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A Working Model on Prevention of Accidents at Hairpin Bend Using IoT

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A B S T R A C T

This abstract presents a proposed solution to address the issue of accidents that occur in hairpin bends, which are often built on steep slopes to allow for a more gradual ascent or descent. Hairpin bends are often arrayed in a zigzag pattern and built to avoid the steepness of the slope, but due to a lack of communication and limited visibility around these bends, vehicles traveling around them are extremely vulnerable to accidents. To tackle this problem, an IOT-based accident prevention system for hairpin bend roads is proposed. This system uses sensors to detect vehicles approaching the bend and alerts drivers on the other side with a red signal and an alert sound. When the road is clear, a green signal is produced, indicating safe passage. The system is designed using various components, including IR module, transistor, buzzer, LED, motor, and batteries. The IR module is used to detect vehicles approaching the bend, while the transistor is used as a switch to control the LEDs and buzzer. The LEDs are used to indicate the status of the road, with red indicating danger and green indicating safety. The buzzer produces an alert sound to grab the attention of the driver.. Overall, this proposed system can improve safety and prevent accidents on hillside roads with hairpin bends. By alerting drivers of oncoming traffic, providing visual and audible signals, and slowing down vehicles when approaching the bend, this system can significantly reduce the risk of accidents and promote safer driving practices.

Keywords: IOT, Hairpin bend, Steepness, vehicles, Limited visibility, Buzzer

1. INTRODUCTION

Fifteen years ago, the International Telecommunications Union (ITU) published its first report on the Internet of Things (IOT). The IOT paradigm was first defined as a new dimension added to the world of Information and Communication Technologies (ICTs) that allows making connections for anyone and anything, anytime and anywhere to create a new dynamic network of networks. Today, IOT is no longer an emerging trend. It has become one of the most important technologies of the current century with applicability in many industries such as transportation, energy, civil infrastructure, smart buildings, environment monitoring, healthcare, defense, manufacturing, and production. IOT continues to grow. Experts predict that, by 2025, about 22 billion IoT devices will be connected to the Internet and will communicate in this IOT environment The Internet of Things is a network of data-transfer devices in and of itself. It also has a lot of ties to Big Data and Cloud Computing. Sensing, Embedded Processing, and Connectivity: The IOT ecosystem senses its environment, such as temperature, gyroscope, and pressure, and uses devices to do embedded processing

- In our country maximum deaths occur due to road accidents, more than number of people killed in terrorist activities.
- Every year, there is more than 1.5% increase in road accidents and more than 6 lakh road accidents in India occurred, for every one minute one road accident and for every 4 minutes one death is due to road accident.

Fig 01: IOT

1.1. Hairpin Bend

Hairpin bends are often built when a route climbs up or down a steep slope, so that it can travel mostly across the slope with only moderate steepness, and are often arranged in a zigzag pattern.A hairpin turn is a bend in a road with a very acute inner angle, making it necessary for an oncoming vehicle to turn about 180° to continue on the road. It is named for its resemblance to a bent metal hairpin. Due to a lack of communication and zero visibility over hairpin curves, vehicles travelling around these hairpin bend are extremely vulnerable to accident.According to survey, 10% of the total vehicle accidents happen on curved segments in hill stations. It is risky while driving in bends and curves In order to provide solution, an IOT based Accident Prevention System for Hairpin Bend Roads has been proposed in this work.

Fig 02 : Hairpin Bend

Vehicles play a significant part in our daily lives, such as commuting from one location to another, transporting goods, food, and so on, by reducing travel time for humans. According to past knowledge and reports many accidents occur on mountainous roads owing to the lack of vision of other vehicles approaching from the opposite direction, landslides, and adverse weather conditions. However, no safeguards or actions to avoid them have been implemented. Human life is lost as a result of this. Vehicles moving through hairpin bends have a higher chance of accidents. Because there is a lack of visibility between vehicles in the hairpins, therefore, drivers must be extremely cautious in these deep curves while driving. And also, there is traffic congestion due to unorganized movements. Vehicles are important in the day-to-day lives of every human being. Also, there is a high rate of accidents that occur due to high speeds and rash driving. The situation in hilly areas is more dangerous. Because of hairpin bends, the vehicles have zero visibility. So the proposed system will help to avoid accidents at hairpin bends and save lives

