UNLV

Flappy Bird Handheld Game

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Contents

1 Overview

In this project, I recreated the popular arcade-style game *Flappy Bird*. Using a microcontroller board, I programmed the game to use one button for input, a piezo buzzer for sound, and an I2C OLED screen for display. The microcontroller board and the other components were then soldered onto a perfboard to create a permanent design. Finally, all of the components were carefully placed inside a 3D-printed case to produce a finished product.

1.1 What is Flappy Bird?

Flappy Bird is a popular arcade-style game. Traditionally played on a mobile phone, the user controls a small bird that falls automatically due to gravity. Every time the user taps the screen, the bird flaps upward. The goal is to keep the bird in the air and navigate it through gaps between pipes. If the user hits a pipe or the ground, the game ends. The goal is to make it through as many pipes as possible.

1.2 Milestones

1. Create the Flappy Bird program in C++ and move it to the Arduino Nano.
2. Prototype the design with a breadboard.
3. Solder components to a perfboard.
4. Introduce a 3.7 V Li-ion rechargeable battery and Adafruit PowerBoost.
5. Design and 3D print the case.
   a. Design front and back halves.
   b. Design “box and strap” style parts for mounting the button.
6. Mount all parts to the case to create a finished design.

2 Flappy Bird Program

2.1 Hardware Interface

- Button input
- Buzzer output
- OLED display output
- EEPROM storage

2.2 Game State Control

- Menu
- Play
- Game Over

2.3 Physics

- Gravity
- "Flap" velocity
- Update position

2.4 Obstacles

- Pipe position
- Gap location
- Respawning

2.5 Collision and Scoring

- Rectangle overlap
- Scoring
- Lose on collision

2.6 Persistence

- Load high score
- Save high score

3 Electrical Design

3.1 Nano to OLED Screen Wiring

Nano Pin	Screen Pin
A4	SDA
A5	SCL
GND	GND
3.3 V Rail	VCC

3.2 Nano to Button Wiring

Nano Pin	Button Pin
GND	GND
D2	VCC

3.3 Buzzer Wiring

Nano Pin	Buzzer
GND	Ground (black)
D9	Positive (red)

3.4 On/Off Switch and Adafruit PowerBoost Wiring

Adafruit PowerBoost	On/Off Switch	Nano Pin
GND	Ground (black)	N/A
EN	Positive (red)	N/A
GND	N/A	GND (Rail)
5 V	N/A	5 V

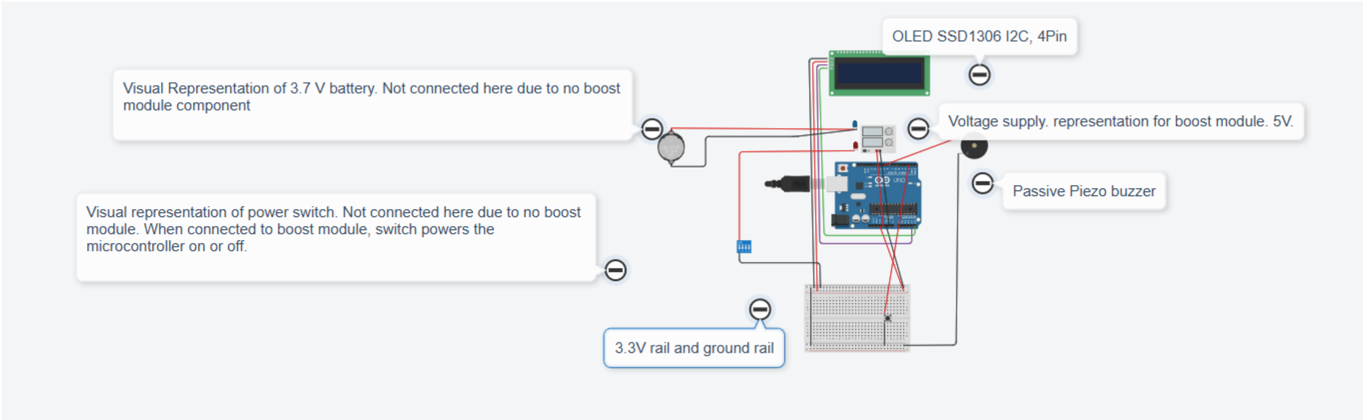

Figure 1: TinkerCAD design

3.5 PowerBoost 1000 Charger

The boost converter converted the voltage from the 3.7 V battery to the approximately 5 V needed for the microcontroller board. It also allowed for the use of a power switch by utilizing the enable input pin. The system is powered on when EN is set high and powered off when EN is tied to GND. When off, the regulator stops switching and the load is isolated from the input.

