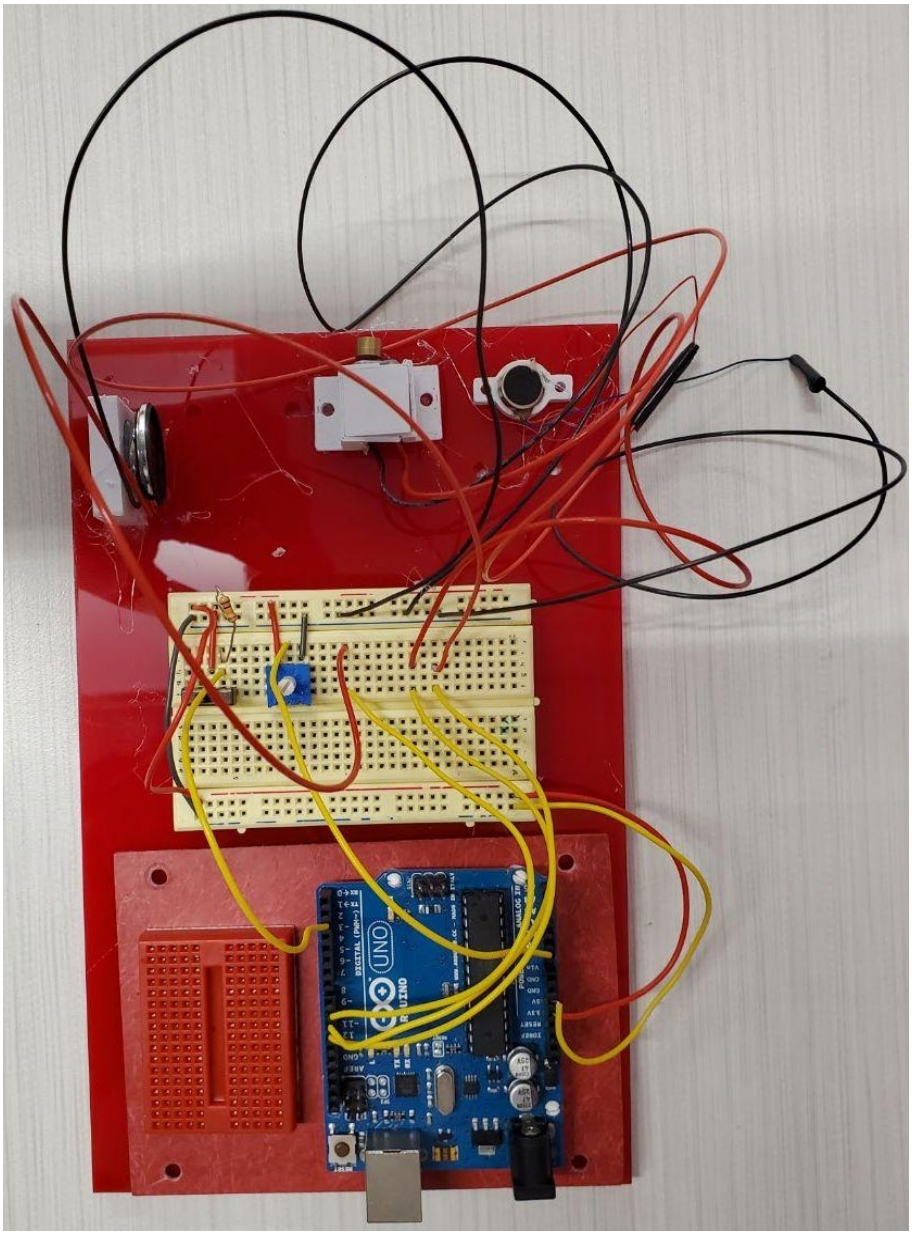
MAE 3780: Individual Project Final Report

