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Two-Dimensional Obstacle Avoidance using Mobile Robot

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Abstract: Every year, we find more and more road accidents due to increased traffic on the roads, and if you see the statistics, you will find that the causalities are more every year than that of 1970 Indo -Pak war. Experts say, increased motorist population, long working hours and stressful life are the major reasons for the rise in road accidents. The factors are beyond one's control, but if we could alert the driver on the highway, could save many precious lives. This paper is about advanced technologies in cars for making it more intelligent this work in this papert is to develop an inexpensive sensor system for an automobile that can predict an imminent collision with another vehicle, just before the collision occurs. Here we are connecting sensors to Ardino UNO. If the sensors get activated the controller will give warning sounds by using buzzer. Also it stops the vehicle by using motor.

I. INTRODUCTION

As per the surveys held, statistics stated by various governments of different countries and states, every year, road accidents rate is continuously climbing up due to increased traffic on the roads. The causality rate is progressively increasing year by year. Experts say that the increase in motorist population is one of the main reasons for it. Long working hours is one more major concern of the city people. The life is more and more stressful now a days. The above three points mentioned are predominantly known as the primary and most common reasons for the road accidents, and especially on highways in most of the states. If we could alert the vehicle driver on the highway much ahead in time, could save many precious lives and leads to reduction in death rate due to highway accidents. It is quite common to fix up some sort of system on the highways which can detect the speed of the vehicle and convey to the driver that he is not in the permitted speed limit in a particular area. So we need to develop an inexpensive sensor system for an automobile that can predict an imminent collision with another vehicle, just before the collision occurs. The prediction needs to occur at least 100 ms before the collision, so that there is adequate time to initiate active passenger protection measures to protect the occupants of the vehicle during the crash.

A. Motivation

The main idea of the new proposed sensing system is to use the inherent magnetic field of a vehicle for position estimation. A vehicle is made of many metallic parts (for example, chassis, engine, body, etc.), which have a residual magnetic field and/or get magnetized in the Earth's magnetic field. These magnetic fields create a net magnetic field for the whole vehicle, which can be analytically modeled as a function of vehicle-specific parameters and position around the vehicle. By measuring the magnetic field using anisotropic magneto resistive (AMR) sensors, the position of the vehicle can be estimated if the vehicle-specific parameters are known.

II. RELATED WORK

The Development of Vehicle Position Estimation Algorithms Based on the Use of AMR Sensors [1][2] This paper focuses on the use of anisotropic magneto resistive (AMR) sensors for imminent crash detection in cars. The AMR sensors are used to measure the magnetic field from another vehicle in close proximity to estimate relative position and velocity from the measurement. An analytical formulation for the relationship between magnetic field and vehicle position is developed. The challenges in the use of the AMR sensors include their nonlinear behavior, limited range, and magnetic signature levels that vary with each type of car. An adaptive filter based on the iterated extended Kalman filter (IEKF) is developed to automatically tune filter parameters for each encountered car and to reliably estimate relative car position. The utilization of an additional sonar sensor during the initial detection of the encountered vehicle is shown to highly speed up the parameter convergence of the filter. Experimental results are presented from a number of tests with various vehicles to show that the proposed sensor system is viable.

