Automobile Safety System

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ABSTRACT: From passive elements to advanced active systems that affect vehicle stability and impact vehicle dynamics, various efforts have been made to improve safety on our roads, including pedestrian safety. This paper provides a simple description of the safety structures, equipment and futures of vehicles. Presented information has been gathered from different sources, and is focused on the work of these systems over time and the characteristics of their cooperation. The aim of this text is to create a general framework for classifying these systems which will allow their overview to be given in a detailed way. An airbag is an automobile safety device that is used to save the life of both drivers and passengers during a crash. An airbag's function is to shield occupants during a crash and protect their bodies when they hit interior items such as steering indoor wheels or windows, etc. The device, which takes single-chip microcomputer as the control centre and combines with multimeter-wave and ultrasonic distance measurement technology, can detect the distance from vehicle to vehicle and determine the vehicle's safety status. The sharp rise in car sales, traffic accidents have become increasingly common and serious. At the same time, with the rapid advancement of science and technology, automotive technology has also evolved rapidly; automotive safety technology has slowly become involved in all aspects of the automobile.

KEYWORDS: Convertible Vehicle, Inter-Vehicle Communications, Radar Systems, Safety System, Safety Seat, Ultrasonic Wave.

INTRODUCTION

Road collisions are uncompromising matters that can affect vehicles and vehicle occupants involved in them very adversely. Strong forces acting on human body during a car accident can cause severe injury and the damage may be very serious, possibly fatal. There are several different factors that influence the severity of the accident, such as type of crash (roll-over, side-on crash head-on crash, etc.), speed of the car, use or not use of seat belts, airbags of the car, seat location, type of impact object another vehicle, solid object, etc.[1]. Injuries are related in large measure to the sum of kinetic energy applied to the human body. The human body cannot withstand a lot of the kinetic forces generated in road traffic crashes. For the reasons listed above, a range of steps need to be taken to avoid the occurrence of the crash and to improve passenger safety. In the production and design of vehicles, growing attention is given to fulfilling vehicle safety requirements. Such conditions are set by the regulatory regulations in place and also by the customer's conditions. Vehicle health is one of the cornerstones of a success in contemporary market precisely because of the customer requirements[2]. Vehicle manufacturers are dedicating more and more resources to these concerns in the production of new vehicles and they are also focusing on the production of a range of safety devices that could additionally be mounted in vehicles. Modern cars are generally constructed with a specific focus on maintaining high safety standards for road users, walkers, cyclists, other vehicles, etc. In order to maintain the highest safety standards, modern cars are fitted with driver support systems that are even capable of removing the driver in certain situations e.g. automatic manoeuvring system that transfers a vehicle from a traffic lane to a parking space, automated car accident detection and warning system that detects the location of the vehicle and calls for assistance, etc.[3].

DISTANCE MEASUREMENT PRINCIPLE

Science and technology growth, radar technology has been widely used in the different industries. More common is the radar transmitter with millimetre wave and ultrasonic wave. Millimetre wave refers to electromagnetic waves varying from 1 ~ 10 mm in wavelength. And the high resolution of the antenna elements and their small size can be adjusted to the harsh environment. The millimetre-wave radar is highly accurate, anti-interference capable, low elevation output and small size, lightweight and can be adjusted to any weather conditions[4]. Figure 1 shows crash-avoidance system ranging schemes.

