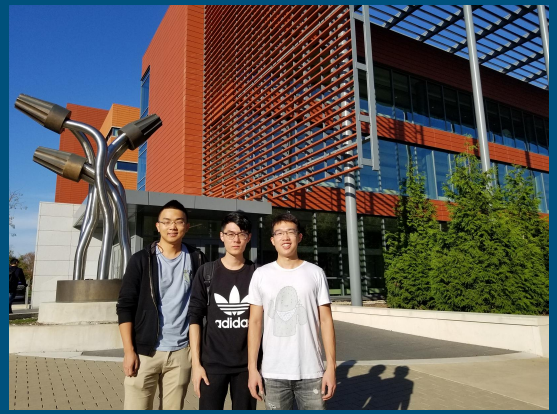
ECE 445
Tic-Tac-Toe Gamebox

Nuochen Lyu
Jiacheng Zhu
Minkang Yang

Team 30
TA: Xinrui Zhu

Introduction

- An arcade game
- Bring HAPPINESS to people.
- More development potential...



Objective

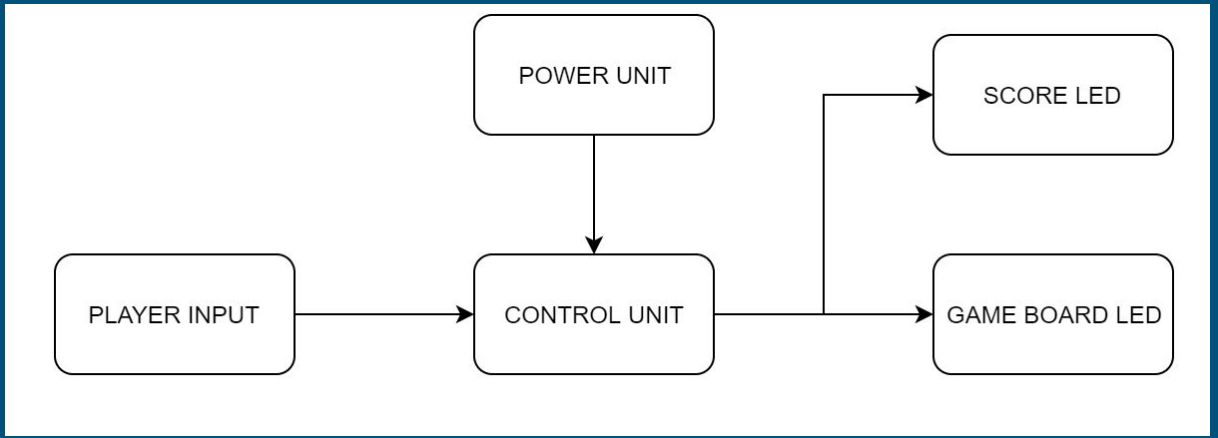
GOAL: Create a controller-based led - matrix board game that can interact with human player

1. Player vs Player
2. Player vs AI
3. Display pattern

Flowchart Overview

-receive input from player

-output led pattern to matrix



LED Matrix Selection

- Display different pattern
- Input pin must not be over-complicated
- Input in an acceptable range
- full control

Decision: MAX7219 control based 8x8 LED matrix:

-Only 1 Data input pin, reduce input

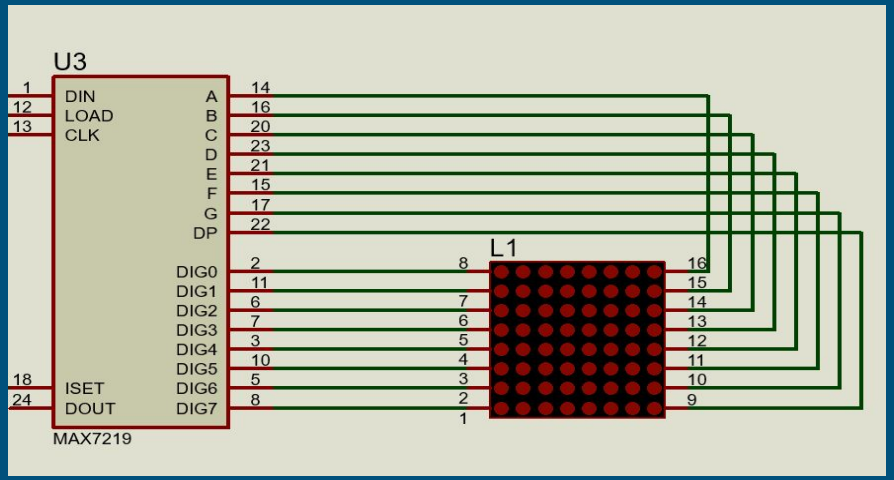
Repetition

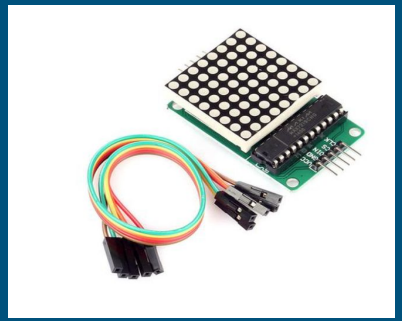
-can toggle on or off without

interrupt the pattern

- all input ports meets Hold Time, setup

Time requirement





Pressure sensor selection

-need to be sensitive enough to detect a “touch”

-resistor range are required to be reasonable

-not easy to break

-sense area need to be large enough to detect a human -finger touch

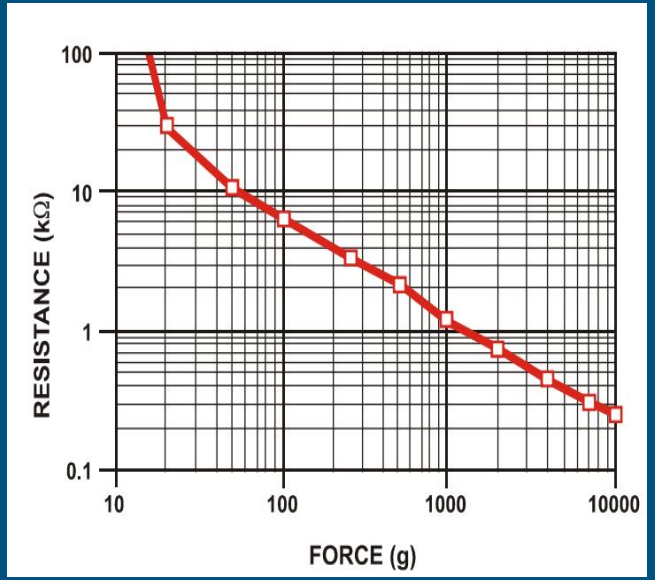
-no short circuit possibility

Decision: SEN-09375

- Range 10-10000 g, with a touch of 1kg(10N),

Resistance will decrease nearly half

- Cover by plastic, easy to bend and no short circuit concern
- Long pin input
- Sensor area is large enough



