

## Design, Implementation and Evaluatinga Method and Device for Speed Reduction of Offender Cars by Police

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### Abstract

This paper presentsan innovative and noninvasive device and method for speed control of outlaw cars in highways and streets. The paper describes a system which utilizes a radio frequency actuated subsystem, a fuel reduction valve or fuel pump flow control module, an Inertial Measurement Unit (IMU), a Global Positioning System (GPS) module and an advanced microcontroller unit. The system can be used in almost all kind of cars despite their varieties. The Police forcesshould use a two factor authentication method to activate system in emergency situation. This invention has been filed as a provisional patent application in the USPTO and the registration number is 62827063.

**Keywords:**Car speed control, Law enforcement, Car accident reduction, Motor vehicle safety, Speed reduction by police

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## **Introduction**

Traffic crashes, has been understood as a latent threat for both road safety and public health and thus remain as the greatest concern relating to transportation worldwide. The latest available figures estimate that 1.35 million people die, while 50 million people seriously injure each year as a result of road crashes (World Health Organization, 2018). Despite some improvements have been taken place during the last decade, about 25,600 people lost their lives on European roads during the year 2018, and more than 1.4 million suffered serious injuries in road crashes. For instance, Spain has registered 102,000 traffic accidents during the last five years, causing 1,800 deaths and 8,900 serious injuries (Dirección General de Tráfico, 2020). These data suggest that, regardless of where the figures come from, the trend continues to rise and remains at a worrying level for public authorities, researchers and – of course – the road users themselves.

Moreover, with the aim of preventing these crashes, governments usually implement road safety actions and different approaches based on their resources, priorities, and contextual features. In this regard, key issues such as law enforcement and police supervision, substance use-related measures, speeding, vehicle technical inspections and infrastructural road improvements have raised the interest of policymakers during recent years (Staton et al., 2016). However, so far, some topics remain underrepresented in terms of actions and measures taken by public authorities. For instance, recidivist traffic offenders, despite the great risks they can pose to road safety, do not constitute a crucial focus of action in most countries, even though key preliminary systematic measures and programs (many of them still in a ‘pilot’ phase) are beginning to be developed in some countries.

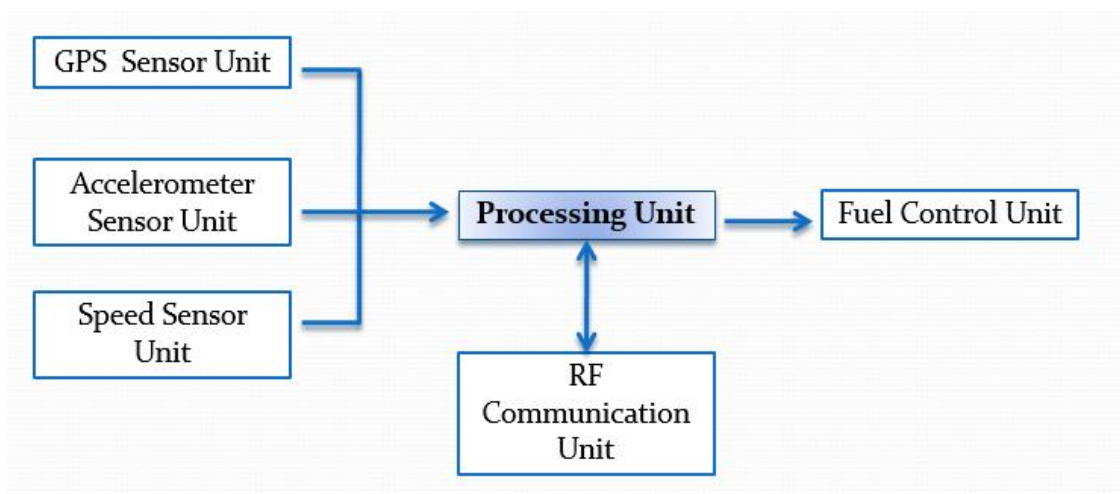
According to statistics at least one-third of motor vehicle fatalities in the U.S are related to breaking safe speed [1]. Beside fatalities, aggressive drivers has very high tendency to break safe speed limit. Criminals also steal cars and use them for crimes and breaks safe speed limit which can cause serious problems and injuries. To solve this problems there is two approach, first one tries to use speed camera to determine and penalize outlaw cars [2], and second approach has focused on control vehicle speed by means of sensors, controllers (which can be based on artificial intelligent) and actuators which has been implemented in automatic vehicle speed control system [3,4]. In the field of technology, some patents has been filed to solve this issue. For instance, U.S. patent No 9248807, entitled “Car Control System”, to Lee et al, has disclosed a car control system for controlling a car by being linked with a car control device (electronic control unit, ECU) [5]. China Patent application No CN106080503, entitled “Car Safe Driving Control System Capable of Increasing Driving Safety Coefficients”, has disclosed a car safe driving control system capable of increasing driving safety coefficients. The car safe driving control system comprises a safe driving controller, an instrument board unit, an automatic speed changer control unit, a safe airbag unit, an engine unit, a braking ABS unit, a car body control unit, an electronic accelerator pedal and a double-flashing-light relay [6].

