Abstract

There is so many blind persons that use a blind stick to help their dally walking or life. But the blind stick will be hit some person when the blind stick waggling. So there is need to develop new walking stick that the stick can be detected the obstacle stealthy. So the bat are the very best object to learn at to stealthy detected the obstacle. From observe the bat, we have a conclusion that use a ultrasound for the detected the obstacle is a good way to do and the new walking stick is use ultrasound theory of the bat perform by the microproccer and the electronic component. This walking stick can be help the blind persons or the person hit by the old waggling blind stick.

Aims

This Electronic Walking Stick for the Blind is use to help the blind person to detect obstacle and depressions in front of him. After detect an object in front of the blind person the Electronic Walking Stick will be sound a the tone of warning signal and warning signal will change gradually when the blind person get closer to the obstacle. Also if too close to the object it will generate a vibration signal with the vibrator.

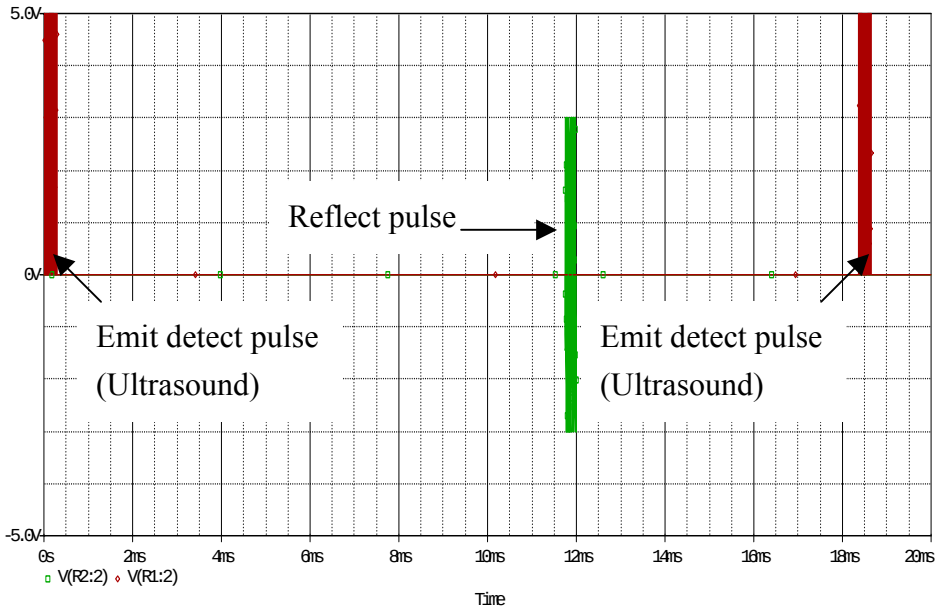
Scope

In our project, we will focus on the ultrasound propagation technique, sound speed. And follow are the basic theory the ultrasound propagation technique sound speed in the free air

Pulse-echo technique.

This technique is a means of underwater Echolocation developed by the military for locating submarines. Brief pulses of ultrasound, ranging from 21kHz to 50 kHz, are emitted in narrow, intense beams. The pulses hit to hard surface it makes the echoes of these pulses, returning at different time intervals depending on the Speed of Sound in the medium. Form the timing from travel time between measurements to surface can be converted the distance between each other.

Here are the times schedule of the pulse-echo technique detect method. [5]



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The speed of the ultrasound in the air

In 1816, the mathematician Laplace proposed that the speed of a longitudinal wave in a gas is given by

$$v = \sqrt{\frac{B}{\rho}} = \sqrt{\frac{\gamma P}{\rho}}$$

Where p is the pressure of the gas, ***p*** the density , and γ is a dimensionless constant(the ratio of the specific heats of the gas: this is covered in the unit Thermal properties)

In the Atmospheric pressure, γ =1.4, P = 0.76x13600x9.8 Pa, ***p*** =1.24, so that v is $v = \sqrt{\frac{1.4 \times 0.76 \times 13600 \times 9.8}{1.29}}$ [6]

$v = 332\ ms^{-1}$, it means that the ultrasonic will traffic in the air is 332m per second. [7]

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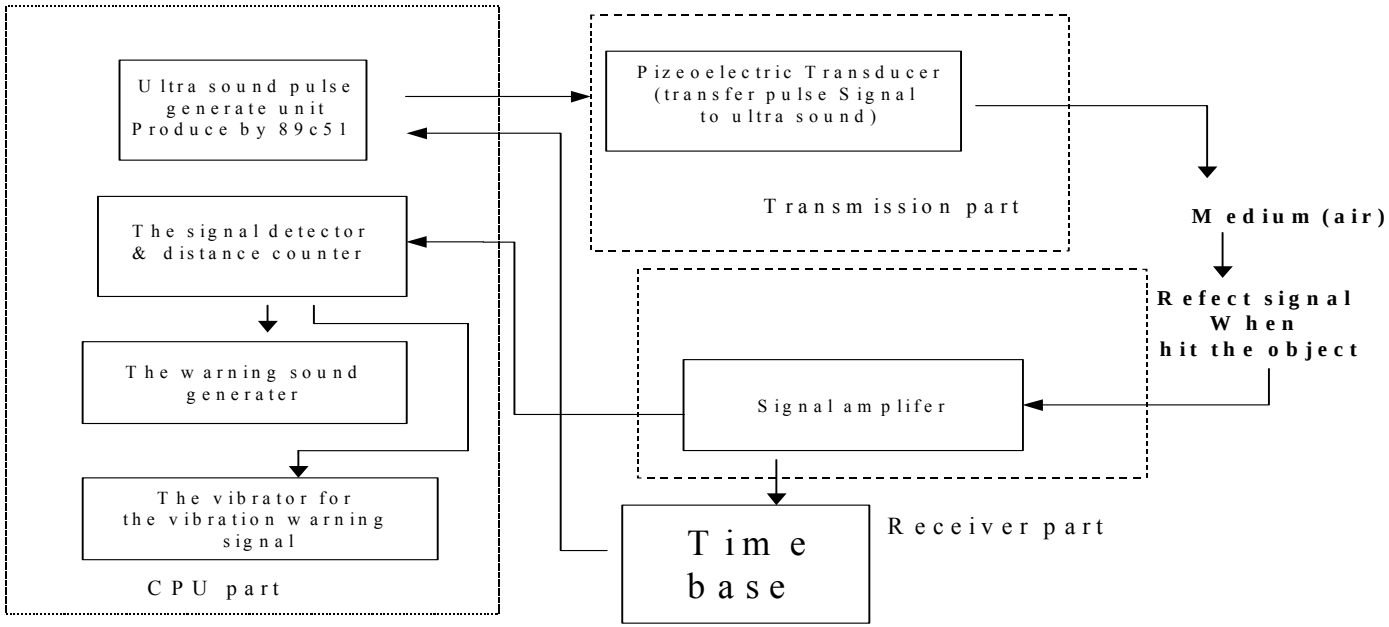
Specification

Supply voltage: 12v(supply by high voltage battery VA23GA)
Transmit & receiver frequency: 40kHz
Detect method: pulse –echo technique
Sampling rate: 1 time/second
Detect range: 10 feet
Accuracy: +/- 1 feet

