Vehicle Speed Detection and Vehicle Count Using Arduino UNO

Archana Chaudhari, Prajakt Dongre, Vaishnavi Kulkarni

Department of Instrumentation and Control, Vishwakarma Institute of Technology, Pune, India

Abstract **–Traffic congestion and rule-breaking are two of the many problems that are contributing to the sharp rise in road accidents. Worldwide, a great deal of traffic accidents are caused by careless driving. In India, 4,73,000 road accidents were reported in total in 2021. Due to a lack of measures to regulate or keep an eye on the speed of vehicles operating on Indian highways, the number of vehicles on the road has significantly increased. For safety reasons, the number of vehicles on the road is counted and overspeed driving is detected with great effectiveness by the suggested technique. It is not at all required for these kinds of incidents to occur from driving while intoxicated because reckless driving is a skill that can be applied by anyone. It will take the use of a cutting-edge speed enforcement technology to solve this issue and lower the accident-related death toll. For safety reasons, this model keeps track of the number of vehicles on the route and detects the speed of those vehicles in locations such as tunnels and landslide-prone areas. The suggested approach will raise the bar for road safety regulations and prove to be incredibly helpful globally.**

Keywords: Vehicle speed detection, Arduino UNO, IR Sensors, vehicle count

I. INTRODUCTION

Worldwide, a great deal of traffic accidents are caused by careless driving. Figures issued by the government in 2021 show that over 140,000 people died on India's roadways in the previous year. Due to a lack of tools to regulate or keep an eye on the speed of cars operating on highways, the number of vehicles in traffic has significantly expanded worldwide. It is not at all required for these kinds of incidents to occur from driving while intoxicated because reckless driving is a skill that can be applied by anyone. New and creative speed enforcement technology must be introduced in order to solve this issue and lower the accident-related death rate.

First of all, there are too few patrol officers to watch and evaluate every driver's behaviour considering the vast distance of driveways. Secondly, the recommendations for reckless driving behaviours are merely descriptive in nature; driving at night or in inclement weather cannot be precisely described by visual observations. In the system that is being presented, a buzzer is used to enforce good road behaviour, and two infrared sensors mounted to the roadside dividers will detect and check the speed of the vehicles to detect reckless driving or overspeeding. This will assist in determining the vehicle's overspeed and can take appropriate action about the driver or rider if their vehicle exceeds the speed limit; a buzzer will sound instantly.

II. LITERATURE REVIEW

Authorities have established clear guidelines for operating vehicles on public roadways. The most prevalent law in any nation is the speed limit on specific highways, which states that you will be breaking the law if your vehicle goes faster than this limit. Therefore, we will use an Arduino UNO and RFID to design and construct a basic car speed detector and car counting circuit in this project. You may use this Arduino automobile Speed Detector project to find out how fast an automobile is travelling. It will also make it possible to tally the number of cars that travel along the route. It will also assist in identifying vehicles that are travelling at excessive speeds, in which case the system will receive an alert and display a warning message on an LCD screen. This project's primary goal is to install the system in a single location and evaluate the results quickly without requiring human assistance. Its goal is to lower the amount of traffic violations that result in accidents on the roads.

An Internet of Things-based solution for affordable vehicle speed detection is presented in this study. Its main goal is to identify reckless drivers in real time and provide early interventions to reduce the number of traffic accidents. Precise time differential and distance travelled analysis is essential for calculating speed. The technology sounds a buzzer to notify the driver when a vehicle exceeds the speed limit. This calculated move emphasises the dedication to developing a workable solution that tackles speeding violations and reduces the number of deadly collisions[1].

This study suggests using an automated method to regulate vehicle speeds in locations where there are speed limits. Drivers are currently breaking speed limits and resisting traffic police enforcement because it is hard to keep an eye on them all the time. This study

uses RFID technology in specific places to provide speed limitation within predetermined bounds. Vehicle RFID tags communicate with RFID readers positioned in these areas. A microprocessor in the car automatically modifies its speed as soon as the scanner picks up the coded signal from the tag[2].

The aim of this study is to develop a system that can identify speeding incidents on roads and help drivers obey speed restrictions. It makes use of GSM connection, RFID technology, and a PIC (18F45K22) microprocessor. The system uses a passive tag and two RFID readers on the car, along with GSM to transmit SMS notifications to the police and owner of the vehicle. A camera also takes pictures of cars that speed in order to collect penalties. Proteus v7.10 was used to simulate the system, which has real-time warnings, affordability, and dependability[3].

