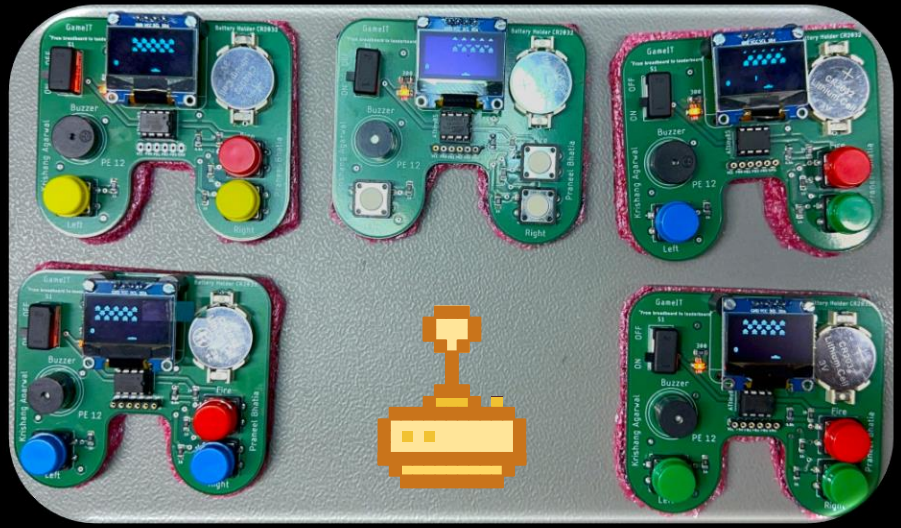
GameIT Retro GameBoy



Practical Electronics Project PE12

Krishang Agarwal (30325) | Praneel Bhatia (30688)

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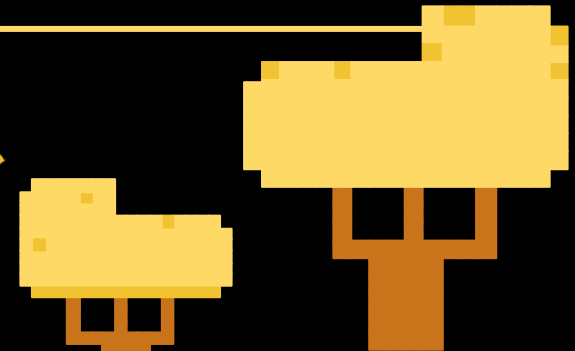



01
Inspiration

The Gameboy - Nintendo

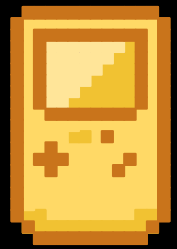
-Easy to fit in pocket

-Portable

-Elegant

-Minimal

-FUN

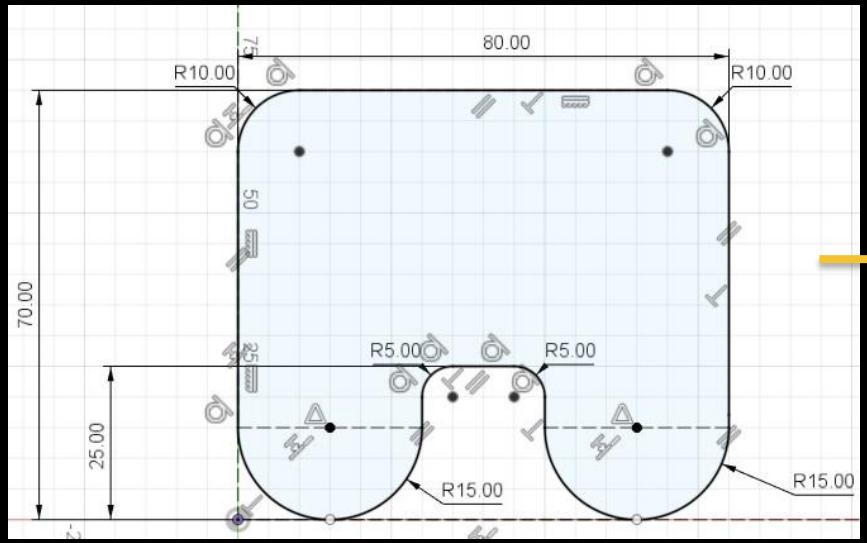


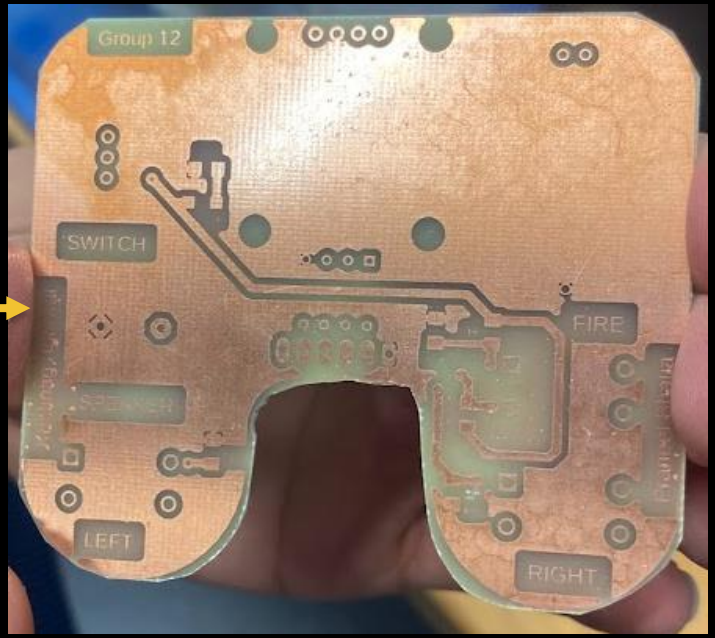
Nintendo Gameboy[1]

Circutry and PCB[2]

