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Speed Detection in Vehicles – The RFID Approach

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Abstract: *India is the second largest populated country with a total population of 1.4 billion in 2002.It is one of the leading countries in the world in terms of vehicle production. With the increase in the vehicle production, there is a parallel increase of road accidents. Despite the government's best effort with new technologies such as LIDAR Gun, Speed Governors, Variable Message Signs, Inductive Loops, road accidents remain a primary cause of death, disability, and hospitalization in India. It is not feasible for the authorities to monitor areas like highways, school zones, hospitals etc. all the time. Hence, there is an urgent requirement for a system that notifies the police. Recent technological advancements have enabled to identify and monitor vehicles on the lane using GPS, GSM, Radar technology, Video surveillance and radio frequency identification to control the speed and movements of the vehicle to avoid any kind of accidents. So, in this project, we are proposing an RFID system which works with RFID tags and readers to identify and track vehicle using radio frequency identification to control the speed of the vehicle in highways.*

Keywords *– RFID, GPS-GSM, Node MCU, Video Processing, IOT vehicle speed*

I. Introduction

With the passing time, society has come to rely on increased technology in practically every aspect of life, as it has improved our quality of life and provided additional benefits. Road accidents are relatively widespread today,with irresponsible driving being the leading cause. The need to check this has been critical, and several ways have been employed. However, as technology advances, several regulatory organizations are requesting computerizedtechnologies to regulate the problem of excessive speeding.

Many equipment and technologies have been used in the past to improve road safety and, as a result, to prevent accidents caused by speed violations, such as RADAR technology, PoliScan speed systems, Average Speed Safety Cameras, and so on. As a solution to the general problem of road speed violations and accompanying accidents on the highways, we propose a method to detect vehicles that exceed the maximum speed restriction set by the respective roadways or highway lights. We provide an automobile speed violation detection system employing WI-FI technology and RFID technology.

The goal is to create a system that can identify any speed violation on the road and send SMS to both the car owner and the police, utilizing the following components: RFID scanners, and GSM modem linked to a microcontroller (Node MCU ESP8266). The main reason for proposing RFID technology as a major component of the speed detection system is to create a cost-effective, accurate, and flexible system that will aid in the prevention of speeding offences and the reduction of deadly accidents.

II. Literarure Survey

Tracking the speed of a vehicle is an important aspect of adhering to speed limits and traffic conditions. Some proficient works used for Speed detection involve RFID, GPS-GSM, video processing techniques.

RFID Technology in Vehicular Speed Detection

RFID is a phrase that refers to radio wave technology that is used to automatically identify things or persons overshort or long distances ranging from a few inches to hundreds of feet. RFID is a technology that can identify objects automatically. RFID has seen widespread adoption in a variety of industries in recent years. RFID systems identify themselves via a mix of tags and readers. The one-of-a-kind code is saved on an RFID tag, which is affixed to a physical object. This tag is used to identify a unique object. RFID tags gather information

about the target by transmitting a code determined by the reader

The Vehicle speed detection based on IoT ensures road safety [1]. It allows to identify the vehicle's speed and send a notification to the driver if the vehicle exceeds the speed limit. The purpose of the system is to keep a trackof vehicle speed and intervene if a rule is broken. The primary benefit is that it protects road safety from reckless driving. Cars are equipped with RFID in [3]. Along the path, intelligent light poles with RFID readers, solar cells are made available. At highway entry and departure points, road sign readers are used to activate or emit recordsvia local and global networks through wireless technology to the central computer. Every three poles are covered in light poles with solar cells that provide energy on both sides of the highway. Connection between the car and the smart street light sensor, is established using a short-range communication protocol.

In [2] moving vehicle speed is read through the LCD module. The recorded speed is compared with the pre- defined speed. The speed of the vehicle is automatically controlled when it exceeds the pre-defined speed limit. The RFID receiver is installed within the limited zones, and the RF transmitter is put at the start and end of the restricted zones. The speedometer in the car determines the vehicle's speed, which is then compared and observedby the controller. When a vehicle's speed exceeds the speed restriction, the car will automatically slow down to fit the zone. A switch is provided in the car in case of an emergency to control the vehicle manually. The vehiclenumber of the car that in which the switch is ON is saved in the cloud. The aim of the cloud is to load the vehicle'sroute map.

The Arduino Uno will be the system's control centre, controlling the two RFID scanners, LCD, buzzer, and GSMmodem. The tag will be scanned by the two RFID readers, and the data from the RFID readers will be collected by the Arduino Uno. When the car passes through the start RFID reader, the timer begins to count down, and when the vehicle passes through the stop RFID reader, the timer stops [4]. The time difference between two consecutive readers for a vehicle is calculated. The vehicle's speed is determined using the calculated time difference and a pre-stored constant distance. The predicted speed is then compared to the previously saved speed,with the result shown on the LCD and serial monitor. If the car exceeds the speed limit, a buzzer will ring to inform the driver, and a text message will be sent to the driver. Radio Frequency Identification (RFID) is a way of tracking or identifying an object via radio transmission over the internet. The reader reads data digitally recorded in an RFID tag. RFID tags have been found being implemented in a variety of industries, depending onthe type of tag used as shown is Fig 1.

