DESIGN AND FABRICATION OF COLLISION DETECTION USING ULTRASONIC TRANSDUCER

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ABSTRACT

Vehicle technology has increased rapidly in recent years, particularly in relation to braking system and sensing system. In parallel to the development of braking technologies, sensors have been developed that are capable of detecting physical obstacles, other vehicles or pedestrians around the vehicle
This development prevents accidents of vehicles using Stereo Multi-Purpose cameras, Automated Emergency Braking Systems and Ultrasonic Sensors. The stereo multi-purpose camera provides spatial intelligence of up to 50 metres in front of the vehicle and there is an environment recognition of 500 metres.An ultrasonic wave emitter provided in a front portion of an automatic braking car producing and emitting ultrasonic waves frontward in a predetermined distance in front of the car. Ultrasonic receiver also formed in a front portion of the car operatively receiving a reflective ultrasonic wave signal as reflected by obstacles positioned within the pre-determined distance in front of the automatic braking car. The reflected wave (detection pulse) was measured to get the distance between the vehicle and the obstacle.Integrated safety systems are based on three principles. They are: collision avoidance, collision mitigation braking systems and forward collision warning.

1.INTRODUCTION

Acoustics, the science of sound, starts as far back as Pythagoras in the 6th century BC, who wrote on the mathematical properties of stringed instruments. Sir Francis Galton constructed a whistle producing ultrasound in 1893. The first technological application of ultrasound was an attempt to detect submarines by Paul Langevin in 1917. The piezoelectric effect, discovered by Jacques and Pierre Curie in 1880, was useful in transducers to generate and detect ultrasonic waves in air and water. Echolocation in bats was discovered by Lazzaro Spallanzani in 1794, when he demonstrated that bats hunted and navigated by inaudible sound and not vision. Ultrasound is defined by the American National Standards Institute as "sound at frequencies greater than 20 kHz."Driving is a compulsory activity for most people. People use their car to move from one place to other place. The number of vehicle is increasing day by day. It is produced tacked tightly and risk to accident. Nowadays, the numbers of accident is so high and uncertainly. Accident will occurs every time and everywhere and cause worst damage, serious injury and dead. Accidents are caused mostly due to the delay in applying of brakes. This work 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. This work is about a system that can control braking system for safety. Using ultrasonic as a ranging sensor, its function based on ultrasonic wave. After transmit by transmitter, the wave can reflect when obstacle detected and receive by receiver. The main target for this project is, car can automatically 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. To prevent these accidents of vehicles from taking place we are using Automated Emergency Brake Systems and Ultrasonic Sensors. The main target for this project is, car cans automatically 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. The avoidance of accidents and mitigation regarding their consequences are the integrated techniques followed by us. Under the unique term "Perceptive Drive", we systematically pursue this method with numerous new assistance systems, greatly enhanced purposes and upheaval defensive systems.The Perceptive Drive changes the vehicle into a "perceptive associate". This identifies a particular range of dangers and proposes support through audible, visual and tactile warnings, also being able to augment the driver's.

2.EXISTING COLLISION DETECTION TECHNIQUES IN AUTOMOBILE

Traditionally, radar and laser systems have been used on cars for adaptive cruise control and collision avoidance. These sensors typically work at inter-vehicle spacing greater than 1 m. They do not work at very small inter-vehicle spacing and further have a very narrow field of view at small distance. Collision prediction based on sensing at large distances is unreliable. For example, even if the relative longitudinal velocity between two vehicles in the same lane is very high, one of the two vehicles could make a lane change resulting in no collision. An imminent collision can be reliably predicted enough to inflate air bags only when the distance between vehicles is very small and when it is clear that the collision cannot be avoided under any circumstances. Radar and laser sensors are not useful for such small distance measurements. Radar or a laser sensor can cost well over $1000.

