임베디드 MCU 프로그래밍

초음파 센서 / Buzzer / 3색 LED 구동 / CCU61 Timer

Architecture and Compiler for Embedded System LAB.
School of Electronics Engineering, KNU, KOREA

ACE Lab.

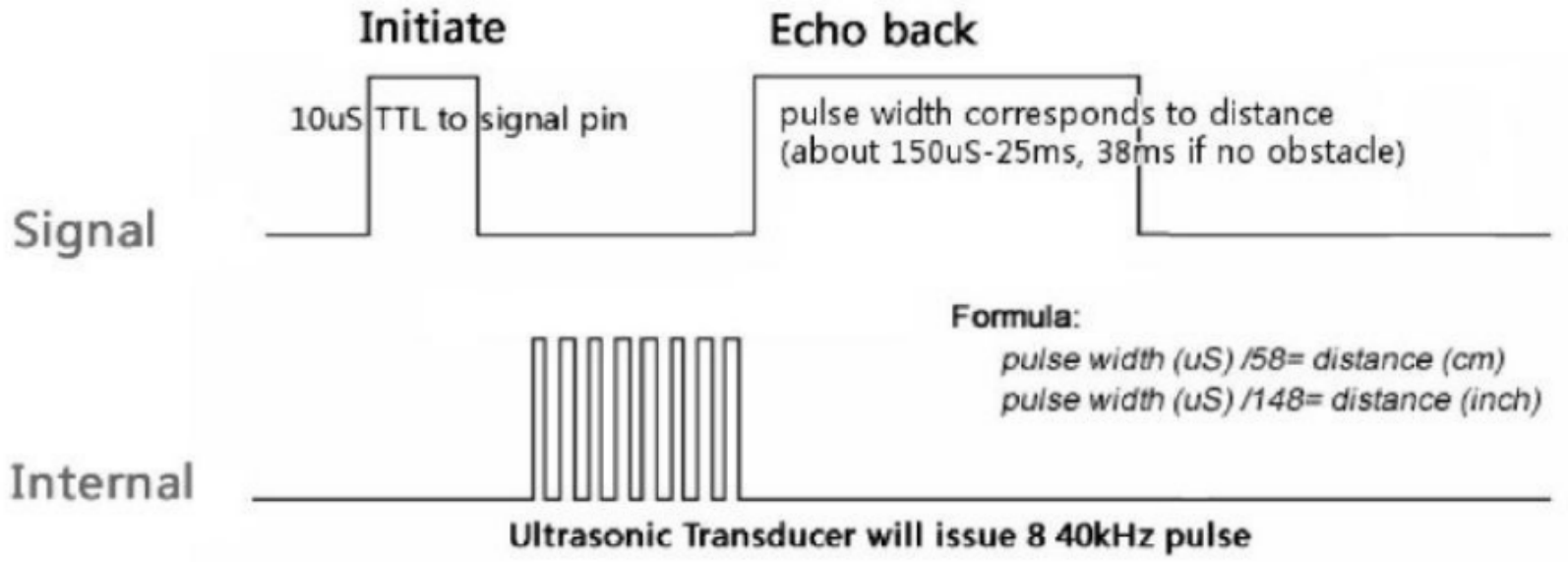
초음파 센서 모듈

VCC = +5VDC
Trig = Trigger input of Sensor
Echo = Echo output of Sensor
GND = GND