Controller Selection

- cheap
- debuggable
- No uncontrollable hazard condition
- Input /output / supply voltage in reasonable range
- AI supported
- 8x8x13 leds supported

Decision : ATMega328P Microcontroller

-Memory size big enough for AI

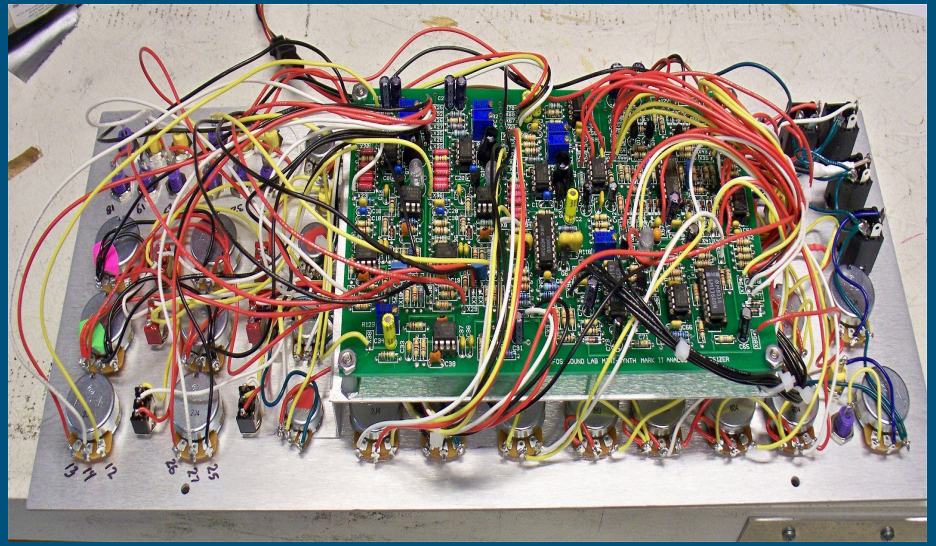
-fairly cheap, use arduino to debug

-input/supply/ output voltage are compatible with most of the IC chips in the market

-hazard condition is controllable by port register manipulation

System Integration

- more than 39 output !!!
- Also, pressure sensor has 9 input in Total



NOT a fan of THIS!

Decision : Use encoder and decoder

- Only one pressure sensor working at one time

- Only one LED lighted at one time

- same for the letter display

74HC147 74HC42 74HC 139

Why HC series?

-LS does not fulfill the input/output

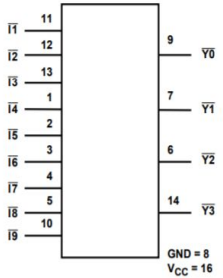
requirement for ATmega328P

We choose N package instead of D package

-clear to debug

-easy to solder

Functional Diagram



TRUTH TABLE

INPUTS									OUTPUTS			
$\overline{I1}$	$\overline{I2}$	$\overline{I3}$	$\overline{I4}$	$\overline{I5}$	$\overline{I6}$	$\overline{I7}$	$\overline{I8}$	$\overline{I9}$	$\overline{Y3}$	$\overline{Y2}$	$\overline{Y1}$	$\overline{Y0}$
H	H	H	H	H	H	H	H	H	H	H	H	H
X	X	X	X	X	X	X	X	L	L	H	H	L
X	X	X	X	X	X	X	L	H	L	H	H	H
X	X	X	X	X	X	L	H	H	H	L	L	L
X	X	X	X	X	L	H	H	H	H	L	L	H
X	X	X	X	L	H	H	H	H	H	L	H	L
X	X	X	L	H	H	H	H	H	H	L	H	H
X	X	L	H	H	H	H	H	H	H	H	L	L
X	L	H	H	H	H	H	H	H	H	H	L	H
L	H	H	H	H	H	H	H	H	H	H	H	L

H = High Logic Level, L = Low Logic Level, X = Don't Care

Integrate Pressure sensor on the circuit

-need a stable, and controllable circuit implementation to make sure the output digital signal meets the Encoder requirement

-Pressure sensor will change its resistance if it sense the force , therefore the output voltage will need to change accordingly.