Table 1 - Accidents in karnataka from the year 2014 - 2018

year	Accidents Reported	Number of People Killed
2014	43,713	10,452
2015	44,011	10,856
2016	44,403	11,133
2017	42,542	10,609
2018	41,707	10,990

2. Methodology

Define the problem: Clearly define the problem you want to solve, which is the prevention of accidents at hairpin bends. Gather information on the statistics of accidents at hairpin bends, their causes, and the factors that contribute to accidents.

Determine the solution: Explore different solutions to prevent accidents at hairpin bends, and select the most appropriate one. In this case, an IoT-based solution could be used to detect and alert drivers of potential danger when approaching hairpin bends.

Design the system: Create a design for the IoT system, including the sensors that will be used to detect approaching vehicles and the algorithms that will analyze the sensor data. Identify the hardware and software components required to build the system.

Develop the prototype: Develop a prototype of the system to test its functionality. This may involve programming microcontrollers, building circuits, and testing the system in a controlled environment.

Test the prototype: Once the prototype is built, test it to ensure that it functions as intended. Use simulated data or real-world data to test the system's accuracy and reliability.

Refine the system: Analyze the results of the testing and refine the system to improve its accuracy, reliability, and overall performance.

Deployment: Once the system is refined, deploy it in real-world settings to test its effectiveness in preventing accidents at hairpin bends. Collect data on the system's performance and use it to further refine the system.

Continuous improvement: As more data is collected, analyze it to identify areas for improvement and implement changes to the system to further optimize its performance.

In summary, the methodology for developing a working model for the prevention of accidents at hairpin bends using IOT involves defining the problem, determining the solution, designing the system, developing a prototype, testing the prototype, refining the system, deploying it in real-world settings, and continuously improving it.

2.1. Experimental Work

A sensor is a device that detects and responds to a specific type of input from the physical environment. Sensors are used in various applications and industries such as in smartphones, automotive, security systems, medical equipment, and many others. They are designed to measurevarious physical quantities such as temperature, light, humidity, motion, pressure, and others, and then convert that measurement into an electrical signal that can be processed by a computer or 11 other device. Automatic Signal Alert for Preventing Accidents in Hair Pin Bend Roads. Automatic signal for hairpin bend and hill side road turns. Hair pin bend sign with opposite or upcoming vehicle alertsiren Hairpin bend accidents occur mostly because of the driver unable to see the vehicle coming from the opposite sides of the road curves. Our system uses sensors to detect any vehicles reaching hair pin bend and alerts immediately on other side vehicles by red signal and also producing alert sound. It hair pin bend road is clear green signal is produced. Thus this system provides safety for drivers to prevent hill side accidents and ride safely in hill side roads An infrared sensor is an electronic device, that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation rather then emitting it that is called as a passive IR sensor is ually in the infrared spectrum, all the objects a late some form of thermal radiations. These types of radiations are invisible to our eyes, that can be detected by an in frared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light fallson the photodiode. The resistance sand these output voltages. change in proportion to the magnitude of the IR light received. Rainfall information for the study area from 2000 to 2022 was gathered and evaluated from the Indian Meteorological Department. It was noted that the research area's average yearly rainfall was 1574 mm. Below is the step-by-step process used to create a rainwater collection structure.

