**Introductory Description:**

If you drive, you must know that the difficult part of driving is to drive backward while backing up or parking. Because a driver can not see certain parts of the rear view from the driver seat, reverse driving has been troubling for many people. Hitting a pole can result in US$500-$1500 in damages to your vehicle while backing up your car just below 5 miles per hour. Moreover, small children sometimes are not possible to see from inside a car, especially when they are behind it. According to the data from the NSW Motor Accidents Authority, 17 children have been killed by reversing cars over the past three years. In fact, a friend of mine just hit a vehicle while backing up in a Western Washington University parking lot. Due to the facts above, a thought comes into my mind: I will design a Reversing Aid Sensor System (RASS) that will save lives and money.

The Reversing Aid Sensor System will save lives and money because it will detect objects that are behind the vehicle, and provides sound warnings and a distance readout. Moreover, the system will be designed for external installation: the sensors will be attached on the car rear lamp. This method will not require the user to make holes on a car, so the car appearance will be unchanged. The RASS will be easy and fast to install. It will let you overcome the blind spot of the rear view and guide you to drive in and out of a tight parking space.
**Detailed Functional Description:**

The sensor selection is an important part of this project. I will choose ultrasonic sensors because these sensors work well on broad area detection and non-contact distance measuring. Nevertheless, the ultrasonic sensor has unique advantages over conventional sensors. It measures and detects distance to moving objects and has virtually unlimited maintenance-free life span. Variables that can interfere with the operation of ultrasonic sensing include: target surface angle, reflective surface roughness, and changes in temperature or humidity…etc. However, the ultrasonic sensor is able to detect targets, which can be any kinds of reflective form. Also it is resistant to external disturbances such as vibration, so it can function properly when a vehicle is running on a bumpy road.

This device requires two ultrasonic sensors to interface with the 68HC12 microcontroller, which is the central processor unit of the device. The ultrasonic signal is like an audible sound wave but with much higher frequency. The ultrasonic sensors send out sound wave in a shape of a cone to the target object (Fig A), such as a wall behind the car. Then the sound wave bounce back to the sensors, which are communicated with the processor. At this point, by determining the degree of the target angle, the processor calculates the distance between the target object and the sensors. My application requires a target angle beyond the capability of a single sensor, so I will use two sensors to provide even a broader detecting angle (Fig B). A minimum distance between an object and the sensors is required to provide a time delay so that the echoes can be interpreted. After the microcontroller calculates the distance, it will output the ranging measurement in feet to the LED display and an audible warning signal through the speaker. The speaker will change its sound rate and frequency depending on the range between the vehicle and an object. There is a toggle switch on the microcontroller unit allowing the driver to turn off the
system when he/she doesn't need its assistance. The RASS will consume power from the car battery.

In fact, some vehicle manufacturers already put a parking radar in the car, and the radar is activated when the shift stick is placed into the R position. For those car owners who don't have parking radar within their car, my Reversing Aid Sensor System is a good choice to go with because the system is designed to be installed externally. Since the device is not activated through the shift stick of a vehicle, anyone is able to install the system on his/her own. Besides, there is another, better option to activate the device: a software solution (Professor Morton’s idea). By defining an absolute distance in the program code, the device will be activated if any object appears within the absolute range. This feature promotes my system to another level. Now the system is not only useful in the parking process, but can also alarm a driver when another vehicle approaches his/her car on the road.

![Fig A](image)

![Fig B](image)
I believe that many people have experienced the difficulty of driving in and out of a tight parking space on the street. The fact that so many cars have scratches on the corners of the bumpers proves only few drivers have good luck when they park on the street. Sometimes the situation gets worse. People hit a vehicle or a pole because they can’t see the blind spot while they are backing up. If you are a car owner, you must hate it when an accident happens because
you will have to report to a police officer, the insurance company, and a body shop. All the paperwork, time consuming, and huge amount of repair money can really be pain of the neck. The Reversing Aid Sensor System is a sophisticated, ultrasonic sensing device that is designed to detect what you can not see around your vehicle. The installation is easy and fast. You can simply DIY (Do it yourself) at home. The system is suitable for all kinds of automobiles. You don’t need to make any hole on your precious car. Just take a few minutes, and then you will be enjoying the pleasure of driving.

**Comparison of competing product:**

Many companies make competing products on the market. Velleman is one of the companies that make Parking Radar Kit. The kit has the following specification:

Detection range: 5cm-1.5m; angle: 5°

Transmitter frequency: 40kHz

PCB size: base (4.9"L x 1.9"W) sensor (3.8"L x 1.1"W)

Requires: 10-15V @ 16mA max or auto power plug.
This product has similar function as my project. Nevertheless, the Reversing Aid Sensor System has two more features: LED display and external installation. LED display lets a driver know exactly how much space he/she still has to adjust the vehicle; external installation lets a vehicle owner save the trouble of making holes on the car and keeps the original appearance of the vehicle. Tian Li Electronics Company Limited makes external parking radar also, but my project costs much less to make comparing with Tian Li's product. The alarm feature, which detects a vehicle approaching from behind, also makes the Reversing Aid Sensor System stand out on the market.

**Construction:**

I will borrow the 68HC12 microcontroller unit from the Electronics Engineering Technology Program of Western Washington University. All the other electronic parts of the system can be ordered on line for a reasonable price. The microcontroller, a LED display, a speaker, and a toggle switch will be built into a device, which will be placed next to the instrument panel on the driver side of a car. The sensors, which are connected to the microcontroller, will be attached on the car rear lamp. When a user attaches the sensors on the vehicle, ensure that there is no obstacle within the sensing angle ($90^\circ$, see the diagrams below). Also, the adhesive surface should be vertical. Otherwise, improper sensing warning may be generated. The device will be placed next to the instrumental panel on the driver side.
Demonstration of Project:

Demonstration will be the fun part of this project because people get to ride on a chair to test the device. People can install the Reversing Aid Sensor System by themselves to experience the easy and fast installation. Furthermore, I will tape the floor at every foot. People can actually “drive” the chair and compare the LED readout with the distance between the chair and an object. Driver can experience how the system shows them exact distance between the car and an object behind, and then avoid damaging the vehicle.
Sketch of Assembled device