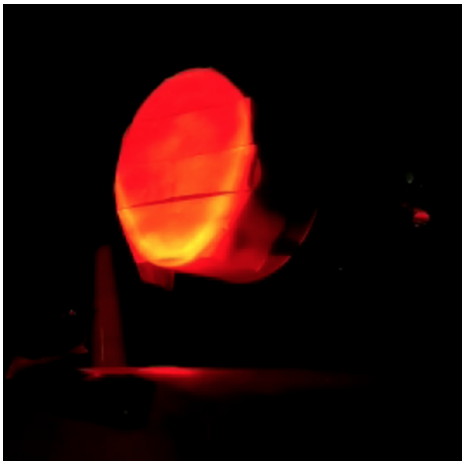
# Target Practice

# Versions

## ✔️V0.1 - Basic hit detector (23/08/2020)

### Objective

Define a simple hit detection mechanism and a simple way to change the target's color once hit.

## ✔️V0.2 - Framed Target

### Objective

Experiment with materials and structures. Define potential targets with their dimensions and required materials.

### Materials

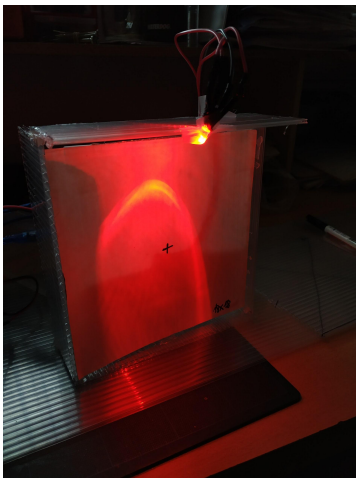
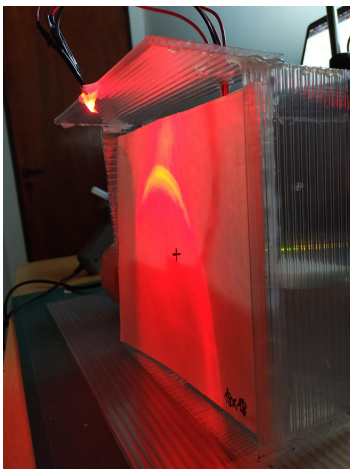
Polycarbonate sheets

### Notes & Conclusions

1. Built 1 target with following measurements:
    a. Front and Back: 18x18 cm
    b. Sides, Top and Bottom: 19x8 cm
        i. The idea was for the front plate to be fully covered by sides, top and bottom.
        ii. Also, this leaves a gap between the front and top plates of 1 cm. Still not high enough to have led + wires

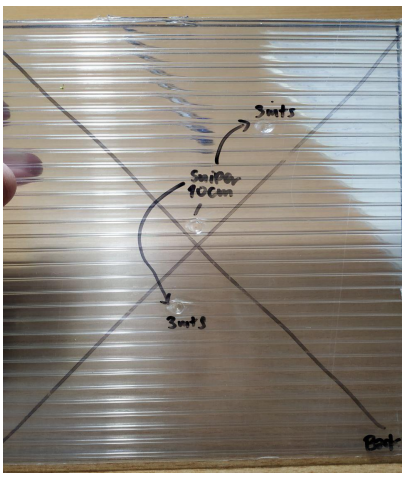
iii. Top was placed ¾ of its width extending over the front plate in order to slightly shield the front plate from the sun and provide the LED with some distance to get the appropriate angle in relation to the front plate.
iv. Internally, this provided 4cm for sensor and cable wiring, which seemed kinda good but 6cm is probably better.

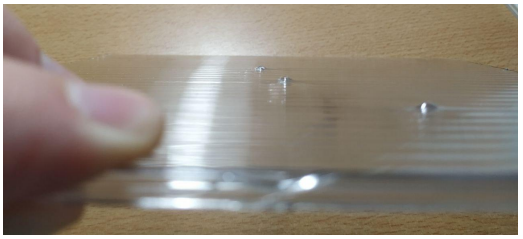
2. The LED was placed at the end of the top plate in an A shaped cut.
    a. The wires couldn't be fitted properly through the gap between front and top plates.
3. In order to try the desired structure, everything was glued together with a plastic glue gun. A stronger structure could be achieved using silicone glue (takes around 24hs to dry).
4. Placed a paper in front of the front panel.
5. Up close, the structure looks awful. The paper covers most of it, and from a few meters, you can't tell that it is poorly constructed.
6. Cutting polycarbonate with a cutter was not really effective. The process is tedious and the cuts are very imprecise.
    a. Unless I can cut these with a handsaw, the process will not work.