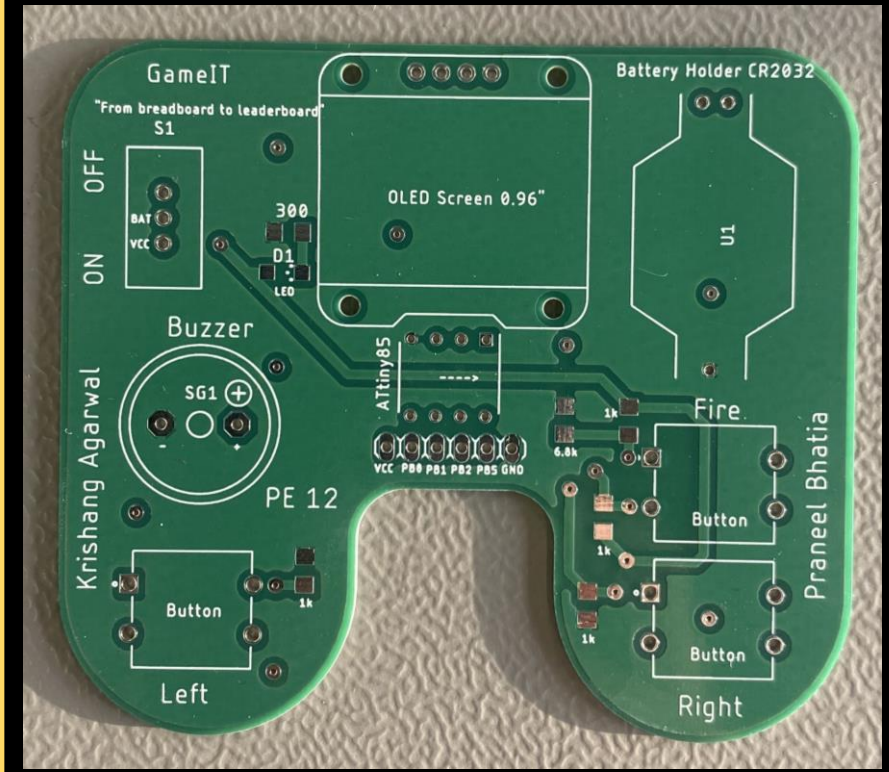

02
Design

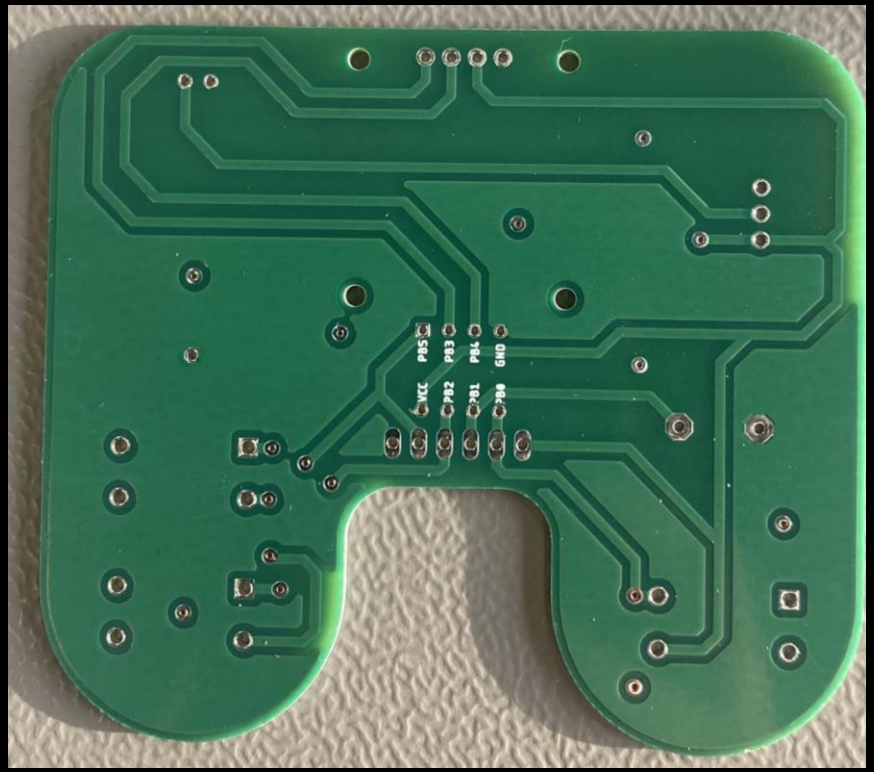
Shape


80.00
R10.00
R10.00
70.00
50
25
25.00
R5.00
R5.00
R15.00
R15.00

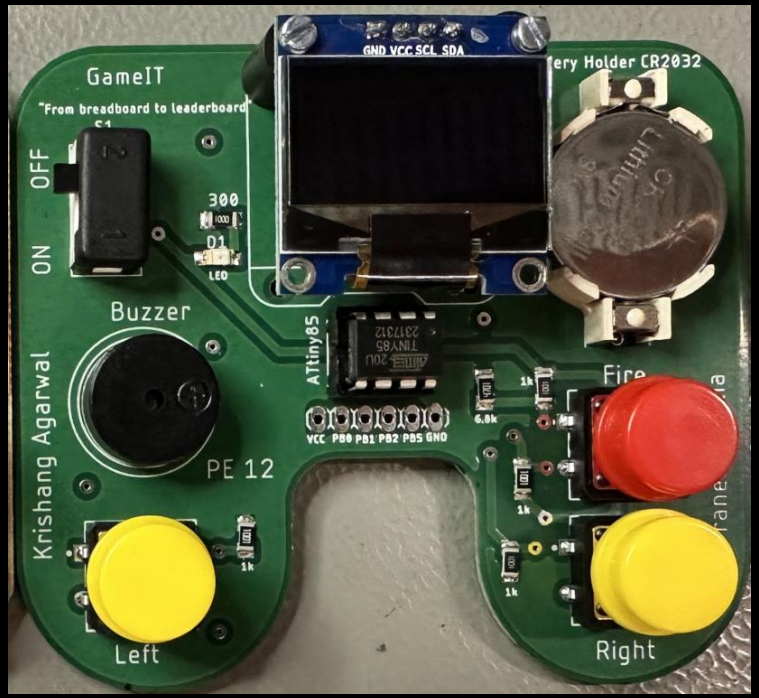

Group 12
SWITCH
FIRE
LEFT
RIGHT

PCB Design


GameIT
"From breadboard to leaderboard"
S1
ON
OFF
BAT
VCC
300
D1
LED
OLED Screen 0.96"
Battery Holder CR2032
U1
Buzzer
SG1
ATtiny85
VCC P80 P81 P82 P85 GND
1k
6.8k
Fire
Button
Button
Button
Left
Right
PE 12
Krishang Agarwal
Praneel Bhatia


VCC
P85
P83
P82
P81
P84
P80
GND

Features



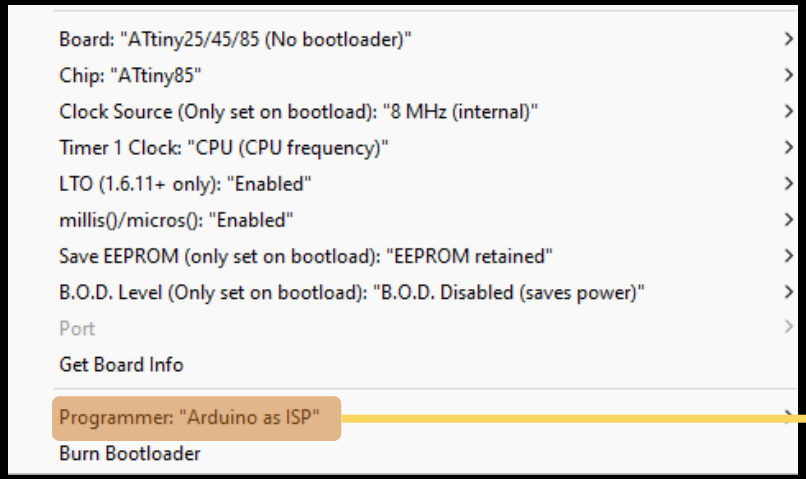
+ 3 Action Buttons to control games
+ Interchangeable ATTiny85 chip for different games
+ Can run 15+ games such as:

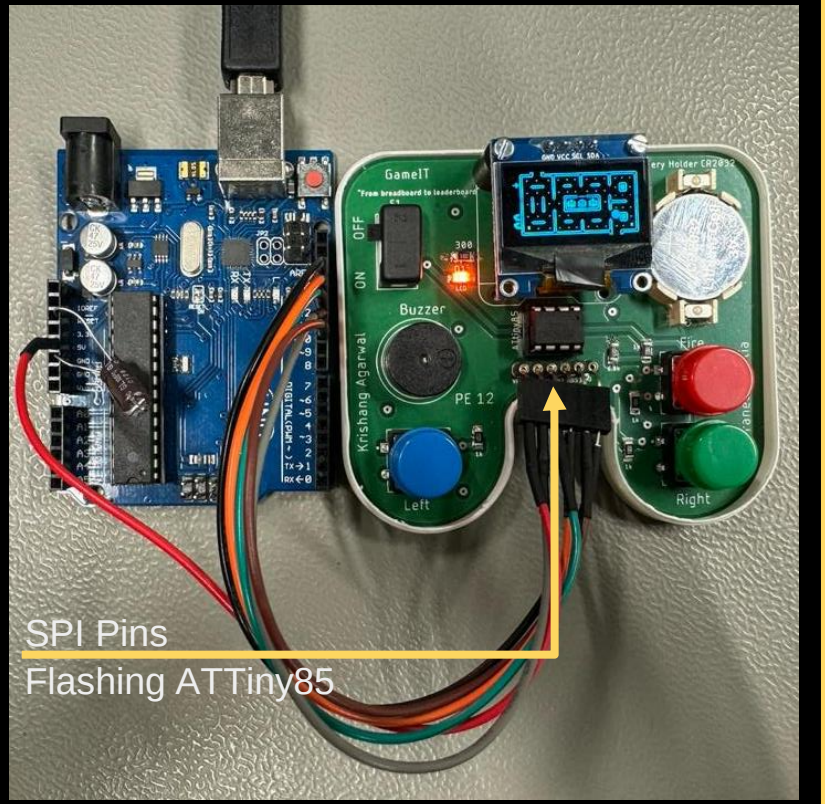
Space Invaders	PACMAN
BATBonanza	Frogger (Crossy road)
Tetris	UFO Stacker

+ Buzzer for enhanced game experience with sound
+ Convenient and easily available power source CR2032 battery
+ Bright OLED display
+ Flashing Pins embedded onto the PCB for onboard flashing
+ Compact and aesthetic design

Programming

+ Dedicated Flashing SPI Pins on PCB
+ Arduino as ISP to flash the ATTiny85
+ Programming using Arduino IDE





