Tracking Drug Adherence

Clint Pose
HCDE 539
Final Repo

Problem

Patients Don't Take Their Medication

Global Burden of Disease

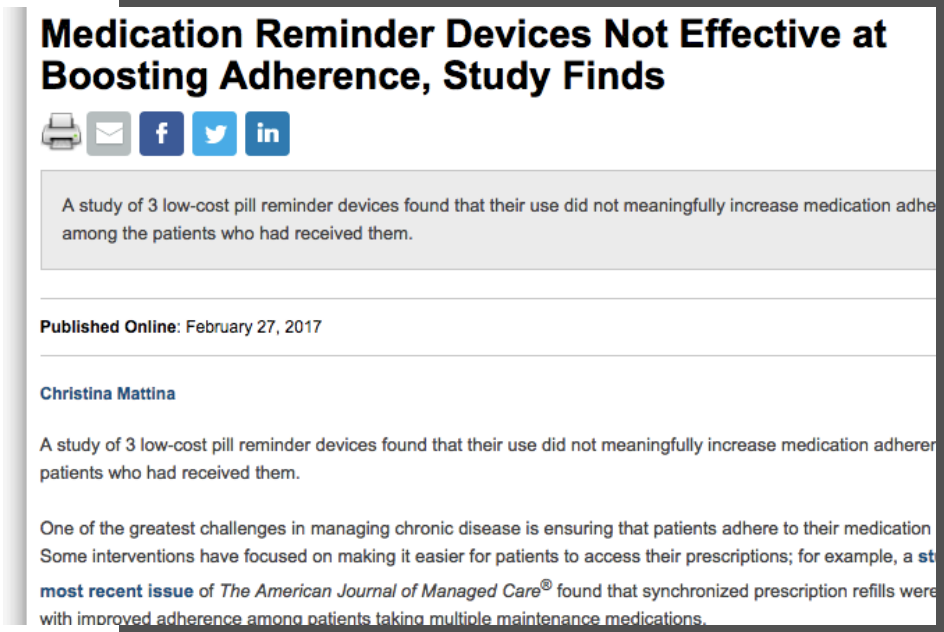
The World Health Organization (WHO) estimates that drug adherence in developed countries is less than 50%

In developing countries, estimates for adherence are even lower.

Treatment for drug resistant strains of HIV, Tuberculosis, and bacterial infections is expensive and can bankrupt local health care systems.

Current Adherence Devices Aren't Working

Studies for current drug adherence devices (electronic pill capsules, watch reminders) show negligible efficacy.



Medication Reminder Devices Not Effective at Boosting Adherence, Study Finds

A study of 3 low-cost pill reminder devices found that their use did not meaningfully increase medication adhe among the patients who had received them.

Published Online: February 27, 2017

Christina Mattina

A study of 3 low-cost pill reminder devices found that their use did not meaningfully increase medication adherer patients who had received them.

One of the greatest challenges in managing chronic disease is ensuring that patients adhere to their medication Some interventions have focused on making it easier for patients to access their prescriptions; for example, a st

