ISSN 2347 - 3983
Volume 8. No. 5, May 2020
International Journal of Emerging Trends in Engineering Research
Available Online at http://www.warse.org/IJETER/static/pdf/file/ijeter72852020.pdf
https://doi.org/10.30534/ijeter/2020/72852020

Vehicular Speed Limiting Control System in Critical Zones Using Global Positioning System

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ABSTRACT

Road accidents usually occur due to drivers' excessive speeds which often lead to loss of property or even casualties. Given that, road safety is a practice that all drivers must adhere to especially in critical zones where there is a higher risk of possible loss of property or lives. Despite all the measures given to drivers such as imposing traffic rules and attempts such as making use of speed limiters for speed regulation in critical zones, there is still a high number of reported accidents that exist due to drivers' carelessness. The project aims to solve the problem by having a speed limiting control system that would act upon drivers' carelessness especially in critical zones. The proposed system will make use of the Global Positioning System (GPS) technology to determine the location of critical zones and automatically adjust the speed of the vehicle once it reaches the speed limit.

Key words: Speed limiting control system, Global Positioning System (GPS), critical zone.

1. INTRODUCTION

According to the data provided by Metropolitan Manila Development Authority's (MMDA) Metro Manila Accident Reporting and Analysis System (MMARAS), 394 deaths out of the 383 recorded cases and an average of 320.29 road crashes per day were recorded on the year 2018 which is a slight improvement compared to the year 2017 [1]. Given the slight improvement from the previous year due to MMDA's current interventions, the number of accidents could still be further reduced if practical engineering solutions & research will be made. Although road accidents cannot be monitored & prevented completely, an efficient solution would be to make use of vehicle speed limiters on critical zones where accidents are prone and more lives are at risk such as schools, hospitals, public areas, etc [2,3].

This research aims to implement an effective solution to the given problem by automating the control of speed in vehicles when they reach critical zones through the use of GPS and GSM. The speed of the vehicle at the critical zone will be compared with the maximum allowable speed and will be adjusted accordingly by the system which will depend on the sent coordinates by the GPS & GSM modules.

2. LITERATURE REVIEW

This section consists of several pieces of research related to the project. Each work will be taken a look at and discussed briefly.

Vengadesh and Sekar [4] created an automatic speed control system using RF communication. It is developed mainly for use in cities where there is more congestion in traffic and speed needs to be controlled to avoid accidents. RF transmitters will be placed in certain "speed-limiting zones" such as busy streets, schools, or hospitals. RF transmitters will be placed on the ends of streets of speed-limiting zones while the RF receiver is put inside a vehicle. When the vehicle exceeds the speed limit specific to the speed-limiting zone, the driver is notified. Ignoring this notification will send the vehicle information to the nearest police station via GSM module. This means that the system also works as an enforcement tool. When the vehicle is not inside speed-limiting zones, no speed control will occur. Their group concluded that a possible drawback of using RF is the possibility of interference from other vehicles, in which case, GPS may be used to avoid this. Figure 1 shows the block diagram of the receiver.

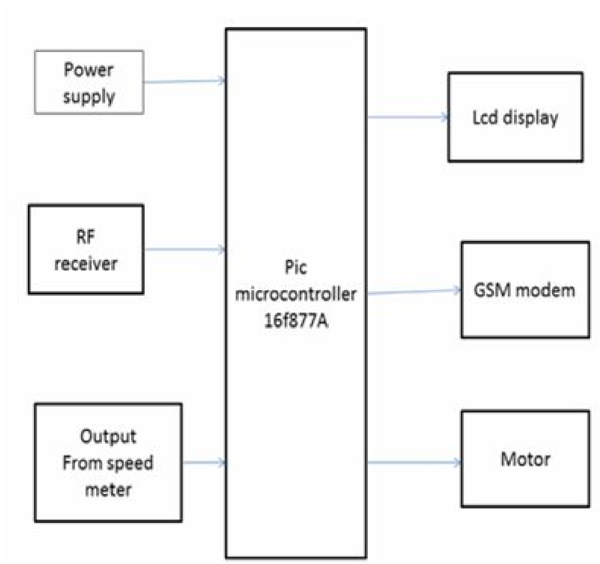

Figure 1: Receiver Block Diagram [4]

