

Safety Car Drive by Using Ultrasonic And Radar Sensors

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Abstract - In this thesis we present the car needs to brake in several situations when the traffic light is red, **when it's to close to the car a head, when another vehicle or pedestrian cuts in front.** Green signals to intimate to the user ready to go by the signals. Over speed can be intimate to the user by the alert sound signals. a) Sensors: that can be connected to your wheel or bumper, to detect objects close to your car. As of today , BMW is building prototypes that use ultrasonic and radar sensors to detect objects. b) 3D imaging device: Google uses LIDAR-the spinning laser radar system to capture 3D Image of environment to input in to the overall data model, and feed into the various **programmers'. c) Cameras: video stereo and infrared cameras that spot road markings, traffic signals and direction signs. Stereo cameras specifically help with capturing 3D images .we implement the c programmed into mat lab which gives best result.**

Keywords: Sensors¹, ultrasonic², programme³, 3D Image⁴, LIDAR⁵.

1. INTRODUCTION

An autonomous vehicle is one in which a computer performs all the tasks that the human driver normally would. Ultimately, this would mean getting in a car, entering the destination into a computer, and enabling the system. From there, the car would take over and drive to the destination with no human input. The car would be able to sense its environment and make steering and speed changes as necessary. This scenario would require all of the automotive technologies: lane detection to aid in passing slower vehicles or exiting a highway; obstacle detection to locate other cars, pedestrians, animals, etc.; adaptive cruise control to maintain a safe speed; collision avoidance to avoid hitting obstacles in the roadway; and **lateral control to maintain the car's position on the roadway.**

Sensors would be needed to alert the car to road or weather conditions to ensure safe traveling speeds. For example, the car would need to slow down in snowy or icy

conditions. We perform many tasks while driving without even thinking about it. Completely automating the car is a challenging task and is a long way off. However, advances have been made in the individual systems. Cruise control is common in cars today. Adaptive cruise control, in which the car slows if it detects a slower moving vehicle in front of it, is starting to become available on higher-end models.

Some cars come equipped with sensors to determine if an obstacle is near and sounds an audible warning to the driver when it is too close. General Motors has stated that they will begin testing driverless cars by 2015, and. Volvo has begun to develop an almost-autonomous 'road train' system for highways which could be integrated in cars by 2020.

1.1 wireless sensor

A robot is more than just a radio-controlled vehicle with extra parts. Both a radio-controlled car and a robot can move around using onboard power and motors, and both can be controlled via radio waves. The robot, however, has two critical capabilities that the simple R/C car does not. The robot can sense its environment, and the robot can adjust its own behaviors based on that knowledge. Sensors are the beginning of that process. A sensor will generally tell the robot About one very simple **thing in the environment and the robot's program will interpret that information to determine how it should react.** The Bumper Switch sensor, for instance, will tell the robot whether it is in contact with a physical object or not. Depending on how the sensor is set up, this can tell the robot a lot of different things. If the sensor is mounted on the front bumper, the robot could use this information to tell whether it has run into an obstacle, like a wall inside a maze. By making good use of sensors to detect the important aspects of its environment, a robot can make things much easier for its human operator. Shown fig 1.1.1 a robot can even operate completely independent of human control, autonomously.

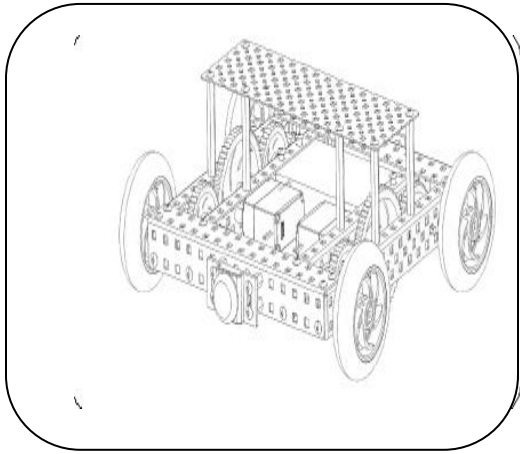


Fig1.1.1 robot operate by automatically.

