

Mechanical Mirrors:

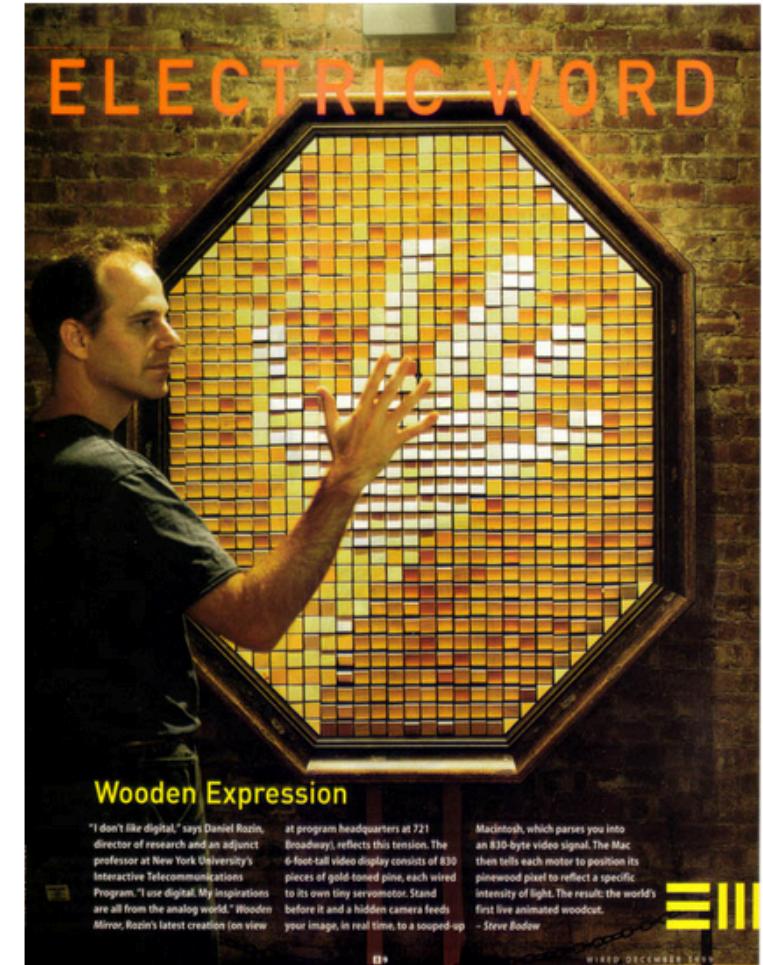
The 4 mechanical mirrors are made of various materials but share the same behavior and interaction; any person standing in front of one of these pieces is instantly reflected on its surface. The mechanical mirrors all have video cameras, motors and computers on board and produce a soothing sound as the viewer interacts with them.

Wooden Mirror - 1999

830 square pieces of wood, 830 servo motors, control electronics, video camera, computer, wood frame.

Size - W 67" x H 80" x D 10" (170cm , 203cm, 25cm).

Built in 1999, this is the first mechanical mirror I built. This piece explores the line between digital and physical, using a warm and natural material such as wood to portray the abstract notion of digital pixels.