## Stress testing

1. Front plate
    ~~a. Minimum Engagement Distance~~
        ~~i. CQB - 1 meter~~
        ~~ii. Assault - 10 meters~~
        ~~iii. DMR - 15 meters~~
        ~~iv. Sniper - 25 meters~~
    ~~b. Excessive force~~
        ~~i. 1 meter full auto with .28s~~
        ~~ii. 5 meters sniper with .43s~~
    c. Point Blank Sniper (~10cm .43s) - 2mm deformation No Penetration

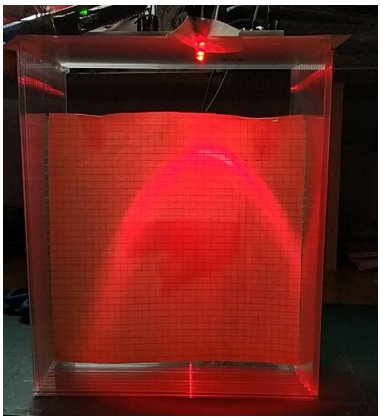
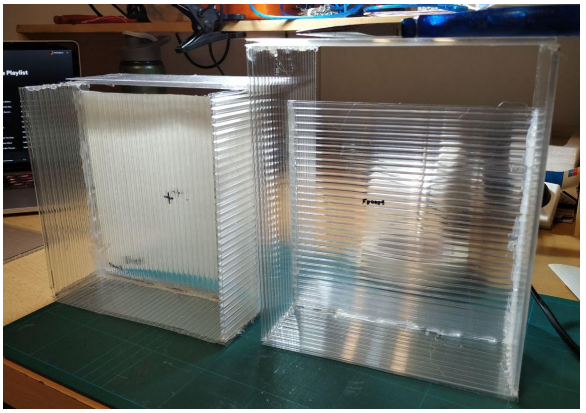




2. General frame structure
    a. After how many hits the structure shape starts to change?
    b. Are glued junctions being separated by the hits?
3. How much weight does it need to be added so that it doesn't fly away by a single shot?

## Next Steps

1. Improving lightning:
    a. Try using 3 LEDs by plate
    b. Try building a target with a sides/top/bottom clearance of 10 cm
        i. Also increase the gap between front-top plates to 4 cms and experiment with wire placement

MKII has a better coverage around the main plate and a higher top in order to provide space for the LED.
MKII measurements:

- Front/Back: 18 cm x 18 cm
- Sides: 22 cm x 12 cm
- Top/Bot: 19 cm x 12 cm

2. Start v0.3

# ✔️V0.3 - Multiple Targets

## Objective

Build 3 framed targets and connect them to the controller.
When hit, they switch colors for a brief time.
Connectors:

1. 4 pin female connectors for LEDs
2. 4 pin male connectors for hitbox
3. 4 pin female connector for each controller's interface w/ hitbox

