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ACCIDENT PREVENTION SYSTEM IN HILLY AREAS AND DEADLY ZONES

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ABSTRACT

In hilly regions, there will be a number of curves and hairpin bends. Roads are one of the most frequently used means of transportation in these areas. Accident rates and death rates in hilly regions are increasing day by day. The roads in this region will certainly have curves and sharp turns, so it is hard to see the vehicle coming from the opposite side. The proposed system aims at reducing the risk of driving vehicles in the field area with hairpin turns and stiff curves. The deployed controller with an ultrasonic sensor detects vehicles approaching a curve and signals the curve or the other side of the curve. There are three levels of LED alerts to the driver driving the vehicle coming from the opposite side of the hairpin bend or curve. It also senses the speed of the vehicle, if the vehicle speed is high, it will alert the driver through the buzzer. These alerts will indirectly convey to the drivers to slow down the speed of the vehicle. The foremost focus of the proposed system is to prevent accidents for the drivers and passengers in order to decrease the death rates in hilly regions. This system also provides a way for analyzing the number of uphill and downhill vehicles in the hill stations by storing the data in the cloud. The analyzed data is viewed over the internet through a web application. The web application serves as a traffic analyzer for those who want to travel by this route.

I.INTRODUCTION

There are many dangerous roads in the world, such as mountain roads and sharp curve roads. In these, few mountain routes will be very small and contain so many curves. As per the statistics, researchers envision that by 2023 the world's motor vehicle fleets will surpass 2 million in numbers. India's automobile fleets grow at an annual rate of around 7 to 8%. Road accidents contribute to over 1.2 million mortalities worldwide and

demand for a safe vehicular country is very high. The privation of medical facilities during the emergency and the increased number of accidents is a major concern to consider in the Modern-day world. In mountainous areas, accidents are primarily caused by the design of the curve roads and hairpin turns, as well as a lack of tracking or monitoring facilities makes the accident situation worse in terrain regions.

II.LITERATURE SURVEY

Marshall, W. E. (2018). Understanding international road safety disparities: Why is Australia so much safer than the United States? Accident Analysis & Prevention, 111, 251-265.

Safe System has been the dominant approach to road safety in Victoria for over fifteen years, guiding the development and implementation of policy. Limited attention has been paid to the development and application of Safe System in a public policy setting. The aims of this research were to describe the intentions of Safe System in Victoria, and analyse how well this aligns with models of successful public policy. Using a qualitative approach, semi-structured interviews were undertaken with Australian and international experts ($n = 10$). These experts represented a range of organisations and leadership levels that were either directly involved in the development or had a detailed understanding of the development of Safe System in Victoria. The interview results were analysed using a policy success model. The findings suggested that Safe System can provide a framework to address road safety in Victoria, however successful public policy needs to ensure that the development of policy addresses the identified problem and that the results are maintained for some time. Safe System meets some of these requirements, but principally lacks explanation for how its overarching approach is meant to be understood and utilised. Practically, road safety professionals need to clarify the purpose of the Safe System concept in order for it to be successfully integrated into public policy. Whilst Safe System requires additional clarification, it has garnered additional interest and debate in road safety and from this perspective has advanced public policy. Road fatalities and serious injuries are a public health problem that is both preventable and treatable. In Australia, road safety has been treated as a priority at both a federal and state level [1,2]. Victoria, is one of Australia's most densely populated states, with a population of 6.7 million people in 2020 [3] and 4.8 million registered vehicles in 2018 [4]. Australia's political system and division of power results in individual jurisdictions taking responsibility for significant components of the development and delivery of road safety policy [1,5]. The State has been recognised as a leader in road safety, particularly through its management approach, policy and introduction of evidence-based legislation such as compulsory seat belt usage laws and random breath testing [6,7]. Historically, Victoria's approach to road safety concentrated on legislating unsafe actions and having strong enforcement mechanisms in place [8], yet in more recent times a new approach has been dominant.

