Design and Development of Obstacle Detection System for Low Ground Clearance Vehicle

[1]Neha Sose, [2]Sonali Pawar, [3]Ruchita Gaikwad, [4]Aarti Kuwar, [5]Prof. D. S. Thosar

[1,2,3,4]UG Student, [5]Professor, [1,2,3,4,5]SVIT COE Nashik, Department of Computer Engineering, Nashik, Maharahstra, India.

[1]nehasose@gmail.com, [2]prdsonali442@gmail.com, [3]ruchitagaikwad23@gmail.com, [4]aartikuwar2014@gmail.com, [5]devidas.thosar@rediffmail.com

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 coloured 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. The importance of the project is calculating accurate distance from any obstacle that we want to measure.

Keywords : Obstacle Detection, AT Mega Microcontroller, Distance.

I. INTRODUCTION

For some time, engineers also having a problem in measuring the distance in the narrow area or dangerous area that contains radioactive or chemical solution. The measure tape is not suitable for this type of measurement because the place is dangerous [1]. To remedy this condition a range meter that uses an ultrasonic has been developed. It will meet the standard speciation and also has the high accuracy for the measurement.

In this new era, a device that uses a sensor is more suitable for measuring the distance. The main aim of this project is to develop the measurement instrument by using ultrasonic sensor and a microcontroller [2][3]. Also most car accidents occurring lately happen when the driver loses his concentration. Hence a device measuring the distances from the surrounding cars and alert the driver when a dangerous situation occurs was a strong motivation for the invention [4].

Fig: A

Fig: B

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 [1][5]. 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 [6][7].

A. Characteristics

a. Operating frequency [6]

The choice of the operating frequency requires a compromise between connecting 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 [6]

When an ultrasonic power is con_ned in a narrow beam, the power density in creases 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 [7]

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 [8]*

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 [8]*

If a smooth at target is inclined more than 3 to the normal of the beam axis, part of the signal is detected away from the sensor and the sensing distance is de-creased.

B. System Features [8]

a. 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.

b. 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.

c. 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.

d. 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.

II. LITERATURE SURVEY

The present invention relates generally to a collision avoidance control system which works to initiate collision avoidance action when the danger of possible collision with a target present ahead of a vehicle is encountered [1]. Automotive collision monitor systems are known which work to estimate stopping distances of a system-equipped vehicle and a target preceding vehicle travelling ahead of the system equipped vehicle and locations of the system equipped vehicle and the target preceding vehicle after the elapse of a preset time to determine the danger of possible collision with the target preceding vehicle based on the stopping distances and the locations [10].

A collision avoidance control system comprising a travel control apparatus working to determine a target acceleration as functions of a distance to the target object and the relative

speed and to decelerate or accelerate the system vehicle based on the target acceleration to control a travel condition of the system vehicle, and wherein the deceleration control activating threshold value is set greater than a maximum deceleration controllable by the travel control apparatus.

III. 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 [2]. Then, the transducers will measure the amount of time taken for a pulse of sound travel to a particular surfaces and return as the reected echo. After that, the circuit that have been programmed with AT mega microcontroller will calculate the distance based on the speed of sound at 25C which an ambient temperature and also the time taken [3]. The distance then will be display on a LCD module Below Block Diagram are shows.

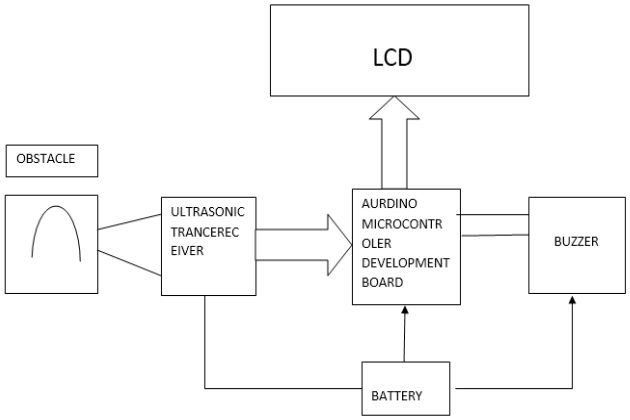

Fig. 1 Block Diagram

The importance of the project is calculating accurate distance from any obstacle that we want to measure [5]. 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].
In this new era, a device that uses a sensor is more suitable for measuring the distance. The main aim of this project is to develop the measurement instrument by using ultrasonic sensor and a microcontroller [6].

Also most car accidents occurring lately happen when the driver loses his concentration. Hence a device measuring the distances from the surrounding cars and alert the driver when a dangerous situation occurs was a strong motivation for the invention.

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 [7].

Available as an optional extra is the Serial LCD Firmware, which allows serial control of the display. This option provides much easier connection and use of the LCD module. The firmware enables microcontrollers (and microcontroller based systems such as the PICAXE) to visually output user instructions or readings onto an LCD module. All LCD commands are transmitted serially via a single microcontroller pin. The firmware can also be connected to the serial port of a computer [10].

A. Application

1. Robotic Sensing.
2. Industry Sectors.
3. Medical ultra-sonography.
4. Radar and Sonar System

IV. RESULT ANALYSIS

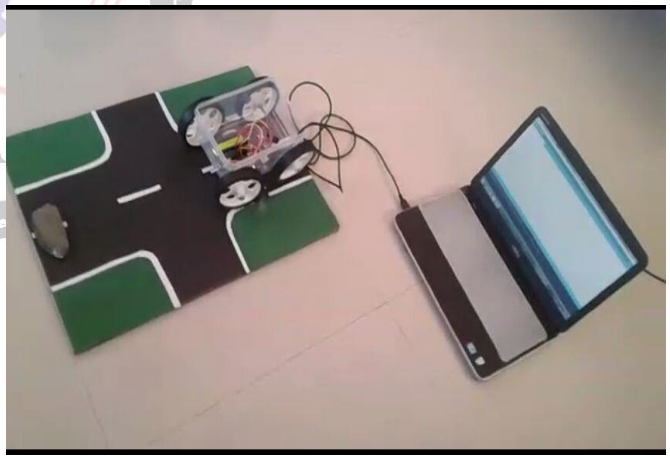

Fig. 2 Arduino Uno

A. Arduino Uno

The fig 2 are shows in Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to

get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip.

B. Alphanumeric Display

Alphanumeric displays are used in a wide range of applications, including palmtop computers, word processors, photocopiers, point of sale terminals, medical instruments, cellular phones, etc. The 16 x 2 intelligent alphanumeric dot matrix display is capable of displaying 224 different characters and symbols. A full list of the characters and symbols is printed on pages 7/8 (note these symbols can vary between brand of LCD used). This booklet provides all the technical specifications for connecting the unit, which requires a single power supply (+5V).

C. Ultrasonic Ranging Module HC - SR04

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm.

The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

(1) Using IO trigger for at least 10us high level signal,

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

(3) IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.

Test distance = (high level time×velocity of sound (340M/S) / 2.

V. CONCLUSION

ATR has studied the LGCVDS concept with surveys, analysis, modeling & simulation, and hardware demonstration; refined the proposed LGCVDS concept; and achieved a feasible and cost-effective design solution in this SBIR Phase I contract. In the follow-on phases, ATR will evolve the feasible LGCVDS concept and seek to demonstrate it as an effective and reliable system. The system should be employed on highway-rail crossings and steep humps on roads.

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