ACCIDENT DETECTION AT U CURVES USING SENSORS AT HILL STATIONS: A CASE OF PAHALGAM TEHSIL (J&K)

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Abstract
The study has adopted the qualitative research approach to garner an exploration into the role of Infrared Radiation sensors into the accident detection in hill stations. The nature of the study is analytical one and it adopted the secondary data sources to garner an insight into the subject matter. The key takeaways of the study has visualized that Pahalgam hill station is vulnerable to road accidents. There are variety of reasons including lesser road width, curved roads and others that have amplified the accidental profile of the hill station. In this background, the information technology has radically transformed the transportation sector. IT has inherent potential to develop the smart transportation mechanism that will detect and prevent the accidents. The proposed 'Infrared Radiation Sensor' model is the unique, cost-effective and sustainable solution to overcome the issues pertaining to accidents in curved roads in the hill stations. The model has inherent potentiality to reduce the accidents, prevent the human losses and minimize the economic damages through the smart and cost-effective approach. However, the issues of timely implementation limited financing and appropriate technology demands the timely intervention for effective implementation of the model.

Key words: Accident, Detection, Sensor, Technology

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1. Introduction

Road safety is the multi-dimensional issue as it incorporates the development and management of road infrastructure, provision for safer vehicles, legal framework, provision for health and preventive care. Creating a sustainable road safety is the prime responsibility of government and its success depends upon the safety strategies and broad based support of all stakeholders. In developing countries like India, the hilly areas witness the large scale accidents due to poorly developed roads, poor infrastructure and unattended hazard zones. The rate of accidents in India is increasing day by day, but the emergency services are lagging far behind *(Joshi et al., 2014)*. Road networks being complex and dynamic systems are greatly influenced by human, environmental and technological elements. There is a direct relationship between the road accidents and geometrical characteristics of roads such as radius of curvature, sight distance and slope. In most of the accidental cases, the number of accidents increases with longitudinal pitch, peak hour volume and tangent length; but decreases with radius of curve *(Himanshi, 2020)*.

In the year 2019, nearly 4.37 lakh accidents were reported in India among them 1.54 lakh accidents were fatal. Two wheelers caused the deadliest accidents were 58,747 deaths have been reported followed by trucks/lorries (22,637 deaths) and cars (21,196 deaths). The road accident deaths account 44% of total accident deaths of India *(Jonath & Regev, 2018)*. There are assorted array of reasons including human factors such as health condition of driver, alcohol consumption, use of mobile phone while driving, age of driver and distraction caused by road advertisements that influence the occurrence of road accidents. Moreover, the environmental factors such as ice rain, rain, fog also play a role for causing the accidents. The statistics have revealed that poor weather conditions significantly determine the occurrence of accidents *(WHO, 2018)*. Accidents are termed as drain on national economy as it results into the deaths, disability, damage to property, environmental degradation and social suffering.

In the above background, the present study has undertaken accident analysis of Pahalgam hill station to identify the factors for causing accidents. Moreover, the study is helpful to craft suggestions that will be remedial for reducing the accidents using the censor technological model. All the subject matter has been presented under appropriate themes in line with the research objectives and appropriate research methodology has been adopted.

2. Objectives of the Study

Hill stations being tourist attractions have radically transformed the socio-economic interactions at large. Accidents in hill stations are regular phenomena's that have incurred the human and economic implications upon the larger scale. In this background, the present study will explore and analyze the following research objectives:

- To investigate the factors responsible for accidents in Hill Station Pahalgam.
- To analyze the relationship between hilly terrain and accidents in Jammu and Kashmir.
- To explore how use of censors will prevent the accidents in U-Curves in Hill stations.