Hence, it is also inconceivable that a number of radar and laser sensors be distributed all around the car in order to predict all the possible types of collisions that can occur. It should be noted that camera-based image processing systems suffer from some of the same narrow field of view problems for small distances between vehicles. An ultrasonic level or sensing system requires no contact with the target. For many processes in the medical, pharmaceutical, military and general industries this is an advantage over inline sensors that may contaminate the liquids inside a vessel or tube or that may be clogged by the product. Both continuous wave and pulsed systems are used. The principle behind a pulsed ultrasonic technology is that the transmit signal consists of short bursts of ultrasonic energy. After each burst, the electronics looks for a return signal within a small window of time corresponding to the time it takes for the energy to pass through the vessel. Only a signal received during this window will qualify for additional signal processing.

3. COMPONENTS USED IN COLLSION DETECTION USING ULTRASONIC TRANSDUCER

3.1 TRANSDUCER

Transducers have a case to insulate them from electrical interference and a wire which receives and relays electrical inputs and outputs to the echo machine. The **active element** is made of **PZT crystal** and can be a single element or more commonly a phased array. Note the thickness of the PZT is generally 1/2 the wavelength of the ultrasound produced. In front of the PZT is a thin layer of material on the surface of the probe called the **matching layer**. Note that the thickness of the matching layer is generally 1/4 the wavelength of the ultrasound produced. The purpose of the matching layer is to try to maximize transmission of ultrasound from the PZT to the patient. Recall that when there is a large difference in impedance between two media, most sound will be reflected and little will be transmitted at the interface. There is a large difference in impedance between the PZT and skin. The matching layer and ultrasound gel have an impedance in between that of the PZT and the skin to reduce the amount of reflection at this interface and improve transmission into the patient

The ultrasonic receiver circuit consists of

1. Inverting amplifier
2. Rectifier & Filter
3. Comparator

3.2 INVERTING AMPLIFIER

The inverting amplifier is the most widely used of all the circuits. The output voltage V0 is fed back to the inverting input terminal through the R_f-R_1 network where R_f is the feedback resistor. Input signal V_i is applied to the inverting input terminal through R_1 and non-inverting input terminal of op-amp is grounded.The negative sign indicates a phase shift of 180^0 between V_i and V_0. The value of R_1 should be kept fairly large to avoid loading effect

4 MICRO CONNTROLLER (ATMEL89C51)

4.1 DESCRIPTION

A Micro controller consists of a powerful CPU tightly coupled with memory (RAM, ROM or EPROM), various I/O features such as Serial ports, Parallel Ports, Timer/Counters, Interrupt Controller, Data Acquisition interfaces-Analog to Digital Converter (ADC), Digital to Analog Converter (ADC), everything integrated onto a single Silicon Chip.Any microcomputer system requires memory to store a sequence of instructions making up a program, parallel port or serial port for communicating with an external system, timer / counter for control purposes like generating time delays, Baud rate for the serial port, apart from the controlling unit called the Central Processing Unit.The AT89C51 is a low power, high performance C-MOS 8-bit microcomputer with 4k bytes of flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel's high-density non-volatile memory technology and is compatible with the industry standard MCS-51 instruction set and pin out.The on-chip flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with flash on the monolithic chip, the AT89C51 is a powerful microcomputer, which provides a highly flexible and cost-effective solution to many embedded control applications.

4.2 FLASH MEMORY

4-kilo byte ROM is available in the Microcontroller. It can be erased and reprogrammed. If the available memory is not enough for the program, we can interface the external ROM with this IC. It has 16 address lines, so maximum of (2^16) i.e. 64 bytes of ROM can be interfaced with the Microcontroller. Both internal and external ROM cannot be used simultaneously.

4.3 INPUT OUPUT PORTS

There are four I/O ports available in AT89C51. They are port 0, port 1, port 2, and port 3. All these ports are eight bit ports. All these ports can be controlled eight-bit port or it can be controlled individually. One of the main feature of this micro controller is it can control the port pins individually. For example to control a LED we need to use one I/O line in Microprocessor with 8255 we have to use an eight bit port. In micro controller we can use only. In 89C51 port 1 is available for users Port 3 is combined with interrupts. This can be used as interrupts (or) I/O ports, ports 2 & port 0 is combined with address bus & data bus.All these port lines are available with internal pull-ups except port 0. If we want to use port 0 as I/O port we have to use pull up resistors. This Micro controller is working in a speed of maximum of 24MHz. This micro controller is available with inbuilt oscillator; just we have to connect the crystal to its terminal.