Datasheet reference: https://www.ti.com/lit/ds/symlink/tps61090.pdf

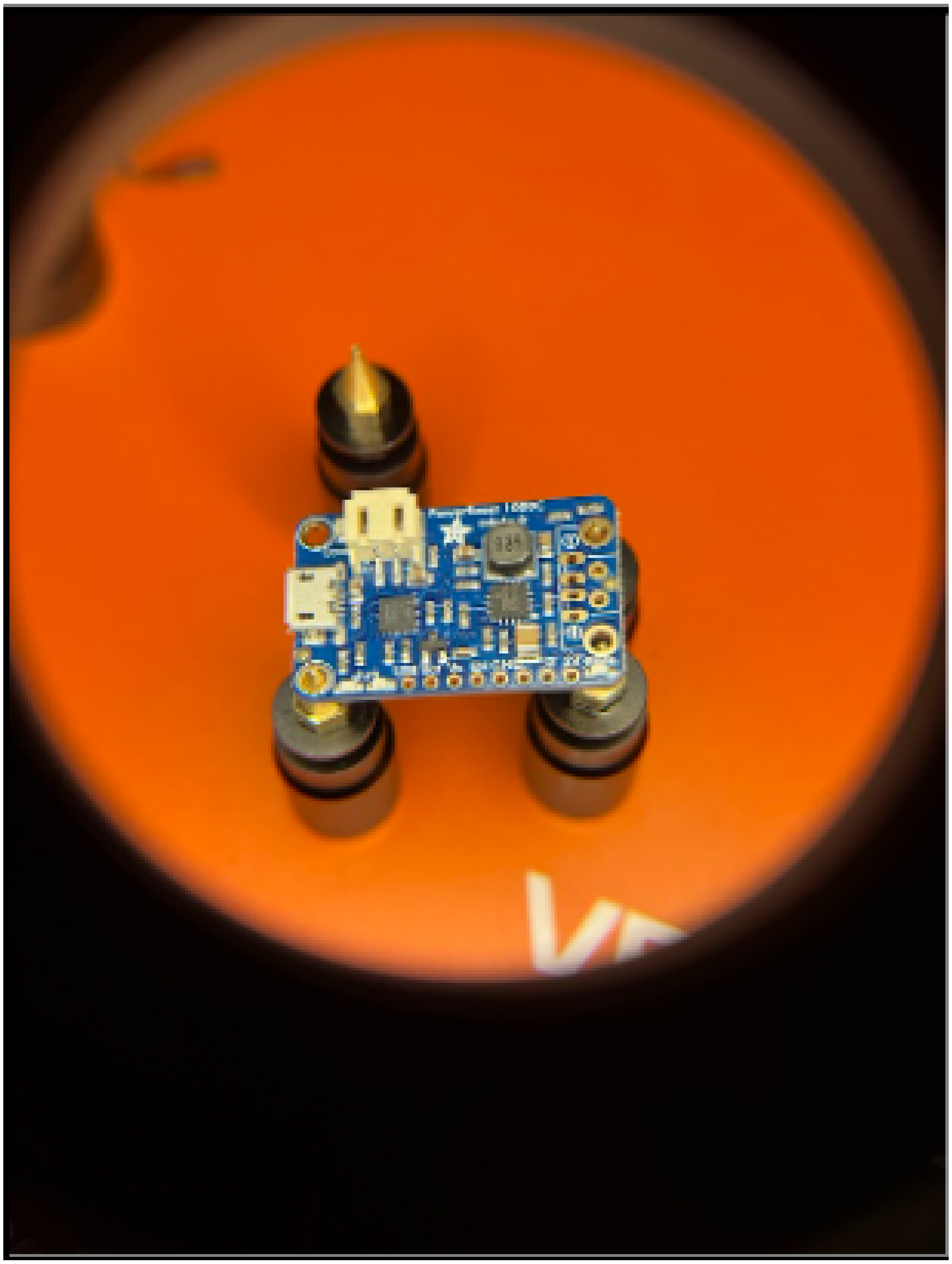

Figure 2: PowerBoost 1000C

Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
EN	11	I	Enable input. (1/VBAT enabled, 0/GND disabled)
FB	14	I	Voltage feedback of adjustable versions
GND	13	I/O	Control/logic ground
LBI	9	I	Low battery comparator input (comparator enabled with EN)
LBO	12	O	Low battery comparator output (open drain)
NC	2		Not connected
PGND	5, 6, 7	I/O	Power ground
PowerPAD™	—	—	Must be soldered to achieve appropriate power dissipation. Should be connected to PGND.
SYNC	10	I	Enable/disable power save mode (1: VBAT disabled, 0: GND enabled, clock signal for synchronization)
SW	3, 4	I	Boost and rectifying switch input