There are a myriad of sensor options available to you in the VEX Robotics Design System. Some of these include ultra-sonic range finders and light sensors Shown in fig 1.1.2.

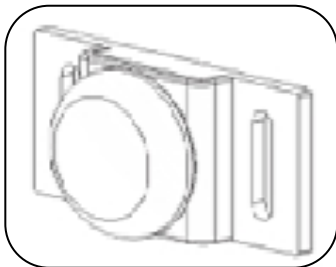


Fig1.1.2.light sensor

1.2 Analog vs digital

Among sensors, there are two main electrical “languages” spoken: **Analog and Digital**. **Analog sensors** communicate with the Microcontroller by sending it an electrical voltage along a wire. By measuring where the sent voltage falls between zero and maximum voltage, the Microcontroller can interpret the voltage as a numeric value for processing. Analog sensors can therefore detect and communicate any value in a range of numbers.

A light sensor, for instance, can communicate how bright a light is by sending a zero voltage for total darkness, sending maximum voltage for a very bright light, or sending an in-between voltage for any other amount of light, depending on exactly how bright.

2. SENSOR

2.1 sensor action

Since the “action” capability is physically interacting with the environment, two types of sensors have to be used in any robotic system.

- “Proprioceptors” for the measurement of the robot’s (internal) parameters;
- “Exteroceptors” for the measurement of its environmental (external, from the robot point of view) parameters.

Data from multiple sensors may be further fused into a common representational format

(world model). Finally, at the perception level, the world model is analyzed to infer the system and environment state, and to assess the consequences of the robotic system’s actions.

2.1.1 Proprioceptor

- From a mechanical point of view a robot appears as an articulated structure consisting of a series of links interconnected by joints. Each joint is driven by an actuator which can change the relative position of the two links connected by that joint.
- Proprioceptors are sensors measuring both kinematic and dynamic parameters of the robot. Based on these measurements the control system activates the actuators to exert torques so that the articulated mechanical structure performs the desired motion.
- The usual kinematics parameters are the joint positions, velocities, and accelerations. Dynamic parameters as forces, torques and inertia are also important to monitor for the proper control of the robotic manipulators.

2.1.2 Exteroceptors

Exteroceptors are sensors that measure the positional or force-type interaction of the robot with its environment.

- Exteroceptors can be classified according to their range as follows:
- contact sensors.
- **proximity (“near to”) sensors.**
- “far away” sensors.

Contact Sensor

Contact sensors are used to detect the positive contact between two mating parts and/or to measure the interaction forces and torques which appear while the

robot manipulator conducts part mating operations. Another type of contact sensors is the tactile sensors which measure a multitude of parameters of the touched object surface.

Tactile Sensing

Tactile sensing is defined as the continuous sensing of variable contact forces over an area within which there is a spatial resolution. Tactile sensing is more complex than touch sensing which usually is a simple Victoria force/torque measurement at a single point. Tactile sensors mounted on the fingers of the hand allow the robot to measure contact force profile and slippage, or to grope and identify object shape.

2.1.2. Proximity sensor

Proximity sensors detect objects which are near but without touching them. These sensors are used for near-field (object approaching or avoidance) robotic operations. Proximity sensors are Classified according to their operating principle; inductive, hall effect, capacitive, ultrasonic and optical. Inductive sensors are based on the change of inductance due to the presence of metallic objects.

2.1.3. "Far away" sensing

Two types of "far away" sensors are used in robotics:

- range sensors and
- vision.
- Range Sensing
- Range sensors measure the distance to objects in their operation area. They are used for robot navigation, obstacle avoidance or to recover the third dimension for monocular vision.

2.2 FORCE/TORQUE SENSORS

- The interaction forces and torques which appear, during mechanical assembly operations, at the robot hand level can be measured by sensors mounted on the joints or on the manipulator wrist.
- The first solution is not too attractive since it needs a conversion of the measured joint torques to equivalent forces and torques at the hand level. The forces and torque measured by a wrist sensor can be converted quite directly at the hand level. Wrist sensors are sensitive, small, compact and not too heavy, which recommends them for force controlled robotic applications.