[8]Detect angle: 45°

Design

Block/ system level diagram for hardware



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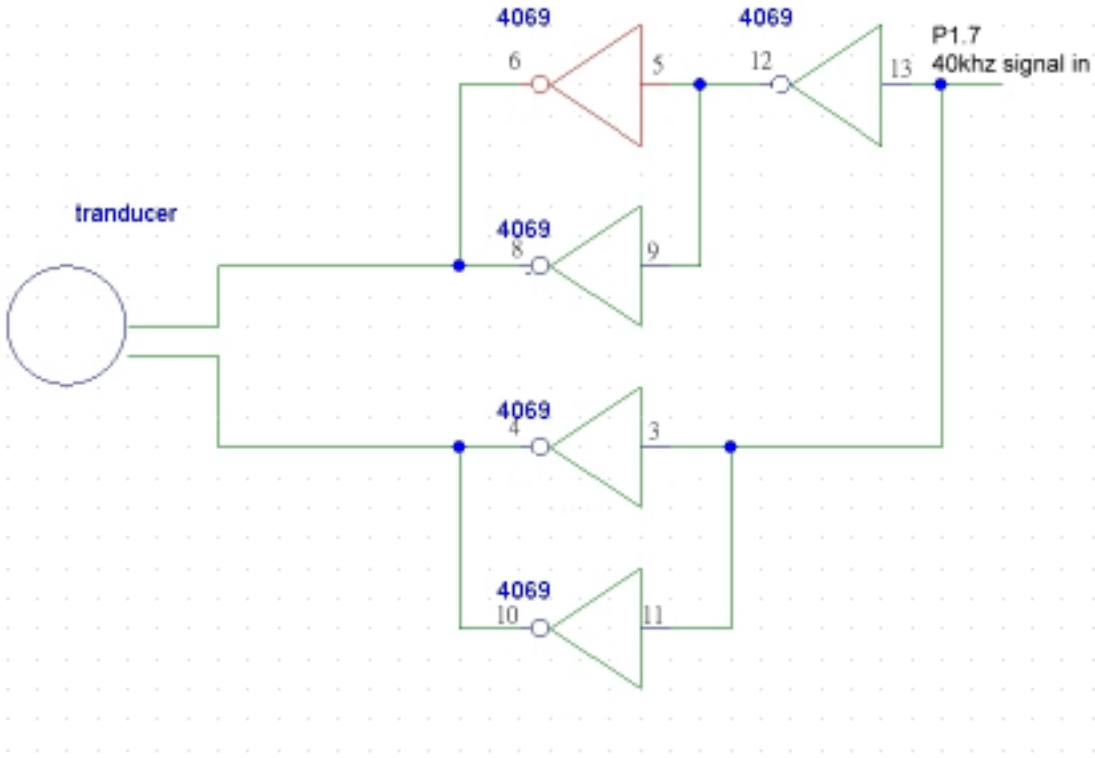
-Circuit diagram

The hardware part will be break down to three parts to discuss
The first part is transmission part, the 40khz ultrasound that generate by the microproccer, that though the 4069 and the sin wave that will transmit the ultrasonic though by the transducer, 4069 that is a hex inverter buffer to use to buffering and shaping the pulse more like than the sin wave. The circuit will be show as follow



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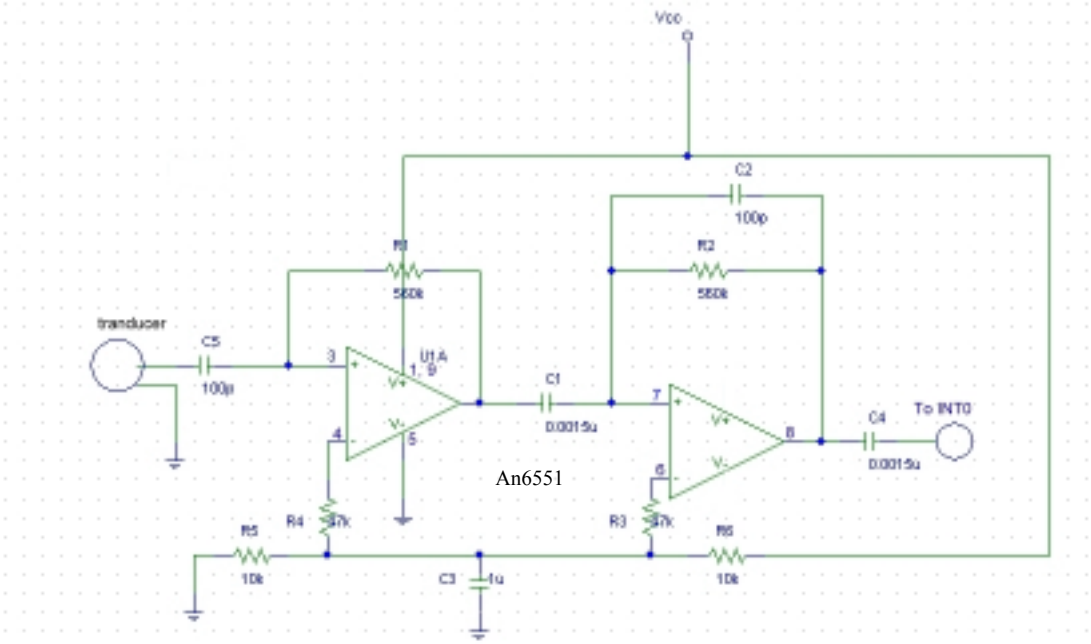
As follow is the receiver part circuit:



The first stage of the amplifier gain 10,and the second stage amplifier gain 13 times total gain is gain 10 *13 = 130, about 40db gain and output to the microproccer.
The first stage of the amplifier is the high pass filter the 100p cap. Is use to filtering the noise under the 40khz signal, the resistor of the cap. is xc = 1/ 2 π f* c

For example at 37khz or below xc = 1/2 π 37k * 100p = 43k or bigger, the resistor is good enough to limit the current to flow to amplifier. The second stage amplifier will call by VCVS- voltage controlled voltage source amplifier. This is one of the types of the butterworth filter. And RC factor can defined by follow equation c = 1/ √ 2 π fo R, as r = 560k,freq(fo) = 40khz, c = 11/ √ 2 π *40khz *560k = 100p. As upper result, second stage is a bandpass filter that selected 40khz signal.
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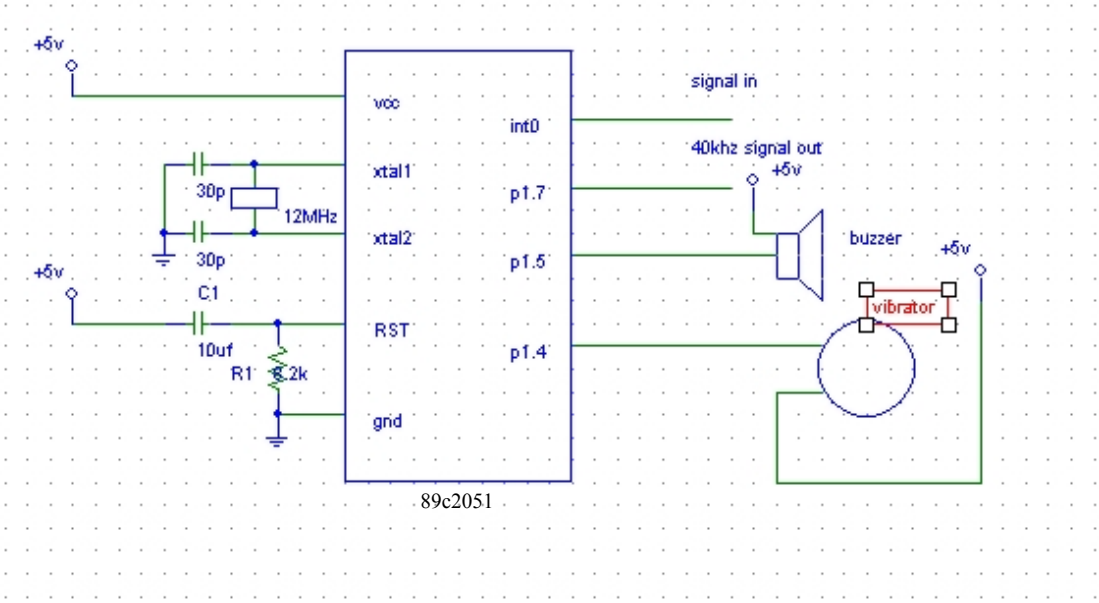
[1]0

Here are third parts of the hardware, the CPU part:



The CPU P1.7 generate a 3ms width 40khz pulse signal to the transmission part, after that the INT0 wait to receive a signal from the receiver part. Whatever the receiver part have a signal or not, that the CPU will generate a sound about every signal second to indicate the CPU is running properly. If a reflect signal was pick up at the receiver part, the burst sound will be generate. If the reflect signal is very close, a signal will send to P1.4 to control the vibrator to vibrate.
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[1]1

-Part list

Type	Part number	Amount
Resistor	8.2k	1
	560k	2
	47k	2
	10k	2
Capacitor	10uf	1
	30pf	2
	1uf	1
	0.0015u	2
	100p	2
IC	7805	1
	7809	1
	89c2051	1
	4069	1
	An6551	1
Crystal oscillator	12MHz	1
Buzzer	5V	1
Vibrator	5V	1
Ultrasound transducer	400ST160	1
	400SR160	1