3. Research Methodology and Techniques

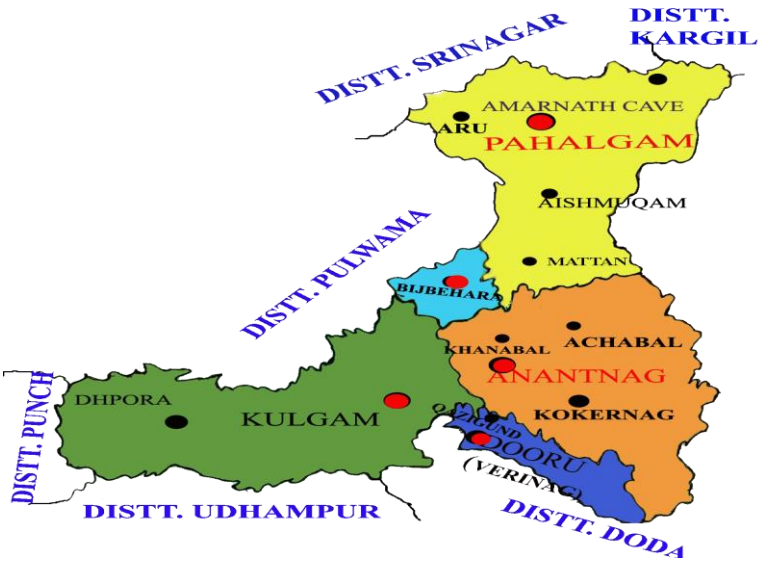
The present study is an exploration into the causes and consequences of accidents in the hill station of Pahalgam region of Jammu and Kashmir. The approach of the study is qualitative one and it adopts the analytical methods to garner insights into the subject matter. They study has used secondary data sources including research journals, new articles, data from Police station Pahalgam. The main stay of the study is accidental profile of Pahalgam which contains the data pertaining to accidents, reasons for accidents and their impact on human lives. More specifically, the data of 36 accidents availed from First Information Reports (FIRs) of 2021-22 from Pahalgam police station were analyzed thoroughly to analyze the reasons for accidents and their impact on socio-economic facets. In this context, the subject matter has been presented under appropriate themes keeping in view the coherency and synchronization of data.

4. Topography of Pahalgam

Pahalgam is a notified town in the Anantnag district of Jammu and Kashmir. The name Pahalgam is combination of two Kashmiri words; *Puheyl (Shepherd) and Goam* (Village). Pahalgam acts as a gateway to many green pastures and meadows and it is the home to nomadic tribal communities including Gujjars and Bakerwals. Pahalgam lies at the average elevation of 8990 feet (2740 meters) with temperate climate having long and cold winter and short and mild summer. According to census 2011, Pahalgam town is the home to 5922 people with 56% male population. The literacy rate of the town is 35% which is quite minimal than state level.

The green lush meadow, fresh water river and snow capped mountains of Pahalgam adds mesmerizing beauty to the region. It's cool invigorating and pleasant climate, melodious flow

of Lidder Nallah attracts large pool of tourists from and outside India. Pahalgam Gulf course and Betab Valley adds to the beauty of Pahalgam. Moreover, the elevated mountains at 7200 feet become the famous tourist destinations for mountaineers and others. Pahalgam is the gateway to *Amarnath Yatra*that connects it to holy shrine via *Chandanwari*. Pahalgam has twofold importance in terms of acting as a beginning point for annual Amarnath Yatra and hosting the tourists from and outside India. In this context, it can be inferred that Pahalgam is the major tourist destination, but the geographical terrain and roads with small widths adds woes to the commuters. Therefore, a large scale of road accidents took place between the Chandawari and Pahalgam town during the peak tourist season.