Parts

DEBO OLED2 0.96”
128x64 Display

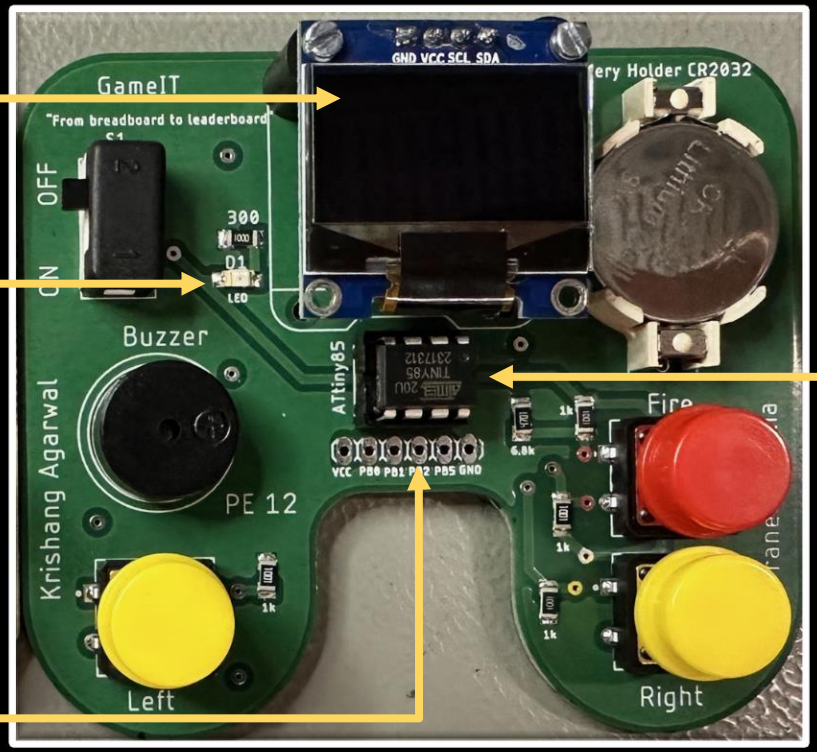
On-Off Switch

SMD Orange LED
Power indicator

Ekulit Buzzer
Game Sounds

Push Button 3
Left Button

SPI Pins
Flashing ATTiny85



CR2032 Holder &
3.3V Battery

ATTINY85
Microcontroller

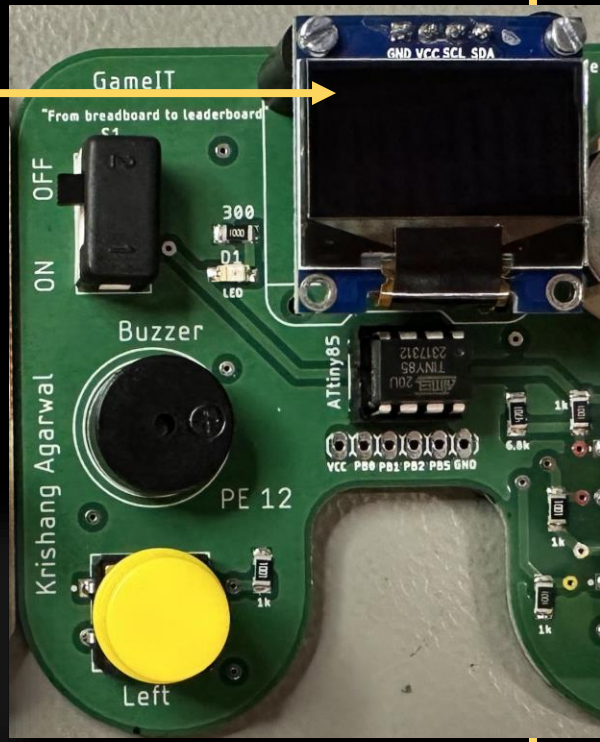
Push Button 1
Fire Button

Push Button 2
Right Button

Parts

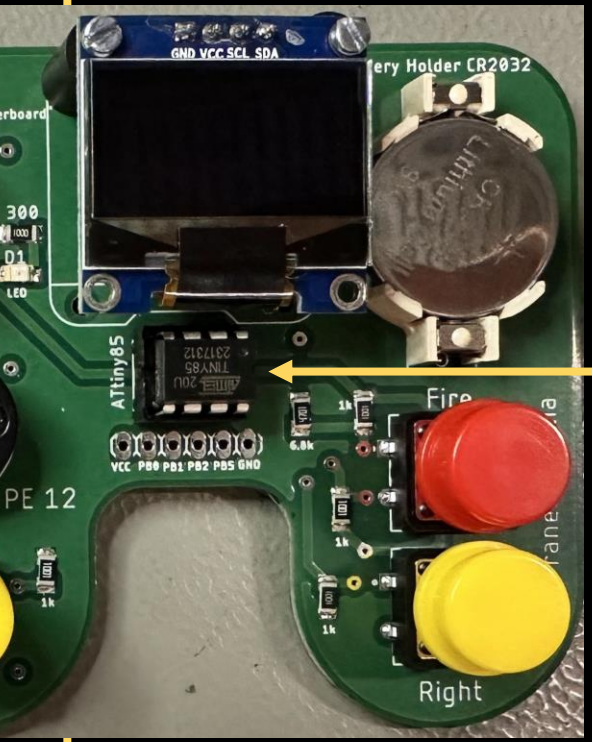
+ i2c communication protocol
+ Single color Display, available in Blue, White, yellow and more
+ 0,96” Screen making it suitable for compact design
+ 128x64 resolution, clear enough to display BitMaps and text
+ Works with 3.3 V and 5V logic
+ Low cost

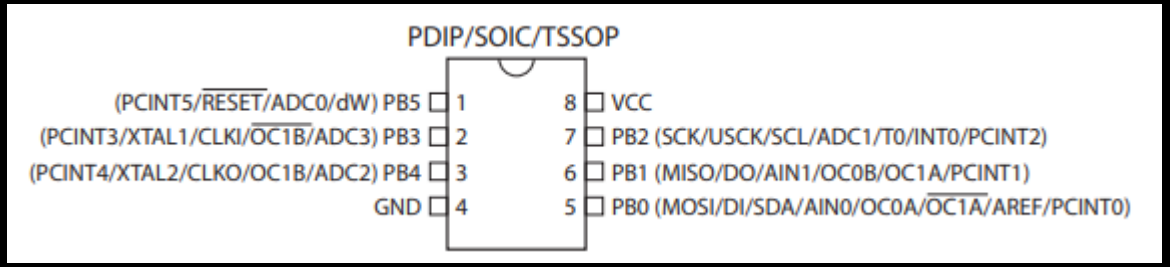
DEBO OLED2 0.96”
128x64 Display



FURTHER SPECIFICATIONS	
Connection	4 pole
Interface	I^2C
SSD-Controller	SSD1306
Voltage supply	3.3 5 V

Parts





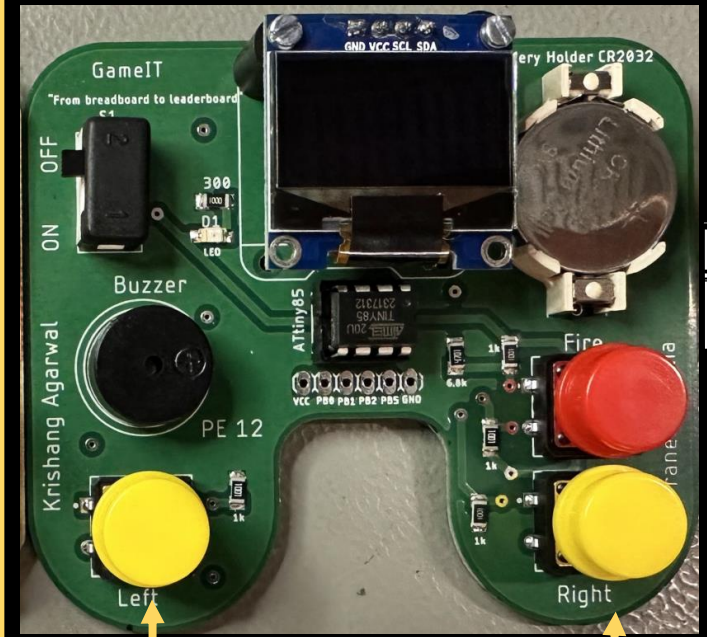
[4] ATTiny85 Datasheet

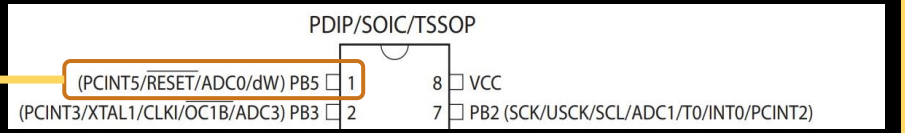
ATTINY85

Microcontroller

+ Operating voltage: 2.7V ~ 5.5V
+ 6 programmable I/O Lines
+ Clock Speed: 1, 8, 16 MHz
+ Industrial Temperature Range: -40°C + 85°C
+ SPI and i2c interface
+ PWM pins
+ 8KB of flash memory and 512 bytes of SRAM and EEPROM to run and store games
+ Power Efficient

Push Button's





[4] ATTiny85 Datasheet

Symbol	Parameter	Condition	Min.	Typ.(1)	Max.	Units
V_{IH3}	Input High-voltage, RESET pin as I/O	V_{CC} = 1.8V - 2.4V V_{CC} = 2.4V - 5.5V	0.7V_{CC}(2) 0.6V_{CC}(2)		V_{CC} +0.5 V_{CC} +0.5	V V

[4] ATTiny85 Datasheet

Push Button 1
Fire Button

We used a voltage divider to bring the voltage within the appropriate range according to the datasheet to use as I/O pin

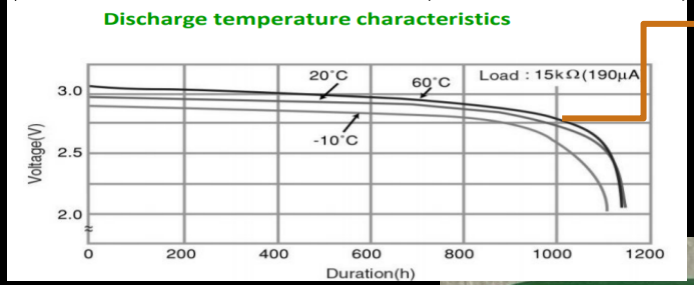
Push Button 2
Right Button

Push Button 3
Left Button

1k ohm Pull down resistor to read 0 when button is not pressed

Power Supply

Part number	CR2032
Nominal voltage	3V
Nominal capacity	225mAh
Continuous drain	0.2mA



[8]Panasonic CR2032 Datasheet

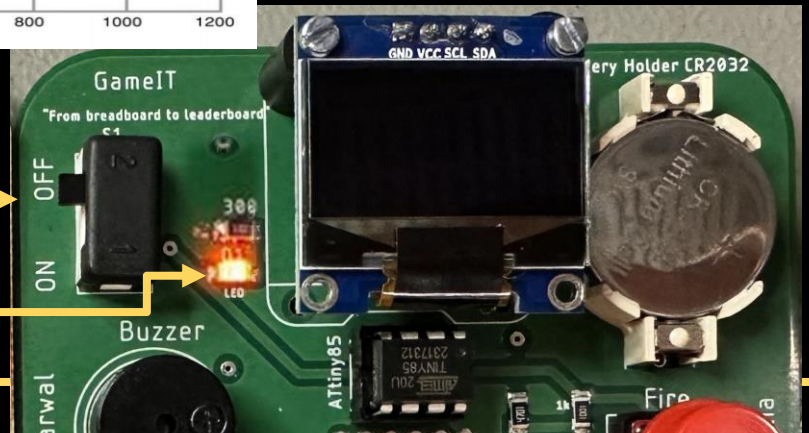
+ 3.3V output with 3V nominal voltage

+ 225mAh nominal capacity for longer game time

+ Small, lightweight and easily interchangeable

+ Maintains a relatively stable voltage for longer duration

+ Dedicated power switch with orange LED indicator



On-Off Switch

SMD Orange LED
Power indicator

CR2032 Holder &
3.3V Battery

Power Consumption

-We have the following known Values using multimeter and Power supply:

Part number	CR2032
Nominal voltage	3V
Nominal capacity	225mAh

Measured Values

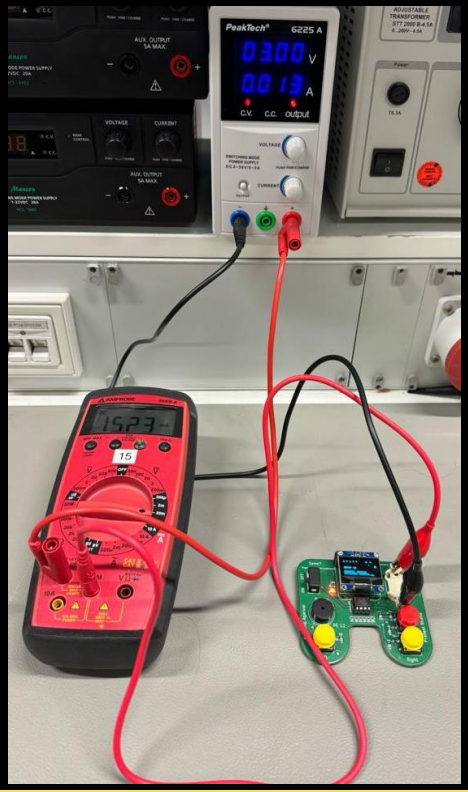
> V_{supply} = 3.0V (Supplied)
> $I_{standby}$ = 13.4mA (Measured)
> I_{ingame} = 17mA (Measured)
>> I_{avg} = ($I_{standby}$ + I_{ingame}) / 2 = **15.2mA**

Power consumed

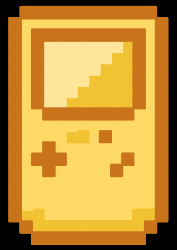
> Formula: P = I_{avg}*V
>> $P_{consumed}$ = 3.0V * 15.2mA = **45.6mW**

Battery Life

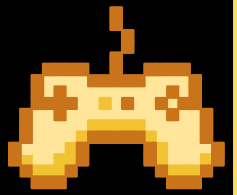
>Formula: Battery Life = Battery Capacity(mAh)/Load Current(mAh)
>Battery Capacity of CR2032 from datasheet[3]: **225mAh**
>>Battery Life = 225mAh/13.5mA => ……..