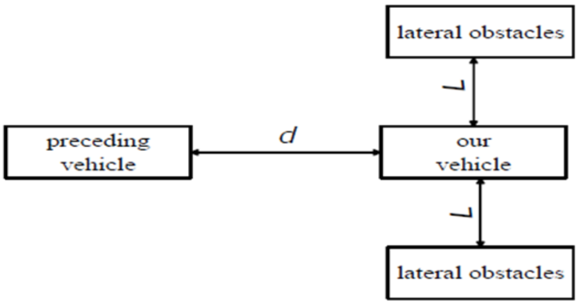

Fig.1: Crash-Avoidance Systems Ranging Schemes

Ultrasonic wave is produced by mechanical vibration of a frequency higher than the audible acoustic wave frequency range of sound waves, transmitted at different speeds in different media, with a clear guideline in the communication process, concentrate energy in a variety of advantages of medium type distribution, small attenuation in the transmission process, reflectivity, having a certain ability to adapt to the harsh working environment etc. The ultrasonic and millimetre wave radar collision avoidance program primarily comprises leading vehicle distance and side barrier measurement[5].

DISTANCE MEASUREMENT BASED ON RADAR SYSTEMS

Radar systems transmitted outwardly to a series of contiguous millimetre wave or ultrasonic through the antenna and the target is received reflected signal measured using a millimetre wave and ultrasonic propagation medium in the process has encountered an obstacle occurring reflected benefits obtained between the vehicle and the vehicle distance measurement. The radar produced by the transmitter has the high-frequency energy of a certain form; the warping of our transmitting antenna places energy radiation in space. As a wave moves in space target reflects a small number of high frequency energy to enter the receiving antenna, the measuring concept is shown in Figure 2. Ultrasound or millimetre-wave radar transmission signals, the receiver receives the target echo signal. The time is delay between the transmitted wave and the echo signal to determine the distance from the radar to the target[6].

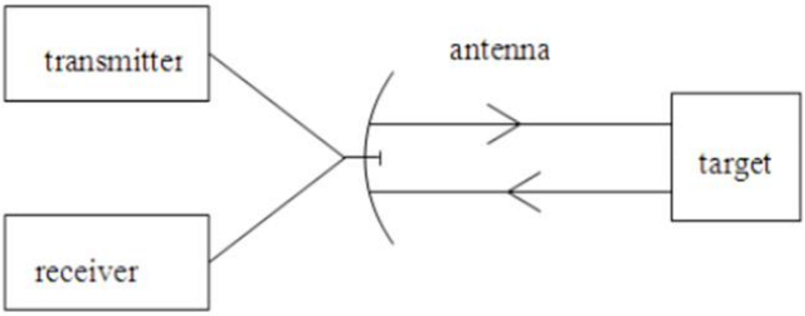

Fig.2: Basic Principle of Radar Ranging

Its expression is as follows:

$$R = C\tau / 2$$

Wherein: C is the electromagnetic wave propagation velocity in air.

DISTANCE MEASUREMENT BASED ON ULTRASONIC WAVE

There are several forms of method of ultrasonic ranging; the method of measuring round trip time is used. The definition of ultrasonic distance measurement is given in Figure 3. Ultrasonic transmitter emits an ultrasonic wave while simultaneously beginning timing, as it hits obstacles, sound waves scatter in the air reflection. When the ultrasonic receiver receives an echo signal stop the clock immediately and record the time difference. The distance between the two can be easily obtained by following radar ranging method formula[7].

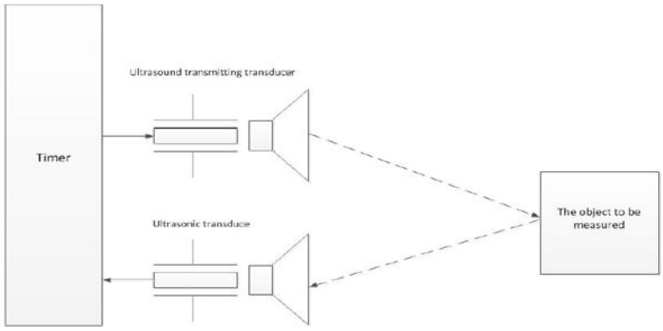

Fig.3: Ultrasonic Ranging Principles

But the frequency of ultrasonic sound which varies with temperature is greater. The heat produced by the car during the driving will process has some velocity and influence of the propagation of ultrasonic wave. And the error of measurement is fairly high too. So when calculating the question of sound velocity compensation, consideration must be provided to which temperature changes a lot under the atmosphere. For this purpose we will use the sound velocity values in the velocity formula temperature compensation to correct it.

$$C = 331.4 + 0.607T$$

Wherein: C is ultrasonic wave velocity in the medium. T is the environment temperature ℃[8].

