IMPLEMENTATION OF A SECURITY DIVICE TO WARN A CAR DRIVER ON SPEEDING IN ACCIDENTABILITY HIGH RISK AREAS IN THE IBARRA CITY

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ABSTRACT. The objective of this paper grade is develops a device that detects and alerts a car driver of a vehicle on speeding in high accident risk in the urban area of the Ibarra city. The system design consists a GPS and a microcontroller as system fundamental parts; The GPS communicates with the electronic circuit sending data as position and velocity; data which are received by the system for later analysis. In the microcontroller is stored the entire code that system controls, so the data are analyzed that GPS sends and compared with the data stored sending the GPS and compared with the data are stored. The software is designed to scan, detect and alert the car driver on speeding through a LCD display, a red LED and a buzzer, every time it exceed the speed limit, the red LED will light and buzzer intermittently, also it displayed on the LCD screen, that it located in an area of high accident risk and which is the minimum speed in that area. The only way that LED and the buzzer go off, is reducing the rate displayed on the LCD screen. In addition the system must comprise an external EEPROM memory to store zones, date, time and speed, where the speed limit was exceeded, having as purpose the transmission of such data to the computer through a USB-SERIAL.

On the computer we developed a graphical interface C # to provide the user the correct reading of the data so we can make the best use for the good of all.

Keywords: vehicle, GPS, speed, zones, educational units.

1. INTRODUCTION

The traffic accidents are a problem that afflicts us globally, therefore Ecuador does not escape this harsh reality, Guillermo Abad managing director of Vial Justice, in La Hora newspaper said that: "the rate has increased in recent years, because most accidents has been recorded, so the national average would be between 32.4 deaths, when the region would be now 23 deaths". The Ibarra city is one of the cities with the highest rate of traffic accidents in the Ecuador, beating 1000 accidents per year.

The speeding is the predominant factor in traffic accidents, decreases the reaction time to perform a maneuver on the vehicle and increases the distance traveled by the vehicle

That is why the creation of this safety device to alert a car driver on speeding, and awareness the car driver about of the accident consequences.

2. DEVELOPMENT SYSTEM

Basically, the system consists of three building blocks such as GPS, who is responsible to receive and to send data as position and speed to microcontroller, which have the stored code that controls the whole system; the microcontroller 18F4550 is responsible for receiving, analyzing, compare the GPS data, and to activate outputs such as LCD, LED and buzzer, plus the data will be stored in EEPROM memory, for later analysis in the computer.
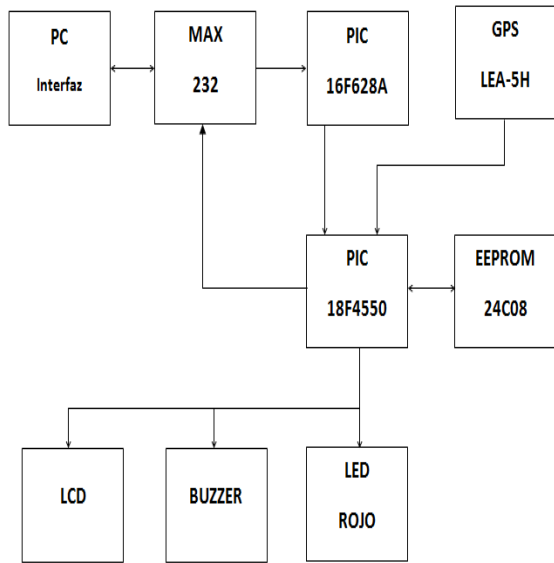
Figure 1 *System Block Diagram*
Source: *Own Elaboration*

The System operation begins when the vehicle is started and the GPS starts functioning, it triangulates with satellites to acquire the position and velocity data to send to PIC18F4550 and compare them with the data stored in the microcontroller.