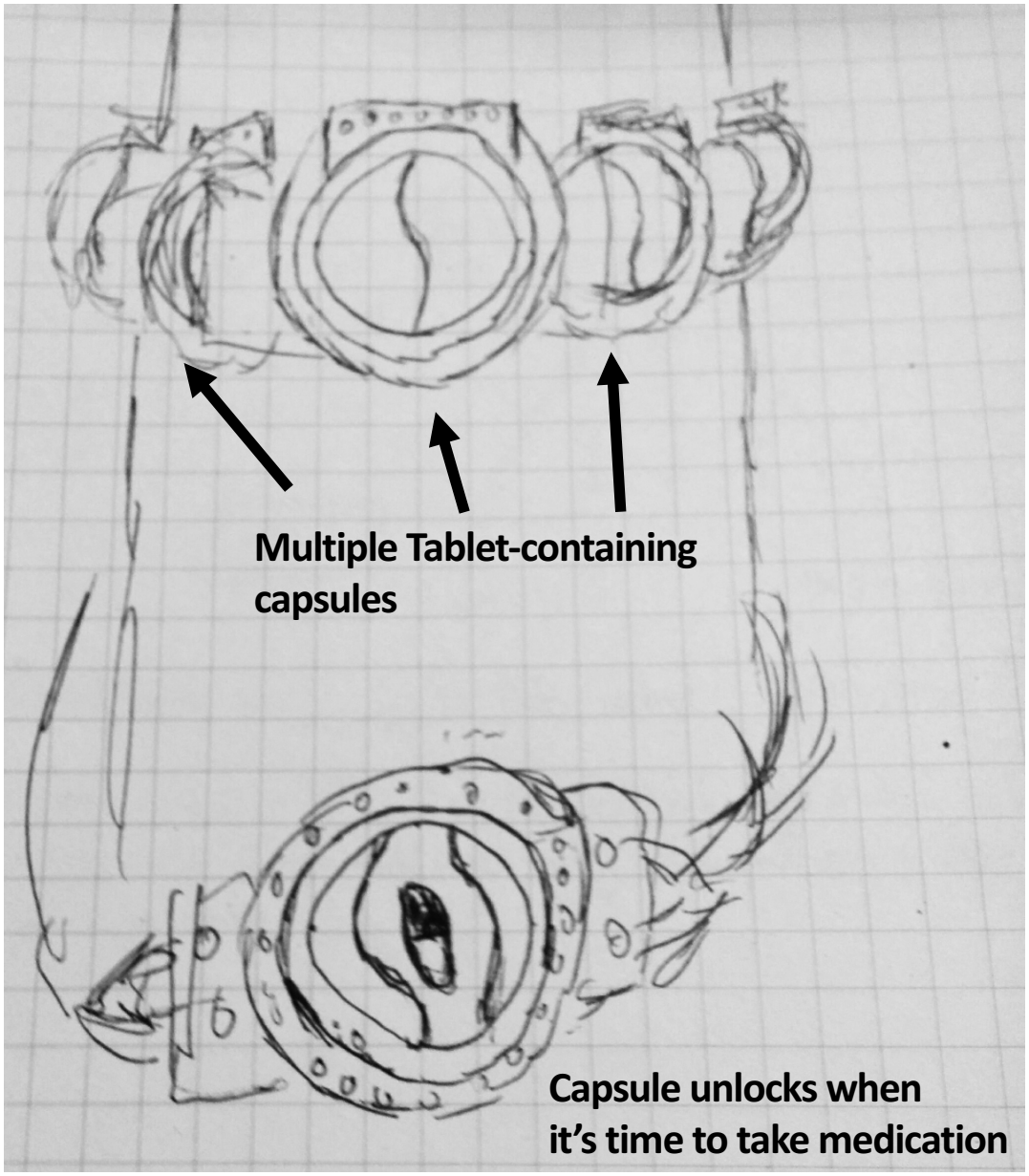
most recent issue of *The American Journal of Managed Care*® found that synchronized prescription refills were with improved adherence among patients taking multiple maintenance medications.

Ideation

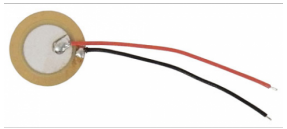
Concept Sketching

Studies note that electronic pill containers, reminder devices, and mobile apps are not effective: but what about a wearable that holds the dosage?

To build something like this, I sketched various concepts that incorporated modular components that each contain a separate tablet.