2.3 ULTRASONIC SENSORS

The last sensor technology to be described in this chapter is the ultrasonic sensor. Polaroid ultrasonic sensors provide the means to determine the vehicle's relative distance from obstacles in the vehicle's path. Ultrasound technology is an inexpensive means to model more complicated laser based radar and microwave technologies that are currently in use around the world in several types of production vehicles.

- The Polaroid sensors can be used to detect objects in front of the vehicle, at a range of 150mm to 2.67m with 10mm resolution. The ultrasound sensor is in fact a kit 31(Figure 2.3.1) designed for use in laboratory settings for experiments involving range finding.
- Operating at 40 kHz, the Polaroid transducer emits an ultrasonic pulse, which is then detected by the transducer when it is reflected off of obstacles in front of the vehicle. The Polaroid sensor is connected to the circuit board shown above, which controls the timing of the pulses and calculates the perceived distance of objects from the sensor.

Board Layout and Connections

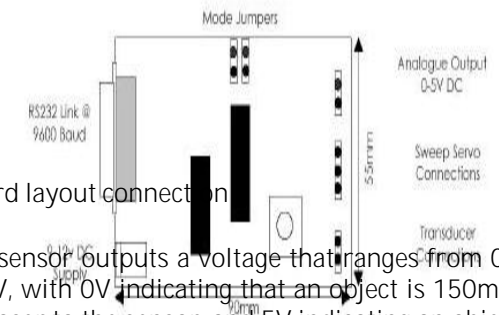


Fig 2.3.1 board layout connection

- The sensor outputs a voltage that ranges from 0V to 5V, with 0V indicating that an object is 150mm or closer to the sensor, and 5V indicating an object is 2.67m or further from the sensor. This voltage is in turn captured using the DSP's analog to digital conversion facility.

3. SENSOR ROBOT CONTROL

3.1 Sensor

To design a robot that can move around in a real world environment with high speed. Fames are constructed on a commercial platform found in remote

controlled model race car applications. This gives the advantage of not having to worry about particular mechanical problems, one of them being differential steering to divide the propulsion power over the back wheels while turning, as is necessary in car-like steering.

ROBOT FAMES

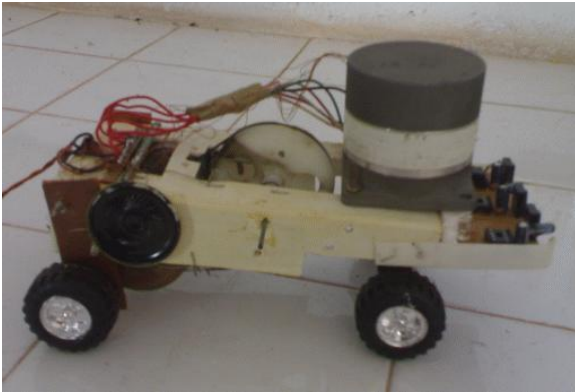


Figure 3.1.1 the robot Fames

3.2 OBSTACLE AVOIDANCE WITH SENSOR

When designing a robot capable of maneuvering at high speed, the design has to take real time constraints into account. The control structure of the robot must be efficient enough to steer the robot in time away from the obstacle. Moreover, since there is only one sensor, there is no direction information, the robot does not know on what side the detected obstacle is. It has to find that out by itself by moving through the environment. The utilization of ego motion to gather more information is usually referred to as flow, for example optical flow as it occurs in the eye of the fly.

For Fames, an ultrasound sensor was used, both for transmitting and receiving a sound burst (sonar). With a sonar sensing technique it is difficult to handle flow, i.e. the first derivative in the distance measurements, because the received signal is not continuous, but is a stream of distinct pulses ('time stamps'). Therefore, the derivative of the sensed data is also a discrete value rather than a continuous one, resulting in inaccurate and slow measurements.