VBAT	8	I	Supply voltage
VOUT	1, 15, 16	O	DC-DC output

Simplified Application Schematic

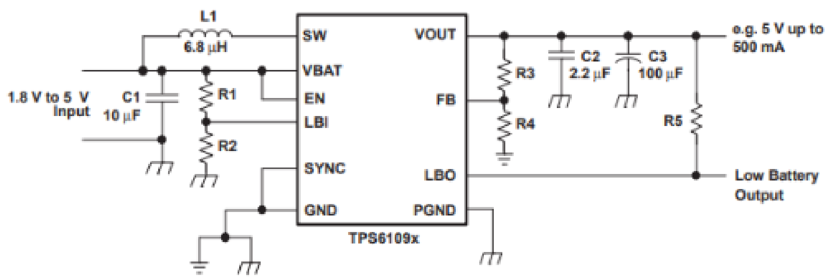

Figure 3: Pin functions and simplified application schematic from Texas Instruments.

4 3D Printed Case Design

4.1 Front Half

The front half of the case features three holes: one for the OLED screen, one for the power switch on the left, and one for the main button on the right. The areas surrounding the openings are recessed to add personality. There are speaker holes on the bottom left.

Dimension	Value
Width	70 mm
Height	85 mm
Length	26 mm
Wall Thickness	2.5 mm
Screen Opening	23.2 × 12.8 × 2.2 mm
Power Switch Hole	6 mm
Main Button Hole	4 mm

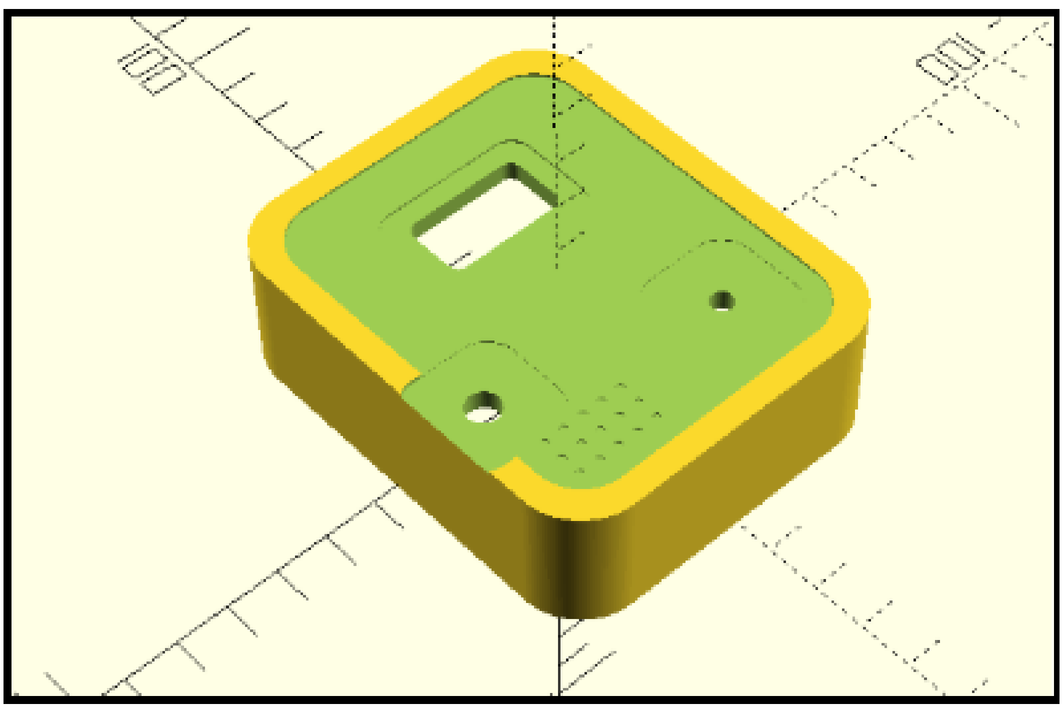

Figure 4: Front half case design.

