ADVANCED DRIVER ASSIST SYSTEM USING MULTI- SENSOR INFORMATION FUSION FOR COPERATIVE DRIVING

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ABSTRACT

Active safety is an important trait of a modern vehicle to provide precaution warning or compensatory control before the pre-crash stage of vehicles safety. All vehicle signal and information are acquired by several in-vehicle sensors , and integrated in vehicle gateway through in-vehicle or vehicle-to-vehicle communications. The information exchanged among the host and surrounding vehicles provide comprehensive vehicle and driving status of each vehicle, so the driver can drive vehicle more safely with the cooperative driving mechanism. The demonstration system consists of a vehicle gateway, which is based on ARM core processor, PIC microcontroller, Bluetooth for I/O control and system management for intensive computation of information fusion and ZigBee for wireless communication. After reaching within the communication limit, the vehicles set time synchronization and then exchange vehicles information. Which consists of following phases path prediction and risk assessment. The risk assessment evaluates the possibility of car crash and transmit the warning message to its surrounding vehicles, if the risk level of vehicle is raised beyond a threshold. The cooperative driving is satisfied by sharing the vehicle information and emergency warning through wireless communication, so a driver can be alert of the dangerous situation and also be suggested an satisfactory response earlier.

Keyword : - *ARM, vehicle to vehicle, Bluetooth and wireless communication etc.*

1. INTRODUCTION

The periodical enhancement in the technique gives human race a new height. After independence, the number of vehicles subsequently increased but in last two decades it spreads radically in every level of the society hence safety becomes major concern. However, due to human avoidance, circumstantial error and negligible accidents happen. Many people lost their life every year in vehicle collision due to driver's incapability to keenly observe the vehicles vicinity while driving [2]. A huge number of vehicle accidents happen each year. Safety is a necessary part of man's life. According to the statistics provided by National Highway Traffic Safety Administration (NHTSA), there were 5,813,000 vehicle crash reported in 2008 by police across US and 37,260 people killed and 2,356,000 people injured [1]. Road safety has been considered important in world over past few time. In case, if vehicle drivers were provided with untimely warnings, a large amount of crashes could have been avoided. It may not be enough only the drivers observation and response to avoid accidents. Thus, if a device is designed and incorporated into the cars it will reduce the commonness of accidents on our roads and various locations. A lot of study has been conducted to develop collision warning systems to help driving. As collision avoidance system, an automatic braking system that operates under critical conditions would be perfect. Practically it is impossible to develop such a braking system which operates only in excessive emergencies [2]. In 1970's, amount of systems uses microwave radar technique to avoids collisions. But such radar systems are not useful due to big antenna size, high cost and difficulties in getting approval in regard to Radio Law in Japan. Apart from microwave radar, laser Radar sensor is also used for sensing the distance but here ultrasonic sensors have been used.

Road and traffic protection can be improved if drivers have the facility to see further down the road and know if collision has occurred, or if they are approach a traffic jam. This can become possible if drivers and vehicles communicate with each other. If traffic information was provided to the drivers and other authorities, the roads

would be safer and traveling on them would become more efficient. To well protect drivers and passengers from car collision, the driving status and vehicle data are acquired and processed by a variety of car electronics before the pre-crash stage of vehicle safety to determine any potential risk condition. Some accidents happen because the driver cannot predict or observe the operation of other drivers. Increasing the response time will largely decrease the probability of car accident. The traffic crashes caused by the human factor in United States America are reported about 80–90% of all incidents by National Highway Traffic Safety Administration (NHTSA), so active vehicle safety is one of the major research topics for intelligent transportation system (ITS). The safety concern is the most important issue for vehicle operation, while cooperative driving improves the vehicle safety by exchanging the vehicle information to enhance the driving information and the response time.

2. HISTORICAL BACKGROUND

The earliest research into inter-vehicular communications was conducted by JSK (Association of Electronic Technology for Automobile Traffic and Driving) of Japan in the early 1982s (Tsugawa, 2005). This work treated inter-vehicular communications primarily as traffic and driver information systems built-in in ATMS (Asynchronous Transfer Mode). From the 1989s through 2000, American PATH (Hedrick et al., 1994) and European "Chaffeur" (Gehring et al.,1997) projects investigated and deployed automated platooning systems through the transmission of data among vehicles. Recently, the promises of wireless communications to support vehicular safety applications have led to several national/international projects around the world. Since 2000, many European projects (CarTALK2000, FleetNet, etc.), supported by automobile manufacturers, private companies and research institutes, have been proposed with the common target to create a communication platform for inter-vehicle communication [4] The IST European Project CarTALK2000 was focusing on innovative driver assistance systems which are based upon inter-vehicle communication. The main objectives were the development of co-operative driver assistance systems and the development of a self-organizing ad-hoc radio network as a communication basis with the aspire of preparing a future standard. The FleetNet project in Germany (FleetNet project - Internet on the road, supported by six manufacturers and three universities from the 2000 though 2004, produced important results on several research areas, including the experimental characterization of VANETs, the proposal of novel network protocols (MAC, routing) and the exploration of different wireless technologies [3]