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Software

-Program listing

```
1     $MOD51
2               ORG     00H
3               AJMP    START
4               ORG     03H
5               AJMP    EX0ISR
6               ORG     100H
7     START:    MOV     SP,#60H
8               MOV     IE,#00H
9               MOV     R5,#0
10               MOV     R6,#0
11               MOV     R1,#6
12               SETB    P1.5
13
14     LOOP:     SETB    P1.7    ;1us
15               MOV     R2,#05  ;1us
16               DJNZ    R2,$    ;2us on (5*2+1=11us)
17               CLR     P1.7    ;1us
18               MOV     R2,#5   ;1us
19               DJNZ    R2,$    ;2us off(5*2+1=11us)
20               DJNZ    R1,LOOP ;25us 1peroid *5 =0.3ms
21
22               MOV     R1,#12  ;TIME DELAY FOR THE DETECT SIGNAL PERIOD
23     DLOOP:    MOV     R2,#06  ;1us
24               DJNZ    R2,$    ;2us on (5*2+1=11us)
25               MOV     R2,#6   ;1us
26               DJNZ    R2,$    ;2us off(5*2+1=11us)
27               DJNZ    R1,DLOOP;26us 1peroid *5 =0.6ms
28
29               MOV     IE,#81H ;SETUP TO DETECT THE SIGNAL
30               SETB    IT0
31
```

```
32    CHECK:  MOV     R7,#11          ;LIMIT = 10 FEET +/- 1 FEET[13]
33    CH1:    DJNZ    R7,AD01         ;CALL DELAY FOR THE 1 FEET TIME
34            JMP     BACK
35    AD01:   ACALL   DELAY01
36            JMP     CH1
37
38    BACK:   MOV     IE,#00H         ;AFTER THE CHECKING, RESET FOR
THE INT
39            ACALL   SOUND           ;SOUND GEN PROGRAM
40            AJMP    START
41
42    EX0ISR: MOV     R6,#01          ;extIt0 program IT0 USE TO RECEIVE
THE SIGNAL
43            MOV     A,R5
44            JZ      RTN1
45    ECH1:   DJNZ    ACC,ERL1        ;SOUND GEN PROGRAM, EACH TIME =
0.1 * FEETS
46            AJMP    RTN1
47    ERL1:   CLR     p1.5
48            ACALL   SDELAY
49            SETB    p1.5
50            ACALL   SDELAY
51            AJMP    ECH1
52    RTN1:   RETI
53
54    DELAY01:CJNE    R6,#1,CHECK1    ;DELAY 1 FEET PROGRAM
55            AJMP    BACK
56    CHECK1: MOV     R1,#4 ;1us
57    LOOP1:  MOV     R2,#227 ;1us
58            DJNZ    R2,$    ;2us (229 * 2 +1 = 459us)
59            DJNZ    R1,LOOP1;2us (459 * 2 * 2 = 1836us)
60            INC     R5
61            RET
62
63    SOUND:  CLR     P1.5    ;SOUND PROGRAM FOR GEN THE SYSTEM NORMAL
SOUND
64            MOV     A,R5
```

