



Use of Modern Technology in Reverse Car Parking System

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ABSTRACT

With the enlargement of automobile field, the number of owned cars is greatly increasing with correspondingly; the number of rookie drivers is strengthening as well. Many of them grumbled that their valuable cars are easily damaged by obstacles that are barely seen through their rear view mirror such as bikes and cycles. On the basis of market researcher survey that in 2010 the world’s car number belabours 6.9 billion, the number of cars yet to appear in the succeeding 8 years will be 1.16 times the current one. Multitudinous people specially pedestrians (person on foot) struck and injured from revoking vehicles each year all over the world. In Pakistan these casualties happen frequently because of immense population in addition many drivers are not fitly edified (toddlers). Many people use bikes or bicycles which are firm to sense while reversing a car for this reason the root notion of this research is to design a device, which will let a person to avoid accident, caused while parking in reverse by the help of ultrasonic sensor we can detect an object, and the collected frequency is detected and amplified. This amplified frequency is given to controller for additional outfits. The beeping as well as LCD display inside the car apprises the driver of the peril and avert a possible mishap.

Keywords: *Sensors, Modern Technology, Microcontroller, Hardware Components.*

1. INTRODUCTION

The reverse car parking system will be a well being gadget that will accurately spot all objects, as children’s, pets, and other autos, that are behind a vehicle. When a driver gears up in repeal manner, the structure will be animated without human entanglement and the sensor will sense the obstacles/ barriers and parade range to the driver. As the car gets nigh to the

hitch the driver will get a beep/LED indication and hence he/she will interlude the vehicle by applying brakes. Indeed, this system is imitation to avoid accidents when it may happen in reverse mode of parking. The exercise and implementation of this project can be applied to any vehicle in particular in public car parks, huge traffic, congested or populated streets or roads. It can also be used in garage or veranda for safe parking. The objectives are [10]:

- Execution of innovative technology in vehicles.
- To reduce the use of energy of maintenance, of a vehicles.
- To decline casualties and injuries caused to people.
- Dependable reverse parking.

The agenda of this fact finding is based upon three key steps; first step is to lodge to ultrasonic sensors. Ultrasonic sensors emit short, high-frequency sound pulses at smooth running meanwhile. These propagate in the air at the velocity of sound. If they strike on an object, then they are evinced back as echo signals to the sensor, which itself computes the distance to the target based on the time-span between emitting the signal and receiving the echo using equation one technique[2].

Distance = speed*time (1) As the distance of an object is determine by the time of duration of work or movement [5]. So that reflected signals are forwarded to the embedded system named microcontroller. The Automatic programmer system then lunches the function of the program to evaluate the distance where then it is transferred to indicators (LCD, LED’s buzzer/beep.

1. Block Diagram:

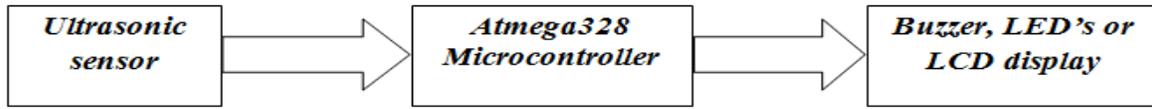


Fig. 1. block diagram of proposed system

A seriousness problem of the people around the world is increase in number of cars throughout the world, which is resulted a big problem in parking. It seizes years of driving experience and rigorous practices to avoid an ugly scratch across on vehicle body [8]. Consequently, it is concluded by researchers design an ultrasonic parking assistant system that will instruct the driver get a sense of how far his or her car is away from a wall or an object behind the car [7]. Table 1 explains the use of components:

Table 1: Use of Components [3]

COMPONENTS	Values	QUANTITY
Microcontroller	AT mega 328	1
Capacitor(electrolytic)	100uf, 10uf, 1uf	3
Resistors	Different Ohms	20
74HC04N Hex Inverter	Nil	1
74HC14N Hex Schmitt-Trigger Inverter	Nil	1
Ultrasonic sensors	Nil	2
PCB, Connecting wires	Nil	1, 4meter
Diodes	1N4148	5
Led, buzzer, lcd	Nil	6,1,1

