Enhancing Road Safety Using Deep Learning

S. Gurunanthan
Department of Artificial intelligence and data science
Rajalakshmi institute of technology
Chennai, India
gurunanthan.s.2021.ad@ritchennai.edu.in

Hari Prasanth
Department of Artificial intelligence and Data science
Rajalakshmi institute of technology
Chennai, India
hari.prasanth.p.2021.ad@ritchennai.edu.in

P .Harriesh
Department of Artificial intelligence and Data science
Rajalakshmi institute of technology
Chennai, India
harriesh.p.2021.ad@ritchennai.edu.in

ABSTRACT:

Road safety is a matter of utmost importance in today's world, as it directly impacts the well-being and lives of millions of people worldwide. Every year, countless lives are lost and many more are injured due to traffic accidents. These incidents not only result in human suffering but also have substantial economic and social costs. This essay explores the various aspects of road safety and emphasizes the collective responsibility that individuals, communities, governments, and organizations share in making our roads safer. Each year, more than 1.2 million people die across the globe due to road crashes; there is a pressing need to understand the underlying cause of the problem. As road safety issues are complex; it involves multi-sectorial ranging from the public, stakeholders to the policy makers. Significant differences exist both across and within countries and therefore policies and interventions need to be adapted to the local environment. The effectiveness of interventions requires a multi-disciplinary approach which include enforcement, engineering and psychological and education approaches. While the resources are limited, road safety interventions must not only address the sustainability of the outcomes but also the cost-effectiveness to implement and maintain it. More important, interventions must be evidence-based and can be evaluated over time before it is translated into policy. Hence, the research cannot be done in silo for better addressing the complexity of road safety issues. For sustainability, road safety interventions need to be guided and governed by policy in the implementation and development.

I. INTRODUCTION

Road safety is an imperative concern that revolves around a comprehensive array of measures and precautions aimed at preserving lives and preventing accidents on our roadways. It is a shared responsibility that involves individuals, communities, governments, and organizations working collaboratively to mitigate risks and promote responsible behavior among road users. One of the fundamental pillars of road safety is education and awareness. Driver education programs and public awareness campaigns inform people about safe driving practices, the dangers of speeding, distracted driving, and driving under the influence. These initiatives underscore the significance of seatbelt usage and helmet safety. Infrastructure plays a crucial role in ensuring road safety. Well-designed roads, clear signage, and efficient traffic management systems reduce accident risks. Additionally, pedestrian-friendly crossings and sidewalks are essential for protecting those on foot. Vehicle safety features and maintenance are pivotal components. Encouraging the use of vehicles equipped with modern safety technologies like anti-lock brakes, airbags, and advanced driver-assistance systems, while promoting regular vehicle maintenance, helps prevent accidents. Law enforcement and regulations are instrumental in maintaining road safety. Strictly enforcing traffic laws and imposing penalties for violations deter reckless driving behaviors. Data analysis guides road safety efforts by identifying trends, high-risk areas, and contributing factors. This information informs targeted interventions and resource allocation. International cooperation, community engagement, and public transportation enhancements further contribute to road safety. These collective efforts endeavor to create safer roadways, reduce accidents, and ultimately save lives, making road safety a paramount concern in our daily lives.

II. LITERATURE SURVEY

Review of literature is important in any research work. Many researchers have carried out research work in the area of road accidents. Some of them have analyzed accident data in different ways. Some of them Identification of Black spot zone. Some of them have developed accident models for forecasting future accident trends. They have also offered road safety recommendations. A literature evaluation of the many topics linked to road accidents and road safety is conducted in this chapter. Yannis T.H. (2014) presented A Review of The Effect of Traffic and Weather Characteristics on Road Safety . Despite the typically contradictory information about the impact of traffic characteristics, some patterns may be seen. For instance, although some research imply a linear link, traffic flow appears to have a non-linear association with accident rates. In terms of meteorological effects, precipitation often results in an increase in accident frequency but does not appear to have a consistent impact on severity. It hasn't been easy to determine how other meteorological factors, such visibility, wind speed, and temperature, affect safety. Real-time data is being used more and more, which not only makes it simpler to recognize the effects of traffic and weather conditions on safety but, more crucially, makes it feasible to determine their combined effect. Several of the

research gaps found in this study may be addressed by the more systematic utilization of this real-time data.

Amir H. Ghods et al. (2012) Differential speed strategies increased the number and rate of car-truck overtakes over the range of volumes considered in this analysis. This implies that the differential speed method used on two-lane rural roadways has a detrimental impact on safety. Positively, the number of car-car overtakes at various volumes has decreased as a result of DSL and MSL methods, improving safety. This latter link implies that slower trucks have a calming influence on the pace of the traffic stream, resulting in fewer contacts between cars. Regarding differential speed control tactics and both the average TTC and PTDO, no discernible influence was seen. Volume had an impact on TTC; it was highest for car-car and car-truck interactions at very low volumes, and it decreased to a minimum in the range of 500 mph to 800 mph before marginally increasing after that. This indicator suggests the highest head-on risk is experienced in the mid volume region. The average speed of traffic decreases in a nonlinear fashion with volume with differential speed strategies indicating a downward shift in this relationship.