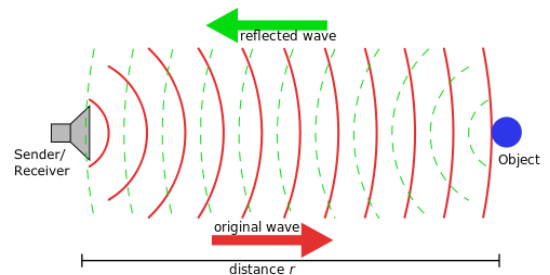
fig 3.2

Avoided accident using sensor

3.3 TYPES OF SENSORS FOR TARGET DETECTION AND TRACKING

Selecting the right sensor is not a strict process. This is about eliminating all the wrong choices based on a series of question aiming to eliminate first the technology that underlying the sensor and then the product that it **doesn't fit to the robot requirements**. When we use the word target, we refer in the same time at a small ball, at an object like a chair, or even at a human that stay in front of the robot.

To select the best sensor from a variety of products and manufacturers is a hard work especially **when you're a beginner and try to build a simple robot**. In few words the sensor has to be selected in concordance with your targets size, shape and range. All of these three features have to be on the same line with the specification of the robot. But even so, it is hard to define the best sensor since the performance and precision of this depend on many factors.



Fig

3.3 Principle of active sonar.

A sensor is a sophisticated device that measures a physical quantity like speed or pressure and converts it

into a signal that can be measured electrically. Sensors are based on several working principals and types of measurements. In our case almost all types of sensors emit signals and measure the reflection to make measurements.

3.4 INFRARED SENSOR

An

infrared sensor measures the IR light that is transmitted in the environment to find objects by an IR LED. This type of sensor is very popular in navigation for object avoidance, distance measured or line following applications. This sensor is very sensitive to IR lights and Sunlight and this is the main reason that an IR sensor is used with great precision in spaces with low light.

On capturing a target in the left range, the left LED connected to the relevant IR LED will illuminate, when a target is captured in right range, the right LED, will illuminate and when a target is captured in the left+ right range, both LED's will illuminate. The rays reflected from the target to the IR receiver, which has a photo transistor that provides analog output, a figure (4). The positions of three IR sensors, figure (5), are perpendicular to a path to follow. A robot provided high illumination light to detect the navigation black line on white background and get a good video quality.

INFRARED LIGHT SENSOR

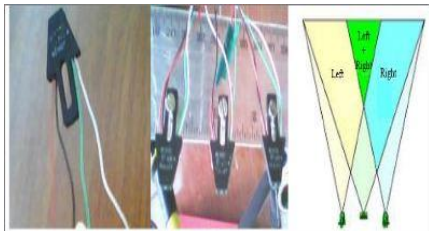


Fig3.4.1. Infrared light sensor

INFRARED -RANGING SENSOR

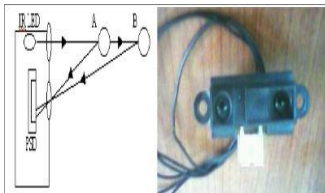


Fig3.4.2. Infrared -ranging sensor

3.5 INTERFACING AND ULTRASONIC SENSORS

The working principle of an ultrasonic sensor is simple and use high-frequency sound waves that are evaluated when the sensor received back the waves. To

determine the distance between the robot and object, the sensor measures the elapsed time between sending and receiving the waves shown fig. WAVES IN SENSOR



Fig 3.5

waves in sensor

4. SERVO MOTORS

The simplicity of a servo is among the features that make them so reliable. The heart of a servo is a small direct current (DC) motor, similar to what you might find in an inexpensive toy. These motors run on electricity from a battery and spin at high RPM (rotations per minute) but put out very low torque (a twisting force used to do work— you apply torque when you open a jar).