Ideation

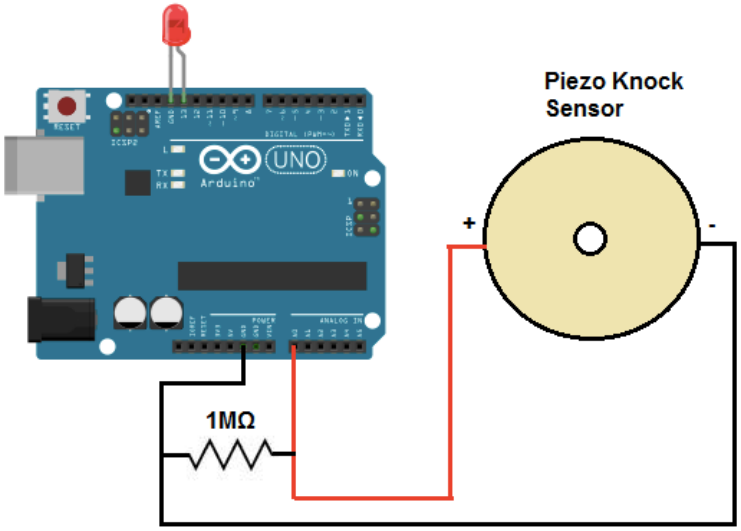


Sensor Selection

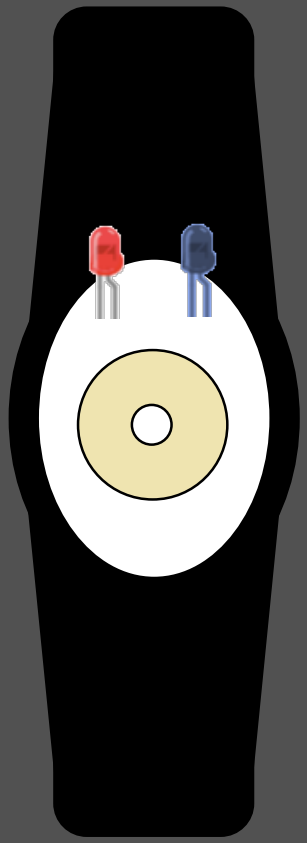
To build smart capsules that can detect the presence of a tablet, I'd need a sensor that can detect the presence of the tablet and record a binary status (FILLED = TRUE/FALSE) for the component.

In the auto industry, knock sensors are used to detect vibrations—for this design, I decided to test using a knock sensor to record the presence of a tablet.

Knock Sensor Schematic



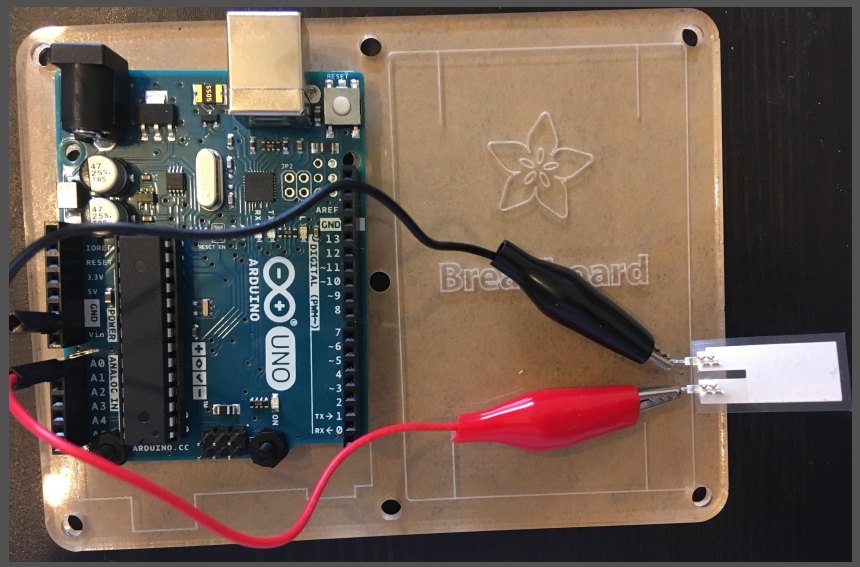
Concept Sketch including knock sensor



Simulating Interactions

Sensor Selection

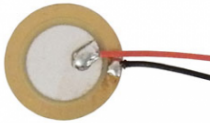
Using a simple setup, I tested three types of knock sensors to find one that was sensitive enough to detect the pill, but not so sensitive that every movement would set off the sensor. I settled on the MEAS-SPCC knock sensor (in image below).



