



# Pedaling Efficiency Interface

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## BACKGROUND

### Bicycle Market

Based on a survey done from Statista (1), there was around 47.5 million cyclists in America in 2017. Statista estimates there is a \$6.2 billion dollar market for bicycles.

### Similar Devices

There are only a few types of gear shifting equipment or add-ons built for bikes. The most known bike shifter is the automatic shifter that comes installed on electric bikes (Figure 1 (2)). According to Joe Kissell's article (3), even though various types of automatic bicycle transmissions have been available for the last 50 years, bicyclists are not warming up to the idea. Joe states that many people think it too expensive, heavy, and unnecessary.

### Our Device

Our team's goal was to create a device that would indicate to the user when to shift in order to increase efficiency, while still allowing the user to manually shift their bicycle. Key requirements for our design are low cost (\$10-\$20), easy installation (10-20 minutes), and universal application (any gear system).

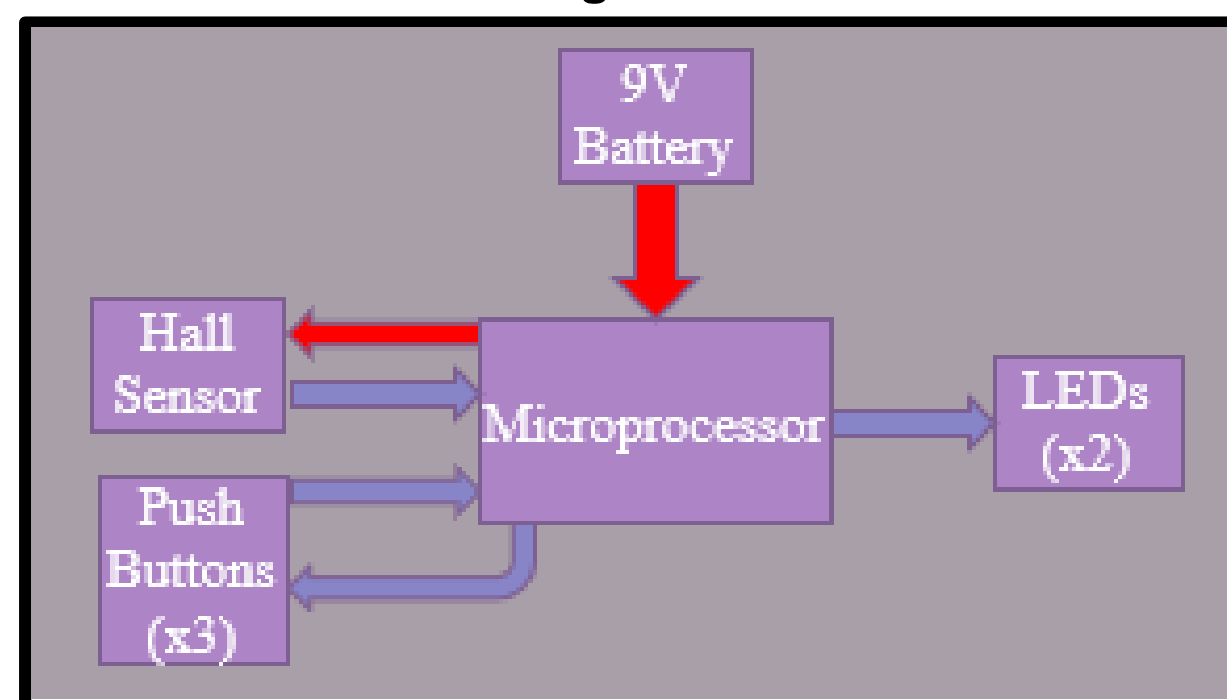
Figure 1



## PROPOSED SOLUTION

Our device uses a hall effect sensor to process the pedaling speed of the bicyclist. The sensor's values determine the work the user is putting in. Based on the user defined pedaling speed the system will indicate to the user when to shift their bicycle gears up or down. There are two separate LEDs which indicate to shift up or down.

