skatEE Project Proposal

1. Introduction

Notre Dame is a large university, totalling at roughly 1200 acres. It's very reasonable that your average student does not want to walk that much each day or wake up that much earlier for their 8:20. And sure there are lime bikes, but who wants to all that work pedaling? We believe the solution is SkatEE. (Second E silent).

2.Problem Description

Transportation on Notre Dame's campus is inefficient. Parking can be a hassle. No existing personal transport service is no effort, no sweat, and can be used nearly immediately. Personal motorized skateboards are expensive whereas a pay-as-you-go, or a rental service would be cheaper. Lime bikes have been a recent success as a partial solution to this problem, allowing easy medium distance travel, but still not fitting the niche of travel in between buildings on campus, and besides, they still require physical activity to operate, so using them could potentially make one sweaty and gross for their next class or appointment. Time is incredibly valuable to students, faculty, and staff at the university, who juggle an agenda filled with many commitments, so finding ways to save time throughout the day are a must. Notre Dame does not offer the lime scooter service, so we want to move into this space with a motorized skateboard sharing service. The engineering problem then is constructing a method of transportation that students can use in a shared service which improves the way that people get to places on campus.

3.Proposed Solution

We will build a motorized skateboard that has the ability to unlock its remote when a user sends a signal from their phone, and re-lock when the mechanism is moved to a “locked” position by being attached to a separate module, so that is acknowledged that is no longer in use. The intent of this project is to provide an alternative to lime bikes to be used within Notre Dame’s huge campus, in order to further improve an individual’s ability to get around quickly and effortlessly.

Motorized skateboards are already in existence, so a great starting point for the solution is to use one of these existing models and modify it. Using a build kit for a motorized skateboard will allow us to become familiar with the device, the power/signals used, and the hardware and software requirements to communicate with our unique technology. We plan on building a printed circuit board, separate remote board docking structure, and mobile application in order to meet the goals of the project.

A well-executed prototype of this electric skateboard will demonstrate the necessary requirements to potentially be used within a sharing service such as lime bike. They will be effective at solving the problem we identified because using electric skateboards allows people to reclaim their schedule by saving them precious time and energy, and they can fit seamlessly within a collegiate community, where many people use skateboards daily. In addition to the initial product, thinking about further about ways to improve convenience, security, cost effectiveness, and maintenance will allow us to further modify our design.

4. Demonstrated Features

Our project will be centered on one essential functionality that we wish to implement. Once we have successfully achieved this initial goal, we will iteratively continue adding features to the skateboard in order to improve its viability as a product.

The minimum viable functionality that our group has decided to focus this project on is the ability to send a signal (wirelessly either through wifi or via bluetooth) that will trigger an unlocking mechanism in our board and thus give the user access to the remote (ergo the board). In order to meet this requirement, we have divided the goal into three smaller parts that we will focus on to simultaneously work on and meet this goal in the most effective way.

The first part consists of the software behind building an application that will allow for us to send a signal from a phone into a receiver through the use of either bluetooth or wifi technology.

The second part will be the design of the receiver, which must include some sort of locking mechanism so that when the device receives the signal, it correctly interprets the it and creates a physical state change on the board (unlocks it).

Finally, the third requirement we must meet in order to complete our minimum viable product is the actual assembly of the board. For this part, we do not plan to build one from scratch, but rather we are looking a cost-effective kits and trying to decide which one would be best to meet our teams goals. We have also done some research on how to assemble the board, and everything we have seen seems very doable for the team.

Once we have successfully completed these three steps and interfaced between them, we should have a working board that, through the reception of a wireless signal, unlocks the remote necessary to be held in order to use. In the eyes of our group, meeting this requirement will solve the motorized ridesharing issue that we were plagued with because:

a) We will have built a motorized vehicle capable of taking you to 1-5 mile places in a quick and effortless manner
b) Will be cheap and you do not have to care for the product
c) Can be dropped off anywhere
d) Will be easily shareable so that you can use it at your convenience

Once the minimum viable feature is complete, we can then move on to other features that we fell would take this idea from a mere project to an actual go-to market product.

The first feature that we would like to work on would be to improve the “remote holder” so that it includes a way to register when the remote is put back into place (our version of ending a ride) and locks the remote. This feature take highest priority after our first product is finished since it would fully complete and improve the ridesharing facet of our motorized skateboards.

The next feature we would want to focus on is the charging of the boards. Really, it would begin by simply making the boards re-chargeable, since I assume we will first begin by purchasing batteries that will at one point decay. Once we jump the rechargeable battery hurdle, we will have to decide whether we envision a charging station where the boards must be dropped off after each use (citi-bike style) or whether we will come up with a different way to ensure the boards are charged and ready for use (incentivize customers to charge them on their own through certain rewards programs ect…).