To make setup simpler, the project design integrates an RFID module with a microcontroller. The goal is to retrieve data from RFID tags in addition to measuring speed. Only speed is measured if it exceeds the limit; otherwise, pertinent data is shown. This usage of RFID technology provides a complete answer and makes use of its proven and adaptable capabilities for a range of applications.[4]

An RFID-based vehicle monitoring system is presented in this research. It consists of an Arduino camera module for image capture, a 13.56 MHz RFID module for vehicle registration, a SIM900A GSM module for SMS notifications to a database, a Tower Pro MG966R Servo Motor for barrier gate integration, and an HC-SR04 ultrasonic sensor for vehicle detection. Positive perception was revealed by user input through surveys, proving dependable, functional, and usable functioning.[5]

In order to monitor red light violations, this work presents the intelligent traffic violation detection and traffic flow analysis system (TVDTFA). To identify cars on the road, the system uses Radio Frequency Identification (RFID) technology. Red light jumping is detected and penalised by a violation detection algorithm that makes use of vehicle data and traffic light signals. Data from the traffic police forum is used to calculate the fine. Additionally, data analytic techniques are used to gather real-time vehicle count data for traffic flow study.[6]

In order to improve toll collecting transparency and address traffic concerns, this article presents an Automated Toll collecting System based on RFID technology. At toll roads, bridges, and tunnels, the planned system does away with wait times and the requirement for payment. It makes use of RFID technology to collect tolls seamlessly and without halting, with tags placed on digital licence plates of automobiles. By reducing human ticket distribution and toll collection, this method improves transparency and lowers mistake rates.[7]

This technique addresses the problem of excessive speeding independent of alcohol intake by successfully detecting it. The use of cutting-edge speed enforcement equipment is essential to lowering accident-related mortality. This method uses an Arduino and GSM-based highway overspeed vehicle detection circuit. In an effort to increase road safety, the system buzzes the driver when they exceed the speed limit and, if they ignore it, sends a message via GSM to the control room.[8]

The focus of this initiative is road safety in India, specifically accidents resulting from speeding and careless driving in close proximity to sensitive sites. In order to automatically limit vehicle speeds within accident-prone zones, it blends an RFID system with a microprocessor. The system has features including an alcohol sensor to prevent drunk driving, a GSM-based punishment system for breaking rules, and automatic braking at zebra crossings when signals are engaged. It fits with the current trend of enhancing road safety through automation and technology.[9]

In this study, an intelligent traffic congestion monitoring and measurement system using probe vehicles—TrafficMonitor—is introduced. It provides a quick and affordable way to analyse traffic congestion in real time. The technology integrates GSM and active RFID (IEEE 802.15.4, 2.4 GHz ISM band). By evaluating typical wait times at traffic signals and vehicle speeds, it determines traffic congestion. The findings, statistics, and field experiments are also presented in the article, which adds value for the government traffic control department.[10]

The purpose of this project is to develop a system for identifying speed limit infractions on the road and promoting driver adherence to them. It presents an effective solution that combines RFID, GSM, and a PIC (18F45K22) microcontroller. When speed limits are broken, the system sends an SMS to the vehicle's owner and the police via two RFID scanners, a passive tag on the car, and GSM. It also takes pictures of cars and applies penalties for speeding.[11]

The goal of this study is to create an integrated system that uses GSM and Active RFID for real-time traffic congestion management and detection. It fills the

vacuum in the literature by concentrating on strategies for either congestion detection or control. By combining the two, the suggested approach overcomes the present constraints on congestion control.[12]

The portable roadside magnetic sensor system for vehicle counting, categorization, and speed measurement is presented in this work. Using a magnetic field model method, the system uses wireless anisotropic magnetic devices deployed alongside the route to reduce errors caused by larger vehicles in neighbouring lanes from 8% to just 1%. Cross-correlation between longitudinally spaced sensors is the basis for speed measurement, which has low error (less than 2.5%) over a large speed range. Estimates of vertical height and magnetic length are used to classify vehicles. Additionally, the system has a 95% accuracy rate when counting right turns at intersections.[13]

