with Grey Spots identified.

7. Lessons learnt

Identifying Grey Spot is a challenge. A simple summation of alerts and setting a threshold is not going to reveal the Grey Spot. The data has to be normalized and the sampling has to spread over different timings of the day. When more vehicles join the aggregation effort the data gets further normalized and provide reliable Grey spot information.

Initial period we had the Auditory and visual alerts muted to get the Grey Spots. However, when alerts are enable to the driver, the driver transforms to be a better driver and eventually the Grey Spot would turn lighter without any changes needed in the infrastructure and traffic management. This is the idealistic.

Grey spot will appear because of infrastructural gaps. Simple shifting of the Bus stops have reduced the Grey Spots and possible causalities.

CONCLUSION

1. CAS has first benefits of avoiding the collision through warnings. Aggregating these warning provides insights for any changes need using the Grey Spots.
2. Grey spots is through the crowd sourcing and more the data is collated better is the reliability
3. Grey Spot further enables further use cases for safe route planning, driver behaviour and profiling

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