Wooden Mirror In Wired Magazine



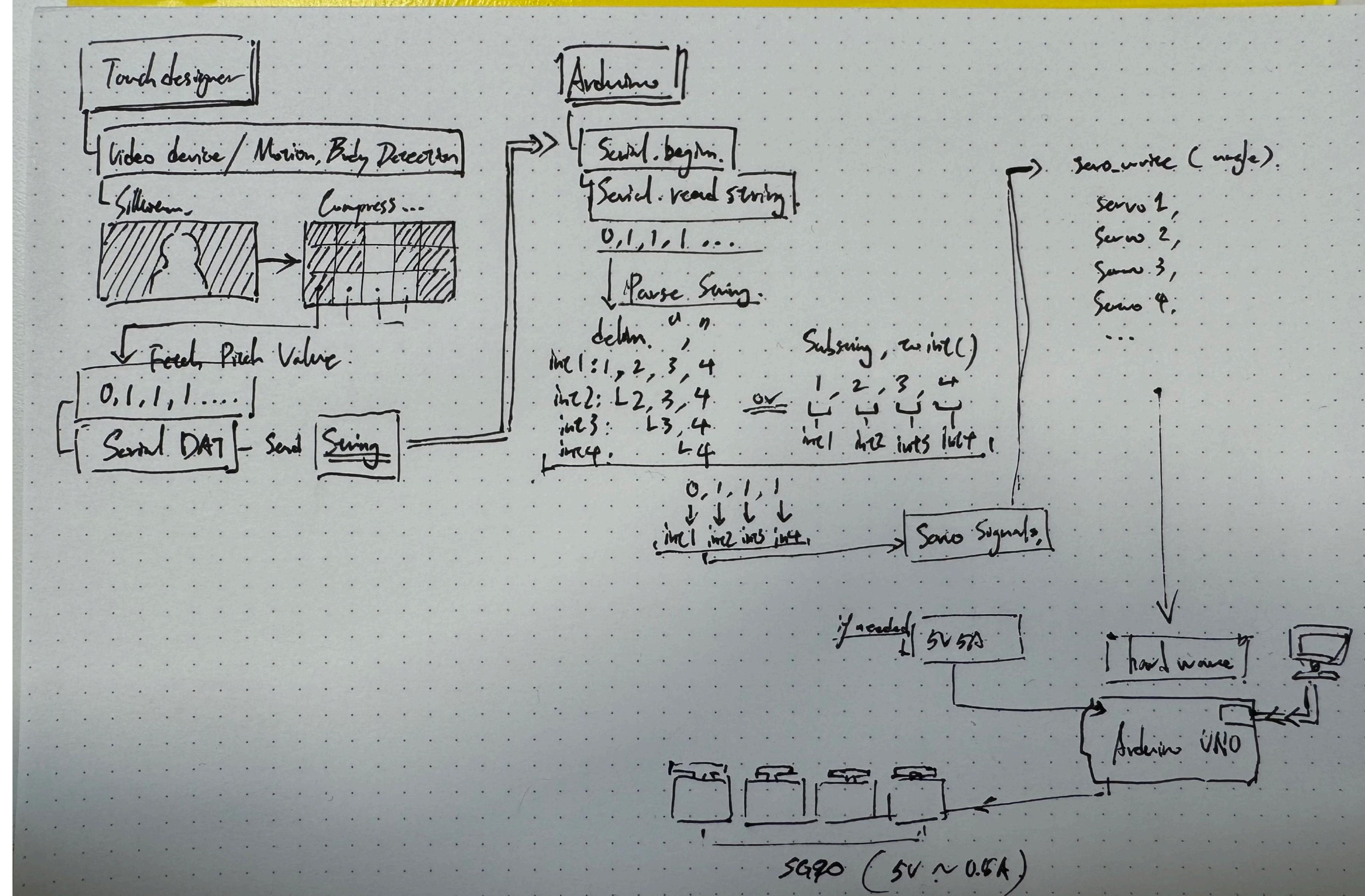
Wooden Mirror At the Israel Museum



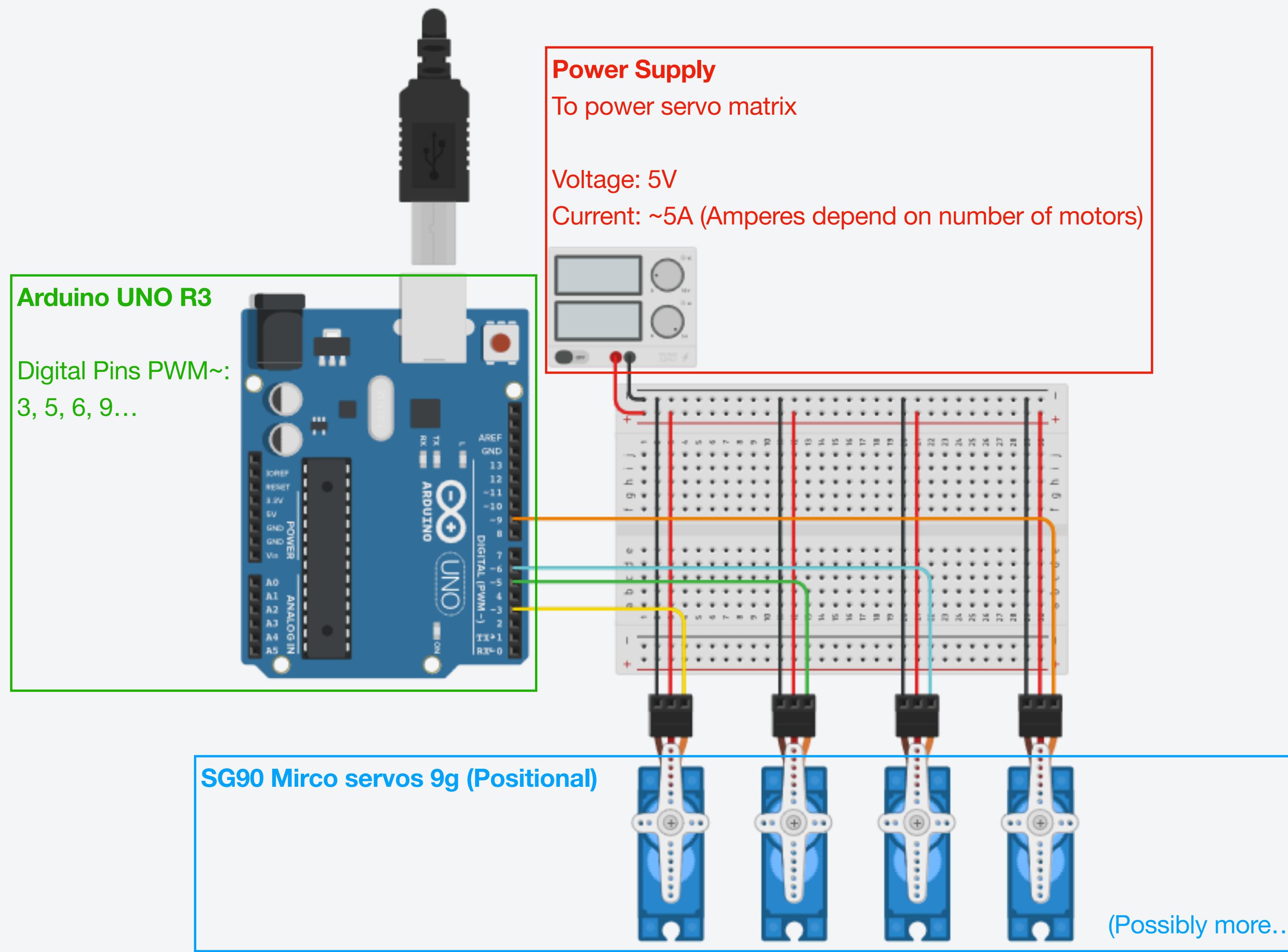
QuickTime movie of Wooden Mirror
(Click to view)

