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Wildlife Protection on Railway track

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ABSTRACT

As human race or human society is growing, the wildlife animals or wild animals are in danger. Railway tracks contribute to the onslaught on wildlife in more ways than the most direct one, which is of course, having animals killed and maimed by trains. Every kind of animal including elephant, tiger, lion have been mowed down by trains on Indian tracks. The device involves an ARDUINO UNO as the primary microcontroller, integrating multiple sensors, such as an IR sensor which is used to detect the animal on the train track, Laser Distance sensor which is placed in the curve of the train track, Motor Driver which is used to control the speed and direction of motor, and Buzzer which gives an alarm to the controller when an animal is being detected on the train track. This project deals about one of the efficient methods to avoid train collision and obstacle detection. This project also includes the establishment of experimental crosswalks along fenced railway sections, where various warning signals will be tested. These crosswalks will be equipped with monitoring systems to evaluate animal behaviour in response to the signals. The effectiveness of these deterrent systems will be assessed through rigorous data collection and analysis.

Index terms: IR Sensor, Microcontroller, Buzzer,Motor driver,DC motors

INTRODUCTION

The coexistence of wildlife and human infra structure is a critical issue in environmental conservation. Railways, while facilitating transportation and economic development, often intersect with natural habitats, posing significant risks to wildlife. Animals crossing rail tracks face threats of injury or death from train collisions, while such incidents canal so cause substantial delays and damage to railway operations.

The Wildlife Protection on Rail Track Project aims to address these challenges by developing innovative solutions to minimize the impact of railways on wildlife and ecosystems. This initiative focuses on understanding the behaviors of animals near rail corridors, assessing high-risk areas, and implementing measures to mitigate conflicts. By integrating technology, ecological research, and infrastructure planning, the project seeks to the safety of wildlife while maintaining efficient railway operations.

Problem Statement

The increasing incidence of Wildlife-Train Collisions (WTCs) poses a significant threat to both animal populations and railway safety. This project seeks to address the critical need for improved wildlife protection along train tracks by identifying and implementing effective solutions that minimize (WTCs), enhance railway safety, and promote the coexistence of transportation infrastructure with wildlife. Despite existing measures, wildlife-vehicle collisions continue to pose a serious threat to both animal population sand railway safety. Current detection methods are often insufficient in terms of real- time responsiveness, accuracy, and adaptability to varying environmental conditions.

PROPOSED SYSTEM

In our proposed work, when the animal enter into the railway track. The IR sensor from train detect the presence of the animal and send an input signal to the controller. Immediately, the Arduino uno board will be on, and send the input signal to motor driver to slow down the train. IR sensor will detect the animal at the distance 150m only so the speed of train will be controllable and additionally the buzzer is fixed on driver side to alert him and take active step to protect the wildlife.

LITREATURE SURVEY

[1] The first study was, “Real monitoring detection of wild animals while crossing the train track” by Mr.M. Nakkeeran1, Dr.D. Sivaganesan2, R.Donsia Siromi3 et at The collaborative effort of wireless sensors will detect the presence of animals near the railway track around the forest/village area. The implementation of an automatic drum alarm system will threaten the animal and thereby preventing it from crossing the railway track. The detected information is also transmitted to the forest office via RF transmitter and receiver.

Though it is very difficult to prevent animal causal it on railways, this system will help them to safely return to their shelter without the risk of being hit by an oncoming train.

[2] The second study, “A real time train track tracking system: design and implementation for Indian railway” by Shreya Mathur, Sunil Pathak, Sunil Guptaetal. The prototype mode has been tested experimentally and the results are analyzed. The experiments are conducted in different areas on New Delhi, India for Indian Railways. The cost is very lesser as compared to previously used manual train tracking system. In future we will try to incorporate few major corrections such as if track is not inspected after due date, message will send to train driver to slow down the speed of train and to the competent authority of railway to make necessary arrangement to carried out inspection as soon as possible.

[3] The third study, “Optimize Railway Track Condition Monitoring and Derailment Prevention System Supported by Cloud Technology” by T.S.Geethaetal. (2021). This paper presents a cloud- based track condition monitoring system which updates information on track abnormalities to the cloud. It enables identification of the abnormality location by the vehicle on the same track, enabling the driver to decrease speed in the specified sections of the route. MEMS

[4] Accelerometers were incorporated in the axle box of the train and the abnormalities

were tested under four abnormal cases. The conclusion from the test result was that the CTMS provides the exact LOA and updates it into the cloud to be shared with other vehicles. This helps avoid network complexity.The fourth study, "Advancing Wildlife Protection: Mask R-CNN for Rail Track Identification'.