In Victoria, road fatalities have been reported from 1905 [9], and peaked in the 1970s. Recognising the significance of the problem, major efforts were implemented to reduce fatalities, leading to the emergence of road safety research [10]. 'Traditional' approaches to road safety viewed the driver as the cause of crashes. As such, the driver was responsible for ensuring a crash did not occur and when a crash did occur, the driver was responsible for the ensuing injuries [11,12]. While strategies to reduce road fatalities and serious injuries focused on enforcement, education and engineering (the 3Es) [13,14], there was a prevailing view and acceptance that fatalities and serious injuries were a fundamental component of the transport network [15]. In effect, the strategies that were applied meant the individual should adjust to the road network as opposed to the network being tolerant of the individual [16].

Faced with stagnating road fatality figures in Europe, a new way of thinking about road safety began to emerge by the late 1980s

[17]. Led by the Scandinavians and influenced by the pioneering work of Haddon and Gordon, a move towards treating the road network and its component parts as a system was underway [16,18]. These approaches recognised that fatalities and serious injuries could be prevented and instead sought to improve road safety by including elements of injury prevention approaches. Notably, these shifts took the focus from blaming the vehicle operator and instead reframed road safety to a more holistic systems-based approach, congruous to models operating in occupational health and safety [19,20]. This approach advocates that there are multiple parties responsible for reducing road trauma and that all parties need to work in harmony to ensure that the entire road transport system is safe [16,21,22]. By the 1990s these approaches to road safety began to manifest [23] with the adoption of a 'forgiving' system, where crash energies do not result in fatalities or serious injuries [24]. It also led to the notion that a target of zero fatalities is achievable [17]. In Sweden, this new approach was labelled Vision Zero and sought a scientific methodology towards human tolerances, a cohesive view of the road network, an ethical approach to the management of road safety and a vision for road safety [23]. Alternatively, the Sustainable Safety approach was developed in the Netherlands, which, when compared to Vision Zero aimed to reduce crashes but where this was not possible, reduce the severity of those crashes. Infrastructure changes to the road network would be supported through enforcement and education [25,26].

While the traditional approaches to road safety had been successful in reducing fatalities and serious injuries in Victoria, these reductions plateaued in the late 1990s and early 2000s, prompting the government to seek enhanced approaches. This led to interest within Australia to new thinking towards road safety. Inspired by the Swedish Vision Zero and the Dutch Sustainable Safety, Australia began developing the 'Safe System' approach [27]. Safe System advocates that it is not acceptable or inevitable to have fatal or serious injuries on roads. It recognises that people make mistakes and crashes will occur (human fallibility), there are limits on the amount of force the human body can tolerate before it is injured (crash tolerances) and that the road network should ensure that where a crash does occur, the forces should not exceed the limits of human tolerance [28]. Originally, Safe System had four elements (or pillars) working together in order to create a safe operating system – roads, vehicles, people and speeds [29]. A fifth pillar, post-crash care, was subsequently added in recognition that the events following a crash play an important role in reducing the prospect of fatality or injury. Victoria was an early adopter of Safe System, having recognised that the approach could improve road safety within the state [30]. In 2004, the Australian Transport Council - Australia's then peak road safety body - ratified Safe System. It has now become a mainstay in Australia, guiding national, state/territory and local government road safety practices [28,31].

Internationally, the Organisation for Economic Co-operation and Development (OECD) recognised Safe System as road safety best practice in 2008 [32]. The OECD, World Bank and World Health Organisation (WHO) encourage all nations to follow Safe System and many nations have and continue to implement Safe System principles [32]. Notwithstanding this