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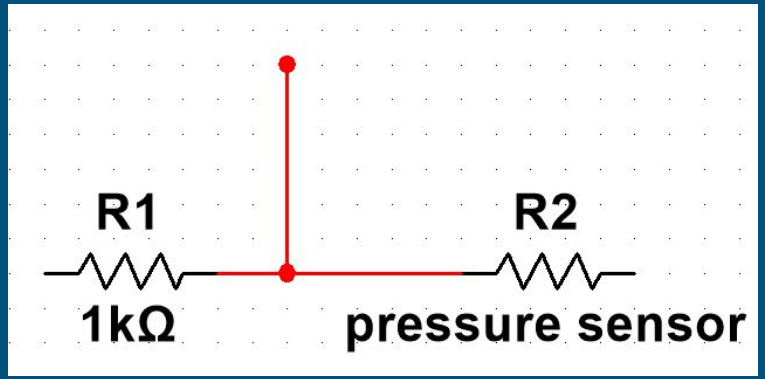
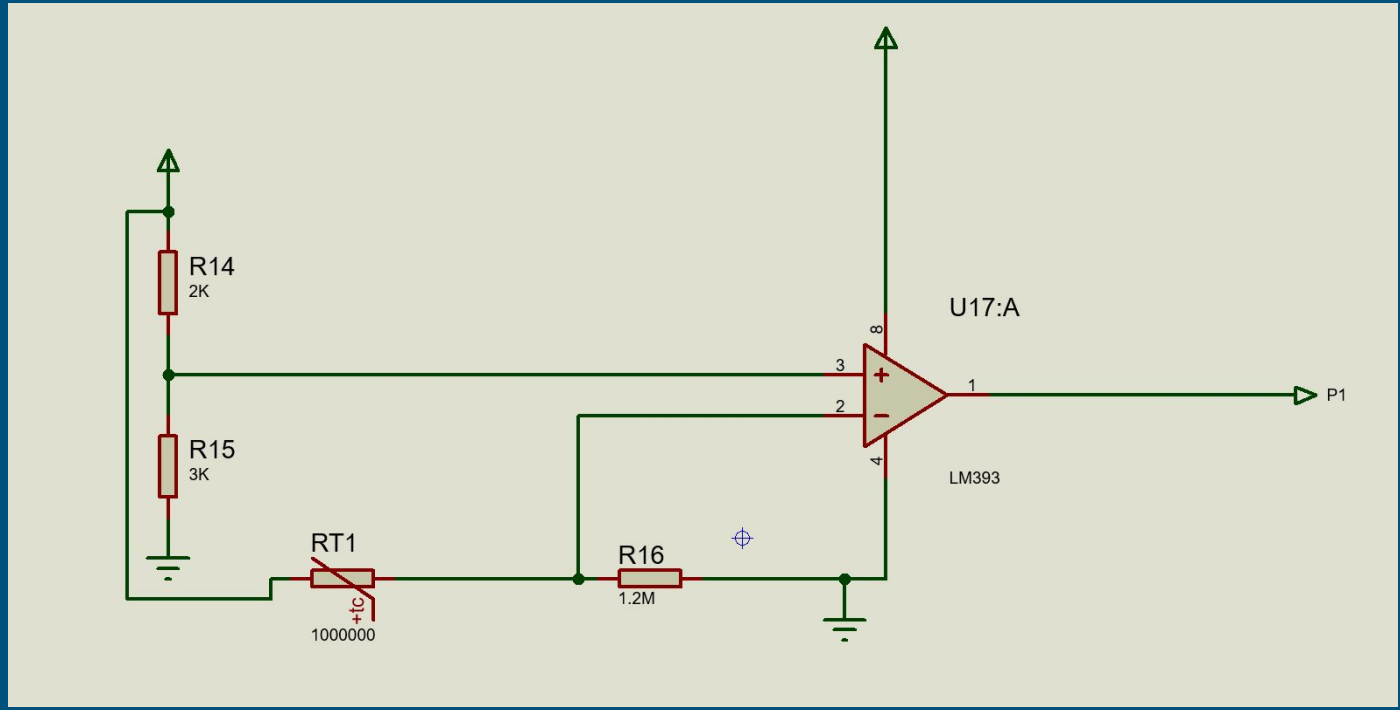


