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

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***ABSTRACT*- The Tyre Killer System is essential for traffic management as it enhances security, controls access, prevents breaches, deters illegal entry, and promotes efficient traffic flow, contributing to safer and more organized urban environments. This Arduino-based fully automatic traffic management system integrates a tyre killer mechanism to enhance safety and efficiency on roadways. Using Arduino microcontrollers, the system automatically controls vehicle access to restricted areas. Unauthorized vehicles are deterred by tyre spikes deployed by the tyre killer system, while authorized vehicles pass safely. The system's design principles, hardware components, and software algorithms are evaluated for real-world effectiveness. Key considerations include scalability, power efficiency, and integration with existing infrastructure. Ultimately, the project aims to contribute to the advancement of automated traffic management technologies for safer urban transportation systems. This project focuses on creating a fully automatic traffic management system using Arduino technology, incorporating a tyre killer system.**

The project aims to evaluate the system's effectiveness through real-world testing and considers scalability, power efficiency, and integration with existing infrastructure. Overall, it seeks to contribute to the advancement of automated traffic management technologies for safer urban transportation systems.

Keywords- Arduino uno, tyrr killer, servo motor.

I. INTRODUCTION

A tyre killer, also known as a tyre spike or a road spike, is a traffic management device typically used in parking lots, toll booths, or other restricted areas to control the flow of traffic. It consists of a row of metal spikes that are embedded in the road surface, facing upwards. When activated, the spikes puncture the tires of vehicles attempting to pass over them in the wrong direction or without authorization. In the face of escalating urbanization and the proliferation of vehicular traffic, ensuring efficient and secure traffic management has become an increasingly pressing concern. To address the challenges posed by unauthorized vehicular access to restricted areas, there is a growing demand for innovative solutions that integrate cutting-edge technology with traditional traffic management strategies.

This paper presents the development of an Arduino-based fully automatic traffic management system, augmented with a tire killer mechanism. By harnessing the power and versatility of Arduino microcontrollers, this system offers a cost-effective and customizable platform for deploying intelligent traffic control solutions. The tyre killer system, a pivotal component of this traffic management framework, serves as a formidable deterrent against unauthorized vehicle intrusion into restricted zones. Through the strategic deployment of tire spikes, this mechanism effectively immobilizes unauthorized vehicles while facilitating unimpeded passage for authorized ones, thus bolstering security measures and safeguarding controlled environments.

By conducting a comprehensive exploration of existing literature, this paper scrutinizes the design principles, hardware configurations, and software algorithms that underpin Arduino-based traffic management systems equipped with tire killer functionality. Additionally, it evaluates the real-world efficacy of these systems by analyzing key performance metrics such as response time, accuracy, and reliability.

Furthermore, this paper delves into critical considerations such as system scalability, power efficiency, and seamless integration with existing infrastructure. By addressing these factors, it aims to furnish valuable insights into the practical implementation and deployment of Arduino-based traffic management solutions. Ultimately, by synthesizing current research and elucidating future prospects, this paper endeavors to contribute to the advancement of automated traffic management technologies. Through the seamless fusion of Arduino microcontrollers and tire killer mechanisms, this innovative approach seeks to usher in a new era of safer, more efficient, and meticulously orchestrated traffic management systems in urban environments.

II. RELATED WORK

Mrs. Kususma Prabhu provides basic functionality of tyre killer mechanism in the paper “implementation of smart tyre killer” [1] which includes the smart and Automatic Vehicle Identification (AVI) system utilizes image processing techniques in MATLAB to detect security threats by identifying vehicles from a stored database. Real-image testing confirms its effectiveness. Using

high-resolution cameras enhances system robustness and speed. Incorporating vehicle color, model, and driver face recognition improves accuracy.

The emergency vehicle is stuck in the traffic jams like Ambulance, presidents VIP convoy and other emergency is also important for the good traffic management, according to the Harshal Gunda, Rishikesh Waghunde, Suraj Malwatkar, Aditya Desai, Pallavi Baviskar, work "SMART TRAFFIC MANAGEMENT SYSTEM USING ARDUINO AND RFID TAGS" [2]. This paper used Algorithm aims to reduce traffic congestion, prioritize emergency vehicles. Uses Uno for roadside RF readers, Mega for LED signals and servo motors. System detects and scans emergency vehicles from left lane. 'Setup()' initializes, 'loop()' executes repeatedly in Arduino IDE.

In the research paper "IOT based Fully Automated Speed Bumps and Road Blockers for Smart Cities" [3], R Prabhu, Dr. M. Ramasamy Utilizing IoT and RFID technology, we sync road complexities to reduce congestion and prioritize emergency vehicles. RF sensors aid vehicle identification and risk reduction. Cloud-connected RFID enables guidance for less congested routes.