Creative Technology 3 : *Kludging as a Creative Approach to Technology*

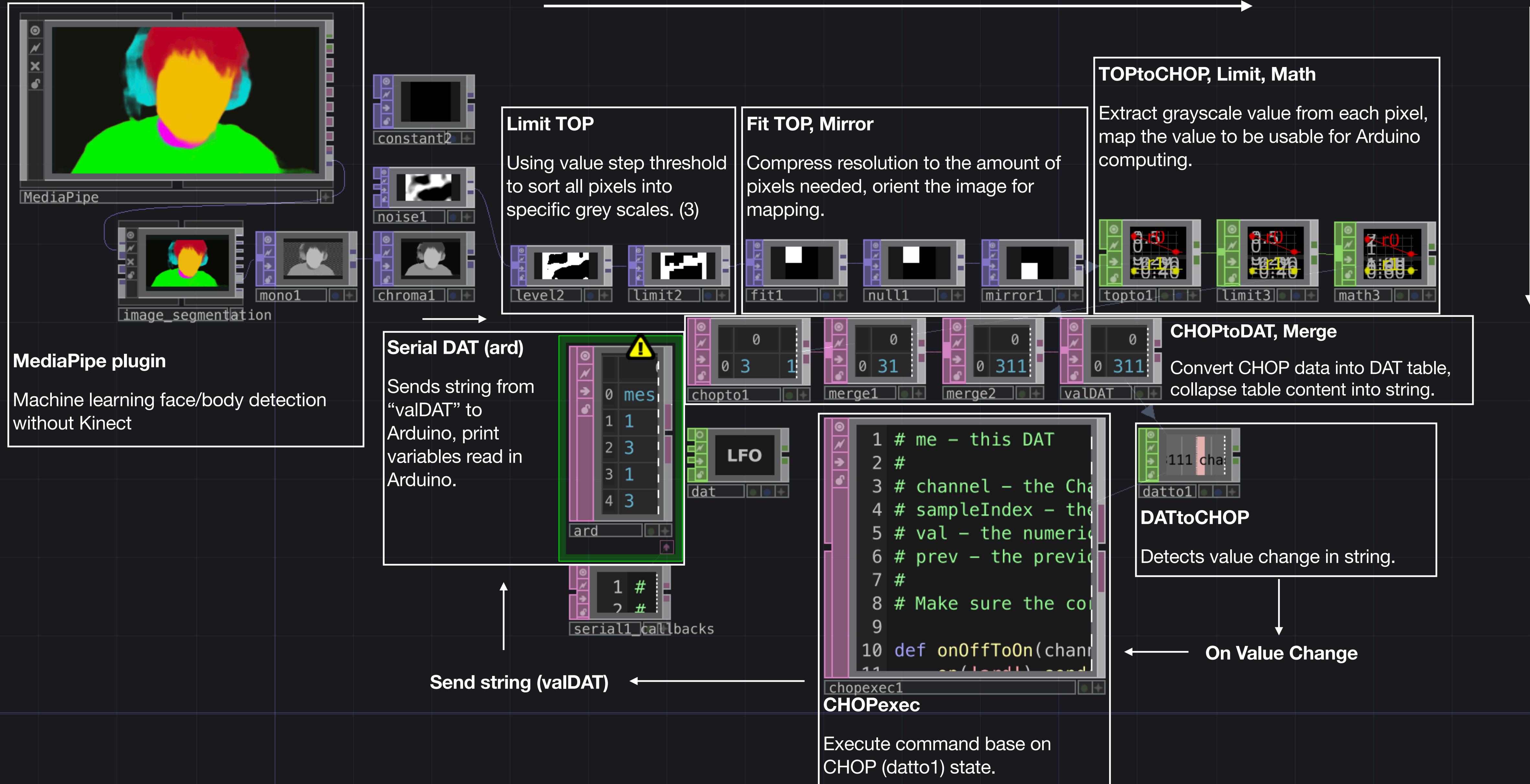
Initial Idea - Diagram Sketch:



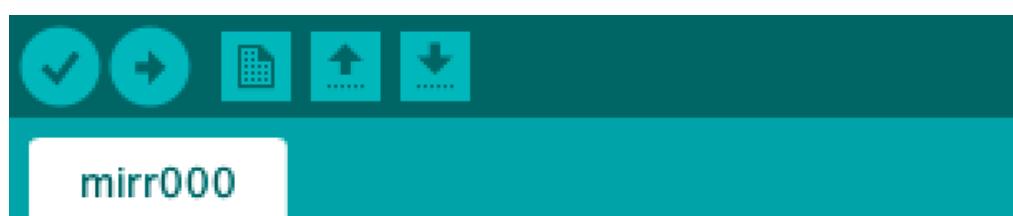
Arduino Circuits:



TouchDesigner Project:



Arduino Code: 1st Version



```
#include <Servo.h>
Servo servo1;
Servo servo2;
Servo servo3;
Servo servo4;
Servo servo5;
Servo servo6;
```

Add servos with servo library

```
int servoInt = 0;
int i;
String state;
int delim = 0;
int numMOT = 1;
int M1,M2,M3,M4,M5,M6;
```

```
void setup()
{
pinMode(LED_BUILTIN,OUTPUT);
```

```
servo1.attach(1);
servo1.attach(2);
servo1.attach(3);
servo1.attach(4);
servo1.attach(5);
servo1.attach(6);
```

Defining var:

initialized servo position, empty string state, motor position int

Attach servos, initialize position

```
servo1.write(servoInt);
servo2.write(servoInt);
servo3.write(servoInt);
servo4.write(servoInt);
servo5.write(servoInt);
servo6.write(servoInt);
```

```
Serial.begin(9600);
```

Serial port start listening

```
void loop()
{
if (Serial.available()>0)
{digitalWrite(LED_BUILTIN,HIGH);
state = Serial.readString();
Serial.print(state);
M1 = state.substring(0,1).toInt();
//delim = state.indexOf(',');
M2 = state.substring(1,2).toInt();
//state = state.substring(delim+1,state.length());
//delim = state.indexOf(',');
M3 = state.substring(2,3).toInt();
//state = state.substring(delim+1,state.length());
//delim = state.indexOf(',');
M4 = state.substring(3,4).toInt();
//state = state.substring(delim+1,state.length());
//delim = state.indexOf(',');
M5 = state.substring(4,5).toInt();
//state = state.substring(delim+1,state.length());
```

"if" serial available:

String state = string received by serial port.

Parse string by index.

(var M1 = 1st digit, var M2 = 2nd digit...)

Drive motors...

Debug 1 (tested with single motor):

BUG:

Problem with serial port reading string. Motors non-responsive to string sent by TouchDesigner.

Later, Motors respond but reinitializes after each received signal.

In-Class trouble-shooting:



```
#include <Servo.h>
Servo servo1;

String state = "";
int M1 = 1;

void setup() {
  servo1.attach(9);
  servo1.write(M1);
  // put your setup code here, to run once:
  Serial.begin(9600);
  while(!Serial);
}
```

```
void loop() {
  // put your main code here, to run repeatedly:
  //if(Serial.available() > 0){

```

```
    digitalWrite(13, HIGH);
    state = Serial.readString();
    if(state.length() > 0){
      M1 = state.toInt();
      servo1.write(M1*45);
      Serial.println(String(M1));
      delay(15);
    }
  //}
}
```

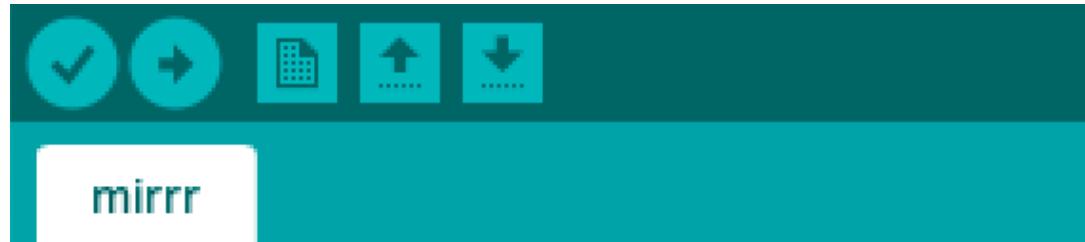
while(!Serial): Halt actions wait for serial port...

