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AME 394 MW 3:00-4:15 PM
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Individual Report

As my first design class, this class taught me a great deal about general design. It was challenging because it was my first experience with implementing digital-physical systems. Coming into this course, my only skills were in circuit design and programming, and my only design knowledge was related to meeting various electrical requirements in circuits. I must admit that I had significant difficulty grasping the design process until I had worked through the steps in both my honors contract and my group project. However, from both of these projects combined I believe that I have come to grasp the design process and most of the considerations involved.

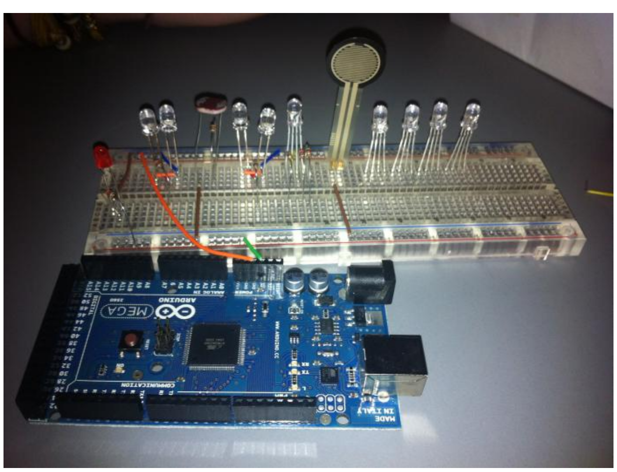
The design process begins with observing and brainstorming problems that are apparent in a chosen environment or activity. For the group project, the chosen environment was a car, while for my honors contract, the environment was the Barrett Dining Hall where I eat every day. Once the environment has been chosen, the brainstorming process focuses on the issues and aspects of the design space. For my honors contract, the problem was easy to identify: the dining hall has a long-standing problem with getting students to return their dishes. For the group project, there was a large in-class brainstorm about cars, based on ethnography that each student conducted on their own vehicle. From this brainstorm, key issues and topics of interest came to light and groups were formed to design a digital-physical system to address each of these. My group, including Trevor Schaffer and Dakota Gidley, chose to address the issue of preparedness in the car. During the in-team brainstorm session that followed our topic selection, we began to form an initial concept regarding car health and weather conditions on road trips. As a group, we decided that people are not always vigilant at maintaining their vehicle or road-awareness while driving, so we decided to implement a system with the intention of addressing these issues together.

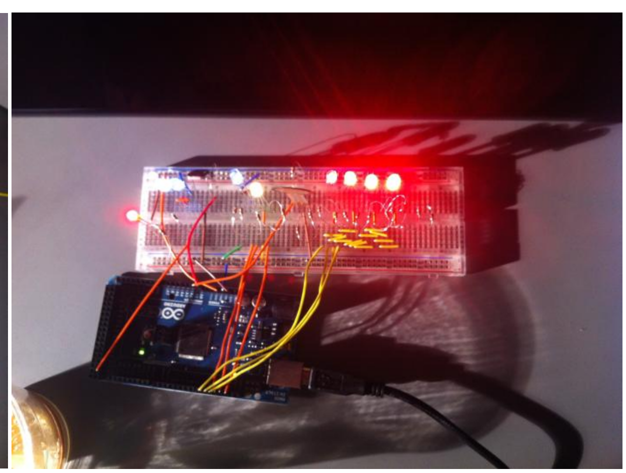
Once the specific need is identified, the next step in the design process is to ideate structures for a solution by identifying key constraints and requirements, while taking into account affordances. This is done by examining both the physical problem space as well as the intended interaction between the potential system and user. It is important to see how these factors either help or hinder the achievement of the desired goal; how the outcome is obtained is just as important as what the outcome is. For the honors contract, this process was carried out by first examining the entire problem space, which was the dining hall in this case:

The dining hall is private property and an important social area, as evidenced by the large amount of seating. This means that my system cannot disturb the regular operation of the facility (i.e. cannot bother dining hall customers or staff and cannot damage the current structure of the facility). I also decided that the punishment policy of the dining hall was relatively ineffective, so I implemented a system based on positive-reinforcement. After analyzing all of my constraints, I decided that the best solution would be a *Guitar Hero*- type game that is implemented on the rotating dish return system, though the feedback would be implemented with lights instead of sound, so as not to interrupt daily conversation. The solution bordered on being an ambient system, but still engaging users, while requiring minimal installation. Furthermore, the interaction between user and system remained embodied through the simplicity of placing a dish in the tray as would normally be done, while the system offered additional affordances from the LEDs on the moving trays that follow the recognizable *Guitar Hero* color scheme. For the group project, we quickly came to the conclusion that a car-based system addressing preparedness on the road should be ambient and should not require any user input while driving. Here is an image that inspired our design concept:

We came to the conclusion that with our current skills, the issues we could best address were monitoring oil and tire changes, tire pressure, and hazardous weather on the roads. We decided that a transparent toy car casing would provide the best affordances to users and it could easily fit on the dashboard of the vehicle. The toy car's headlights would toggle on and off based on what is recommended for the current driving conditions. We chose to have parts of the system light up on the toy car, corresponding to the health of the actual car. These health components on the toy car will be constantly lit up with a certain color ranging from green (new/healthy), to yellow (moderate), to red (flat tire/urgent issue/overdue maintenance). Some components have a reset button for the user to reset the system's tracking after maintenance, but there is no reason or need to use these controls while driving.

Once all of the design parameters have been identified and revised to realistically match all of the constraints, prototyping begins. Here are images for the proof of concept for my group project





It is important to recognize the constraints in the prototype/proof-of-concept. They will always have limitations and will require further work before being ready for final production. For instance, our proof-of-concept for the group project had a self-incrementing internal clock to simulate the performance of the system as the car gained mileage but the final product will need to be adapted to connect to the odometer through some means to pull the mileage straight from the vehicle. This is a significant limitation of the current prototype, but it didn't need to be addressed to successfully prove the concept. The future work for the system includes addressing these current limitations, as well as verifying and improving the functionality of the system under a wider spectrum of conditions, as well as potentially increasing the scope of the system's functionality.

The process of designing a digital-physical system starts with the observation and ideation of a problem or topic to address and continues to the definition of project constraints and paradigms. The design continues with the ideation of several different solutions and the methodical elimination of each solution down to a single remaining solution. The final solution is then prototyped to prove feasibility and effectiveness of the design and then reiteratively revised until it the design is robust enough for final production.