# ROAD SAFETY – RAPTOR
# Road Accident Prevention,Traffic Order Reinforce
## Using IOT, Voice assistant, Machine Learning, AI, Augmented Reality, Computer Vision, Cloud, Analytics, Visualizations, Data science

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***Dedicate this work to my mother**, lost her in road accident - 2007, everyday approximately 400 people in India and 100 people in U.S. And many elsewhere have fatal road accident – if this work could save 10 % lives, that will make huge impact*

**ABSTRACT**

*Purpose* – This paper focuses on the the real world problem, reducing road accident using combination of IOT, Voice assistant, Machine learning, Computer vision, Geo-Analytics, Augmented reality, Data visualization, Maps API, to analyze and prevent road accident in proactive and reactive ways

**Proactive approach**

We have a IOT enabled road safety device (redundant & tamper proof) installed in every vehicle, with many sensors including GPS, Fingerprint reader, accelerometer, alcohol sensor, camera. This system has ID of vehicle & capture Identity of driver using computer vision facial recognition, display to show stats & train user in case they make any mistake, voice assistant to convey feedback and to rectify mistakes

**Reactive approach**

Dashboard monitor for each region traffic office providing list of top n accident prone zones,
Enabling analytics through combination of various factors and bring the top 'n' hot spots per given area as recommendation for various actions to reduce the accident count in a real-world, also suggest possible scenario for real-time and proactive monitoring in this case study with IOT & machine learning, this can be collaborated with Transport, Smart city,
Insurance, Vehicle Manufacturing including monitoring of autonomous vehicle, digital initiatives of government.

## I.INTRODUCTION

Data analysis place a crucial role in our day to day task, when we apply the data analysis to real-world problem through public data-sets available online we can find solutions to more challenging problems faced by mankind

In this paper we will analyze the reactive method and get into the details of proactive method using IOT

ROAD ACCIDENT:

the road accident is the major factor causing many fatality and serious injury in developing country like India, it impact the social life of the family suffering casualty and cause many claims in the insurance. though the government have taken many measures, it will be effective only if proper data is collected for analysis and a through study is done, for the reduction of accident count and making road safer

## II. REAL WORLD DATA SET

*Data collection Method* To We have following data sets for the case study while developing the ideas presented in this paper "Road safety" data-set from data.gov.uk to effectively use data analysis to find solution and solve problems we should focus on quality data sets as the core component of our study, for similar

analysis in India, data has to be collected in the similar format

For Accident data collection we should collect following - accident index (Id for each accident), longitude and latitude coordinates, accident severity, number of vehicles, number of causalities, date, day of week, time, district, highway, road class, road type, road number, speed limit, junction detail, junction control, pedestrian crossing-human control, pedestrian crossing physical facilities, light conditions, weather conditions, road surface conditions, special conditions at site, carriageway hazards, urban or rural area, did police attend scene of accident & LSOA Map(Lower Layer Super Output Area)

Data collection for Causality - Accident index, vehicle reference, casualty reference, sex of casualty, age of causality, age band of casualty, casualty severity, pedestrian location, pedestrian movement, car passenger, bus or coach passenger, pedestrian road maintenance worker, casualty type, casualty home area type

Data collection for vehicle information – Accident index, year, vehicle reference, vehicle type, towing & articulation, vehicle maneuver, vehicle location-restricted lane, junction location, skidding and overturning, hit object in carriageway, vehicle leaving carriageway, hit object off carriageway, 1st point of impact, was vehicle left hand drive, journey purpose of driver, sex of driver, age band of driver, engine capacity(cc), propulsion code, age of vehicle, driver imd decile, driver home area type, make & model

Once the data is collected, it is generally stored in csv format, it can be loaded in to database, and used for further analysis

## III CONSTRUCTING THE MODEL FOR ANALYSIS

The data collected from above process contains information of the Accident, Casualty & vehicle along with the lighting conditions and blood alcohol content

*A. Modeling the entities*

we construct three main entities in the system model

*Accident*, here the Accident refers to each specific accident with the unique accident index, the casualty and the vehicle are linked with the accident index

*Casualty*, the casualty refer to the details of person injured, severity, vehicle reference accident index

*Vehicle*, the Vehicle has the information about the details of the vehicle involved in the accident, vehicle make year, type. e.t.c