The code is programmed to analyze the data received by the GPS and compare them, if the speed is greater than that established by the traffic laws in accidentability high risk area, the buzzer will activate automatically, the LED-red and the LCD that it will be showing a message that it is located in a danger zone and it must slow the velocity to the established, the only way to turn off alarms is slowing the permitted level. Also whenever the speed limit is exceeded it will be stored in the EEPROM memory as data, that there was exceeded speed 50km / h in the zone, both date and time

As the second part we have the transmission of data stored in the EEPROM memory to the computer through a serial communication between the system and the computer.
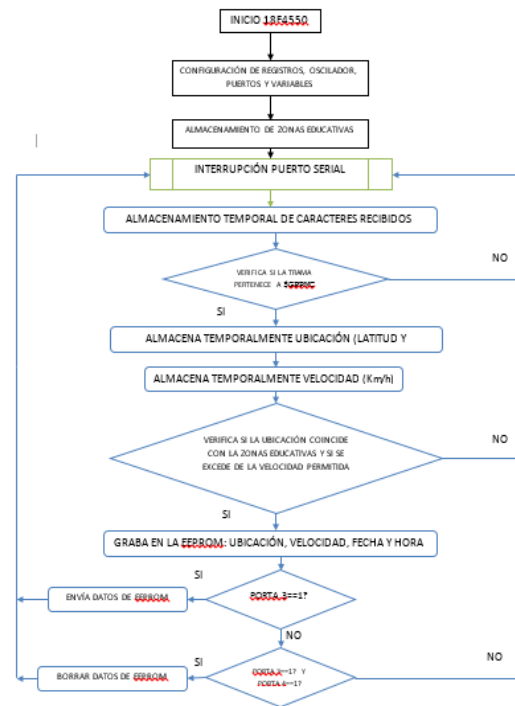

Figure 2 *System Flowchart*
Source: *Own Elaboration*

2.1   CONFIGURATION GPS MODULE

2.1.1   NMEA PROTOCOL
This is a defined protocol and controlled by the US-based National Marine Electronics Association, is a protocol whereby the most GPS receivers and other maritime navigational instruments can communicate with each other and other systems such as controllers, PCs, etc. The remarkable thing is that the information in this protocol is transferred from, for example a GPS PC up, consists of several frames. In the case of GPS receiver LEA - 5H subject matter hereof, each time the receiver (every second) is updated, it transmitted seven frames NMEA protocol:

The GPGGA frame: Global Positioning System.

The GPGLL frame: Geographical position latitude/ longitude and time.

The GPGSA frame: GPS DOP and active satellites.

The GPGSV frame: GPS satellites in view.

The GPRMC frame: Minimum recommended specific Transit.

The GPVTG frame: Ground Speed.

The GPZDA frame: Date and Time

Of these, we will use in this project is the GPRMC frame

2.1.1.1 The GPRMC frame
Always begin with the characters "$ GPRMC," and turn consists of 12 courses that are separated from each other by "," as detailed below:

$GPRMC, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C *

Time UTC (Coordinated Universal Time) format: hhmmss.ss
Data States: A = Active, V = None
Format latitude: ggmm.ssss
Latitude Format: N (north) or S (South)
Format Length: ggmm.ssss
Length Orientation: E (east) or W (west)
Speed in knots: xxx.x
Tracking quality grades: xxx.x
Format Date UTC: ddmmaa
Magnetic variation in degrees
Orientation of the variation: E (east) or W (west)
Checksum: * xx

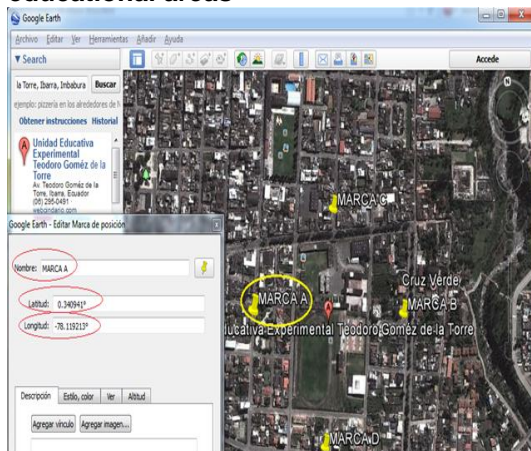### 2.1.2 Finding the coordinates of educational areas

Figure 3 Installing coordinates brands
Source: Program Google Earth

As can be seen in Figure 3 we installed four brands around the educational area, these ones are represented with a yellow colored ellipse and immediately on the picture left side we can see a window that it indicates us the brand name, latitude and length that are represented by red colored ellipses.