4.2 Back Half

The back half of the case has few noticeable features. The dimensions are slightly larger than the front half to allow the back half to slide over and mate with the front half.

Dimension	Value
Width	74.4 mm
Height	89.4 mm
Length	26 mm
Wall Thickness	2.5 mm

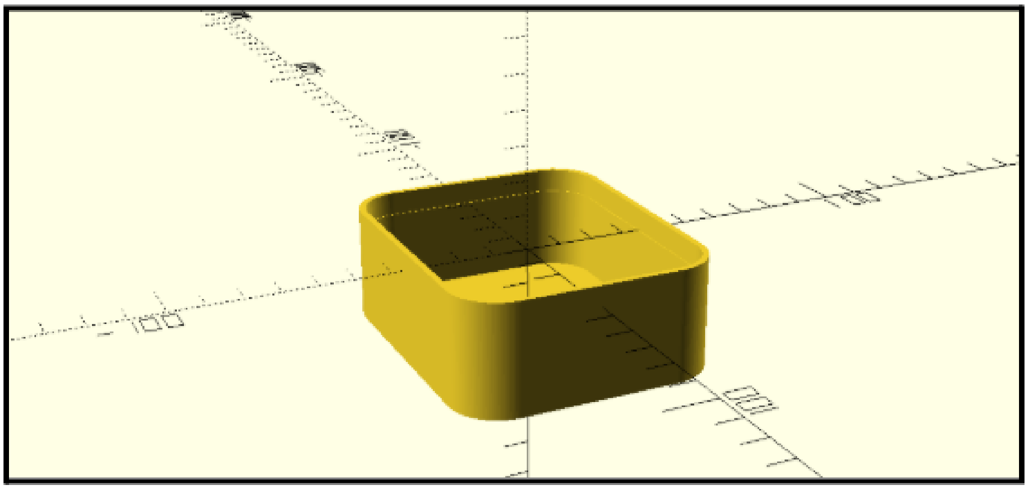

Figure 5: Back half case design.

4.3 Box Mount

The box mount was designed to hold the tactile button in place. It was modeled after an open box with flaps that lie flat against a surface. There is a center cage that is hollowed out to allow the button to be pushed through. The four flaps press flat against the front half of the case and are held down with two M2 × 12 mm screws.

Dimension	Value
Inner Width	6.4 mm
Inner Depth	6.4 mm
Inner Height	4.9 mm
Outer Width	10 mm
Outer Depth	10 mm
Outer Height	6.7 mm
Overall	26 × 26 × 6.7 mm