16.6 H



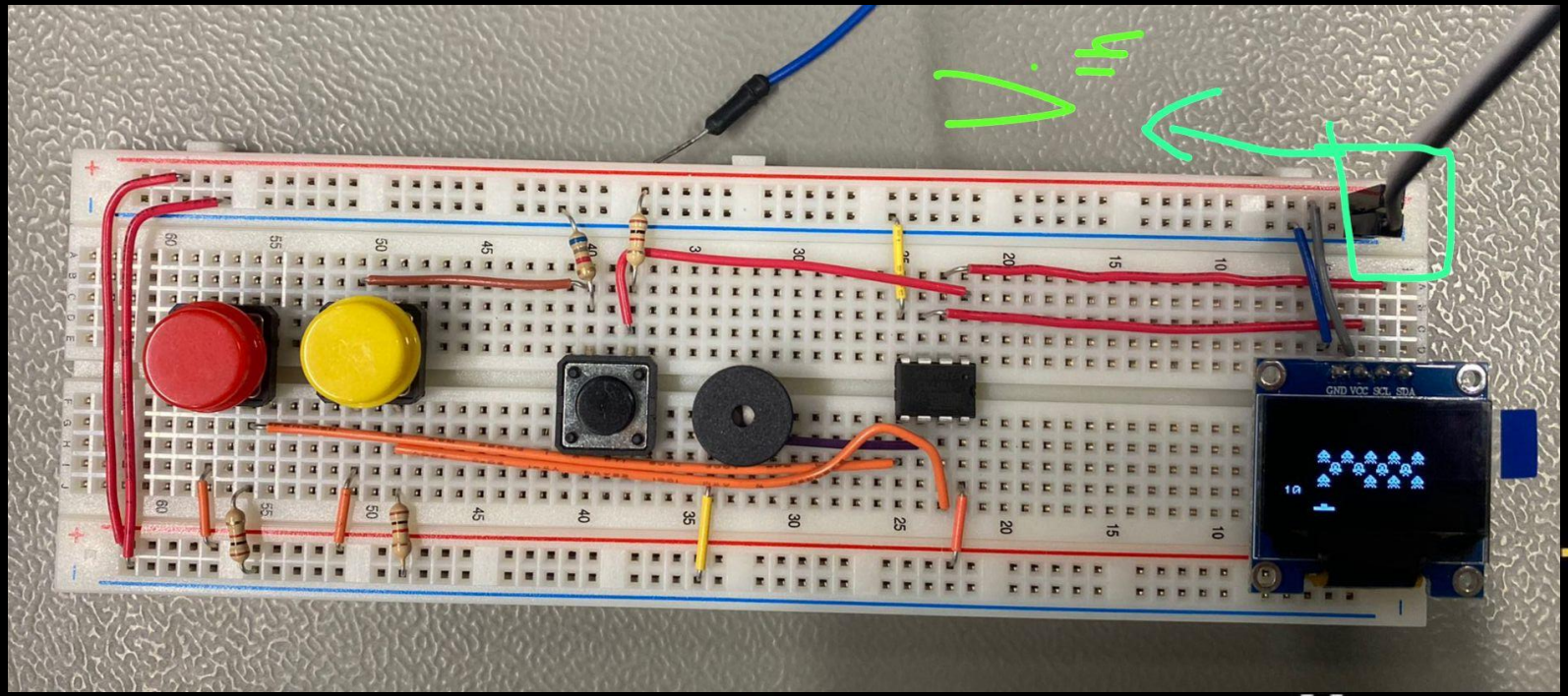
of Play Time



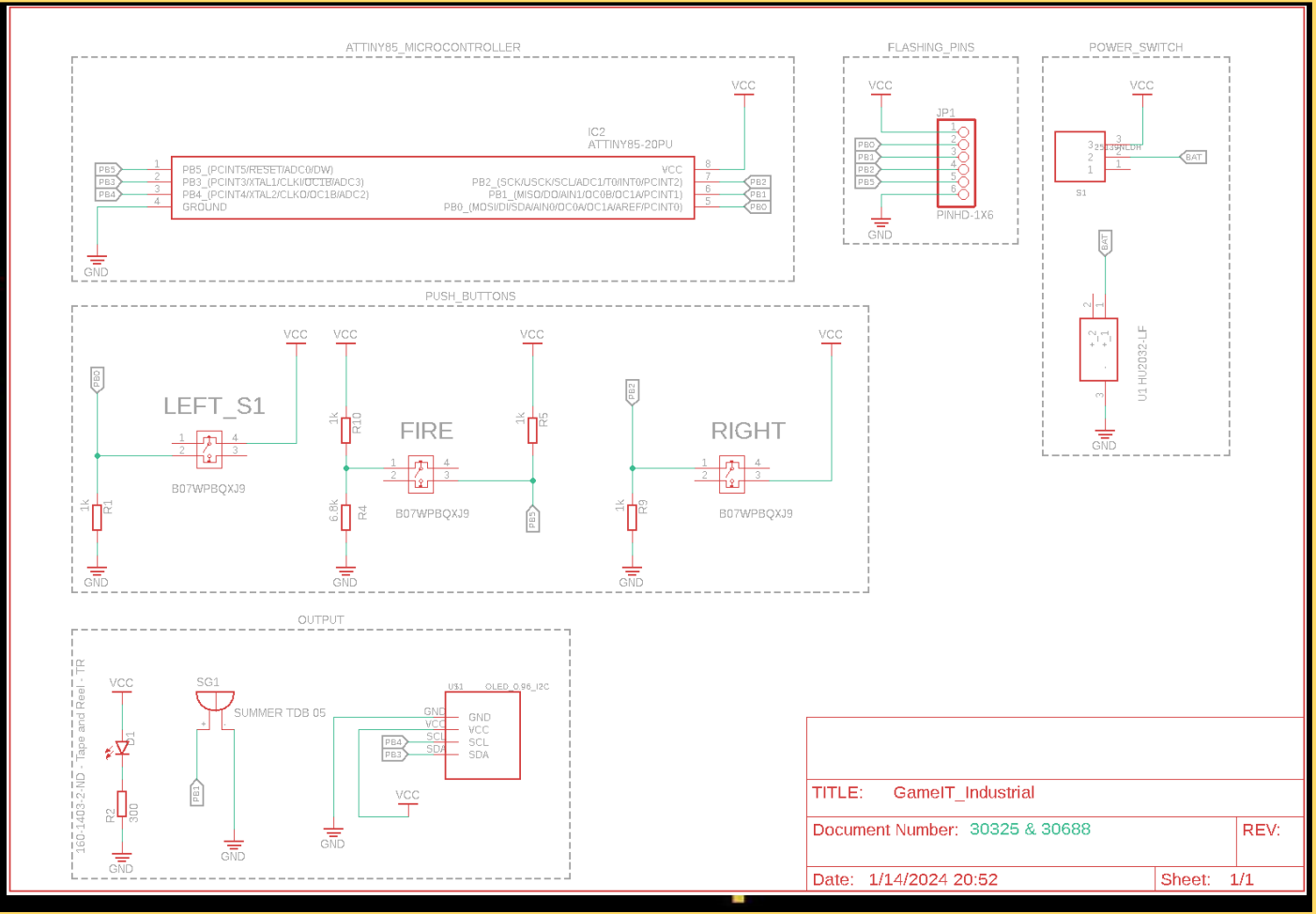
03

Production

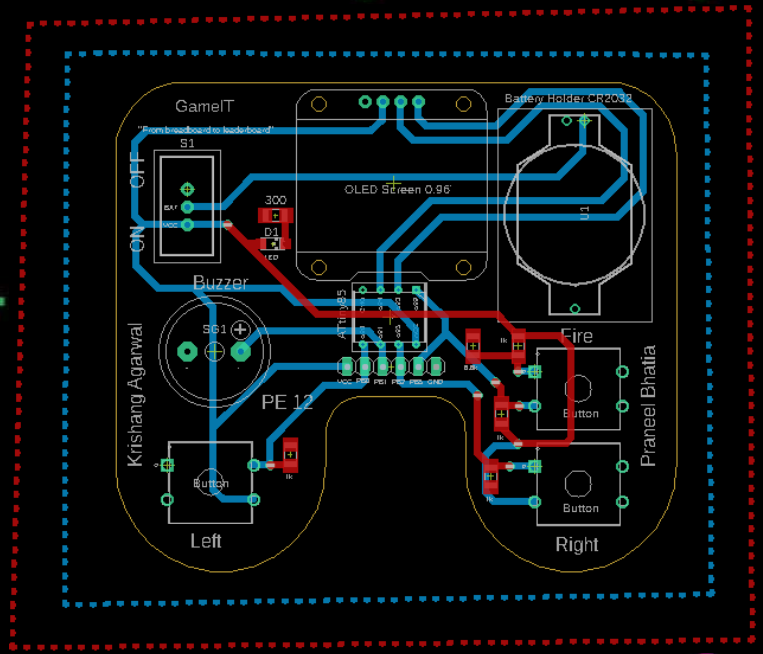
Breadboard



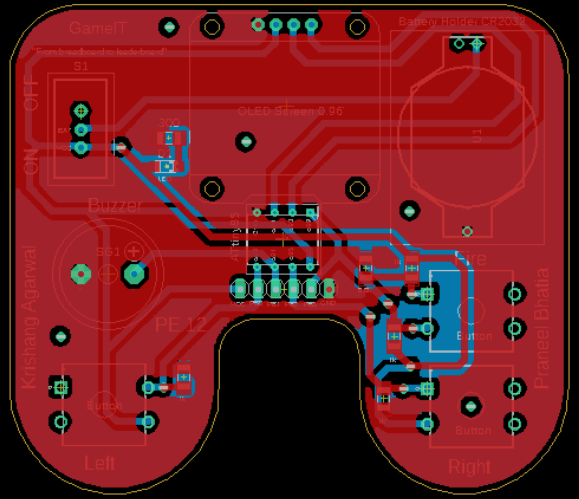
Schematic


ATTINY85_MICROCONTROLLER
IC2
ATTINY85-20PU
PB5_(PCINT5/RESET/ADC0/DW)
PB3_(PCINT3/XTAL1/CLKI/OCT1B/ADC3)
PB4_(PCINT4/XTAL2/CLKO/OC1B/ADC2)
GROUND
VCC
PB2_(SCK/USCK/SCL/ADC1/T0/INT0/PCINT2)
PB1_(MISO/DO/AIN1/OC0B/OC1A/PCINT1)
PB0_(MOSI/DI/SDA/AIN0/OC0A/OC1A/AREF/PCINT0)
FLASHING_PINS
JP1
PINHD-1X6
POWER_SWITCH
S1
U1 HU2032-LF
PUSH_BUTTONS
LEFT_S1
FIRE
RIGHT
B07WPBQXJ9
R1
R10
R4
R5
R9
OUTPUT
SG1
SUMMER TDB 05
D1
R2
300
160-1403-2-ND - Tape and Reel - TR
U$1
OLED_0.96_I2C
GND
VCC
SCL
SDA
TITLE: GameIT_Industrial
Document Number: 30325 & 30688
REV:
Date: 1/14/2024 20:52
Sheet: 1/1

