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Development of Arduino Based Fully Automatic Traffic Management Using Tyre Killer System

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ABSTRACT: Driving on the wrong side and does not follow traffic rule is a pervasive issue in India as well as world wide, posing significant risks to road safety and traffic management. Current penalties for wrong-side driving, though stringent, may not suffice to deter offenders effectively. This paper proposes the development of an advanced traffic management system aimed at raising awareness and promoting adherence to traffic rules, particularly regarding does not follow traffic rule while driving. The system, incorporating Arduino technology, servo motors, and tyre killers, presents a novel approach to address this pressing issue. By strategically deploying tyre killers controlled by servo motors, the system prevents vehicles from entering designated lanes unlawfully, thereby enhancing road safety and compliance with traffic regulations. This project represents a crucial step forward in the realm of traffic management, offering a potential solution to combat wrong-side practices. driving and promote safer road Keywords: Arduino, tyre killer, servo motor, traffic management, road safety, wrong-side driving.

I. INTRODUCTION

The advancement of technology has revolutionized various aspects of modern society, including transportation and traffic management systems. In response to the persistent challenges posed by traffic violations and road safety concerns, innovative solutions are continually being developed to enhance traffic management efficiency and ensure safer road conditions. One such pioneering initiative is the development of an Arduino-based fully automatic traffic management system utilizing a tyre killer system.

The proliferation of wrong-side driving, a prevalent traffic offense in many regions, necessitates robust measures to enforce traffic regulations and promote adherence to road safety protocols. Traditional enforcement methods, such as fines and penalties, have proven insufficient in curbing this behavior effectively. Therefore, there is a pressing need for more proactive and technologically advanced solutions to address this issue.

The proposed traffic management system represents a significant leap forward in the field of traffic control and enforcement. By leveraging Arduino technology, servo motors, and a tire killer mechanism, the system operates autonomously to detect and deter vehicles attempting to enter restricted areas or travel in the wrong direction. This proactive approach not only improves road safety but also minimizes the risk of accidents and congestion caused by unauthorized or reckless driving behavior.

In this paper, we present the design, development, and implementation of the Arduino-based fully automatic traffic management system. We discuss the underlying principles and components of the system, highlighting its functionality and potential impact on traffic management practices. Furthermore, we explore the integration of advanced features, such as real-time monitoring and remote control capabilities, to enhance the system's effectiveness and scalability.

Overall, the development of this innovative traffic management system signifies a significant milestone in the ongoing efforts to create safer and more efficient road networks. Through the utilization of cutting-edge technology and proactive enforcement strategies, we aim to revolutionize traffic management practices and foster a culture of compliance with traffic regulations. This paper serves as a comprehensive exploration of the Arduino-based fully

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automatic traffic management system, shedding light on its design, implementation challenges, and future prospects for enhancing road safety and traffic efficiency.

II. LITERATURE REVIEW

1. Kususma Prabhu's work on the implementation of a smart tire killer mechanism provides a foundational understanding of this technology. The system employs an Automatic Vehicle Identification (AVI) system utilizing image processing techniques in MATLAB for vehicle detection. While effective, this approach can be cost-prohibitive due to the requirement for high-resolution cameras and complex image processing algorithms.

2. Another related study by Harshal Gunda et al. proposes a Smart Traffic Management System using Arduino and RFID tags. This system prioritizes emergency vehicles and aims to reduce traffic congestion. However, it may encounter challenges such as environmental conditions, machine failures, and network issues, leading to potential inaccuracies in vehicle detection and management.

3. In contrast, our proposed Arduino-based system offers a simpler and more robust solution to traffic management. By leveraging Arduino's versatility and reliability, our system minimizes the impact of environmental factors and network dependencies, ensuring consistent performance in real-world scenarios.

4. R Prabhu and Dr. M. Ramasamy's research on IoT-based speed bumps and road blockers highlights the complexity of IoT-based solutions and their reliance on network connectivity. Our Arduino-based system overcomes these limitations by providing a standalone solution that does not rely on external networks for operation.

