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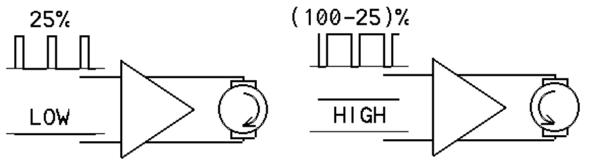
www.didel.com/robots/MotorControl.pdf

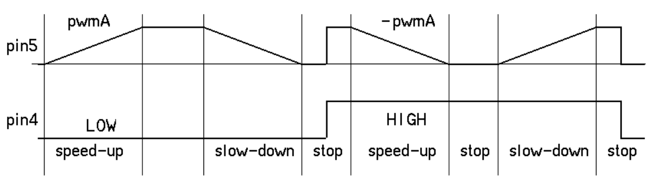
Bidirectionnal motor control with Arduino

Most Arduino motor shields and the MsMot minishield from Didel use pins 4 to 7 for controlling two motors, with PWM outputs (digitalWrite) only on pins 5 and 6. Motor's drivers inputs are connected to pins 4,5 and 6,7.

Let's have a motor or bicolor Led connected to pins 4 and 5. Pin 4 is set a LOW and pin 5 receive an 8-bit PWM value. (`analogWrite(value)`. Now if one wish to reverse the rotation, one need to put a HIGH on pin 4 and set the PWM value on pin 5 to be the complement of what we need. That is, if one need a low speed, a high "analog" value is required, so the difference with the HIGH of the other pin is small. The complement, `255-value` , must be used as shown in next picture.



25% of PWM forward and backward



Accelerate and slow down, forward and backward

You have a robot with two motors? Undersand how to control the motors with digitalWrite (on all pins) and then with analogWrite (only on pins 5 and 6). Wire you motors so that you define

```
    #define BackLeft   4
    #define ForwLeft   5
    #define ForwRight  6
    #define BackRight  7
```

Define several functions to make it move: Forward, Backward, TurnLeft, TurnRight with only one parameter. Turn left is turn on itself here. It could be turn on one wheel – test. PWM value, 0..255 must be sent on pins 5 and 6, with the good state on pins 4 and 7, depending on direction.

```
void Forward (int ss)  // 0-255
{
  analogWrite(ForwLeft, ss);
  digitalWrite(ForwLeft, LOW);
  analogWrite(ForwRight, ss);
  digitalWrite(RecD, LOW);
}
```

```
void Backward (int ss)
{
  analogWrite(ForwLeft, 255-ss);
  digitalWrite(RecG, HIGH);
  analogWrite(ForwRight,  255-ss);
  digitalWrite(RecD, HIGH);
}
```

```
void TurnRight (int ss)
{
  analogWrite(ForwLeft, ss);
  digitalWrite(RecG, LOW);
  analogWrite(ForwRight, 255-ss);
  digitalWrite(RecD, HIGH);
}
```

This is not the best way to do. There are too many functions, and one cannot make smooth turns . Lets define a single function, `Move ()`, with two parameters, the positive and negative speed for the two motors. Stop is Move (0,0), full speed backward is Move (-255,-255), etc.

`Move (left,right)` function has two parameters of type `int`, 16 bits signed. Valid values are between –255 and +255.
The function test with an `if` statement if speed is positive or negative. Positive is easy. Local variable for left speed is named `ls` .
For a negative speed, `ls` is negative, one need first to take the absolute value, `-ls` (`-ls` is positive now) and then we need to take the complement since the other side of the motor must be set at high level.
Value is hence `255-(-ls) = 255+ls`.

What happen if one writes `Move (500,-400) ;` ?
This will be accepted, but a speed higher than 255 will be replaced by its modulo 256 value. A solution could be to saturate the received values at the beginnng of the procedure.

```
 if (rs>255) rs= 255;   if (rs<-255) rs= -255;
 Same for ls.
```

```
// pwm between –255 et +255
void Move (int ls, int rs)  {
  if (ls > 0)
  {
    analogWrite(ForwLeft, ls);
    digitalWrite(RecG, LOW);
  }
  else
  {
    analogWrite(ForwLeft, 255+ls);
    digitalWrite(RecG, HIGH);
  }
  if (rs > 0)
  {
    analogWrite(ForwRight, rs);
    digitalWrite(RecD, LOW);
  }
  else
  {
    analogWrite(ForwRight, 255+rs);
    digitalWrite(RecD, HIGH);
  }
}
```

It is easy now to write a ballet for your robot.

```
      Move (200,-200) ; delay (100); // turn right for 0.1s
      Move (0,0)  ; delay (500);     // stop 0.5s
      etc.
```

The loop to accelerate, slowdown and come back is also quite simple. Add the definitions, the set-up and the function Move, and test. You can use a bicolor Led in place of a motor The speed of change depends on the delay. Here PWM is modified by one every 8 ms. Acceleration phase lasts 256 x 8 = 2048 ms, about 2 seconds.

```
int v;
void loop()
{
  for (v=0;    v<255;  v++) { Move (v,v); delay (8); }
  for (v=255; v>-255; v--) { Move (v,v); delay (8); }
  for (v=-255; v<=0;  v++) { Move (v,v); delay (8); }
  delay (2000) ;
}
```

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