4.1 Controlling a servo motor

Servos

take commands from a series of pulses sent from the computer or radio. A pulse is a transition from low voltage to high voltage which stays high for a short time, and then returns to low. In battery devices such as servos, "low" is considered to be ground or 0 volts and "high" is the battery voltage

OBSERVING VOLTAGE

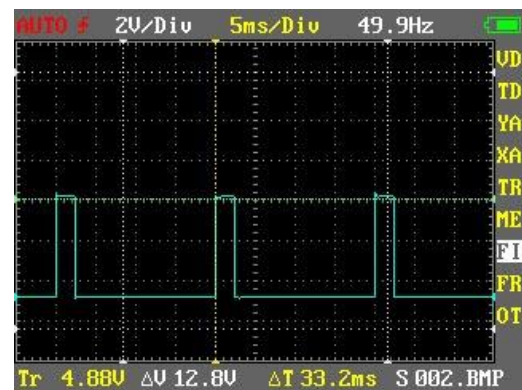


Fig 4.1 instrument for observing voltage

An example of a pulse train you might generate to control a servo as shown in a screen capture from an expensive digital oscilloscope, an instrument for observing voltage.

5. BMW SENSORS IN DRIVERLESS CARS

The car uses steering, breaking and throttle to control acceleration, deceleration and direction in very small, exact amounts. The demonstration is just one aspect of the technical building blocks required to make a LiDAR (also known as LiDAR or Laser Detection and Ranging) has been used extensively for atmospheric research and meteorology due to its excellent resolution. self-driving car. There are also sensors, environ

mental modeling and decision and driving strategy technologies that BMW is working on. Those were not included on this particular test vehicle.

5.1 Harman

The automotive arm of audio specialist Harman Chardon revealed its Individual Sound Zones (ISZ) in-car audio technology that enables drivers and passengers to create their own 'sonic zones'. ISZ uses headrest speakers in a car's regular audio system combined with digital signal processing to segregate different parts of a car for different audio sources, allowing, for example, a front passenger to make a phone call while a rear passenger listens to music.

The system channels audio in a way that provides little interference or crossover between the sources, ensuring that relevant audio is tailored and boosted to individual passenger.



Fig 5.1.1 Harman

6. LIDAR

6.1 Lidar Principles Of Work

The principle behind LiDAR is really quite simple. Shine a small light at a surface and measure the time it takes to return to its source. When you shine a torch on a surface what you are actually seeing is the light being reflected and returning to your retina. Light travels very fast - about 300,000 kilometers per second, 186,000 miles per second or 0.3 meters' per nanosecond so turning a light on appears to be instantaneous. Of course, it's not! The equipment required to measure this needs to operate extremely fast. Only with the advancements in modern computing technology has this become possible.



Fig 6.1 principle of LiDAR

The actual calculation for measuring how far a returning light photon has travelled to and from an object is quite simple:

$$\text{Distance} = (\text{Speed of Light} \times \text{Time of Flight}) / 2.$$

6.2 Working Driverless Car

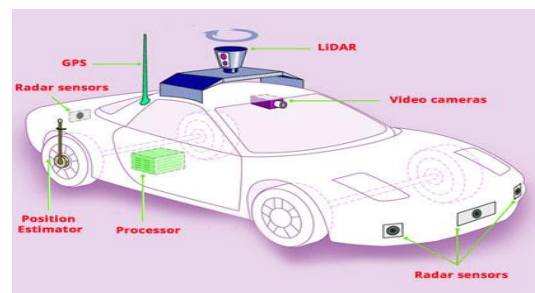


Fig 6.2.1 working of driverless car

A self driving car integrates many of the Google applications to run efficiently. It works with Google Maps – to provide the minute information about the road, Hardware Sensors – To provide information about the real time environment conditions, Artificial Intelligence – Real time decisions are taken with help of this software. Google Maps use the Global positioning system or GPS for proper tracking of the location and directions.

6.3 Artificial Intelligence

Artificial Intelligence (AI) is a kind of intelligence showed by custom-build software or machines. Google Maps and the hardware sensors send the data acquired with the help of various devices to the AI. The AI is the key component of Google driverless car that determines how fast the car should accelerate, determines the moment to slow down/ stop and determines when to take over the steering control of the wheel.

The ultimate goal of AI is to take the car to the destined location safely and legally. Processor employed in this car cross-checks all the information obtained from different sensors to make different objects, obstacles differentiated accurately and make driving through them an easy task. The software developed for this is the sole proprietary product of Google.

