SmartCycle

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Problem Description

➔   130,000 injury-inducing accidents annually in US
➔   1,000 deaths from biking accidents annually
➔ $23 billion lost in injury expenses, hospital expenses, work/productivity losses, etc.
➔   Stationary bikes provide information and data but do not allow you to be mobile
➔   High quality stationary bikes (ex. Peloton) are expensive ($1500-$2500)

Proposed Solution

➔ Automatically shifts gears to facilitate a smooth riding experience
➔ Algorithm for gear shifting will take into account pedal speed and bike incline
➔ A solenoid actuator will be used to manually shift the gears

➔ Aggregates information on heart rate, distance, and speed
➔ All data will be displayed to the user on an LCD display
➔ The data will transmitted via Bluetooth to an smartphone app
➔ This app will be integrated into the Apple Health app
➔ Data on calories burned will be included and will be calculated with force of gravity relative to the incline, pedaling speed, and gear level resistance

Demonstrated Features

➔ Can effectively use a motion sensor and a gyroscope to determine what gear the bike should be in
➔ Automatically shifts the gear to the ideal gear setting based on incoming data
➔ Has the ability to electrically interface with the mechanical gear shifter
➔ Safety check to prevent gear switching if the pedals aren't actively turning
➔ Has an LCD display that shows exercise stats such as distance traveled, bike gear, etc.
➔ Connects using Wifi and Bluetooth to a smartphone app that analyzes bike workouts
➔ Measures heart rate of rider using a sensor

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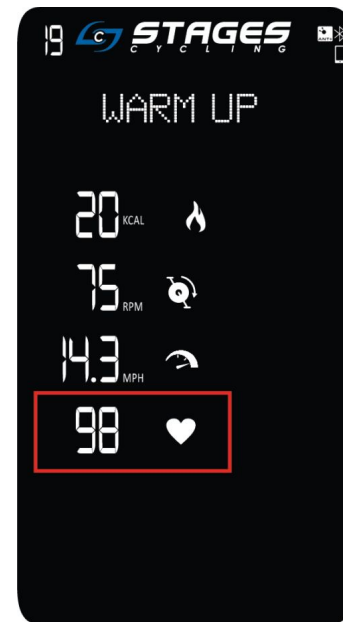
Available Technologies – Push-Pull Solenoid & LCD Panel

➔ Device to convert electrical power to mechanical power

➔ LCD panel will be put on the handlebars as the user interface

➔ Helpful exercise information, such as distance traveled, calories burned, and current gear will be displayed

Available Technologies – Motion Sensor & Gyroscope

➔ Passive Infrared (PIR) sensor

➔ Detects rotational pedal speed using infrared emissions from the users foot
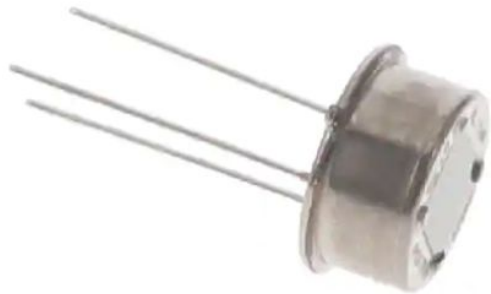
➔ Gyroscope
➔ Senses tilt angle of bike
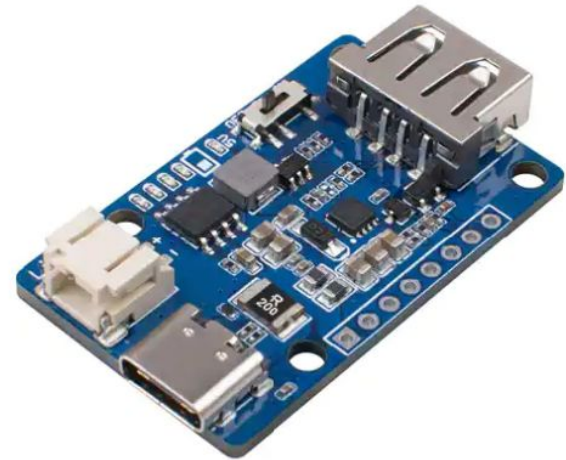➔ Used in conjunction with motion sensor to determine optimal gear choice
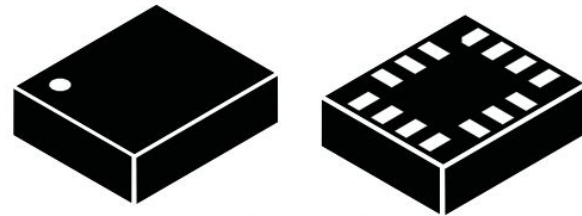
LGA-14L