In this paper, a vision-based system for precise road vehicle counting and classification—even in difficult conditions including shadows and occlusions—is presented. It makes use of current road cameras without the need for calibration, using a strong segmentation algorithm to identify motion and model background pixels. The system outperforms conventional inductive loop detectors in real-time vehicle counting and classification, surpassing them with over 98% accuracy in spite of severe occlusions and effective shadow management.[14]

This study examines intrusive and non-intrusive sensor-based vehicle detection techniques for traffic estimation. These technologies are essential for intelligent transportation systems since they give monitoring stations information on the number, kind, presence, and speed of vehicles, among other things. By merging data from several sources, sensor fusion improves accuracy. The study addresses current technology and mathematical models utilised in this context.[15]

Therefore, the goal of all of the earlier study is to lower the number of traffic accidents on high-speed highways and in areas with heavy traffic, such as schools. Many of these issues are remedied, and a significant portion of traffic congestion and auto accidents are avoided, thanks to RFID, GSM, and GPS technologies.

The suggested solution is a practical and affordable way to keep cars moving at the right pace on highways and prevent accidents. Discipline on the roads can be maintained by making drivers aware of their speed through the use of SMS alerts.

III. PROPOSED SYSTEM

The applied model has the potential to alleviate traffic congestion, reduce traffic accidents, and enhance traffic rule compliance to a higher degree in the actual world. The Arduino IDE, which is compatible with the Arduino UNO, is used to compile and test the method's code. The Arduino UNO Board, a 16*2 LCD display, IR sensors, an I2C interface, a buzzer, a breadboard, and jumper wires are among the parts used in this project. We refer to inter-integrated circuits as I2C. Since it is a bus interface connection protocol built into serial communication devices, it is utilised in the project. Consequently, it can be utilised for serial communication and accurate data display according to the sensor input on the LCD display.The connection of the circuit is done as shown in the following Fig. 1.

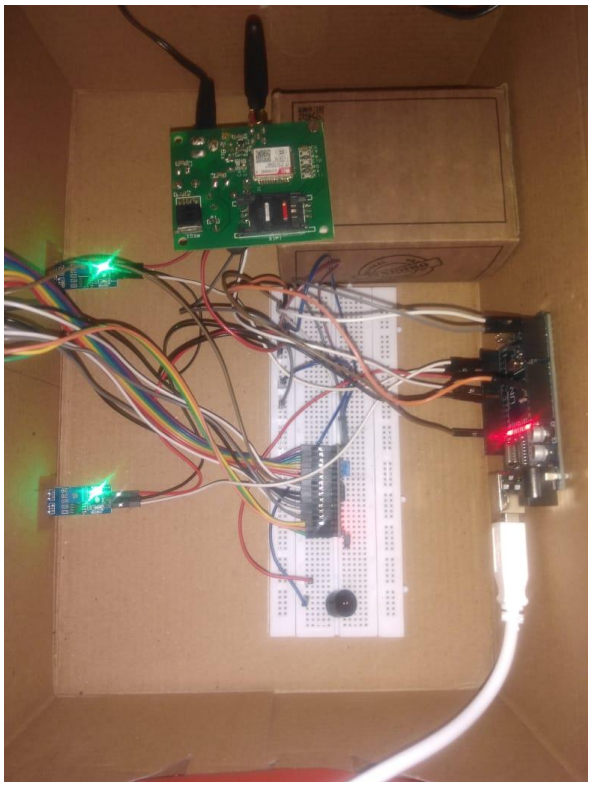

Fig. 1. Circuit Diagram

The way the model operates is that it receives information in the form of a vehicle approaching from one side of the IR sensor and moving to the other. The vehicle's count is incremented relative to the preceding vehicle count when it arrives and decremented upon exiting. The LCD Display, which serves as a display screen on roads, shows both the incremented and decremented values. A buzzer is incorporated into the system to alert the driver when they enter or exit their car. It can also be used to alert officials of vehicle entries or departures.

In addition, the time it takes the vehicle to move between the two sensors is a factor in determining its speed. The technology will inform the driver by SMS if the vehicle exceeds the 30 km/h speed restriction, giving them the opportunity to slow down.

The block diagram (Bird's eye view) of the proposed system is shown in the below Fig. 2.