In their research, Sethuramalingam et al [5] proposed a speed regulating system that utilizes both GPS and GSM. The reasoning for this is to complement the two technologies and eliminate the problems encountered by using each on their own (for example, blocking). Components of their system include GPS and GSM modules, LCD, speed control motor, and Zigbee transceiver. In their conclusion, the group states that their proposed system is unique and better than speed controllers currently available at that time. Figure 2 shows the Vehicular Section pedestrian limit.

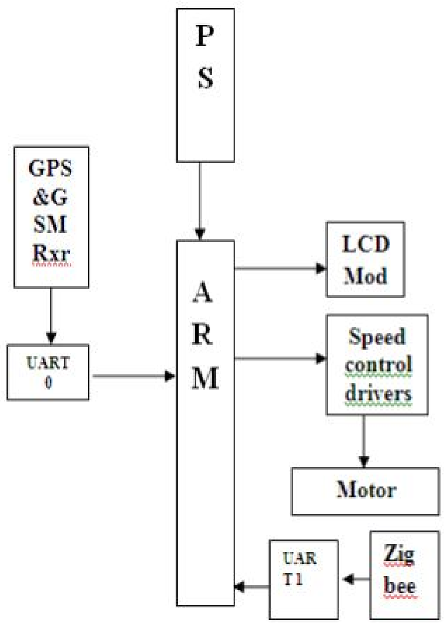

Figure 2: Vehicular Section and Pedestrian Limit Block Diagram [5]

Figure 3 shows the Microcontroller Block Diagram.

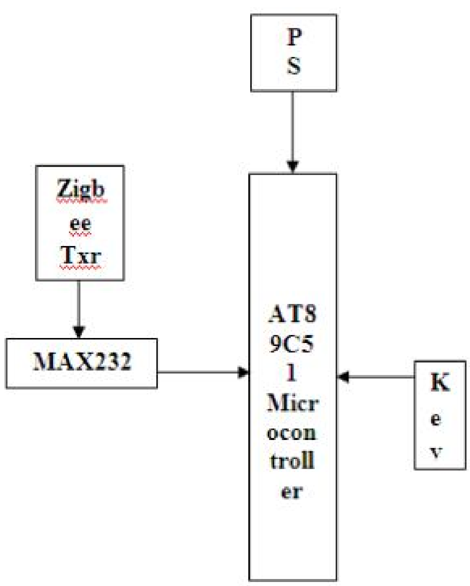

Figure 3: Microcontroller Block Diagram [5]

Perez et al [6] present an intelligent vehicle speed controller based on RFID and the concept of infrastructure to vehicle (I2V) communication. The motivation behind the study is to have a dynamic map generator (a sensing or plotting technology that adapts a map to the condition of the road) for vehicle speed control purposes. This would be the go-to approach to sudden changes in the road or terrain like road renovation or construction. Existing technology like GPS and GIS provide mostly static information for vehicles. The approach taken is a robust one, utilizing three different sensors; RFID, hall effect, and DGPS. Figure 4 shows the Signal Strength of Tags versus Distance.

