

EC GR 4161

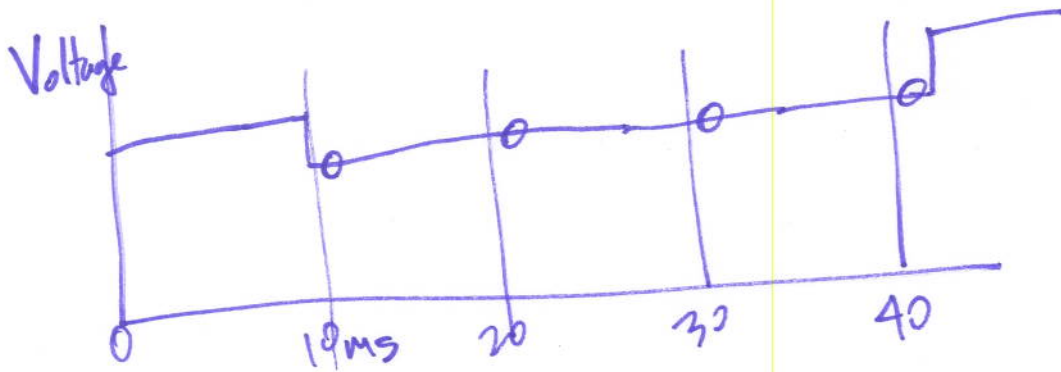
LECTURE 8

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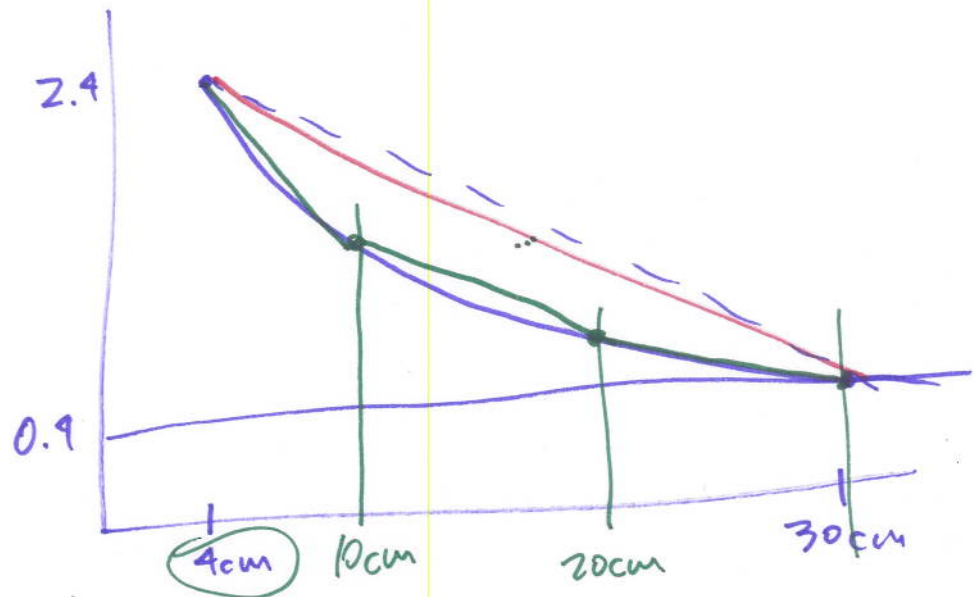
Sharp IR Rangefinder GP2D120

32ms period, $f = \frac{1}{0.032 \text{ sec}} = 31.25 \text{ Hz}$

(1)



Expectation



Software to measure:
write a C/algorithm/steps

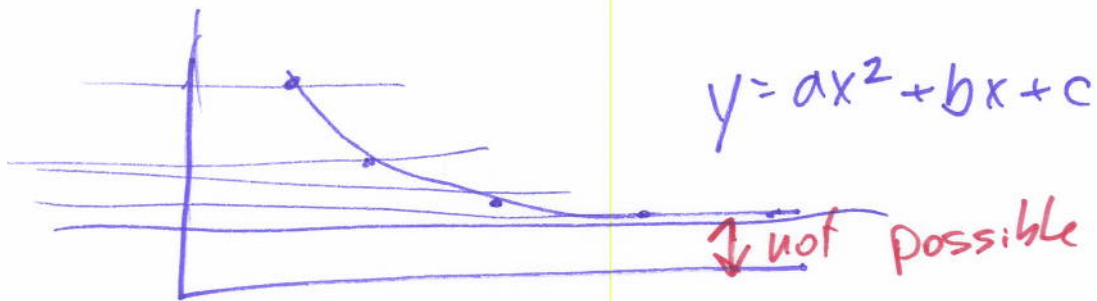
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OPTION 1