Three Sensors Evaluated

Not sensitive enough

Sensitive, but values mappable



Too sensitive

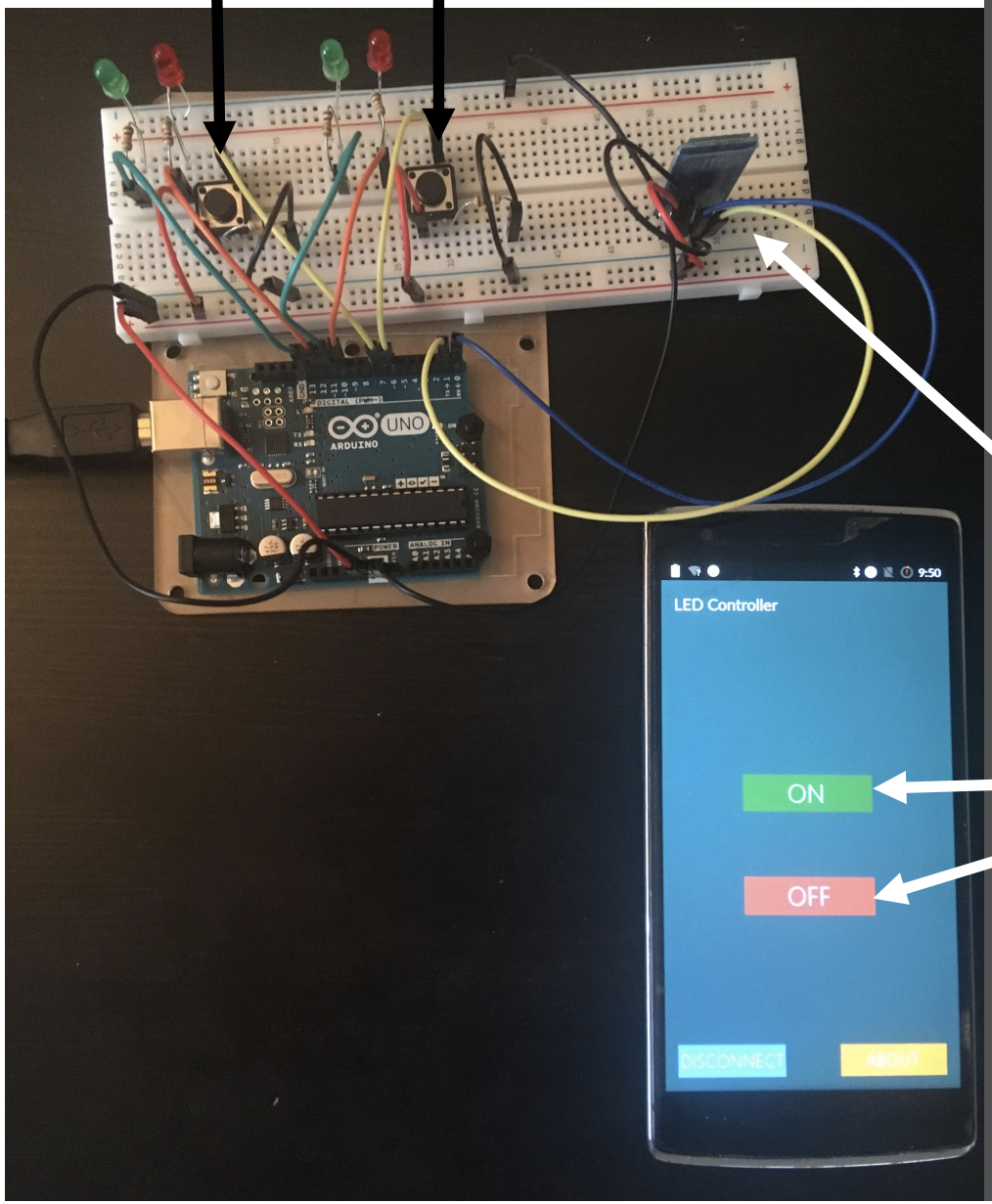
Snippet of Arduino Code

```
// these constants won't change:
const int ledPin = 13;      // led connected to digita
const int knockSensor = A0; // the piezo is connected
const int threshold = 100;  // threshold value to deci

// these variables will change:
int sensorReading = 0;      // variable to store the v
int ledState = LOW;         // variable used to store

void setup() {
  pinMode(ledPin, OUTPUT); // declare the ledPin as as
  Serial.begin(9600);       // use the serial port
}

void loop() {
  // read the sensor and store it in the variable sens
  sensorReading = analogRead(knockSensor);
```