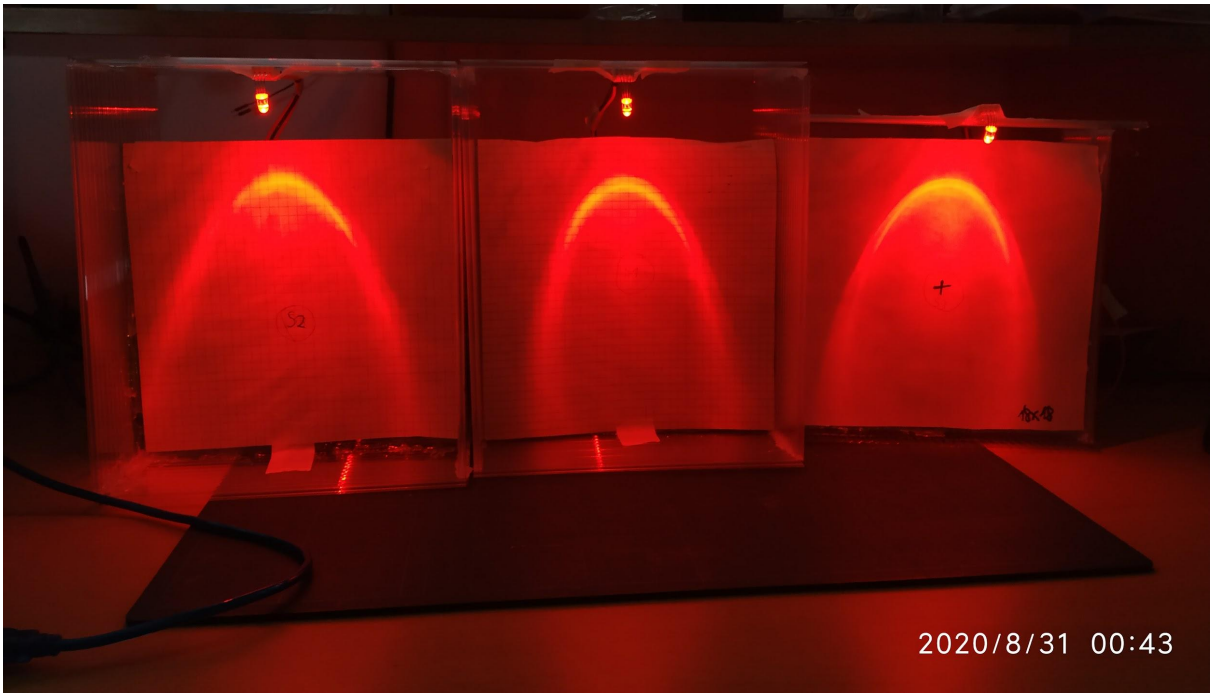
## Materials

- 1.5 m x USB Extender
- 8.4 m x Wire
- 1632 cm2 x Polycarbonate sheet
- 6 x 4 pin female connectors
- 3 x 4 pin male connectors

## Tasks

1. Build 3 MKII target frames
2. Prepare wiring for
    a. 3 LEDs => 3 female connectors
    b. 3 targets => 3 male connectors
    c. 3 controller output => 3 female connectors
        i. Lengths:
            1. 1 x 30 cm
            2. 2 x 90 cm
    d. 3 sensors =>

## Notes & Conclusions



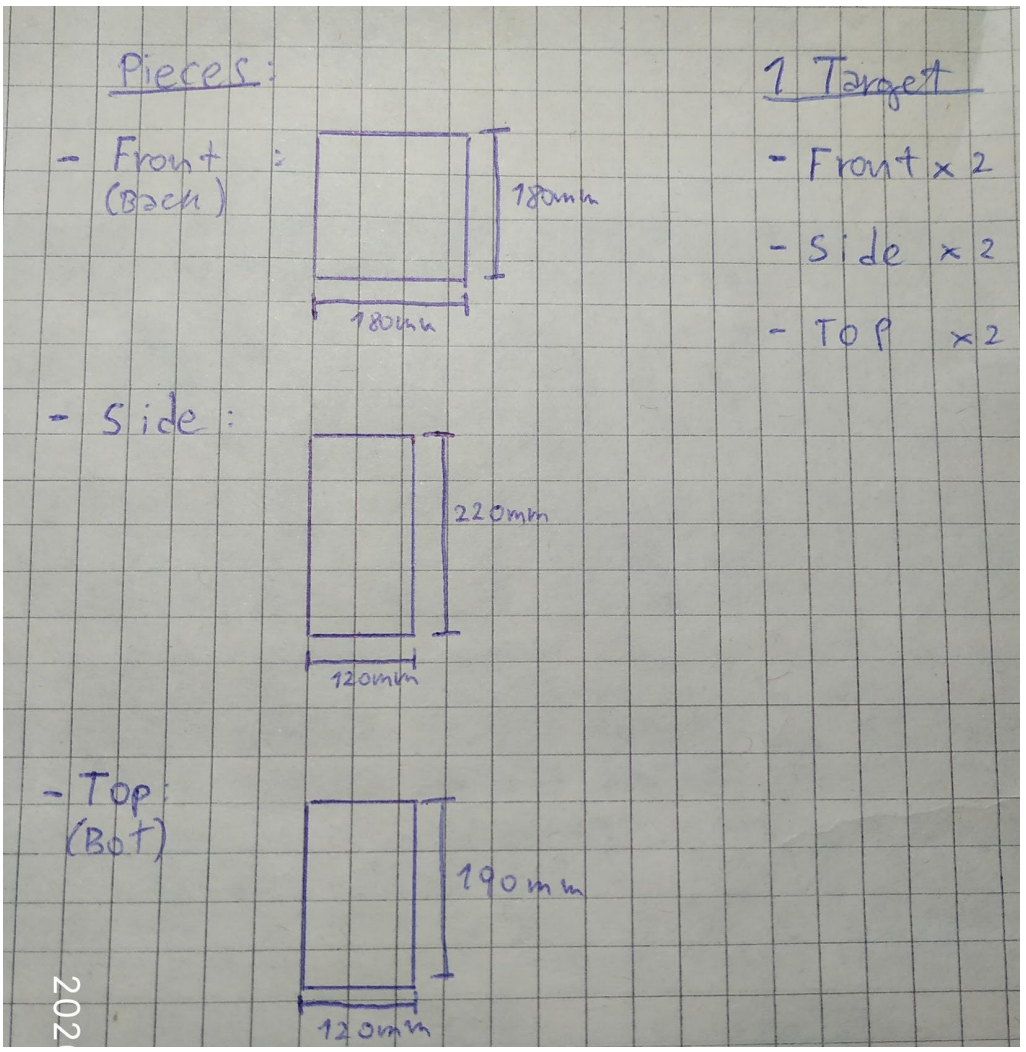

I’ve done it! Took a lot more effort than anticipated. Main relevant issues:

1. Polycarbonate
2. Wiring

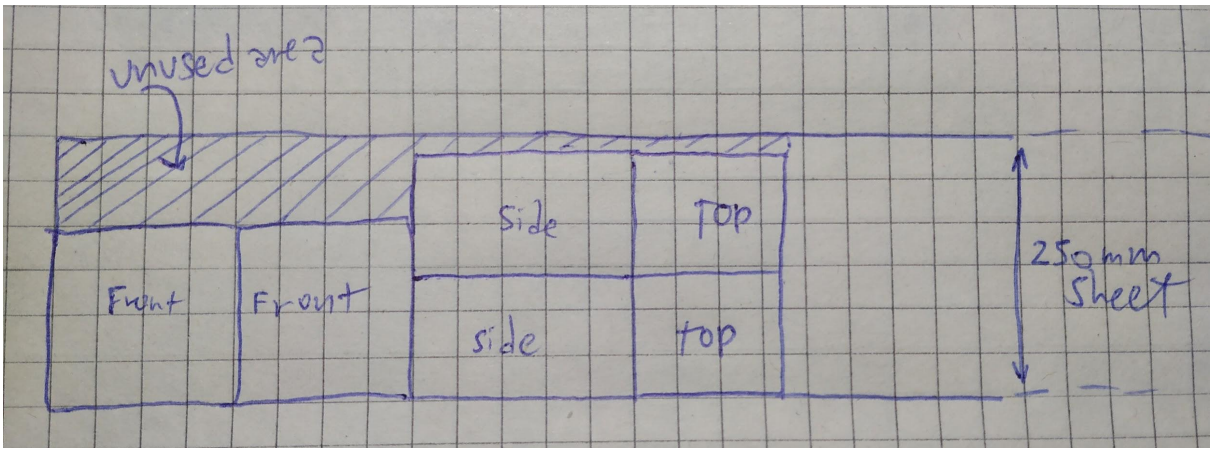
### Polycarbonate

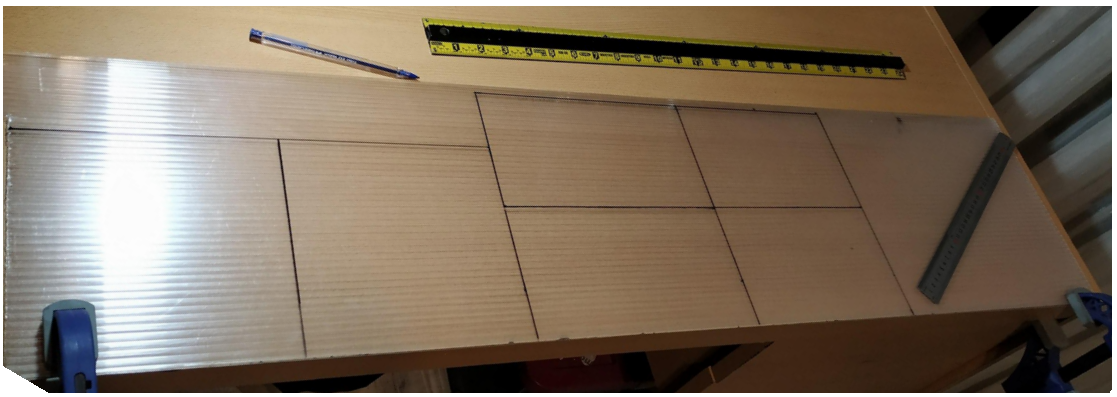
#### Layout

This is the definition of each of the target pieces:



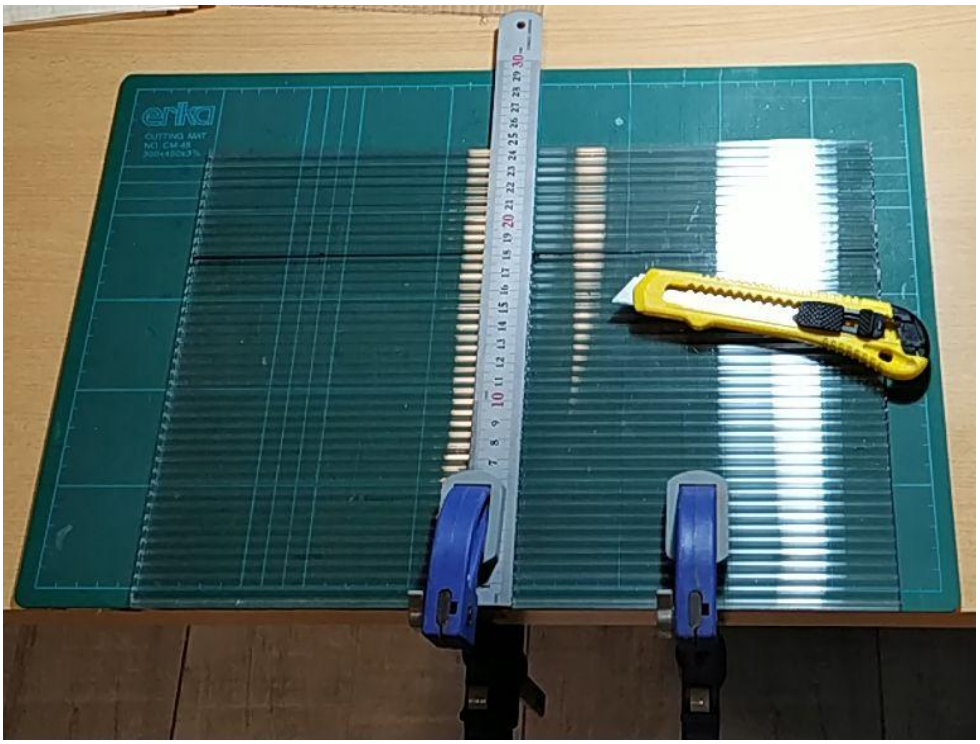

Then, designed a basic layout on a single polycarbonate sheet, with the following distribution:

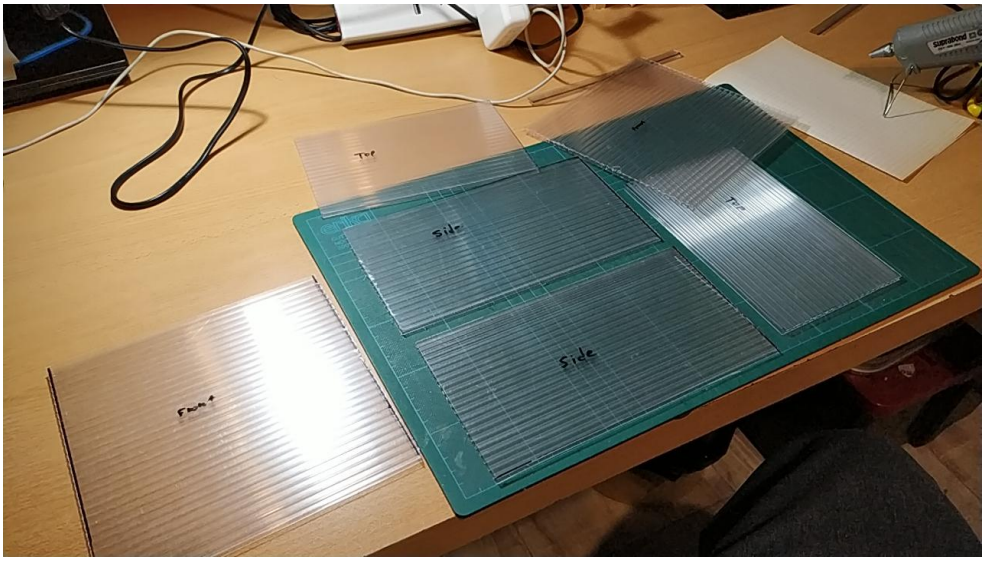




## Cutting

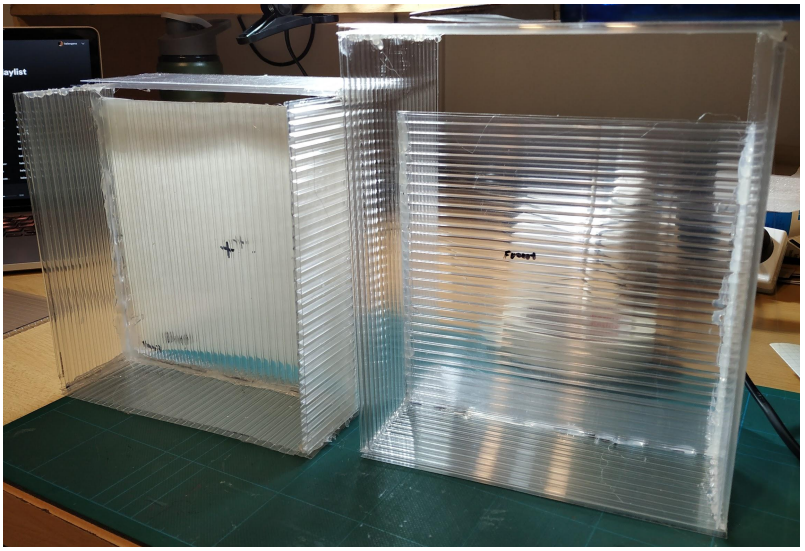
After marking the layout, pieces can be easily cut with a cutter, metal ruler and any kind of clamps that can hold the materials to the table.