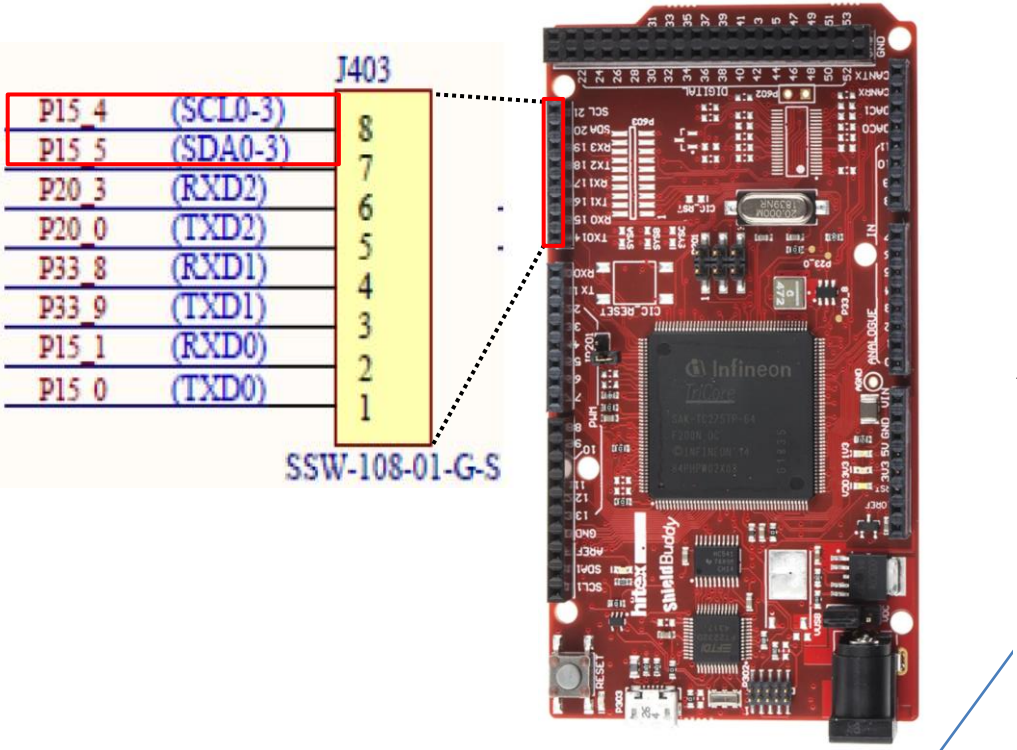
초음파 센서 모듈

Time = Width of Echo pulse, in uS (micro second)

- Distance in centimeters = Time / 58
- Distance in inches = Time / 148
- Or you can utilize the speed of sound, which is 340m/s



Hitex ShieldBuddy TC275



External Interrupt

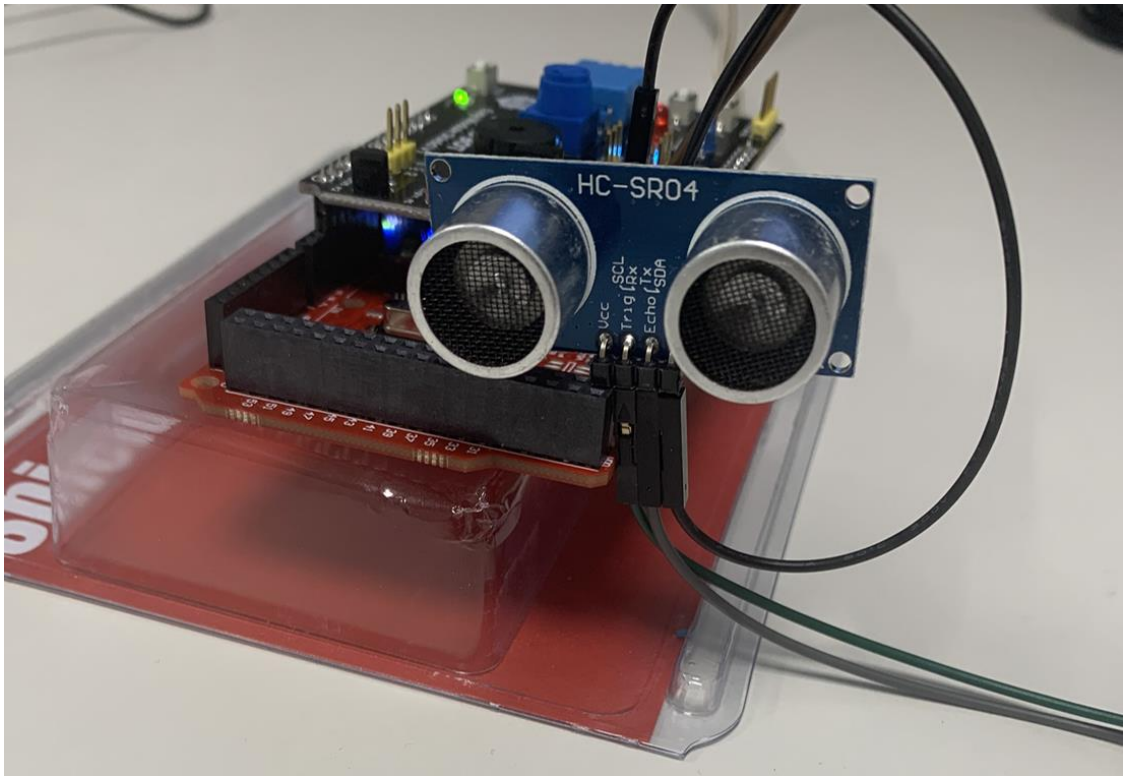
Pin	Symbol	Ctrl	Type	Function
138	P15.5	I	MP / PU1 / VEXT	General-purpose input
	TIN76			GTM input
	ARX1B			ASCLIN1 input
	MTSR2A			QSPI2 input
	REQ13			SCU input
	SDA0C			I2C0 input
	P15.5	O0		General-purpose output
	TOUT76	O1		GTM output
	ATX1	O2		ASCLIN1 output
	MTSR2	O3		QSPI2 output
	END02	O4		MSC0 output
	EN00	O5		MSC0 output
	SDA0	O6		I2C0 output
	CC61	O7		CCU60 output
137	P15.4	I	MP / PU1 / VEXT	General-purpose input
	TIN75			GTM input
	MRST2A			QSPI2 input
	REQ0			SCU input
	SCL0C			I2C0 input
	P15.4	O0		General-purpose output
	TOUT75	O1		GTM output
	ATX1	O2		ASCLIN1 output
	MRST2	O3		QSPI2 output
	–	O4		Reserved
	–	O5		Reserved
	SCL0	O6		I2C0 output
	CC62	O7		CCU60 output