III. OBJECTIVE

The objectives of road safety are aimed at reducing the number of accidents, injuries, and fatalities on our roadways. These objectives are typically established by governments, organizations, and communities to create safer environments for all road users. Here are some common objectives of road safety:

- Reduce Fatalities and Injuries: The primary objective of road safety is to reduce the number of deaths and injuries resulting from road traffic accidents. This includes both motorized and non-motorized road users, such as pedestrians and cyclists.
- Prevent Accidents: Road safety aims to prevent accidents from occurring in the first place through various measures such as improved road design, traffic management, and education.
- Promote Safe Behavior: Encourage all road users to adopt safe behaviors, including obeying traffic rules and regulations, wearing seatbelts, and avoiding distracted or impaired driving.
- Improve Infrastructure: Upgrade and maintain road infrastructure to minimize hazards, such as potholes, sharp curves, and inadequate signage, which can contribute to accidents.
- Enhance Vehicle Safety: Promote the use of vehicles that meet safety standards and are equipped with safety features such as airbags, anti-lock braking systems (ABS), and electronic stability control.
- Educate and Raise Awareness: Conduct educational campaigns and programs to raise awareness about road safety among all road users, including children, teenagers, and adults.
- Enforce Traffic Laws: Strictly enforce traffic laws and regulations to deter risky behaviors and hold violators accountable through penalties and fines.
- Reduce Speeding: Implement measures to control and reduce speeding, such as setting appropriate speed limits, using speed cameras, and creating speed zones in high-risk areas,
- Protect Vulnerable Road Users: Focus on the safety of vulnerable road users like pedestrians, cyclists, motorcyclists, and the elderly by providing dedicated lanes, safe crossings, and education.

V. CHALLENGES

Road safety is a critical concern worldwide, as traffic accidents can lead to loss of life, injuries, and significant economic costs. There are several challenges in road safety that governments, organizations, and individuals must address to reduce accidents and make roads safer. Some of the key challenges include:

- Distracted Driving: The use of smartphones and other electronic devices while driving has become a major concern. Texting, talking on the phone, and using apps can divert a driver's attention from the road and increase the risk of accidents.
- Speeding: Excessive speed is a leading cause of road accidents. Enforcing speed limits and educating drivers about the dangers of speeding are ongoing challenges.
- Impaired Driving: Driving under the influence of alcohol, drugs, or prescription medication impairs judgment and reaction time, making it a significant contributor to road accidents.
- Infrastructure and Road Design: Poor road design, lack of proper signage, and inadequate infrastructure can lead to accidents. This includes issues like poorly marked intersections, insufficient lighting, and inadequate pedestrian crosswalks.

- Vulnerable Road Users: Pedestrians, bicyclists, and motorcyclists are at a higher risk of injury or death in accidents involving larger vehicles. Protecting vulnerable road users through improved infrastructure and public awareness is crucial.

V. INSIGHTS:

- Pedestrian collision occurs mostly occurs in residential areas of the city.
- Pedestrian collision also occurs at peak time of school and college in city.
- Pedestrian collision occurs due to blind spot of large vehicle like truck.
- Pedestrian who are under the influence of alcohol or while drug may not take safe decision while crossing streets.
- Headway monitoring warning has the highest count in the whole dataset and it is prone in all speed count.
- Headway monitoring warning mostly occurs due to lack of attention (or) driver distraction according to dataset.
- Poor road condition such as uneven surface, potholes con affect a vehicle ability to stop quickly can also cause Heading monitoring warning Headway
- In emergency situation where the driver needs to stop suddenly, the headway monitoring system may issue warnings to ensure the driver reacts appropriately.
- 9. Lane Departure Warning is predominantly more in higher speed and more prone in highway.
- 10. Sometimes, driver may not use their turn signals when Changing lanes, leading to unintended lane departure.
- When merging onto highway (or) changing lanes, LDW can provide warning if the driver is not maintaining proper lane discipline during manewer.
- Construction zone (or) temporary road marking may confuse LDW system, leading to false warning.
- FCW: FCW can warn drivers who are not paying attention to the road and may not notice a slowing or stopping vehicle in front.
- If the driver doesn't react Promptly to a slowing or stopped vehicle ahead, FCW can Provide a last resort warning before automatically engaging emergency braking (If equipped).
- From the data set, the warning occurs due to speeding up and lack of attention of drivers.

VI. CONCLUSION:

In conclusion, road safety is a critical global concern that demands continuous attention and concerted efforts from governments, organizations, and individuals. The challenges associated with road safety are multifaceted and complex, ranging from distracted driving and speeding to impaired driving, infrastructure deficiencies, and vulnerable road users' safety.

By addressing the challenges, raising awareness, implementing effective strategies, and fostering a culture of responsible road use, we can make significant progress in reducing the number of accidents, injuries, and fatalities on our roads. Prioritizing road safety is an investment in public health and well-being, and it saves lives, resources, and human potential.

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