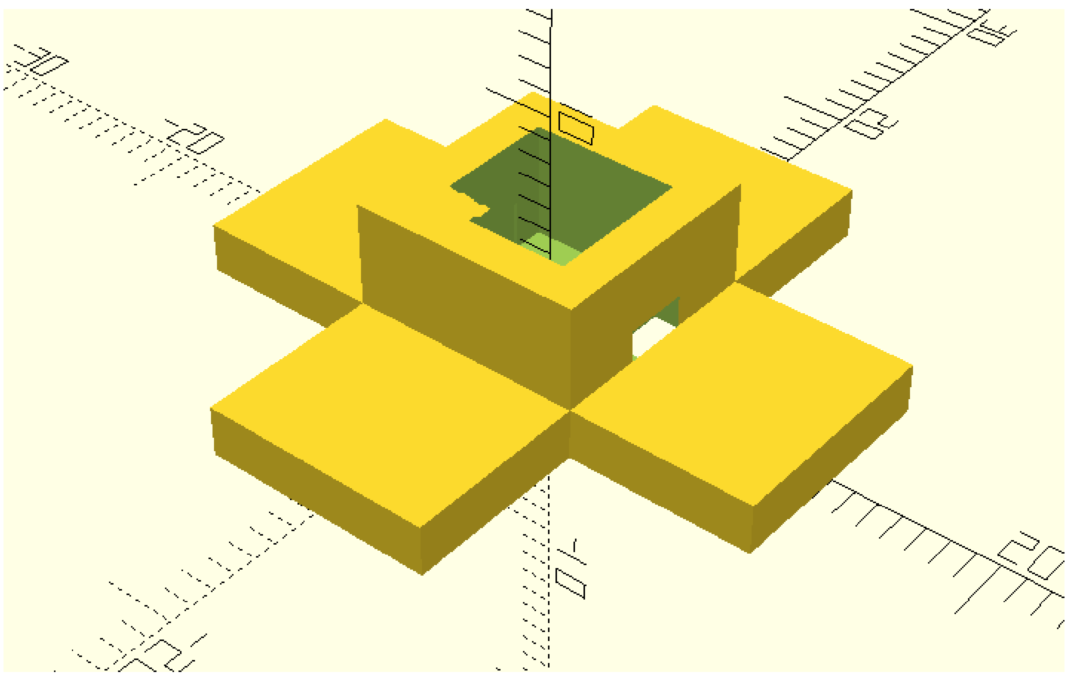

Figure 6: Box mount design.

4.4 Box Strap

The box strap component was designed to sit over the box mount. It is a small arch that snugly holds the button in place. There are two flaps that line up with the flaps of the box mount. Two M2 × 12 mm screws hold the strap in place and prevent the button from moving.

Dimension	Value
Length	25 mm
Width	4 mm
Height	8 mm

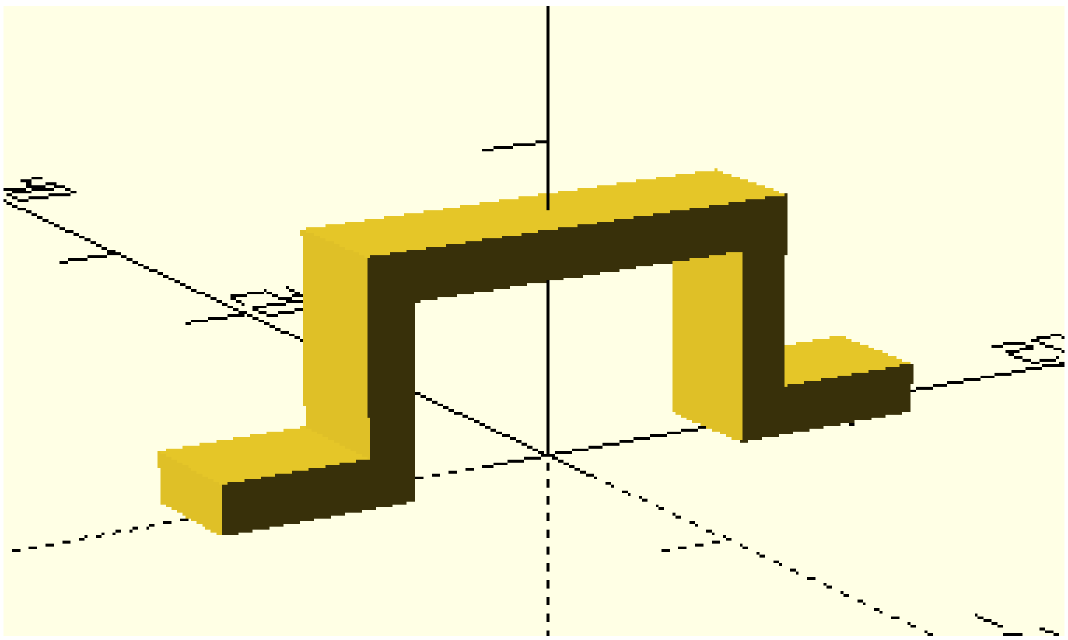

Figure 7: Box strap design.

5 Parts and Tools

5.1 Parts Used

Part Type	Part Name	Part Price
Microcontroller	Arduino Nano	$5.33
5V booster/Mini USB charging	Adafruit PowerBoost (Product #2465)	$8.99
Screen	0.96" OLED Module I2C Serial 128x64 SSD1306	$7.99
Passive Buzzer	Adafruit Piezo Buzzer	$3.99
Battery	3.7 V LiOn battery	$11.85
On/Off Switch	Uxcell 125 VAC 2 Position Terminal SPST Mini Toggle (20 pcs)	$15.09
Tactile button	6x6x13 mm Generic button (200 pcs pack)	$9.99
Screws	M2 × 12 mm screws × 11 pcs (1500 pcs)	$23.99
Nuts	M2 nuts × 11 pcs	N/A
Cabinet Bumper Pads	Austor Rubber Adhesive Bumper Pads	$6.59
Misc.	Wire, solder, flux, jumpers, headers, etc.	N/A

5.2 Tools Used

Tool	Tool Name
3D Printer	Bambu Lab A1 Combo 3D Printer
Soldering Iron	Yihua 60 W Digital Display Soldering Iron

6 Final Design and Build Photos

Figure 8: Final handheld design with button cover.