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```
65              JZ      SS4
66      SS1:    DJNZ    ACC,SCH1
67              JMP     SS2
68      SCH1:   ACALL   SDELAY
69              AJMP    SS1
70      SS2:    SETB    P1.5
71              MOV     A,R5
72      SS3:    DJNZ    ACC,SCH2
73              JMP     SS4
74      SCH2:   ACALL   SDELAY
75              AJMP    SS3
76      SS4:    SETB    P1.5
77              RET
78
79      SDELAY: MOV     R1,#200 ;1US    ;0.1S DELAY PROGRAM
80      SLOOP1: MOV     R2,#250 ;1US
81              DJNZ    R2,$    ;2US    (250* 2 + 1 = 251uS)
82              DJNZ    R1,SLOOP1;2US   (251* 4 *2 = 2ms)
83              RET
84              END
```

.1-12 are the initial part of the program,
5. the external int pointer has been set.
6. the main program set to 100H prevent the data area in microproccer
7. the stick point set to safety data area
8.disable all the int
9-11 are use to initial the meter counter(feet)(R5)and the receive signal flag ,(R6) is use to like a flag. If receive a signal, R6 = 1.(R1) is use to determine the pulse width of the 40khz pulse that transmit for detector
12.reset the buzzer sound to off.

.14-27 are the second part of the program, produce a 0.3ms width 40khz pulse
14-16 are the program produce high state of the 40khz, 14 set to high state, and then 15-16 is provide looping for a suitable waiting timing, from the way of the machine cycle, (14)1 machine cycle+ (15)1 + (16)2

[14]machine cycle * 5 = 12us.[14]
17-20 are the program produce low state of the 40khz, the method as use as 14-16, two of them will add to the full cycle = 12us +12us = 24us, nearly to the 40khz, 1/25us = 40khz, 1/24us = 38khz, because that the 40khz = 1/25us/2 = 12.5us(half on/off cycle) in 12Mhz clock, the machine cycle = 1us, the IC can't provide less than 1us clock.