## Assembly

Glue gun everything.

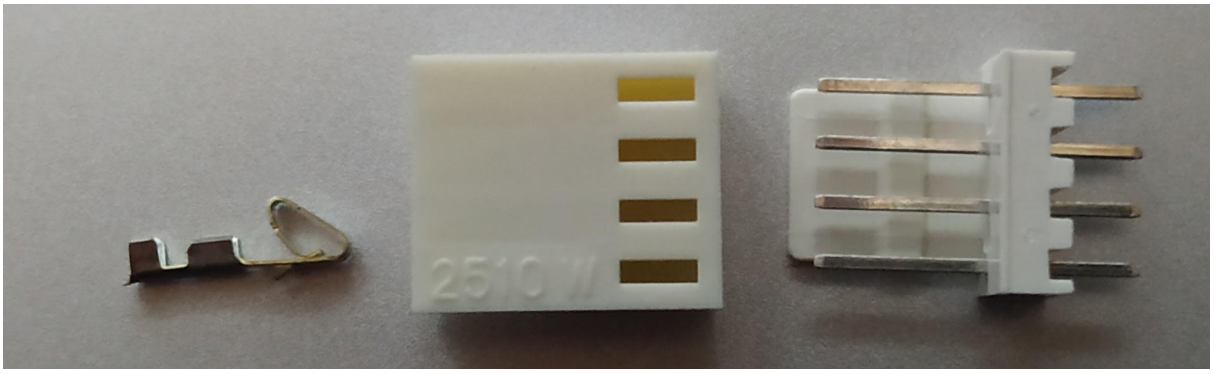


## Wiring

Since I didn't have a fully designed connection layout, no desire to wait until getting a few experimental PCB boards, and wanting to keep costs low, I decided to just go with cable and hack my way through this iteration (spoilers: bad idea).

### *Failed Connectors*

Originally, I wanted to create modular targets with connectors that allowed me to easily connect/disconnect from the main circuit.
I tried this connectors out

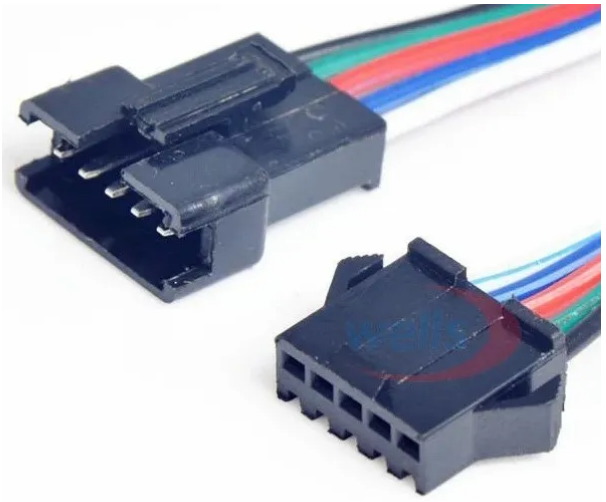



The females are actually a solid option, as they are relatively simple to connect to wires. However, the male counterparts are designed to be placed on boards. I tried to solder them to 4 wires, it was a complete disaster:

- Casing melted and pins shifted their angles
- Wires were a paint to solder and practically impossible to insulate as they are very close to each other.

Once again, I hacked my way through that, and soldered single pins (image below) to each wire while holding them with a clamp so they wouldn't shift their angle considerably.

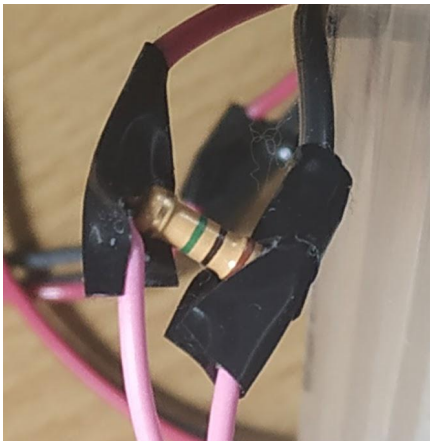
Final result: awful but functional.
Consider using the following connectors that are designed for wire to wire connections. These are listed as: "JST SM"