Detected problem with "Serial.available()>0"

Issue resolved with alternate if statement with "state.length()>0"



Arduino Code: Refined Prototype



mirrr

```
#include <Servo.h>
```

Add servos 1-4 with servo library

```
Servo servo1;
Servo servo2;
Servo servo3;
Servo servo4;
//Servo servo5;
//Servo servo6;
```

```
int servoInt = 0;
int i;
String state = "";
int delim = 0;
int M1,M2,M3,M4,M5,M6;
```

```
void setup()
{
    pinMode(LED_BUILTIN,OUTPUT);
//    pinMode(1,OUTPUT);
//    pinMode(2,OUTPUT);
//    pinMode(3,OUTPUT);
//    pinMode(4,OUTPUT);
//    pinMode(5,OUTPUT);
//    pinMode(6,OUTPUT);
```

```
    servo1.attach(3);
    servo2.attach(5);
    servo3.attach(6);
    servo4.attach(9);
//    servo5.attach(5);
//    servo6.attach(6);
```

Attach servos, initialize position

```
    servo1.write(servoInt);
    servo2.write(servoInt);
    servo3.write(servoInt);
    servo4.write(servoInt);
//    servo5.write(servoInt);
//    servo6.write(servoInt);
```

```
    Serial.begin(9600);
//while(!Serial);
```

```
}
```

Serial port start listening

while(!Serial): Halt actions wait for serial port...
(taken out to test effect on program speed)

```
void loop()
{
    //if (Serial.available() > 0){
        digitalWrite(13, HIGH);
        //digitalWrite(LED_BUILTIN,HIGH);
        state = Serial.readString();
        if(state.length() > 0){
            //Serial.println(state);
            M1 = state.substring(0,1).toInt();
            M2 = state.substring(1,2).toInt();
            M3 = state.substring(2,3).toInt();
            M4 = state.substring(3,4).toInt();
            servo1.write(M1*45);
            servo2.write(M2*45);
            servo3.write(M3*45);
            servo4.write(M4*45);
            Serial.println(String(M1));
            Serial.println(String(M2));
            Serial.println(String(M3));
            Serial.println(String(M4));
            //delay(15);
        } else { M1 = 0; M2 = 0; M3 = 0; M4 = 0; }
        //    //delim = state.indexOf(',');
        //    M2 = state.substring(1,2).toInt();
        //    //state = state.substring(delim+1,state.length());
        //
        //    //delim = state.indexOf(',');
        //    M3 = state.substring(2,3).toInt();
        //    //state = state.substring(delim+1,state.length());
        //
        //    //delim = state.indexOf(',');
        //    M4 = state.substring(3,4).toInt();
        //    //state = state.substring(delim+1,state.length());
        //
        //    //delim = state.indexOf(',');
        //    M5 = state.substring(4,5).toInt();
        //    //state = state.substring(delim+1,state.length());
        //
        //    //delim = state.indexOf(',');
        //    M6 = state.substring(5,6).toInt();
        //    //state = state.substring(delim+1,state.length());
    }
}
```

String state = string received by serial port.

THEN

"if" received serial length > 0:

Parse string by index.

(var M1 = 1st digit, var M2 = 2nd digit...)