1st sample/measure several points
"curve fit" equation

(2)



2nd program the following algorithm

```
while (1) {  
    measure rd value (measureA)  
    use formula to determine distance  
    print/use distance  
}
```

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option 2

(3)

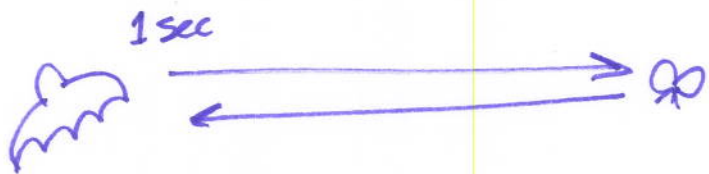
1st Build a database of V vs dist
A/D Converter 8-bits

V	Dist
0000 0000	⋮
⋮	⋮
0001 0000	300 (mm)
0011 0001	298 (mm)
⋮	⋮
1001 0000	42 (mm)
1001 0001	40 mm

~~distarray[256] =~~

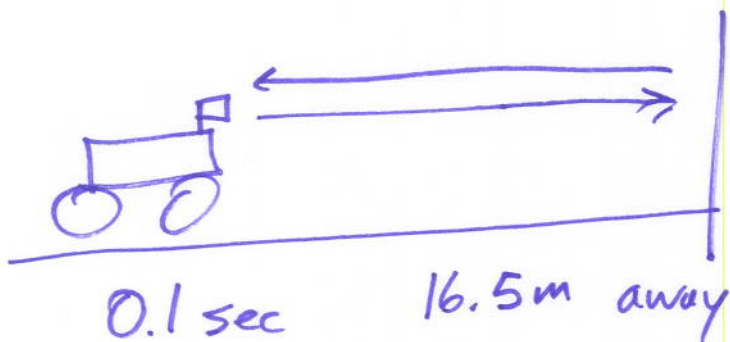
int distarray[256] = {0, 0, 0, 0, ..., 300, 298, 296...
..... 42, 40, 40, 0, 0, 0, 0, ...};

measureA = adc(0);
distance = distarray[measureA];



Speed of sound = 330 m/sec

1 sec = 165 m away



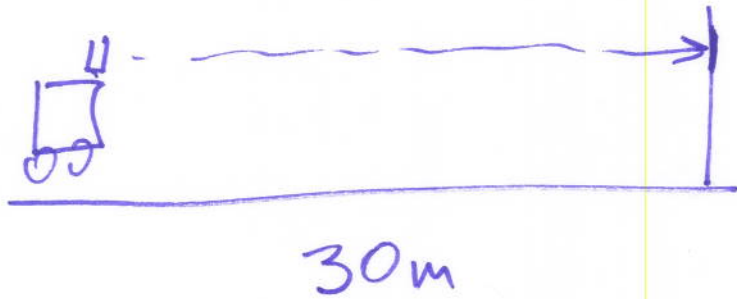
Problem if a vehicle w/ US sends a chirp/ping, is moving a 1m/sec, and a stationary object is 30m away, how long will it take for the chirp to be reflected back?