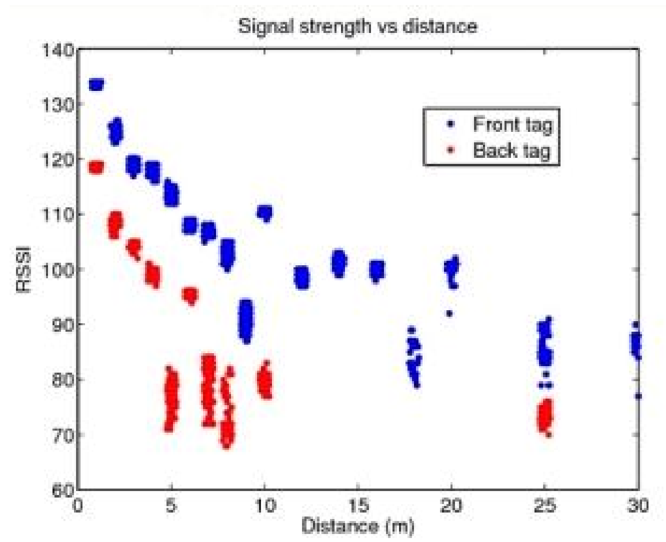

Figure 4: Signal Strength of Tags versus Distance [6]

Figure 5 shows the Signal Strength of Tags versus the rotational angle.

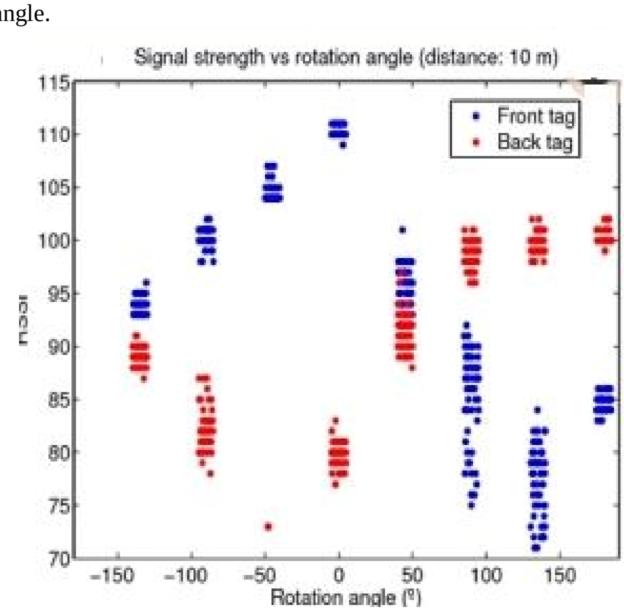

Figure 5: Signal Strength of Tags versus rotational angle [6]

Figure 6 shows the RFID Subsystem.

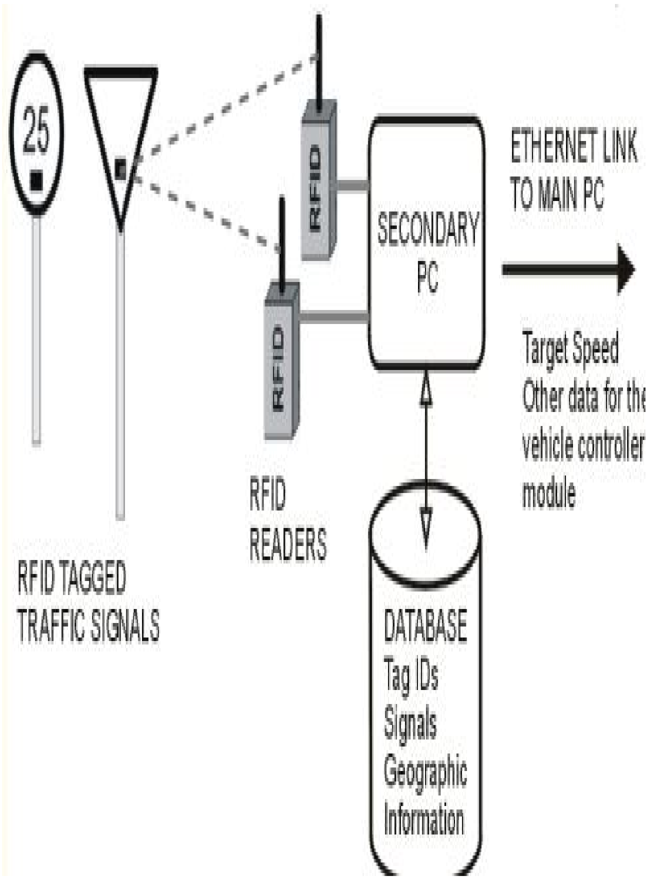

Figure 6: RFID Subsystems [6]