Fig 1: Application of different RFID Tags

GPS-GSM Technology in Vehicular Speed Detection

The Global Positioning System (GPS) is a service that offers users navigation, positioning, and time. The GlobalSystem for Mobile Communication (GSM) is a cellular technology that is free and digital and is used for mobilecommunication.

In this technology, The GPS module receives location data from satellites in terms of latitude and longitude. Thisdata is processed by the microcontroller and sent to the GSM modem. The information is then sent to the owner'smobile phone through the GSM modem.

[5] The goal is to develop a system that identifies speeding vehicles that violate a predetermined speed restrictionand notify the respective authorities. The GPS, Google Maps, Radar and an IoT module are all part of the system. The electronic tracking device is charged by a network of GPS sensors and IoT application and works on 12 V lithium batteries. To minimize the vehicle's speed in some areas, such as accident-prone zones, a

smart vehicle over speeding sensor is used and linked with IoT. The equipment includes a GPS sensing module with a transmitter and receiver that works in conjunction with an electronic tracking device to detect vehicle speed. Road identification accuracy is dependent on road names put into Google maps. The system computes the vehicle's speed and displays it on an LCD monitor. When a vehicle is discovered speeding, the proposed device emits a buzzer signal to alert authorities.

Video processing Technology in Vehicular Speed Detection

A traffic monitoring system model has been developed to increase road safety. The system's goal is to predict any traffic events/anomalies, and then corrective steps are implemented by safety professionals. A summary of the event is generated using the live stream which is stored in the database. This helps in organizing and easy access of the event videos, these videos will help in training, inspection and improvement purpose [6]. These operations are repeated in real time until the video stream is finished. However, once an anomaly is detected, an alarm is produced immediately in the control room, prompting the operator to consider preventative actions to avoid a road accident. These measures need to be done in real time and offline mode to prevent road incidents. As mentioned earlier no action is taken by the safety professionals, until and unless it detects pre-events. So, there is a direct relation between the effective detection of pre-events and the increase in road safety.

[7] A real-time vehicular traffic violation detection system is implemented through image processing techniques. Firstly, the video data is converted to frames and each frame is pre-processed to remove the bold shadow. Morphological operation is used to restore parts lost during the shadow removal and the object of the binary image is detected using object detection. Next, identification of the vehicle counts and estimation of speed is carried out. Localization of number plate is done using Edge histogram. Later, the number plate character segmentation is done, and the details of the vehicle identified in the traffic violation are sent to traffic regulation room using GSM modem.

III. Proposed Rfid Model

In the proposed model represented in Fig 2, RFID modules and the passive RFID tags are fixed onto the vehicle. Once the vehicle with the tag comes in the proximity of the reader, it reads and extracts the data from the tag. The readers are connected to a Node MCU which acts as a transceiver. The data represents the timestamps of the vehicle at the start and end points. The time stamps are converted into the unit of speed with the formula

$$V_S = \frac{D}{T}$$

Where, Vs represents the speed of the vehicle
T is the average of the timestamps in millisecondsD is the pre-defined distance which can vary.

If the speed surpasses the predetermined limit, an alert is sent to the authorization via the WiFi module that is linked to the system.

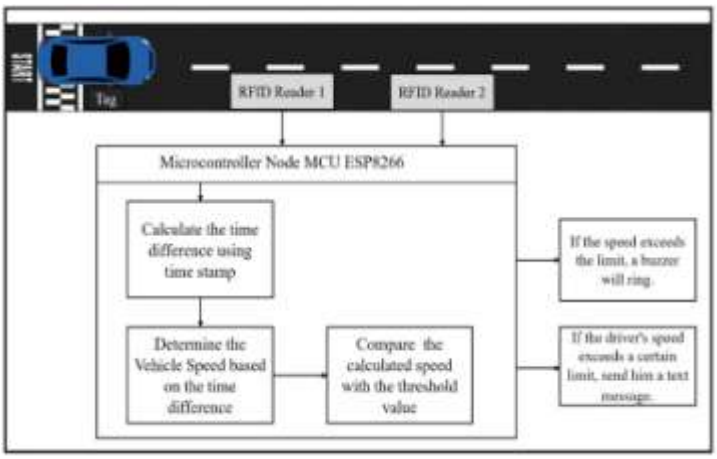

Fig 2: Architecture of the prototype model

This project's system flow will be represented in flowchart Fig 3, simulating a setup in which the start RFID readerscans the vehicle every time it passes past it. The timer will then start to count until the car passes through the next RFID reader. The time difference between two consecutive readers for a vehicle is calculated. The vehicle'sspeed is determined using the calculated time difference and distance. If the car exceeds the speed limit, the buzzerwill ring, and the driver will receive a text message informing them of the speed violation.

