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Hair Pin Bend Alerting System Using IOT

Manish Kumar Thakur [iD] [*1], Yashaswini A [iD][†2], and Ratnakirti Roy [iD][‡3]

[1]Associate Professor, Department Of MCA, Acharya Institute of Technology, Bangalore
[2]Department Of MCA, Acharya Institute of Technology, Bangalore
[3]Associate Professor, Department of MCA, Acharya Institute of Technology, Bangalore

Abstract

One pressing problem that necessitates innovative solutions is the avoidance of accidents on ghat roads. Using Internet of Things (IoT) technology is one promising way to increase road safety in these challenging conditions. The uneven terrain and abrupt curves of the Ghat Road provide unique risks to motorists, necessitating preventative steps to lower crash rates and improve overall traffic safety. The appliance of IoT devices and systems in ghat road environments is examined in this abstract with a view to reduce risk and improve accident prevention techniques. There will be tight curves and small roads in the mountains. The driver of an automobile is blind to oncoming vehicles and animals on the road in these types of situations. Each year, this problem claims the lives of thousands of humans and animals. The fix for this problem is to alert the driver to oncoming vehicles and animals in the Ghats area.

Keywords: Accident prevention. Ghat road. Arduino R3. IR (infrared) sensor.

[*]Email: mthakur00@gmail.com Corresponding Author
[†]Email: yashaswinia.22.mcav@acharya.ac.in
[‡]Email: ratnakirti2817@acharya.ac.in

1 Introduction

Developing a comprehensive approach to deal with the growing issue of accidents in a mountain pass is an essential undertaking requiring creative and practical thinking. Mountains are more likely to experience accidents, which leads to a higher death toll. This area's roads are steep and twisted, making it challenging for drivers to see cars on the other side. The survey states that hill stations account for 13% of all accidents or the majority of accidents. (Mehdi et al., 2022).In order to improve public administration and services, e-governance covers a range of technology elements, such as artificial intelligence (AI) and the Internet of Things (IoT). (Mittal, 2020). The Hair Pin Bend Alerting System, which uses IoT, is one real-world example of how these technologies are being used to improve traffic management and road safety. The primary objective is to create an effective alarm system that will reduce the awful number of accidents that happen in these challenging environments. Technology is utilized in this procedure, specifically LED lights that detect an approaching car from the other side of a curved road and turn on. The Arduino microcontroller board is delicately connected to a series of very sensitive infrared sensors to produce a seamless and effective mechanism that is vital in this detection process.

Mechanism is formed by the integration of IR sensor to an Arduino microcontroller board. This proposed solution has a value that goes much beyond technological innovation. It represents an intense dedication to protecting those who cross the dangerous ghat areas and saving lives. The basic thought is in accord to the understanding of the natural hazards presented by the tricky curves and sharp hills typical of ghat roads, where accidents frequently have dangerous consequences. This device aims to change road safety procedures in these dangerous areas by strategically lighting LED lights to alert drivers to the availability of vehicles coming nearer from the opposite direction. The main goals of road safety measures are the protection of human life and the avoidance of accidents, particularly in difficult surfaces like ghat sections that are renowned for their dangerous turns and unpredictable circumstances.

This research introduces a complex alarm system that makes use of modern technology, representing an innovative method to reduce accident rates in ghat sections. The main part of this system is the clever positioning of LED lights, which activate when a car is spotted approaching from the other direction along the curved path. The quick and precise identification of approaching cars is made possible by the smooth integration of extremely sensitive infrared sensors with the adaptable Arduino microcontroller board. This innovative technique has far-reaching ramifications that go well beyond technology innovation. It can prevent terrible accidents and save lives, providing drivers going through ghat sections a sense of confidence. This article serves glow of hope for a future where road safety and opens the way for a better, more secure transportation landscape through a precise combination of proactive safety measures and modern technical solutions.

