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Design and Development of Obstacle Detection System for Ground Clearance Vehicle

Ms. Neha Sose, Ms. Sonali Pawar, Ms. Aarti Kuwar, Ms Ruchita Gaikwad & Prof. D. S. Thosar
SVIT COE, Chincholi, Nashik.

Abstract: *Nowadays, we have some difficulties in obtaining the distance that we want to measure. Even though, measuring tape is an easy option, but this kind of tool will have a limitation of manual error. Before this, engineers have produced a range finder module but in the end, they find out the module have many disadvantages like limitation for distance, different result for different colored obstacles, and need a calibration for every time before starts using it. Manual distance measuring is always done at the expense of human error. Precise and fix measurement of low range distance, is the main objective for this project.*

This device can measure distance in the range of 0.5m to 4m with the accuracy of 1cm.This project is used to measure the distance by using ultrasonic sensors. It works by transmitting ultrasonic waves at 40 kHz. Then, the transducers will measure the amount of time taken for a pulse of sound travel to a particular surfaces and return as the reflected echo. After that, the circuit that have been programmed with AT mega microcontroller will calculate the distance based on the speed of sound at 25°C which an ambient temperature and also the time taken. The distance then will be display on a LCD module.

1. Introduction

In this paper, Driving is a compulsory activity for most people. People use cars to move from one place to another. The number of vehicles is increasing day by day. It is produced tacked tightly and risk to accident. Nowadays, the numbers of accident is so high and uncertainly. Accidents occur frequently and cause worst damage, serious injury and death. These accidents are mostly caused by delay of the driver to hit the brake. This project is designed to develop a new system that can solve this problem where drivers may not brake manually but the vehicles can stop automatically due to obstacles. The main target for this project is vehicle tracking monitoring system. In this project cars can detect the obstacles when the sensor senses the obstacles.

A. Operating frequency

The choice of the operating frequency requires a compromise between conflicting needs. High frequency allows us to use short trains of pulses and then to measure small minimum distances. However, ultrasonic attenuation is highly increased with high frequency and reduces in this way the maximum detectable distance.

B. Directivity

When an ultrasonic power is confined in a narrow beam, the power density increases and therefore the maximum detectable distance increases. However, a small highly focused transducers has to be carefully aligned, otherwise the transmitted beam can be out of the receiving transducer cone and could not be detected.

C. Acoustic matching

The maximum power transfer is achieved by matching the acoustic impedance of the transducer and the propagation medium. The proper choice of the operating parameters is quite delicate in the case of ultrasonic sensors for air applications. In fact, in this case, the attenuation of ultrasonic waves is much greater than that in the liquid at the same frequency, therefore, only relative low frequencies are adequate. The lower limit for the frequency should be higher than the acoustic frequencies of the mechanical parts around the meter (in order to discriminate this acoustic noise from the signal).

D. Switching frequency

The maximum frequency at which the sensor is capable of turning on and off depends on several variables. The most significant are target size, target material and distance to the target. The smaller the target, the more difficult it is to detect. Thus, maximum frequency for a small target will be lower than for a large target. Materials that absorb high frequency sound (cotton, sponge, etc.) are more difficult to sense than steel, glass, or plastic. Thus, they also have a lower maximum switching frequency. Target-to-sensor distance is very important in determining maximum switching frequency.

E. Inclination to ultrasonic beam, surface finish

If a smooth flat target is inclined more than ±3° to the normal of the beam axis, part of the signal is deflected away from the sensor and the sensing distance is decreased. However, for small targets located close to the sensor, the deviation from normal may be increased to ±8°. If the target is inclined more than ±12° to the normal of the beam axis, all the signal is deflected away from the sensor and the sensor will not respond. A beam striking a target with a coarse surface (such as granular material) is diffused and reflected in all directions and some of the energy returns to the sensor as a weakened echo.

2. Methodology

Design the Low Cost Autonomous Vehicle

By using microcontrollers, ultrasonic sensors and a global positioning systems result in a low-cost autonomous vehicle that will navigate to a desired location with obstacle avoidance.

Monitor the Vehicle

The one of the most important objective of the project is vehicle monitoring for various sensors and real time vehicle tracking . Vehicle will also sense the signal status and control the vehicle using signal status, if the signal status is green then vehicle will operate in normal mode, but red signal is detected the vehicle will be operate in automatic breaking mode.

Collision Detection and Accident Avoidance with Vehicle Tracking

Cars can run automatic braking due to obstacles when the sensor senses the obstacles. The braking circuit function is to brake the car automatically after received signal from the sensor. If the car speed decreases then breaks will be applied to avoid the possible accident.

Intercommunication between Two Vehicles

The system in which the cars that are close will communicate with each other on a RF link. The cars will communicate about the current speed. The cars can also communicate about the traffic condition, Weather condition etc.

3. Implementation

The proposed system will be designed to avoid a direct collision to the obstacle. For this system design the car model that represent to car. Here the car will be equipped with an ultrasonic sensor which will continuously track for any obstacles from the front side.

If the obstacles are detected then the microcontroller will continuously compare the distance given by the ultrasonic sensor. If the obstacle is at a safe distance then the car will keep going at the same speed. If the distance keeps reducing indicating that the obstacle is coming closer to the current car then the microcontroller will start informing to the driver until the distance is within safe parameters. This process will continue in a loop until the car comes to a Stop.

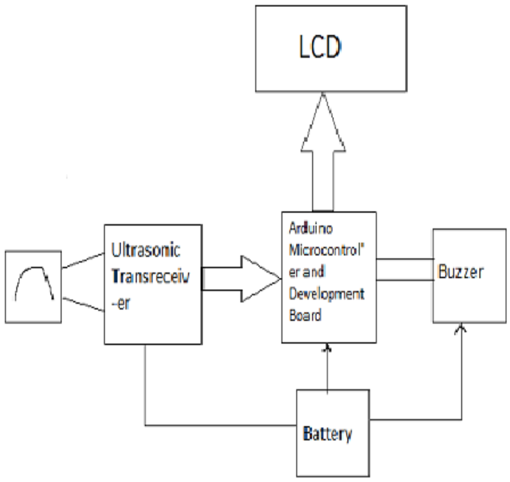

Figure 1 System Architecture

A. System Architecture

This device can measure distance in the range of 0.5m to 4m with the accuracy of 1cm.This project is used to measure the distance by using ultrasonic sensors. It works by transmitting ultrasonic waves at 40 kHz. Then, the transducers will measure the amount of time taken for a pulse of sound travel to a particular surfaces and return as the reflected echo. After that, the circuit that have been programmed with AT mega microcontroller will calculate the distance based on the speed of sound at 25°C which an ambient temperature and also the time taken. The distance then will be display LCD modules.
The importance of the project is calculating accurate distance from any obstacle that we want to measure. The device can be used in many different fields and

categories like distance calculation in construction field, robots, car sensor to avoid obstacles and many other applications.

4. Conclusion

In this work, we studied the discrete distances to moving objects can be detected and measured. Less affected by target materials and surfaces, and not affected by color. Solid-state units have virtually unlimited, maintenance free life. Can detect small objects over long operating distances. Resistance to external disturbances such as vibration, infrared radiation, ambient noise, and EMI radiation.

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