Ultrasonic

VDD(5V)

Trig	P15_4
Echo	P15_5
GND	GND

거리(cm) printf로 출력



초음파 센서 모듈

1. 프로그래밍

    ① Trigger 출력.

    ② Timer Start.

    ③ External interrupt falling Edge Detection Interrupt → CNT Read

    ④ External interrupt rising Edge Detection Interrupt → CNT Read

    ⑤ CNT 차이를 이용하여 거리 계산

    ⑥ External Interrupt가 Timer Max나 정해진 시간까지 발생하지 않을 시 초음파 센서 초기 모드로 전환.

2. Github에 Rerence Source code 제공 예정

Buzzer 구동

모듈	TC275 Shield Buddy Pin	TC275 Pin	TC275 관련기능
Buzzer	D5	P02_3	PWM

D2	P02.3	I	LP / PU1 / VEXT	General-purpose input
	TIN3			GTM input
	ARX1G			ASCLIN1 input
	RXDCAN2B			CAN node 2 input
	RXDB2			ERAY input
	PSIRX0B			PSI5 input
	DSCIN5B			DSADC channel 5 input B
	SDI11			MSC1 input
	CIFD3			CIF input
	P02.3	O0		General-purpose output
	TOUT3	O1		GTM output
	ASLSO2	O2		ASCLIN2 output
	SLSO34	O3		QSPI3 output
	DSCOUT5	O4		DSADC channel 5 output
	–	O5		Reserved
	–	O6		Reserved
	COUT61	O7		CCU60 output

TOM0 – Channel 11

Port	Input	Output	Input Timer Mapped		Output Timer Mapped			
			A	B	A	B	C	D
P02.2	TIN2	TOUT2	TIM0_2	TIM1_2	TOM0_10	TOM1_10	ATOM 0_2	ATOM 1_2
P02.3	TIN3	TOUT3	TIM0_3	TIM1_3	TOM0_11	TOM1_11	ATOM 0_3	ATOM 1_3

```
// Buzzer ON
 GTM_CMU_CLK_EN |= ((0x2) << EN_FXCLK);

// Buzzer Off
 GTM_CMU_CLK_EN &= ~((0x2) << EN_FXCLK); // disable
```

github에 Reference code 제공예정

	옥타브(Octaves)							
	1	2	3	4	5	6	7	8
C(도)	32.7	65.4	130.8	261.6	523.2	1046.5	2093.0	4186.0
C#	34.6	69.3	138.6	277.2	554.4	1108.7	2217.5	4434.9
D(레)	36.7	73.4	146.8	293.7	587.3	1174.7	2349.3	4698.6
D#	38.9	77.8	155.6	311.1	622.2	1244.5	2489.0	4978.0
E(미)	41.2	82.4	164.8	329.6	659.3	1318.5	2637.0	5274.0
F(파)	43.7	87.3	174.6	349.2	698.5	1396.9	2793.8	5587.7
F#	46.2	92.5	185.0	370.0	740.0	1480.0	2960.0	5919.9
G(솔)	49.0	98.0	196.0	392.0	783.9	1568.0	3136.0	6271.9
G#	51.9	103.8	207.7	415.3	830.6	1661.2	3322.4	6644.9
A(라)	55.0	110.0	220.0	440.0	880.0	1760.0	3520.0	7040.0
A#	58.3	116.5	233.1	466.1	932.3	1864.7	3729.3	7458.6
B(시)	61.7	123.5	246.9	493.9	987.8	1975.5	3951.0	7902.1