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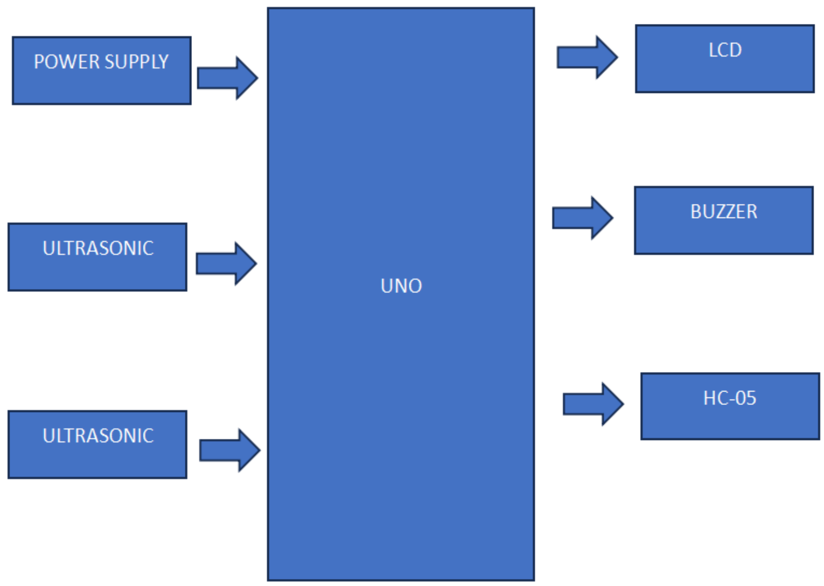
recognition, and in spite of Australia having adopted Safe System 16 years ago, the forecasted reductions in the road toll and other key indicators have not been met [33]. A review of the Australian National Road Safety Strategy in 2018 identified a failure to meet the targets set out in the Strategy, and suggested potential failures of Safe System implementation [34].

Woolley and Crozier [34] report a lack of will to pursue the changes required to adopt Safe System within Australia. This is supported by Muir, Johnston and Howard [35] who reported that the implementation challenges of Safe System are political and social, rather than technical. Whilst these challenges could be overcome, research by Mooren, Grzebieta, and Job [30] identified that each of the Australian jurisdictions they examined interpreted Safe System differently and seek to apply it in different environments. While there has been systematic examination of implementation issues, the concept and intentions of Safe System have not been considered in existing research.

Both Vision Zero and Sustainable Safety have received detailed analysis considering whether the zero target is achievable [36], its impact on public health [37,38], how it is interpreted and applied [39] and its effects on public policy [40]. However, in Australia, and in particular Victoria, there has been limited analysis of the policy cycle and implementation of Safe System, and a lack of systematic investigation of the role of public policy to determine where the opportunities and challenges lie. The primary objective of this paper is to therefore identify the purpose of Safe System in Victoria and explore Safe System from a public policy perspective. The focus is an examination of the role of the Safe System approach in public policy. For the purpose of this research, the definition of Safe System first articulated by the Australian Transport Council was used [41] which describes Safe System as a "the way different elements of the road transport system combine and interact with human behaviour to produce an overall effect on total road trauma" (p. i).

Block diagram



III.PROPOSED SYSTEM

The **Accident Prevention System for Hilly Areas and Deadly Zones** is designed to enhance road safety in regions that are prone to accidents due to their challenging terrain, sharp curves, and hazardous conditions. The system leverages various technologies including sensors, IoT, GPS, and real-time communication to provide early warnings and preventive measures for vehicles, reducing the risk of accidents in hilly areas and other critical zones.

1. Hazardous Zone Detection:

The system is equipped with sensors strategically placed along the roads in hilly areas and deadly zones. These sensors monitor environmental conditions such as fog, rain, landslides, and steep inclines, which may increase the likelihood of accidents. The sensors can also detect the sharpness of curves and other road characteristics that pose risks to vehicles. The data is transmitted to a central control unit, alerting drivers in real time.

2. Vehicle Speed Monitoring:

Speed is a major factor in road accidents, especially in hilly areas. The system continuously monitors the speed of vehicles through radar or GPS-based speed detection technology. If a vehicle is detected exceeding the safe speed limit for a particular stretch of road, the system sends automatic warnings to the driver through dashboard alerts or external signage. Additionally, it can trigger speed bumps or activate flashing lights to prompt drivers to reduce their speed.