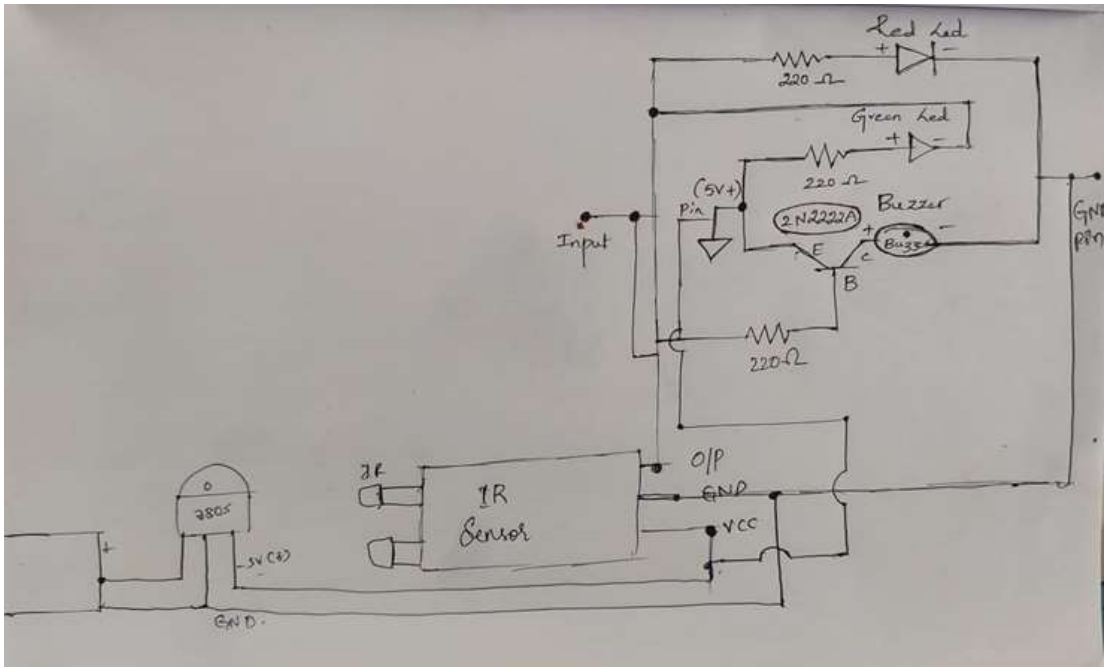

Fig 03 : working model

Table 1 - MATERIALS USED

S. No	Items	QUANTITY
1	IR SESNSOR	2
2	N2222 TRANSISTO	2
3	Buzzer	2
4	7805 regulator	2
5	220 ohm resistor	6
6	orange LED	2
7	green LED	2

8	zero pcb	2
9	meter belt wire	2
10	9 VOLT BATTERY	2
11	BATTERY CAP	2
12	wooden blocks	3
13	Trees	3
14	Cars	1
15	WOODEN CARDBOARD	1

RESULTS AND DISCUSSIONS

In this project, the transmitter section includes an IR sensor, which transmits continuous IR rays to be received by an IR receiver module. An IR output terminal of the receiver varies depending upon its receiving of IR rays. Since this variation cannot be analyzed as such, therefore this output can be fed to a comparator circuit. Here an operational amplifier (00- amp) of LM 339 is used as comparator circuit. When the IR receiver does not receive a signal, the potential at the inverting input goes higher than that non-inverting input of the comparator IC (LM339). Thus the output of the comparator goes low, but the LED does not glow. When the IR receiver module receives signal to the potential at the inverting input goes low.Thus the output of the comparator (LM339) goes high and the LED starts glowing. Resistor R (100), R2 (10k) and R3 (330) are used to ensure that minimum 10A current passes through the IR LED Devices like Photodiode and normal LEDs respectively. Resistor VR2 preset-5k) is used to adjust the output terminals. Resistor VR1 (presot-10k) is used to set the sensitivity of the circuit Diagram

Fig 04 : Final working model

Conclusion

In conclusion, the use of IoT technology in preventing accidents in hairpin bend roads is a promising approach. By integrating sensors and cameras, data can be collected and analyzed in real-time to detect and alert drivers of potential hazards. Additionally, with the use of machine learning algorithms, the system can learn and adapt to changing road conditions and driver behavior, making it more effective over time.

To ensure the success of such a system, it is important to consider factors such as reliability, cost-effectiveness, and ease of implementation. Furthermore, it is crucial to ensure that the system complies with data privacy regulations and does not infringe on the rights of road users.

Overall, the integration of IoT technology in preventing accidents in hairpin bend roads has the potential to significantly improve road safety and save lives. However, it is important to continue research and development in this field to optimize the system's effectiveness and address any challenges that may arise.

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