The basic objective of this article based on the Sound Navigation and Ranging (SONAR) methodology that is used for researching the covered range and route of a remote object underwater by transmitting sound waves and diagnosing echo from it[2]. Firstly, a continuous of small ultrasonic pulses are proceed using a transducer that alters voltage Pulses into sound waves. The sending data is reflected off an object, and the reflected wave is then reached by another transducer that converts sound format data into voltage format. The transmitted signal is also represented by the name “ping” while received signal is called “pong”[4]. To estimate the flight time between the ping and the pong, the distance between the device and an object can be easily calculated by multiplying the flight time with the speed of sound. Note that the time measured represents the

time it takes a pulse to travel to an object plus the time it takes to travel back to the receiver. Hence, the measured time is halved in calculating the appropriate distance as shows equation II[9]:

$$\text{Distance} = (\text{Time elapsed}/2) * 340.29 \text{ m/s} \dots \dots \dots \text{II}$$

Since a single computation may misrepresent the actual distance, a integral received signals were sampled and averaged to give more accurate distance measurement. The calculated distance is then disintegrated into five portions that represent the level of proximity from the object as shown table 2

Table 2: Range of LED Light[3]

Distance Interval (cm)	LED light-up					
00 to 15	1	2	3	4	5	6
15 to 20	1	2	3	4	5	
20 to 25	1	2	3	4		
25 to 30	1	2	3			
30 to 35	1	2				
35+	1					

Based on the distance interval one or more LEDs will light up; the smallest distance (0 to 15cm) will turn on all six LEDs, the next shortest distance (15 to 20cm) will light up 5 out of 6 LEDs, and this process will goes on. Moreover to the representation of the distance with the LEDs, a piezo speaker is used to emit warning beeps based on the distance intervals shown above [7].

2. HARDWARE TRADEOFFS

The total parts of hardware pre owned in this research were off. If components that are widely used in simple Analog circuitry, hence using other parts from different manufacturer or vendor would not have given us better results. Like the 40kHz transducer it is used as transmitter and receiver was a generic component that has the same electrical features with any other 40kHz transducers. Even so, there was a high tradeoffs when choosing which range of voltage to use for the forwarding signal. During our

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hardware-testing phase, we found out that the effective range of our system is proportional to the power of the transmitted signal. High range was initially preferred, but it is also know that maximum power achieved by using operational amplifier will also amplify the noise ratio error. The effective space of the used device was important, but acquiring clean square pulses were much more important in terms of doing calculation with the received signal. The voltage range of the transmitted signal can be modified up to +18V but by reason of spikes and noise ratio the outcome consist of random calculation. Degrading the value down to +12V gave an acceptable outcome, and also has a practical use in vehicles of 12V that can easily tapped from the fuse box of any standard cars.

3. SOFTWARE TRADEOFFS

The key software tradeoffs have the arrangement of timing. The main priority is to produce a box of signals at the functional frequency of the transducer up to 40 kHz which means it is forbidden to only one interrupt; having more than one implied an overlap of the interrupt meaning one was going to be missed. Being limited to one timer also states that it is

freedom to code is limited. In order to generate the pulses it is necessary to limit the capacity that expands the properties:

Timing: up to 40 kHz pulses it can't have a rapid interrupt, so the timing of the pong is limited to the fastest interrupt that it could have generate the pulses.

Sound: having single interrupt limited capacity to generate accurate sound [10].

To attain rapid reading on a data signal it is need to easy code. This meant that the interrupt had to be fairly fast which could not further exploit the interrupt without causing some problems in the functionality of the system [9].

4. DESIGNS TANDARDS & INTELLECTUAL PROPERTY CONSIDERATION

As shown in Fig 2 the architecture is a single portable device that does not interact with any secondary device. Many number of sensor system used for parking consist of a simple design and has largely name in market.