Figure 9: Final handheld design shown powered off and on.

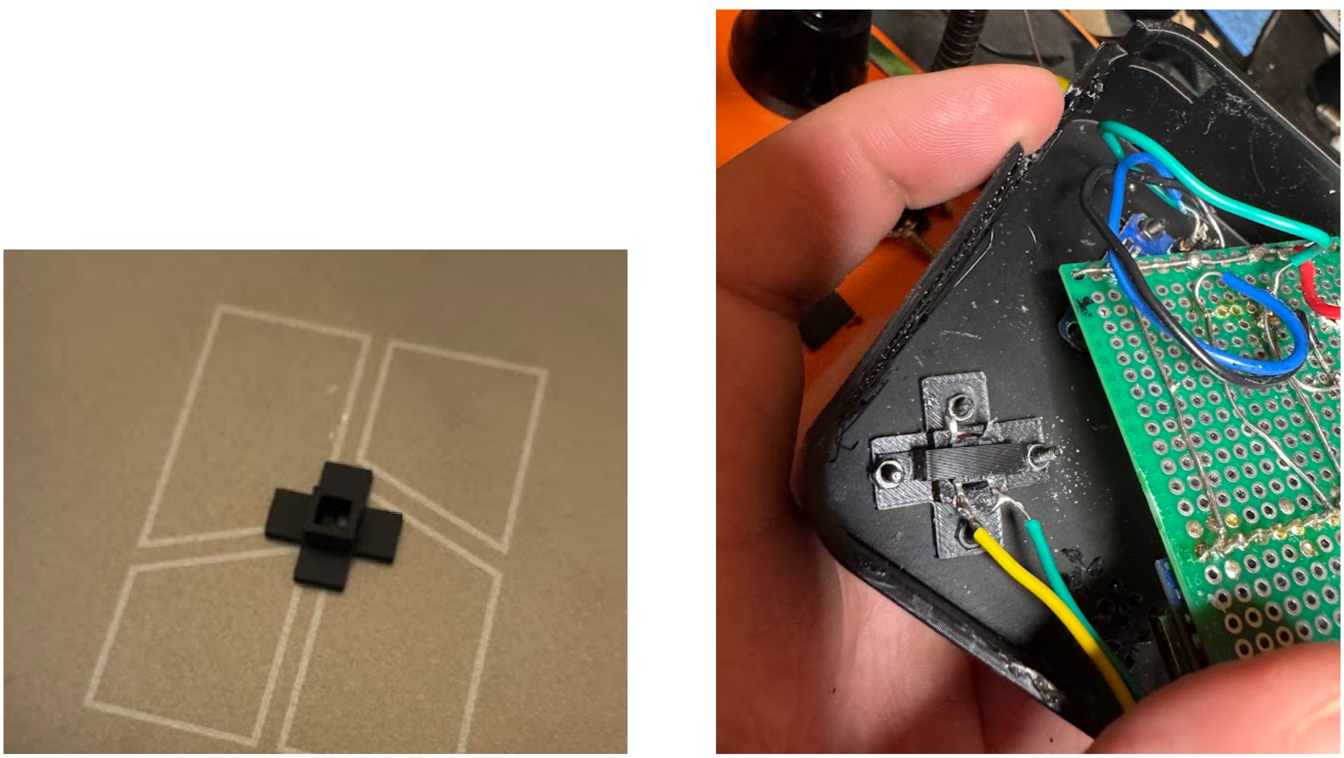

Figure 10: Button mounted and box mount design.

Figure 11: Early case design.

Figure 12: Front half of case.

Figure 13: Back half of case.