Alarm Pillow



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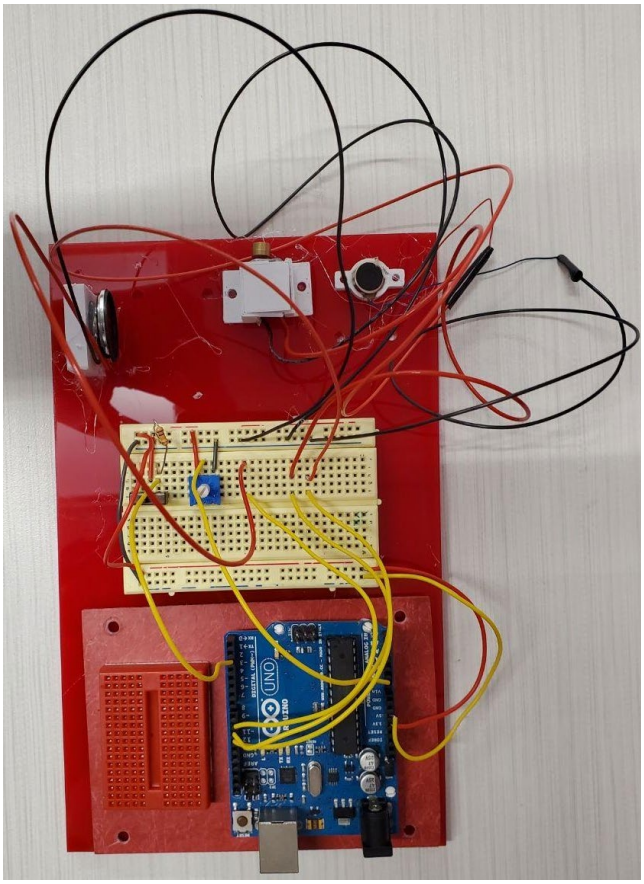
Overview

The alarm pillow is an insert that slides into a pillow and vibrates/makes a sound at predetermined intervals. These intervals are set by the user and can range from seconds to hours. The alarm pillow is powered by an Arduino placed on an acrylic sheet. There are two inputs, a slide switch, and a potentiometer. There are three outputs a small vibration motor, a large vibration motor, and a speaker. The slide switch turns the alarm on and off. The potentiometer controls the vibration of the motor.



Completed Device

Design Considerations

If I could redo the project with the same constraint, I would not have included the smaller vibration motor and would instead have included one more of the larger vibration motor. This is because the smaller vibration motor does not provide nearly as much vibration per cost as the larger one. Additionally, the larger vibration motor is simpler to constrain due to its more rectangular shape. The other design choice I would change is I would have tried to remove the Arduino off the board it comes with. I did not

remove the Arduino from the included board because I didn't want to unnecessarily modify any given components, but it would have made my form factor smaller making my material cost for acrylic lower.

If I had more time and money I would purchase a stronger vibration motor and a louder speaker. The current speaker is rated to 82 dB but does not get that loud in actual operation, I think a physically larger speaker would do the trick and get loud enough for alarm usage. Another addition to the project would be having the user choose a speaker sound. The current project plays a 500 Hz wave (a B4 note) which isn't the most pleasant sound to hear. Another choice would be to incorporate some form of a real-time clock (RTC). The RTC chip I purchased was a surface mount component which meant I could not solder the pins to incorporate it into my circuit. This meant that I had to adapt my project to not use a clock functionality to activate the alarm but rather use a method where it would track time-based on how long it had been on. This works fine to create an alarm that goes off in intervals, but it would be more convenient to have it work based on the actual world time.

Assembly Instructions

1. Place the speaker holder (Figure 5) in the acrylic base plate (Figure 2) and hot glue it.
2. Place the vibration motor A holder (Figure 3) on the acrylic base plate and hot glue it.
3. Place the vibration motor B holder (Figure 4) on the acrylic base plate and hot glue it.
4. Place the speaker (Figure 8) on the speaker holder and hot glue it.
5. Place vibration motor A (Figure 6) on its respective holder and hot glue it.
6. Repeat step 5 for vibration motor B (Figure 7).
7. Use double-sided tape to secure the breadboard and Arduino on the baseplate (Figure 1).
8. You will now have something that looks like Figure 1. It is ok to change the placement of the Arduino and breadboard if you wish.