5. COMPLETE SCHEMATIC CIRCUIT

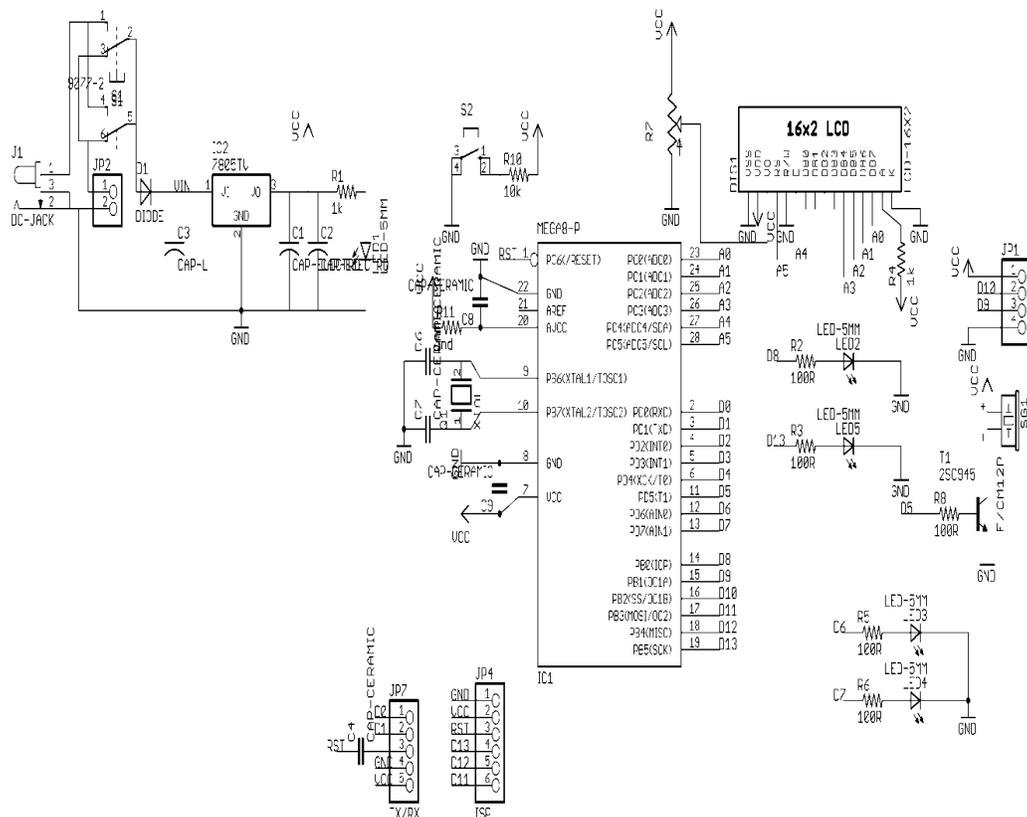


Fig. 2. Circuit diagram of Proposed system

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The hardware circuit is broken down into two main sub-circuits the transmitter circuit and receiver

circuit. The basic schematic diagram of the transmitter circuit is shown in Fig. 2.

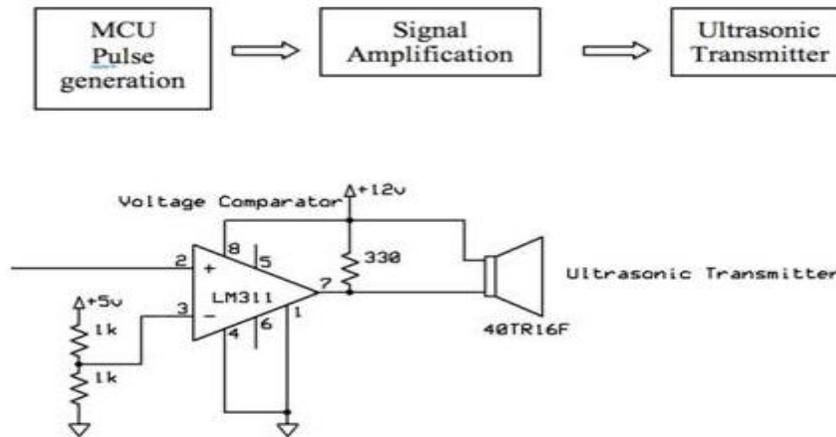


Fig. 3. System Transmitter Circuit[5]

A series of five short pulses are applied by the microcontroller only has 5V of magnitude, which will be attenuated down to less than 20 mV when attained by the receiver circuit. Therefore (LM311) voltage comparator is used for signal modification before transmitting the signal. LM311 is used instead of regular operational amplifier since it has faster switching speed. Low-to-high and high-to-low level output response times duration is 115ns to 165ns, which is better for proposed architecture and the space of each pulse of data is 12.5micro of seconds. The voltage comparator compares the 5V input generated by the (MCU), If this voltage portion of the input pulse is larger than that of the value of 2.5V the outputs 12V drawn from the power

supply and drives the ultrasonic transducer, otherwise it outputs zero that's why 5V input data are amplified to 12V . The ultrasonic transducer used to convert its input into sound pulses and forwarded these pulses to next process at 40 kHz rate of frequency. Once the transmitted wave collide with an obstacle it is reflected back and received by another ultrasonic transducer that functions as a receiver such process is shown in Fig :5.