5. Additionally, studies such as "Vehicle Safety System using IoT" and "Smart Traffic Control System for Emergency Vehicle Clearance" underscore the importance of vehicle safety and emergency response in traffic management. Our Arduino-based system incorporates similar safety features while offering a cost-effective and efficient solution for traffic management challenges.

Overall, our research contributes to the development of a practical and accessible traffic management system that prioritizes simplicity, reliability, and cost-effectiveness. By leveraging Arduino technology, we aim to address the pressing need for safer and more efficient traffic management solutions in urban environments.

III. WHAT ARE TYRE KILLERS AND WHY ARE THEY USED?

Tyre killers are devices designed to enforce one-way traffic flow by puncturing the tires of vehicles traveling in the wrong direction. They consist of metal strips embedded with spikes, resembling a speed breaker for vehicles traveling in the correct direction but posing a hazard to those driving against the flow of traffic.

The need for tyre killers arises from the limitations of automated traffic gate systems, particularly in railway crossings. While automatic gates can effectively block traffic when a train approaches, there remains a risk of vehicles getting trapped between the closing gates, leading to potential accidents. To mitigate this risk, tyre killers are deployed as a safety measure to prevent vehicles from crossing the railway line when a train is detected.

When sensors detect an approaching train, warning signals such as flashing red lights and audible sirens alert motorists to stop. Shortly thereafter, the tyre killers are activated, deploying metal strips with spikes to puncture the tires of any vehicles attempting to cross the railway line illegally. By allowing traffic to flow in only one direction, the tyre killers help maintain safety and prevent accidents by ensuring that vehicles do not get stuck on the tracks.

In summary, tyre killers serve as a crucial component of traffic management systems, particularly at railway crossings, by effectively deterring wrong-way driving and enhancing overall safety on the roads.

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Fig 1 Tyre Killer

IV. WORKING MECHANISM

3.1 SYSTEM DESIGN

In automatic operation of tyre killer system placed on traffic signals which kills the wrong side tyres and also done the same for breaking the signal rules as well. In this system firstly we used servo motors to up-down the tyre killer mechanism which are followed by the traffic signal behaviour which means that the if the signal is Yellow then the tyre killer mechanism is ready to up coming direction, in the RED signal of traffic signal light, the tyre killer mechanism is fully coming tto kills the tyres. And lastly Green signal is ON then only the tyre killer mechanism goes down. That procedure is conclude that, this system is depending on the traffic management system.

3.2 IMPLEMENTATION

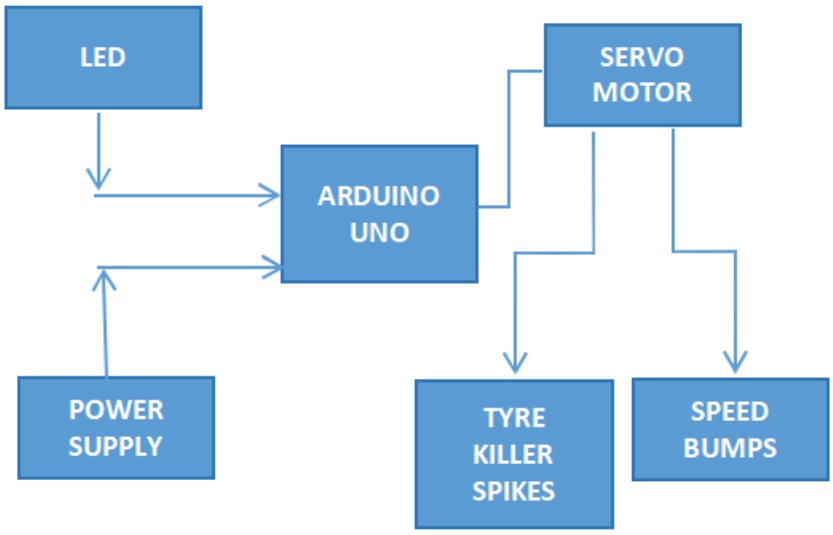

Fig 3.1.1 Block diagram of Automatic tyre killer system

The development of an Arduino-based fully automatic traffic management system using a tyre killer system relies heavily on the coordination with the existing traffic signal system. Here's a detailed explanation of how these two systems work together.