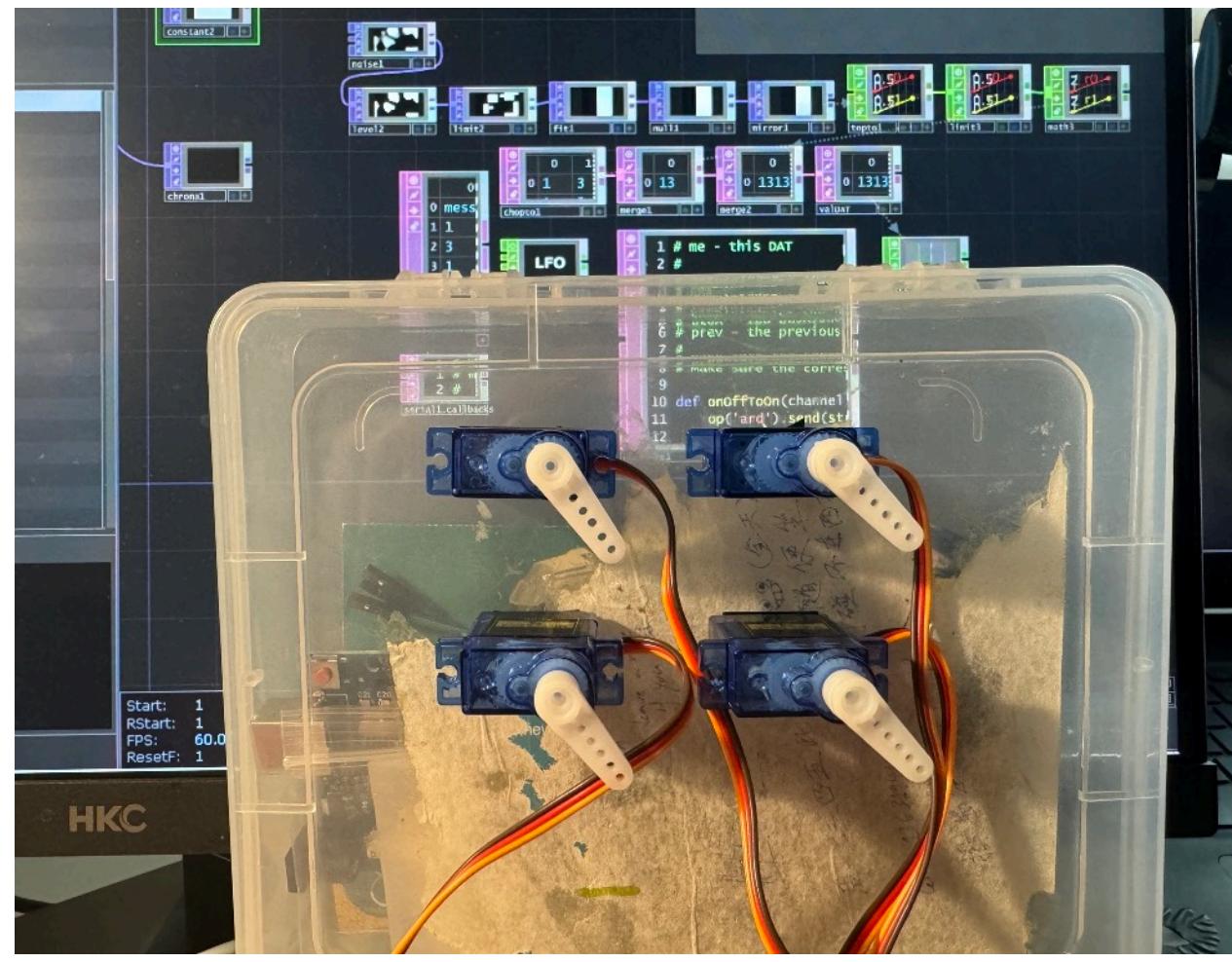
Write servo positions with corresponding int.

Serial.println to print int in Touchdesigner project for monitoring.

"else":

