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Research Article

ADVANCED DRIVER ASSISTANCE SYSTEMS FOR AUTOMOBILES USING WPAN

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ABSTRACT

Road sign detection is important to a robotic vehicle that drives on roads automatically. In this paper, road signs are detected by means of rules that restrict and require signs to appear only in limited regions using wireless. They are then recognized using a PAN ID matching method. The method is fast and can easily be modified to include new classes of signs. As with any vehicle, an autonomous vehicle driving on public roads must obey the rules of the road. Many of these rules are conveyed through the use of road signs. So an autonomous vehicle must be able to detect and recognize these road signs and change its behavior accordingly. This paper describes a fast method for locating and recognizing road signs in a sequence of signals. Advanced Driver Assistance Systems, or ADAS, are systems to help the driver in the driving process. When designed with a safe Human-Machine Interface, it should increase car safety and more generally road safety. Intelligent vehicles refer to cars, trucks, buses, etc. on which sensors and control systems have been integrated in order to assist the driving task, hence their name Advanced Driver Assistance Systems (ADAS).

Keywords: Transceiver, Wireless Personal Area Network, GPS, Vehicle alert.

INTRODUCTION

Advanced driver systems (ADAS) contain a human machine interface unit and control unit to assist driver in driving vehicle with care and safety. ADAS can be seen as a set of systems that assists the driver to stay in comfort. Most ADAS are of an imminent character, warning the driver in time critical situations. However, critical warning alone is not optimal solution in keeping drivers from avoiding traffic accidents. If the driver misinterprets the warning and takes a wrong action or simply does not react to the warning in time, there is an obvious risk that an accident will occur[1-4]. If on the other hand, the driver is fully aware of the driving situation and does take appropriate actions before a critical event arises, chances are that fewer incidents will take place and fewer imminent warnings will have to be presented to him.

The system is constructed using MiWi peer-to-peer wireless networking protocol based on IEEE.802.15.4 (LR-WPAN) running at 2.4 GHz. Microchip XLP (Extreme Low Power) nano-watt microcontrollers are used as the controller in wireless motes. Motes are operated only by battery power[5].

RELATED WORK

Driver assistance system has three subsystems - driver, vehicle and road side environment. A discord between the three results in traffic accidents. An information system connects the three subsystems. It has four fields.

Information system for single user

Information system for inter vehicle

Information system for vehicle to road side environment

Study on vehicle to driver relations

Some ADAS presently in trend are

1 - Control Configured Vehicle (CCV) system - Ultra-light vehicle drive independently with each other. Vehicle linked by forming a platoon and communicated via Omni directional radar.

2 - Active Driver Assistance System - Automobile is driven for a short distance when driver feels sick or drowses off.

3 - Adaptive cruise control system - A forward looking sensor placed in front of a vehicle to scan other vehicles. By matching the speed of other vehicles, the vehicle speed is reduced by applying brake or control accelerator of vehicle.

4 - Intelligent Intersection System – The system indicates pedestrian presence in front of vehicle and guide in speed and direction of vehicle.

At present the vehicles like car, bus and truck are driven by human. In future the vehicles will be driven by robots. Some important road signs are school zone, crash zone and speed lane. Robot can detect the road signs and control the accelerator, brake pedal and steering of car[6].

Main reason for accidents seems to be car speed. Wired communication is not possible between car and zone because car is moving dynamically. To control car speed, wireless communication can be established between each zone and vehicle.Here we use adaptive threshold to detect pedestrians crossing a street. Pedestrian protection system plays important role in advanced driver assistance. The algorithm used to identify the presence of pedestrian is based on the shoe of pedestrian lying on street pavement. Three alarm zones used are red, yellow, and green. In all zones, pixel dimensions change directly proportional to speed of vehicle[7].

The algorithm uses a window size adapted to the zone. A shoe has three characteristics sole, heel, and tip. We can detect the shoe of pedestrian using 20% to 5% adaptive threshold and find border characteristics of sole, heel, tip, and top of shoe. This algorithm implemented is m-code and hardware design in VHDL. This system detects the presence of pedestrian on a street.Here we see the use of DAARIA: Driver Assistance by Augmented Reality for Intelligent Automobile to detect the position of obstacles and quantification of the danger offered by them. Metaphor navigation and driving planning assistance First metaphor allows choosing direction Second metaphor allows user to reach destination without prior knowledge about the road Metaphor of augmented road provides highlighted way to user when looking directly at road[8].

