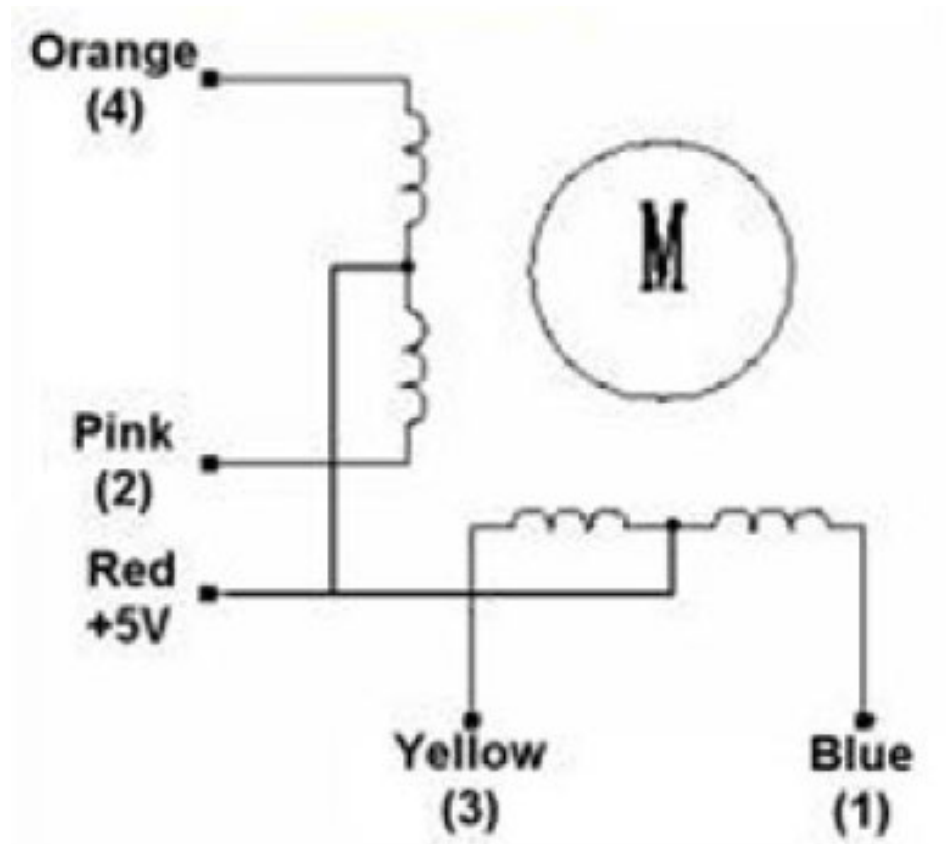




Microcontrollers & Applications

Lecture 6.2: Step Motors

Step Motor: Structure



Step Motor: Control

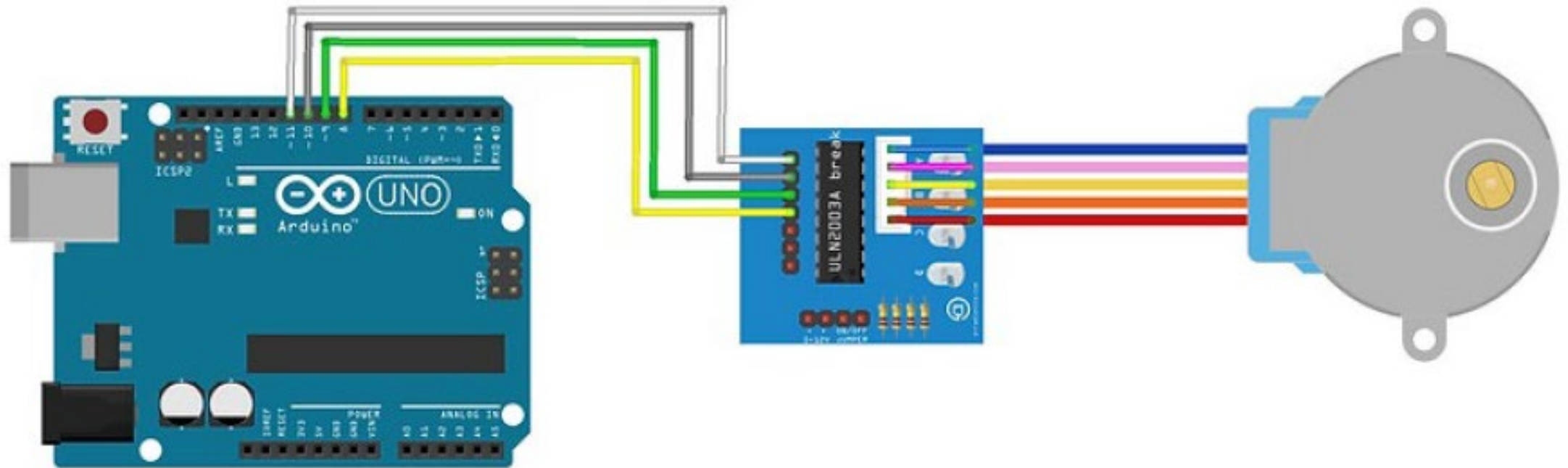
Switching Sequence

| Clockwise direction | Orange | Yellow | Pink | Blue |
|---------------------|--------|--------|------|------|
| Step 1 | + | | | |
| Step 2 | + | + | | |
| Step 3 | | + | | |
| Step 4 | | + | + | |
| Step 5 | | | + | |
| Step 6 | | | + | + |
| Step 7 | | | | + |
| Step 8 | + | | | + |

Details

- For 1 full round, it must step $(360/5.625)*8 = 64*8 = 512$ times.
 - Step degrees: 5.625 (5 point, not 5 thousand 😊)
 - It has a gear ratio of 8:1
- The switching sequence must be applied in a given order on the left table.
- To the counter clockwise rotation, the sequence must be applied in a reverse order.
- Using driver circuits is almost essential to apply higher currents in most cases.
- Step motors are used in printers, copiers, etc.

Step Motor Control: Arduino Example (1)



Step Motor Control: Arduino Example (2)

```
/*
@2024 by Yalcin Isler

This Arduino example demonstrates bidirectional