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Implementation of In-vehicle Multi-sensor Information Fusion Gateway for Cooperative Driving [3], this paper focuses on the active safety is an important feature of a modern vehicle to provide precaution warning or compensatory control before the pre-crash stage of vehicle safety. All vehicle signals and information are acquired by several in-vehicle sensors on ECUs or surrounding vehicles, and integrated in vehicle gateway through in-vehicle or vehicle-to-vehicle communications. The information exchanged among the host and surrounding vehicles provides comprehensive vehicle and driving status of each vehicle, so the driver can drive more safely with the cooperative driving mechanism. The demonstration system consists of a vehicle gateway, which is based on a heterogeneous multi-core processor, consisting of one ARM core for I/O control and system management and two DSP cores for intensive computation of information fusion. After reaching within the communication limit, the vehicles set up time synchronization and then exchange vehicle information. The acquired sensor data and received vehicle information are time aligned and fed into PAC DSPs for information fusion, which consists of four phases, signal processing, location mapping, trajectory prediction and risk assessment. The risk assessment evaluates the probability of car crash and broadcast the warning message to its surrounding vehicles, if the risk level is raised beyond a threshold. The cooperative driving is fulfilled by sharing the vehicle information and emergency warning through wireless communication, so a driver can be aware of the dangerous situation and also be suggested an adequate response earlier. Towards predictive yaw stability control [4], in this paper it presents the possibility to predict vehicle loss of control using information about the host vehicle's state and the road ahead is investigated. A threat assessment algorithm that predicts loss of control based on assumptions of the driver's future behavior is proposed. The algorithm can be used in an active safety system to motivate e.g. either earlier conventional yaw control interventions or completely autonomous maneuvers in order to keep the vehicle on the road. The algorithm has been experimentally tested and based on measurements it is shown that it is possible to predict powerful under steer situations if the future geometrical path of the vehicle is known. Model-Based Probabilistic Collision Detection in Autonomous Driving [5], this paper describes the safety of the planned paths of autonomous cars with respect to the movement of other traffic participants is considered. Therefore, the stochastic occupancy of the road by other vehicles is predicted. The prediction considers uncertainties originating from the measurements and the possible behaviors of other traffic participants. In addition, the interaction of traffic participants, as well as the limitation of driving maneuvers due to the road geometry, is considered. The result of the presented approach is the probability of a crash for a specific trajectory of the autonomous car. The presented approach is efficient as most of the intensive computations are performed offline, which results in a lean online algorithm for real-time application. Design of pedestrian detection systems for the prediction of car-to-pedestrian accidents [6] in this paper study of vehicle-to-pedestrian crashes were classified into eleven typical scenarios. The essential characteristics of vehicle-to-pedestrian accidents were identified. The statistical behaviors of the many different systems involved (vehicle, pedestrian, environment, and advanced driver assistance devices) were modeled. Then, Monte-Carlo simulations were carried out for critical vehicle and pedestrian road situations. The developed simulation tool allows the evaluation and validation of the performances of potential innovative systems.

II. DESIGN METHODOLOGY

The below Figure 1 describes the complete block diagram of the system for Two dimensional senor system for automotive crash predication.