- **Too unstable**
- **Not possible to deliver 0 V voltage**

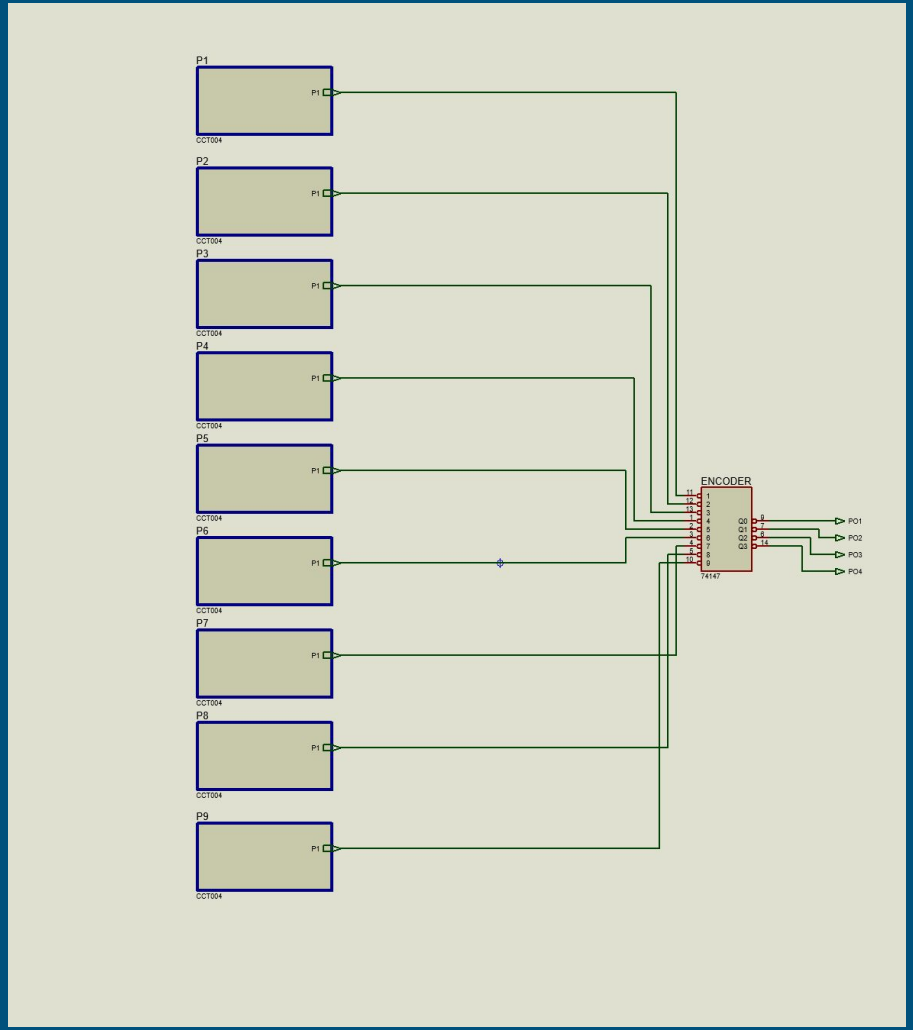
OP-AMP - A/D converter module

- stable output
- easy to debug



A/D converter - encoder module

- Deliver an instant change 4 -bit digital input



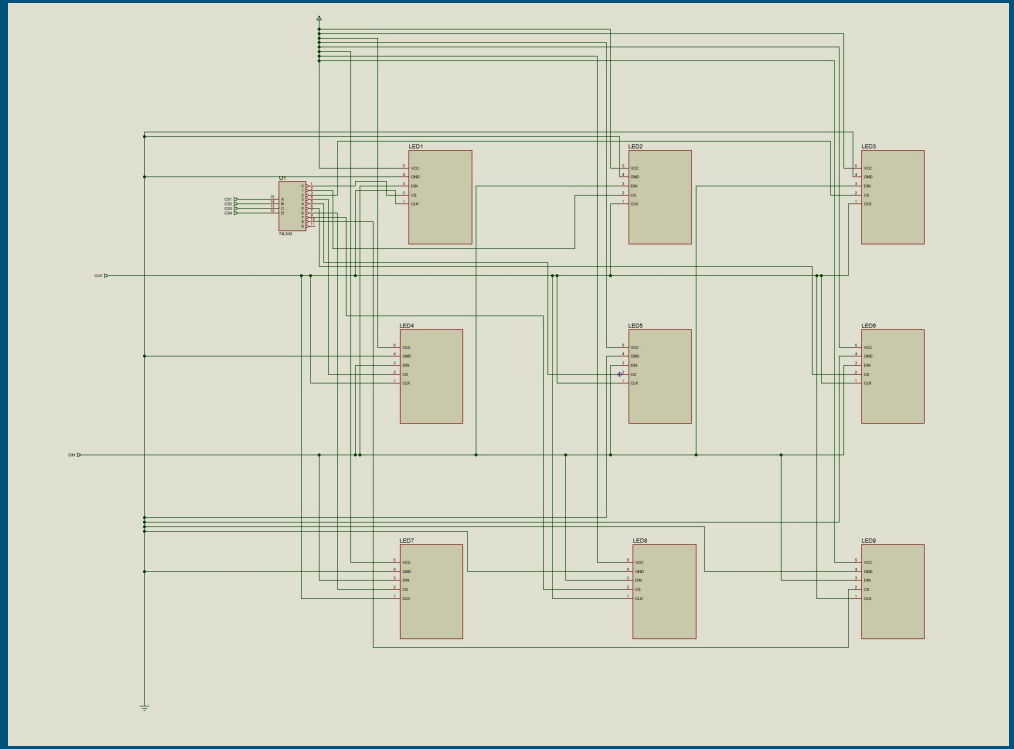
encoder - matrix diagram

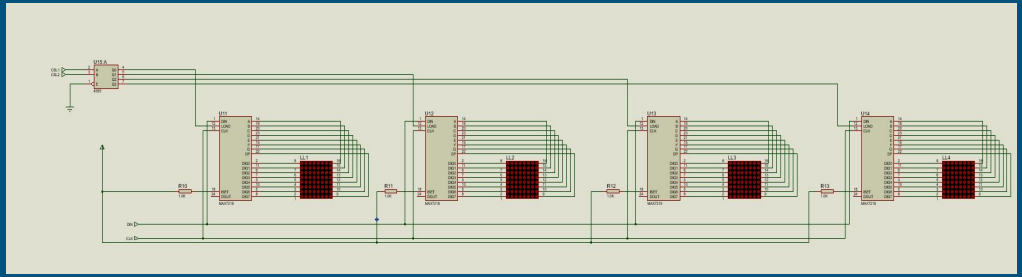
small block-> chip +matrix

-CLK, DATA in the bus

-Decoder deliver chip select

-pattern be store in the MAX7219 first

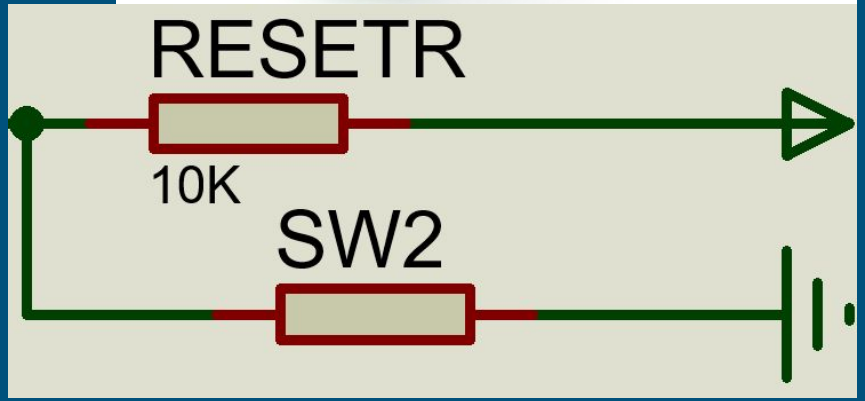




Switch(Reset Button)