"Vehicle safety system using IoT" [4]. This system operates in two stages: ignition and monitoring. Additionally, it features a user- friendly Heads Up Display (HUD) created with HTML on a tablet, enhancing user experience with intuitive instructions and real- time monitoring updates. The ignition mode primarily aims to conduct a comprehensive biometric check of the driver, ensuring security before car operation. It includes face recognition, fingerprint verification, and breath analysis to detect alcohol influence, ensuring safe driving practices.

In [5], the authors suggest employing deep learning for real-time navigation maps, dynamically adjusting to road diversions and weather conditions via vehicular ad hoc networks (VANETs). In [6], the authors advocate an intelligent solution emphasizing road safety and mobility, leveraging "vehicle-to-infrastructure" communication to identify road obstacles and issues.

In paper [6] author Kavya P Walad, Jyothi Shetty, provides the traffic light control through the "Traffic Light Control System Using Image Processing ". The paper discusses drawbacks of existing traffic control systems and proposes a flexible traffic light control system based on traffic density. It suggests using edge detection techniques, particularly discussing gradient-based and Laplacian-based operators in MATLAB. While Gaussian-based edge detection is sensitive to noise, Canny edge detection performs well but is computationally costly and susceptible to weak edges. Future improvements could involve exploring fuzzy logic and morphological-based edge detection techniques to enhance traffic light control systems, saving time and reducing operating costs.

Author D.Aswani, and C. Padma, (Ph.D) [7] of paper "Smart Traffic Control System for Emergency Vehicle Clearance" provides the knowledge about An automatic traffic signal control system based on traffic density saves manual effort and requires minimal human intervention. Stolen vehicle detection alerts authorities and sends SMS notifications for quick recovery. Emergency vehicle clearance prioritizes ambulance and fire truck passage, reducing response time and saving lives. Future enhancements may include testing with longer-range RFID readers and integrating GPS for precise stolen vehicle location tracking.

III. BLOCK DIAGRAM

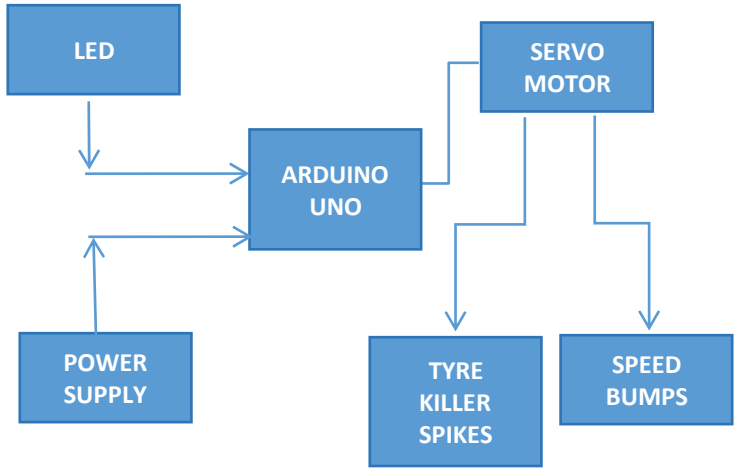

Fig 3.1 Block diagram of automatic tyke killer system

IV. HARDWARE DESCRIPTION

4.1 ARDUINO UNO

Fig 4.1.1 Arduino Uno

The Arduino Uno is a popular microcontroller board used for prototyping and DIY electronics projects. It features an ATmega328P microcontroller, digital and analog input/output pins, USB connectivity for programming and power, and a simple programming interface.

4.2 SERVO MOTOR

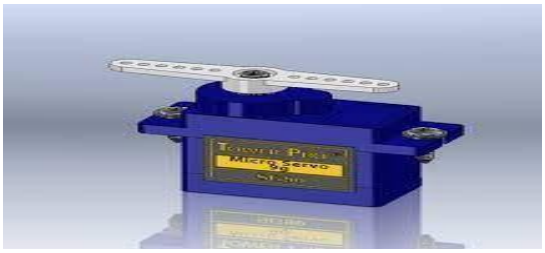

Fig 4.2.1 Servo motor

A servo motor is a type of motor that is designed to provide precise control of angular or linear position, velocity, and acceleration. It operates based on feedback control, meaning it adjusts its position based on signals it receives, typically from a control system. Servo motors are commonly used in applications requiring precise motion control, such as robotics, automation, and remote control systems. They are characterized by their ability to rotate to a specific angle and maintain that position, making them ideal for tasks requiring accurate positioning.

4.3 TYRE KILLER SPIKES

Fig 4.3.1 Tyre killer spikes

Tyre killer spikes are essential for traffic management and security for several reasons:

Unauthorized Vehicle Prevention: Tyre killers act as a deterrent against unauthorized vehicles attempting to enter restricted areas, such as military bases, government buildings, or private properties. The spikes puncture the tires of vehicles attempting to bypass security measures, effectively preventing unauthorized access.