4.4 PWM

This a feature of the development board which takes in a varying duty cycle digital wave and gives its corresponding analog value to one of the pins controlling the motors. This pin decides the speed of the motor, thus a regulation in speed is achieved

4.5 RELAY

Relays are switching device. It is the heart of industrial electronic system. Every industrial electronic system required some type of switching device (or) relay. For the simplest photo-electric relay to the most advanced. Depending up on the basic force available for relay contact closing and opening there is several types of relays. Some of them are listed below:Electronic relays made of vacuum tubes, gas tubes solid state devices and saturable core reactions.Electromagnetic relays is form of electromagnets in which the coil current produces a magnetic effect to pull or push flat soft iron armatures of strips carrying relay contacts. Several relay contacts can be operated to get several possible ON/OFF combinations

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4.6 LCD (liquid crystal display)

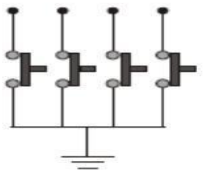
The LCD is a thin flat display device made up of microcontroller pixels arranged in front of the light source or reflector. It uses very small amount of the electric power and is therefore suitable for use in battery powered electronic devices.

4.7 BUZZER

A buzzer or beeper is a signalling device, usually electronic, typically used in automobiles, household appliances such as microwave oven, or game shows. It most commonly consists of a number of switches or sensors connected to the control unit that determines if and which button was pushed or if a pre-set time has lapsed, and usually illuminates a light on the appropriate button or control panel and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound.

4.8 KEYPAD

A numeric keypad, or number pad for short, is the small, palm-sized, seventeen key section of a computer keyboard, usually on the very far right. The numeric keypad features digits 0 to 9, addition (+), subtraction (-), multiplication (*) and division (/) symbols, a decimal point (.) and Number Lock and Enter keys. Laptop keyboards often do not have a number pad, but may provide number pad input by holding a modifier key (typically lapelled "Fn") and operating keys on the standard keyboard.