3. BLOCK DIAGRAM

In this project, the sensor like Air pressure sensor, Ultrasonic sensor, Eye blink sensor would be connected to the PIC Microcontroller. The Sensor gives the analog output which is further given to the ADC which is inbuilt in the PIC microcontroller. This node will sense sensor parameters and will transmit it to display node which is inbuilt in ARM processor by using Bluetooth module. This data is processed and further given to the ZigBee wireless module.

In single vehicle there will be two nodes sensor node and display node. These two node communication will be carried by Bluetooth module. On display node these transmitted parameters will be received by another ARM processor and same will display on 16X4 LCD. Exactly same will be in another vehicle. These two vehicles will communicate with each other with Zigbee module. Both vehicles will transmit their own parameters to one another. If any threshold crosses, other vehicle will get alert.

Here designing a system to avoid a nonstop collision between two vehicles. For this we are making two vehicle models representing the two CARS. Here the car will be arranged with an ultrasonic sensor which will continuously track for any obstacles from the front side. If the obstacle is detected then the microcontroller will continuously compare the distance given by the ultrasonic sensor. If the next car is at a safe distance then the CAR will keep going at the same speed. If the distance keeps reducing, indicating that the front vehicle is coming closer to the current vehicle then the microcontroller will start alert to both of them until the distance is within safe parameters. This process will continue in a loop until the vehicle comes to a Stop. In this way we can ensure that a safe distance is always maintained between the two vehicles and thus Accident can be avoided. The IR sensors are interfaced which are connected to the three sides of the car to detect any closeness to the car. The IR sensor will give a pulse to the microcontroller. The microcontroller will turn on the buzzer which will alert the driver in time to avoid the road and highway accident.

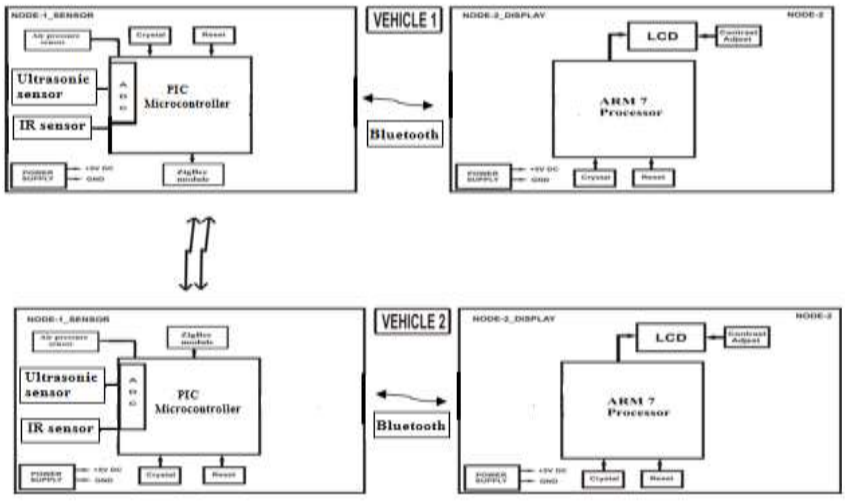
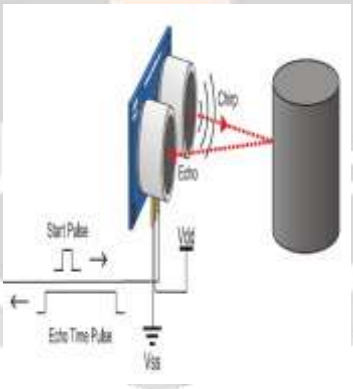


Fig-1 Block Diagram of System

4. HARDWARE DESCRIPTION

1.1 Ultrasonic sensor:

HC-SR04 is an ultrasonic ranging unit that provides 2 cm to 400 cm non-contact measurement function. The range accuracy can reach to 3mm and effectual angle is greater than 15°. It can be powered from a 5Volt power supply.