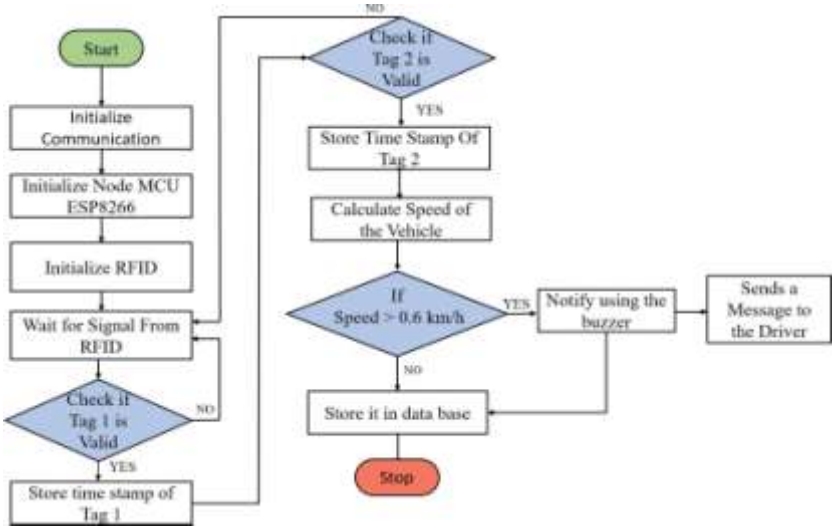

Fig 3: Data flow of the proposed model

IV. Figures And Tables

The prototype model as show in Fig 4 includes RFID readers to read the RFID Tags and Node MCU ESP8288 as a microcontroller is used.

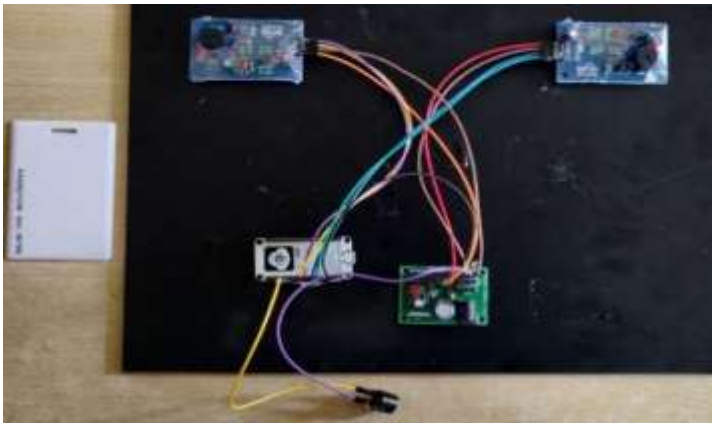

Fig 4: Circuit connection for the RFID prototype

Pin Connection between RFID Reader and Node MCU as shown in table 1

Table 1

RFID Reader (r1, r2)	**Node MCU ESP8266**
r1(TX)	r1(D6)
r2(TX)	r2(D7)
r1(RX)	r1(D5)
r2(RX)	r2(D8)

Connection between Power Supply to RFID readers (r1, r2) and Node MCU as shown intable 2

Table 2

RFID Reader (r1, r2), Node MCU	**Power Supply**
r1(GND)	GND
r2(GND)	GND
r1(5V)	5V
r2(5V)	5V
Node MCU(GND)	GND

Connection between Buzzer to Node MCU and Power Supply as shown in table 2

Table 3

Node MCU and Power Supply	**Buzzer**
Node MCU(D2)	Buzzer(P1)
Power Supply (GND)	Buzzer(P2)

V. Results

Fig 5 illustrates the connection between the TCP Client and Node MCU. The system and the Node MCU are required to be connected on a single network. With the successful connection of the networks the Node MCU must be connected to the server (Telnet) to provide bidirectional communication using port 8888.

Fig 5: establishing connection between TCP client and Node MCU

Whenever the Vehicle passes through the points the tag is scanned by the RFID readers at the starting and the point which is shown in Fig 6

Fig 6: Vehicle details scanned by the RFID reader

The Driver receives the alert message notifying them to reduce the speed along with the current speed of the vehicle.

Fig 7: Notification to the driver that vehicle speed > 0.60 km/hr

When the vehicle passes through the RFID readers then the system automatically calculates the speed as shown in the Fig 8

Fig 8: Vehicle speed is < 0.6km/hr. no notification is sent

VI. Conclusion

In today's world, where car accidents are on the rise, a vehicle tracking system is crucial. Hence, we are proposing a cost-effective system which is based on IOT. This system is flexible and portable so that it can be easily installed and used anywhere for the purpose of the vehicle speed detection. This system will help in detecting the rash driving vehicle at real time so that there is a chance in reducing the road accidents by acting

against those vehicles. Therefore, this technology can improve the transportation system through effective management, as well as the traffic safety of high-speed highways.

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