(2.5 x 3 x 0.83 mm) typ.

Available Technologies – Power

➔ 2Ah, 3.7 LiPo battery
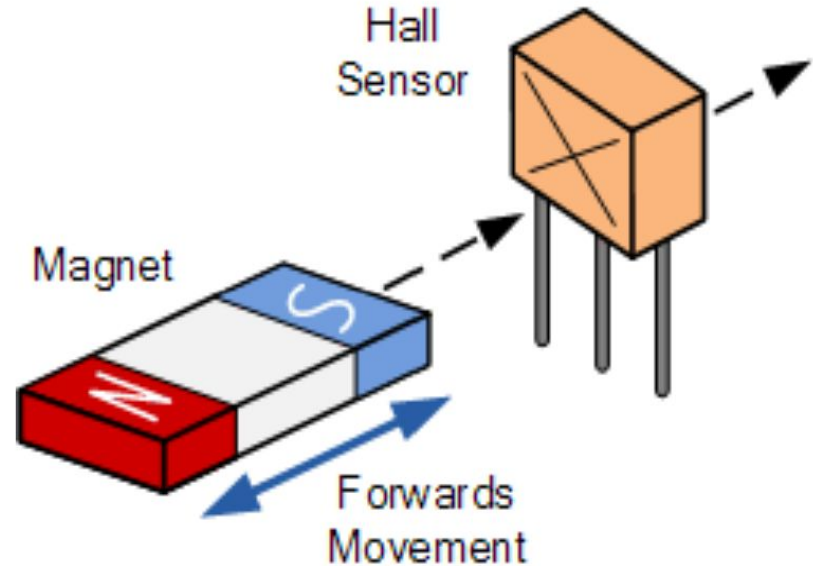➔ Projected 300 hours of battery life

➔ USB type C interface for recharging

Available Technologies – Sensor for Distance

➔ Hall Effect sensor to determine distance bike travels

➔ Works by attaching a sensor on the bike frame and a magnet on a spoke of the bike wheel

➔ Sensor used to determine RPM of bike wheels which can be converted to linear distance

Hall Sensor

Magnet

S

N

Forwards Movement

https://www.electronics-tutorials.ws/electromagnetism/hall-effect.html

# Available Technologies – Heart Rate Monitor

➔ Example heart rate sensor circuit for Arduino

➔ Uses an infrared emitter LED to detect blood flow

➔ Use this as a basis to make our own board
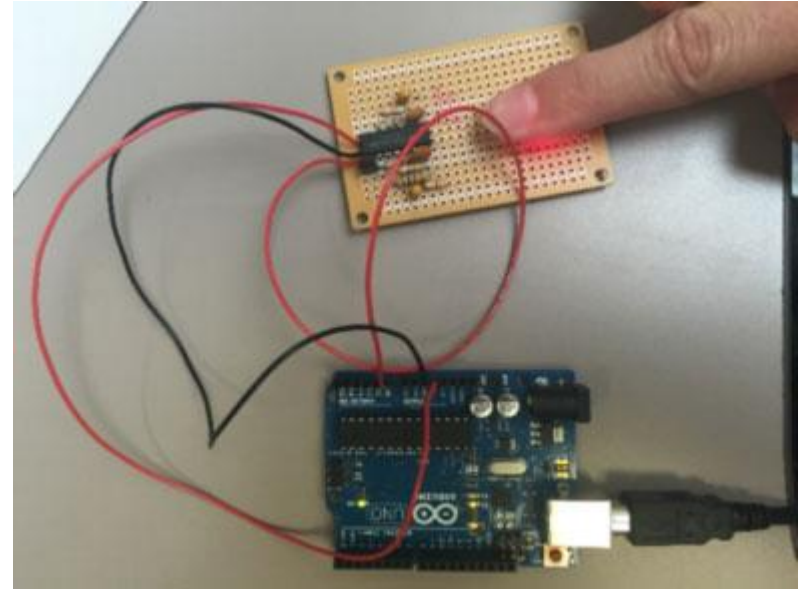
Engineering Content