Operation Instructions

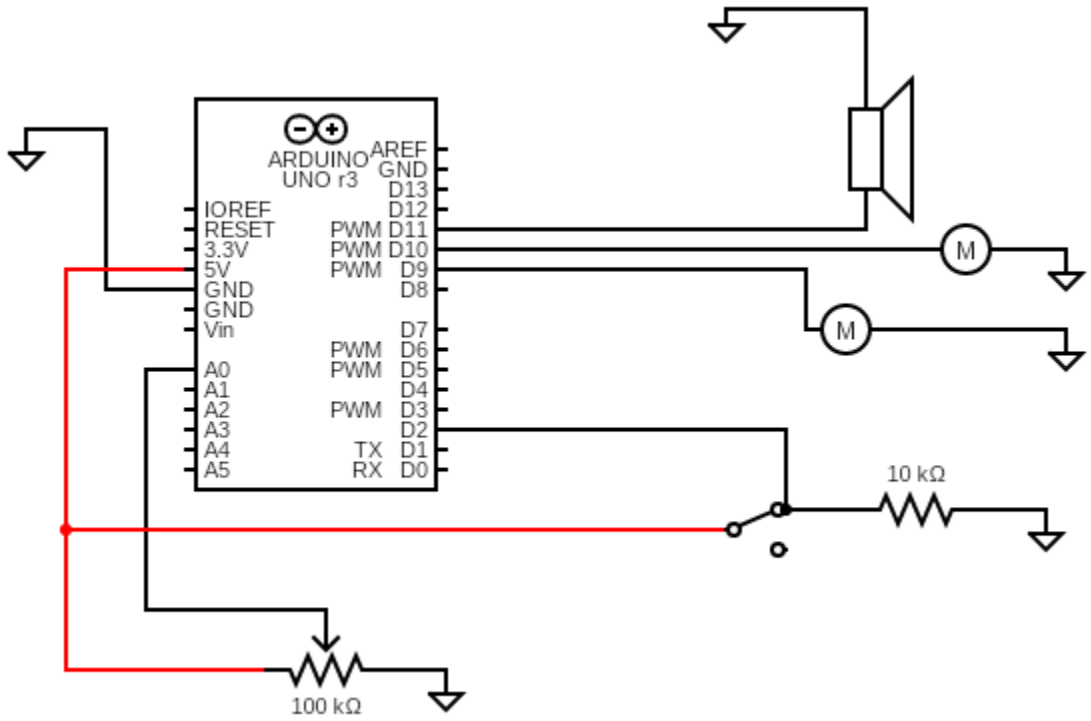
1. Connect the Arduino to power using the USB cable.
2. (Optional) Upload code to change speaker pitch if desired as well as the time interval for the alarm.

3. The alarm will activate every interval as long as the slide switch is pushed up. To turn off the alarm you must move the slide switch down while it is ringing. To reprime the alarm, you must move the slide switch back up.
4. To control the strength of the vibration motor you can adjust the potentiometer to the level you desire
5. To disconnect the alarm completely unplug the Arduino from the computer.