Midpoint Calculating

- Midpoint Lenght $= \frac{Coordinate\ A + Coordinate\ B}{2}$
- Midpoint Latitude $= \frac{Coordinate\ C + Coordinate\ D}{2}$

2.1.2.1 Calculating the Areas

Equation 1 Midpoint between two coordinates
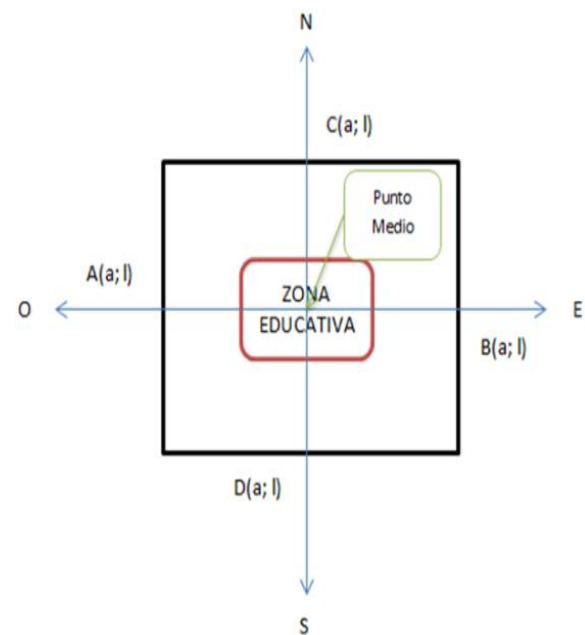**Source:** Analytical Geometry

Figure 4 Graphical representation area, midpoint coordinates
Source: Own Elaboration

Distance calculating between the midpoint and the coordinates:

Distance Length X = Coordinate A – Midpoint Length

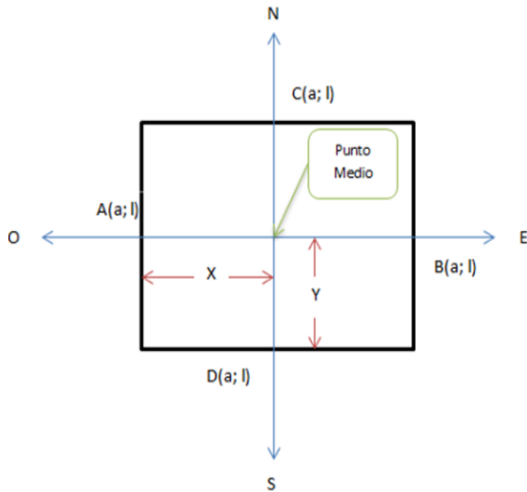Distance Latitude Y = Coordinate D – Midpoint Latitude

Figure 5 Distances Graphical
representation X e Y
Source: Own Elaboration

2.1.3 Interface Design

For interface design it has used a fairly simple scheme for the purpose of easy comprehension and rapid adaptation to the interface operation and the system as a whole.

In the following figure we can observe the interface scheme operation and its components.

Figure 6 Schematic work Interface
Source: Own Elaboration

As shown on Figure 6, the GUI consists of the necessary that they are detailed below both the list as the buttons:

List.- This an option that it gives us the program to cover some data in an organized and separately way, as displayed in the interface of Figure 6, on the list have five potions are:

> **Data:** the number of data is displayed.
> **Date:** The date on which the violation occurred is displayed.
> **Time:** The time at which the offense occurred is displayed.
> **Zone:** the name of the area in which the offense occurred is displayed.
> **Speed:** it will visualized that exceeded the speed limit permitted in the city urban area by traffic law.

Buttons.- is another of the offered options by the program to can set an order and create a link between a button and its operation established by the user, then we will detail the characteristics of the buttons in the interface.

> **Open Port**.- This is essential to start communication between the system and the computer.
>
> **Read Data**.- simply pushing this button, immediately it will visualized all data that are in the system.
>
> **Export**.- The function of this button is to save data.
>
> **Clear Data**.- With this button automatically we can erase all data.

2.1.4 Operation

The system is connected directly to the vehicle cable ignition, this will allow our system to work only when the car is turned on and likewise turns off when the car is turned off.

2.1.4.1 Viewing System cases

Case 1 The first case , it will visualize on the LCD screen the word "WELCOME", this one is will display when the vehicle is turned on and therefore the system will power.