offered answers =

- ~~.1813~~
- ~~.1813~~
- ~~.178~~

- .18543 ✓
- .09036 ✓✓✓
- ~~.0909~~

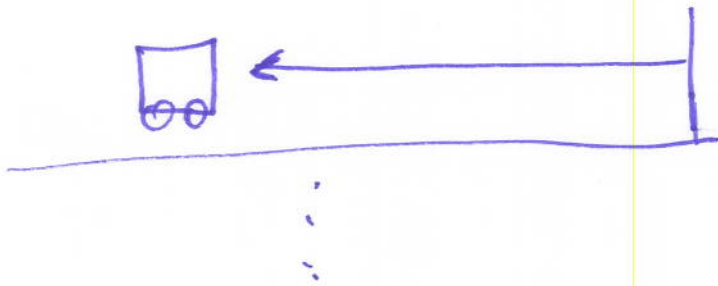
- ~~.179999~~
- ~~.18123~~
- .1815 ✓



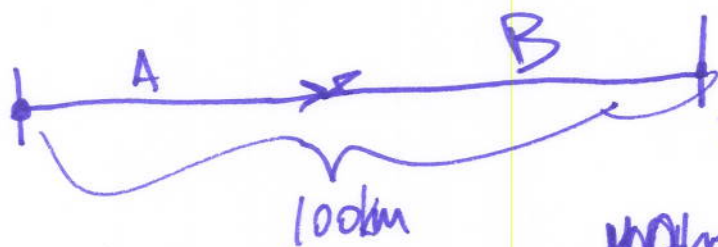
$$\text{Time 1 direction} = \frac{30\text{m}}{333\text{m/s}} = 0.09090909 \text{ sec}$$

How far did the vehicle travel in that time?

$$0.09090909 \text{ Sec} * \frac{1\text{m}}{\text{Sec}} = 0.09090909\text{m}$$



Train A → 50km/h
 Train B ← 50km/h



$$V_A t + V_B t = \text{dist}$$

$$= \frac{50\text{km}}{\text{h}} t(\text{hr}) + \frac{50\text{km}}{\text{h}} t(\text{hr})$$

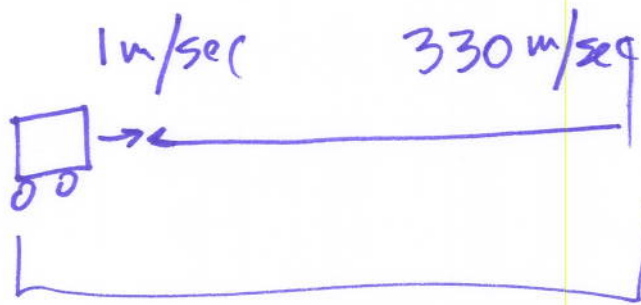
$$100\text{km} = 100\text{km} * t$$

$$t = 1\text{hr}$$

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$$29.90909091 = (30 - 0.09090909)$$

$$29.90909091 = t + 330t$$

$$= 331t$$

$$0.0903598 \text{ sec} = t \quad (\text{"returned" time})$$

$$\begin{aligned} \text{Total time} &= \text{transmit} + \text{returned} \\ &= 0.09090909 \text{ sec} + 0.0903598 \text{ sec} \\ &= 0.181269 \text{ sec} \end{aligned}$$

Example: An automobile travels at 100 km/m

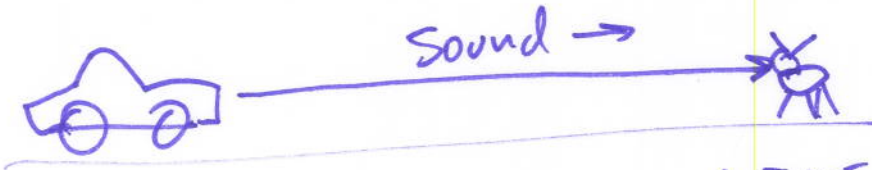
Assume an ultra sound system for the vehicle can identify a deer in the road at 500 meters, how much distance ~~time~~ does this give the driver to avoid the deer.

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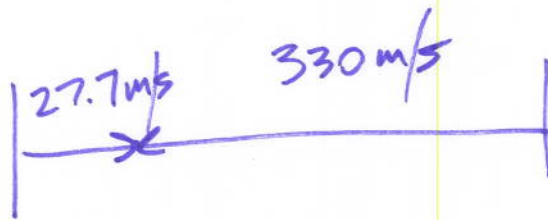
(7)

$$100 \text{ km/hr} = 100000 \text{ m/hr} \times \frac{1 \text{ hr}}{3600 \text{ sec}}$$
$$= 27.7 \text{ m/sec} \quad (\text{Car velocity})$$



$$500 \text{ m} \times \frac{\text{sec}}{330 \text{ m}} = 1.515 \text{ sec}$$

$$1.515 \text{ sec, the car moves} = 27.7 \frac{\text{m}}{\text{sec}} \times 1.515 \text{ sec}$$
$$= 42.0875 \text{ m}$$



distance =

$$457.91 \text{ m} = \frac{27.7 \text{ m}}{\text{s}} t_{\text{sec}} + \frac{330 \text{ m}}{\text{s}} t_{\text{sec}}$$