-Signal is 0 when button is pressed

-hard code inside microcontroller



Round up everything

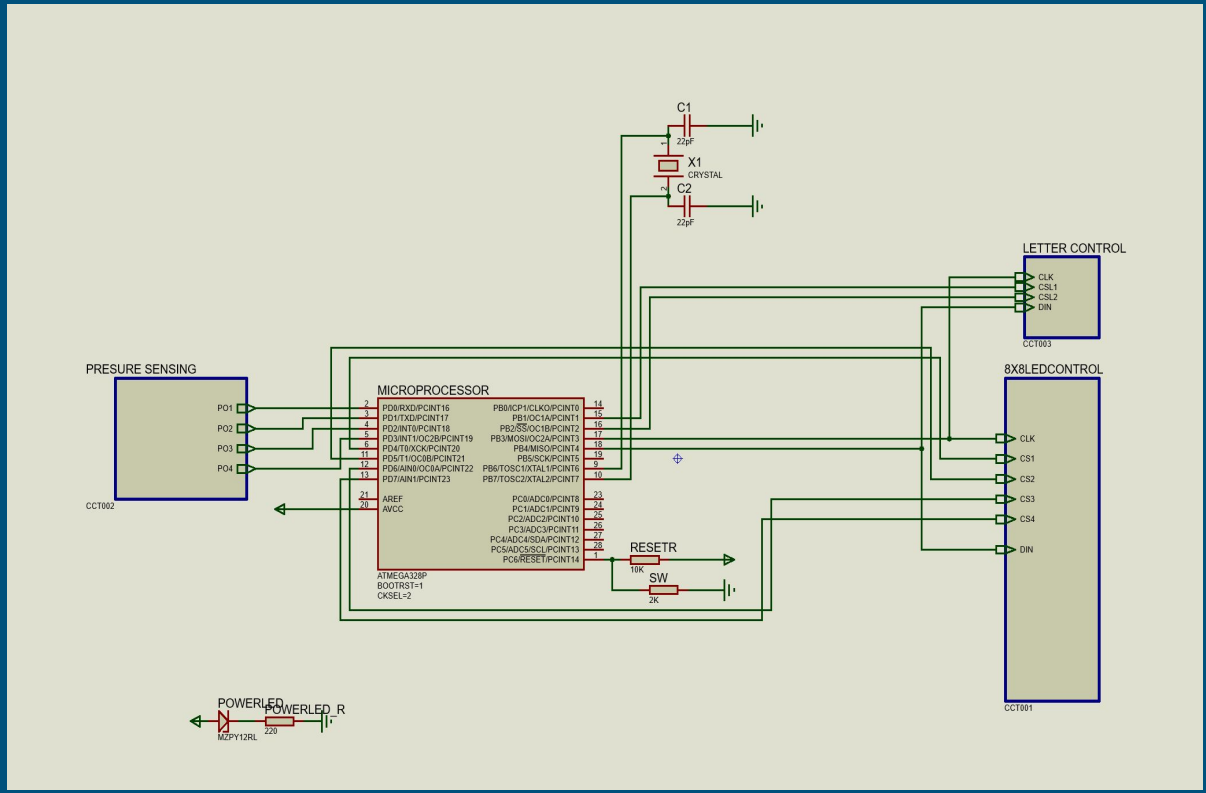
-power LED shows if power

Working correctly

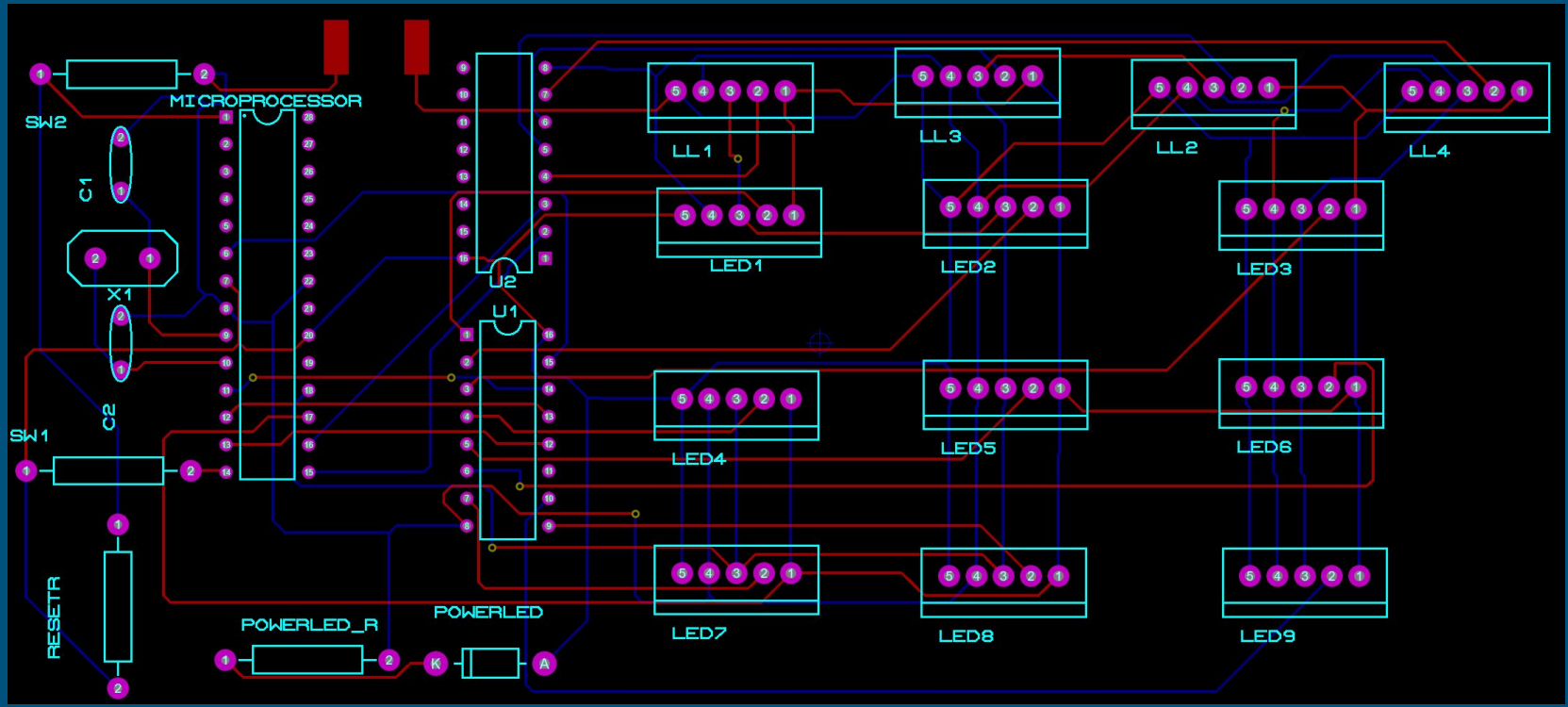
- switches are controlling the

Reset function.

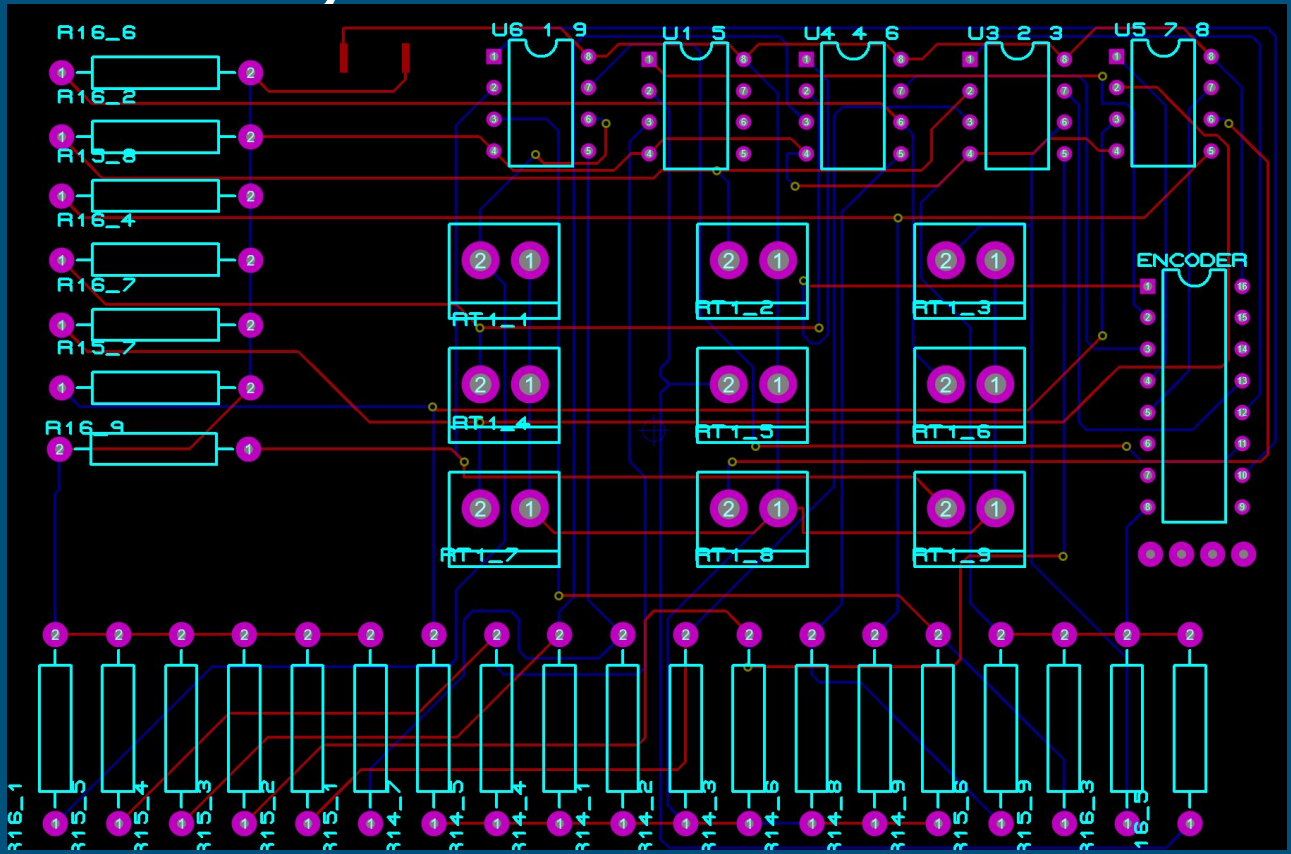
-add necessary element to make Microcontroller working