CONVERTIBLE VEHICLE SAFETY SEAT

These seats are designed to accommodate the child weighing between 40 and 65 lb. They may be in rear-facing orientation or forward-facing orientation. These seats can be used as long as the child fits properly, with the tops of the child's ears below the car seat back and shoulders below the openings of the seat collar, or until the child exceeds the device's maximum weight. The convertible alone is a healthy option for the family who cannot afford both the infant-only and the convertible CRS styles[9]. This seat is for forward-facing use only and can usually accommodate children weighing between 20 and 100 lb. The seat has the ability to turn from a five-point harness configuration to a booster seat for belt positioning. Three key harness restraints designs are used to lock children into the CRS. Most popular is a five-point restraint that buckles across the knees, with two straps at the shoulders around the baby and two straps at the hips. Overhead shield harnesses use a padded bar which swings between the child's legs over the head and buckles. The brace "T-shield" is less common and requires a piece of "T" or triangular plastic permanently attached to the straps of the shoulder that latches between the legs of the infant. Belt-positioning booster seats are recommended for children from the time they have outgrown their convertible seat to a height of 4 ft. 9, typically between the ages of 8 and 12. The aim of the booster seat is to lift the child in the seat in order to ensure the car seatbelt is placed correctly. The shoulder belt is supposed to rest around the chest without touching the neck or forehead, and the lap belt is supposed to lie above the upper thighs and not abdomen. The child must be tall enough to sit back with legs bent at the knees and feet falling down against the ground. Two types of booster seats exist: one has a high back and the other lacks the back. It has been shown that the high back booster seat provides a 70 per cent reduction in lateral impact injury compared to the no-back booster seat. Therefore the high-back variety is favoured when using a booster seat. Seatbelts cannot be used alone when fitted correctly, which is typically when the child weighs more than 80 lb. or is at least 4 ft. 9 in height[10]. Figure 4 shows the vehicle safety seat.

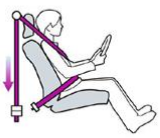

Fig.4: Vehicle Safety Seat

ETD AND SEAT BELT FORCE LIMITER

The front seat belts and some of the rear outside belts are fitted with ETD's. Additionally belt force limiters are used in some seat belt systems. If deployed in the event of an incident, these are decreased by an ETD at belt slack. The occupant is restrained earlier and thus earlier participates in the deceleration of the vehicle which decreases the occupant load during the collision. Additionally, the seat belt is also equipped with a force limiter which reduces the peak seat belt force excreted on the occupant upon activation. The belt force limiter is calibrated to the front air bag which in turn takes on some of the forces caused by the seat belt, thus providing a more even distribution of the load. When the ignition is on the ETD s is deployed during a frontal or rear end collision of significant severity which is sensed and rendered safer by incidents of high longitudinal deceleration or acceleration[11]. Figure 5 shows vehicle safety features.

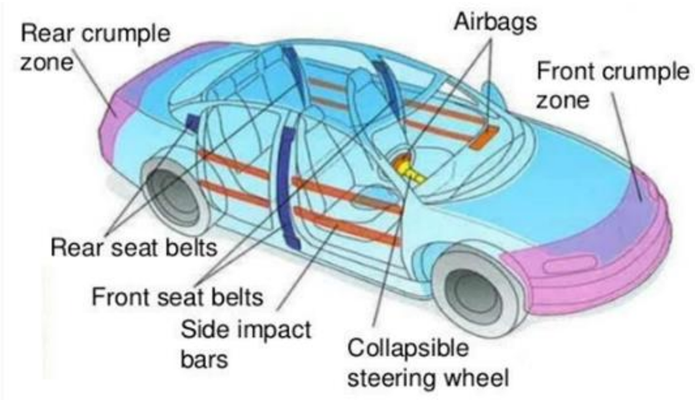

Fig.5: Vehicle Safety Features

In the field of automotive safety the words "active" and "passive" are clear but essential concepts. 'Active safety' is used to refer to equipment that helps avoid a crash and 'passive protection' to vehicle components primarily airbags, seatbelts, and the vehicle's physical structure that help protect the occupants during a crash.