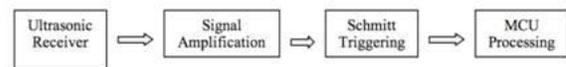


Fig. 5. Function of transducer [6]

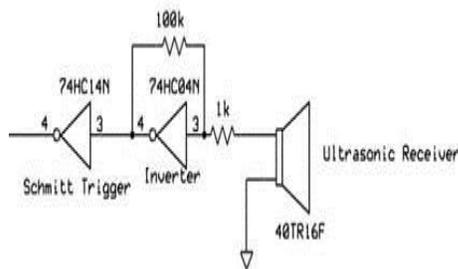


Fig. 4. System Receiver Circuit [5]

Firstly, the ultrasonic transducer converts the received sound wave into voltage. The received signal was only about (50mV), which means that it has to be amplified by a factor of 100 to get a 5V

signal. Therefore (74HC04N) Hex Inverter with 100k ohm/1k ohm resistor pair is used to achieve a gain of 100. The propagation delay of the inverter is 19ns, with not concern of switching speed. The inverted and amplified signal is then inputted to a (74HC14N) Schmitt Trigger to produce a better square wave. The value below the trigger voltage (2.5V) gave logical zero (0V) and the value above (2.5V) gave logical high (5V). it must be remember that the inverted signal from the inverter is inverted back by the Schmitt trigger. The output of the Schmitt trigger is then fed into port B.1 where then it is received by microcontroller for the purpose of processing and distance estimation.

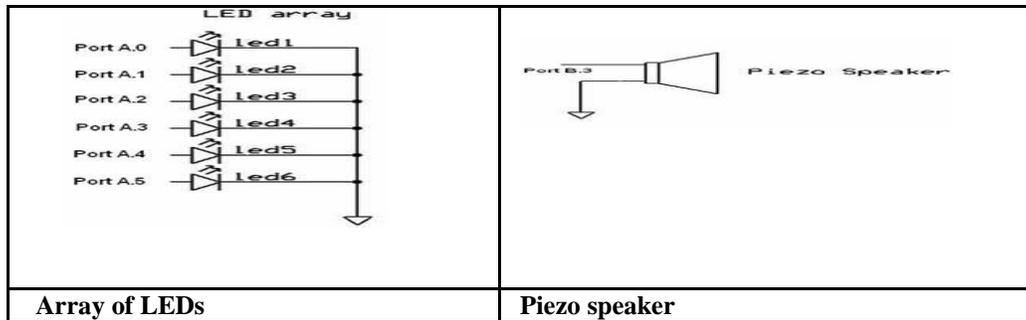


Fig. 7. LEDs Array & Piezo Speaker [8]

An array of 6 number of LEDs and a piezo speaker is connected to port A and port B as available in Fig: 7 where three respectively to warn the user of his or her proximity from the interfering obstacle as it is discussed in High Level Design.

6. SOFTWARE DESIGN

The designed program is divided into four different procedures:

i) Interrupt [TIM2_COMP] t2_compare (void)

The interrupt frequency is up to 160 kHz In order to obtain this which is used no pre scalar on the clock and set (OCR2) to 49 and TCCR0 is set to compare on match. The key functionality of the interrupt is to generate 5 levels up to range of frequency at 40 kHz. So it is then implemented a counter that sets (PORTB.0) toggling that after each part second pass through the interrupt. After five regular series of pulses have been emitted it is then wait for the counter to reach 700 (4.375 ms)[7]. The delay duration of time is the equivalent of sound traveling a length of (1.49 m), which means that it gave a range of 70 cm. In practice this range could not be obtained with addition it is searched on emitting a series of five short pulses instead of one since it delivers more power. It is tested with a range of 1 to 8 pulses in a set of ping and The best results came from 5 pulses, meaning that the received signal was stronger when 5 pulses are emitted [12].