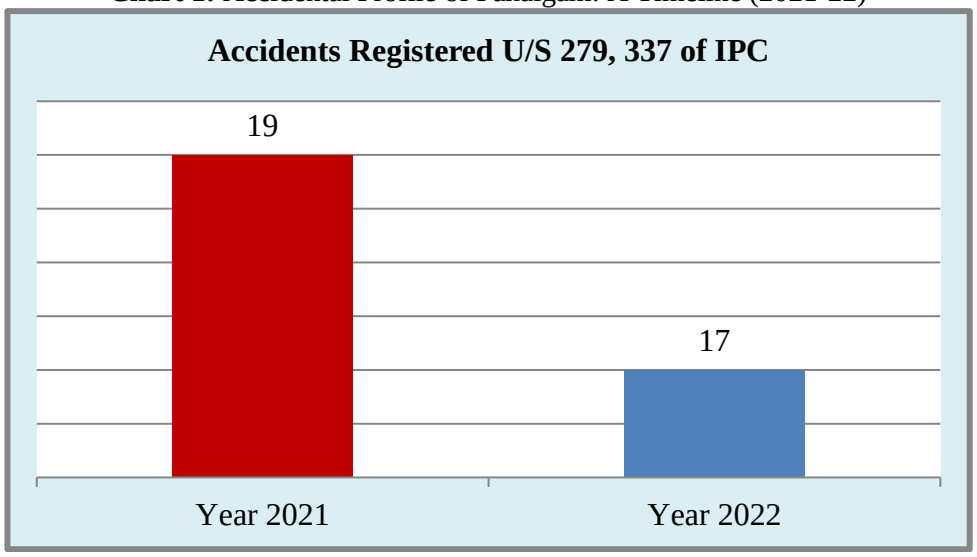
5. Data Interpretation and Data Analysis

This section provides the interpretation and analysis of data of 36 road accidents in the hill station Pahalgam, Jammu and Kashmir. The data sets are related to the year 2021-22 and the findings in this section are more specifically related to Pahalgam. In this section, the reasons for accidents, the socio-economic impact of accidents have been analyzed thoroughly. All the findings of the study have been presented under appropriate themes as listed below:

Table 1: Accidental Profile of Pahalgam: A Timeline (2021-22)

Accidents Registered U/S 279, 337 of IPC	Number of Accidents
Year 2021	19
Year 2022	17
Total	**36**

Chart 1: Accidental Profile of Pahalgam: A Timeline (2021-22)

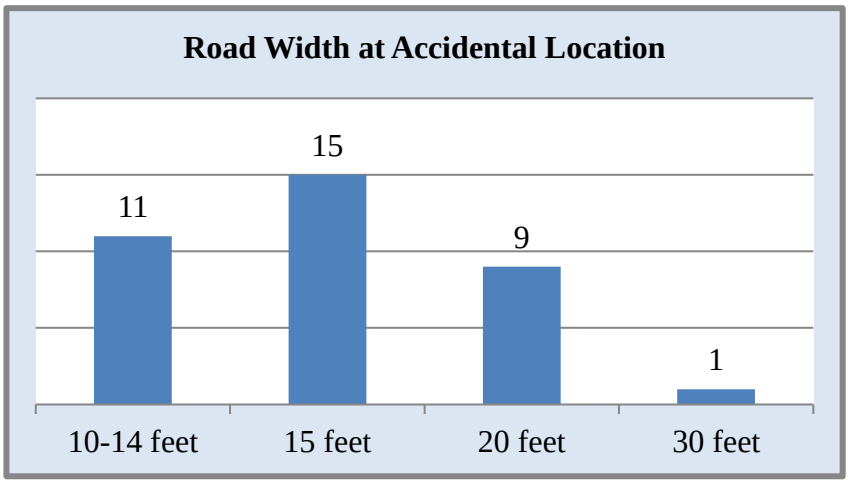


The data pertaining to accidents under the jurisdiction of Police Station Pahalgam in the year 2021-22 has stated that 36 FIRs have been registered Under Section (U/S) 279, 337 of *Indian Penal Code* (IPC). In the year 2021, 19 FIRs have been registered and in the year 2022, 17 FIRs have been registered. These FIRs have been registered in connection with accidents between the *Chandanwari* and *Pahalgam* tourist destinations that lie in the District Anantnag of Jammu and Kashmir. In these accidents, either an injury or death was reported. In this context, the subsequent sections will undertake the analysis of 36 accidents with respect to causes and consequences in Pahalgam hill station.