Key pad

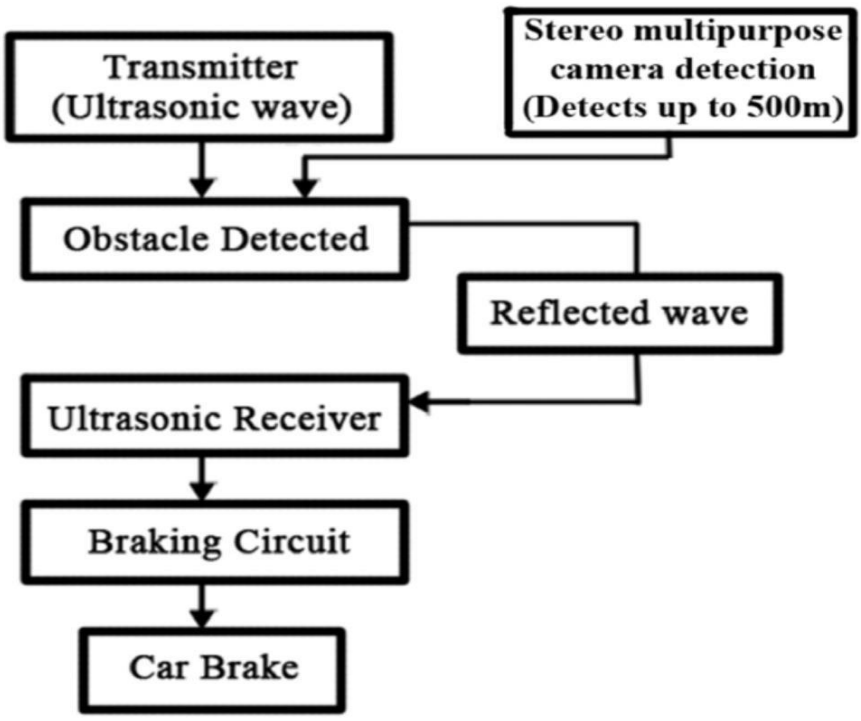
4.9 TRANSFORMER

Transformer is a static device, which transfers electrical energy from one alternating current circuit to another without change in frequency. The working principle behind its operation is faraday laws of electromagnetic induction, whichstates that, "whenever current carrying conductor is moved in a magnetic field, flux linked with the conductor changes and emf is induced in the conductor". Transformer is used in step down mode of operation in the sense it provides an output, which is reduced in form compared to input. It depends upon number of turns in the winding i.e., turns ratio. Primary winding is fed with a supply of 230v, 50Hz a.c, which appears as an voltage approximately 15v across secondary winding. This voltage is fed into the rectifier circuit for the purpose of rectification i.e., converting a.c. input to D.C. output. The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output.

5 WORKING OF THE ULTRSONIC TRANSDUCER IN COLLISION DETECTION

5.1 WORKING

The scope of this work is to develop a safety car braking system using ultrasonic sensor (Fig.1) and to design a vehicle with less human attention to the driving. Currently in cars there aren't technologies to prevent accidents. But they have introduced sensors that would detect any obstacles. Besides this it also gives an alert to the driver. In this work we are enhancing the existing work by introducing automatic brakes, which would get its input from the sensors, which will then generate the brakes and prevent from collisions to take place. Here a stereo multi-purpose camera provides spatial intelligence of up to 50 metres in front of the vehicle and there is an environment recognition of 500 metres. This camera provides spatial intelligence of up to 50 metres in front of the vehicle and there is an environment recognition of 500 metres. Vehicles driving ahead and pedestrians also have a variety of traffic signals and on-road markings that are detected and have been assigned a spatial grouping. The data from short-range ultrasonic sensors that are positioned all around the vehicle as well as from long-range ultrasonic sensors with approximate-range detection capabilities provides data on the distance from detected objects. The stereo-multiple camera helps in detection of objects, pedestrians, vehicles or people. This detection is very reliable. It produces a framework to detect objects that are in motion on road using a stereo camera. This system detects moving features There is ultrasonic transducer that will transform back the sound wave to electrical energy. This signal amplified by an amplifier. The amplified signal is compared with reference signal to detect components in the amplified signal due to obstacles on the road surface.The magnitude of the reference signal or the amplification factor of the amplifier is controlled to maintain a constant ratio between the average of the reference signal and the average of the amplified signal. This allows the ultrasonic sensor to examine the existence of vehicles.Once this is complete the sensors give an alarm as to an obstacle detected. The processed signal will be send to the braking circuit. The braking circuit here is also known as the Emergency Braking System. The Emergency Braking System is known as an independent road safety system designed for vehicles. This is able to detect incidents where the speed relative to this and the distance between the target and the host suggests here that a collision is impending. At the braking circuit, brake pressures are applied here automatically. This provides maximum brake boost instantly as soon as the driver engages the brakes. After this if the driver's steering actions or the brake that he applies is not sufficient to avoid a collision then the Emergency Braking System with the maximum pressure given by the brakes will be to support mitigation of the impact.



6. CONCLUSION

The framework of the proposed system is developed for a safety car braking system using ultrasonic sensor and to design a vehicle with less human attention to the driving. This technology could be further enhanced. The same can be implemented in aircrafts, submarines. But automatic brakes cannot be used always. So it can be replaced by action of automatic diversion with the help of various sensors such as radar sensors, distance sensors, etc. The stereo multiple camera has a kind of approach which also enables an assist to further develop the system to be able to detect slowly moving object in a very disturbed environment. There are experiments which are being conducted with challenging on-road datasets. The results displayed are that of a combined approach which outperforms than a feature-based approach in a disturbed environment.

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