2 Literature Review

10% of all vehicular incidents in hill stations, according to research, happen on curved roads. It is risky to drive around bends and curves. (Radhamani et al., 2023) suggests an IoT-based Accident Prevention System for hairpin bend roads as a possible solution to reduce accidents, particularly at U curves and hairpin bends. This system aims to develop traffic warning signals that alert drivers to approaching vehicles on either side of the bend. An Internet of Things (IoT)-based accident prevention system for hairpin bend roads has been developed to prevent accidents primarily at hairpin bends and U curves by notifying drivers of approaching cars through traffic warning signals. (Poongothai & Gokulkathirvel, 2022). As digitizing technology is being used everywhere even in our daily lives. (Gautam & Mittal, 2022). Artificial Intelligence (AI) and other developing technologies must be properly integrated into national structures in order to improve services provided to the citizens .(Mittal & Gautam, 2023).

A project described by CH.SRIKANTH et al.'s (2022) that uses a microcontroller board with sensors and LEDs to notify the driver when a vehicle is approaching their blind area or turn. The sensors and LEDs are interfaced with the microcontroller based on vehicle detection. Goel et al.'s (2022) presents a cost-effective approach to preventing accidents in hairpin curves using a Raspberry Pi microcontroller and various IoT sensors, including ultrasonic sensors, along with devices like LEDs and LCDs. Pradeepkumar et al.'s (2023) described a system where the oncoming car's driver is alerted by an ultrasonic range detection sensor on one side of the road prior to the bend and a light warning system on the other side following the turn. The authors of Subrahmanyam, Aravind, and Sai's (2023) suggest an alerting system wherein drivers can be watchful and slow down their vehicle by adhering to the LED light on/off criterion. This system aims to prevent fatal traffic accidents. ("Sensor Assisted Ghat Road Navigation and Accident Prevention," 2022) proposes using two infrared-based sensors to create an Arduino-based road protection alerting system that increases driving comfort and safety on ghat roads and mountainous area roads.

An inventive Arduino-integrated ultrasonic sensor accident prevention system can be used in the suggested treatment. The gadget uses LED signals and a siren to warn automobiles that are coming at these curves. (Onkar & William, 2024). Another system is proposed by Karthik et al.'s (2023) detects oncoming vehicles using sensors. It sounds an alert and flashes a red signal to drivers on the other side. A green light indicates safe travel when the road is clear. The system's design includes various components such as an IR module, transistor, buzzer, LED, motor, and batteries. The transistor acts as a switch to operate the LEDs and buzzer, while the IR module detects when a car is nearing the bend. The LEDs display the road's condition: red indicates danger, and green indicates safety. To get the driver's attention, the buzzer emits an alarm sound.

Hence, the use of Internet of Things-based accident prevention systems made especially for U curves and hairpin bends. To alert drivers of approaching cars, these systems often use a combination of sensors, microcontrollers, and alerting devices including buzzers, LEDs, and LCDs. Solutions are made more affordable and effective by combining technologies like infrared and ultrasonic sensors with microcontroller platforms like Arduino and Raspberry Pi which promote better driving habits on hazardous road segments.

3 Methodology Used

In order to solve this issue, we intend to install a sensor by the side of the road to notify drivers of any obstacles or vehicles in the Ghats section. Light will glow at this time the opposite side of the curve. The sensor will not receive the signal and the light will not glow if the vehicle or object is not present. The motorist might slow down or stop his car when the light the go out, depending on the situation. Using LED screens and buzzers, which will notify if there are cars coming from the other direction of the road, can help prevent accidents. It does not make any distraction to drivers while driving. When two cars pass from the other direction of the curved road the IR sensor senses the car and the LED color turns into red and raises the buzzer giving danger signal and then the LED color turns into green to allow the one car to pass and then the other LED color turns green. Assignable to simple techniques, it is beneficial to use in a substantial of places and even in critical cross section of roads.

