# Project Synapse

Kyle Chong

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## Contents

# 1. Introduction

## 1.1 - Overview

Welcome to my project!!

I'm currently building an STM32G031K6Tx based watch with three major goals:
1) accurately detect when I snap my fingers, 2) fire a wireless transmission, and 3) continuously function at low power. The RF packet will be read by a receiver module that connects to my lightswitch, turning my lights on and off via a servo.

The project is currently in active development, and this file will be updated frequently.

## 1.2 - Roadmap

[ ✓ ] Wireless Communication Protocol

- Designed and implemented a robust 2.4GHz protocol for the E01-ML01S transceiver.
- Built and validated the receiver module, achieving a 100% packet success rate with proper IC and actuator decoupling.

[ ✓ ] Hardware Design and Integration

- Designed and fabricated a custom PCB to integrate the MCU, sensor, and power management circuitry in a wearable form factor.
- Assembled a fully functional prototype, packaging the custom hardware and battery into a compact watch enclosure.

[In Progress] Snap-Detection Firmware

- Developing accurate snap-detecting algorithm using the onboard piezo sensor (Currently at 20% accuracy, looking for >90%)
- Currently evaluating performance trade-offs between the piezo sensor and a MEMS microphone + IMU solution for future revisions

[Future] Low-Power Optimization

- Implement interrupt-driven, ultra-low-power sleep modes to achieve a target battery life of 3+ months

# 2. Transmitter Module

## 2.1 - System Architecture

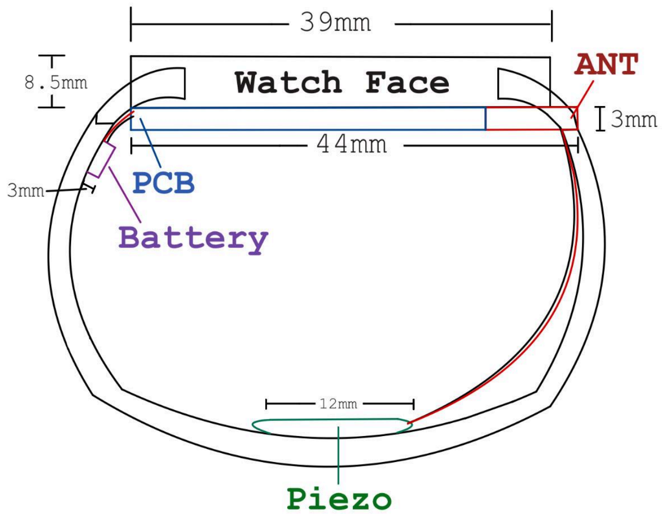


**Figure 2.1**
**(Side View)**

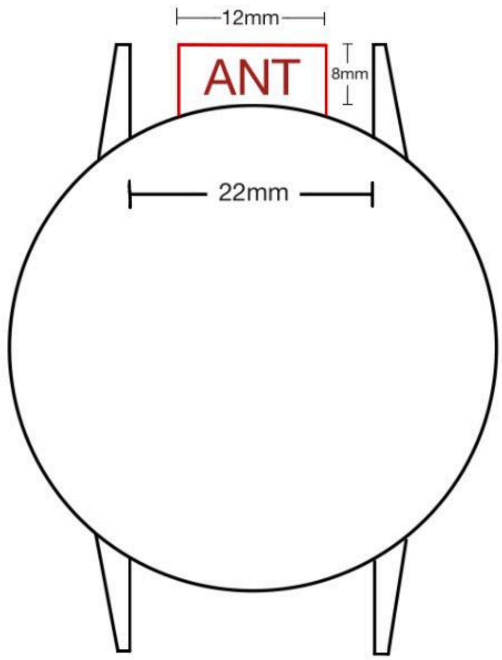


**Figure 2.2**
**(Top View)**

When integrating the hardware into the watch, the primary considerations were the size and location of the PCB. In order to maintain a natural, invisible look and feel, the PCB was reduced down to a 3mm thickness. Additionally, the wireless antenna needed to be kept away from metal, so the PCB housing was designed to overhang off the edge of the watch, protruding through the watch strap via a hole cut by an oblong leather punch.

## 2.2 - PCB Design

The PCB flashes code via an ST-Link v3 miniE, along with a TC2070 adapter, which is placed onto the TC2070 footprint (Figure 2.3, top left corner). Although I would recommend outsourcing assembly (as the smallest footprints are 0603), the E01-ML01S should be soldered by hand, as it hangs over the edge of the PCB, which can cause issues in assembly.

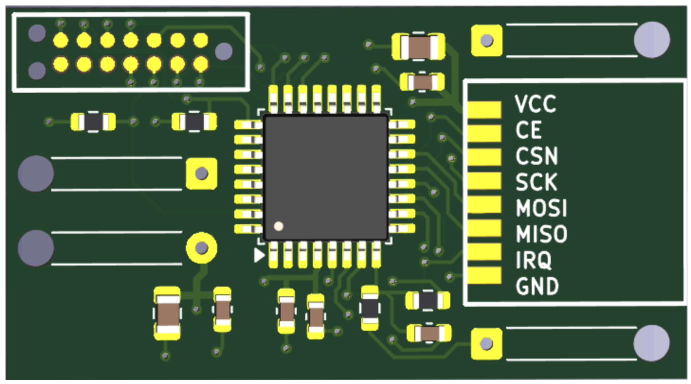


**Figure 2.3**

*Gerbers can be found in Github

## 2.3 - PCB Housing

I used an SLA printer for the PCB housing, as my nozzles for alternate printers weren't equipped to deal with the .4mm walls that my housing used.
*.stl files can be found in Github

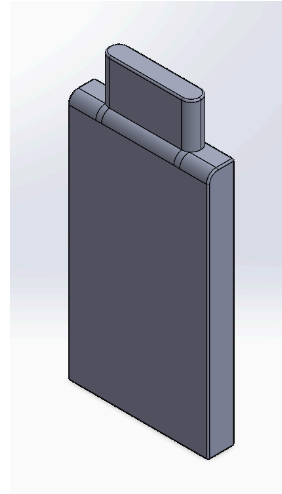

**Figure 2.4**

## 2.4 - Bill of Materials

I used

# 3. Receiver Module

## 3.1 - System Architecture