Traffic Flow Control: Tyre killers help regulate traffic flow by ensuring vehicles enter and exit designated areas through authorized routes only. This helps maintain order and safety within the vicinity, especially in high-security zones or areas prone to unauthorized entry.

Cost-Effective Security Solution: Tyre killers offer a cost-effective security solution compared to other alternatives such as barriers, gates, or security personnel. Once installed, they require minimal maintenance and operate automatically, reducing the need for continuous human supervision.

Overall, tyre killer spikes play a crucial role in enhancing security, controlling traffic flow, and preventing unauthorized access to restricted areas, making them an important component of modern security and traffic management systems.

4.4. SPEED BUMPS:

Speed bumps are important for traffic management and road safety for several reasons:

Fig 4.4.1 Speed Bump

Speed Reduction: The primary purpose of speed bumps is to slow down vehicles, particularly in areas where speeding poses a risk to pedestrians, cyclists, or other road users. By forcing drivers to reduce their speed, speed bumps help enhance safety and prevent accidents.

Traffic Calming: Speed bumps are effective traffic calming measures, especially in residential areas, school zones, or areas with high pedestrian activity. They discourage speeding and promote a safer environment for residents and pedestrians.

Accident Prevention: Speed bumps can help prevent accidents, particularly those caused by excessive speed. By introducing a

physical obstacle on the road, they encourage drivers to drive more cautiously and attentively, reducing the likelihood of collisions.

Encouraging Compliance: Speed bumps serve as visual and tactile reminders for drivers to adhere to speed limits and traffic regulations. They encourage compliance with speed restrictions and promote responsible driving behavior.

Protecting Vulnerable Road Users: Speed bumps are particularly beneficial for protecting vulnerable road users such as children, elderly pedestrians, and cyclists, who may be at greater risk of injury from speeding vehicles.

Overall, speed bumps play a crucial role in promoting road safety, reducing speeding, preventing accidents, and creating safer environments for all road users.

4.5 POWER SUPPLY

Selecting the right power supply is crucial for the reliable and efficient operation of an Arduino-based fully automatic traffic management system, including a tyre killer system. Consider the specific requirements and constraints of your project to choose the most suitable power supply solution.

V. WORKING PRINCIPLE

The development of an Arduino-based fully automatic traffic management system incorporating a tyre killer system involves several steps and components.

Arduino Uno: The Arduino Uno is a popular microcontroller board used for prototyping and DIY electronics projects. It features an ATmega328P microcontroller, digital and analog input/output pins, USB connectivity for programming and power, and a simple programming interface.

Servo Motor: The servo motor is responsible for raising and lowering the tyre killer spikes. It receives commands from the Arduino Uno to activate or deactivate the spikes based on the detected traffic conditions.

Tyre Killer Spikes: The tyre killer spikes are physical barriers installed on the road surface. When activated, they rise from the ground to puncture the tires of unauthorized vehicles attempting to pass through restricted areas.

Speed Bumpers: Speed bumpers are installed on the road surface to slow down vehicles. They help regulate traffic speed and enhance safety, especially in areas where speeding is a concern.

Working Principle:

Traffic Density Analysis: Based on the data received from the sensors, the Arduino Uno calculates the traffic density in real-time. It determines whether the traffic volume warrants activating the tyre killer system or speed bumpers.

Automatic Control: If the traffic density exceeds a certain threshold, indicating a potential security risk or congestion, the Arduino Uno activates the servo motor to raise the tyre killer spikes. This prevents unauthorized vehicles from entering the restricted area.

Emergency Vehicle Clearance: The system includes special provisions for emergency vehicles such as ambulances or fire trucks. When an emergency vehicle approaches, sensors detect its presence, and the Arduino Uno triggers the servo motor to lower the tyre killer spikes or activate the speed bumpers, allowing the vehicle to pass through unimpeded.

Overall, the Arduino-based fully automatic traffic management system integrates various hardware components, including the Arduino Uno, servo motor, tyre killer spikes, and speed bumpers, to enhance security and regulate traffic flow effectively. The system's working principle involves real-time traffic detection, analysis, and automatic control to ensure efficient operation and safety on the road.

VI. CONCLUSION

The literature that reviewed so far show that, the almost all the works are built around Arduino Microcontroller. These systems are governed by some or the other short coming like circuit complications, high cost, difficult to implement and so many. These lacunas in the present work has motivate to work in this direction and lays a foundation for the Development of Arduino Based Fully Automatic Traffic Management Using Tyre Killer System, this system will ensure the rectification of the lacunas available in the present systems.

Moreover, the system would be simple, low cost and portable. This will help the individual one to handle the system with ease. Also, the data / Samples collected will be made available on the cloud. This information / Data will be helpful for the future purpose, one can apply the predictive model on this samples and can generate the future trends as far as then traffic of particular area is concerned.

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