3.2.1 Arduino UNO

The Arduino Uno microcontroller module utilizes the ATmega328P microcontroller (datasheet), featuring 14 digital input/output pins, 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header, and a reset button. This comprehensive array of components provides all the necessary features for a wide range of projects. Whether connecting to a computer via USB or powered by an AC-to-DC converter or battery, the Arduino Uno is ready for use.

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Memory-wise, it relies on SRAM for volatile storage, while Flash and EEPROM are utilized for non-volatile storage. Programming the microcontroller is facilitated by the Arduino project's integrated development environment (IDE), which is based on the C and C++ programming languages.

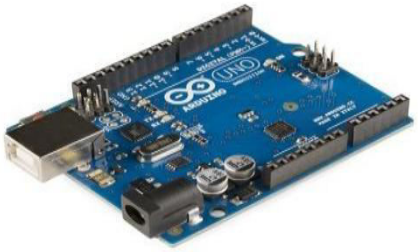

Fig 3.2.1 Arduino UNO

The Arduino Uno finds application in various fields, including:

Embedded platforms
Robotics
Object motion control
Parking lot counters
These versatile applications highlight the flexibility and utility of the Arduino Uno microcontroller in diverse projects and scenarios.

3.2.2. Servo Motor

A servo motor is a type of rotary actuator that allows for precise control of angular position. It consists of a motor coupled with a feedback sensor that provides information about the motor shaft's position. Servo motors are commonly used in various applications that require controlled motion, such as robotics, industrial automation, RC vehicles, and consumer electronics.

The operation of a servo motor is based on the principle of feedback control. When a desired position is sent to the servo motor controller, it compares this position with the actual position feedback from the sensor. The controller then adjusts the motor's speed and direction to minimize the error between the desired and actual positions, thereby ensuring accurate and stable motion control.

Servo motors are characterized by their high precision, high torque-to-size ratio, and ability to maintain position without power consumption. They are available in various sizes and torque ratings to suit different applications. Additionally, servo motors often feature a limited range of motion, typically up to 180 degrees, making them well-suited for tasks requiring controlled and repeatable motion within a specific range.

Overall, servo motors play a crucial role in modern automation systems, offering precise and reliable motion control in a wide range of applications.

Fig 3.2.2 Servo Motor

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3.2.3 Tyre killer spikes

Fig 3.2.3 Tyre killer spikes

Tyre killer spikes are metal strips equipped with sharp, pointed spikes that are designed to puncture the tires of vehicles. These spikes are typically mounted on a surface such as roads, parking lots, or entry points to restricted areas.

The primary purpose of tyre killer spikes is to prevent unauthorized vehicles from entering specific areas by causing damage to their tires if they attempt to drive over the spikes. This serves as a deterrent against illegal entry or intrusion and helps enhance security measures at sensitive locations such as military bases, government buildings, embassies, airports, and high-security facilities.

Tyre killer spikes are often used in conjunction with automated security systems or manned checkpoints to reinforce perimeter security and control access to restricted zones. They are designed to be sturdy and durable to withstand the weight and impact of vehicles while effectively puncturing their tires to immobilize them.

Overall, tyre killer spikes are an effective security measure to prevent unauthorized vehicular access and enhance perimeter protection in critical infrastructure facilities and sensitive areas.

3.2.4 Speed Bumbs

Fig 3.2.4 Speed Bumps

Speed bumps, also known as speed humps or speed breakers, are traffic calming devices placed on roads to reduce vehicle speeds in specific areas. They are typically constructed as raised sections of pavement across the width of the roadway, usually made of asphalt or rubber, with a height ranging from 3 to 4 inches and a length of several feet.

