Ultrasonic Vehicle Safety System for Obstacle Avoidance
P Kettararavinthnathan\textsuperscript{1} M Dinesh Kumar\textsuperscript{2} M. M. Pravin Kumar\textsuperscript{3} Arutselvi.S\textsuperscript{4}
\textsuperscript{1,2,3}Department Instrumentation & Control Engineering
\textsuperscript{4}Saranathan College of Engineering, Trichy, India

Abstract— In this paper we deal with the obstacle avoidance system for automated wheel chair used by the disabled persons. Our project aims at building virtual instrument that makes the vehicle to apply brake system automatically, when there is any obstacle in front of the vehicle. It is detected and sensed by the ultrasonic sensor and its gives the output voltage to MYRIO. It is myRIO which interface the LabVIEW and the pc. LabVIEW (Laboratory virtual instrument engineering work bench) is a graphical programming language that uses an icon instead of lines of text to create an application. The LabVIEW programs can be fetched over myRIO & can be operated through Wi-Fi.

Key words: Ultrasonic sensors, myRIO, LabVIEW, DC Motors

I. INTRODUCTION
Ultrasonic sound is a cyclic sound pressure with a frequency greater than the upper limit of human hearing(20 KHz). It can be used for obstacle detection. An ultrasonic pulse is generated in a particular direction. If there is an object in path of this pulse, part or all of the pulse will be reflected back to the transmitter as an echo and can be detected through the receiver path. By measuring the difference in time between the pulse being transmitted and the echo being received, it is possible to determine how far away the object is. Since these waves cannot be seen, they provide a base for security systems. In this project, detection of distance of an approaching target is done using ultrasonic transceivers.

This sensor contains an ultrasonic transmitter and receiver, which will provide a voltage output proportional to distance of the target. The target in this case is an obstacle like stationary objects and human beings at the place where the wheelchair with smart driving assistance is operated. An ultrasonic sensor transmits ultrasonic waves into the air and detects reflected waves from an object. There are many applications for ultrasonic sensor, such as automatic door openers, back up sensors for automobiles. Accompanied by the rapid development of information processing technology, new fields of applications, such as factory automation equipment and car electronics, are increasing nowadays.

The scope of the project is that when obstacle is present in front of the wheelchair, the speed of the wheelchair can be controlled, instead of applying brakes manually at situations. So the project can be developed by implementing throttle control. The main objective of project is to provide safety mode of wheelchair by using a driving assistance made of ultrasonic sensors and virtual instrumentation. Virtual instrumentation provides a platform for implementing various processes at industries and at lower levels too.

The flexibility and versatility of the virtual instruments helps to create a foundation for all engineering applications, making it cost effective, real time, and debugging tool.

II. HARDWARE COMPONENTS
- Ultrasonic sensor
- Power supply
- Driver circuit
- myRIO
- DC motor

A. Features of Ultrasonic Distance Sensor:
- Measurable distance of 10cm to 400cm(4m)
- 5DC supply voltage
- Compact sized SMD design
- Accuracy of ±1cm
- Modulated at 40 KHz
- Resolution 0.1cm

The myRIO takes information from three ultrasonic sensors which measure the distance from the chair to an obstacle located in different positions of the wheelchair.

The output from the sensors is in the voltage range of 0-10V. The voltage increases as the density of the sound received by the sensor becomes high. The increase and decrease in the density of sound waves received by the sensors indicates how far the obstacle is away from the wheel chair. The output voltage from sensor is sent to myRIO, which in turn controls the speed of the motor.

B. Ultrasonic Sensor:
Ultrasonic sensors have a transducer vibrates at ultrasonic frequencies. Ultrasonic transducers are transducers that convert ultrasound waves to electrical signals or vice versa. Those that both transmit and receive may also be called ultrasonic transceivers; many ultrasonic sensors besides being sensors are indeed transceivers because they can both sense and transmit. It produces the pulses which are emitted in a cone shaped beam and aimed at a particular object and it measures the time delay between the emitted and echo pulse to determine the target object. They detected clear transparent and shiny target as easily as dark and opaque material.

Fig. 1: Ultrasonic Sensor

C. Driver Circuit:
In electronics, a driver circuit is an electrical circuit it is used to control another circuit or a components such as
liquid crystal display (LCD), transistor. An amplifier also considers as a driver for voltage circuit that keep attached components operated within a broad range of output voltage.