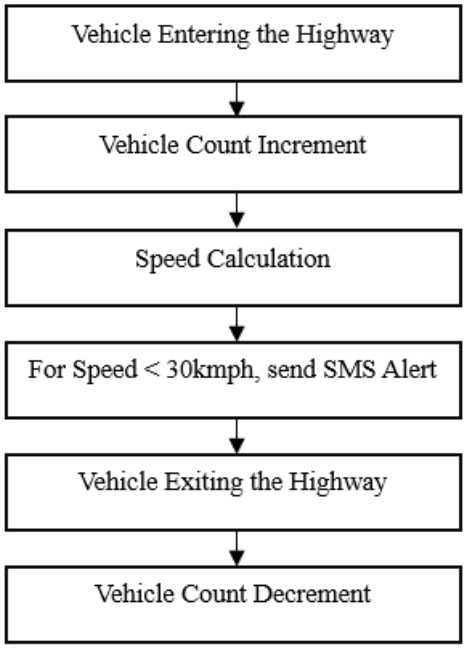

Fig.2 Block Diagram of the Proposed Architecture

The model functions well, and once the code has been uploaded to the Arduino UNO Board, it is possible to test the system by identifying the number of vehicles entering and leaving a given roadway using hand gestures that depict automobiles. Additionally, with the assistance of the GSM module, the system is able to inform the driver who is speeding with an SMS. In this way, the unique strategy that has been deployed reduces traffic accidents effectively using the aforementioned strategies. It accomplishes the goals of ensuring road safety and easing traffic congestion.

IV. RESULTS AND DISCUSSION

The system works efficiently and shows the vehicle count in an appropriate manner. The first IR sensor counts the count of incoming vehicles, and the second IR sensor reduces the count of the exiting vehicle. The following Fig. 3. shows the displaying of the vehicle count on the LCD Display.

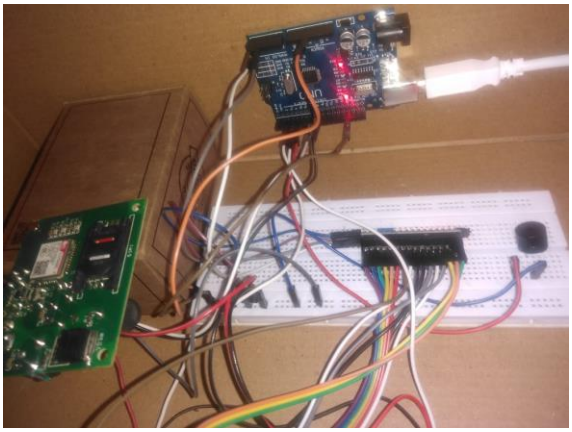

Fig. 4. Components used in the model

Fig. 5. Displaying Vehicle Count

Secondly, to ensure alertness on the road, once the driver enters the highway or the tunnel, a buzzer beeps. It also beeps on the exit of the highway, by making the model more interactive (the buzzer is shown in the below Fig6).

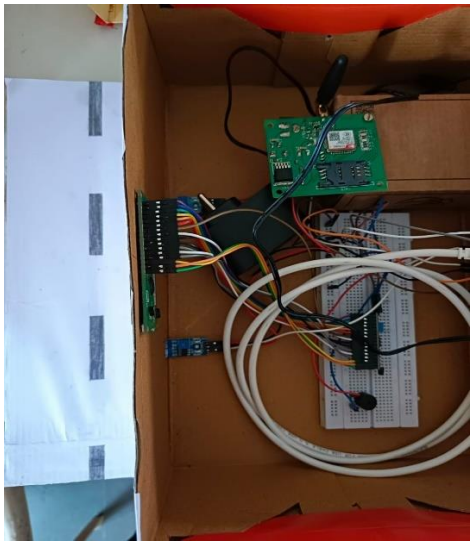

Fig. Buzzer mechanism

The model also detects the speed of the vehicle crossing the speed limits and sends an SMS alert to the drivers in

the car with the help of the SIM800C GSM module. It is an efficient way to reduce road traffic congestion by directly contacting the driver and maintaining proper discipline on roads. The following Fig shows an example of an SMS alert in case of over-speeding, and violating traffic norms.

As a result, from the above displayed figures and the actual working of the model, it can be considered as an useful and effective solution for preventing violation of traffic rules, and ensuring safety in accident-prone areas. Several developments in such models can make the traffic system and law more efficient and precise in their daily work.