RGB - PWM

모듈		TC275 Shield Buddy Pin	TC275 Pin	TC275 관련기능
RGB LED	Red	D9	P02_7	GPIO, PWM
	Green	D10	P10_5	GPIO, PWM
	Blue	D11	P10_3	GPIO, PWM

Pin	Symbol	Ctrl	Type	Function
F2	P02.7	I	MP / PU1 / VEXT	General-purpose input
	TIN7			GTM input
	SCLK3A			QSPI3 input
	PSIRX2B			PSI5 input
	SENT1C			SENT input
	CC61INC			CCU60 input
	CCPOS1A			CCU60 input
	T13HRB			CCU61 input
	T3EUDA			GPT120 input
	CIFD7			CIF input
	DSCIN3B			DSADC channel 3 input B
	DSITR4E			DSADC channel 4 input E
	P02.7	O0		General-purpose output
	TOUT7	O1		GTM output
	–	O2		Reserved
	SCLK3	O3		QSPI3 output
	DSCOUT3	O4		DSADC channel 3 output
	VADCEMUX01	O5		VADC output
	SPC1	O6		SENT output
	CC61	O7		CCU60 output

Pin	Symbol	Ctrl	Type	Function
A6	P10.3	I	MP / PU1 / VEXT	General-purpose input
	TIN105			GTM input
	MTSR1A			QSPI1 input
	REQ3			SCU input
	T5INB			GPT120 input
	P10.3	O0		General-purpose output
	TOUT105	O1		GTM output
	VADCG6BFL3	O2		VADC output
	MTSR1	O3		QSPI1 output
	EN00	O4		MSC0 output
	END02	O5		MSC0 output
	TXDCAN2	O6		CAN node 2 output
	–	O7		Reserved
B5	P10.5	I	LP / PU1 / VEXT	General-purpose input
	TIN107			GTM input
	HWCFG4			SCU input
	INJ01			MSC0 input
	P10.5	O0		General-purpose output
	TOUT107	O1		GTM output
	ATX2	O2		ASCLIN2 output
	SLSO38	O3		QSPI3 output
	SLSO19	O4		QSPI1 output
	T6OUT	O5		GPT120 output
	ASLSO2	O6		ASCLIN2 output
	-	O7		Reserved

RGB - PWM

Port	Input	Output	Input Timer Mapped		Output Timer Mapped			
			A	B	A	B	C	D
P02.7	TIN7	TOUT7	TIM0_7	TIM1_7	TOM0_15	TOM1_15	ATOM 0_7	ATOM 1_7
P02.8	TIN8	TOUT8	TIM2_0	TIM3_0	TOM0_8	TOM1_0	ATOM 0_0	ATOM 1_0
P10.0	TIN102	TOUT102	TIM0_4	TIM1_4	TOM0_4	TOM2_12	ATOM 1_4	ATOM 4_4
P10.1	TIN103	TOUT103	TIM0_1	TIM1_1	TOM0_1	TOM2_9	ATOM 1_1	ATOM 4_1
P10.2	TIN104	TOUT104	TIM0_2	TIM1_2	TOM0_2	TOM2_10	ATOM 1_2	ATOM 4_2
P10.3	TIN105	TOUT105	TIM0_3	TIM1_3	TOM0_3	TOM2_11	ATOM 1_3	ATOM 4_3
P10.4	TIN106	TOUT106	TIM0_6	TIM1_6	TOM0_6	TOM2_6	ATOM 0_6	ATOM 4_6
P10.5	TIN107	TOUT107	TIM0_2	TIM1_2	TOM0_2	TOM2_10	ATOM 1_2	ATOM 4_2

Red

Blue

Green

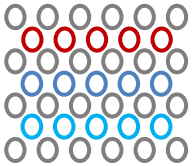
github에 Reference code 제공예정

Timer – CCU61 추가

1. CCU60 / CCU61의 T12를 사용하여 각각 Timer Interrupt 발생
2. Github에 Rerence Source code 제공 예정

Q & A

Thank you for your attention



Architecture and
Compiler
for Embedded Systems Lab.

School of Electronics Engineering, KNU

ACE Lab (hn02301@gmail.com)