Figure 2



Block Diagram

## SYSTEM DESIGN

### Display Interface

The front display is described in detail below. Here, we will elaborate on the circuit connections.

### Wiring

There is wiring running up the side of the bicycle which holds the necessary connections for powering and reading the hall effect sensor.

### Magnet (cased)

The magnet is used, because it creates the field that triggers the hall effect sensor. It is directly attached to one of the bicycle's pedals.

### Hall Effect Sensor (cased)

The hall effect sensor processes how far away the magnet (pedal) is from it. This also the microprocessor to determine the time between each pedal cycle.

### Shift Up

The blue LED will light up when the user should be shifting the bicycle to a higher gear.

### Shift Down

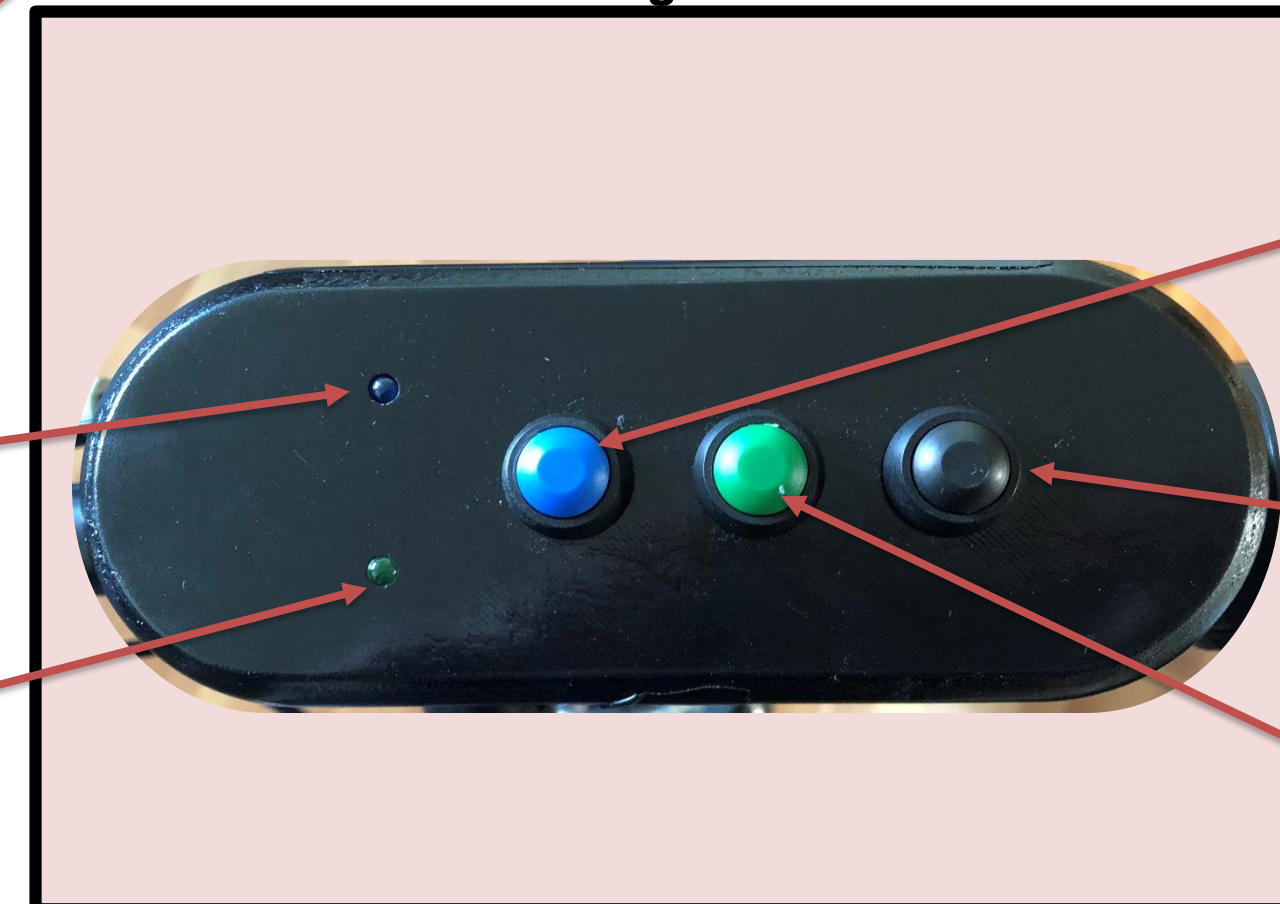
The green LED will light up when the user should be shifting the bicycle to a lower gear.