So 38khz is the best resolution to this situation.
21 is use the looping provide 0.3ms timing 24us * 6 times * 2machine cycle(2us) = 0.3ms
22-27 is use to do the looping to prevent the cross talk of the two sensor because the transmits will need two time so the looping will use 0.6ms
29-38,42-61 is the receiver program
29, 30 is use to setup the Int0 and enable the trigger, 32 R7 is use to limit the detect range(10feet+/-1feet)
33 & 34 is use observe that the detect range has been out now.
35 is use to call 1 feet time counter delay to counter feet.
38 is use to disable the input signal after the counting feet.
42-52is a Int0 service routine,
42 is use to set the flag(R6) to Ack. the main program that is the signal is receive.
45-52 is use to feet counter to generate the sound, when the less feet has been count, the sound will be generate more frequently. There is about 0.1 second generate in every period.
54-61 is a delay program to counter the 1 feet ultrasound transmits in the air the ultrasound transmits has been cal to 1836us.
39-40,63-84 is the sound generate program
39-40 is use to call the sound program to generate system normal "beep" sound(no detect)
63-84 is the procedure that generate single beep sound.
63 is use to enable the sound
64-84 is the procedure that make a 0.5s delay.

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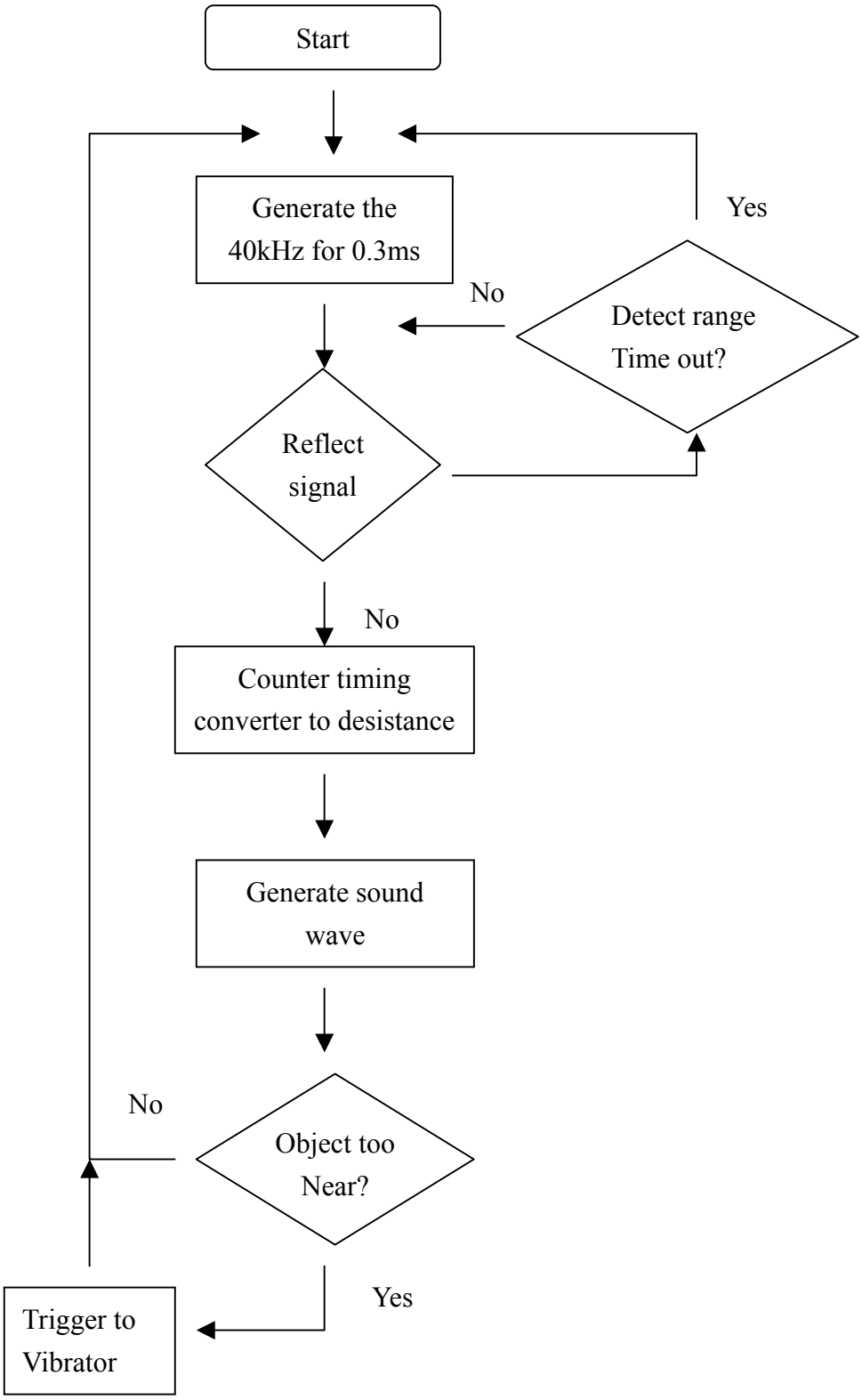
-Flowchart

The flowchart of the main program[15]



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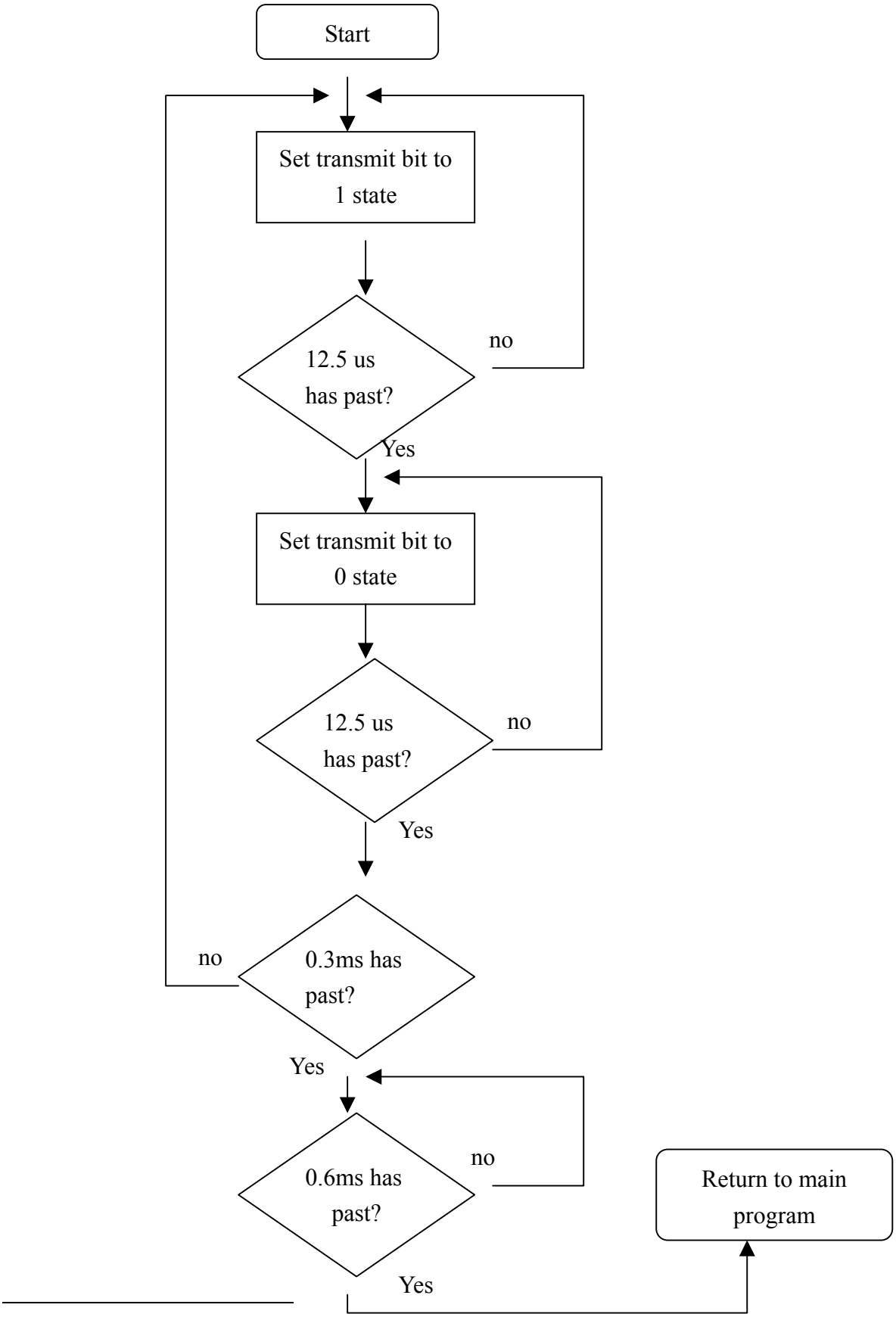