Routing

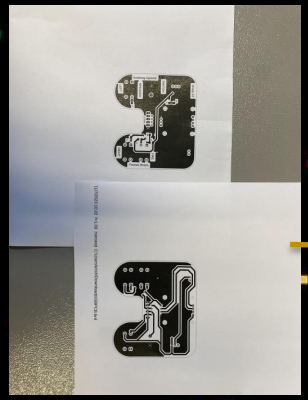


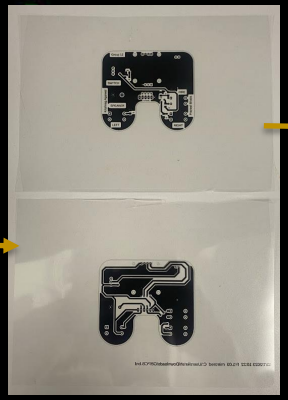
Final Routing

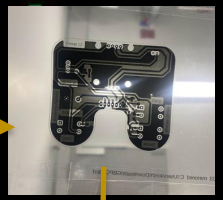


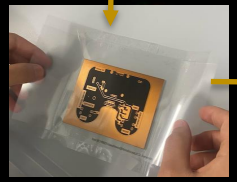
HSRW Version

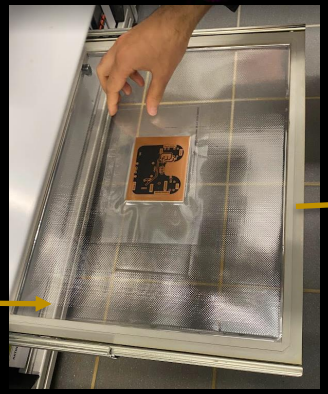
PCB Fabrication

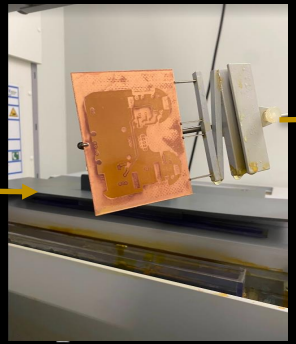


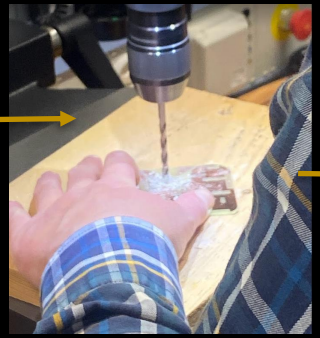


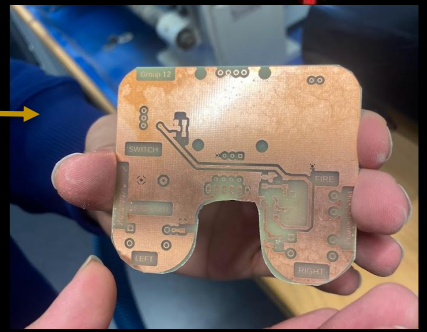




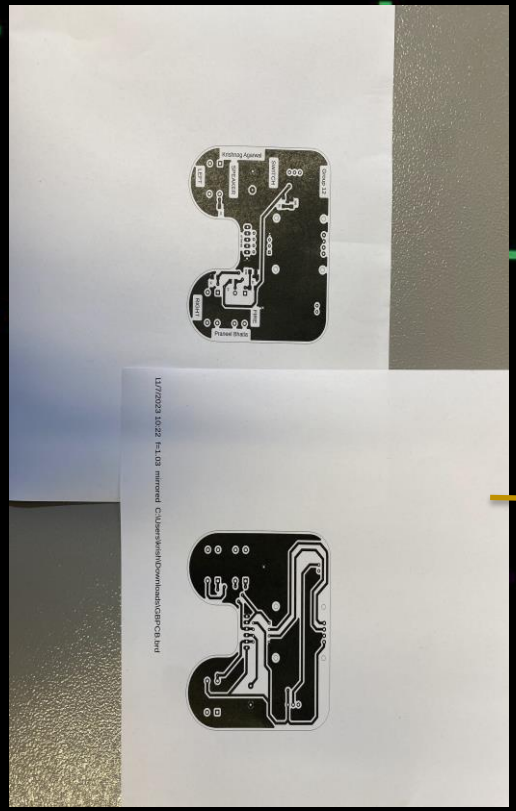


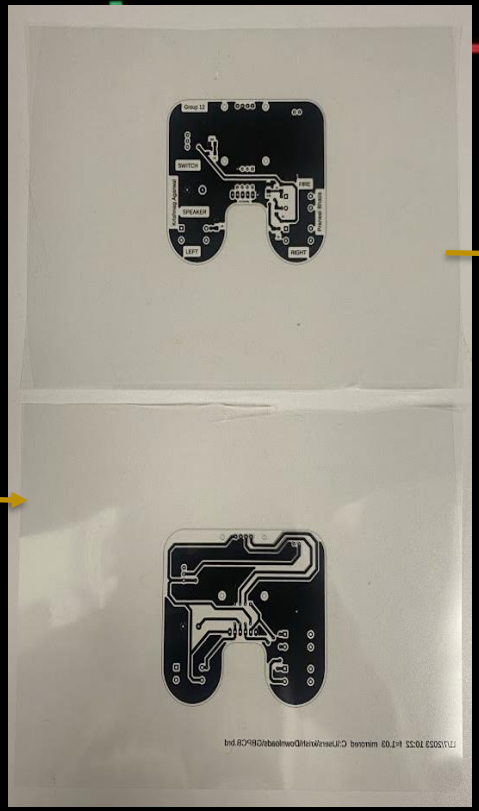


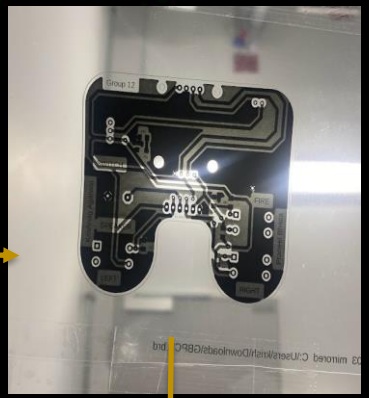


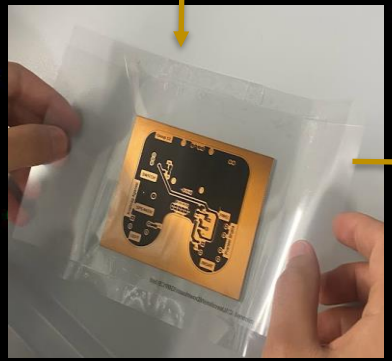


PCB Fabrication

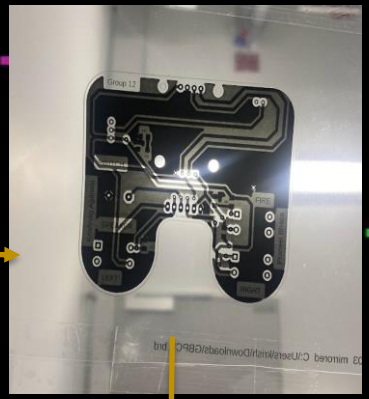


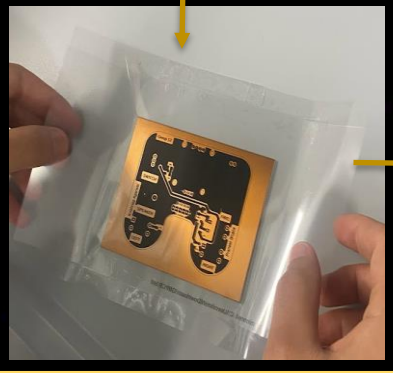


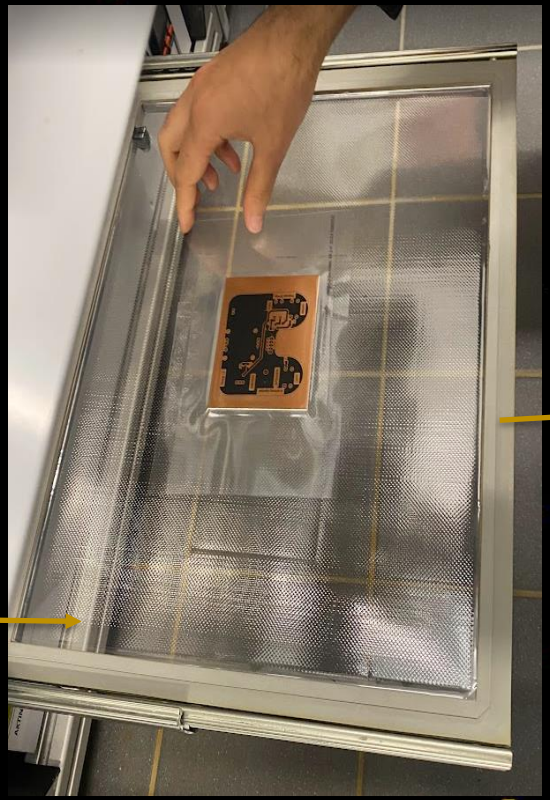




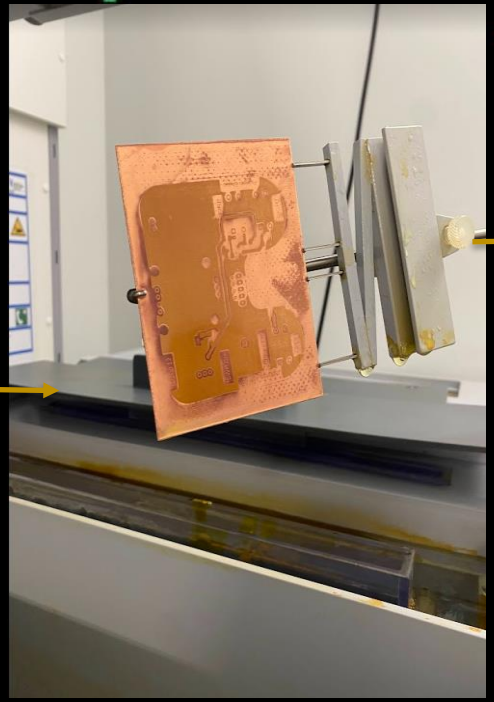
PCB Fabrication







PCB Fabrication



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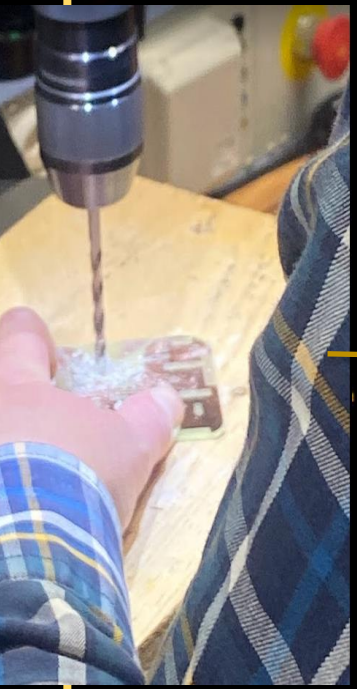

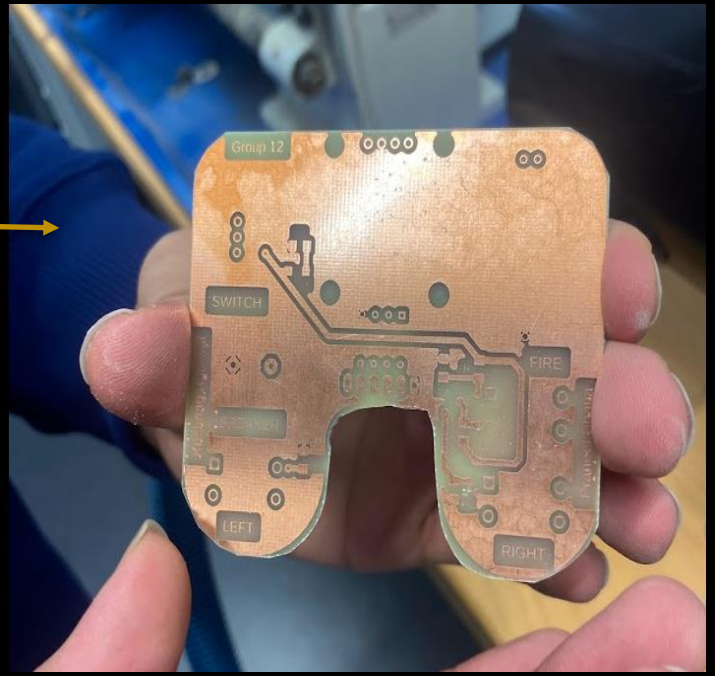

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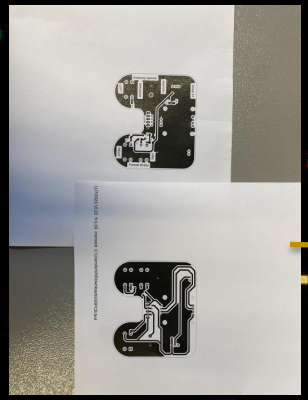
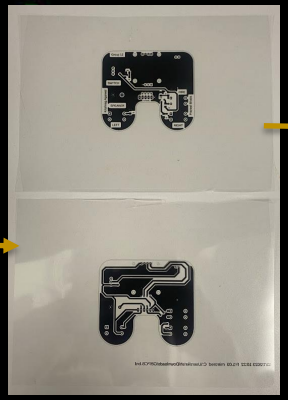
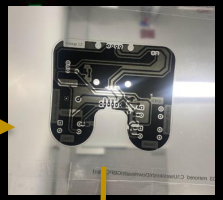
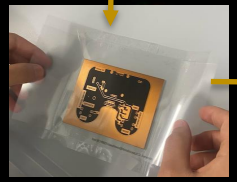
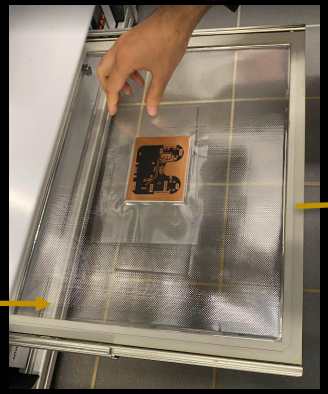
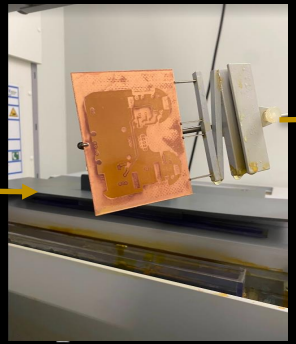


