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Review Paper on Accident Prevention System for Hilly Regions

[1] Er. Haiqa Khursheed, [2] Er. Ajay Vikram, [3] Er. Preetpal Singh

[1] M.tech Scholar, [2]Assistant professor, [3]Assistant professor

[1] Department of Civil Engineering

[1] Rayat Bahra University, Mohali, Punjab, India

Abstract: In many developing countries, some roads continue to handout to serious and often fatal accidents. In all over the world, mountainous regions are home to some of the riskiest roads, characterized by narrow paths, sharp curves, and steep slopes. These factors significantly increase the likelihood of accidents. Implementing a vehicle accident prevention system is essential for improving safety on such perilous routes. Over time, numerous accidents on these roads have led to vehicles falling off cliffs, often making recovery difficult. Such incidents result in devastating loss of life and heavy financial costs for both individuals and governments. This paper proposes a vehicle accident prevention system tailored for curvy and steep roads, aiming to reduce accidents at sharp turns and hairpin bends. Drivers frequently face visibility challenges on these routes, increasing the risk of head-on collisions. This project seeks to address these dangers and reduce accident rates.

Index terms: **Arduino, Cables & Connectors, IR Sensors, Power Supply, PCB, Breadboards**

I. INTRODUCTION

In 2014 it was recorded that 1, 83,000 people died in road accidents, and it contributes 11% to the world accident rates on hilly regions. Some of the prominent causes of these fatal and risky accidents are over-speeding, driving on the wrong side and, driving under the influence of alcohol. This alarming figure translates to nearly 377 deaths every day, with unexpected obstacles contributing to 3.7% of such incidents [1]. The peril is particularly pronounced on mountain roads, which are inherently risky due to their narrowness, steep gradients, and sharp hairpin bends. Globally, some of the most treacherous routes include the Kolli Hill Roads, the Gata Loops, the 3-Level Zigzag Roads in Sikkim, and the Leh-Manali Highway, each known for their hazardous conditions.

Drivers face challenges significantly while driving on sharp curves associated with hairpin bends. Transport vehicles that pass through these sharp curves and bends often lack the navigation to pass safely through these curves, leading to collision, rolling over of vehicles, and plunging off the cliff (See Figure 1 below). Such accidents not only result in severe casualties but also lead to road closures for extended periods, requiring the deployment of heavy machinery for vehicle recovery and repairs [2]. The disruption caused extends beyond immediate safety concerns, impacting transportation networks and incurring high financial and logistical costs.

There are some of the traditional safety measures, such as convex mirrors and auditory warnings that frequently are insufficient to mitigate risks. As accidents at these locations continue to claim lives and strain resources, there is an urgent need for innovative and effective safety solutions tailored for hilly and mountainous roads. This pressing issue underscores the necessity for modern accident prevention systems designed to address the unique challenges of these terrains, ensuring improved visibility and timely alerts to prevent life-threatening incidents.

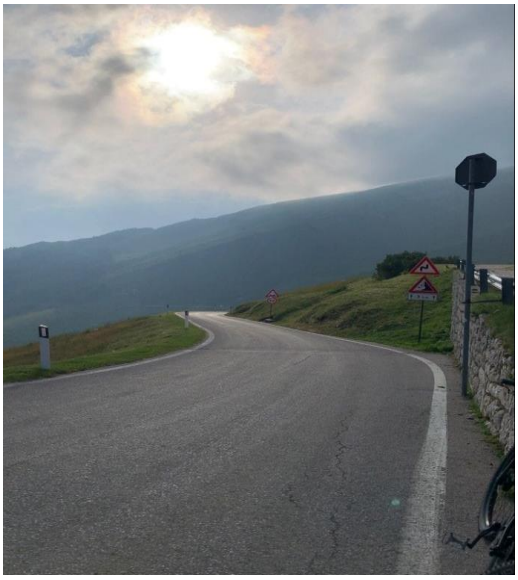

Figure 1. Hairpin bend and sharp curves

II. LITERATURE SURVEY

A. ***Aravinda B, Chaithra Lakshmi C, Deeksha, and Ashutha K***, **Sensor-Based Accident Prevention System** introduced an infra-red sensor-based accident prevention system that involved ultrasonic sensors placed right before or near the curves and LED lights positioned after them. The ultrasonic sensors emit pulses that reflect off approaching vehicles, triggering the LED light to alert drivers of oncoming traffic. This system helps drivers take precautionary measures, thereby reducing accidents on curvy and mountainous roads.

B. ***Ranga Sreedhar Galla***, **Reducing Road Accidents on Sharp Curves Using Arduino** Introduced a solution with positive effect to minimize accidents on slippery and hilly roads. The study culminates the problem of low visibility at hairpin bends and curves, particularly at night when glare from opposing headlights abstruse drivers vision. The proposed solution highlights on placing ultrasonic sensors before the curve, and LED lights beyond it, to provide early warnings to drivers.

