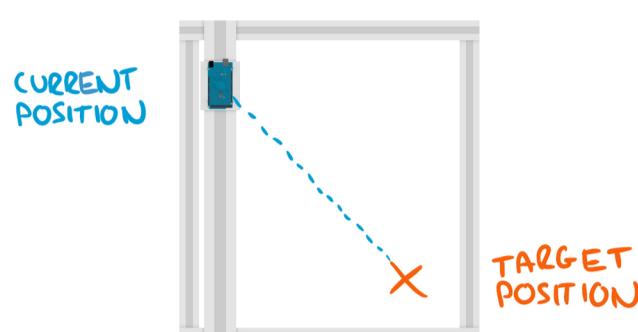


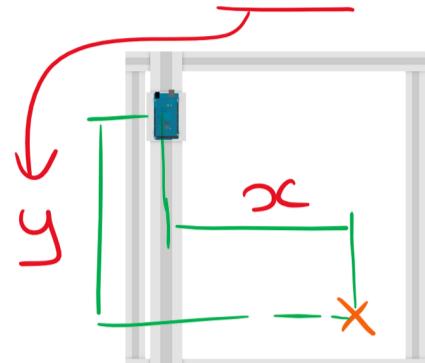
# gantry movement

## logic overview

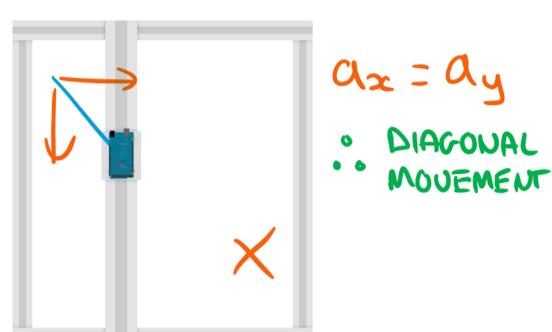
1. Input requested x, y position



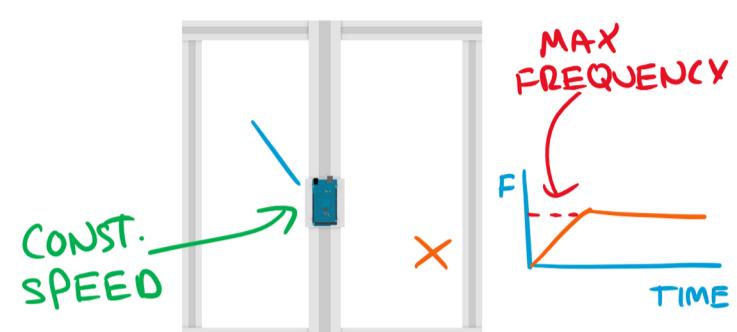
2. Determine shortest dimension



3. Accelerate both axes



4. If max speed reached, stop ramping



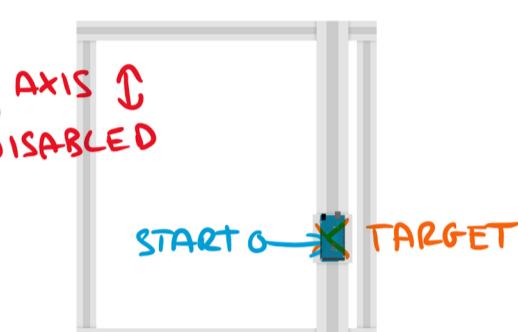
5. If halfway to target, proportionally ramp down



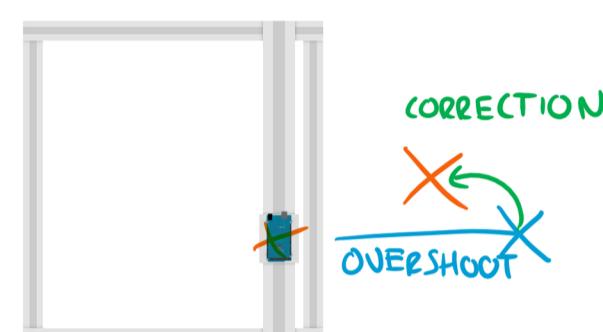
6. Stop once target is reached



7. Repeat for longer dimension



8. Make minor corrections if required



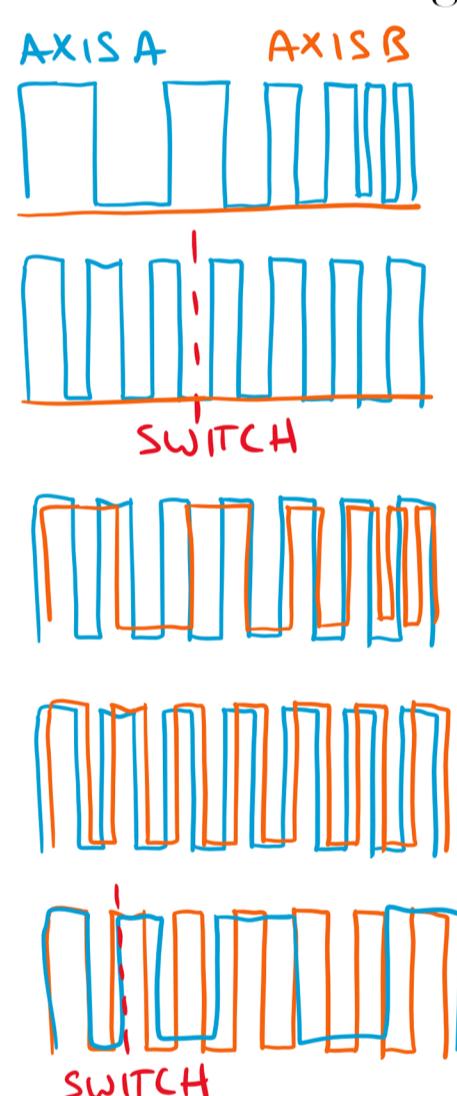
## electronics

The gantry stepper motors require a pulse train to move. This is provided by the Arduino 'playTone' function.