3. Curve and Slope Warning System:

Hilly areas often feature sharp curves and steep slopes that can be difficult to navigate. The system incorporates a curve and slope detection module that provides drivers with visual and audio warnings before they approach dangerous curves or steep inclines. These warnings are communicated via road signs that change dynamically based on real-time road conditions, or directly to the vehicle's onboard system using Vehicle-to-Infrastructure (V2I) communication.

4. Collision Avoidance System:

To prevent accidents caused by poor visibility or sharp turns, the system uses ultrasonic or infrared sensors to detect the proximity of vehicles. When another vehicle is detected on a blind curve or steep incline, the system issues a warning to both vehicles, alerting drivers of the potential danger ahead. In critical scenarios, the system may even automatically control the vehicle's speed to ensure safe passage through the risky zone.

5. Emergency Communication Network:

The system integrates with an IoT-based emergency communication network, enabling vehicles to send distress signals if an accident occurs. GPS modules installed in vehicles allow real-time tracking of vehicle location, and in case of an emergency, the system sends alerts to nearby emergency services, road safety authorities, and other vehicles in the vicinity. This quick response can significantly reduce the time it takes for help to arrive in remote or hilly areas.

6. Road Condition Monitoring:

The system includes a module for continuous monitoring of road conditions. In areas prone to landslides, heavy rains, or snow, sensors are used to detect changes in road surface conditions such as water accumulation, ice formation, or debris from landslides. When dangerous road conditions are detected, the system sends out warnings to approaching vehicles, advising them to slow down or reroute if necessary. In some cases, the system can automatically close off hazardous sections of the road.

7. Vehicle Health Monitoring:

For added safety, the system can be integrated with the vehicle's onboard diagnostics to monitor critical parameters such as brake performance, tire pressure, and engine status. In case of any malfunction or degradation in performance, the system alerts the driver to take preventive action, thus reducing the chances of brake failure or other mechanical issues that may lead to accidents, particularly on steep and winding roads.

8. Cloud-based Data Storage and Analysis:

The data collected by sensors and the monitoring system is transmitted to a cloud platform, where it is stored and analyzed. This data helps authorities understand traffic patterns, accident hotspots, and road conditions over time. By analyzing this information, the system can be improved to provide more accurate warnings, and authorities can take preventive measures such as improving road infrastructure or installing additional safety equipment in high-risk zones.

9. User-friendly Interface:

Drivers interact with the system through a user-friendly interface integrated into their vehicle's onboard system or via a mobile app. The interface provides real-time updates on road conditions, warnings about hazardous zones, and recommendations for safer routes. The app can also be used to report accidents or dangerous conditions, which are then communicated to other vehicles and the relevant authorities.

10. Scalability and Future Enhancements:

The system is designed to be scalable, allowing for the addition of new modules or expansion to other dangerous road regions. Future enhancements may include the integration of autonomous vehicle technologies for automatic navigation in risky areas, advanced machine learning algorithms for predicting accidents based on road and vehicle data, and further development of Vehicle-to-Vehicle (V2V) communication for better coordination between vehicles.

The **Accident Prevention System for Hilly Areas and Deadly Zones** provides a comprehensive solution to the challenges faced in high-risk terrains. By integrating advanced sensors, real-time communication, and intelligent warning systems, it enhances driver awareness and vehicle safety, ultimately reducing the risk of accidents and improving the overall safety of transportation in hilly regions.

IV.CONCLUSION

The main aim of the project is to prevent accidents in hilly regions. We are providing the accident prevention system by using Ultrasonic sensors. The accident prevention system was developed and tested. The system was able to alert the vehicle approaching in the opposite direction of the curve, hairpin bend, or blind spots to reduce the accident rate in hilly regions. This system will decrease the rate of accidents in hilly regions. Mainly, It requires LED lights that detect the vehicles to stop and gets the prevention. This is how Ultrasonic sensor used and helped to prevent the accidents in hilly regions.

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