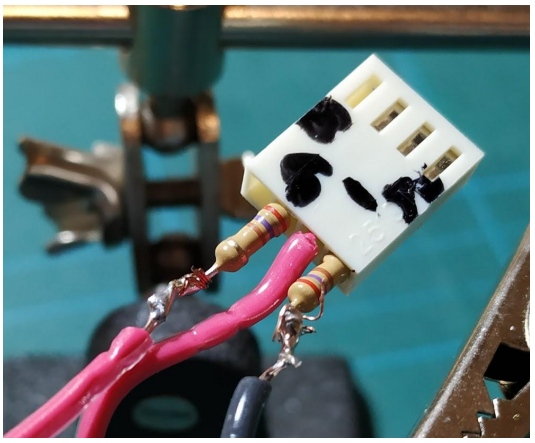
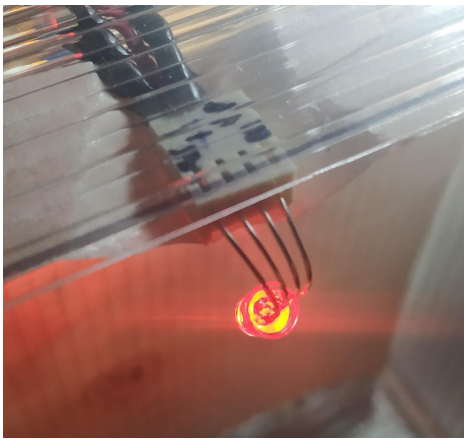
## Hackeries

Basically, all required components were soldered between cable connections.

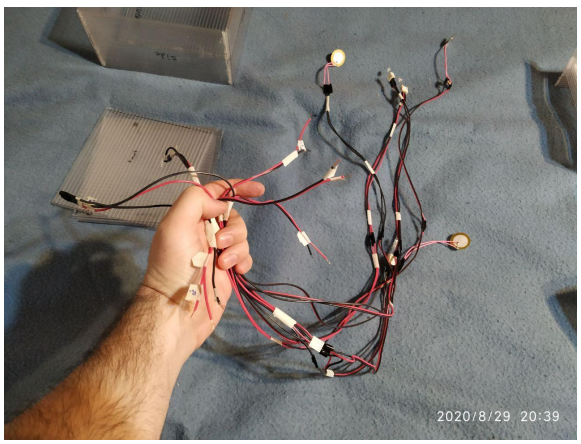
### *Piezo Resistors*

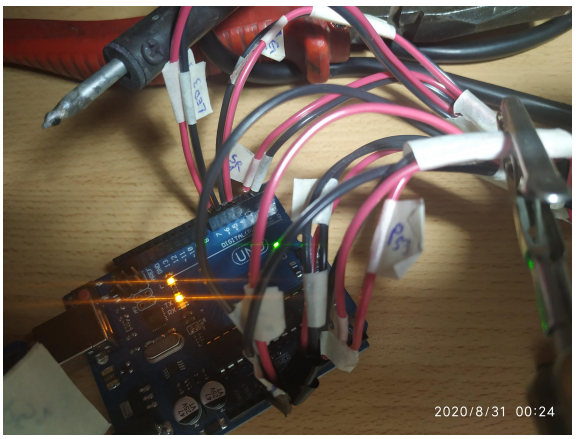



### *Led resistors*

### *Cable Hell*





Wiring Conclusion

Design a main PCB board that:

- Connects to the main power source
- Connects to Arduino
- Includes all required electronic components

All connections between the main PCB and targets should be through JST SM connectors. The connector for LEDs turned out to be a good basic approach as LEDs can be easily replaced: remove current one, insera new one, bend it to desired angle.

# ✔️V0.4 - Basic Time Trial/Countdown Game

## 13/09/2020

Implement the following cycle:

- Start: All targets are turned off
- Random target turns red (no time out)
- Once it gets hit turns green for a few seconds and then is turned off
- Immediately one of the other two targets is selected and turns red
- Repeat indefinitely

## Notes & Conclusions

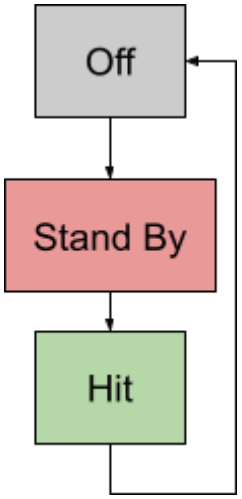
**Absolute success!**
https://www.instagram.com/p/CFGBhrYHv4L/?igshid=t2c4n1kak3wa

## Code

Refactored the project to C++.
**Added a git tag: v0.4**
Implemented a “Target” class for handling each target.
Each controls:

- Piezo reading
- Red and Green Led pins

A target uses a state machine:




Off

- Leds are turned off
- Nothing is done

Stand By

- Red Led is turned on
- Reading Piezo sensor
- If hit is registered, transitions to Hit state

Hit

- Green Led is turned on
- Waits for a given time before transitioning to Off state

By default, when a Target is created, it is set to the Off state.
To transition it to Stand By, use the Target->enable() method.

There are 2 method types essential to each state:

1. Handle State
2. Transition to State

Handle State is used on each loop when the Target is updated
(Target->update(currentTime)).