operation of a 28BYJ-48, using a ULN2003 interface board
to drive the stepper. The 28BYJ-48 motor is a 4-phase, 8-
beat motor, geared down by a factor of 68. One bipolar
winding is on motor pins 1 & 3 and the other on motor
pins 2 & 4. The step angle is 5.625 (360/64) and the
Current draw is 92mA.

*/

int MOTOR1 = 8; // Blue pin of the Step Motor

int MOTOR2 = 9; // Pink pin of the Step Motor

int MOTOR3 = 10; // Yellow pin of the Step Motor

int MOTOR4 = 11; // Orange pin of the Step Motor
                // Red pin is connected to +5V

int motorDelay = 1200; // in microseconds
int STEPS_PER_REVOLUTION = 8 * 64;
int LOOKUP[8] = {b01000, b01100, b00100, b00110,
b00010, b00011, b00001, b01001};
int count = 0; // counting the number of steps
```

Step Motor Control: Arduino Example (3)

```
void setup() {  
  pinMode(MOTOR1, OUTPUT);  
  pinMode(MOTOR2, OUTPUT);  
  pinMode(MOTOR3, OUTPUT);  
  pinMode(MOTOR4, OUTPUT);  
  Serial.begin(9600);  
}
```

```
void loop() {  
  if (count < STEPS_PER_REVOLUTION)  
    clockwise();  
  else if (count == 2*STEPS_PER_REVOLUTION)  
    count = 0;  
  else  
    anticlockwise();  
  
  count++;  
}
```