Metaphor of unrolled map provides global knowledge of environment. Metaphor of driving safety.

Metaphor of highlighter highlights other vehicles, pedestrian & lanes. Metaphor of radar to mark the imminent hazard with an arrow indicating its direction.

Driver should take care of car speed according to the zone of driving. For instance, consider school Zone, car speed should be fixed below 30 Km. In the proposed system, RF communication is used to link car and the zone. To increase or decrease the car speed PWM technique is implemented. GPS locates the position of car to the driver. UART connects PIC Microcontroller and GPS. I^2C Bus is used in communicating PIC Microcontroller and LCD Display in Serial in Parallel out manner[9].

HARDWARE SETUP

The hardware setup plays a vital role in the designing process of this robot vehicle. The following are the building blocks of the vehicle. They are:

PIC18F45J11 Microcontroller.
MRF24J40MA RF Transceiver
L293D Motor Driver.
16x2 LCD Display.
DC gear motor for car.
RF.
GPS.

The above are the building blocks of our system. Our system consists of three units, they are as follows:

Zone Unit
Vehicle Unit.
GPS Unit.

In the hardware setup PIC18F45J11 microcontroller is the main block. It includes Flash Memory. The main reason for using PIC is because it is cost effective and uses a much reduced instruction set, consisting of around 35 instructions only. This IC can be erased and reprogrammed up-to 10000 times.

The system is constructed using MiWi peer to peer wireless networking protocol based on IEEE 802.15.4 running at 2.4 GHz. It provides 16 channels and operates on all PIC micro-controllers. It always functions as a state machine and supports a sleeping device at the end of the communication. It also always enables frequency agility[10].

Here a 16x2 LCD display is used. It is very cheap and shows the actual latitude and longitude position of the vehicle. L293D motor driver is used. It has on board heat sink for better performance and can drive up-to 36V and total DC current of 600mA.

I^2C bus is used for LCD display. It is a low bandwidth short distance protocol. It provides a single way talk between ICs by using two wires for serial clock and serial data and both the lines being bi-directional.

Here RF communication is used as link between the danger zone and the robotic vehicle. GPS is normally referred to as Global Positioning System. When the vehicle is travelling from one place to another it can be monitored by this GPS[11].

This GPS is mounted on our robotic vehicle and it will provide the latitude and longitude position of the vehicle. So these are the detail explanation of the building blocks. Now let us see about the units which are mentioned above.

A. ZONE UNIT:

The zone unit here is a school zone or an accident zone. This zone is a pre-determined position which will have a fixed latitude and longitude. This zone is an important zone that has to be crossed by a vehicle very safely as many humans will cross the road and enter into the zone.

ALGORITHM

The unit function test and compatibility test are performed and the driving robot suitable to various differential kinds of vehicles developed based on RTK-GPS (real time Kinematic-Global Positioning System) speed control and path following algorithm is used to keep the velocity of vehicle from overshoot of vehicle speed. Driving robot consists of steering wheel, gear selection, accelerator and brake pedal robots.

V error is the error velocity using reference velocity V ref compared with current car velocity V car. Driving robot controls acceleration by pedal position to maintain the velocity. Acceleration error is used in compensation element with gain K_a. Control output U_{inc} determined by both velocity error and acceleration error[12].

V error=V ref - V car

A error=A ref - A car

$U_{inc} = (K_p + K_d)$.V error - K_d.V olderror+K_a.Aerror

For the path following Candidate zone

P represents paths position candidate zone and next target position of vehicle[13].

R represents reference position in the storage path of controller.

Φd angle of candidate zone

D1 is minimum distance and D2 is maximum distance.

The steering Angle and direction of steering angle is calculated as follows

Figure (i): School zone

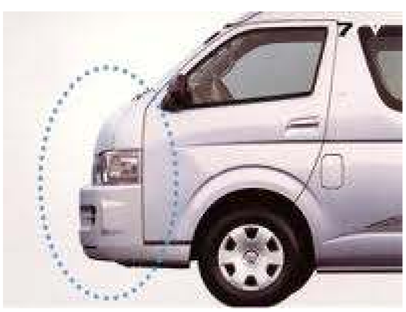
Figure (ii): Vehicle unit with GPS

$\theta ref = 1/\cos\left(Pt - k.Pt\frac{1}{|Pt-1Pt|PtRi+1}|\right)$

d (θref) = sign (Pt - uXPtPw + 1 – (Pt - uPtXPRut))

The minimum distance and maximum distance is calculated as given below.