- System Design and Component Integration: Create the architecture for the density-based Ghat road alerting system, integrating electrical parts like the Arduino R3, IR sensors, LED indicators, Buzzer, and other parts that are provided. To enable efficient data gathering, decide where to put these parts and how to connect them.
- Sensor Positioning and Adjustment: Place infrared sensors at key intersections on the ghat road to accurately detect availability of cars from the other .
- Control and Signal Display: LED indicators are used to show the information from the other direction of the curve. Phases of the signal are indicated by different colours; for example, green indicates that "there is no object out of range curve," while red indicates that "a vehicle is arriving from the other side.
- Testing & Validation: To assess the system's efficacy and performance, put it through an accurate testing process in both simulated and actual condition. To evaluate the effect regarding the system on ghat road, measure performance measures such average time of response to vehicle detection.
- Optimization & Fine-Tuning: Based on test findings and user comments, make changes to optimize the system's performance. To improve accuracy and dependability, adjust parameters including weather, traffic volume, and road surface conditions.
- Record-keeping and Reporting: Throughout the implementation process, keep thorough

records of the system design, sensor placement maps, calibration techniques, and test outcomes. Write a thorough report outlining the approach, conclusions, and suggestions for upcoming upgrades or implementations.

4 Architecture

The following figure represents the architecture of proposed model:(see figure 1)

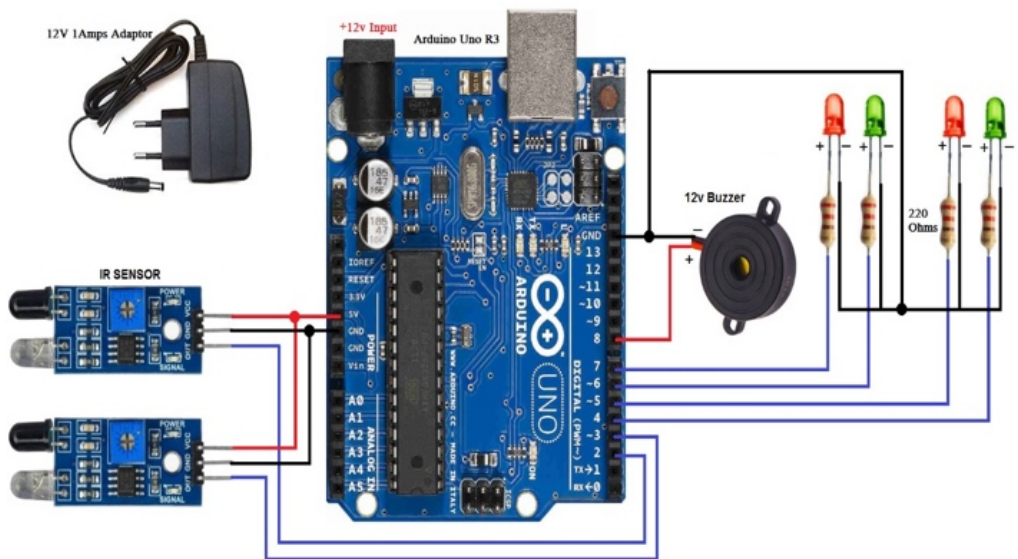Figure 1. Architecture of Hairpin Bend Alerting System

– Sensor Network:
  * Infrared Sensor: Usually positioned at crossroads, these sensors are positioned strategically throughout the road network. The system can track traffic flow and density because to its capacity to identify infrared radiation generated by moving objects like cars and people.(see figure 2).
  * Buzzer: it alerts the driver by producing a sound so that the driver gets to know about the vehicle approaching from the other side. (see figure 3).