INTER-VEHICLE COMMUNICATIONS

ITS communications systems are specified to cover four types of communication systems: inter-vehicle, road-to-vehicle, wide-area wireless and wire line. This makes clear, inter-vehicle communication is an essential component of the ITS environment. Inter-vehicle communications involve driver-to-vehicle contact, but we'll describe it as on-board communications. Consequently the systems presented in this paper are those based on the description. One feature of inter-vehicle communication is that unlike road-to-vehicle communication, where the position of road beacons determines the communications site, contact with other vehicles can take place anywhere. Information and data that would be difficult or impossible to quantify from a single vehicle can be obtained by contact between vehicles. Inter-vehicle communications allow the scope of on-board sensing systems to be broadened, a feature exploited in vehicle safety communication systems. ATMS / ATIS (Advanced Traffic Management Systems / Advanced Traveller Information Systems) integrate inter-vehicle communications mainly as traffic and driver information systems. Efforts to extend it to driver assistance and autonomous driving systems integrated in AVCSS (Advanced Vehicle Control and Safety Systems) have been made since[12]. Figure 6 shows the communication systems in ITS system architecture.

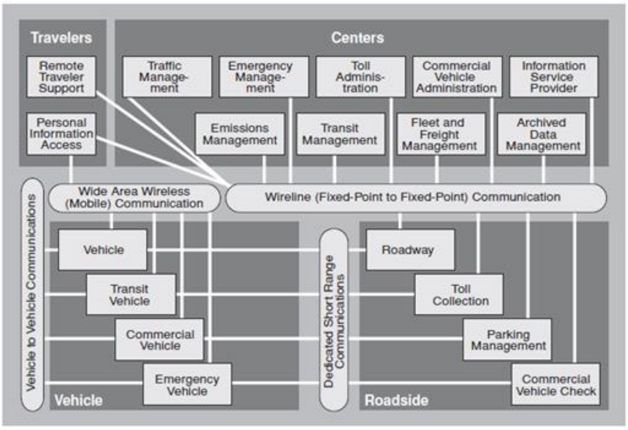

Fig.6: Communication Systems in ITS System Architecture

CONCLUSION

Vehicles appear to be mainly fitted with smart safety systems which would prevent driving risks or mitigate the consequences in the event of an accident. These systems provide improved vehicle control in different driving conditions, increase passenger safety and comfort and promote communication and monitoring of the situation on the road. Vehicles are fitted with a large number of sensors, transducers, actuators and control units whose role is to organize the co-operation of all of the vehicle's electronic and mechatronic components and enhance connectivity with other road users. By studying the functional requirements of the automotive active safety system, the AT89S52 microcontroller is designed to monitor the heart, combined with radar measurement technology and active safety systems architecture, proposed device hardware solution, a mathematical model and the corresponding computer software to develop the algorithm. The system is capable of fulfilling real-time identification of vehicle state data, such as speed, vehicle information; and timely determination of vehicle safety status and driver input status information, while the system can be played when appropriate to avoid safety accidents, thereby enhancing the active safety efficiency of the vehicle. Inter-vehicle communications have the potential of significantly contributing to active safety in automotive traffic by broadening the scope of both drivers and on-board sensing systems. Nevertheless, there are also many unanswered problems today including technological concerns such as standardization, technology issues such as application frameworks, and legal and institutional concerns.

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