*B. Modeling the relationship*

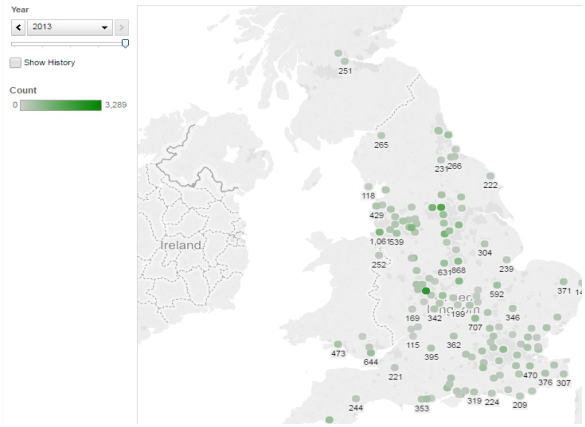
The accident data is related with the casualty data and it is related with the vehicle data with the accident index specific for each accident, vehicle reference, casualty reference is also used to relate to various attributes

## IV REACTIVE ANALYSIS TO RECUCE ACCIDENT COUNT

We next use the model explained in the previous session to develop solution to the road accident's problem I this session we present solution for reactive analysis, we identify the hot spots that frequently have accidents and then perform the root cause analysis using attributes of weather, casualty, vehicles.

### A. *Detect areas of accident hot spot – Map*

Plot the accident spots in the map using latitude and longitude coordinates
Target the top accident prone zones by identifying the top 'n' accident prone spots for a given location by year/month/



These maps will be available at granular location level aligning with the traffic department, so specific area can make corrective actions to reduce the accident count

***New Emergency care recommendation and optimizing ambulance positions***

**1)*Suggest locations for new Emergency care hospitals.***

Reducing the distance traveled for emergency care by opening new hospital in a distributed fashion which ultimately reduce the distance from accident spot to emergency care and gives the shortest path

first we identify the maximum distance traveled from the accident spot to the nearest emergency care and prepare a list of locations which need to have emergency care to strategically reducing the travel time and distance which enable accident victims to reach hospitals on time within the golden hour

2)***Optimize placement of ambulance***

When ambulance is called from the accident spot it should take minimum time to reach the accident spot, using analytics we can effectively reduce travel time to reach accident spots by identifying optimal parking location for the ambulance.

**External factors impacting accident count**

*a) Effect of economic recession and the reduction in accident count*

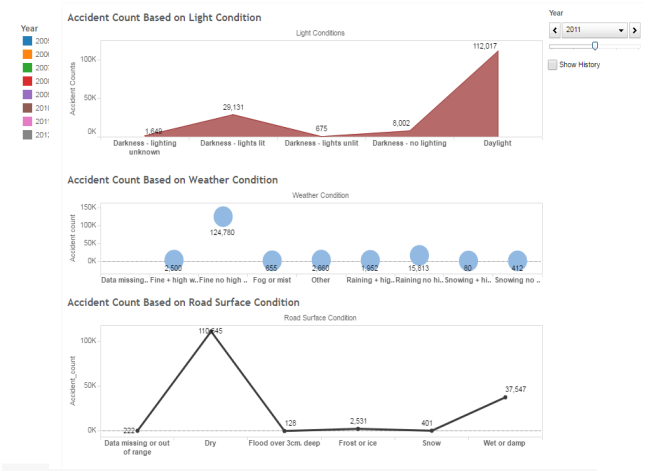
In the following graph we can identify the reduction in the

accident count during recession years 2008

when the economy is growing people travel lot thus there is increase in accident count and we have to increase the rules the reduce the accident

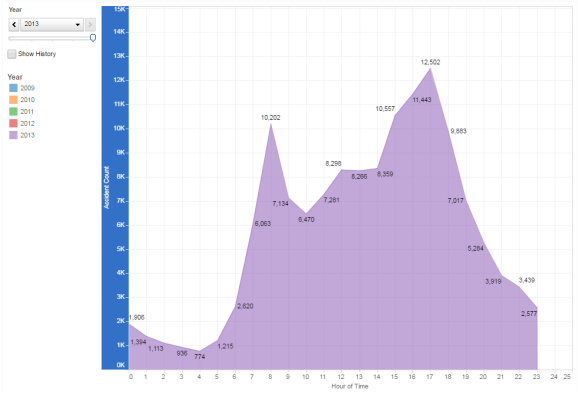
*b) Effect of bad weather and reduction in accident count*

weather is inversely proportional to accident count – people tend to be more cautious during very bad weather, snow, heavy rain, poor visibility, e.t.c




people choose alternative safer mode of transport during these times thus reducing overall accident count during bad weather

*c) Influence of peak office hour 8 AM & 5 PM and accident count*




There is direct correlation between office hours and the accident count, every year we can observe the accident peak during 8 AM & 5 PM which is the office hours in UK, 3 to 5 PM have more accidents than 8 AM