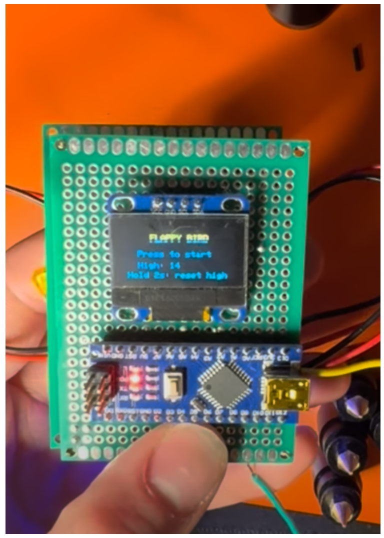

Figure 14: Perfboard implementation.

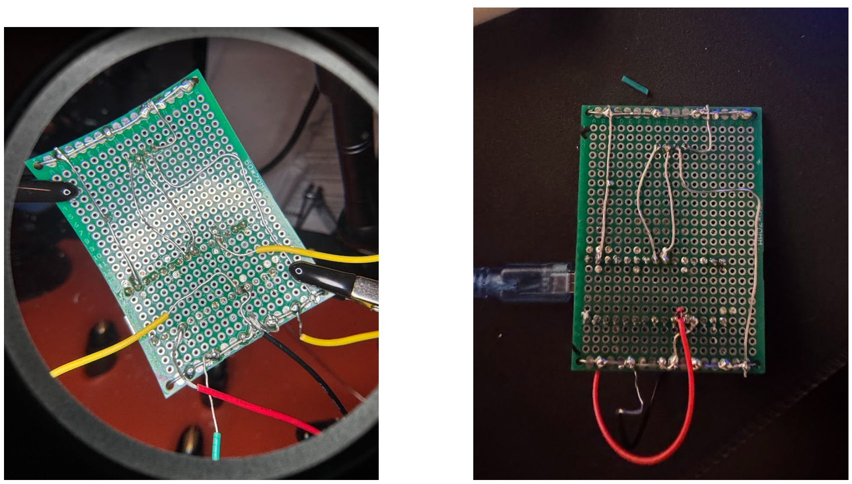

Figure 15: Soldered perfboard – back.

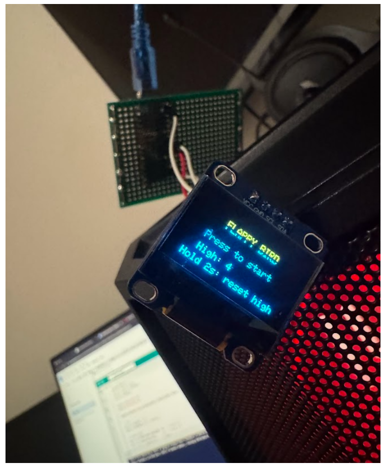

Figure 16: Early testing after soldering microcontroller.

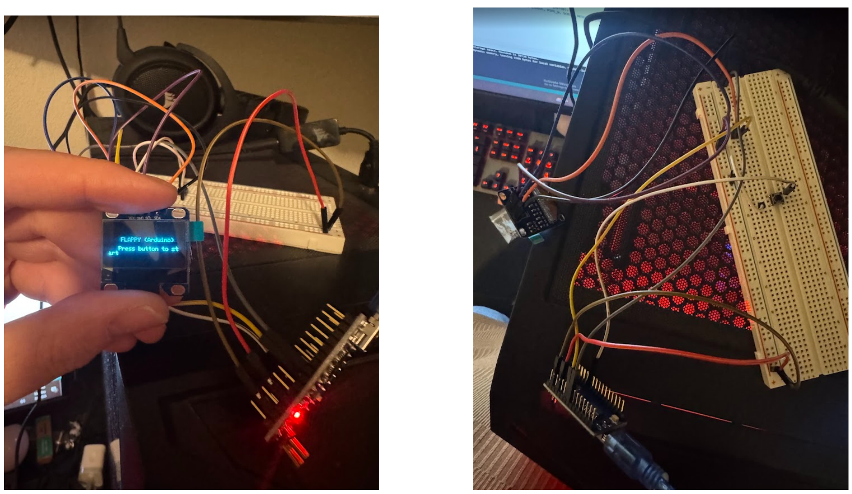

Figure 17: Breadboard prototype.

7 LTSpice Circuits and Graphs

The following are rough estimates of current and voltages in the circuit. The pulse waveform simulates the change in current, such as the piezo buzzer beeping. The circuit is composed of a 5 V source representing the PowerBoost, a series resistor representing real-world loss, a capacitor, and a pulsing current source.

The capacitor acts as an energy tank so that when current suddenly spikes, it can dump current quickly. When current drops, it recharges.