Table 2: Road Width at Accident Location

Road Width at Accidental Location	Number of Accidents
10-14 feet	11
15 feet	15
20 feet	09
30 feet	01
Total	**36**

Chart 2: Road Width at Accident Location



There are multitudes of reasons that play a role in causing the accidents. According to the data, the limited road width became the prime reason for causing accidents. The data has stated that 11 accidents took place in those areas where the road width lies between 11-14 feet and 15 accidents took place in those areas where road width is 15 feet. While as 9 accidents took place in those areas where the road width is 20 feet and only 1 accident took place in area where road width is 30 feet. Therefore, it can be inferred that majority of the accidents have take place in areas having road width less than 15 feet. Road width becomes a central component that determines the nature of accident.

Table 3: Season of Accidents

Season of Accidents	Number of Accidents
Winter (November - February)	11
Summer (March - October)	25
Total	**36**

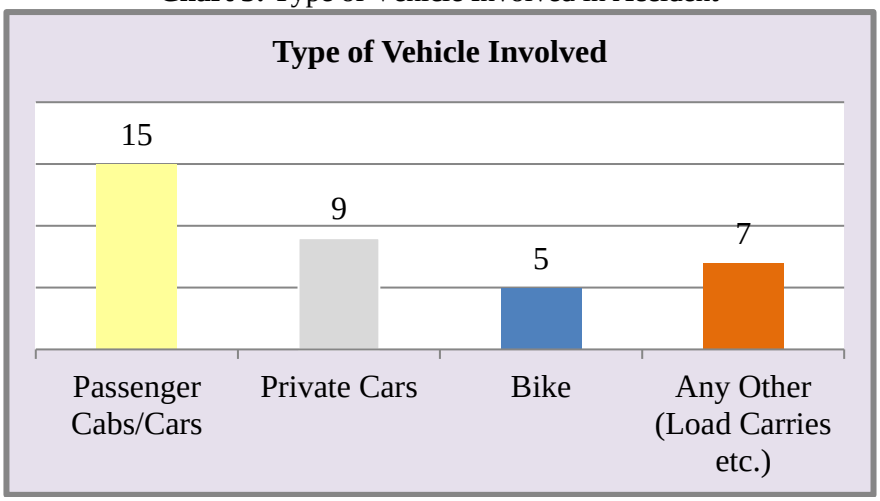
Moreover, the weather and climatic conditions also determine the nature and intensity of accidents.

Pahalgam being the famous tourist spot know for its mesmerizing beauty has witnessed the frequent accidents. According to the 2021-22 accidental data of Pahalgam, out of 36 accidents 11 have taken place in winter season (November to February) and 25 accidents have taken place in summer season (March to October). During the summer season, Pahalgam attracts large pool of tourists from other parts of India and abroad. The large influx of tourists in peak summer has inherent issues including traffic jam, car parking, rash driving and others. It is in this background, these issues become the prime cause for accidents. More importantly, majority of the accidents have taken place between 8am to 6pm; while as negligible or no accidents took place during the night time.

Table 4: Type of Vehicle Involved in Accident

Type of Vehicle Involved	Number of Accidents
Passenger Cabs/Cars	15
Private Cars	09
Bike	05
Any Other (Load Carries etc.)	07
Total	**36**