Accidents are very less during 4 AM.
5 PM is the more accident prone hour

*δ) Day of week and the accident count*

Sunday has the lowest number of accidents, Friday has the highest number of accidents (more people drink and drive),
the numbers gradually increase from Monday till Friday and reduces during Saturday and Sunday

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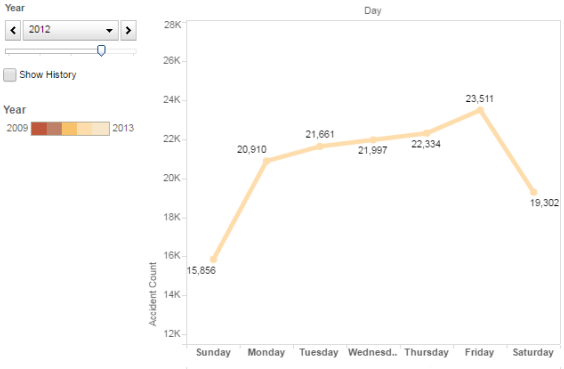
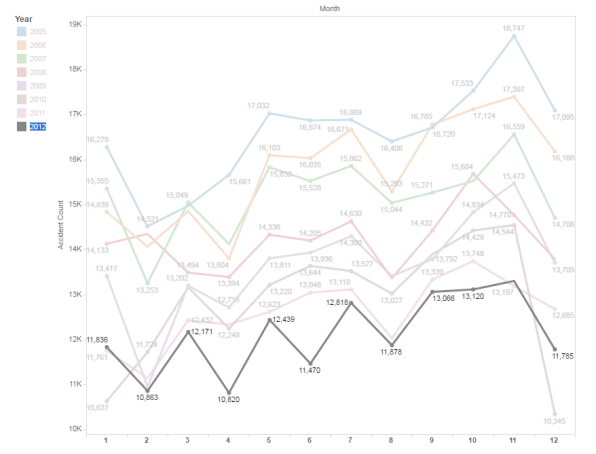



Sundays are usually safer compared with Friday

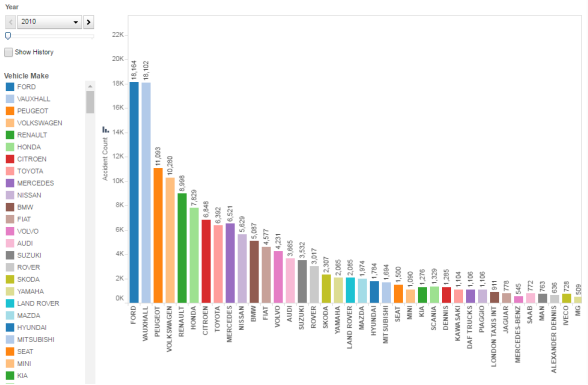
*e) month and the accident count*

The monthly trend for the U.K. Can be observed as zig zag pattern, from the below image is Odd month accident count are higher and even month accident count are lower, February has the lowest accident count this is due to the cold weather in the winter, the accident count peaks in November




February is the safest month compared with November.

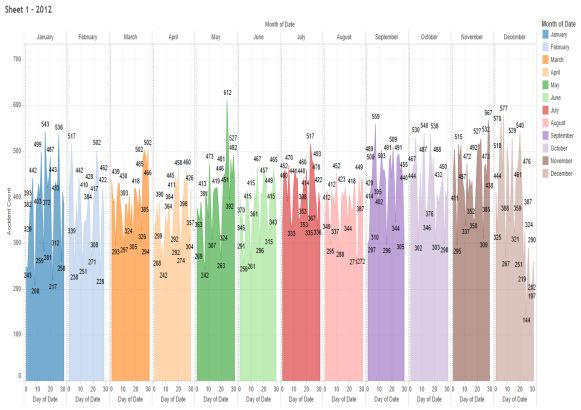
*f)Accident count of vehicles involved by manufacturer*



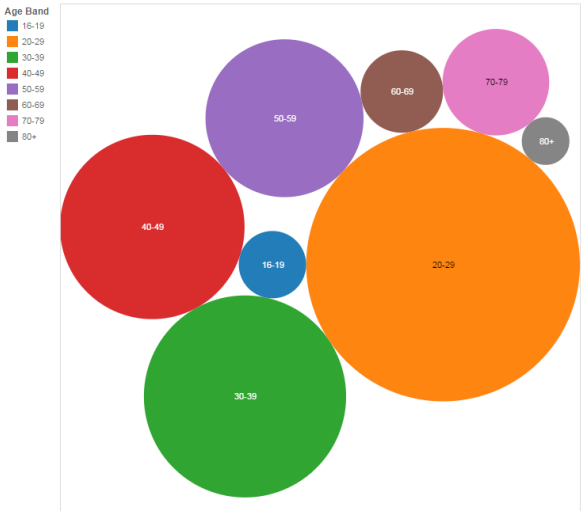

This graph shows the accident count for vehicle manufacturer per year

*g) Accident count by day – monthly/yearly view*

this graph shows the complete view for a year, we can observe the lowest accident count is during Christmas week and highest during the month of may