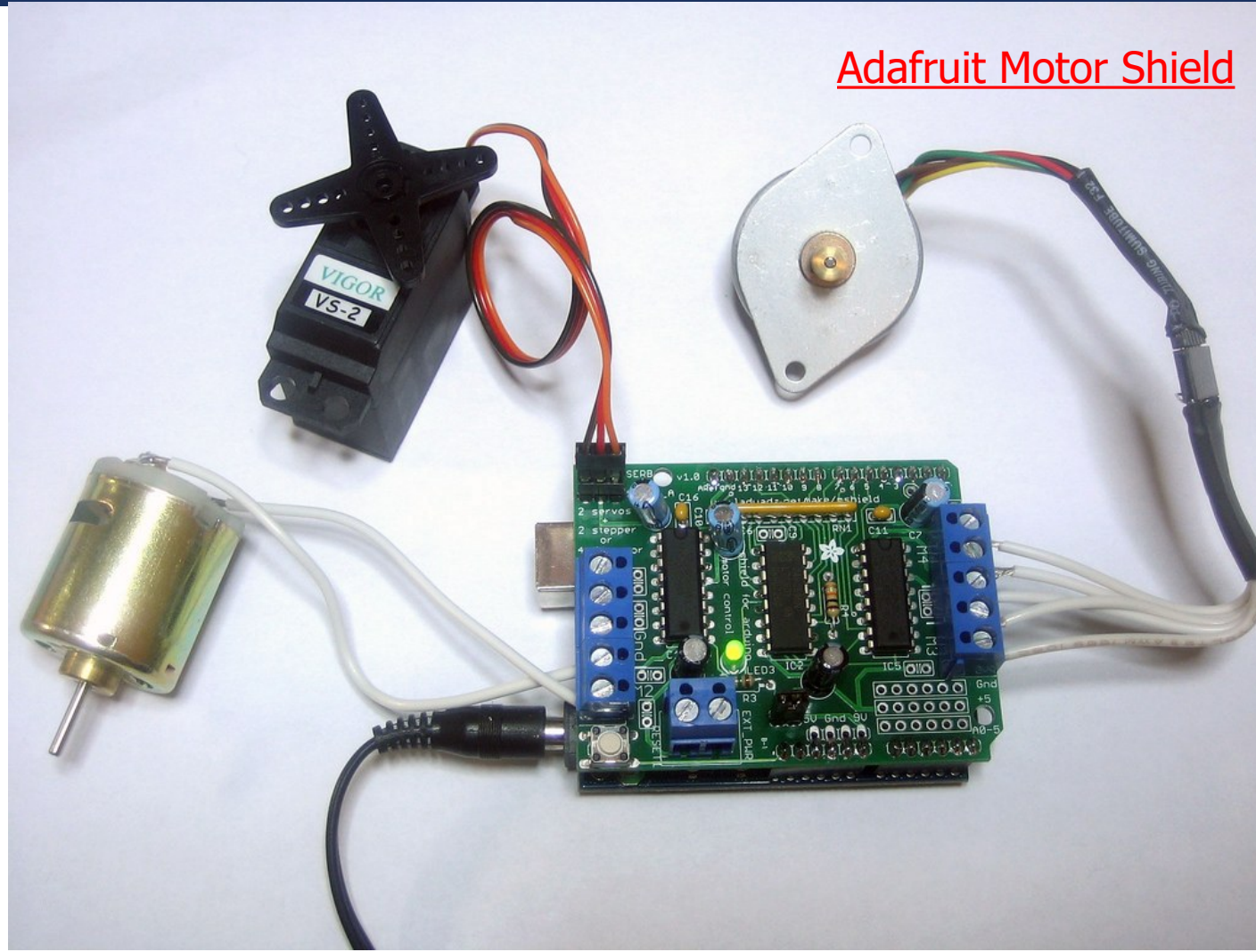
Step Motor Control: Arduino Example (4)

```
void clockwise() {  
    for (int i= 0; i<=7; i++)  
        setOutput(i);  
}
```

```
void anticlockwise() {  
    for (int i= 7; i>=0; i--)  
        setOutput(i);  
}
```

```
void setOutput(int step) {  
    digitalWrite(MOTOR1, bitRead(LOOKUP[step], 0);  
    digitalWrite(MOTOR2, bitRead(LOOKUP[step], 1);  
    digitalWrite(MOTOR3, bitRead(LOOKUP[step], 2);  
    digitalWrite(MOTOR4, bitRead(LOOKUP[step], 3);  
    delayMicroseconds(motorDelay);  
}
```

Step Motor Control: Arduino Example (5)



Step Motor Control: Arduino Example (6)

```
/*
Single: single-coil activation
Double: 2 coils are activated at once (for higher torque)
Interleave: alternates between single and double to get twice the
resolution (but half the speed)
Microstep: coils are PWM'd to create smooth motion between steps
*/
#include <AFMotor.h>
AF_Stepper motor(64, 2); // 64 steps/tour and motor is connected to
the M3&M4.

void setup() {
  Serial.begin(9600); Serial.println("Stepper test!");
  motor.setSpeed(10); // 10 rpm
  motor.step(100, FORWARD, SINGLE);

  motor.release();
  delay(1000);
}

void loop() {
  motor.step(100, FORWARD, SINGLE);
  motor.step(100, BACKWARD, SINGLE);
  motor.step(100, FORWARD, DOUBLE);
  motor.step(100, BACKWARD, DOUBLE);
  motor.step(100, FORWARD, INTERLEAVE);
  motor.step(100, BACKWARD, INTERLEAVE);
  motor.step(100, FORWARD, MICROSTEP);
  motor.step(100, BACKWARD, MICROSTEP);
}
```

Left to Students

- If there are two step motors that control X-axis and Y-axis to carry a laser tool, and there is digital active-high output to open this tool, can you draw any rectangle with given dimension using this tool and motors?



Thanks for
listening 😊

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