2015

Automotive Object Detection Training System

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ELECTRICAL AND COMPUTER

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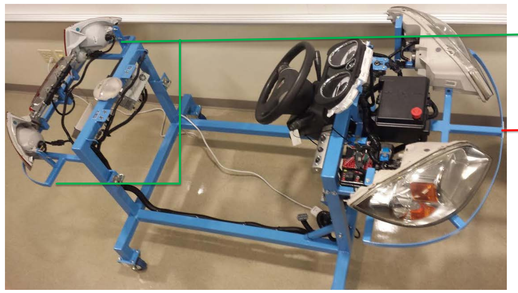
CAPSTONE DESIGN EXPO 2015

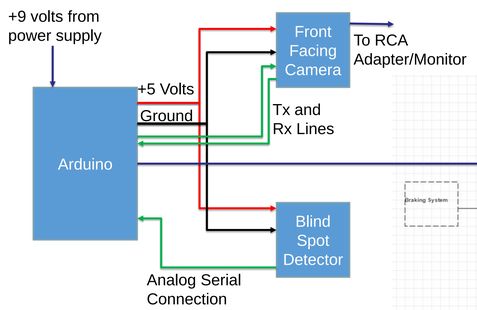
Background

With the consumer's safety always in mind, automobile companies are adding more to their systems to help detect and prevent collisions. Among these technologies is the object detection system. In summary, this system warns or reacts to oncoming objects that could put the driver in danger. As with any piece of technology, there are problems and bugs that will occur in the object detection system. In turn, this requires the availability of technicians who can troubleshoot and fix these systems. Currently, there are no systems in the market that simulate troubleshooting of object detection systems. Our Automotive Object Detection Training Simulator will provide the needed simulation to help automotive technicians learn how to troubleshoot object detection systems. Our device will be attached to a simulator that is currently on the market, the ConsuLab Light and Accessory Simulator pictured below.

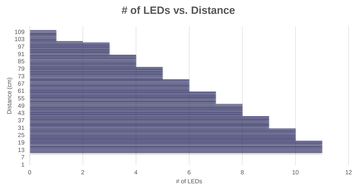


Modified ConsuLAb Light and Accessory Simulator

The system will consist of three main components that will be attached to the existing simulator. The first component is the blind spot detection, which is found in cars such as the Mazda3 and Mercedes-Benz S-Class. The camera system and automatic braking system, also called moving object detection in the market today, has been featured in the Nissan Rogue Crossover.



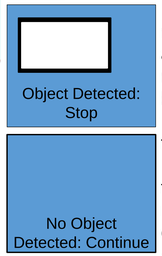
Blind Spot Detection System



# of LEDs vs. Distance of Blind Spot Detection

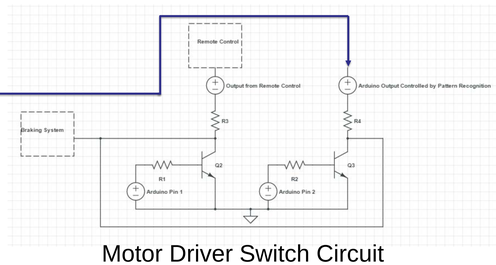
Ultrasonic sensors were chosen because the systems used for blind spot detection use similar technology and will give students a good idea on how an actual system would work. Ultrasonic sensors are mounted on the sides of the simulator for blind spot detection. The blind spot detection component of the software reads inputs from the ultrasonic sensors and determines if there is an object for an extended period of time. It then outputs a voltage signal to turn LEDs on, depending on the distance of the object.

Camera System



The camera attached to the front of the vehicle bears the responsibility of detecting shapes through a pixel-sorting algorithm. As the designated stop shape enters the camera's range of view, the algorithm searches and matches adjacent pixels based on the contour of the shape. If these adjacent pixels are matched and recognized as the designated stop shape, then a trigger is sent to the braking system. Otherwise, the camera keeps running and searching for an array of pixels that would form the designated shape. Theoretically, this illustrates how a car in motion would automatically brake when the front facing camera detects an incoming object. Then, the Arduino outputs to the Automatic Braking System and a bank of LEDs.

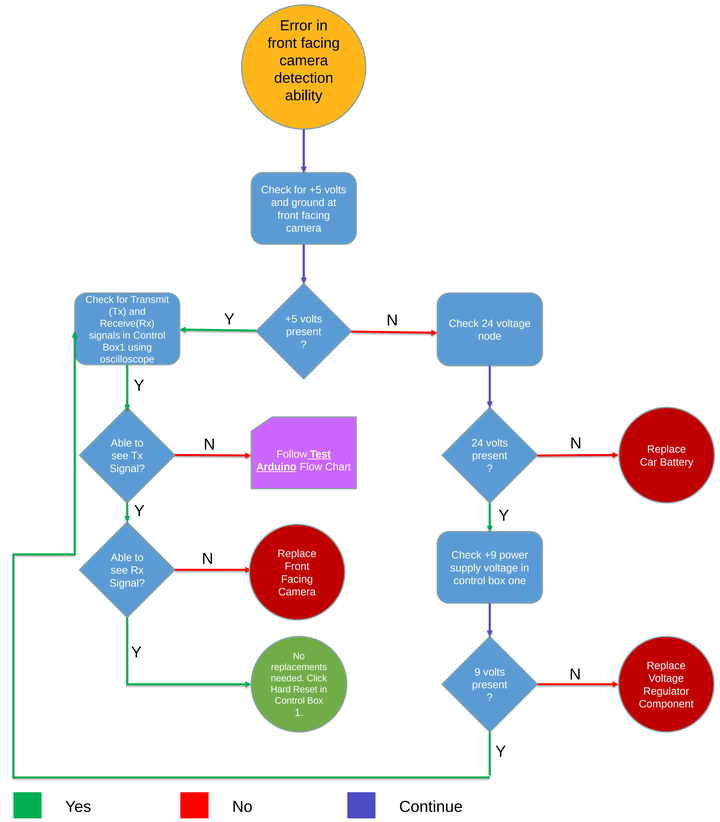
Automatic Braking System



Motor Driver Switch Circuit

Another team has modified the simulator to move. Our braking system will then override the radio frequency (RF) signal sent by the remote control they will use to control it. A switching circuit was created using two NPN bipolar junction transistors (BJTs). This system works by sending a signal from the Arduino Uno to open or close the switch. When the camera detects the designated stop shape, a low voltage source will be sent to the base of the NPN BJT cutting off the RF signal and a high voltage source will be sent from the Arduino Uno mimicking the RF signal.

Troubleshooting Flowchart



This is a sample flowchart for an error occurring in the front facing camera's object detection ability. Students will troubleshoot the system using flow charts similar to this to reach solutions for various errors. Students will use a multimeter and oscilloscope to test the connections at various points in the system. Some debugging processes can lead to other flow charts, shown by the purple squares.

Our team would like to thank Melissa Gay (JSRCC) and Dr. Charles Cartin for the assistance they provided during this project. This project was funded in part, by NSF Grant ##1104190

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