3. Design - PCB Board Layout -LED module

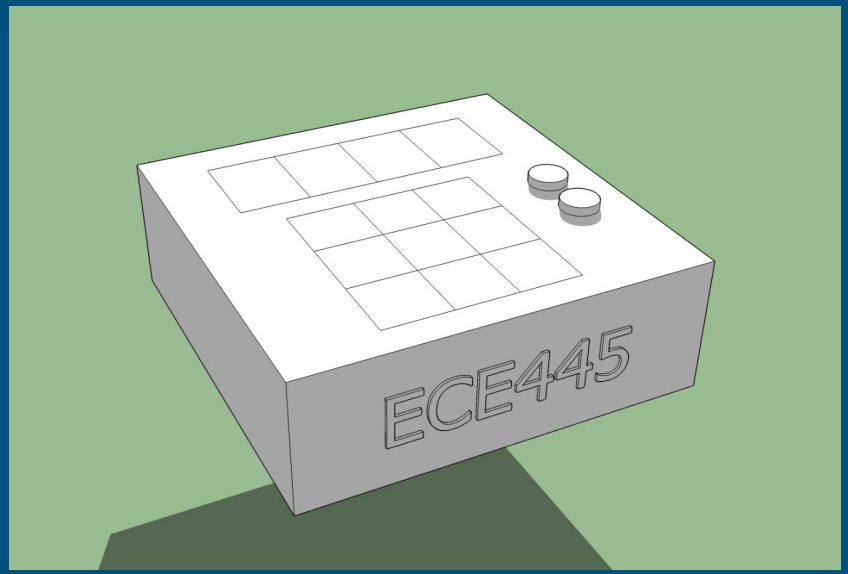


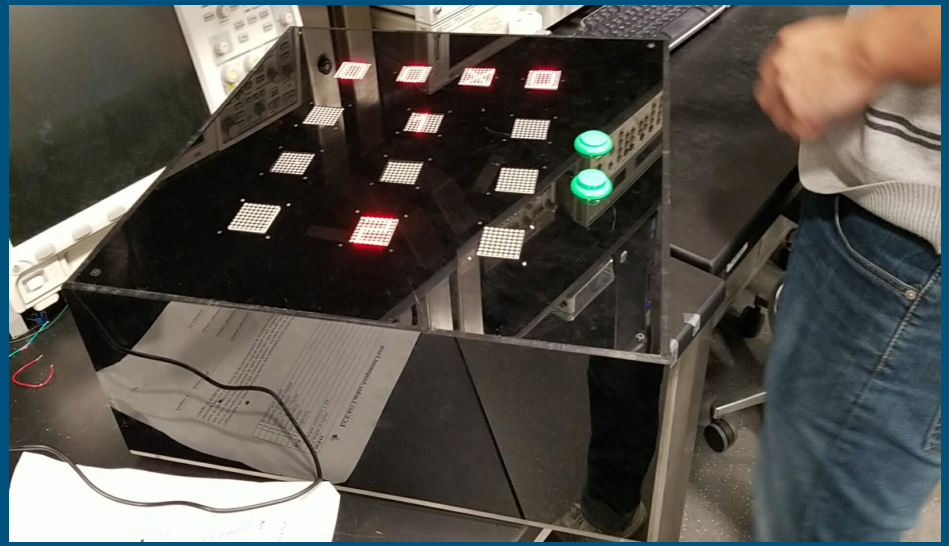
Design - PCB Board Layout - AD module



3.1 Physical diagram

In real physical design, we set the each led matrix with more distance in between





