Problem
The opioid epidemic has been a rising issue, and although there are some efforts to decrease this, none have been very successful. There needs to be a stricter way of informing a doctor when a patient is susceptible to addiction without taking away complete control from them. A pill cap that counts the number of pills coming from the box and sends that data to the doctor is a solution that could help greatly with this epidemic. The current design is big and simple, and we want to improve upon this by optimizing the size and functionality.

Solution
A smart medication pillbox with a built in mechanical component, wireless transmission capabilities, and an accompanying app to track the number of pills taken out of the pill box. To ensure accurate measurements of the number of pills taken out, we use a mechanical pill dispenser system to limit only one pill to be taken out at a time.

link is here: https://youtu.be/iwnlcyby1cw?start=69

A small laser will be pointing across the opening of the pill box where pills can exit, while a photoresistor is placed on the other side of the opening, receiving the laser. The laser is blocked whenever a pill is taken out, which is sensed via the photoresistor, and this data is displayed on a small monitor, alongside being transmitted wirelessly to an app.

Visual Aid
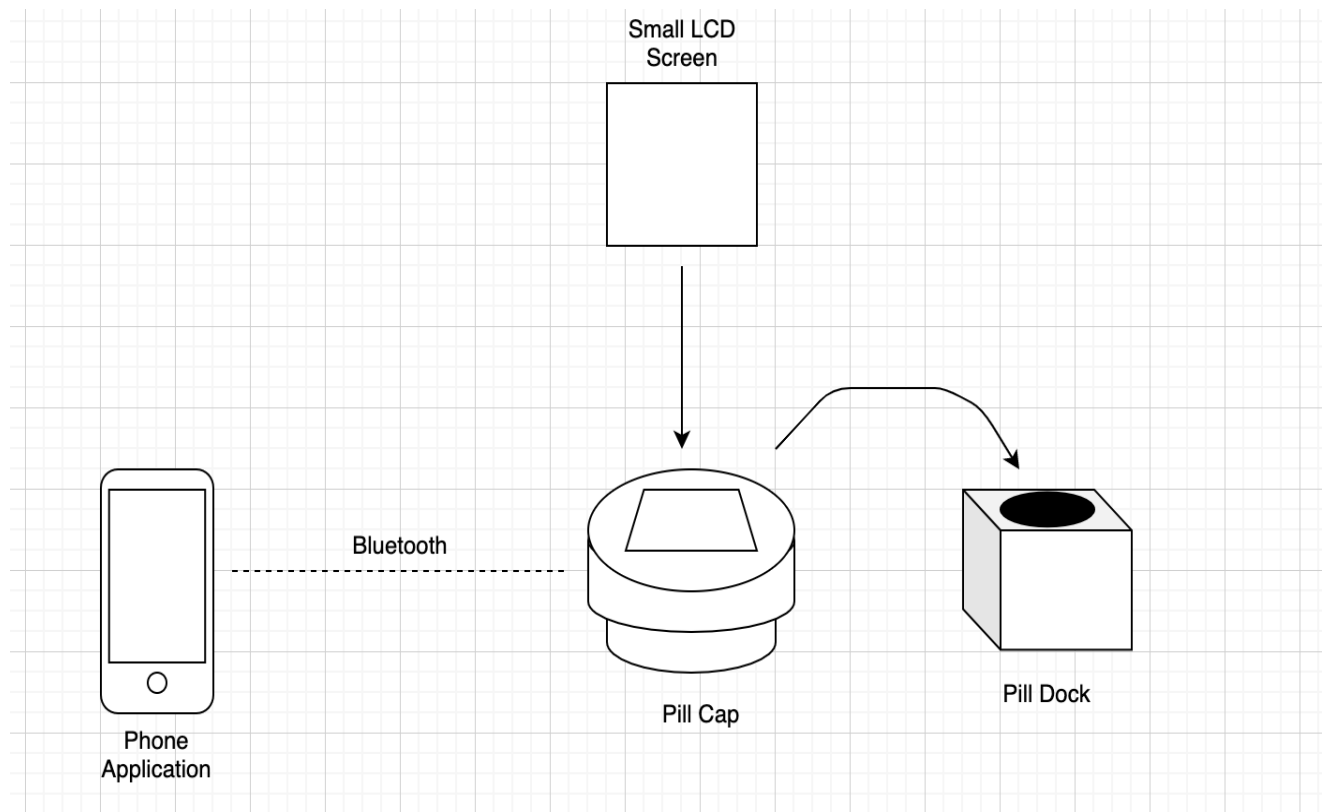
High-Level Requirements List
- The pill dispensing mechanism, the bluetooth board, and the screen should fit in a space of 2.9718 cm in diameter (diameter of a pill cap) and 1.5 cm in height.
- The pill dispensing mechanism must trigger the laser to turn on. The mechanism must also only dispense one pill at a time with an accuracy of at least 95%.
- The battery powering the screen, laser, as well as bluetooth chip should be able to last a week. The pill dispensing mechanism will trigger the whole system to stay on for 5 seconds to conserve energy.

Power Subsystem
1. Entire subsystem must be small enough to fit on the PillBox Lid housing. Current plan is to have a diameter of about 3 inches.
2. Voltage regulator must be able to regulate battery output voltage to 3.3V±0.5V. Bluetooth Tx/Rx, Counter Display, Counter Memory all operate at 3.3V, with tolerances ranging of around 1.0V.
3. Supply different current levels for various chipsets, from ~180 mA to 1.37uA(bluetooth chip, seems off)

Communication Subsystem
1. Bluetooth transmission reliably connects with external device, where connection remains unbroken given pillbox not out of range of device. (A few meters for now?)
2. Counter display reasonably quickly responds to pills detected. Max 1s.

Memory Subsystem
1. Memory retains data on pills dispensed and doctors' input data even when the PillSafe device is turned off(until battery dies).
2. Separate data between pill dispensed count and for other information(doctor's input data such as recommended dosage and starting pill count).
3. Be able to store information of at least a few 16-bit integers. Min 160 bit storage space?

Dock Subsystem
1. Be able to communicate with internal memory subsystem reliably without data loss.
2. Able to output data in external device compatible format.
3. Able to receive data to write to memory subsystem, and convert to memory subsystem compatible format.

Detection Subsystem
1. Be able to accurately detect when a pill has crossed
2. Auto turns off the sensor to make sure power of battery is conserved
3. Accurately sends information to memory subsystem when a pill has crossed

Ejection Subsystem
1. Be able to eject one and only one pill from using the levers described in the gif
2. When lever is triggered, must turn on the laser detection system to check

Tolerance Analysis

The main risk to the project could potentially be ensuring the battery life is conserved and lasts a long time even though it is used for the sensor and the bluetooth component. The way we are tackling this is by making sure the bluetooth module and laser module is switched completely off when a pill is not actively being dispensed.

Ethics and Safety

Our main concern is violating patient confidentiality. We want to avoid this issue by making sure the patient data is only accessible to the doctor, and the patient is allowed to take the cap off when they want. We will just track when the pills are coming out of the bottle through the pill cap. We want to make sure that we do not take any control for the patient which is why we did not enforce any type of lock on the Pill Safe cap.