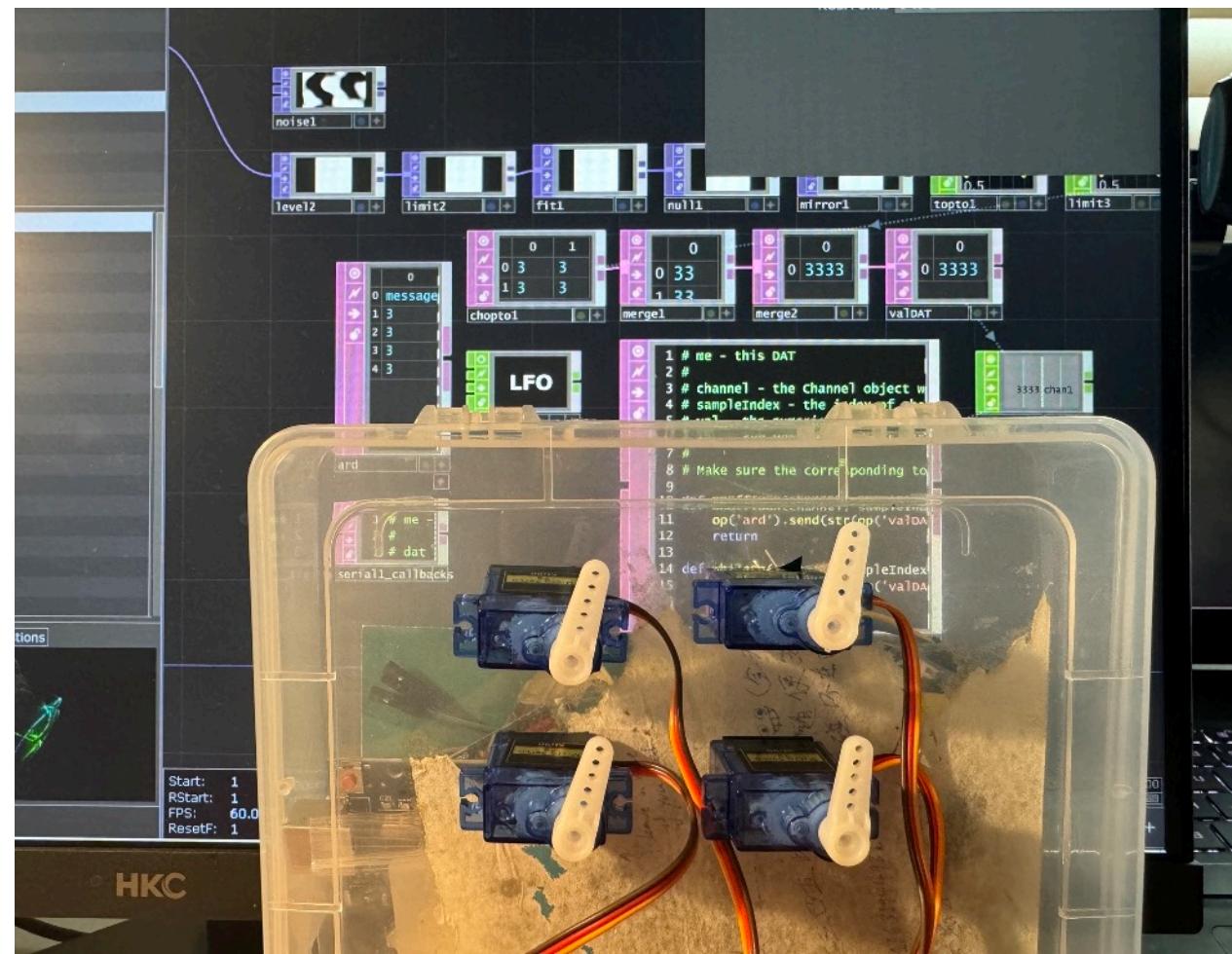
all servo positions = 0

Test Demo 1 (With Noise Node) :



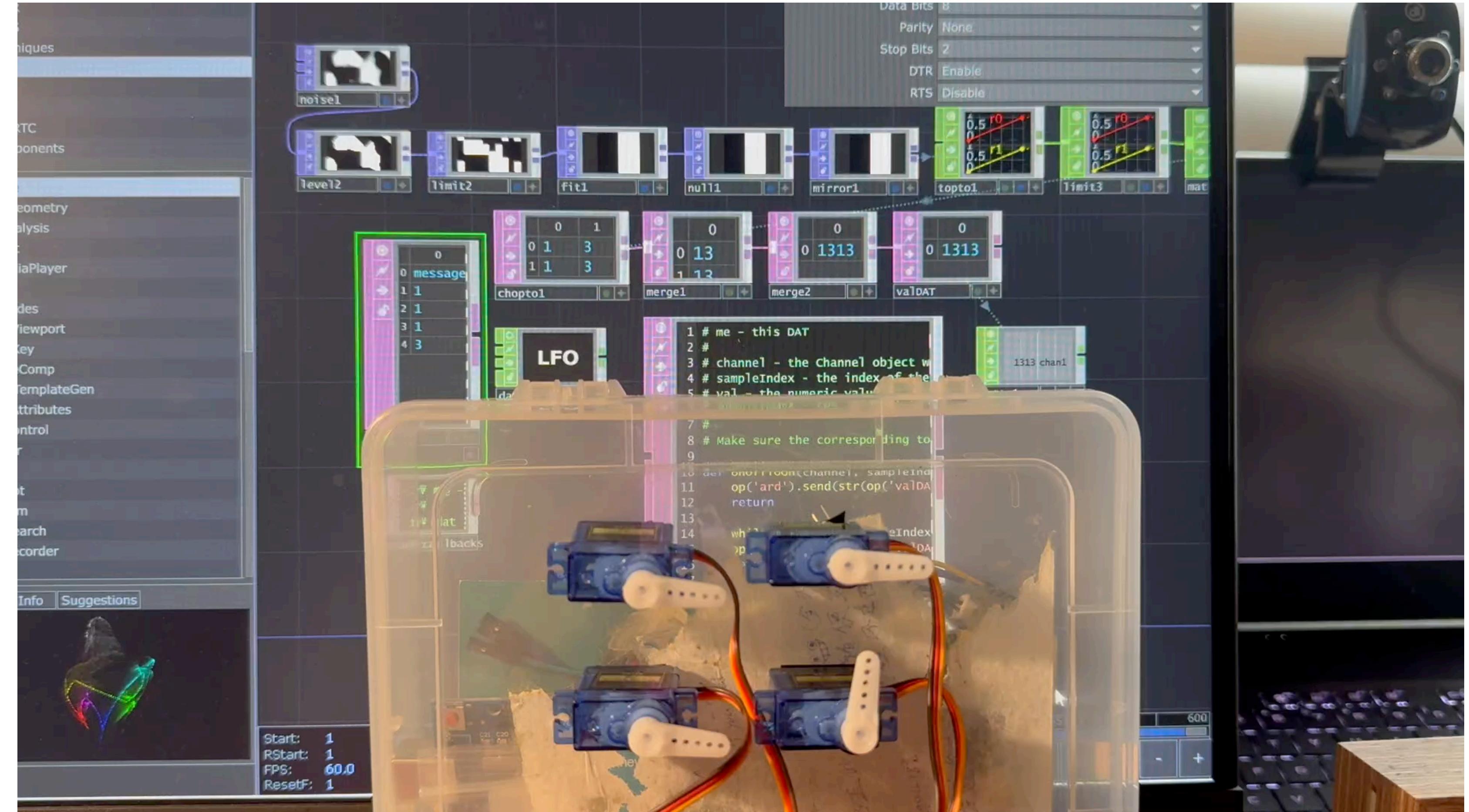
Initialized Positions:

No string signal received.