➔ We will have to start by designing the individual interfaces on the different parts of the bike.
➔ We will need someone working on…
◆ The electrical-mechanical interface meant to move the gear-shifter and where to angle the solenoids
◆ The code for the fitness app and the bluetooth component connecting to the heartbeat sensor
◆ Programming the different functions of the system into the board and how all of the different components will wire to the board
- the speed and distance analysis with the wheel sensor and LCD
- the safety check with the pedal sensor
- the motion sensor boundaries and gyroscope settings for the gear shifter to act upon
◆ How to fit the different devices to the bike and assemble everything together so that the whole SmartCycle functions as one cohesive system

System Block Diagram
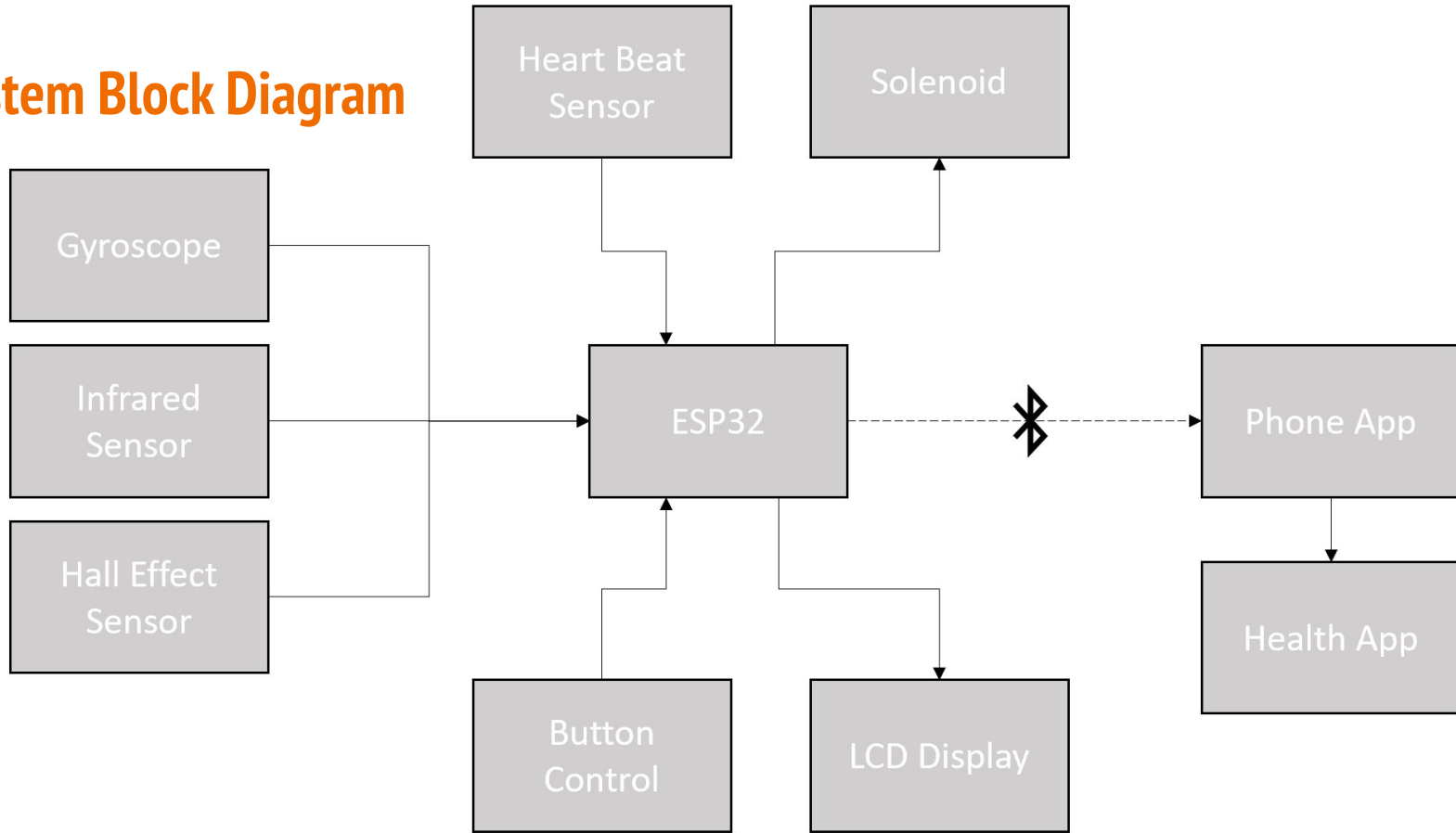
Sensor Map
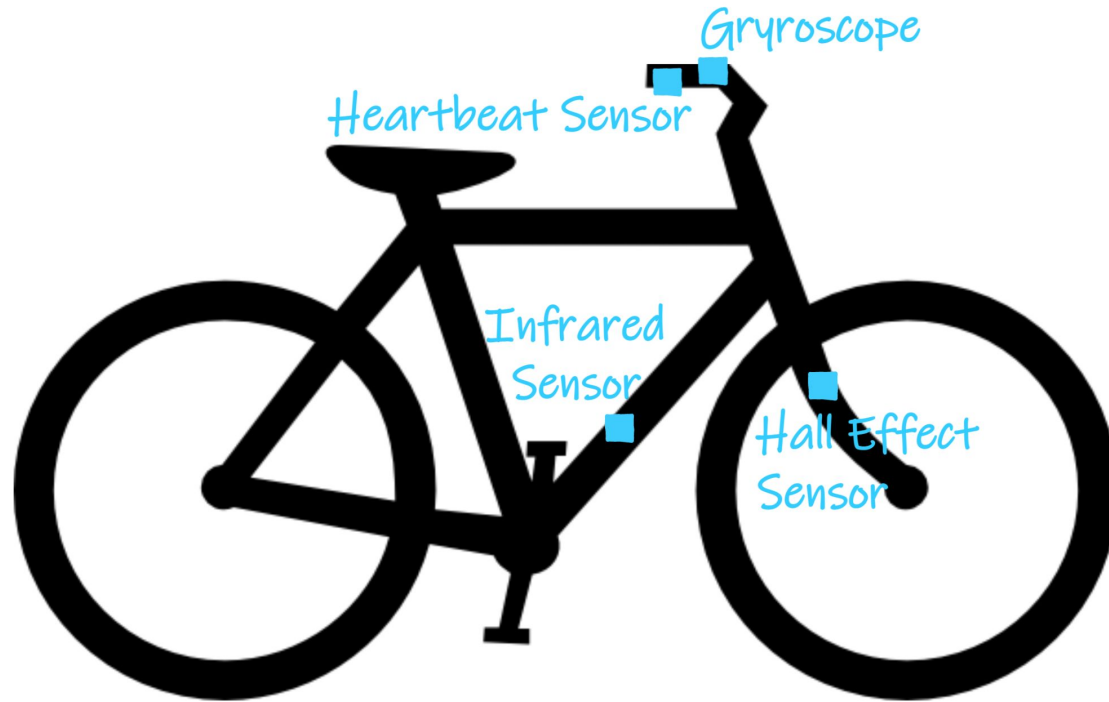
Conclusion

➔   This product will make casual biking far more enjoyable and simple for the rider and will likely lead to fewer accidents for those who commute by bike

➔   It will also allow the technological benefits of a traditionally stationary exercise bike to translate to an outdoor setting

➔   We believe that this product will effectively serve a generation becoming increasingly interested in biking as a form of transportation