Figure 7 *System Initialization*
***Source:** Own Elaboration*

Case 2 The second case, it will visualize on the LCD screen the phrase "Offline Connecting", this means the time it takes to recognize the GPS satellites and connect with them in order to calculate your current position.
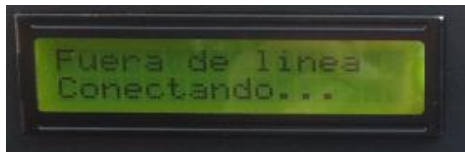

Figure 8 *Calculation of the position of the GPS*
***Source:** Own Elaboration*

Case 3 The third case, it will visualize on the LCD screen the phrase "Ibarra City" and the vehicle speed which is riding is also displayed too, this means that the car is not in a danger zone.
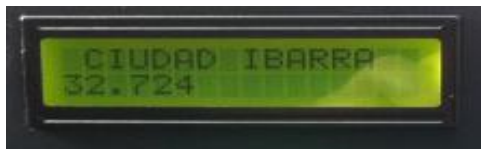

Figure 9 *Position and Vehicle speed*
***Source:** Own Elaboration*

Case 4 The fourth case, it will visualize on the LCD screen the phrase "Danger - Zone" on the first line and second line "Reduce to 50 km / h", this means you are in a danger zone accident and more than 50 km / h speed.

Figure 10 *Velocity faster than 50Km/h*
***Source:** Own Elaboration*

2.1.4.2 Management GUI
Then process the correct components for interface operation will be detailed.

Step 1. To transport the data system to the computer is essential to connect the computer to the system through USB-SERIAL cable.

Step 2. Once connected the system and the computer we will do a click on the button **Open Port** of the GUI in order to configure the communication system, it means, enable the "**com or port**" of the computer to the GUI, once the "**com or port**" sets the Open port button will transform automatically into Close Port button.

Step 3. Once established communication port, we proceed to click on the Read Data button to transport all data stored in the system to the list of GUI

Step 4. Once the data displayed on our list of the GUI, we proceed to click the Export button to save data and to store them safely.

Step 5. Finally we make a click the Clear Data button to clean and empty the EEPROM memory.

3. Results System

3.1 Stability and Security System
After having followed the correctly established steps and verified response it time can be deduce that the system is suitable to be implemented in any electromechanical vehicle that exceeding 50km / h, getting a good performance, and as result the confidence in the system both the driver as for pedestrians.

3.2 Driver Awareness
Any idea, project or campaign which is conducted by the public to try to reduce the number of traffic accidents is in order to sensitize every human being to handle speeding or under the influence of alcohol can trigger an irreversible catastrophe in which they are targeted more than two people. It is for this reason that this project was created with the purpose of raising awareness to the driver about speeding, alerting three different ways as are led flashing, intermittent buzzer and finally the message on the LCD.

Now if the driver ignores the warning alarms will indicate when you are speeding, these are saved in the system for further and correct use

The traffic law says the vehicle that exceeding the speed limit in urban areas shall be liable to the following:

> Prison three days
> Penalty of a unified basic worker's compensation

> Reduction of 10 points on the license.

3.3 Application of the prototype

The system can be applied in the following institutions in order to teach students the importance of respecting traffic laws, especially the speed limit and these are:

> National Transit Agency
> National Police
> Professional Drivers' Union
> Driving School UTN
> ANETA
> CATI

4. Conclusions

- The Microcontrollers are present in many of the devices we interact with in our daily lives, and go unnoticed until we put special emphasis on knowing how to manage our lives easier. They can be found anywhere in our house, office or work, such as televisions, telephones, elevators etc.
- We highlight microcontrollers his infinite application that makes them ideal to solve every problem that arises in the design of new devices elements.
- It was demonstrated by implementing the system and testing it is possible to perform a system that makes use of satellite technology, thereby achieving a greater benefit to the user in the economics and reliability.
- The system installation to the vehicle is very practical, with that we define it will not be difficult for the system to be installed in each car of the city, to reduce the number of traffic accidents.
- C # is a tool to develop graphical interfaces as well as the management of ports, facilitating user interaction with the application.

- Work transfer, viewing and manipulating data obtained by the system to the user through the graphical interface on the computer is provided.
- In this work all the objectives were achieved, therefore concludes that the work has been successful and a brief contribution to the development of future projects expected

5. Acknowledgements

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