ECE375 Lab 7

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Timer/Counters

- Understand the 8-bit Timer/Counters to generate Pulse-Width Modulation (PWM)
- Control the motor speed of BumpBot using PWM signal
- Read Atmega128 Datasheet
  - 73p (Alternate Functions of Port B)
  - 92p - 110p (Timer/Counter)

Read/Write 16bit Register

- Write 16 bit-register
  - out TCNT1H, r17 ; write to high byte first
  - out TCNT1L, r16 ; write to low byte second
- Read 16 bit-register
  - in r16, TCNT1L ; read from low byte first
  - in r17, TCNT1H ; read from high byte second
- 111p-120p

PWM Output

Alternate Functions of Port B

Port Pin	Alternate Functions
PB7	OC2/OC1C(1) (Output Compare and PWM Output for Timer/Counter2 or Output Compare and PWM Output C for Timer/Counter1)
PB6	OC1B (Output Compare and PWM Output B for Timer/Counter1)
PB5	OC1A (Output Compare and PWM Output A for Timer/Counter1)
PB4	OC0 (Output Compare and PWM Output for Timer/Counter0)
PB3	MISO (SPI Bus Master Input/Slave Output)
PB2	MOSI (SPI Bus Master Output/Slave Input)
PB1	SCK (SPI Bus Serial Clock)
PB0	$\overline{SS}$ (SPI Slave Select input)

Duty Cycle

- Change Duty Cycle to control speed
  - 100% duty cycle - Halt
  - 50% duty cycle - Half Speed
  - 0% duty cycle - Full Speed
- Use Output Compare Register (OCR)

Wave Generation Mode (WGM)

Mode	WGM01[1] (CTC0)	WGM00[1] (PWM0)	Timer/Counter Mode of Operation	TOP	Update of OCR0 at	TOV0 Flag Set on
0	0	0	Normal	0xFF	Immediate	MAX
1	0	1	PWM, Phase Correct	0xFF	TOP	BOTTOM
2	1	0	CTC	OCR0	Immediate	MAX
3	1	1	Fast PWM	0xFF	BOTTOM	MAX

Compare Output Mode (COM)

Table 54. Compare Output Mode, Fast PWM Mode[1]

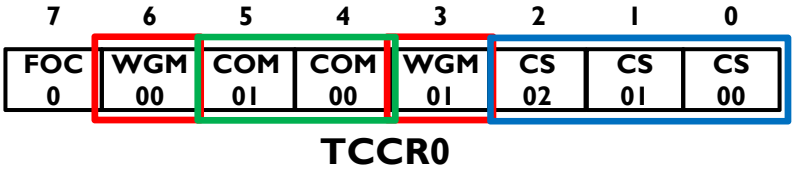
COM01	COM00	Description
0	0	Normal port operation, OC0 disconnected.
0	1	Reserved
1	0	Clear OC0 on compare match, set OC0 at BOTTOM, (non-inverting mode)
1	1	Set OC0 on compare match, clear OC0 at BOTTOM, (inverting mode)

Clock Selection (CS)

Table 56. Clock Select Bit Description

CS02	CS01	CS00	Description
0	0	0	No clock source (Timer/Counter stopped)
0	0	1	clk_{T0S}/(No prescaling)
0	1	0	clk_{T0S}/8 (From prescaler)
0	1	1	clk_{T0S}/32 (From prescaler)
1	0	0	clk_{T0S}/64 (From prescaler)
1	0	1	clk_{T0S}/128 (From prescaler)
1	1	0	clk_{T0S}/256 (From prescaler)
1	1	1	clk_{T0S}/1024 (From prescaler)

Timer/Counter Control Register



TCCR0

Wave Generation Mode (WGM)

Compare Output Mode (COM)

Clock Selection (CS)

Demo Check

- 16 speed levels
- PORTB 0-3 indicate current speed level
- PORTB 4,7 brightness change
- 4 Functions for Control Speed
  - SPEED_DOWN
  - SPEED_UP
  - SPEED_MIN
  - SPEED_MAX
- Speed levels bound max and min
- Single button press results single action

Checklists for Lab 7

- Demo Checklist
  - All four speed changes work correctly
  - Smooth transitions (1 press, 1 change)
  - No Speed Level overflow or underflow
  - MovFwd signals never overwritten
  - Motor enable signals correctly active low
  - Actually using PWM, no manual toggling
- Challenge Checklist
  - Time updates every 1 sec, no leading 0s
  - Buttons still work and reset count on LCD

Questions?