Simulating Alerts

For testing Bluetooth alerts, I set up buttons to simulate a binary input for each tablet. In this set up there are two inputs, simulating a twice-daily dosing regimen.

Buttons to simulate binary input
(FILLED = TRUE/FALSE)



Bluetooth Receiveer

Android application buttons sending binary data to Arduino.
For this simulation, I had the ”0” value (represented by the Off button), correspond to the second input.

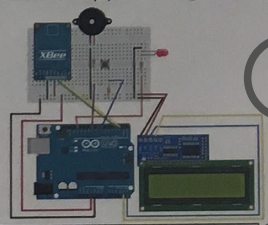
Final Design

Clint Posey

WeTa: A Wearable Drug Adherence Tracker

Networked Prototype

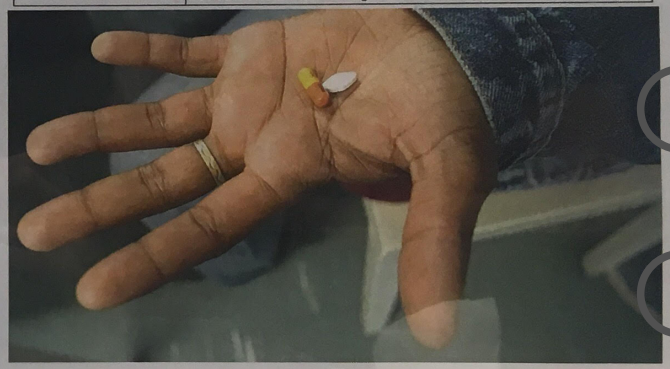
WeTa is a simulator for a networked device that tracks a patient's adherence to a drug regimen. The device detects if pills are present and notifies the user to take their medication. It also tracks when patients have missed doses to help prevent drug resistance.



- Press button to simulate detection of pill within container
- Send alert to device
- If pill is detected, alert will change

Alert Conditions

Alert Type Code	Description
FILLED_ALERT	Device has been activated and filled
UNFILLED_ALERT	Device has been activated and isn't filled
MISSEDDOSE_ALERT	Device is UNFILLED before and during scheduled dosing window; OR Device is FILLED both during and after dosing window



Reflections

There were many challenges for developing this prototype.
Namely, the code for reading the values from the sensor needs to be better tuned to receive consistent values. For this reasons, when I tested the alerts, I stuck with a button to simulate a binary input (to make debugging easier).

For the Bluetooth alerts, I encountered many bugs and minor roadblocks. First, I couldn't find a good Arduino—iOS application, so I stuck with Android. Second, I needed to disconnect the Bluetooth RX/TX lines whenever I downloaded new Arduino code (otherwise I'd receive an error).

For the code itself, I struggled with the conditional logic. For this set up, I wanted to nest an If/else statement in another If/else statement:

If input from Bluetooth is 1
Then If Filled=True for Button 1
Light LED

This presented many logical headaches in my code to ensure all of my code was included in the correct logical flow. I still have kinks to work out in this logic.

Overall, I enjoyed this project and think the prototype I developed shows promise!

Appendix A: Arduino Diagram