Appendix A: BOM

Part Name	Unit/Size	PN	Vendor/Source	Cost Per Unit	Total Cost
Ordered Parts					
RTC chip	1	MCP7940M-I/SN-ND	Digi-Key	$0.62	$0.62
Speaker	1	433-1248-ND	Digi-Key	$1.54	$1.54
Vibration Motor (2 pack) (Split with someone else)	0.5	B07Q71F4L9	Amazon	$8.99	$4.50
Smaller Vibration motor	1	1738-FIT0774-ND	Digi-Key	$0.99	$0.99
Manufactured Parts					
Acrylic (5" x 8")	5" x 8"	N/A	RPL	$0.05	$6.30
Vibration Motor A holder (PLA)	1.496 cm^3	N/A	RPL	$0.40	$0.60
Vibration Motor B holder (PLA)	0.428 cm^3	N/A	RPL	$0.40	$0.17
Speaker Holder (PLA)	4.609 cm^3	N/A	RPL	$0.40	$1.84
Scavenged Parts					
Hot Glue	1 stick	N/A	Owned	$0.10	$0.10
22 AWG Wire	3 ft	N/A	Owned	$0.30	$0.30
Double-sided tape	3 inches	N/A	Owned	$0.10	$0.10
Kit Parts					
100k Ohm Trimpot	1	2291079	Jameco	$0.97	$0.97
Mini Power Switch	1	2258831	Jameco	$0.49	$0.49
Arduino Board	1	1050-1024-ND	Digi-Key	$20.90	$20.90
Wire Kit	1	B07PQKNQ22	Amazon	$2.17	$2.17
Resistor 10k Ohm	1	10kQBK-ND	Digi-Key	$0.01	$0.01
USB A to USB B Cable	1	39918	Monoprice	$1.09	$1.09
				Cost for Purchased/Scavenged Parts	$17.06
				Total Cost	$42.69