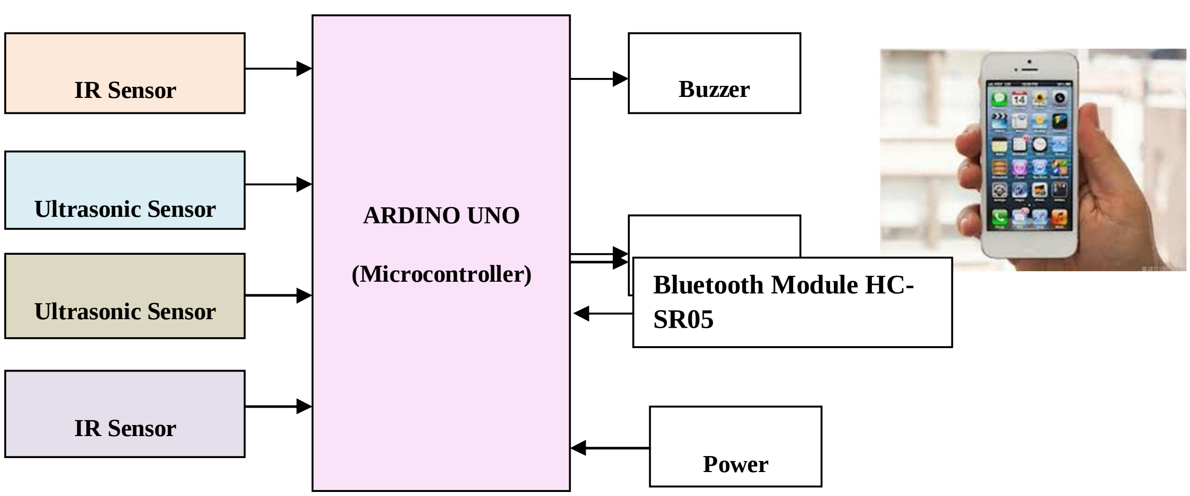


Figure 1 Complete block diagram of Crash Predication

An Obstacle Avoidance Robot is an intelligent robot, which can automatically sense and overcome obstacles on its path. It contains of a Microcontroller to process the data, and Ultrasonic sensors to detect the obstacles on its path.

Obstacle avoidance is one of the most important aspects of mobile robotics. Without it robot movement would be very restrictive and fragile. This tutorial explains obstacle avoidance using ultrasonics sensors. This project also presents a dynamic steering algorithm which ensures that the robot does n't have to stop in front of an obstacle which allows robot to navigate smoothly in an unknown environment, avoiding collisions.

The obstacle avoidance robotic vehicle uses ultrasonic sensors for its movements. The motors are connected through motor driver IC to microcontroller. The ultrasonic sensor is attached in front of the robot.

Whenever the robot is going on the desired path the ultrasonic sensor transmits the ultrasonic waves continuously from its sensor head. Whenever an obstacle comes ahead of it the ultrasonic waves are reflected back from an object and that information is passed to the microcontroller. The microcontroller controls the motors left, right, back, front, based on ultrasonic signals. In order to control the speed of each motor pulse width modulation is used (PWM).

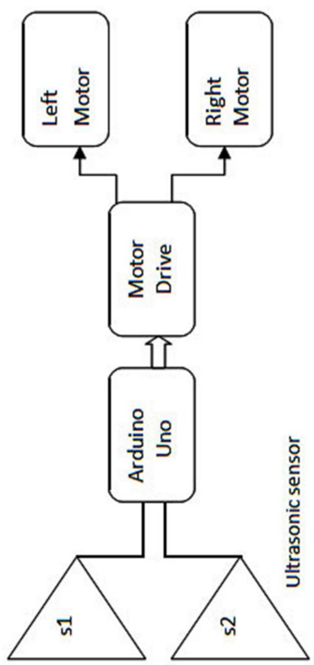
Materials used

Robo Car

Arduino Uno

Ultrasonic sensor

Block diagram of Obstacle Avoidance Robot



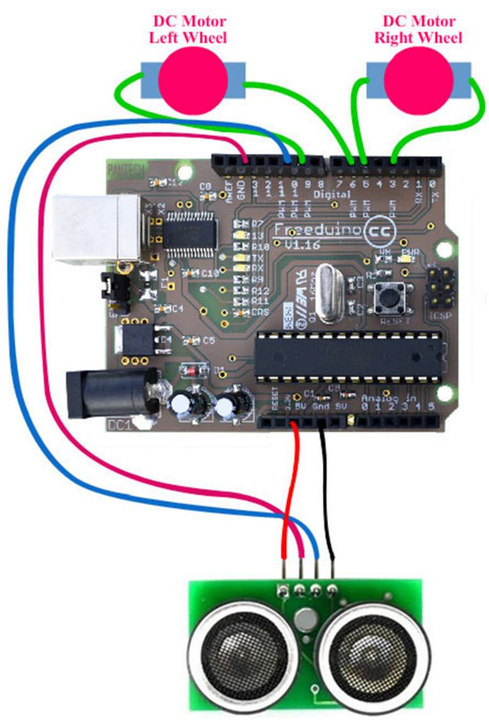


Figure 2 Circuit diagram to interface Ultrasonic sensors with arduino uno

The ultrasonic sensor is used for obstacle detection. Ultrasonic sensor transmits the ultrasonic waves from its sensor head and again receives the ultrasonic waves reflected from an object.