Figure 3



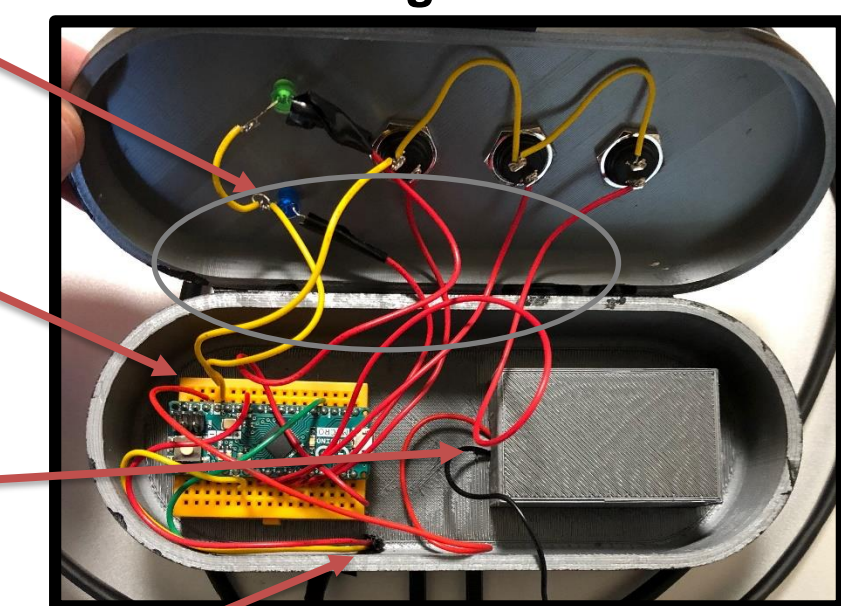
Complete Device

Figure 4



Front Display Interface

Figure 5



Circuit Connections

LEDs and Buttons Wires

Arduino Micro

Battery Wires

Hall Effect Sensor Wires

### Set Speed Button

Press the blue button until both LEDs blink. After the LEDs have blinked the next two pedal cycles will determine the speed the user wants to pedal at.

### Off Button

Press the black button for about five second, until both LEDs blink. After the LEDs have blinked the system will have turned off.

### On Button

Press the green button until both LEDs blink. After the LEDs have blinked the system will have turned on.

## FUTURE DIRECTION

- A smaller, rechargeable battery
- Additional coding to anticipate atypical biking scenarios
- New casing designs that would decrease the size of the product
- A small, digital display screen instead of the LEDs
- Replacing the 'on' and 'off' buttons with a single on/off switch system
- Allowing the user to program in the gearing system so the device specifies the gear to shift to
- Using wireless communication between the hall effect sensor and the microprocessor

## REFERENCES

- 1 Fuller, Steve. "Topic: Cycling." [www.statista.com](http://www.statista.com), [www.statista.com/topics/1686/cycling/](http://www.statista.com/topics/1686/cycling/).
- 2 "EVELO Aurora - A Unique and Versatile Electric Bike." EVELO, [www.evelo.com/electric-bicycles/aurora/](http://www.evelo.com/electric-bicycles/aurora/).
- 3 Kissell, Joe, et al. "Joe Kissell." Interesting Thing of the Day, 9 May 2019, [itotd.com/articles/8562/automatic-transmissions-for-bicycles/](http://itotd.com/articles/8562/automatic-transmissions-for-bicycles/).

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## CONTACT INFORMATION

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