V. CONCLUSION AND FUTURE SCOPE

The suggested approach offers a great and affordable means of lowering traffic accidents and upholding speed restrictions. In order to ensure safety in the event of tunnel jams or in areas vulnerable to landslides, this method can be utilised efficiently to count the number of cars entering the tunnel. By using a cutting-edge microcontroller development board and technology, it can be strengthened.

This project can be made more useful for roadways by making a few adjustments, such as adding an auto-fine for reckless driving and automatic warnings for lane-cutting. The suggested technique can also be used to keep track of the number of cars in parking lots of malls, schools, and offices. This gadget can be greatly improved in accuracy and robustness by using the Computer Vision or Machine Learning (ML) model.

REFERENCES

[1] “Speed Detection in Vehicles – The RFID Approach” Tisha S Jain, Vidula D Prasanna, Zainul Azam I Samudri, Vikas K Vashist, Sowmya K. N

[2] “RFID-Based Automatic Vehicle Speed Control” A. Karthikeyan, G. Arshad Parvez, K. Kishore Kumar, M. Lavanya, R. Mathuprakas

[3] Al-Shabibi, Lujaina, Nadarajan Jayaraman, and Jayavrinda Vrindavanam. "Automobile speed violation detection system using RFID and GSM technologies." *Int. J. Appl. Inf. Syst* 7, no. 6 (2014): 24-29.

[4] Mas’od, Khairi‘Imran, and Nurul Rodziah Abdul Ghafar. "Development of Vehicle Speed Measurement Using RFID" *Journal of Engineering Technology* 90 (2021): 108-111.

[5] Panganiban, Edward B., and Jennifer C. Dela Cruz. "RFID-based vehicle monitoring system." In *2017IEEE 9th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM)*, pp. 1-6. IEEE, 2017.

[6] Saritha, M., S. Rajalakshmi, S. Angel Deborah, R. S. Milton, S. Thirumla Devi, M. Vrithika, and G. B. Krishnap Priya. "RFID-based traffic violation detection and traffic flow analysis system." *International Journal of Pure and Applied Mathematics* 118, no. 20 (2018): 319-328.

[7] Ahmed, Sabbir, Tamkin Mahmud Tan, Anna Mary Mondol, Zawad Alam, Noshin Nawal, and Jia Uddin. "Automated toll collection system based on RFID sensor." In *2019 International Carnahan Conference on Security Technology (ICCST)*, pp. 1-3. IEEE, 2019.

[8] “Vehicle Overspeeding Indication Through GSM” Deekshitha, Bharath Kumar, N Bhargav, Mrs. M. Usha. Rani

[9] “Automatic Vehicle Speed Reduction and Accident Prevention System Using RF Technology” Prof. Sandeep Sharma, Sumit Kishore, Shrey Mishra, Dhruv Girotra, Hardik Talwar

[10] Mandal, Koushik, Arindam Sen, Abhijnan Chakraborty, Siuli Roy, Suvadip Batabyal, and Somprakash Bandyopadhyay. "Road traffic congestion monitoring and measurement using active RFID and GSM technology." In *2011 14th International IEEE Conference on Intelligent Transportation Systems (ITSC)*, pp. 1375-1379. IEEE, 2011.

[11] Al-Shabibi, Lujaina, Nadarajan Jayaraman, and Jayavrinda Vrindavanam. "Automobile speed violation detection system using RFID and GSM technologies." *Int. J. Appl. Inf. Syst* 7, no. 6 (2014): 24-29.

[12] Roy, Siuli, Somprakash Bandyopadhyay, Munmun Das, Suvadip Batabyal, and Sankhadeep Pal. "Real time traffic congestion detection and management using Active RFID and GSM technology." *ITSC, Kyoto, Japan* 48 (2010).

[13] Taghvaeeyan, Saber, and Rajesh Rajamani. "Portable roadside sensors for vehicle counting, classification, and speed measurement." *IEEE Transactions on Intelligent Transportation Systems* 15, no. 1 (2013): 73-83.

[14] Crouzil, Alain, Louahdi Khoudour, Paul Valiere, and Dung Nghy Truong Cong. "Automatic vehicle counting system for traffic monitoring." *Journal of Electronic Imaging* 25, no. 5 (2016): 051207-051207.

[15] Tasgaonkar, Pankaj P., Rahul Dev Garg, and Pradeep Kumar Garg. "Vehicle detection and traffic estimation with sensors technologies for intelligent transportation systems." *Sensing and Imaging* 21 (2020): 1-28.