Despite these and other improvement in the field of car safety control, still further improvement and reliable device and method are necessary. This paper describes an innovative method for this issue.

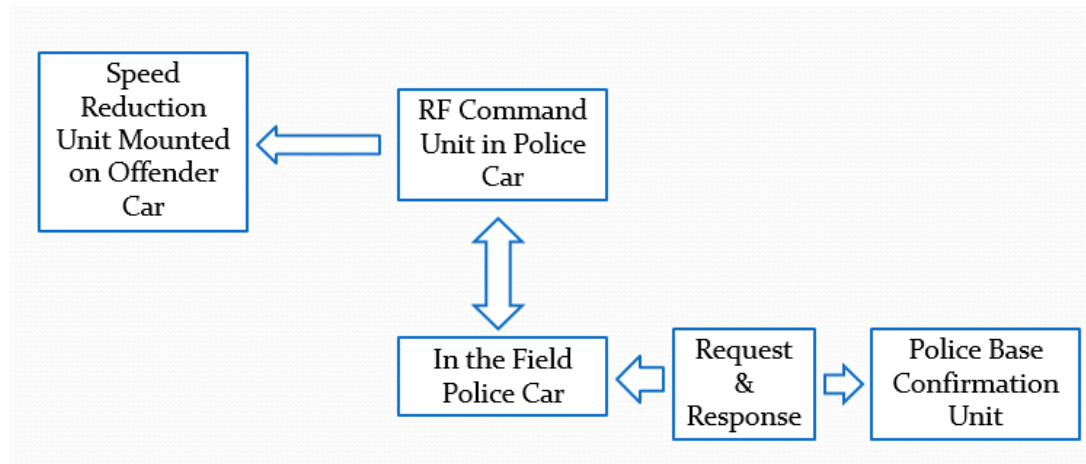
## **Material and Method**

Schematic block diagram of the invention has been shown in Fig.1 and Fig.2 and components and subsystems of the invention are as follow:

- RF Communication Unit
- Processing Unit
- Fuel Control Unit
- Police Command Mobile Unit
- Police Base Confirmation Fixed Unit
- Acceleration and Speed Sensor Unit in Offender Car
- GPS Unit
- Speed Detection Unit in Police Car