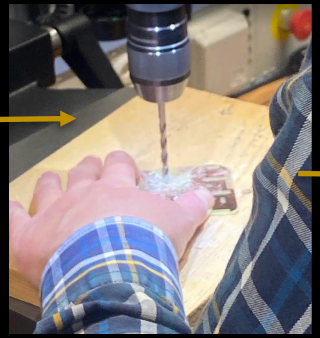


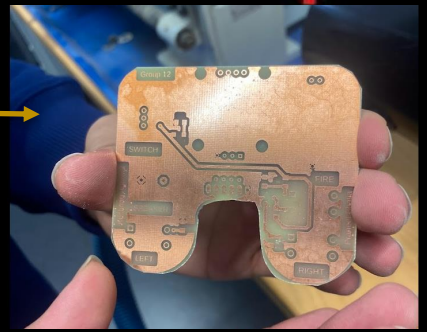








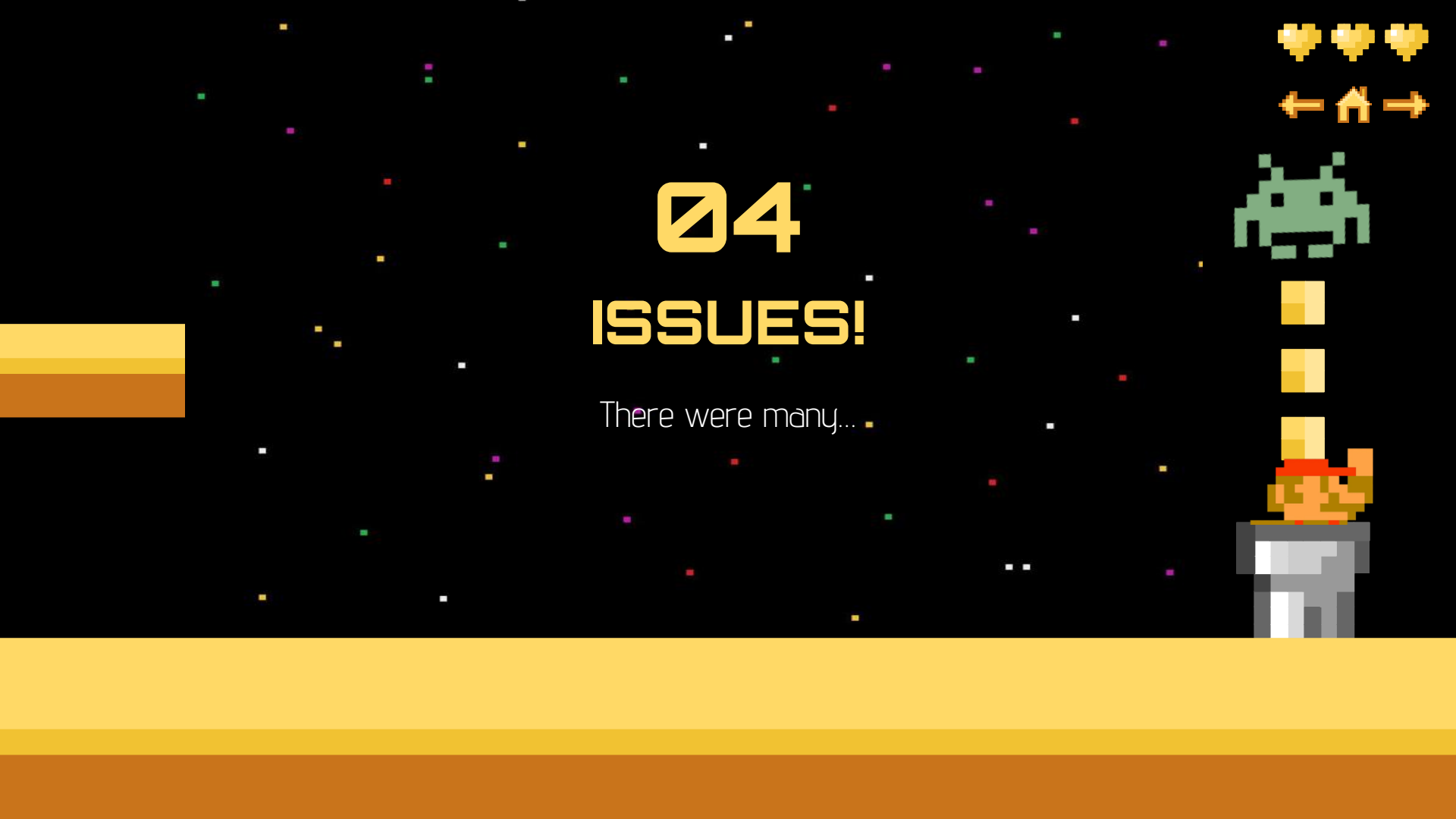




04

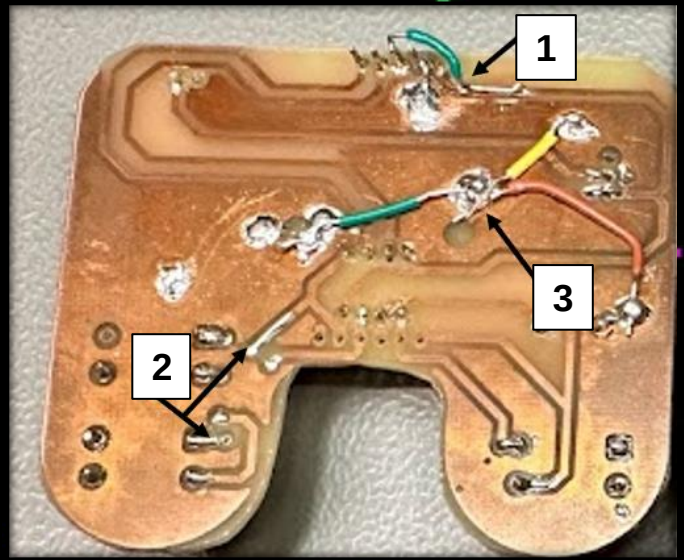
ISSUES!

There were many...



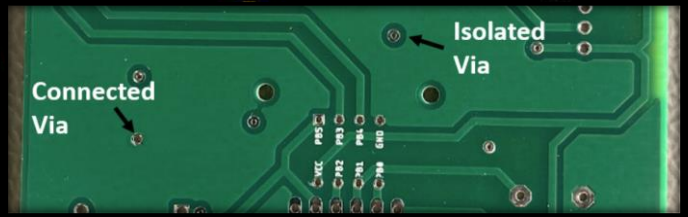
Design Issues

1. VCC and GND switched
2. Disconnected ground planes
3. Connectivity break between vias and pads



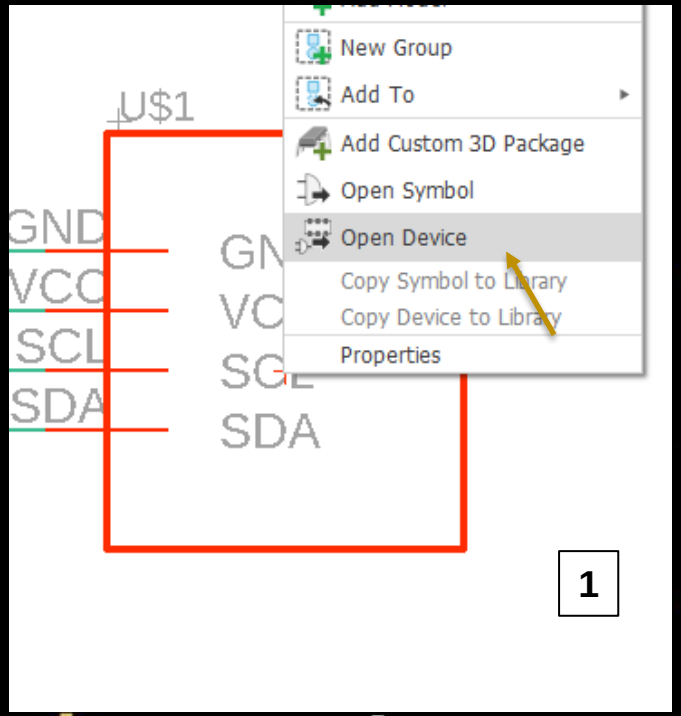
4. No ground plane

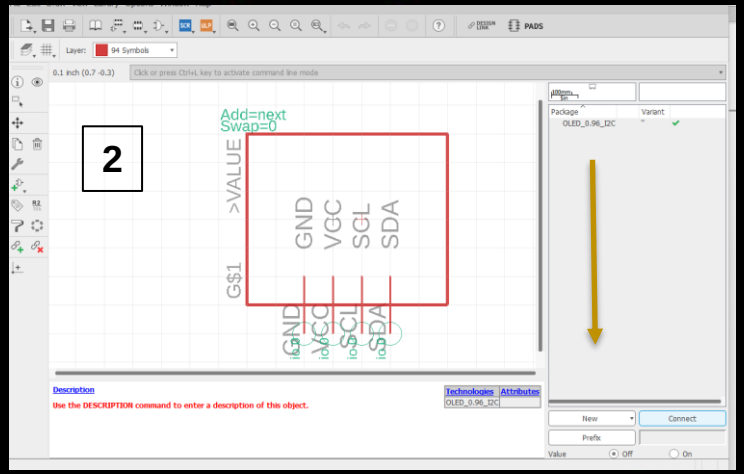
5. Isolated vias instead of connected vias