$$1.28 \text{ sec } t$$

Car travels in second part of signal

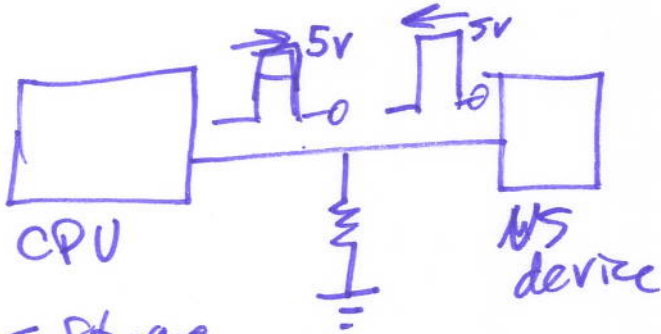
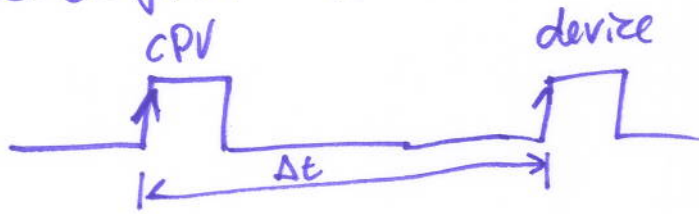
$$1.28 \text{ sec} \times \frac{27.7 \text{ m}}{\text{sec}} = 35.46 \text{ m}$$

$$\text{distance away now} = 500 - 42.0875 - 35.46$$
$$= 422 \text{ m}$$

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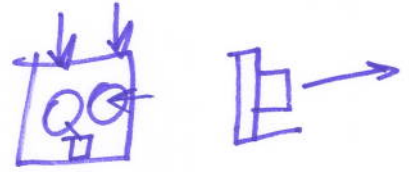
Control ultrasound



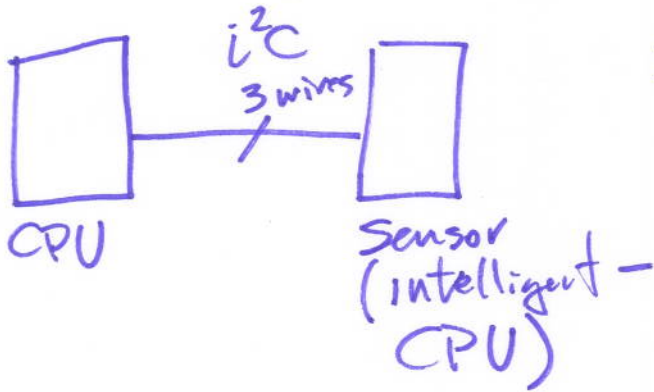
Software in CPU

to poll/interrupt

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Serial Comm

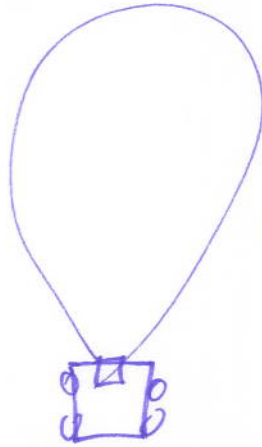
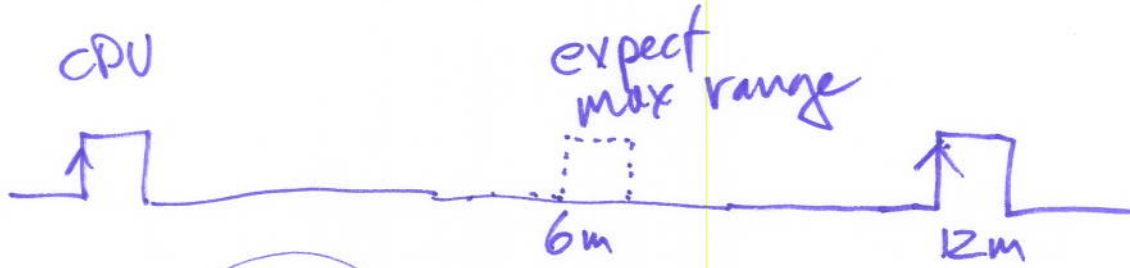


send bytes

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Nothing in range

Exceeded range
Signal received
after 75ms.

What is the max
f of US sensor
system that sees
nothing?

$$f = \frac{1}{0.015 \text{ sec}} = 13.3$$

Configuration
allows you
to identify
a rough
location

