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AME 394 Physical Digital System

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### How to Build a Physical Digital System

The goal of this paper is to inform you on the basics when considering how to build a digital physical system. There are many different things to consider when creating a physical digital system including but not limited to: interaction between the levels of interaction between the user and the device, the context in which the device will be used, I.E social on business context, the physicality of the device and the ethics.

My final project group consisted of Ketan Julio and myself, we decided that we wanted to focus on the entertainment aspect of a car. After coming up with a few ideas, we decided to narrow down our choices to two basic ideas, the first being a laser projected HUD on the windshield that would give the driver information on various entertainment related subjects, such as the name and artist playing on the radio or cd player, the weather, and even live scores from various sport stations.



Figure 1 A basic HUD

We rejected this idea due to the fact that no one in the group knew how to program a laser projector so we decided instead to create a music oscillator which will flash LEDs in synch with music. The plan was

to put multicolored LEDs on the inside panel of the car and then you could plug in a control box to any music device you wanted. We figured that this would help enhance a user's musical experience in a car while providing them with a unique experience that not many people have. While planning this device we had to take in account the advice given to us during a critique session which mainly consisted of concerns about the safety of this product.

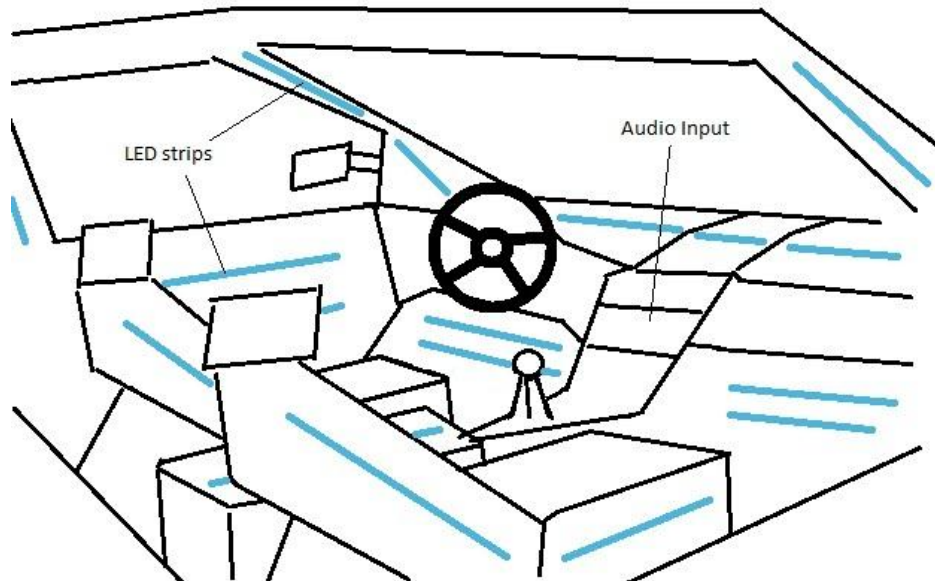


Figure 2 a prototype sketch of our design

The most important thing to consider when building your device is to determine what level of interaction it will have. There are four basic levels of interaction to consider: ambient display, implicit interaction, subtle interaction, and personal interaction, ranging from impersonal to personal interaction respectively. Since there would be very little interaction between the user and the device we determined that it would have an ambient display level of interaction.

The second thing we considered when making this device is to make sure what kind of system the device would be and in what scale it would be on. Once again there are four different kinds of systems: wearable's, ambient, art, and public displays that sit on a scale ranging from personal-large scale. By looking at the levels of interaction of our device we determined that it would fall under an ambient system on the personal scale. This conclusion was reached by realizing that our system operated in the background of the user, and did not require him to pay attention to it for it to function, and since the system is housed inside of a car, it was easy to determine that this is a personal system since at the very most seven people will be able to experience this system at one time.

As mentioned previously we needed to be aware of the ethics of this device and concentrate on whether this product was safe for the user, and wouldn't in fact distract him from the most important task, driving. In order to address this concern we decided to put resistors in our design in order to dim the brightness of the LEDs, and on top of that we also put in limits on the code as to how bright the LEDs on this device could shine. We also updated our prototype sketch in order to address some concerns from the critique session, and removed the LEDs from the upper right and left paneling as well as take out any LED's that would be directly in line with the driver, as it caused some concern with others that it may impair the drivers night vision. We were not able to address all of the concerns we came across unfortunately as we ran out of time when building this device, but for future updates, we planned on putting a slider on the control box in order to give the driver some more control on how bright they wanted the lights to be in any given situation.

After all of these ideas were taken into account we started to actually build the device and program the code for it, this is also known as the design process. Ketan and I mapped out exactly how we wanted the device to look like and what parts were needed in order to make this work while Julio worked on coding the device, Ketan and I helped when we could. Out of all the work we had done up to this point it is easy to say that the coding of this device was the most challenging. At first we had problems with the actual detection of the sound, so in order to minimize confusion; we decided to only use three basic instruments for the code to look for: high hat, kick drum, and the snare. These constraints made the unit function much more coherently and look good while doing it. The source code for this device and a video showing how to operate that source code can be found at here at my [wiki](#).

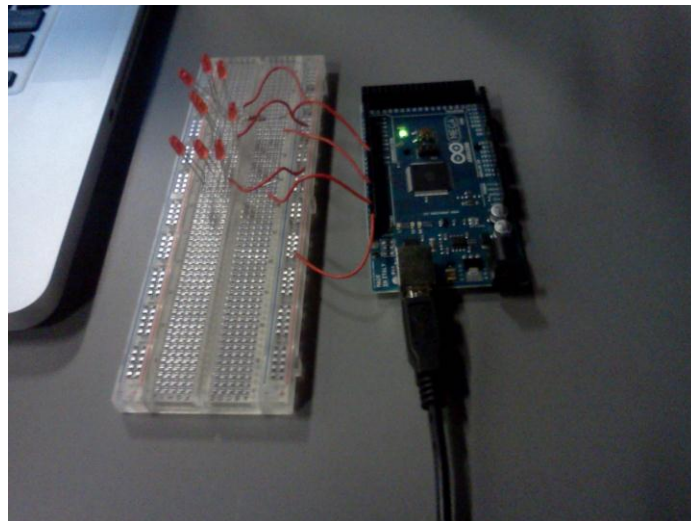


Figure 3 final device

There were a few challenges in this project that we were unable to overcome in this current version but hope to fix in a future update. During the showcase we encountered a problem with the device freezing up after 20 seconds where the code would still run perfectly but the LED's would stop flashing with the music. I think that this may be a memory issue with the arduino and that it is ill equipped to handle the constant stream of data from the computer. As with any design process the first version is never perfect and will require some updates, but as of now it is functional, and served our purpose in adding a new visual element to an already exciting thing, and that is what a physical digital system is supposed to do.