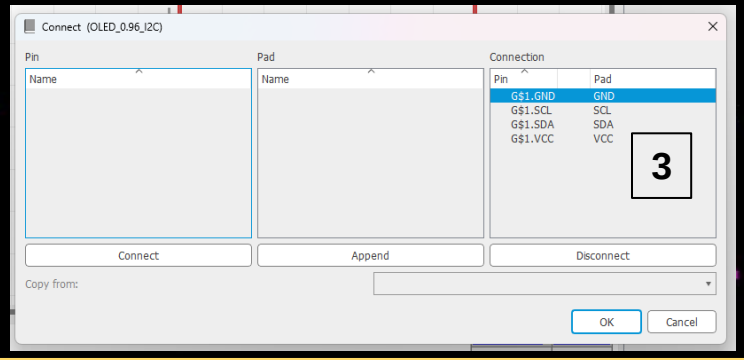


Design Issues

6. GND and VCC switched in schematic.







Design Issues

Fire Button not Working

We had to change the Vout of the voltage divider so that it doesn't fall into the range of RESET Pin Threshold voltage.

We swapped out the 6.8k ohm Resistor to a 4.7k ohm Resistor.

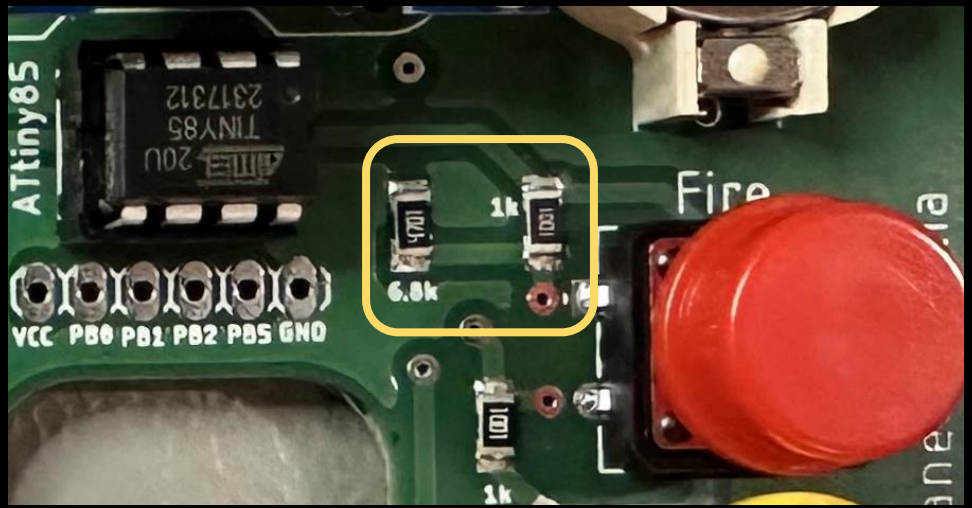
According to **datasheet**:
Min V = $0.6*V_{cc}$ = 0.6*3V = 1.8V
Max V = V_{cc}+0.5 = 3.5V
Range: 1.8V ~ 3.5V

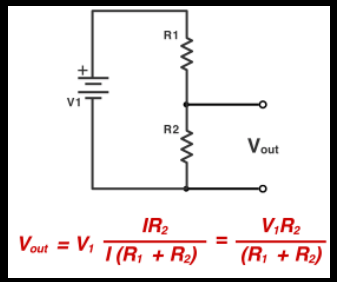
Measured values:
V_{cc} = 3V
$V_{fire,button}$ = 2.40V

***measured with multimeter**

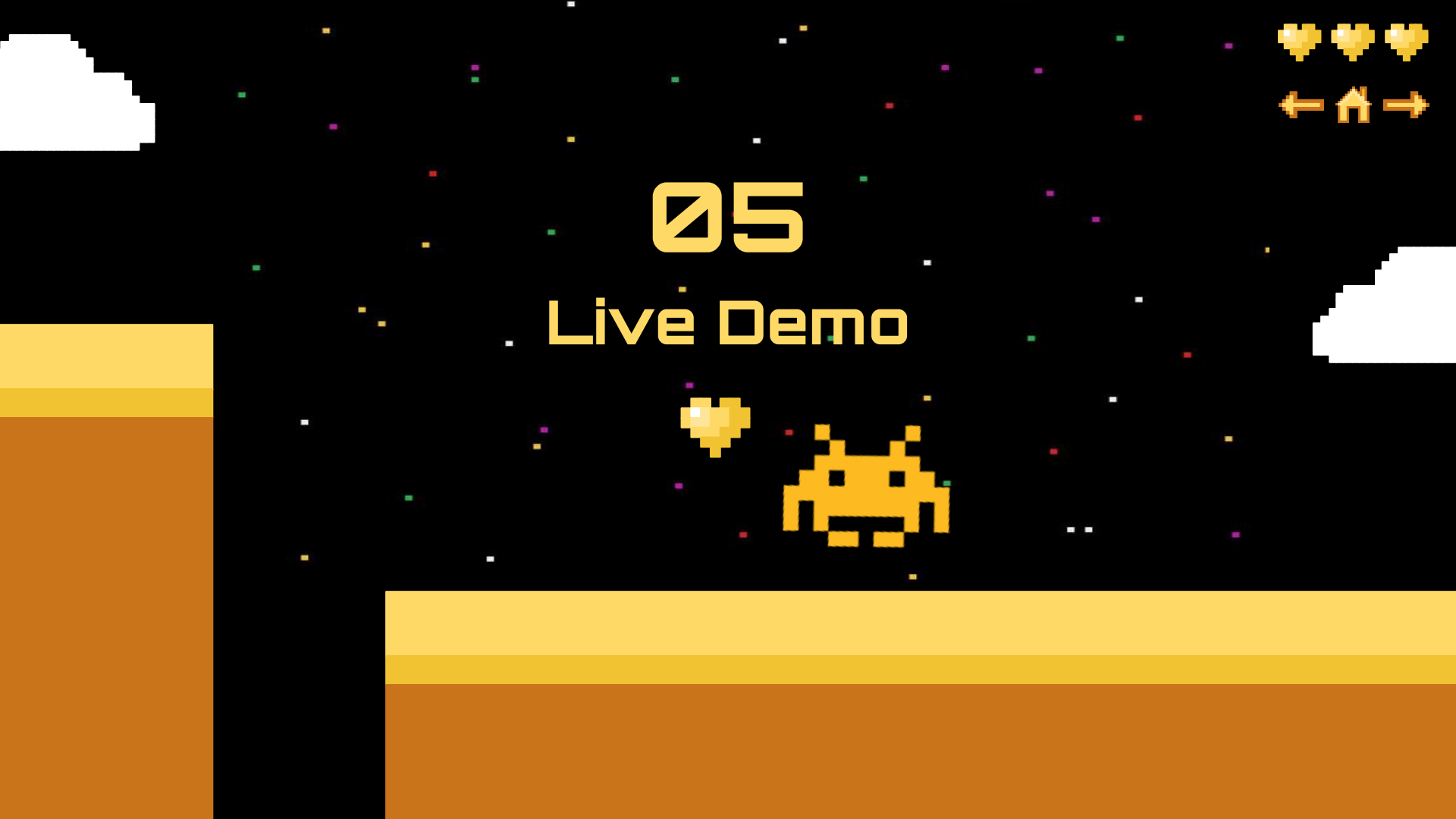
Symbol	Parameter	Condition	Min.	Typ.[1]	Max.	Units
V_{IH3}	Input High-voltage, RESET pin as I/O	V_{CC} = 1.8V - 2.4V V_{CC} = 2.4V - 5.5V	0.7V_{CC}[2] 0.6V_{CC}[2]		V_{CC} +0.5 V_{CC} +0.5	V V

[4] ATTiny85 Datasheet





[5] Voltage Divider formula


05
Live Demo

Working Video

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[1] *OIP.7ES9VNWH3EirBbn2WE6byWAAAA (474×351)*. (n.d.). https://th.bing.com/th/id/OIP.7ES9VNwH3eirBbn2wE6bywAAAA?rs=1&pid=ImgDetMain

[2] *OIP.YS58WI7_Mn2ExBONObTJHWHaFJ (474×355)*. (n.d.). https://th.bing.com/th/id/OIP.yS58WI7_mn2exbONobtJhwHaFj?pid=ImgDet&w=474&h=355&rs=1

[3] *R.aa2d5eb95546e9f1df7e17ee4e2baa3e (4160×3120)*. (n.d.). https://th.bing.com/th/id/R.aa2d5eb95546e9f1df7e17ee4e2baa3e?rik=ew4rU6eh3IDuRw&riu=http%3a%2f%2fbcscalibration.ie%2fwp-content%2fuploads%2f2019%2f06%2fIMG_20190609_121856.jpg&ehk=mwSgPH5VI01oFTGgdUvzwOJ5OHEvSyGRNn2ne%2boeJJw%3d&risl=1&pid=ImgRaw&r=0

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