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CE 426 Real Time Embedded Systems

Mechanical Design Group

February 15, 2017

## **Mechanical Design Review for Autonomous Car Project**

### Overview

The responsibility of the mechanical group is to not only become intimately familiar with how the hardware on the car works, but also to assist other groups in mounting and wiring sensors and computing platforms. We will work with groups to identify possible mounting locations for the sensors and create mounts. We will also assist in the cable management of the car, to ensure the wires do not interfere with anything else (i.e. wires getting tangled in the wheels) and the overall aesthetic of the car is maintained.

### Background

The concept of a small autonomous car was developed in the first revision by Dr. Kwon. In this project, we will be implementing techniques learned in class to develop a real-time system that can navigate around the Electrical and Computer Engineering department.

We have purchased a model Mini Cooper vehicle. Our plan is to add several sensors including a LIDAR array and multiple ultrasonic sensors. We will be implementing a single board computer for ultrasonic data processing and a laptop running Linux to process the data from the LIDAR array. In the mechanical group, we will need to handle how to accurately mount these sensors to collect the most reliable data.

### Objectives

The objectives of the mechanical hardware group are very straightforward. We will provide assistance to other teams by working with them in where sensors are mounted, understanding how all mechanical linkages on the vehicle work, and mounting any computing platforms necessary.

The location of sensor mounts will be very important to the car because how the sensors are mounted will directly impact the quality of the data. In order to collect the best possible data, we will work with other teams to understand how best to collect data. By understanding the sensors, we will be able to offer the best mounting solutions. Our mounts will also need to be stable and reliable to ensure that they do not come loose during a minor collision.

Mounting the computing platforms such as the Tiva C Series TM4C123G Board and Laptop are also very important. They need to be secured so the wires/cables do not get dislodged when transporting the vehicle or in the case of collisions. They also need to be in an area where they will be protected from hazards outside the car.

There will be two distinct types of mounts: Soft mounts and hard mounts. Soft mounts will be components mounted with super glue, tape, or by drilling into the car body. These mounts are destructive to the surface but do not require additional complex hardware. Hard mounts will be options such as a 3D printed mount or formed piece of clear acrylic. These mounts will take much longer to create and will be custom to each item we are trying to mount. While they will take longer, they will also be more “correct” in that the hardware will be mounted accurately and securely by the specified mounting holes instead of just being glued or taped onto the car body.

### Deliverables

The deliverables for this project are as follows: First, we plan to model all mounts in a 3D modeling software. We will also make a rough model of the car so that we can have an idea of the location of mounting the sensors on the vehicle. We also will be tracing paths for the wiring.

The second deliverable will be having all of the mounts created and attached to the car. We plan to model all of the sensor hole positions so that we can 3D print or laser cut precision mounts. We also will be able to quickly modify any mount to rapidly create the best possible mounting solutions.

Third, we plan on working with the electronics team to complete the wiring for the car and the sensors. The wiring needs to be run in a clear and deliberate manner that will make it easy to hook sensors to computing platforms. Using zip ties and cable mounts, we can keep the wires organized and tangle free. We will also use a label maker to clearly label each wire. If we plan on running the wires through tight quarters, it’s vital that we are able to identify each wire quickly and accurately. Putting in more time up front on keeping the wiring clean will allow us to more easily connect systems as the car becomes more complex.

### Current Plan of Action

Our current plan of action is to begin by modeling the entire car and modeling each sensor and computing platform we will be using. Having these models will be a good starting point for visualizing where the sensors should be mounted. We can also begin designing hard mounts for sensors. We will work with other groups to gain a better understanding of what mounting systems are required for optimal data collection.

After we have began collecting mounts, we will start mounting items onto the car. We hope to see the other groups get their sensors functioning by the time that we have gotten our mounts constructed so we can place the sensors on the car as they become functional. If the other groups are not ready, we can prep the car by mounting both the laptop and the Tiva board. We have planned to mount the Texas Instruments board in the front of the car so we can mount it securely and we will mount the laptop where the current seat is located.

We plan to create the hard mounts through two means. The first is by 3D printing any mount that is designed to have a small, lightweight sensor attached to it. This is good for rapid development but will not be as secure as the second option. The second option is to use acrylic with a laser cutter and a former to make curves and specific shapes. This will be much more effort but will also give us more strength in our mounts. It also give us the option to use clear mounting hardware instead of an opaque plastic from 3D printing. We plan to use acrylic for the hood cover of the car, giving people an inside look into the computing board inside the car. We will also use it for mounting the laptop because of the strength and ease of working with.