Transition to State is also used internally by the Target to set up everything for the next state (mainly turning off Leds for now).

# V0.5 - Hit Counter LCD

**Implement**

1. LCD displays:
    a. Stopwatch: minutes:seconds.milliseconds
    b. Targets that were hit
2. A button for resetting the stopwatch and target count
    a. When the button is pressed, all target leds are Off.
        i. LCD displays a countdown of 3 seconds
        ii. Then Stopwatch starts and first target is enabled
    b. Consider importing Button class from capture-point project

**Design / Experiment**

1. Better connections for wires to arduino
    a. Just soldered wires
    b. Regular Pins
    c. Which would be the ideal connectors to the female pins on the arduino board?
        i. .1” pin?

# V0.6 - Complete Time Trial Game

# V0.x - General Refactor

- Code Refactor:
    - Replace switches (Main, Target) with proper State Machine pattern with classes
- Wiring Refactor:
    - Better connector array to quickly attach/detach from Arduino, but solid enough to transport it from room to room.
    - DESIGN but not implement the main PCB for:
        - 3 sensors
        - 6 leds
        - power source (providing the main 5v directly from power supply and not Arduino as it has a capped 200mA output for that pin)

## V0.x - Complete Reflex Game

## V0.x - Menu and Basic Time Trial Game

## V0.x - Up to 6 targets

Experiment

- Target positioning
    - E.g.: 4 targets standing level, 1 target crouch level, 1 target prone level

Materials
Power supply - how many amps?
Mux + transistors 2n2222 (npn)

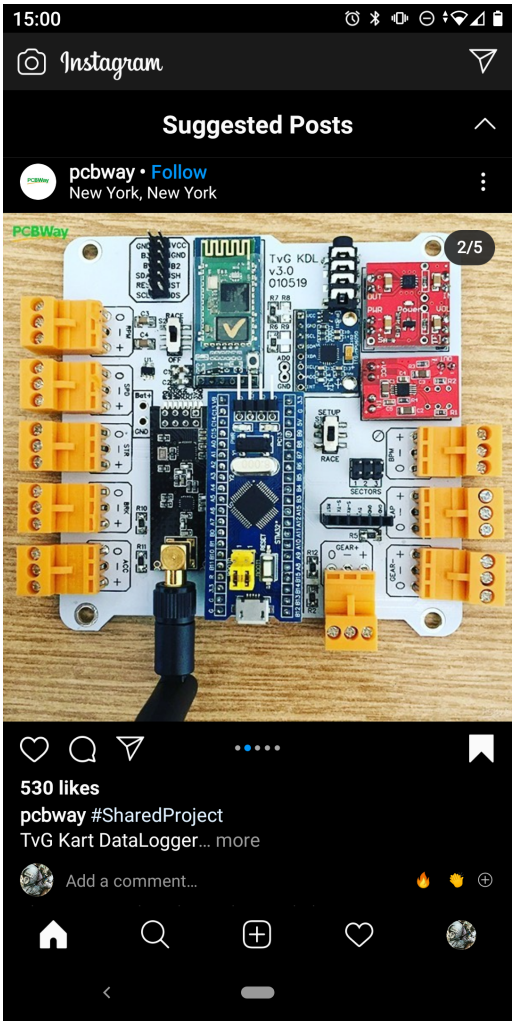
## V0.10 - Hitboxes 2.0

Steel plates
Torso targets
Better lights
Enhancements based on user feedback

# Pending Features

1. CODE
    a. Remove use of Delay completely
    b. Startup check sensors and LEDs
    c. Startup animation with Mankuzos + @mkz.tortuga
2. Sound/buzzer
3. Wireless controller + screen
4. Target Hit Points
    a. Configure 1/2/3 hits - e.g.:
        i. No hit - Red
        ii. 1 hit - Yellow
        iii. 2 hits - Pink
        iv. 3 hits - Green
5. Game Modes
    a. Endless
        i. Timer + Counter
    b. Modifiers
        i. Signal for:

            1. Reload
            2. Change Stance
            3. Move to Location
            4. Change Weapon
6. Phone App?
    a. Track progress
    b. Export/share
7. Single target standalone version:
    a. Red-green on hit.
    b. No arduino, only electronics
    c. Energy saver: no light, green on hit
    d. Sensitivity adjustable with potentiometer
8. Publishing for the world
    a. 3D printable models
        i. $1 for model download?
    b. Code repo
        i. Which License?
    c. Part list
        i. Amazon list so I can get some revenue?
    d. Easy soldering + mounting everything
        i. YT video
9. Design pcb that is just plug and play. L like this https://www.instagram.com/p/CFO9u88j_O5/?igshid=2d15peqvbzxn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