3. THEORETICAL CONSIDERATION

The main idea is to have information obtained from a GPS signal, present this to the driver (and notify them if within proximity), and slow down the vehicle if necessary. Different information transmission technology is used for different parts of the system. It can follow the systems in [7,8,9,10]. The components of the proposed system are an indicating device, engine control unit, and braking system. The indicating device serves as the “bridge” so to say, for the information to get to the user. An Android application is installed on the indicating device [11,12,13]. This application can show the current location via a global positioning system as well as if there are any critical zones nearby. The engine control unit makes use of an Arduino microcontroller. This system uses a classical Control System function [14,15]. The Arduino does the processing of the information received and sends it to the braking system.

4. DESIGN CONSIDERATION

The overall system is described in the block diagram shown in Figure 6 [16].

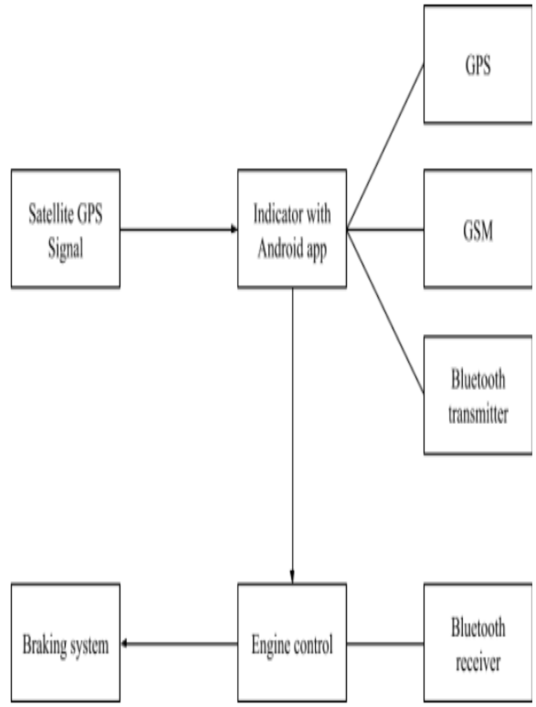

Figure 6: System overview

The Android application is designed such that it is minimalistic and easy to use. It shows the bare minimum of what is needed for the system [17,18,19]. The first thing that greets the user is a login screen for authentication. After successful login, the user can choose from a list of critical zones, such as schools, or hospitals. In GPS view, the user can see the current location and nearby critical zones. Push notifications appear when nearby these zones. In transmission of engine control to braking system, serial transmission is used (RS232) since this is simple and inexpensive [20].

5. METHODOLOGY

Using the phone’s built-in GPS sensors, a notification will be sent to the user via the mobile application alerting him once a critical zone has been reached. The Arduino microcontroller is connected via bluetooth that will receive the GPS signals that will handle the braking system. As the user enters the critical area detected by the GPS, the braking system will act upon by reducing the vehicle’s speed using Arduino’s built-in PWM features.

6. RESULTS AND DISCUSSION

The critical areas are preselected in the application including the speed limit depending on the area. The user will be notified once he enters the critical area to minimize the speed but once he reaches the speed limit, the speed limiting control system will trigger the braking system and will adjust the speed accordingly until the speed reaches below the limit.

7. CONCLUSION

The system is tested to be working as intended and can be used as a tool for road safety. The use of both GPS and GSM for location tracking avoids the complexities present when using only one of these. For future recommendations, additional functionality can be added such that slowing down does not occur all the time, but only during peak hours. This selective speed reduction can add "intelligence" to the existing system.

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