Figure 2. Infrared Sensor

Figure 3. Buzzer (12v)

* Data Acquisition and Processing Unit: ArduinoR3: The Arduino R3, which functions as the system's brain, gathers data from the sensor network, processes it instantly, and uses control algorithms to alert the drivers. (see figure 4).
* Sensor Interfaces: These parts make it easier for the Arduino R3 and sensor network to communicate. They supply the inputs that the Arduino need organize receive data from the IR sensors.
* Power Supply: The 12V powers the complete system, allowing it to function continuously even when there are no external power sources available.
* Status indications LEDs Red & Green: In this case, the green lead indicates that there are no vehicles approaching from the opposite direction and that traffic can pass without difficulty, while the red led indicates a potential risk.(see figure 5).

Figure 4. Arduino R3

Figure 5. Light Emitting Diodes

5 Flow Chart

This flowchart shows how to use an infrared sensor to monitor the presence of a vehicle and what should happen when the sensor detects a vehicle.(see figure 6). This is a thorough explanation:

1. Start: The process begins Does an Infrared Sensor Find a Vehicle? If a car is detected by the infrared sensor, it is determined at the first decision point.

2. No: If no vehicle is detected, the flow proceeds to "Keep LED Green" and "No Immediate Action Needed". The system continues monitoring without any immediate response.

3. Yes: If a vehicle is detected, the flow proceeds to "Activate Red LED and Buzzer.

4. Activate Red LED and Buzzer: When a vehicle is detected, a red LED is activated

along with a buzzer to signal the detection.

5. Activate Red LED and Buzzer: When a vehicle is detected, a red LED is activated along with a buzzer to signal the detection.

6. Alert Driver: The driver must be informed as the following action, probably This flowchart demonstrates how to use an infrared sensor to monitor a vehicle's presence and the appropriate actions to be performed in response to the sensor's detection through the activated red, green LED and buzzer.

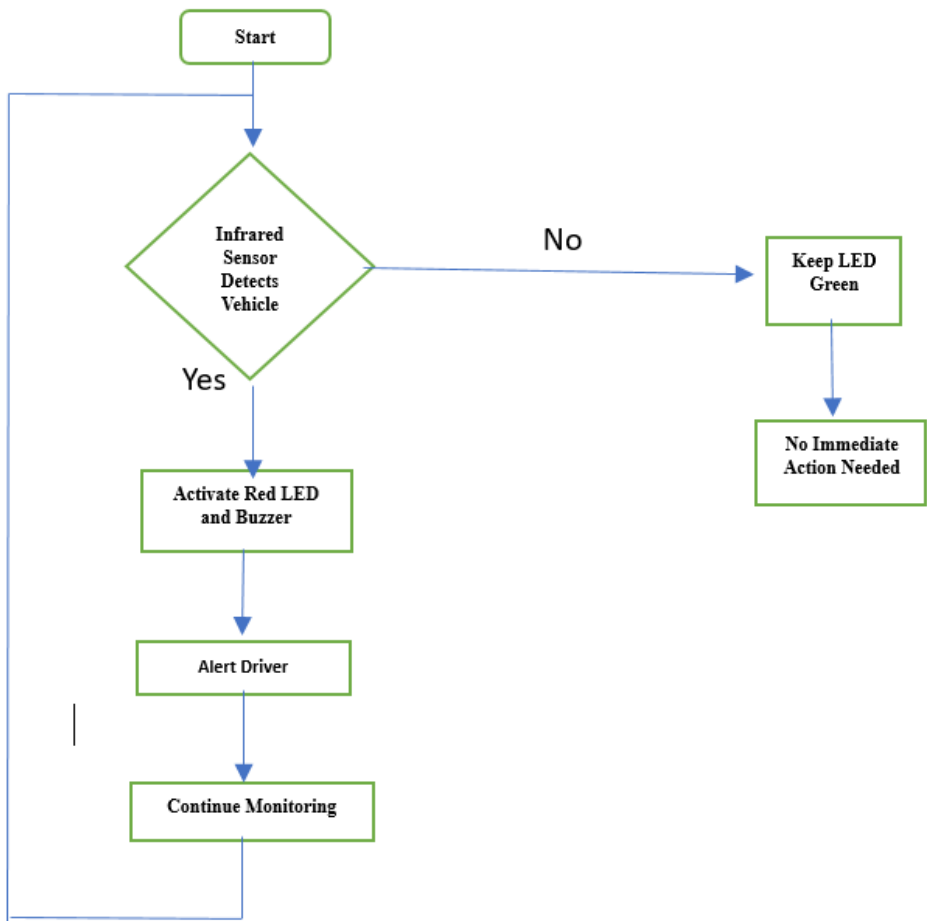7. Continue Monitoring: After alerting the driver, the system continues monitoring for the present of a vehicle.