Full Extension Positions:

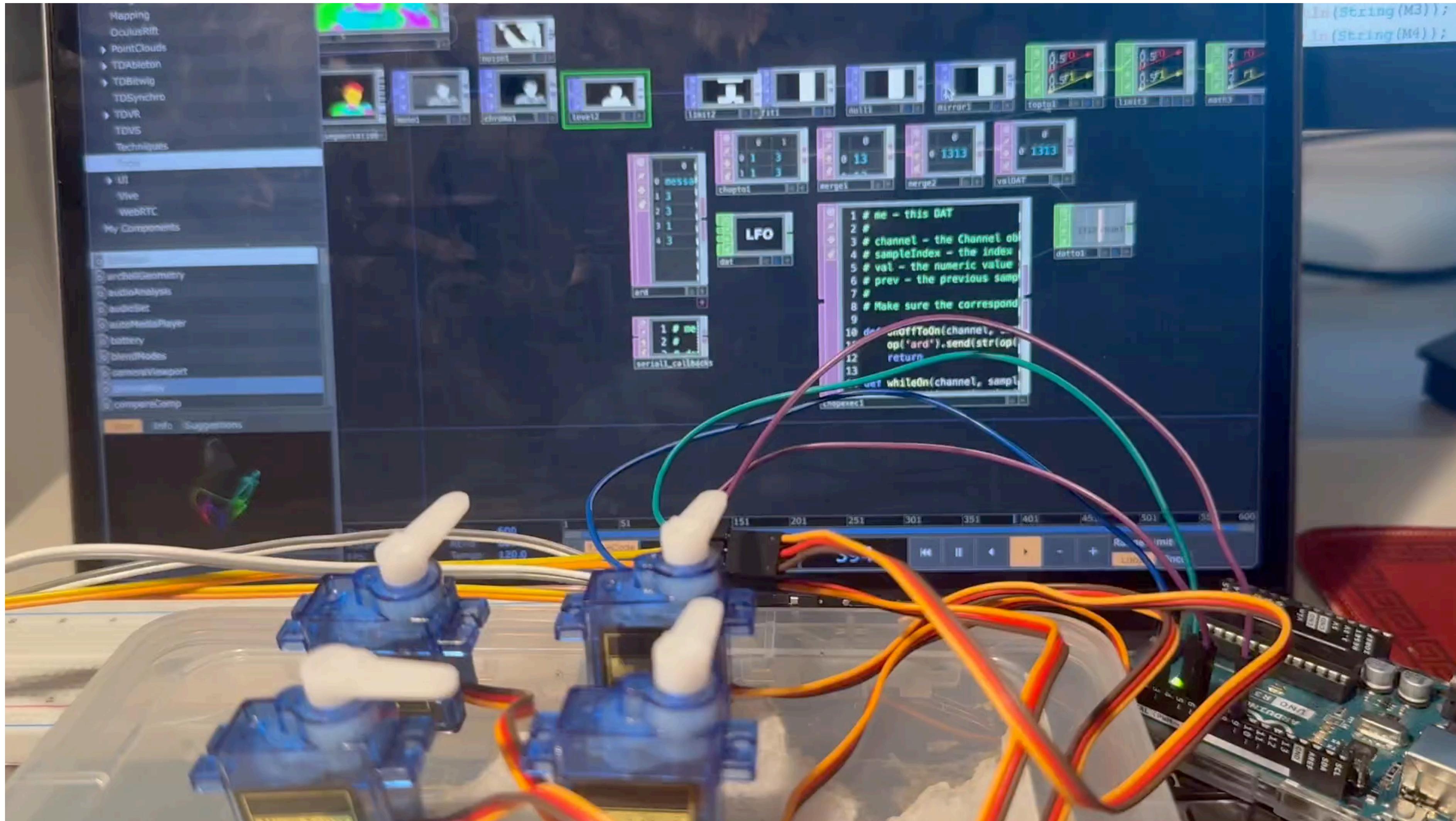
White screen values.



Issue Detected: Speed of value change

Value changes too quickly, changing before the motors respond, leads to display error.

Test Demo 2 (With MediaPipe plugin) :



Same Issue: Speed of value change

Value changes too quickly, changing before the motors respond, leads to display error.

Further optimization required.

PLAN FOR FUTURE OPTIMIZATION:

1. Increase