The flowchart of the transit a 0.3ms 40khz ultrasound pulse[16]



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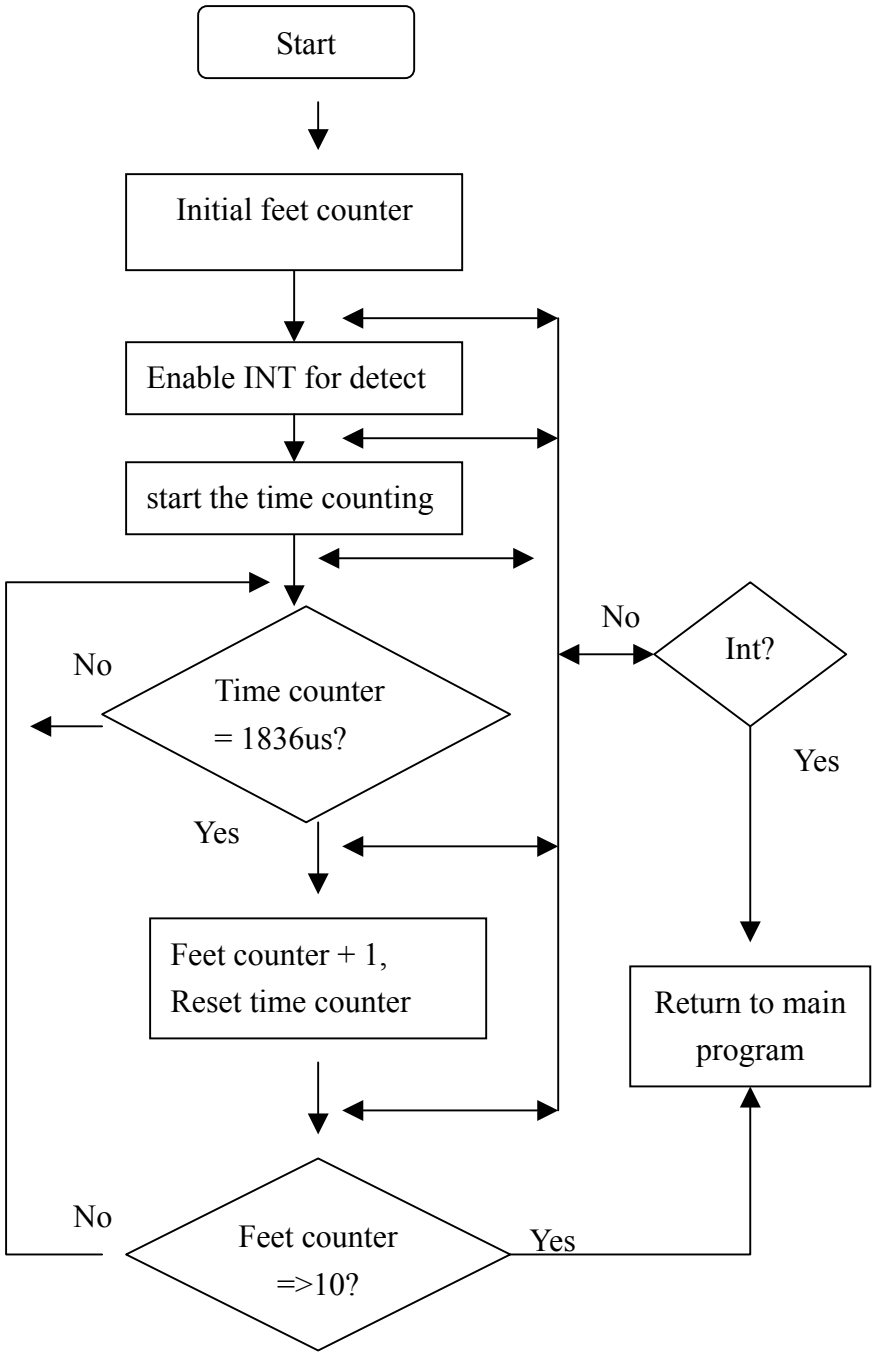
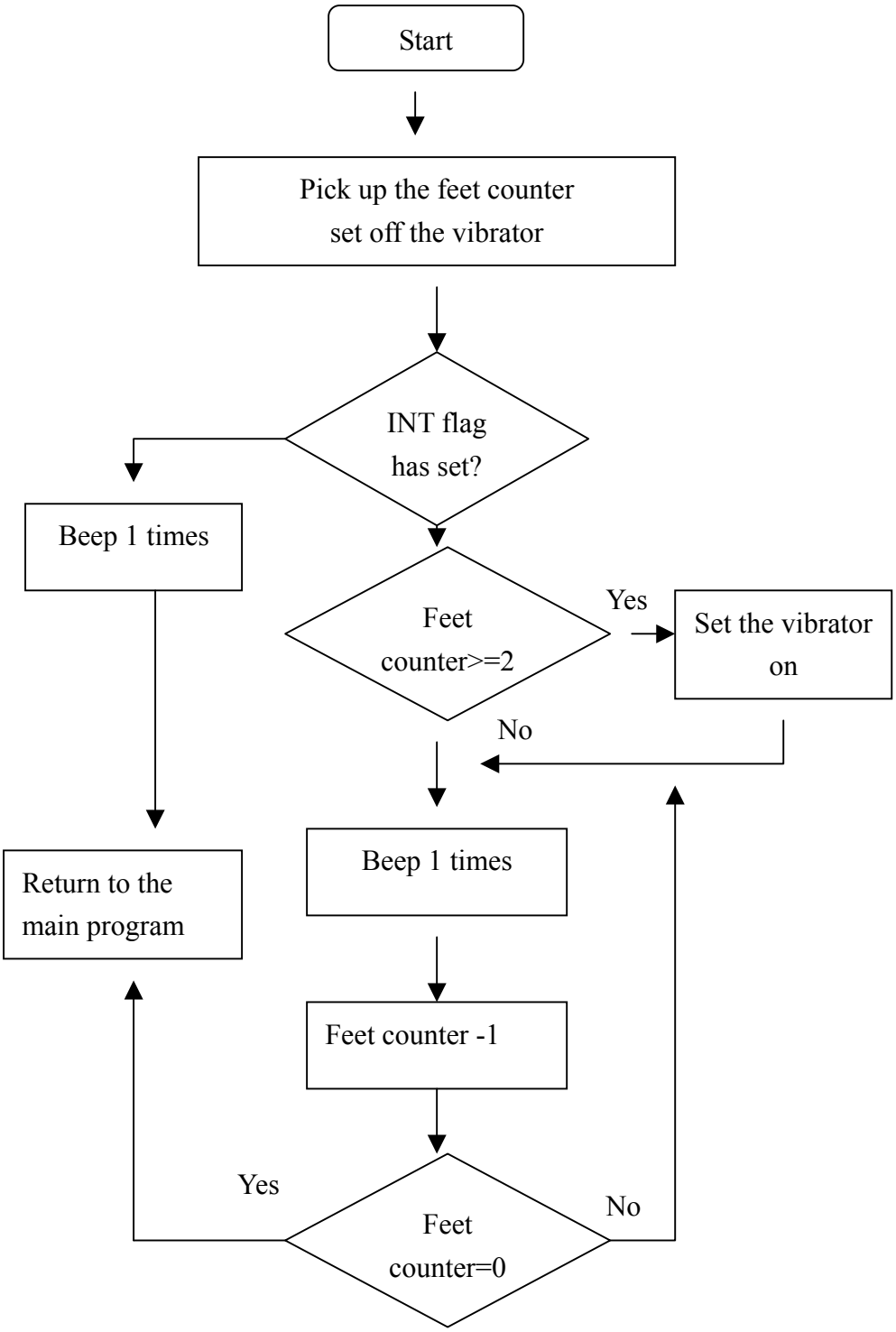
The receive program flowchart[17]



17

The tone generate and vibration trigger flowchart [18]



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User manual

1. Plug in the power
2. When the system normal, a beep sound will be generate in very single second.
3. Apply the ultrasound sensor to the obstacle, you will hear a burst “beep” sound, the burst will indicate your location to the obstacle, the sound will be “beep” more frequently, for example the obstacle will “beep” 2 times when the obstacle at 10 feet.
   4 times when the obstacle at 8feet etc. When the obstacle is close to 2 feet, the vibrator will be vibrating.[19]

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Test procedure

Test instrument: 10MHz or above oscillopscope

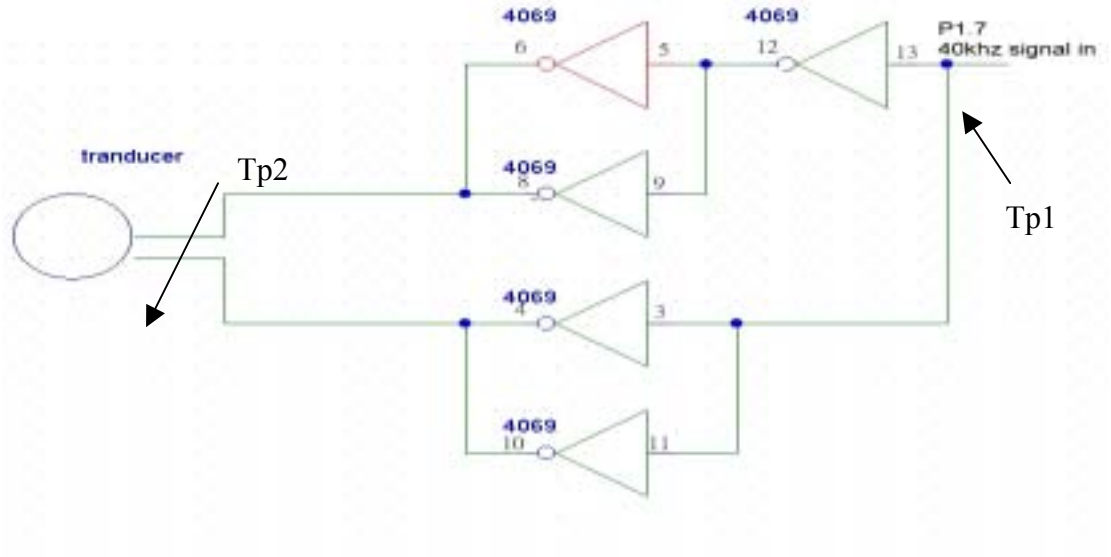
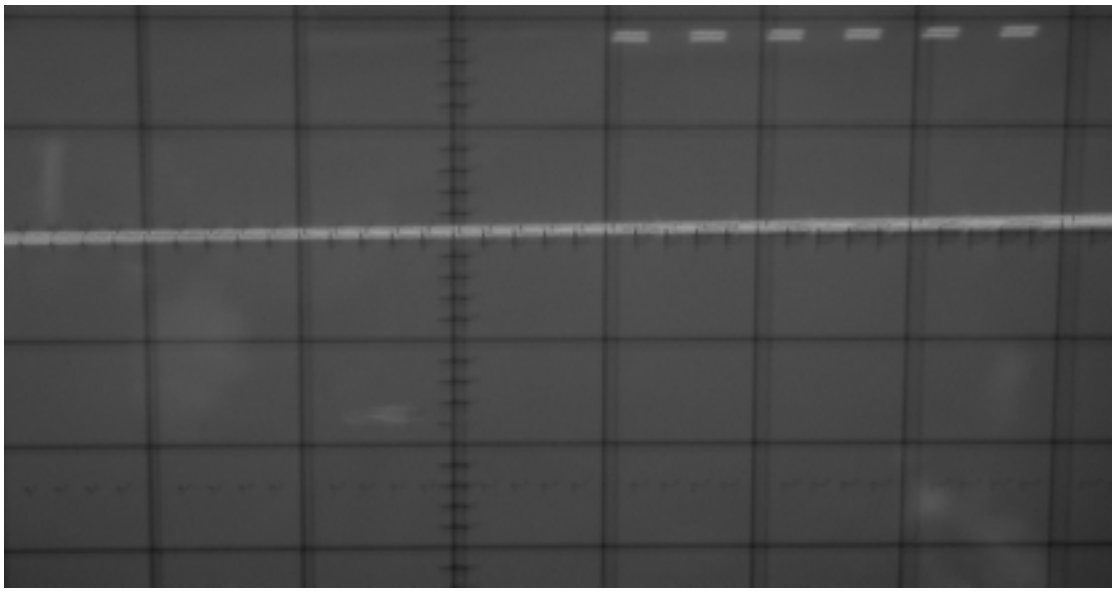


Fig 1.

1. Apply test probe to fig1. Tp1 and tp2, the normal situation will like this



You will observe a 5V(Tp1) or 9V(Tp2) X 6 pulse and every single pulse period is 25us[20]

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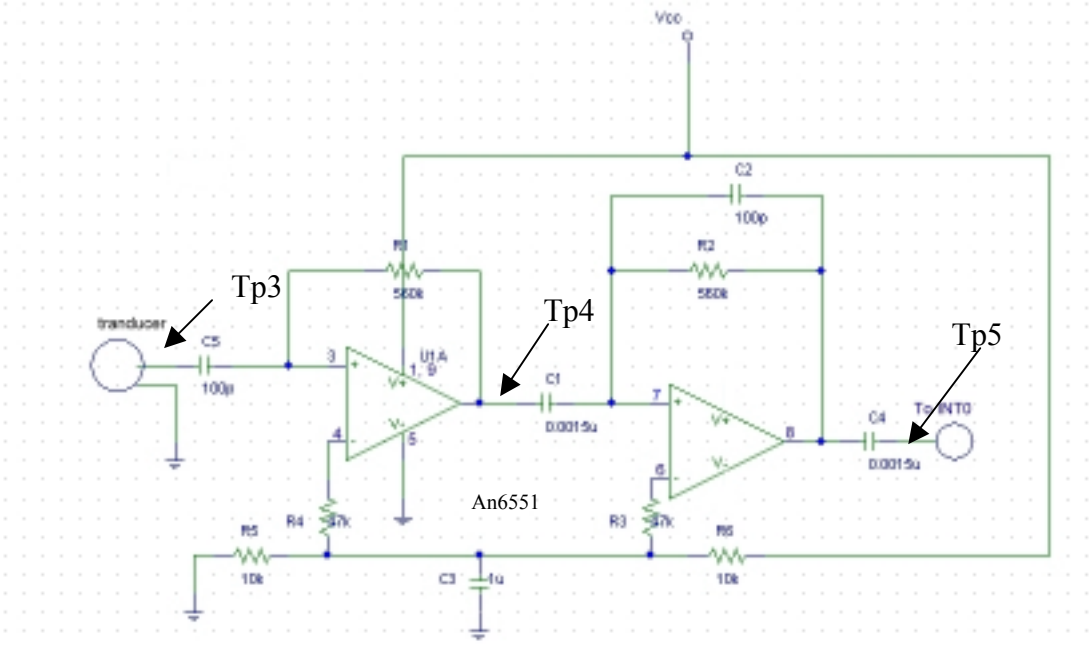
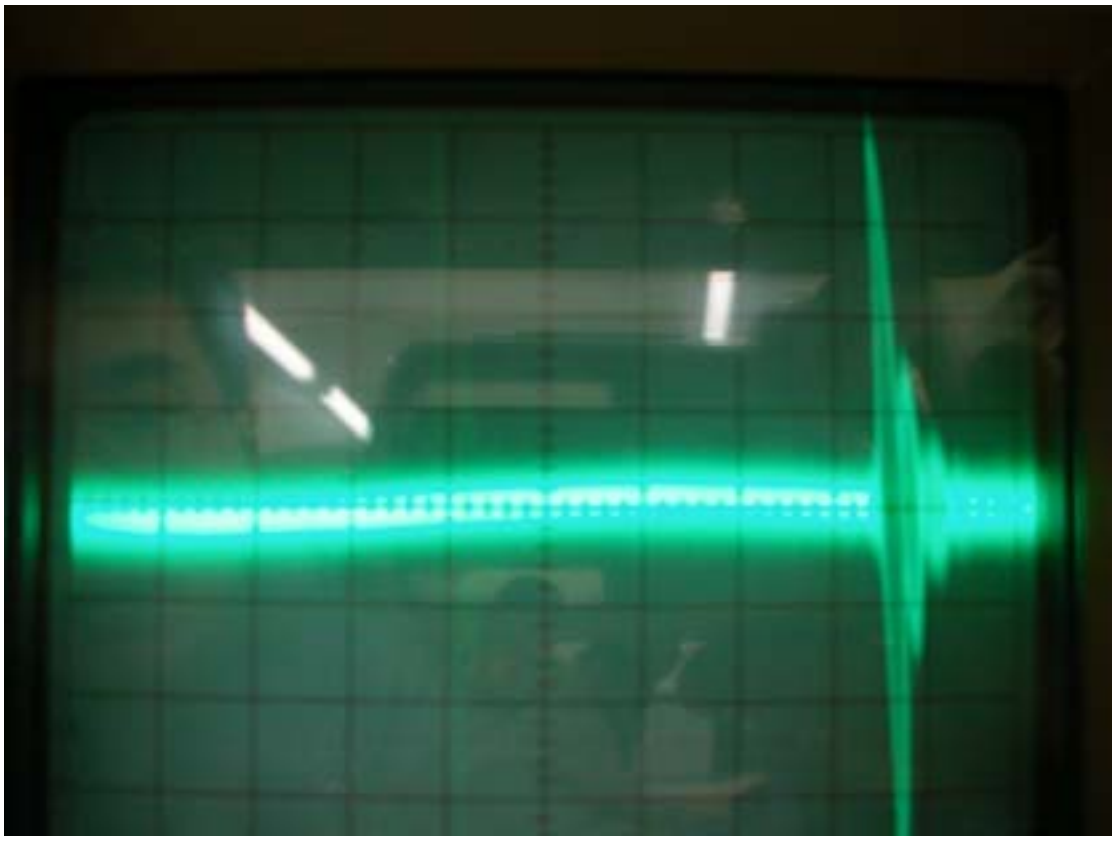


Fig2.

2. Apply test probe to fig2. Tp3 at he normal situation will like this



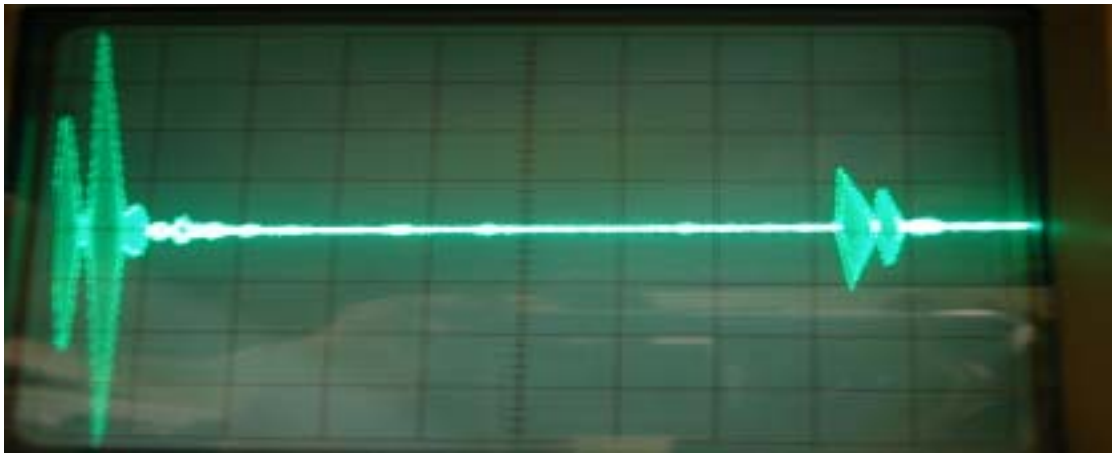
The pulse will more than 4mV and not more than 2us second pulse width [21]

[21]

2. Apply test probe to fig2. Tp4 at he normal situation will like this (if the obstacle is hit)