Chart 3: Type of Vehicle Involved in Accident

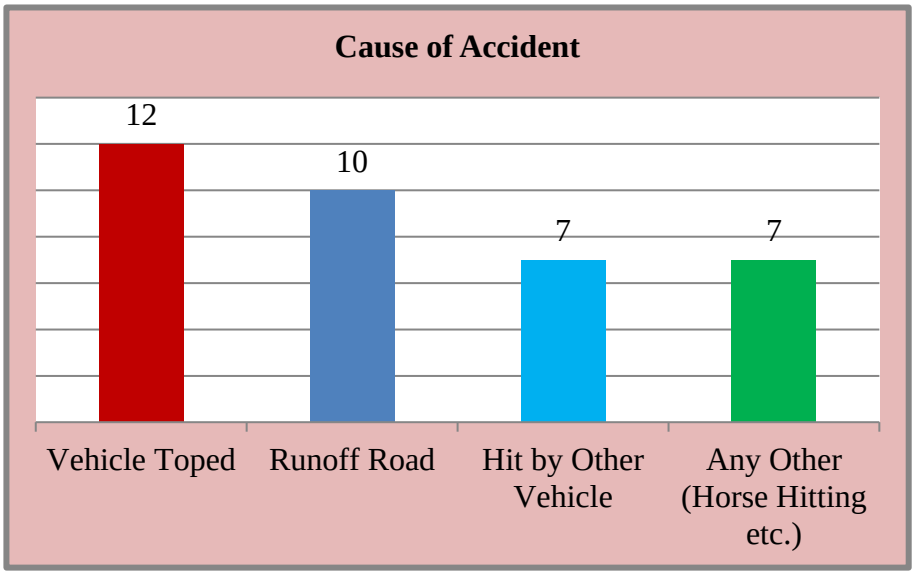


The type of vehicle involved in an accident greatly varies from place to place. Out of total 36 accidents analyzed, 15 accidents involved passenger cabs/cars and 9 accidents involved private cars. While as bikes were also involved in 5 accidents and other vehicles including load carriers were involved in 7 other accidents. Majority of the accidents involve passenger cabs and private cars. However, Heavy Motor Vehicles (HMVs) are rarely involved in accidents from Chandanwari to Pahalgam.

Table 5: Cause of Accident

Cause of Accident	Number of Accidents
Vehicle Toped	12
Runoff Road	10
Hit by Other Vehicle	07
Any Other (Horse Hitting etc.)	07
Total	**36**

Chart 4: Cause of Accident

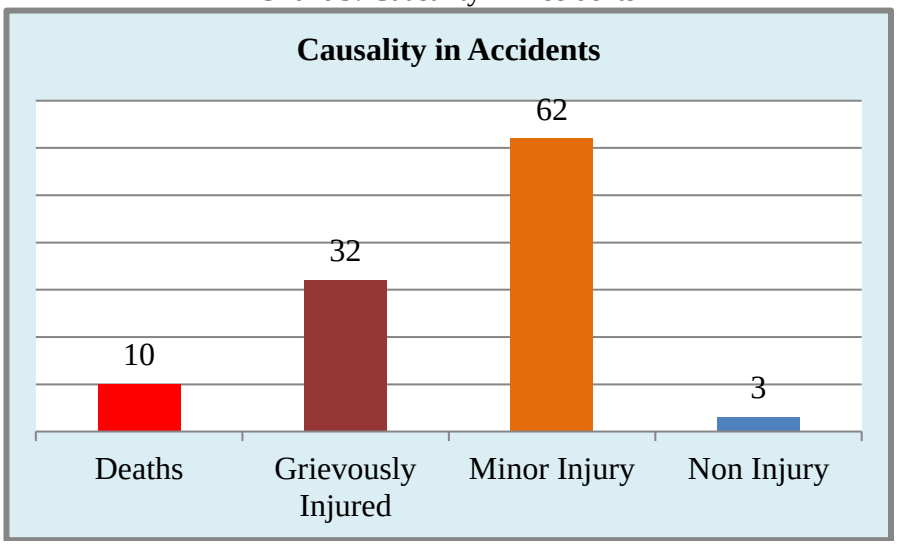


There is variety of reasons that cause an accident. Out of 36 accidents in Pahalgam hill station, in 12 accidents vehicle has topped and 10 accidents were caused due to runoff road. While as in 7 accidents vehicle was hit by other vehicle and other cause of accidents include horse hitting and others. Pahalgam hosts diverse set of tourists from different countries of the world that makes is congested during the peak tourist season. The greater influx of tourists adds woes to the traffic and large traffic becomes a reason for accidents. However, the data has stated that accidents in Pahalgam are scattered in random position. Accidents took place on upper reaches of Chandanwari, blind curves of Pahalgam and traffic congested areas.