Software Overview

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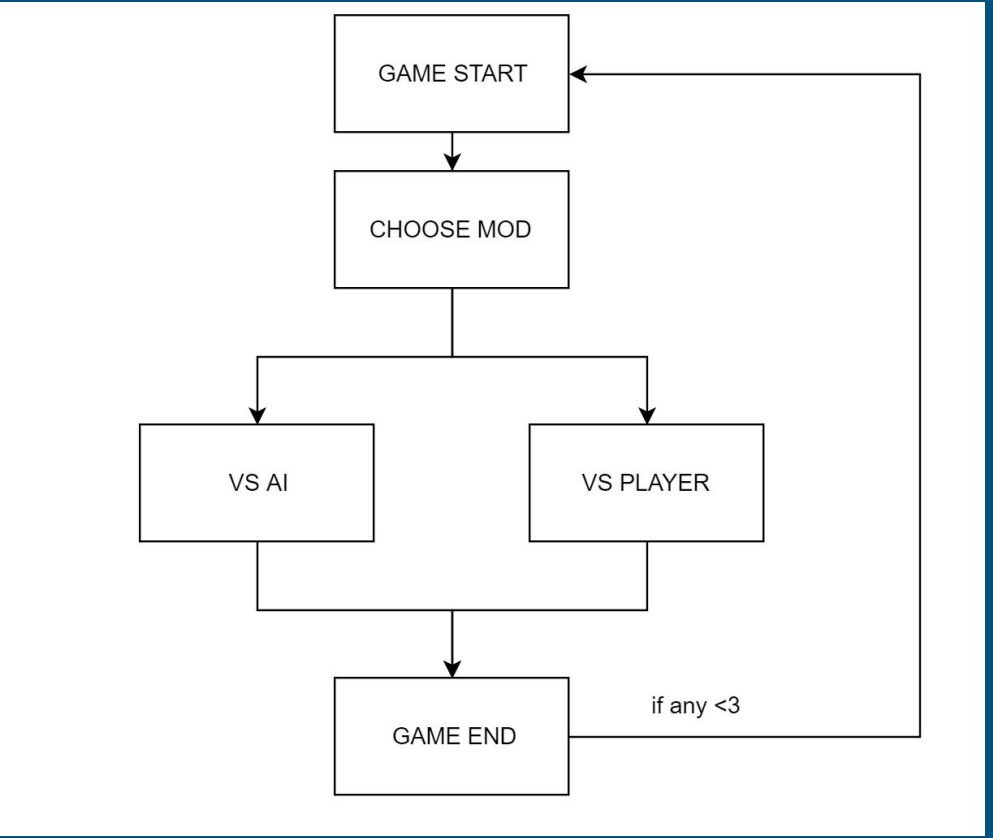
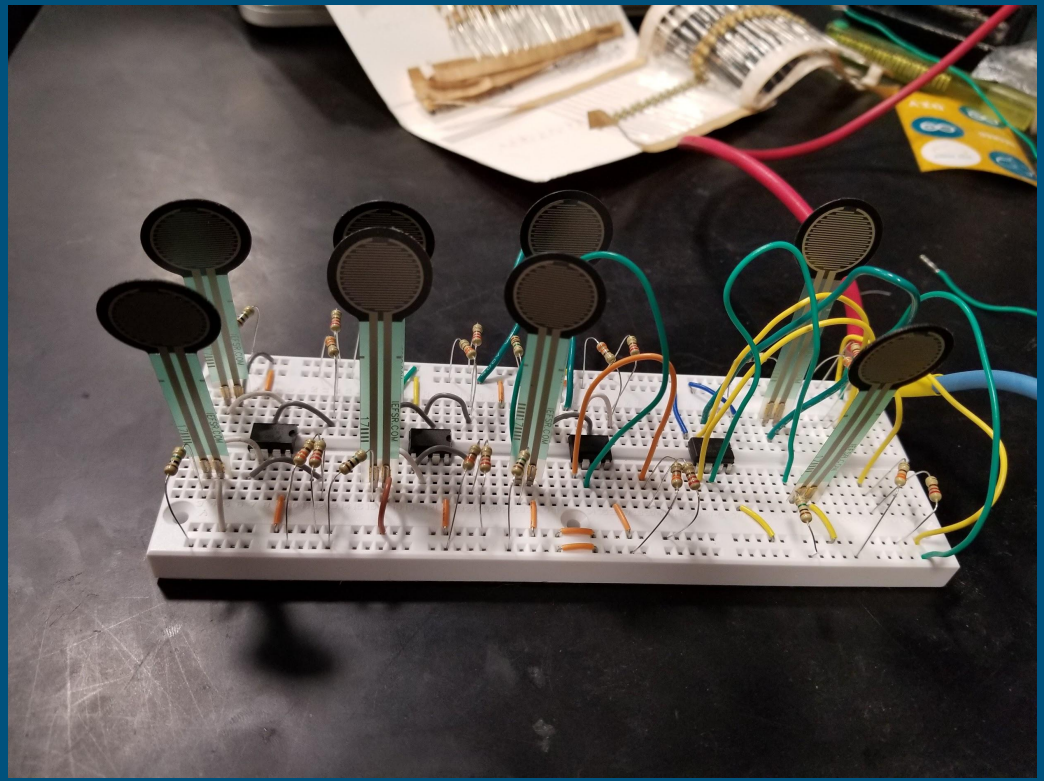