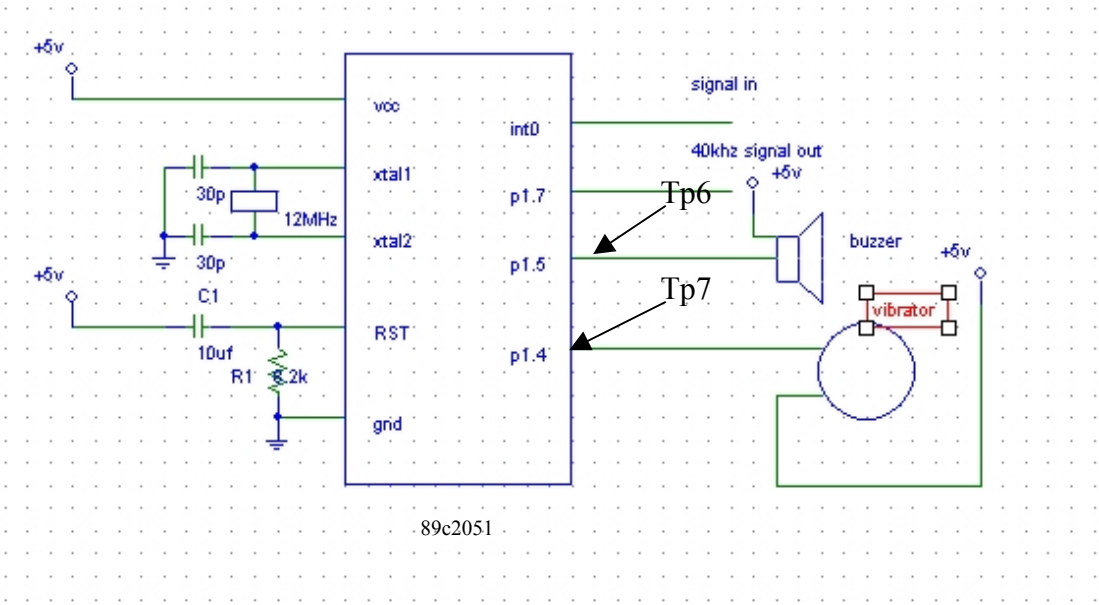
The pulse width will not less than 2ms and the level will not less than 40mv

3.apply test probe to fig2. Tp5 at he normal situation will like this (if the obstacle is hit)



The pulse width will not less than 2ms and the level will not less than 1V peak to peak.[22]

22



3. Apply the test probe to Tp6 & Tp7, and the result when obstacle hit, tp6 will appear a burst pulse, the single pulse width will not less then 0.1s, all of the pulse not more than 1s, when the obstacle at 10 feet, tp6 will generate 2 pulse, 1 feet will generate 10 pulse etc. when the obstacle at 2 feet or below. Tp7 will have a turn to 0v; in normal there is a 5v in Tp7.[23]

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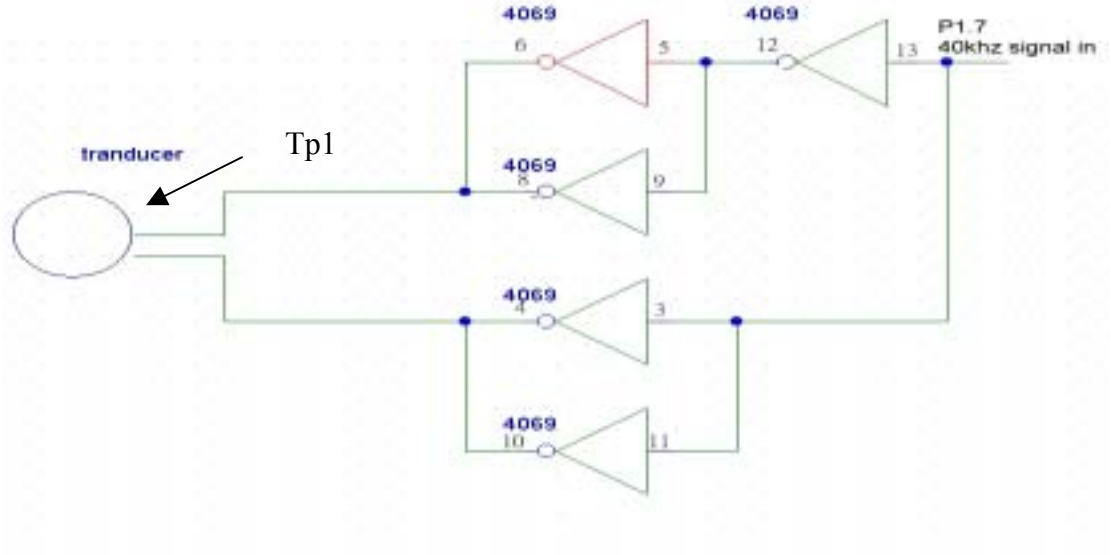
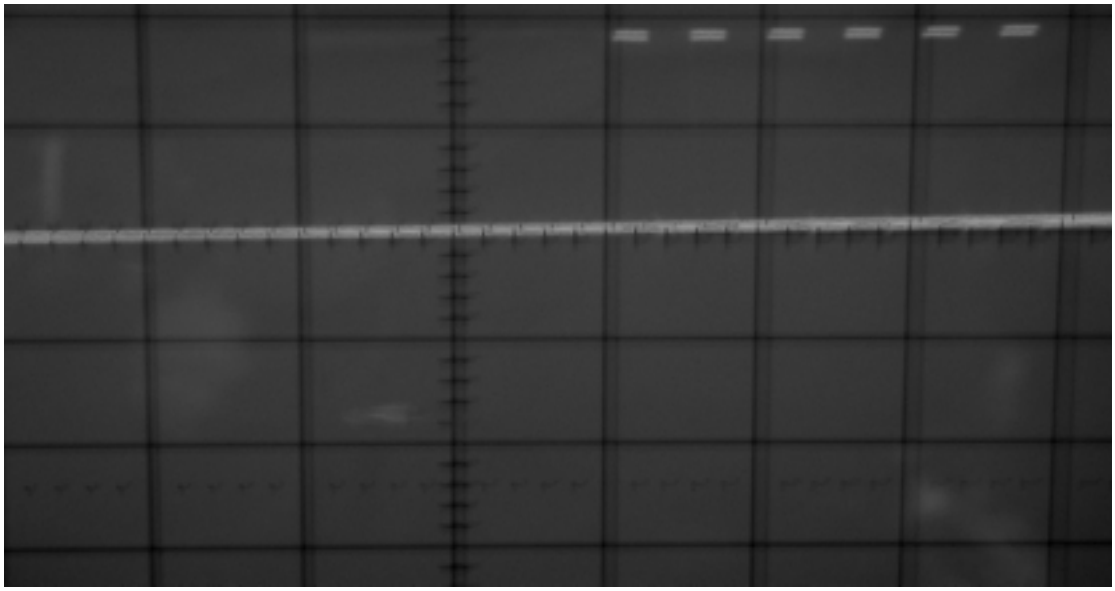
Result

Here are the result of our observe:



At Tp1



50us per each vertical block
5v per each horizontal block[24]

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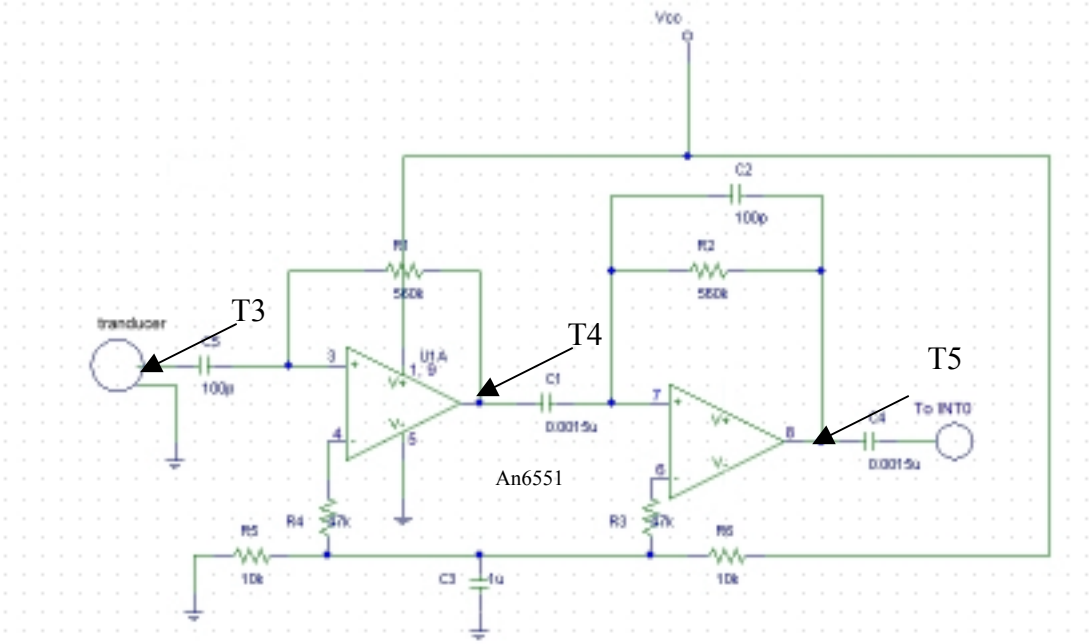
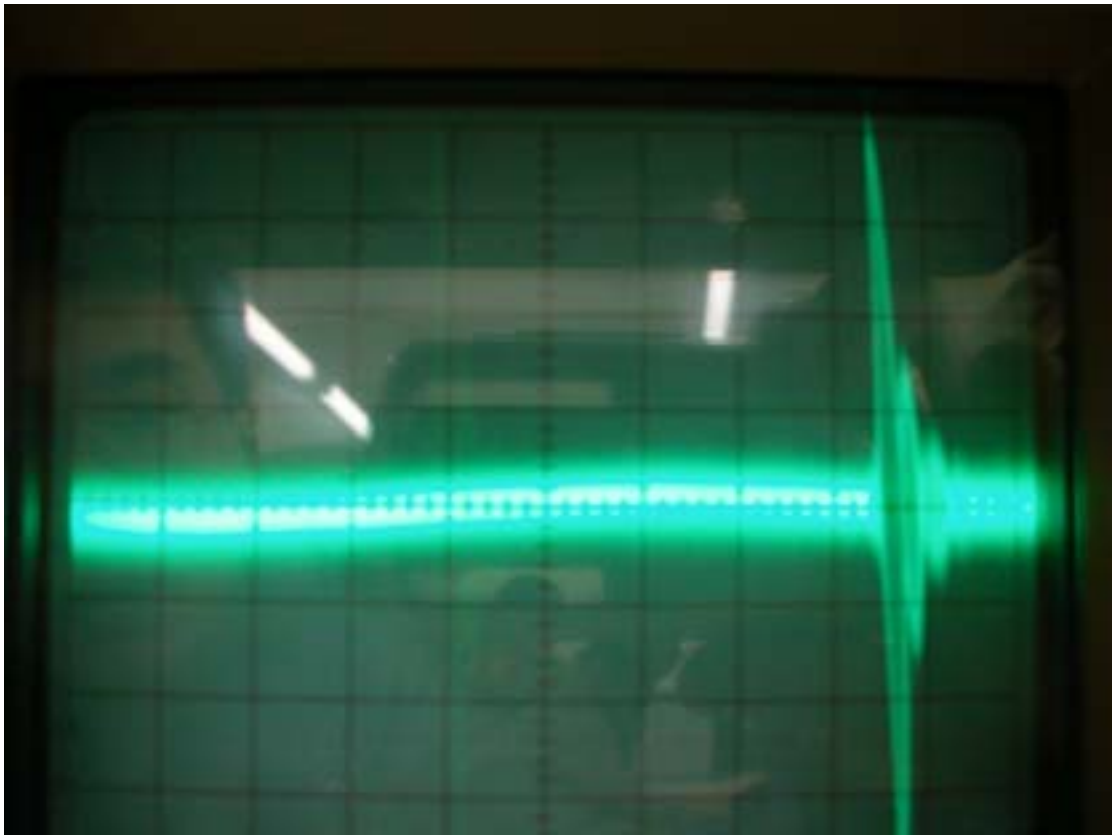


At Tp3



This record at the 5 inch that 4mv for each horizontal block
2us per each vertical block[25]

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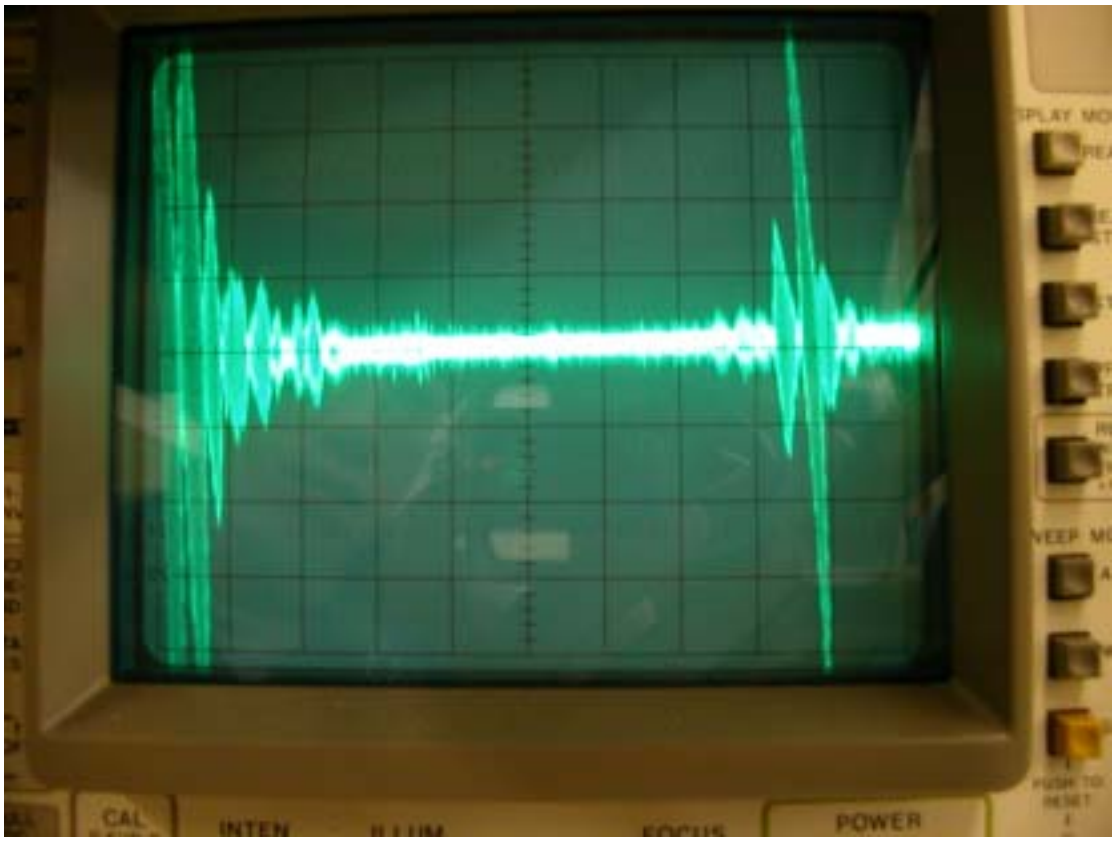
At Tp4



This record at 3m 10mv for each vertical block
2ms per each horizontal block

At Tp4

This record at 3m 0.5v for each vertical block
2ms per each horizontal block

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Comments and discussions