C. ***R. Saranya and R. Arun Kumar***, **Causes of Accidents** highlighted accident causes such as drunk driving, over speeding, distractions, and driver drowsiness. Drowsiness, in particular, was identified as a leading cause, with drivers falling asleep briefly at high speeds, resulting in fatal accidents. Their system includes a buzzer that activates when drowsiness is detected.

D. ***Bhanot, R., & Prasad, R. (2020),*** **Road Safety in Hilly Areas: An Analysis of Accident Patterns**, focuses on prevention of accidents on different patterns of roads and regions. The research highlights the risks associated with geographic and climatic conditions of the certain areas.

E. ***Gupta, R., & Sahu, D. (2023***), **Impact of Environmental Factors on Road Traffic Accidents in Hilly Regions,** highlights on the geographic focus of the hilly regions, and the environmental factors that impose the risk of vulnerability of the accidents in these areas. The research also provide the prominent amount of solution and the usage of infra red sensors on the high altitude roads and regions

F. ***Khanna, P., & Gupta, A. (2021),*** **Utilization of Advanced Technologies for Enhancing Road Safety. Safety Science,** The research emphasizes on the techniques that enhance the road safety on hilly regions and other vulnerable areas that are more prone to accidents. The study culminates the use of sensor gadgets to sense the fatality of the accidents and the proposed solutions that are cost effective are also mentioned in the study

3. Proposed Work

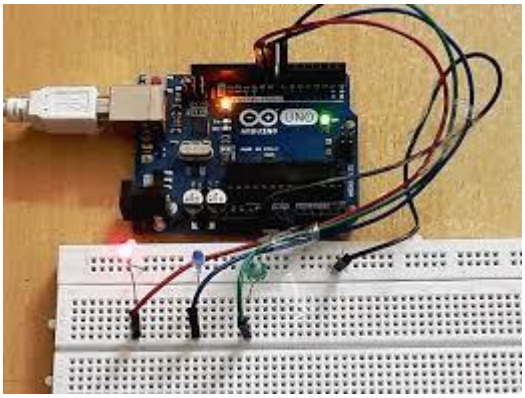

Figure 2: Arduino system

This system employs Arduino technology to emphasize and develop an accident prevention mechanism for hilly and mountainous roads. The goal is to alert and inform drivers to oncoming vehicles or obstacles by using IR sensors placed on either side of the road before curves. LED lights and buzzers are installed beyond the curve to signal danger. When vehicles approach from opposite directions, the IR sensors detect them, prompting the LED to turn red and the buzzer to activate. When the road is clear, the light turns green, allowing safe passage. This automated system enhances safety on hazardous roads.

A. SOFTWARE HARDWARE REQUIRED FOR THE PURPOSE SYSTEM

The following are the software and hardware required to implement the desired recommendation system.

a) Software Required

1) Arduino IDE is open source software which makes easy to write code for microcontroller AtmZega 328 and allows uploading on board. The environment is written in java and based on processing and other source software.
2) Arduino IDE can be used on Windows, Linux (Both 32 and 64 bits), and Mac OS.
3) Current versions are Arduino 1.5x Beta Version.

b) Hardware required:

1) IR Sensors
2) Arduino Uno
3) PCB and Breadboards
4) Buzzer
5) Power Supply
6) Cables and connectors
7) LED

B. ADVANTAGES ARDUINO SYSTEM & INFRA RED SYSTEM

1. The usage of Arduino system and infrared sensors reduces accidents on mountain and curved roads. This enhances the alert signals to the drivers before approaching the sharp bends and curves.
2. Saves lives by preventing collisions. Practices designed to enhance safety and reduce the likelihood of accidents.
3. Fully automated and easy to implement, setup is quite **easy to implement** with basic Arduino knowledge and can be fully automated to respond to IR signals or objects detected by infrared sensors.
4. Cost-effective installation, economically sound system that works efficiently in economically weaker regions

III. FUTURE SCOPE

a. To develop protective casings around the system and IR sensors to safeguard it from environmental damage because of harsh weather like rainfall, hailstorm and snow because moisture contact causes corrosion.
b. Minimize the size of the systems, for easier and quick installation on narrow roads. This will help in quick service of repair in times of needs, because if the size of the system is minimum it can be transported efficiently without any damage to the system.
c. Enhance the system to detect vehicle counts and speeds, issuing warnings for natural disasters or traffic conditions.

IV. CONCLUSION

This project focuses on reducing accidents on curved and mountainous roads by using IR sensors and LED lights to alert drivers of approaching vehicles. By integrating modern technology, this system improves road safety and helps save lives. The proposed solution addresses the need for enhanced safety measures on treacherous roads. The effectiveness of this model depends on the availability of the proper funding, and proper support from the associated ministry. Expand on how the IR sensor works and its integration into vehicles or roadside infrastructure. This would help readers understand its functionality and feasibility. Include examples of how the model could be adapted to other hilly regions, emphasizing the similarities in road conditions or traffic patterns that make it applicable. Provide examples of potential funding sources or strategies to garner administrative support. Discussing challenges and solutions in these areas would add depth to the argument.

REFFERENCS

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