Table 6: Causality in Accidents

Causality in Accidents	Frequency
Deaths	10
Grievously Injured	32
Minor Injury	62
Non Injury	03
Total	**107**

Chart 5: Causality in Accidents



Accidents have inherent tendency to negatively affect the socio-economic avenues. According to the data, a total of 10 deaths were reported in all 36 accidents in Pahalgam. Majority of the deaths were reported in passenger bus/cars; while as no death is reported in two wheeler (Motorbike). Moreover, 32 people were grievously injured and 62 people faced minor injury. In all the death cases, the deceased belongs to the age category of 25-55 years. Majority of the victims with injuries fall under the age bracket of 18-45 years. However, only 05 people below 18 years got injured in all the 36 accidents.

6. Technological and Transportation: A Functional Perspective

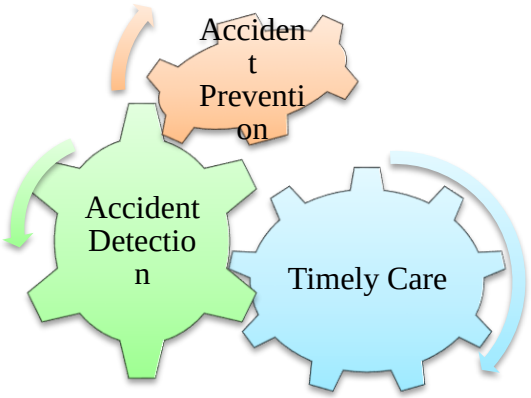
The technological innovations have transformed the socio-economic interactions across the globe. Digital influx has revolutionized and revitalized the transportation system in the positive orientation. The strong foothold of Information Technology (IT) in transportation has played a role in travel safety, creating fuel efficient transportation mechanism and real time delivery of goods and services. According to *Mutya, et. al, (2015),* due to the dangerously growing fatality rates in developing countries, accidents are quickly becoming recognised as a serious public health problem in many countries. One of the main factors in all traffic accidents is careless driving brought on by long periods of waiting and blind corners. Traffic accidents result in an estimated 1.2 million fatalities and 20 to 50 million injuries annually. In such circumstances, a passive, cost-effective approach is needed to prevent these traffic accidents.

Murshed& Chowdhry (2019) have proposed a smart system to reduce the number of mishaps on road i.e. Internet of Things (IoT) technologies could be used to prevent the accidents and more importantly there needs to configure GPS module to enhance the system. In the view of *Anand M. G. et al. (2019)* curved roadways are the accident prone areas that need to be developed in a smart way. To prevent the accidents in these curved roads, ultrasonic sensors connected with microcontroller could be used. These sensors will deliver the timely information to the driver with regard to the cars/bikes coming from other side of the road.*Rakul et al. (2016)* has also supported the smart system to prevent the vehicle crashes in sharp curves, hairpin bends and blind curves. In this regard, they have proposed the idea of ultrasonic sensors for effective prevention of accidents.

Saraf&Chavan (2013) have presented a road recognition method that can be used to compile data in the form of a single map. This will help the driver to understand the volume of traffic in that specific region and to further aid the driver in lowering the running time for blind spot or curve road identification. And while building a unique

prototype for the field of Intelligent Transportation System, the machine learning technique to detecting and recognizing cars may be taken into consideration. Moreover, *Unaiza et al. (2016)*have laid their focuses on accident prevention as well as accident detection. The combination of hardware- and software-based devices can be used to aid in accident detection and prevention. According to *Sharma et al. (2019)* accident detection techniques using Internet of Things (IoT) are gaining momentum. The need is to focus upon notifying the authorities about the mishap and save the people thereby. In this regard, the integration of smart sensors and GPS system within the car should be put in place for timely remedy of accident victims.