WORKING METHODOLOGY

BLOCK DIAGRAM

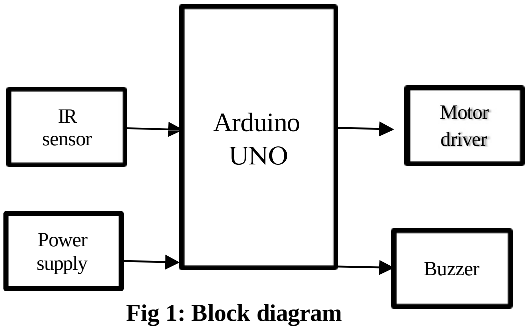

Fig 1: Block diagram

Methodology refers to the systematic, theoretical analysis of research methods within a field, encompassing research design, data collection, sampling, data analysis, ethical considerations, and validity and reliability. It provides a framework for collecting, analyzing, and interpreting data. This ensures the research is methodologically sound and credible. The Fig 4.1 represents a system architecture centered around an Arduino microcontroller interfacing with various components. The Arduino microcontroller serves as the central unit, managing all the connected components. On the left side, the L298 motor driver is connected to the Arduino to control a DC motor, allowing for adjustments in motor speed and direction. The **IR sensor** helps to detect the presence of wildlife on the railway track and it detect the radiations from the warm body animals up to 100m, while the **Laser Distance sensor** is integrated with the IR sensor that detects the curvature of train track which is going to help in adjusting the direction of IR sensor, the **Buzzer** gets operated when animal is detected on train track system and triggers the alarm to driver allowing train operate or to slow down the train, the **Motor Driver** is used to control the speed and direction of the motor.

1. Identification & Risk Assessment Conduct **geospatial mapping** of railway tracks passing through wildlife corridors. Use **historical data & AI models** to identify high-risk zones where wildlife crossings are frequent.

Work with **wildlife conservationists** to understand species behavior and movement patterns.

HARDWARE DETAILS

2.1 MICROCONTROLLER

The Arduino Uno (Fig 1.1) isa highly popular microcontroller boardbuilt around the

ATmega328P microcontroller, known for its versatility and ease of use. It operates at a voltage of 5V, making it compatible with a wide range of sensors and modules. Inboard features 14digital input/output pins, six of which can be used as PWM outputs, allowing for fine control of devices like motors and

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LEDs. Additionally, it includes six analog input pins for reading sensor data. The Arduino Uno offers a straight forward programming interface via the Arduino IDE, which supports a vast library of pre written code for various applications. It has 6 analog input pins, labeled A0 to A5, which can read signals from analog sensors. The board also includes a power supply section with pins for 5V, 3.3V, ground (GND), and VIN. The power pins enable the board to be powered either through a USB connection or an external power source. There are also pins for SPI communication (10, 11, 12, 13), I2C communication(A4, A5 for SDA and SCL), and UART serial communication(pins 0 and 1 for RX and TX). Furthermore, the Arduino Uno has a reset pin for restarting the program.

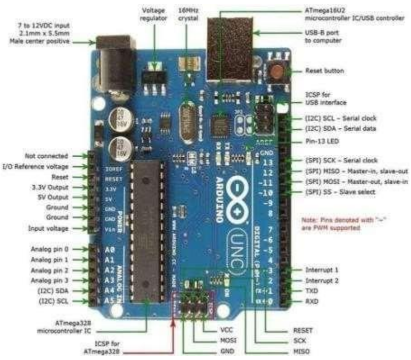

Fig2.1: Microcontroller Board

2.2 L298N Motor Driver.

The Fig 3.2 shows that L298 Motor Driver is an integrated circuit used for controlling the direction and speed of DC and stepper motors. It features a dual H-bridge configuration, allowing independent control of two motors with an operating voltage range of 5V. A current capacity of up to 2A per channel.

Key Features:

- **Dual H-Bridge:**

This design allows the driver to control two motors independently or drive a single motor in both forward and reverse directions.

- **High Voltage Capability:**

It can handle a wide range of motor voltages, typically up to 46V, making it compatible with different motor types.

- **High Current Output:**

The L298N can deliver significant current to motors, enabling it to drive powerful motors.

- **Logic Level Inputs:**

The driver accepts standard logic level signals from microcontrollers, simplifying integration into electronic projects.

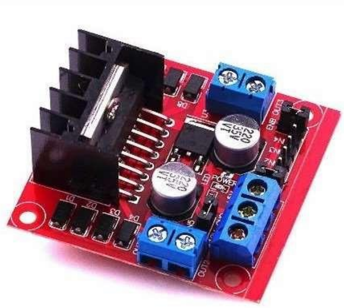

Fig 2.2 : L298N Motor Driver

2.3 DC Motor:

The DC motor converts direct current (DC) electrical energy in to mechanical energy, widely used for its simplicity and precise control. Fig 3.3 consists of a stator, which provides a constant magnetic field, and a rotor (armature)that rotates with in this field. The inter action between the magnetic field and the current in the rotor generates torque, causing rotation. Speed and direction can be controlled by varying the input voltage or current. This makes DC motors ideal for applications in robotics, vehicles, and industrial machinery. key features:

- **High Starting Torque:**

DC motors can produce a significant amount of torque when initially started, making them suitable for applications requiring high initial power like heavy machinery.