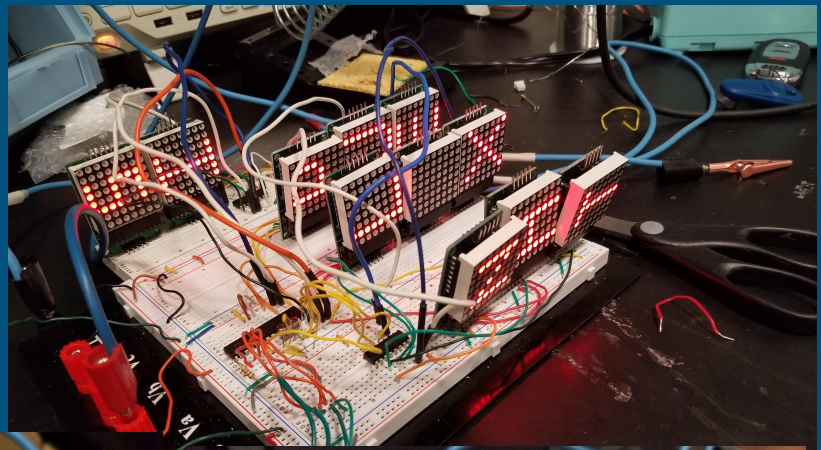
4.R & V

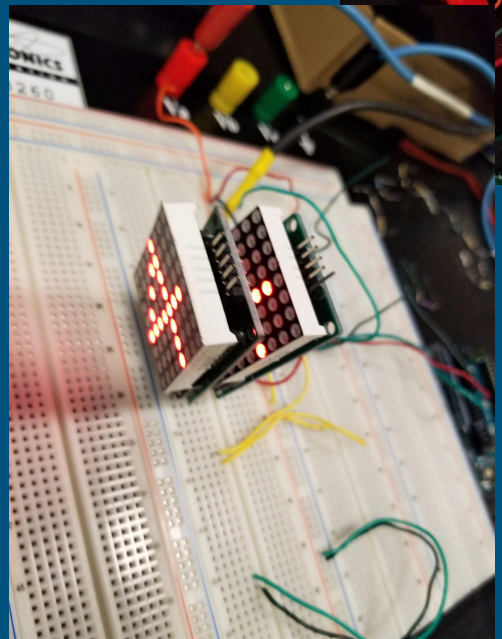
A/D convertor module

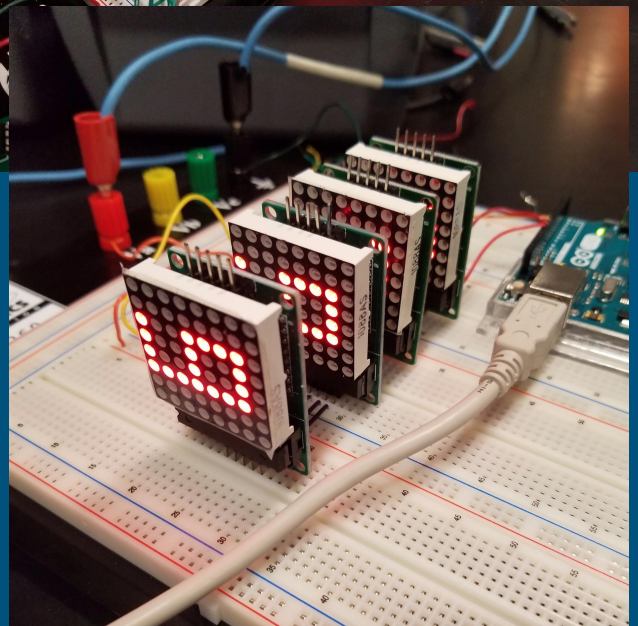


4.R & V

LED module & Score display





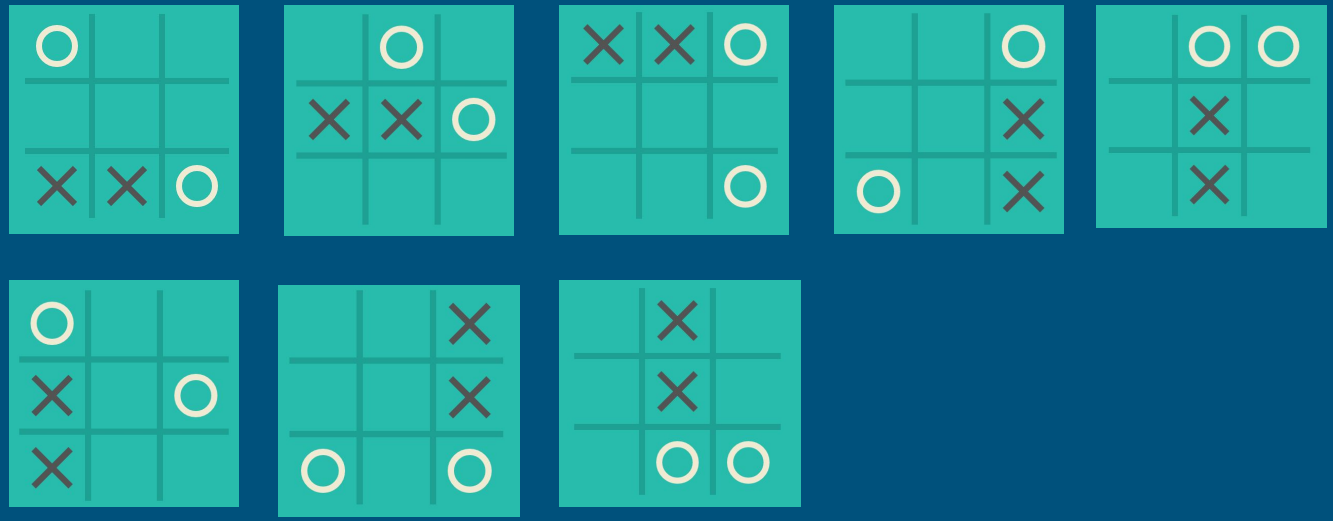


4.R & V

Microprocessor

4.R & V

Software



5.Our Story...Headache moments

1. LED does not work on breadboard
2. OP-AMP does not work
3. Encoder decoder hazard condition
4. PCB board -- extremely hard to solder
5. Physical design -- circuit shortage
6. things get stolen

6.Fun Fact

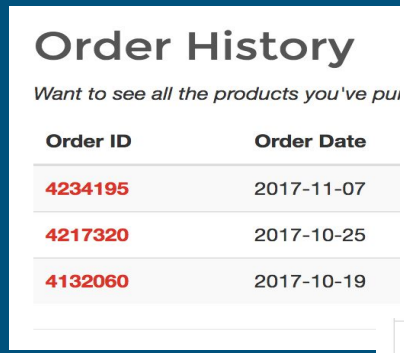
Total Cost:

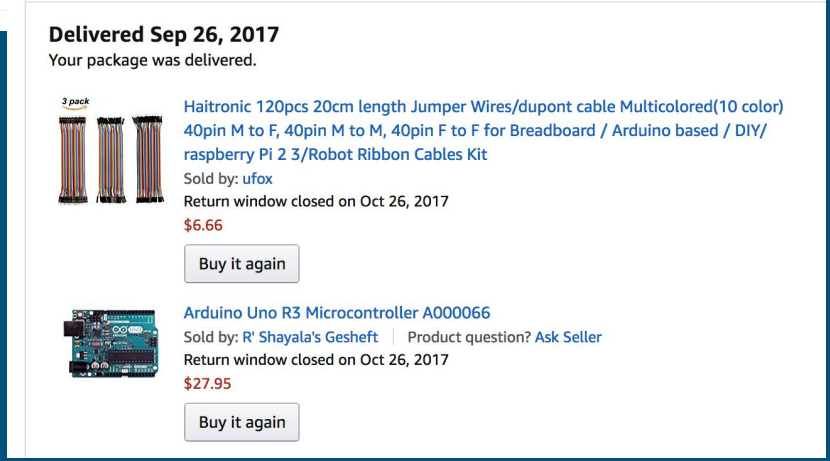
374+495+150= 1019$

Actually Cost:

13*5 + 14 + 9*5 + 3 = 127$

Labor hour: 280 hour/person





7.Teamwork & Schedule

A/D Converter Component test-->WhiteBoard A/D Module Test->

Multiple A/D Modules + Encoder on WhiteBoard Test->

LED individual test->whiteboard(wb) led multi test->wb led multi test+decoder->Arduino software test + A/D->

Arduino software test + LED-> All testing whiteboard ->

PCB A/D + whiteboard LED->PCB A/D+PCB LED->Physical design PCB->

Physical design+PCB+button ->All+software test->Final demo

8.Conclusion & Outlook

Built Strong Friendship between team members

Gain great knowledge on PCB design, IC chip selection, microcontroller

Potential more development on the box

Learned how to design PCB