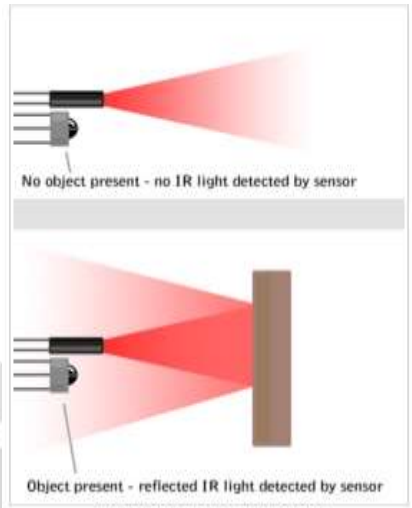


Ultrasonic sensors (also known as transceivers when they both send and receive, but more generally called transducers) work on a principle similar to radar or sonar which calculates attributes of object by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensor generates high frequency sound waves and calculates the echo which is received reverse by the sensor. Sensors calculate the time period between sending the signal and receiving the echo to decide the distance to an object.

1.2 IR sensor:

Infrared radiation is the portion of electromagnetic spectrum having wavelengths longer than visible light wavelengths, but smaller than microwaves, light wavelengths, but smaller than microwaves, i.e., the region roughly from 0.75µm to 1000 µm is the infrared region. Infrared waves are not visible to human eyes. The wavelength region of 0.75µm to 3 µm is called near infrared, the region from 3 µm to 6 µm is called mid infrared and the region higher than 6 µm is called far infrared.

Principle of operation:



Depiction of the operation of an IR Sensor

IR Sensors work by using a particular light sensor to detect a select light wavelength in the Infra-Red (IR) spectrum. By using an LED which produce light at the same wavelength as what the sensor is looking for, you can look at the intensity of the received light. When an object is close to the sensor, the light from the LED bounces off the object and into the light sensor. This results in a large fly in the intensity, which we already know can be detected with a threshold.

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1.3 Microchip PIC18

PIC-18F4685 is an enhanced flash microcontroller with CAN. The PIC18, which includes a RISC CPU running up to 10 MIPS, with 16-bit wide instructions and 8-bit wide data path, is dedicated to the ECUs functioning as low-end I/O control or data acquisition. There are 4 timers, one capture/compare/ PWM module and up to 8 channels 10-bit ADC modules and a Master Synchronous Serial Port operating with SPI or I2C modes.

1.4 ARM LPC2148:

The LPC2141/2/4/6/8 microcontrollers are based on a 32/16 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high rate flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and a unique accelerator architecture enable 32-bit code execution at the highest clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. Due to their tiny size and low power consumption, LPC2141/2/4/6/8 are ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale.

1.5 MPXM2202 on chip temperature compensated and silicon pressure sensor

The MPXM2202 device is a silicon piezo-resistive pressure sensor providing a highly accurate and linear voltage output directly proportional to the applied pressure. The sensor is a single, monolithic silicon diaphragm with the strain gauge and a thin–film resistor network integrated on–chip. The chip is laser trimmed for precise span and offset calibration and temperature compensation.

1.6 Bluetooth module

The Bluetooth radio interface operates in the unlicensed ISM (Industrial, Scientific and Medical) band starting at 2.402 GHz and ending at 2.483 GHz in the USA and Europe. A Bluetooth module supports both point to point and point to multipoint connections. It provides the physical layer and a low-level communication protocol. Bluetooth uses a quick frequency- hopping (1600 hops per second) packet-switched protocol in order to minimize interference with other products that use, the ISM band. Short data packets maximize throughout during interfering. A TDM (Time Division multiplexing) technique divide, the channel into 625 p/s slots. Transmission occurs in packets that occupy an odd number of slots (up to 5). Each packet is transmitted on a different hop frequency with a maximum frequency hopping rate of 1600 hops/s. Up to 8 devices can share a piconet which has one master with all the others becoming slaves.

1.7 ZigBee Technology

ZigBee is low cost and low power, wireless mesh network. The low cost allows the technology to be widely used in wireless control and monitoring applications. Mesh networking provides high reliability and more extensive range. ZigBee operates in the industrial, scientific and medical (ISM) radio bands; 868 MHz in Europe; 915 MHz in USA and Australia, 2.4 GHz in most jurisdictions worldwide. The zigbee network supports both star and tree typical networks, and generic mesh networks. Every network must have one coordinate and device, tasked with its creation, control of its parameters and basic maintenance.

5. CONCLUSION

In this system, the multi-sensor information fusion is implemented for computing the relative position, velocity, acceleration and current status of the host vehicle, so the potential collision risk can be assessed and the cooperative driving feature is provided by exchanging information with surrounding vehicles through wireless communications. The system also useful in giving warning signals with continues tracking of front-side obstacles. This system will have a proportionate increase in the level that avoids possible accidents and result in improved intercommunication using latest technologies.

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