- **Speed Control:**

By adjusting the voltage applied to the motor, you can easily control its speed.

- **Commutator:**

This component reverses the current direction in the armature coils, allowing continuous rotation.

- **Back EMF:**

When a DC motor rotates, it generates a counter electromotive force (back EMF) which helps regulate the motor's speed.

Fig 2.3: DC motors

2.4 Buzzer:

A buzzer is a small yet powerful sound-emitting device that plays a crucial role in modern electronics. It is designed to convert electrical energy into sound, serving as an alerting or signaling mechanism in a wide array of applications. Buzzers are valued for their ability to produce audible tones that can convey warnings, notifications, or user feedback in a clear and attention-grabbing manner. A buzzer is an electro mechanical or electronic device that produces sound when activated. It is widely used in various applications for signaling, alerting, or as a feedback mechanism. Buzzers are known for the simplicity, reliability, and ability to produce a range of sounds, from simple beeps to complex tones.

Fig 2.4:Buzzer

2.5 IR Sensor :

An Infrared (IR) sensor is a device that detects and measures infrared radiation, which is a form of electromagnetic energy with wavelengths longer than visible light but shorter than microwaves. IR sensors are commonly used in various applications such as object detection, motion sensing, and proximity sensing. IR radiation is part of the electromagnetic spectrum, and is invisible to the human eye. IR sensors can detect heat and motion.IR sensors work by emitting infrared light, which is reflected back by objects and picked up by the sensor's receiver. The time it takes for the light to reflect back allows the sensor to determine the object's distance and presence.

Key Features:

- **Non-contact sensing:**

IR sensors can detect objects without physically touching them, making them suitable for applications where contact could damage the object or sensor.

- **Infrared radiation detection:**

They work by detecting the infrared radiation emitted by objects, allowing them to sense heat sources.

- **Wide detection range:**

Depending on the design, IR sensors can detect objects over a wide range of distances.

- **High accuracy:**

IR sensors can provide precise detection of object presence and movement.

- **EMI immunity:**

They are generally not affected by electromagnetic interference, making them reliable in noisy environments.

- **Motion detection:**

By monitoring changes in the detected infrared radiation, IR sensors can detect movement.

- **Proximity sensing:**

Can be used to detect how close an object is to the sensor.

- **Temperature sensing:**

Some specialized IR sensors can measure the temperature of an object based on the intensity of the infrared radiation it emits.

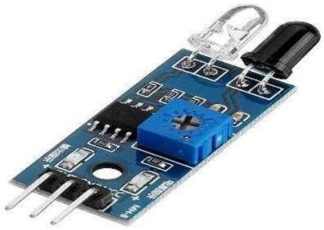

Fig 2.5:IR Sensor HARDWARE RESULT

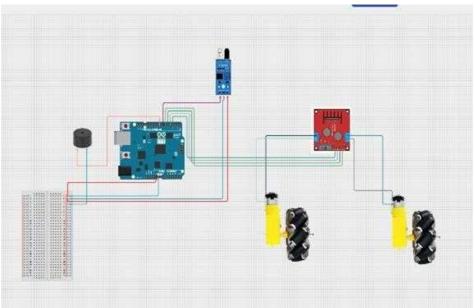

Fig3: Hardware Implementation

RESULT

The implementation of wildlife protection systems on railway tracks has shown promising results in reducing animal fatalities and ensuring safer railway operations. Measures such as wildlife crossings, fencing, and technology- driven detection systems have significantly minimized collisions between trains and animals. For example, under passes and over passes have allowed safe passage for wildlife, maintaining ecological connectivity while reducing mortality rates by up to 90% in some regions.

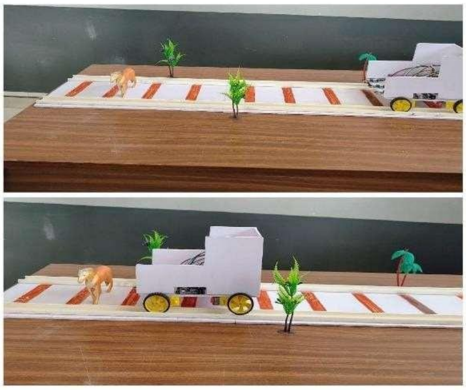

Fig 4: Wildlife protection on railway track CONCLUSION

In conclusion, protecting wildlife on railway tracks is a crucial step toward balancing infra structure development with biodiversity conservation. Implementing measures such as wildlife crossings, fencing, and technology- driven systems has proven effective in reducing animal fatalities and improving railway safety. These interventions not only preserve ecological integrity by maintaining habitat connectivity but also enhance their liability and efficiency of railway operations by preventing collisions and disruptions. While challenges such as high costs, maintenance requirements, and terrain limitations persist, advancements in cost- effective technologies and collaborative planning offer promising solutions. By integrating wildlife protection strategies into railway project planning and involving stakeholders such as conservationists, governments, and local communities, it is possible to create sustainable railway networks that coexist harmoniously with the natural environment.

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