The current source was given the following values for simulation:

- Idle current: 30 mA
- Pulse current: 250 mA
- Delay before first pulse: 20 mA
- Rise time: 0.0005
- Fall time: 0.0005
- Pulse width: 0.03
- Period: 0.2

Note: These values were chosen arbitrarily to roughly represent the activity of the circuit. They are not exact values.

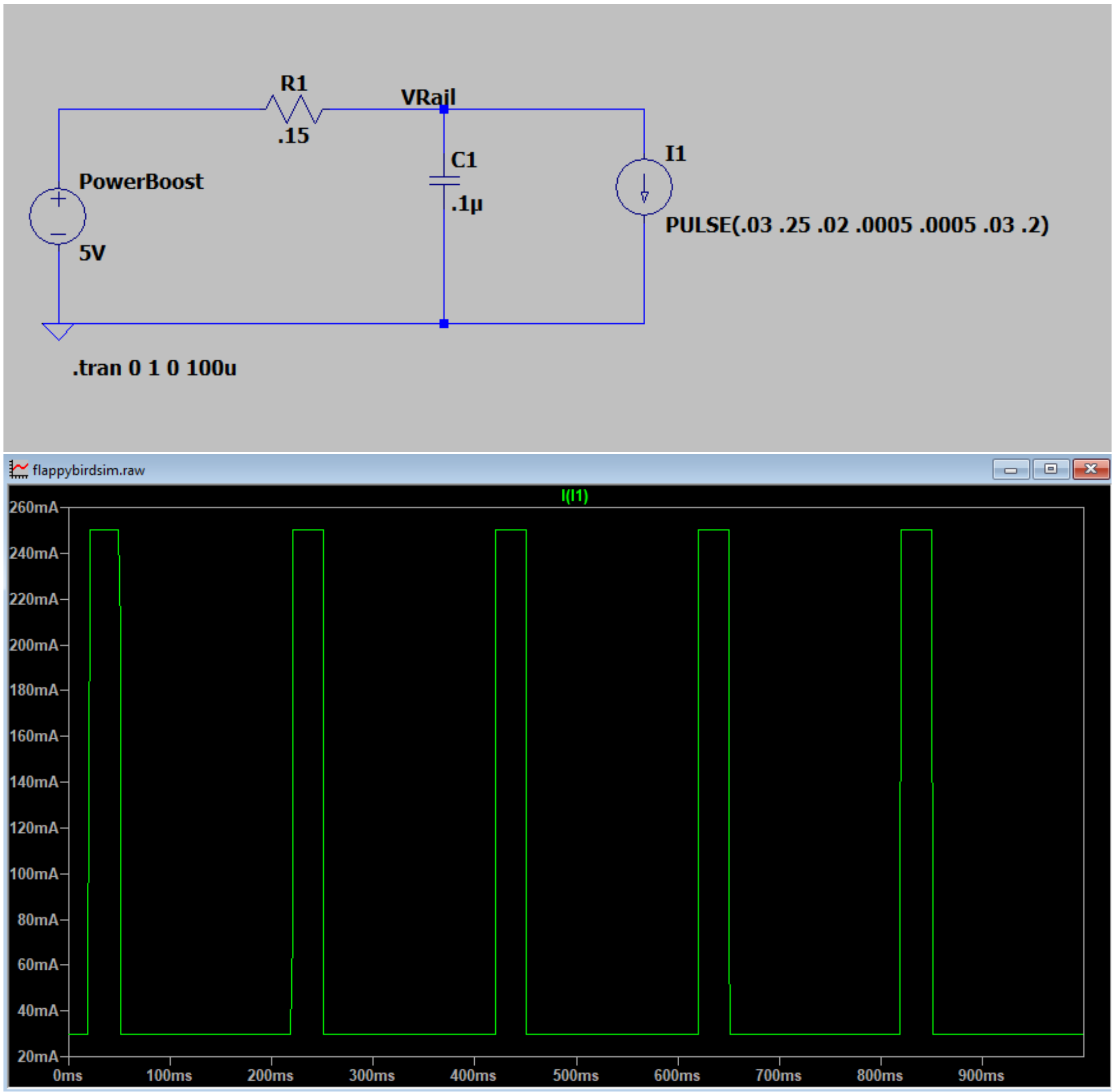

Figure 18: LTSpice circuit and graph.