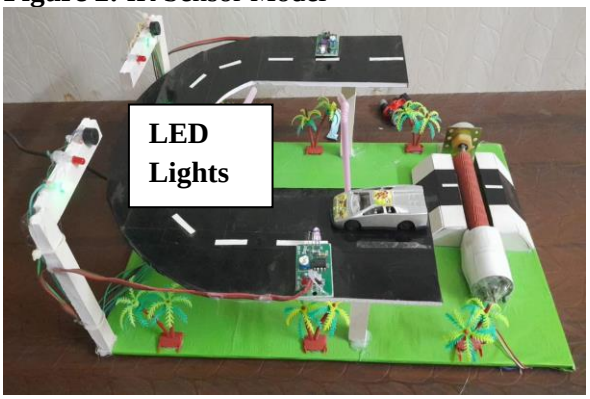
Figure 1: IR Sensor Utility in Accidents



7. Accident Detection Using Infrared Radiation Sensors at Hill Stations

India being the home to second largest population witnesses the growing incidents of road accidents. According to *Million Death Study* (MDS), nearly 137K people die every year due to road accidents in India.Factors such as mountainous roads, hair pin bends and narrow curved roads are mostly responsible for causing accidental deaths. In the hair pin bends, driver is unable to see the vehicle/obstacle coming from the opposite side of the curve. These episodes inflict the larger damage to people and property. More importantly, the loss of lives and destruction to roads is being caused *(Sarode, S. et al., 2021)*. In this background, the proposed sensor model for accident detection at U-curves is an ideal, cost-effective and sustainable solution.

Figure 2: IR Sensor Model



Hill stations including Pahalgam are embedded with curved and sloppy roads that make it difficult for the driver to drive efficiently and without any danger. Infrared Radiation sensor enabled model is the preventive tool to prevent the accidents in real time at U curved roads in these hilly areas. The model has made use of multiple components that makes it energy efficient, real time accident detector and a sustainable energy mechanism. All the components and their utility have been presented below:

- Barrier: The barrier is embedded with rotary mechanism that generates the electricity with the help of converter. Barrier acts as a stoppage unit that limits the speed of vehicle and paves the way for smooth passage of traffic.
- Battery: The battery stores the electricity generated from barrier and this electricity is used to power the IR sensors and lights of the model. The electricity stored is also used to power the nearby road lights that make it easier for vehicles to pass/move.
- IR Sensor Module: The module detects the movement of vehicles coming from one side and communicated the same to other curved side for safe passage. IR sensors are vital components of the model that define the safe passage for vehicles.
- Red and Green Light: The detection of traffic movement via IR sensors makes the Red light to blink on other side of the curved road that makes it easier for the other side to understand the traffic scenario. The red line that blinks in opposite side

of the traffic signals the vehicles from other side to stop.

▪ Green Light: The blinking of green light signifies that the vehicle can play smoothly as there is no vehicle coming from other side of curved road.

8. Conclusion

Hill stations laden with curves have become a greatest threat to the human lives. Each year, many accidents took place in these curves that negatively affect the social and economic facets to the larger extent. In this background, the Infrared Radiation laden Sensor model is aimed at establishing the smart road mechanism that will save the human lives and reduce the amount of accidents in curved roads. The model is self sufficient in nature as it automatically generates the electricity for powering the IR sensors and the green and red lights thereby. Moreover, the electricity generated is sustainable in nature and it will be utilized to light the adjacent road sides for effective and safe passage of vehicles. However, the issues pertaining to vibrant financing, administrative will and robust technological innovations are the areas that demand the timely intervention for effective implementation of the model.

9. References

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