**Fig. 2: Driver circuit**

### D. Power Supply:

The Lead acid battery of 12 voltages is given as a power supply to the driver circuit of the system. Lead acid storage baterry cells consist of lead peroxide (PbO₂), spongelead (Pb), dilute sulfuric acid (H₂SO₄). In which electrical energy can be stored as a chemical energy is then converted to electrical energy required.

**Fig. 3: power supply**

### E. MyRIO:

**Fig. 4: schematic view of NI-myRIO**

It is a hardware device works under the LABview software package developed by the national instruments. It is used to acquire the real time signals. Signals can be acquired and processed in LabVIEW and the generated signals can be used in real time. It consists of two expansion ports (MXP) connectors A and B carry identical set of signals and both have 34 pin outs and a mini system port (MSP) called Connector C. It provides the connection with computer through USB or wireless connectivity. NI-myRIO has 3.3v, 5v, +/- 15v power output.

### F. DC Motor:

There are three main components of motor used in these ultrasonic based safety system vehicles are:

1. Motor
2. Rotary to linear motion converter mechanism
3. Parking switch.

This mechanism is used to convert rotary motion to linear motion and the motors are driven at low or normal speed just if the dash switch is being still on. The motor we used in our project is a 30RPM gear motor. The voltage & current ratings are 12V & 5A respectively.

**Fig. 5: 30rpm DC Gear motor**

### G. LabVIEW:

Laboratory Virtual Instrumentation Work Bench abbreviated as LabVIEW is a Virtual programming language. LabVIEW is a highly productive, development environment for creating custom application that interacts with the real world signals in fields such as science and engineering.

LabVIEW is a dataflow programming language. Execution is determined by the structure of a graphical block diagram (the LabVIEW-source code) on which the programmer connects different function-nodes by drawing wires. These wires propagate variables and any node can execute as soon as all its input data become available. Since this might be the case for multiple nodes simultaneously, G(LabVIEW) is inherently capable of parallel execution.

LabVIEW consists of mainly three parts for the user interfacing, they are: Front panel, block diagram and connector panel. All of the objects placed on the front panel will appear on the back panel as terminals. The back panel also contains structures and functions which perform operations on controls and supply data to indicators. The structures and functions are found on the Functions palette and can be placed on the back panel. Collectively controls, indicators, structures and functions will be referred to as nodes. Nodes are connected to one another using wires.

LabVIEW 2014 is implemented in our project which is useful for interfacing the myRIO, which in turn can
easily interface many hardware and software components easily. Thus LabVIEW acts as a useful interfacing component & avoids the usage of components of larger size.

III. BLOCK DIAGRAM

![Block diagram of obstacle avoidance](image)

Fig. 6: Block diagram of obstacle avoidance

A. Driving Assistance:

The basic idea of the driving assistance module (the Driving Assistant) is to detour obstacles in a way that is most likely to be acceptable for the user. By taking into account the desired travelling direction in terms of the curve indicated by the user via the joystick or another device that gives similar directions, the assistant decides whether to avoid an obstacle, and if yes, to which side, i.e. to the right or to the left. The Driving Assistant controls both speed and steering of the wheelchair. The speed is always reduced in a way that the wheelchair cannot collidewith the obstacles in the environment. The steering is controlled to avoid obstacles to the side the user intends to, or not to avoid an obstacle if the user directly heads toward it. In the latter case, the wheelchair would simply stop to prevent a collision.

Calculate the range through the time interval between sending trigger signal and receiving echo signal. The Ultrasound Sensor is a very affordable proximity/distance sensor that has been used mainly for object avoidance in various robotics projects.

1) Formula:

\[ \text{Range} = \text{high level time} \times \text{velocity (340M/S)} / 2; \]

IV. SIMULATION AND RESULTS

The following depicts the block diagram and front panel window of the simulation.

A. Block Diagram:

![Block diagram for ultrasonic sensors](image)

Fig. 7: block diagram for ultrasonic sensors

In block diagram the analog input represents the output from the ultrasonic sensors to myRIO, which is then compared whether the output voltage is below the maximum acceptable voltage. The analog output (0-5volts) is the power supply to the ultrasonic sensors. The LED’s in the front panel indicates the response of the ultrasonic sensors and running status of the motor.

![Front panel for ultrasonic sensor](image)

Fig. 8: Front panel for ultrasonic sensor

V. CONCLUSION

Thus the smart driving assistant module has been implemented successfully. The main profit of the project of avoiding the obstacles on the path of the wheelchair is achieved using the smart driving assistance containing LabVIEW and myRIO.

REFERENCES


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