Our project is fail to the receiver circuit output signal was so low to detected by the microproccer. (1V peak to peak) There is more than 3.2V that can be detected by the microproccer with the buffer IC. As long as our observe, the receiver circuit is running properly. Because the receiver circuit has a large amplify (about 30db amplify), this is hard to amplify the signal to more large level. Because the slew rate is limit to the amplify action, for example, the slew rate 1v/us, it means that if the amplifier circuit is the voltage follow bandwidth 1MHz, if 10 time amplify, the bandwidth will decrease to 100kHz, if the 30db amplify, the bandwidth will decrease to very low level, we have use the two level amplifier to due the 30db amplify result but more large level will made signal distort the signal itself, because of the signal to noise ratio is not very good, about 1:2 2= noise, 4 = signal. So there is not to do with the receiver part, at now, we think that the transmit part should use follow method to improve the signal that picked up at receiver:

1. Parallel connection resistor to the transducer at the transmit part to matching the transducer to cause full power transfer.
2. Connect a amplifier between the microproccer 40kHz pulse clock output and the transducer to increase transducer voltage.

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Conclusion

The electronic walking stick is a portable electronic product; the power consummation is mainly target to due with. But the transmit and receive circuit will have a great power lost, it will power down when the blind person that on the street, so the walking stick may need to design less power lost and indicate the blind person to change their battery when it was too late.[29]

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