Figure 6. Flow Chart

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6 Results

The installation of a system that lowers the number of accidents in the ghat area using LED lights, infrared sensors, and an Arduino microcontroller board is a significant step toward enhancing road safety.(see figure 7).On roads with curves, the deployment of technology to alert drivers to oncoming vehicles can significantly reduce the risk of collisions and save lives. The main purpose of this system is to detect approaching cars from the other side of the curved path by using infrared sensors.

These sensors are essential for real-time vehicle detection, which allows for the prompt delivery of alerts to drivers. These sensors can be interfaced with the Arduino board so that the system can process the sensor data and turn on the LED lights to indicate the presence of an oncoming vehicle. This system's active approach to warning drivers about possible crashes is one of its main advantages. LED lights that illuminate provide drivers with visual clues so they can react to approaching traffic and modify their driving style accordingly.
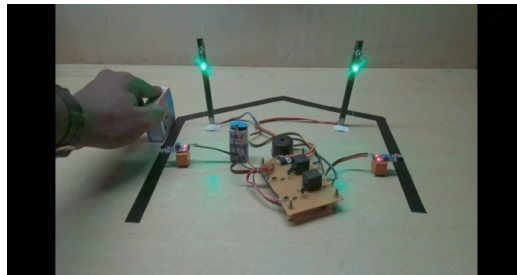

Figure 7. Working Of Hair Pin Bend Alerting System

This improves road safety in the ghat segment generally as well as the safety of individual drivers. Furthermore, it is impossible to accurately estimate the system's potential contribution to accident prevention. Accidents on curving roads, particularly in ghat sections, are frequently blamed on things like poor warning systems and poor visibility. The method shows significant promise in reducing the risks involved with driving in such difficult terrains by utilizing technology to handle these issues. Using an Arduino microcontroller board, infrared sensors, and LED lights to lower the number of accidents in the ghat area is a significant step toward increasing road safety. Preventing collisions and saving lives can be greatly enhanced by utilizing technology to alert drivers to oncoming vehicles on curved roadways. The efficient use of infrared sensors to identify approaching cars from the other side of the curved path is the main purpose of this technology.

7   Conclusions

The project's goal is to lower the number of accidents in the ghat portion. LED lights are used to alert drivers when a car approaches from the other side of the curved road in order to do this. The Arduino microcontroller board is interfaced with infrared sensors to aid with vehicle detection. By implementing this, we can prevent thousands of deaths on the curved roads in the Ghat section. This is a cheap and easy project to put into action in many different places, like when houses, buildings, or trees block the view of the road.

By working together, we 'identify the cars and save lives. Additionally, it can save lives in an emergency by sending notifications for rescue efforts to the police, fire department, and hospitals. In this study, we got to know about the accident which occurs the road at Ghat section. We understand the causes and effect of accidents and then founded out a solution introducing a new technique to avoid such accident. The new method uses two infrared sensors and two LED screens to show approaching cars from an angle. It can prevent serious injuries or fatalities among road users at Ghats. By utilizing technology, we can prevent thousands of fatalities and numerous injuries on these hazardous roadways. This makes the travel safer and helps to reduce the number of accidents. Life is more valuable than anything else since it cannot be replaced once lost. Thus, this approach plays an important role in saving this priceless life.

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