Role of ITS and Traffic Technologies in Achieving the Vision Zero Goal by the Year 2025

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Vision Zero 2025 describes a scenario where there is no transportation related fatalities or serious injuries in the United States, encompassing a wider vision of safe mobility for all. There were over 37,000 fatalities in the U.S due to traffic related crashes according to the National Center for Statistics and Analysis, and motor vehicle related deaths is the leading cause of fatality for people under the age of 55, as of 2018. This trend had been consistent over the previous years and it was an enormous challenge to drastically bring down the fatalities from 37, 000 to 0 in the next 7 years. The leading causes of traffic related deaths and serious injuries are over-speeding and driving under influence of alcohol. This was followed by motor cycle crashes, pedestrians involved crashes and distracted driving. Once we curbed these leading causes, we were able to reduce overall fatalities to Zero. This is where we turned towards Intelligent Transportation Systems to assist us in the pursuit of Visio Zero.

ITS was enabled by extensive use of devices and sensors attached on both the vehicles and the road infrastructure. Smart phones, on-board diagnostic sensors, LiDAR, radar, and cameras were employed in the vehicle's side. Cameras, motion sensors, radar, auditory sensors, short range embedded sensors, dynamic sign boards, etc. were employed on the road side. The essential component of all these sensors was the communication between them and that was enabled through Internet of Things. These sensors were further networked with each other and were connected to a centralized monitoring center in each city. These monitoring centers obtain data, processed the data from all sensors and provided safety insights to us. These sensors and devices are working together to have made the Vision Zero a reality. The following paragraphs highlight the applications of these technologies in bringing roadway fatalities to zero in 2025.

Since over speeding was one of the leading causes of fatalities, ITS was used to reduce driver speed, and protect the pedestrians and bikers from speeding vehicles. In urban areas, locations identified as high bike-pedestrian movement with the network of street cameras were fitted with dynamic signs at least the stopping sight distance ahead on that roadway warning the drivers about the pedestrians ahead, as well as provided the speed limits based on people's movement. Artificial Intelligence was heavily used to process the video from the cameras in real-time and identify the high pedestrian and bikers' movement. This combination of cameras, AI, dynamic signs along with synchronized traffic lights served very well during special event days. In rural roadways, pedestrian safety was ensured by placing a flashing, dynamic, stick-figure 'pedestrian walking' sign ahead of the intersections to sensitize the drivers. Unlike urban areas with extensive array of cameras, rural areas were fitted with motion detectors and when a pedestrian was detected, the sign displays a moving stick figure. This made drivers more attentive to the road and cautious of their speed. In case of a connected vehicle that saw arrivals since 2019, the pedestrian ahead information was directly sent to the display or audio device in the vehicle. In addition, to counter the distracted pedestrians walking across the cross walk, their smart phones were forced to hang up if they step into the cross walk and the screen indicated them to look up. This was achieved with embedded jammers in the cross walk and the phone's GPS location.

Driving under the influence of alcohol was the next leading cause of deaths on the U.S. roadways, that is, 30 people killed were every day as per National Highway Traffic Safety Administration. A person's

reaction time, judgement and motor senses are impaired with alcohol in the blood stream and the drunk driving behavior can be characterized by a set of observable actions like sudden acceleration, driving without controlling the speed, etc. These subtle characteristics was used with the ITS sensors and AI to detect drunk drivers. Every vehicle on public roads were tracked to a certain distance with the help of the network of cameras and other sensors, sufficient to classify the driver behavior including normal, drowsy, drunk, etc. Once the drunk driving behavior was determined, that vehicle was flagged, and its location was informed to the authorities to take it out of the roadway.

In the recent decades the advancement of the vehicle technologies had allowed people to driver faster with less discomfort. However, the roadway design – such as curve super elevation, curve radius, lane width, etc. have not caught up with the advancements of the vehicle technologies. Hence, the design being inadequate to the higher speeds of travel was leading to higher number of crashes, especially in the rural roads. Smart phone sensors or dedicated sensor devices were deployed in each vehicle and were used to record the vehicle dynamics (such as acceleration, yaw, and speed) on the roads and the data crowd sourced from these devices helped locate the roadways which were not forgiving to speeding drivers. This information was sent out to the transportation agency to take corrective action as well as sent out to other devices connected to the network to warn the drivers of dangerous situation. In addition, the autonomous vehicles with their LiDAR and video cameras, continuously recorded data and advanced algorithms were plugged into their processors to identify bad roads. This further validated the accuracy of crowd sourced data. These technologies were not only used for identifying the bad roads, but were also employed to warn drivers if they are driving in speeds excess of the safe conditions and offered audible and visual information of the road section ahead.

Vision Zero was possible because the policy makers and planners embraced ITS and other traffic technologies. The success of these applications not just depended on the availability of these technologies but on more confident experimentation and use of these technologies in the past decade.