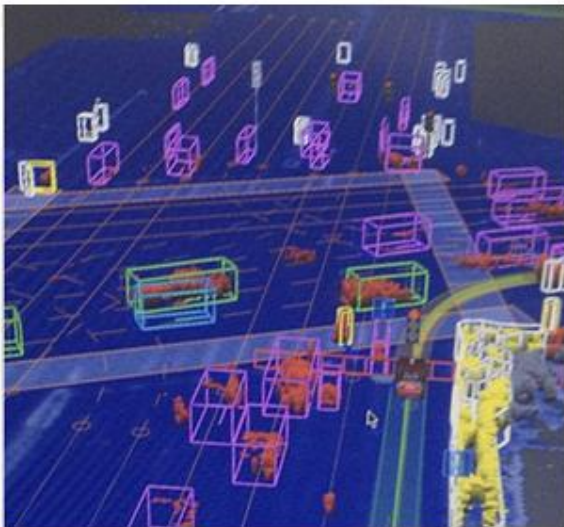


fig 6.3 outside view of Self Driving Car

7. MONITOR IN DRIVERLESS CAR

In-Vehicle Computer (Car PC or car computer) is designed to perform multiple in-car functions, including infotainment, fleet management, telemetric, video surveillance, taxi dispatch and law enforcement. A newer unique needs in intelligent traffic system, asset management, job dispatch, video surveillance and fuel saving has come to the market recently.

MONITOR OF THE SYSTEM

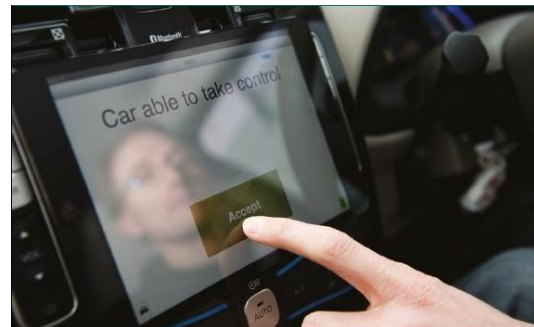


fig 7.1 some action of person

The car can take control when passenger does some action on the monitor of the system.

8. IMPLEMENTATION PROGRAMME IN MAT LAB

```
% initialize car, position, speed, road, etc.
init;
i = 0;
t = [0, .1];
S_model = 0;
s_dot_model = 0;
S_model_2 = 0;
s_dot_model_2 = 0;
s_dot_model0 = 0;
k_u1 = 10;
x0_prev = x0 - cos(theta0)*u1*T;
y0_prev = y0 - sin(theta0)*u1*T;
x0_prev2 = x0_prev - cos(theta0)*u1*T;
y0_prev2 = y0_prev - sin(theta0)*u1*T;
x0_2_prev = x0_2 - cos(theta0_2)*u1_2*T;
y0_2_prev = y0_2 - sin(theta0_2)*u1_2*T;
x0_2_prev2 = x0_2_prev - cos(theta0_2)*u1_2*T;
y0_2_prev2 = y0_2_prev - sin(theta0_2)*u1_2*T;
distance x = x0 - x0_2;
distance y = y0 - y0_2;
distance x_prev = x0_prev - x0_2_prev;
distance y_prev = y0_prev - y0_2_prev;
```

```
distance x_prev2 = x0_prev2 - x0_2_prev2;  
distance y_prev2 = y0_prev2 - y0_2_prev2;  
err_h = 0;
```

9. CONCLUSION

There are many different technologies available that can assist in creating autonomous vehicle systems. Items such as GPS, automated cruise control, and lane keeping assistance are available to consumers on some luxury vehicles.

The problem is winning the trust of the people to allow a computer to drive a vehicle for them. Because of this, there must be research and testing done Over and over again to assure a near fool proof final product. The product will not be accepted instantly, but over time as the systems become more widely used people will realize the benefits of it.

The implementation of autonomous vehicles will bring up the problem of replacing humans with computers that can do the work for them. There will not be an instant change in society, but it will become more apparent over time as they are integrated into society. As more and more vehicles on the road become autonomous, the effects on everyday life will be shown.

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