This function can only be used on one pin at a time... but there are two axis, so two stepper motors.

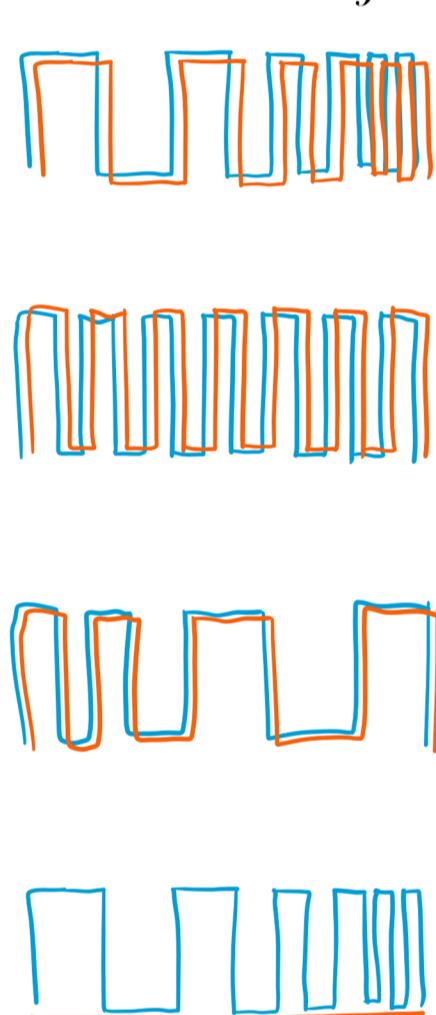
why?

### original idea



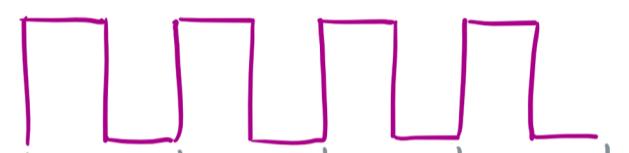
1. Stepper axis A ramps up using playTone pin.
2. When axis A is at full speed, input to motor switches to a constant pulse generator; a 555 astable oscillator circuit.
3. This allows axis B to be ramped up with playTone pin.
4. Both axis run at full speed using the 555 oscillator, until they approach their target.
5. Control switches back to playTone pin when ramping down.

### final idea

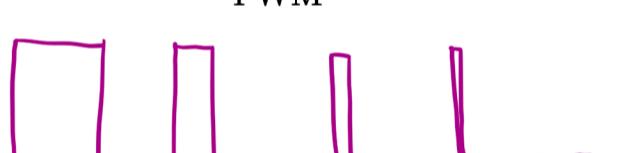


1. Both axes ramp up simultaneously using playTone pin.
2. Continue ramping until maximum speed reached, or over halfway to closest target.
3. Ramp down until shortest axis reaches its target, then disable this axis only.
4. Repeat this movement for longer axis, until it reaches its target.

### Pulse train waveform

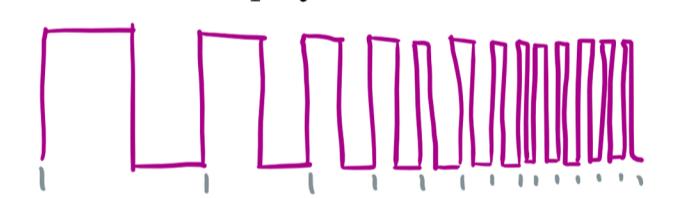


### PWM



Fixed frequency      Variable duty cycle

### playTone



Variable frequency      Fixed duty cycle

Designed to play notes from buzzers!

## positional feedback

### BACKGROUND

No. of pulses sent to stepper motors is proportional to the distance travelled.

### PROBLEM A

No built in way to count sent pulses. Estimations can be inaccurate.

### SOLUTION A

Use the Arduino to read the pulses, and keep track through software.

### PROBLEM B

No built in way to count single steps, but there is a rotary encoder library...

### SOLUTION B

Turn the single pulse train into something recognisable as a rotary encoder, and use the library.



from pulse generator circuit

Required Output

## circuit design

Toggle pin switches between inputs

(555 circuit later removed)

Input A

Ramp pin

Input B

Encoder Inputs

One axis, circuit repeated for second axis

STEPPER MOTOR

Positive Edge Trigger Generator

7400 series logic chips

## software design

```
function = goToPos([x, y])
```

```
enable both axes
```

```
while less than halfway to closest target axis
    update current position variables
    output pulses to axes
```

```
if frequency less than max frequency
    increase frequency
```

```
while more than halfway to closest target axis
    ...
    reduce frequency proportionally to distance left
```

```
%% Repeat for remaining distance on long axis only
```

```
if target surpassed
    perform minor corrections
```

ACCELERATION PHASE

DECELERATION PHASE

CORRECTION PHASE