Finally, in the case that we are able to complete of all the features/goals we have already set for ourselves, the last aspect that we would like to consider for this project would be the security features of our boards. In order to ensure that our ridesharing service is cheap, profitable and

reliable, our boards must be used multiple times a day. This will only occur if there is a high availability of boards, meaning that all boards must remain evenly spread throughout campus. This forces us to consider the possibility of people stealing boards as well as simply using them without paying for the rides (normal skateboard- not the motorized feature). To mitigate these issues, we have come up with some security features that we believe would work to discourage such behavior and thus maintain a high level of accessibility of the boards to the everyday late student.

To combat board stealing, we envision attaching a GPS locator to the boards, which can track its movements, and can sense if it is being moved when a ride has not been paid for. If this occurs, we plan to have the board emit a beeping signal, as well as threaten the perpetrator with calling the police.

5.Available Technologies (Hunt)

Links to available technologies:

- Skateboard parts website: https://diyelectricskateboard.com/blogs/diy-electric-skateboard-tutorials/electric-skateboard-parts
- Electronic Cabinet Lock: https://www.amazon.com/Solenoid-Electric-Control-Assembly-Cabinet/dp/B073DXLRYX

Detailed single motor build:

- Part 1 https://youtu.be/LJqyWRSqOy4
- Part 2 https://youtu.be/-tBjXlVo3ok
- Part 3 https://youtu.be/_mNnHp7sOBE

There are three major functional blocks in our project which we aim to tackle, one at a time. They function independently of one another and allow us to be flexible so that complications or setbacks can be accounted for as we dive into the project.

1. Electric Skateboard

There is an abundance of resources online which can help us accomplish the first and foremost task of this project: building the base electric skateboard. After doing some research, we have discovered that the most effective, cost and time efficient method is to purchase pre-made parts instead of try and make them on our own. These items include the ESC, motor, motor mount, pulleys, remote controller, receiver, battery, cables, trucks, wheels, and deck. There is a tutorial on YouTube from a guy who purchased similar parts and assembled the board without much of a problem. We already know which parts are compatible and the

YouTube tutorial series explains in detail how to set everything up to make it work, including programming the electronic speed control and remote. Many of these selected parts are specifically designed for electric skateboards, which is convenient and reliable. This portion of the project will require minimal engineering, just an assembly of the parts, some soldering, and some basic ESC software installation.

2. SWIFT Application

We will need to make an application on the iPhone so that the user can walk up to a board, open the app, type in the code that is written on the board, and therefore unlock and be able to use the skateboard. If we make it this far, we would like to potentially incorporate QR scanning to make the unlocking process more streamlined. Limebike currently uses this technology, and there is open source code on the internet that we could use to try and implement this feature. The other potential feature is GPS technology that tells you where the nearby available skateboards are, but this is an idea we would only approach if we achieved the previous goals in the application. The SWIFT application requires computer science knowledge and understanding, which we plan on acquiring.

3. Remote Holster/Lock

In order to make this skateboard a viable, rentable product in the real world, there needs to be a place where the remote can be stored on the board when the remote is not in use. Given that some variation of this feature needs to exist in order for our product to work, it makes the most sense to have locking technology in this holder where the remote will be secured until the user is ready to ride. This lock will prevent passerby from stealing the board, as well as insure that the user locks the remote back in the board in order to end the ride. We thought that the best technology to implement this idea is by 3D printing a remote holster using one of the 3D printers in Stinson. There are also many available locks online which are controlled electronically with a solenoid.

6. Engineering Content

a. Electric Skateboard - Will require minimum engineering.
b. SWIFT Application - Will require engineering knowledge, specifically with computer science. Previous classmates have done similar things with SWIFT, and they will be a helpful resource if we get stuck on this part of the project.
c. Remote Holster/Lock - Will require help from a fellow Mech-E to figure out the CAD, but the locking technology already exists online and can be purchased.

7.Conclusions

This project is comprised of three main parts: skateboard build, remote holster build, and app creation. Since we will not be able to match quality of great brands and we are working on a one semester time constraint we will not be building the board from scratch or doing much mechanical work. We will be buying the starter kit designated above. Once that is completed and all parts are in we will work on the holster and the app in parallel.

The holster will be most likely 3-D printed as it will be in the rather unique shape of the skateboard remote, which looks similar to the handle of a gun. For the locking mechanism will will be using either a relay or a solenoid with a magnetic lock. The user will have to replace the lock themselves once they are finished using the board. A hopeful feature of the board will be to register whether or not the remote is in the holster.