The primary purpose of speed bumps is to slow down vehicle traffic, particularly in areas where safety concerns arise due to high speeds. They are commonly installed in residential neighborhoods, school zones, parking lots, and other areas where pedestrian and vehicular traffic intersect. Speed bumps are effective in reducing vehicle speeds by requiring drivers to slow down to negotiate the raised surface, thereby enhancing safety for pedestrians, cyclists, and other road users.

3.3. Flowchart of system

Traffic Signal System Overview:
The traffic signal system comprises traffic lights and controllers strategically placed at intersections and crossings to regulate the flow of vehicles.
Each traffic light typically consists of red, yellow, and green lights, indicating stop, caution, and go, respectively.

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The traffic signal controller manages the timing and sequencing of the lights based on predefined signal patterns or dynamically adjusts them in response to traffic conditions.
Integration with Arduino-Based System:

The Arduino-based traffic management system is designed to complement the existing traffic signal system by enhancing safety and enforcing traffic rules, particularly at critical points such as railway crossings.
When a train is detected approaching a railway crossing, the Arduino system communicates with the traffic signal controller to initiate specific actions to ensure safe crossing.
The Arduino system may receive input from sensors or cameras positioned along the railway tracks to detect the presence of an approaching train.
Traffic Signal Control During Normal Operation:

Under normal conditions, the traffic signal system operates independently, cycling through predefined signal patterns to regulate traffic flow at intersections.
The Arduino-based system remains inactive during this time, monitoring the status of the traffic signal lights but not interfering with their operation.

Activation During Train Approach:
When the Arduino system detects an approaching train, it triggers a sequence of actions to alert motorists and enforce one-way traffic flow using the tyre killer system.
The traffic signal controller receives signals from the Arduino system to change the traffic lights at the intersection near the railway crossing.
The traffic lights switch to red, indicating stop, while additional warning signals such as flashing lights and audible sirens may also activate to alert motorists to the impending train.

Enforcement of One-Way Traffic Flow:
As the traffic lights turn red, the tyre killer system is activated, deploying metal strips with spikes to puncture the tires of any vehicles attempting to cross the railway line in the wrong direction.
This effectively prevents vehicles from getting trapped between the closing gates or attempting to cross the railway line when a train is approaching.
Coordination and Synchronization:

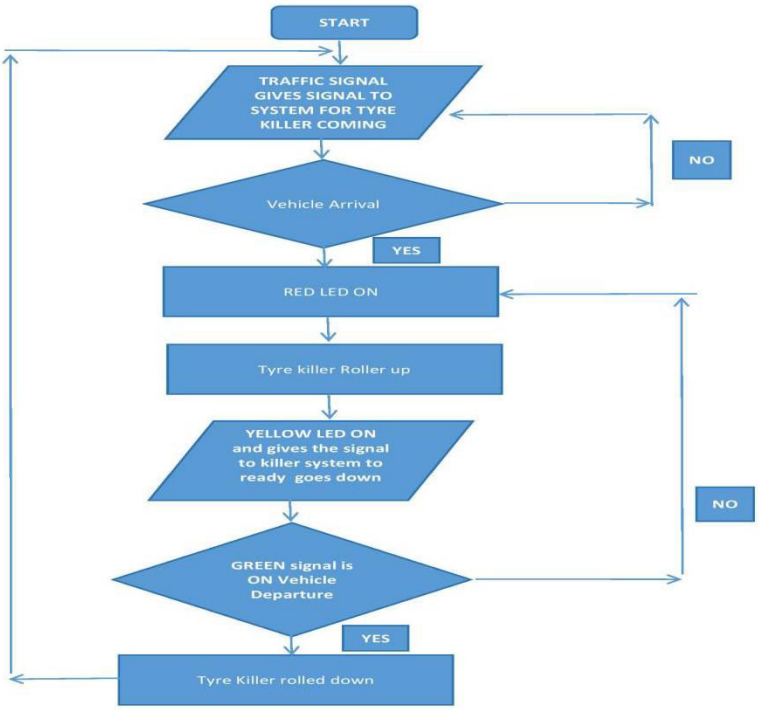

Fig 3.2.1 Flowchart of the system

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The Arduino-based system ensures seamless coordination and synchronization with the traffic signal system to minimize disruptions to traffic flow and enhance safety.
In summary, the development of the Arduino-based fully automatic traffic management system relies on effective coordination with the existing traffic signal system to ensure safe and efficient traffic flow, particularly at road crossings. By integrating with the traffic signal system, the Arduino system enhances safety measures and enforces traffic rules to prevent accidents and ensure smooth operations at critical intersections.

Explanation of the flowchart for the development of an Arduino-based fully automatic traffic management system using a tyre killer system:

Initialization:

This is the starting point of the flowchart where the system initializes its operations.
Traffic Signal System:

This section checks the status of the traffic signal to determine whether it is green or red.

If the traffic signal is green:
Traffic is allowed to proceed normally.
The system monitors for any vehicles attempting to cross the red light illegally during this time.

If the traffic signal is red:
Traffic flow is halted to prevent vehicles from crossing the line.
The tyre killer system is activated to enforce one-way traffic flow and prevent vehicles from crossing the railway line illegally.

Tyre Killer System:
This part of the flowchart handles the operation of the tyre killer system.
It checks whether a train is detected approaching the railway crossing:

If a vehicle is detected:.
The tyre killer system is triggered to deploy, puncturing the tires of any vehicles attempting to cross the red signal illegally.

This marks the end of the flowchart, signifying the completion of the system's operations.
In summary, the flowchart outlines the sequential steps involved in the operation of the Arduino-based fully automatic traffic management system using a tyre killer system. It demonstrates how the system integrates with the traffic signal system to ensure safe and efficient traffic management at railway crossings and traffic signal as well.

IV. RESULTS

Fig 4.1 Hardware model of Automatic tyre killer system

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The figure shows the setup that is implemented to perform the automatic operation of tyre killler system based on traffic management concept. In this system the tyre killer spikes open when the traffic signal gives the command fr that and same for the closed process.
In our project we have taken the distance of 50 cm in the model from the center of the traffic area. After the traffic signal is RED. The tyre killer spikes goes up direction. Then sometime is provided for vehicls that are between the tyre killer to go out.
The time for each step was specified and following results were obtained

Sr. No	Operation	Time Required
1.	LED Light to Flash and tyre killer ready	5 s
2.	Tyre killer to roll up	5 s
3.	Free passage of vehicles between the two tyre killer	5 s
	Total Time	**15 s**

Table 1:- Observation table for time of operation of Traffic Signal and our system

The ON and OFF times of traffic signals, also known as signal timings, are carefully planned duration for displaying specific signal indications like green, yellow, and red. Green signals allow traffic to proceed for a specified ON time before transitioning. Yellow signals, indicating a change to red, have a short ON time of 3 to 5 seconds. Red signals, signaling a stop, typically have an ON time of 30 to 90 seconds. These timings are determined by traffic engineers based on factors such as traffic volume and intersection geometry, with periodic adjustments made to enhance traffic flow and safety.

In the above statement, the system is work on the traffic management rules and gives the according to the traffic signals. As we discuss above in the flowchart of the system.

V. CONCLUSION

In this proposed system, we have endeavored to introduce a straightforward yet efficient solution for traffic management using tyre killer systems. By harnessing new technologies, this system offers increased sustainability and longevity. Implementation of this system presents an opportunity for more effective modernization of traffic management infrastructure, particularly in high-security areas or Traffic signals. By automating the operation of tyre killer systems, we aim to minimize human interference and mitigate errors that may arise due to human factors. This automation ensures that tyre killer systems operate precisely and reliably, reducing unauthorized vehicle access. Additionally, the automated operation guarantees timely opening and closing of the tyre killer systems, even in the event of train schedule delays, thereby minimizing traffic congestion and enhancing overall traffic management efficiency at key points such as signal crossings.

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