Appendix B: Circuit Diagram



Circuit Diagram

Appendix C: CAD Files

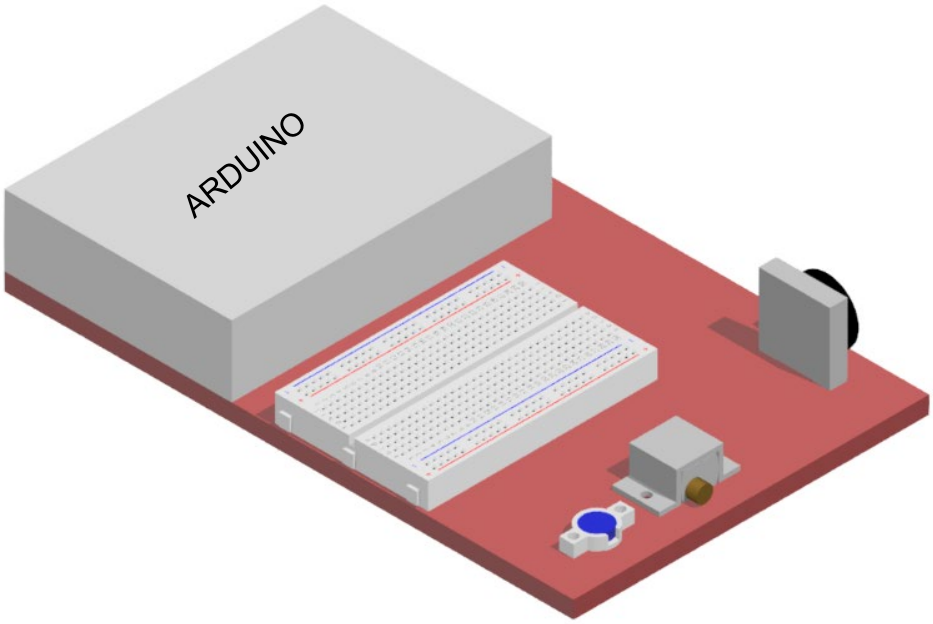


Figure 1: Full Assembly

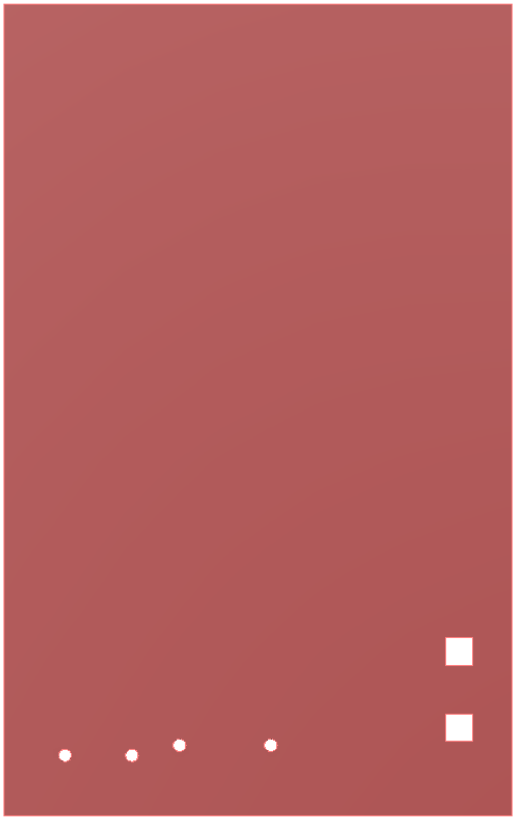


Figure 2: Acrylic Base Plate

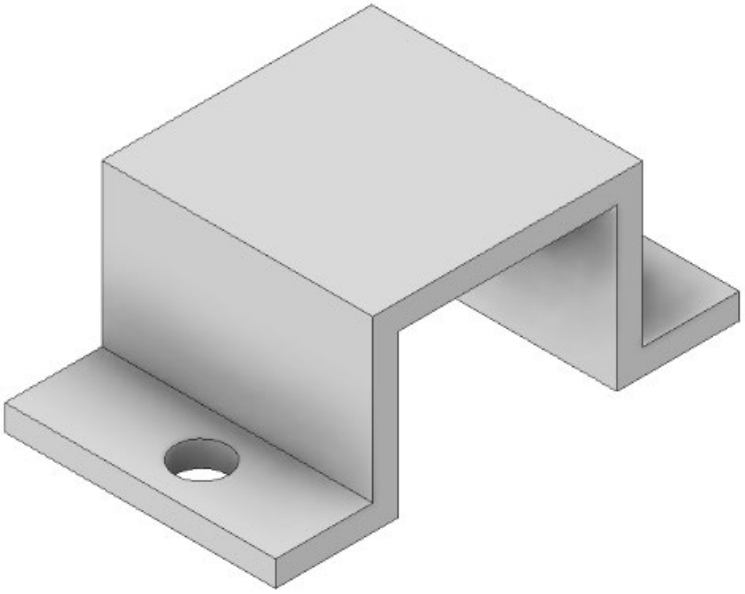


Figure 3: Vibration Motor A Holder

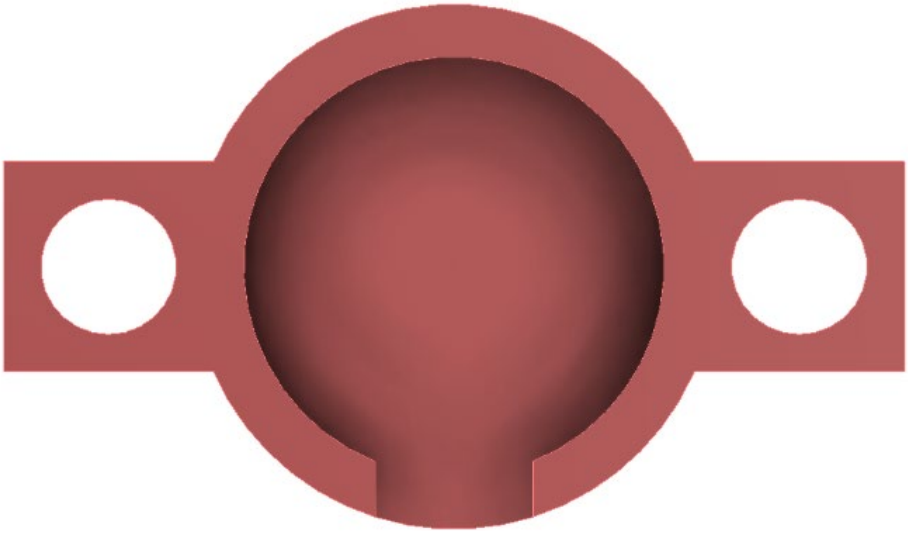


Figure 4: Vibration Motor B Holder

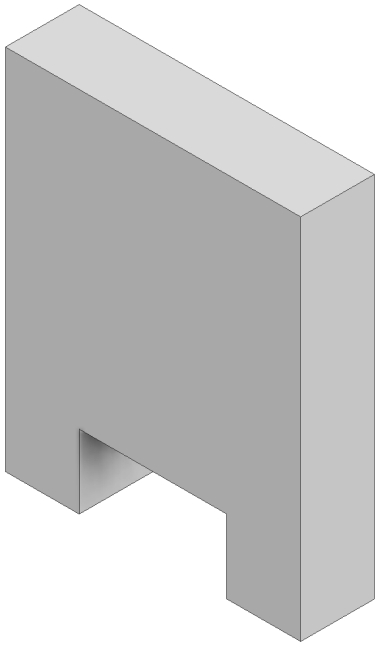


Figure 5: Speaker Holder

Figure 6: Vibration Motor A

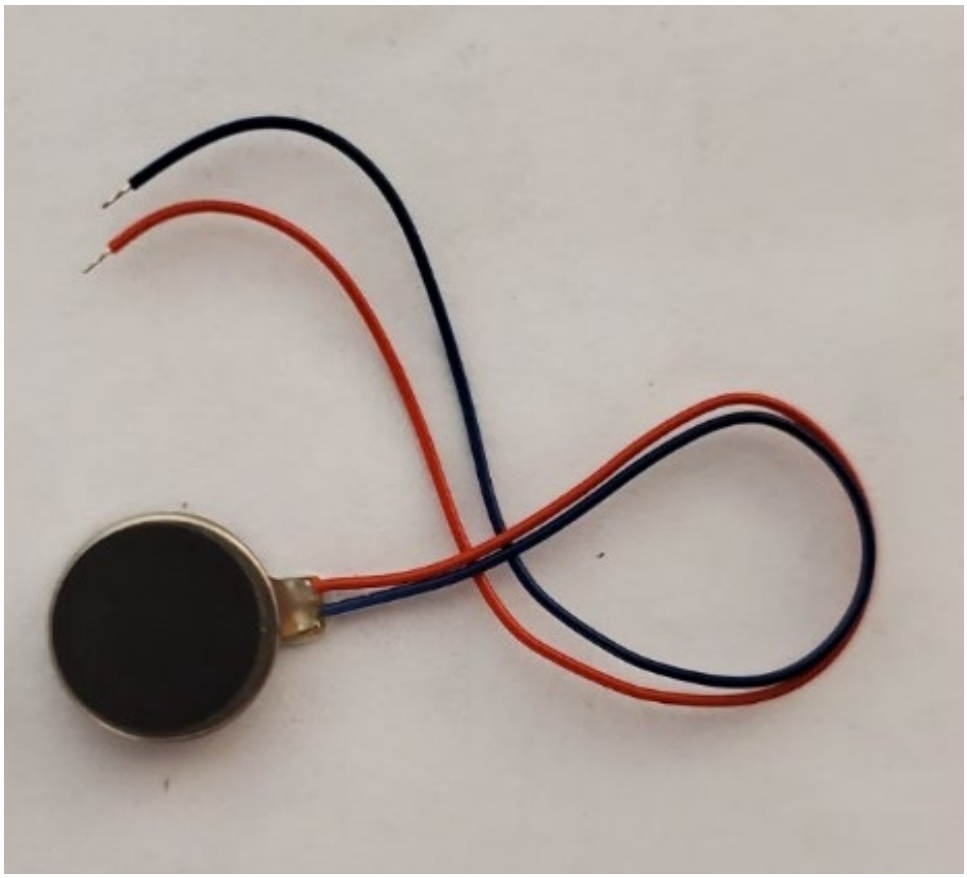


Figure 7: Vibration Motor B

Figure 8: Speaker

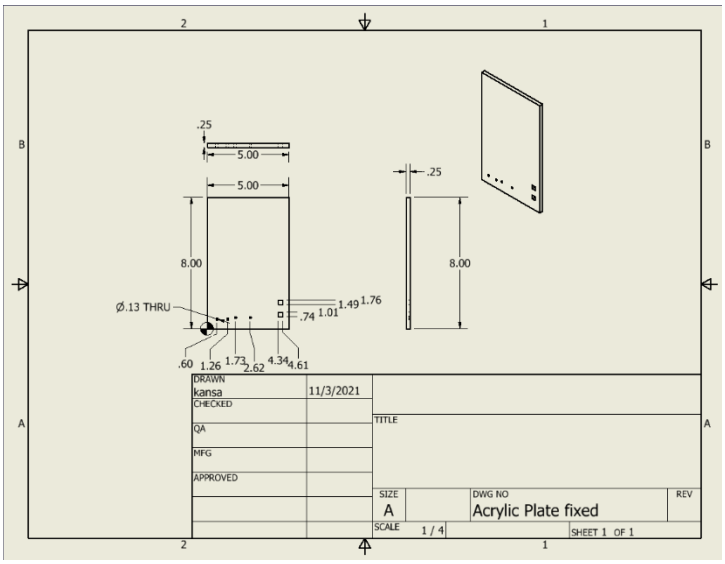


Figure 9 Acrylic Plate Drawing

Appendix D: Commented Code

```
/* DESCRIPTION: this program will cause two speakers to vibrate and a speaker
    to make noise every specified interval if the slide switch is sending a
    high signal to the input pin. To change the length of time between alarms