There are many applications use ultrasonic sensors like instruction alarm systems, automatic door openers etc. The ultrasonic sensor is very compact and has a very high performance.

Ultrasonic Sensor General Diagram

A. Working principle

1) The ultrasonic sensor emits the short and high frequency signal.

2) These propagate in the air at the velocity of sound.

3) If they hit any object, then they reflect back echo signal to the sensor.

4) The ultrasonic sensor consists of a multi vibrator, fixed to the base.
5) The multi vibrator is combination of a resonator and vibrator.
6) The resonator delivers ultrasonic wave generated by the vibration.
7) The ultrasonic sensor actually consists of two parts; the emitter which produces a 40 kHz sound wave and detector detects 40 kHz sound wave and sends electrical signal back to the microcontroller.

B. Ultrasonic Working Principle

The ultrasonic sensor enables the robot to virtually see and recognize object, avoid obstacles, measure distance. The operating range of ultrasonic sensor is 10 cm to 30 cm.

C. Operation of the Ultrasonic Sensor

When an electrical pulse of high voltage is applied to the ultrasonic transducer it vibrates across a specific spectrum of frequencies and generates a burst of sound waves. Whenever any obstacle comes ahead of the ultrasonic sensor the sound waves will reflect back in the form of echo and generates an electric pulse. It calculates the time taken between sending sound waves and receiving echo. The echo patterns will be compared with the patterns of sound waves to determine detected signal's condition.

Note: The ultrasonic receiver shall detect signal from the ultrasonic transmitter while the transmit waves hit on the object. The combination of these two sensors will allow the robot to detect the object in its path. The ultrasonic sensor is attached in front of the robot and that sensor will also help the robot navigate through the hall of any building.

D. Differential Drive Algorithm

There are a lot of different types of drive algorithms for driving robotic cars. One such method is the differential drive method.

I know it sound fancy but that's no big deal. We will be using only one pair of motors to drive the car. Check out he video for seeing how the hardware is connected. We will just have one castor wheel asides from the two motors and it will be used to give mechanical stability to the robot car.

Now the obvious question is how the car will change direction if it has only two wheels. That is when the differential drive algoritm comes in the picture. The direction control is achieved by rotating one of the wheels in one direction and the other in another direction. The following table might give you a better understanding.

Left Motor	Right Motor	Direction
Front	Front	Front
Front	Back	Right
Back	Front	Left
Back	Back	Back

As you should have guessed, the car will go front or back if both the pair of motors operate in one direction and left or right if they operate in different directions

VI. RESULT AND ANALYSIS

A. Interfacing Bluetooth Module With ROBO

Fig:3 (a)Robo Fig(b) (Bluetooth SPP Pro App) Fig(c) (Blue Control APP)

VII. CONCLUSION

Robot is a system that contains sensors, control systems, manipulators, power supplies and software all working together to perform a task. Designing, building, programming and testing a robot is a combination of physics, mechanical engineering, electrical engineering, structural engineering, mathematics and computing. Obstacle Detecting Robot is a machine that detects any obstacle present in its way and if found, changes its direction automatically. Two Ultrasonic sensors are arranged at front side and back side of the robot. Two IR proximity sensors are also arranged at left and right side of robot. The ultrasoni sensor detection range is upto 13 feet whereas IR sensor detection range is few cms. If the vehicle encounters the obstacle then robot turns automatically to avoid collision. The sensor is interfaced with ATMEGA328 microcontroller which processes data and controls robot movements through L293d motor driver circuit. The dc motors are interfaced with the L293d circuit. We can also control robot in manual mode using android phone and bluetooth communication. We are using HC-05 bluetooth module which is interfaced with arduino. This is connected with the serial communication pins of Arduino. We can control robot movements such as Forward, Backward, Left, Right Stop etc.

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