ii) Void light flashing (void)

Main objective of this procedure is to flash on the LEDs where then LEDs are determined for purpose of upper and lower boundaries, that came to be 40cm and 15cm respectively, So with this data is fragmented up to range into 6 different distance intervals. When a pong is received then it is estimated the average covered path to find the space between objects. The closer the object is to the transducers more LEDs will be lighted up.

iii) Void sound gen (void)

The third procedure generates a beeping sound on the basis of the distance of the object. The same ranges are used as light flashing to achieve congruency between the LEDs and the sound, Moreover a function generator is used to produce sound with a sine wave and with a square wave. Again using the function generator it is decided to run the wave up to 4 kHz of frequency range. The way in which the procedure produces the sound is simply by setting and clarifying (TCCR0). The speed at which the (TCCR0) set and reset depends on the proximity of the object, the closer it is the shorter we make the intervals. TCCR0 is set to run on Compare on match, with a pre scalar of 256 and OCR0 set to 7. OC0 is toggled on every match.

iv) Void main (void)

The key function begins by initializing all the timers and counters, as well as any variable that needed to be set. Within the while loop we only have to “ if ” statements. The first one reads PINB.1 to detect any pong. It also checks that all five pulses have been emitted by checking that count is beyond 40 revolutions. It is need to perform this check because each time it emit pulses the receiver picks up some noise ratio that could be read as a pong by the (MCU). If a pulse is detected then it will immediately read the number of cycles that elapsed from the first pulse until the pong detected. Once this we perform then appropriate operations to calculate the distance in cm. Since we are running the interrupt at 160 kHz this means that every cycle represents .2125 cm ((1/160000) Sec * 340 m/Sec)[9]. Multiplying the number of cycles by this factor and dividing by 2 (to account for the distance to the object and back) we calculate the actual distance. With this data we run a running average of 7. We decided on obtaining an average because that way we reduce any errors in our readings. We chose 7 by experimentation. We tried a range of 5 to 20 running average calculations, but we observed that after 7 the improvements in the calculations began to be insignificant. From within this “ if ” statement we also call sound gen and light flashing, but we do this once the

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average for that cycle has been calculated. The other “ if ” statement checks to see if more than 20 consecutive set of pulses have been emitted without any response. If so it turns off any LEDs and sets (TCCR0) to zero (turns sound off). This amount of sets was determined by experimentation as well. We tried different quantities starting at 6, but they would be too fast. We scaled them by 2s until we got to 20 and got appropriate results from the system.

7. CONCLUSION

Our system can detect an object within a range of 40cm with accuracy of about 1cm in the distance interval of 15 to 40cm. If we were to do this project again, we would try to increase the effective range and enhance the accuracy by implementing some kind of noise reduction circuit. Furthermore, we would like to implement an array of ultrasonic receiver so that we can determine the location of the object with respect to the ultrasonic transmitter. Finally, usability of the system can be improved by making it completely portable and attachable to the bumper of any commercial vehicles.

REFERENCES

- [1] <http://wardsauto.com> Accessed.2012.02.14
- [2] <http://www.electronicshub.org/reverse-parking-sensor-circuit/>
- [3] <http://www.futurlec.com/News/Dallas/Dallas8051.html>
- [4] www.doityourself.com/trouble-shooting/your-reverse-car-parking-system
- [5] <http://www.microsonic.de/en/Interesting-facts.html>
- [6] [http://www.migatron.com/whois-2.Ultrasonic Parking Assistant Handheld Ultrasonic Rangefinder Atmel Mega32 Microcontroller](http://www.migatron.com/whois-2.Ultrasonic-Parking-Assistant-Handheld-Ultrasonic-Rangefinder-Atmel-Mega32-Microcontroller)
- [7] Texas Instrument LM311: Differential Comparator
- [8] Texas Instrument 74HC04N: Hex Inverter
- [9] Texas Instrument 74HC14N: Hex Schmitt-Trigger Inverter
- [10] V.W.S. Tang, Y. Zheng, J. Cao, “An Intelligent Car
- [11] Park Management System Based On Wireless Sensor
- [12] Networks”, 2006 1st International Symposium On Pervasive