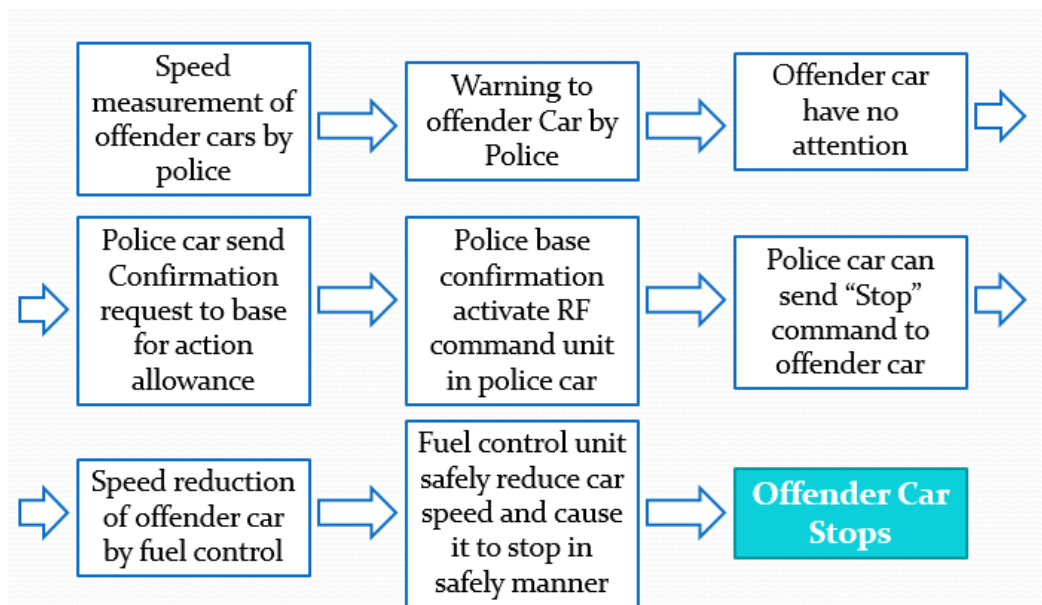


• **Fig 1. Schematic diagram of the system installed in the car**



**Fig 2. Schematic diagram of overall system and relation between them**

By using this invention in pursuit situation, police cars can send a confirmation message to base station of the police force and if they realize emergency situation and action, the equipment installed in police cars can send radio frequency command to device installed in offender cars, and the system by means of fuel control unit installed in output tube of fuel tank or fuel pump control unit and by means of close loop controller based on acceleration and speed and position data of offender cars, reduce criminal cars speed and stop them safely. Procedure of “Stopping Action” is shown in Fig.3.



• **Fig3. Procedure of speed reduction**

The general solution to stop cars is fuel control by an intelligent valve on fuel tube or an electronic controller on electrical fuel pump, so this invention can work in parallel with car other subsystems and independently control the speed of a car. Moreover the system can be installed in various kinds of cars. Four main subsystems of the invention are shown in Fig.2. The Speed Reduction Unit (SRU) (Fig.4) is installed in car and can be activated by RF command from police cars. Because of the law enforcement confirmation requirement, RF command unit need two factor activation processes, one confirmation command from police base station, and another is command from police force in the field.

Subsystems of SRU are shown in fig 1. The fuel control valve or fuel pump controller is controlled by a processor and based on data from accelerometer, speed and position of offender car. At high speed, safety standards need proper procedure for stopping cars. So at first processor measures speed and position of offender car. Then based on this data and data gathered from on board accelerometer does an intelligent algorithm and procedure to reduce and stop offender cars. And finally turn the car off. The SRU (Based on fuel pump control architecture) has been shown in Fig.4. As shown in Fig.4, the SRU is very small and versatile.



**Fig.4. Speed Reduction Unit (SRU)**

This invention has been filed as Provisional U.S. patent application No 9248807 and has won following awards and medals:

- 1- Gold Medal, Geneva Invention, Switzerland, Geneva-2019, April 2019
- 2- Gold Medal, International Invention Festival, Silicon Valley, SVIIF-2019, the U.S.A, June 2019
- 3- Gold Medal, Idea-Invention-New Products Fair, Nuremburg, Germany, iENA-2019, November 2019

4- Gold Medal, International Warsaw Invention Show, Warsaw, Poland, IWIS-2019, October 2019

5- Bronze Medal, International Innovation Exhibition, Zagreb, Croatia, ARCA-2019, October 2019

6- Gold Medal, International Salon of Invention and New Technologies, INOVAMAK-2019, Macedonia, September 2019

7- Special Award, Indonesian Invention and Innovation Promotion Association, INNOPA, Nuremburg, Germany, November 2019

### **Conclusion**

Present paper has described a novel method and device in the field of car safety. The invention has filed for U.S provisional patent application and has won 7 IFIA supported international awards and medals. This invention has made by researchers and has tested on a Peugeot 206 car in 2019-2020. The results show reliable and effective operation and thus can prevent hard crash and reduce fatalities and mortality rate due to motor vehicles accident.

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