D1= Vt.TTAD1

D2=Vt.TTAD2

Vt → vehicle speed at time‘t’.

TTA→ Time of access

Distance between front axle and real axle of vehicle is denoted as L. The angular velocity is calculated as follows.

θ=Vt.sinΦd / L

This is how the speed of the vehicle is slowed down when the vehicle reaches the accident or school zone[14].

TEST SETUP

There are two zones. They are school zone and crash zone. RF transceiver is placed in each zone and inside the vehicle to establish wireless communication. LED indicator indicates whether RF link exists between car and zone. When the car is moving near school zone, the RF transceiver placed in that zone will transmit the signal to the car which is crossing the school zone[15].

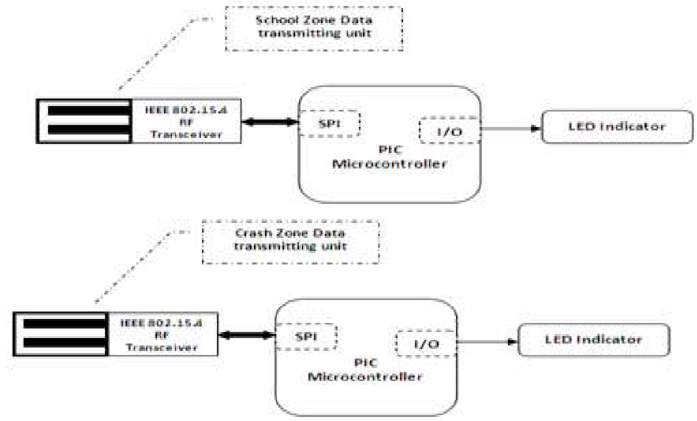

Figure (iii): Modules for school zone and crash zone data transmitting unit

PIC microcontroller placed in the car will receive that signal and control the car speed using PWM (Pulse Width Modulation) technique. PWM is used to control the car speed by varying the duty cycle of the control signal. To increase the car speed, duty cycle will be reduced and to decrease the car speed, the duty cycle will be increased. By increasing the duty cycle, the car speed will be reduced below 30Km.

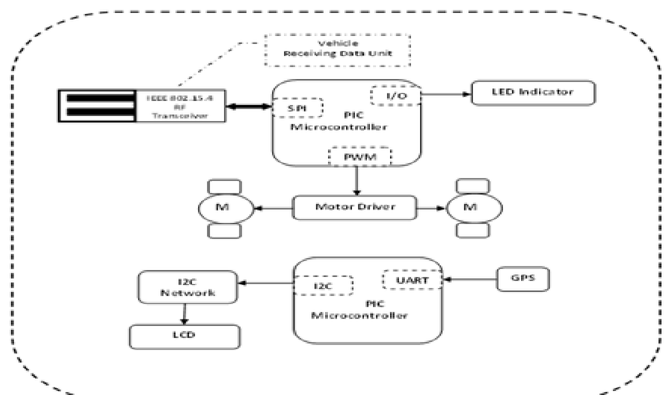

Figure (iv): Block diagram of vehicle receiving data unit

For the crash zone, the car speed should be limited to 40Km. GPS (Global Positioning System) is installed inside the car to indicate the position of the car to owner and avoid theft. UART connects the GPS to PIC microcontroller placed inside the vehicle. UART (Universal Asynchronous Receiver Transmitter) is used for asynchronous transmission. PIC will transmit the position of car to LCD display through I^2C network.PIC Microcontroller will give the output to LCD display in parallel manner. But LCD display will get the input in serial manner. To solve the problem the I^2C network is used in serial in parallel out mode. Thus, by using RF communication and PIC Microcontroller we can detect the road signs and limit the car speed[16-20].

CONCLUSION

The objective of this project to detect road signs and limit the car speed and it is achieved by establishing RF communication between the car and the zone. The car speed is adjusted according to the area of driving. RF communication exists between the car and the zone. And by Pulse Width Modulation technique, car speed is limited by varying the duty cycle of its control signal. LCD displays the location of the car by using GPS. Thus, this project improves the safety and security of driving. The cost of its implementation is also very low. Although the RF communication range of WPAN is limited to 400 ft, it can be used for actual application by intelligent placement of motes relative to a zone. ADAS can also be implemented using existing RF communication systems, where GPS can be a speed control tool when it is used with predated map of the location where the car is headed.

FUTURE WORK

In future we can additionally implement the systems like automatic car parking, drowsiness detection, blind spot detection and lane detection by using ARM Processor.

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