*h) Accident due to alcohol consumption*
the following graph shows the the age band and the alcohol related accident




*i) Accident by gender*

the following graph shows the distribution of accident by gender

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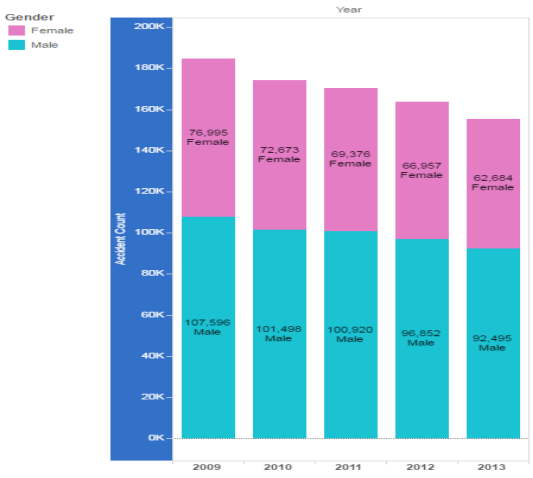


***The ten most frequently reported contributory factors for vehicle or pedestrian***

1) Driver/Rider failed to look properly
2) Driver/Rider failed to judge other person's path or speed
3) Driver/Rider careless, reckless or in a hurry
4) Poor turn or manoeuvre
5) Loss of control
6) Pedestrian failed to look properly
7) Slippery road (due to weather)
8) Sudden braking
9) Following too close
10) Traveling too fast for conditions

*Under reported accidents*
Driver/rider using mobile phone,
impaired by drugs,
impaired by alcohol

*Other contributory factor*

Driver/rider error or reaction
Behavior or inexperience
Impairment or distraction

## V. PROACTIVE MEASURES & REALTIME MONITORING

Road accident count can be further reduced if we have implemented transport regulation and mandatory impose of following rules

- Every vehicle should have a Road Safety box, monitoring device which is enabled with IOT, this must be **tamper proof**, redundant and fail safe to make sure continuous monitoring-as of now we can call it Safety box, it has various sensors pro
- Every vehicle should have fingerprint sensor to record the driver/rider information, this will be linked to the social security number / aadhar number which is further linked with bank account
- using computer vision we do the facial recognition of the driver and also detect if the driver is distracted or using mobile phone – this reduces driver score
- Vehicle sensor data can be analyzed for any issues in vehicle, which will be automatically communicated to driver and nearest service center for fix
- GPS device attached to each vehicle to monitor any traffic violation in real-time this should have data plan enabled specific for this purpose and all the vehicle information is analyzed region wise transport authority, we can profile the driving pattern and define normal driving pattern, detect abnormal activity and take actions
- if any violations in traffic light or exceeding speed limit detected automatic fine has to be issued and amount can be automatically debited from the bank account
- repeated offenders has to pay fine heavier fines 2X number of times the first time offenders
- those who drive under normal threshold can be rewarded with discounts in insurance
- speed cams is not that effective, here we use GPS sensors to regularly check if speed threshold for the current road is not breached, if the user breach then automatically deduct fine in social security number / aadhar linked bank account
- Sensors at the traffic signals to detect any violations and impose automated real-time fines to social security number / aadhar linked bank account
- if any abnormal behavior is detected in driving pattern it can be communicated to the driver as real-time feedback with corrective action with the help of voice

assistant, all the mistakes detected will have feedback and corrective suggestion from voice assistant, if driver does not correct mistake then it initiate automated fines and points reduction

- we maintain road safety score for each driver, based on the score the insurance may offer discount for high score or penalize user with more premium if they have low score

## VI. CONCLUSION AND FUTURE RESEARCH

Past research has suggested that, by utilizing knowledge of analytics we can solve various real world problems using public data sets

But to provide further effective control of overall accident we need strong regulations and impose proactive real-time monitoring of all vehicle, have regular collection of all key data points for every accident


## 1. ACKNOWLEDGEMENT

I would like to Thank data.gov.uk for enabling public data-sets without which this study will not be possible, tableau public for free visualization tool which brought more insights into plain data.


## 2. REFERENCES


Road Safety Data https://data.gov.uk/dataset/road-accidents-safety-data



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