    change the alarmTime variable. The theory of operation is the user sets
    the alarm duration however long they want it to be, say 10 seconds.
    Then they slide the switch up. Once the switch is slid up the alarm will
    activate once the amount of time elapsed reaches 10 seconds. To turn off
    the alarm the user just needs to slide the switch back down.
 */
double pot = 0; // raw potentiometer signal
double high = 1023; // highest possible pot signal
double multiplier = 255; // analogWrite is on a scale of 0-255
double pwm = 0; // variable for writing to motor
int slidePin = 2; //input pin for the slide switch
int speakerPin = 9; //output pin for the speaker
int vibMotorAPin = 10; // output pin for motor A
int vibMotorBPin = 11; // output pin for motor B
int alarmTime = 5; //time between alarms
int alarmTimeMilli = alarmTime * 1000; //time between alarms converted to
milliseconds
void setup()
{
  pinMode(slidePin, INPUT); // input pin for slide switch
  pinMode(speakerPin, OUTPUT); //output to vibration motor A
  pinMode(vibMotorAPin, OUTPUT); // output to vibration motor B
  pinMode(vibMotorBPin, OUTPUT); // output to speaker
  Serial.begin(9600);

}
void loop()
{
 Serial.println(millis()); //keeps track of time
  if(millis() % alarmTimeMilli < 50) { //if within 50 milliseconds of the in-
terval
      while(digitalRead(slidePin) == HIGH) { //while the slide switch is "on"
        pot = analogRead(A0); //reads value from potentiometer
        pwm = (pot/high) * multiplier; //scales it for the motors
        tone(speakerPin, 500); // plays a 500 Hz tone
        analogWrite(vibMotorAPin,pwm); // vibrates motor A
        analogWrite(vibMotorBPin,pwm); // vibrates motor B
      }
    }

  else {
    noTone(speakerPin); //stops the speaker
    analogWrite(vibMotorAPin,0); //stops the motor
    analogWrite(vibMotorBPin,0); //stops the motor
  }
}
```