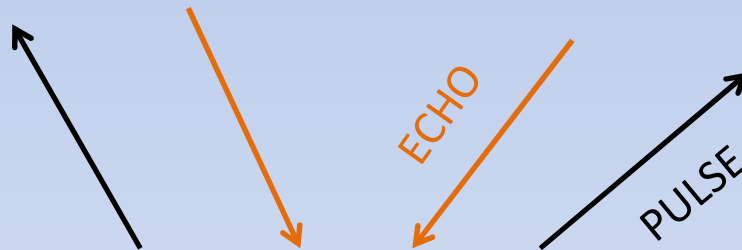


Mechatronics' Project

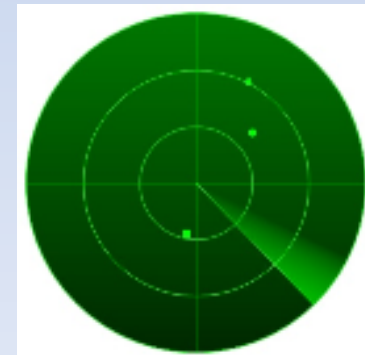
*The hunter
(a 3D tracking system)*

*Team 6
Riccardo Castellani
Edoardo Mura
Andrea Pacilli*

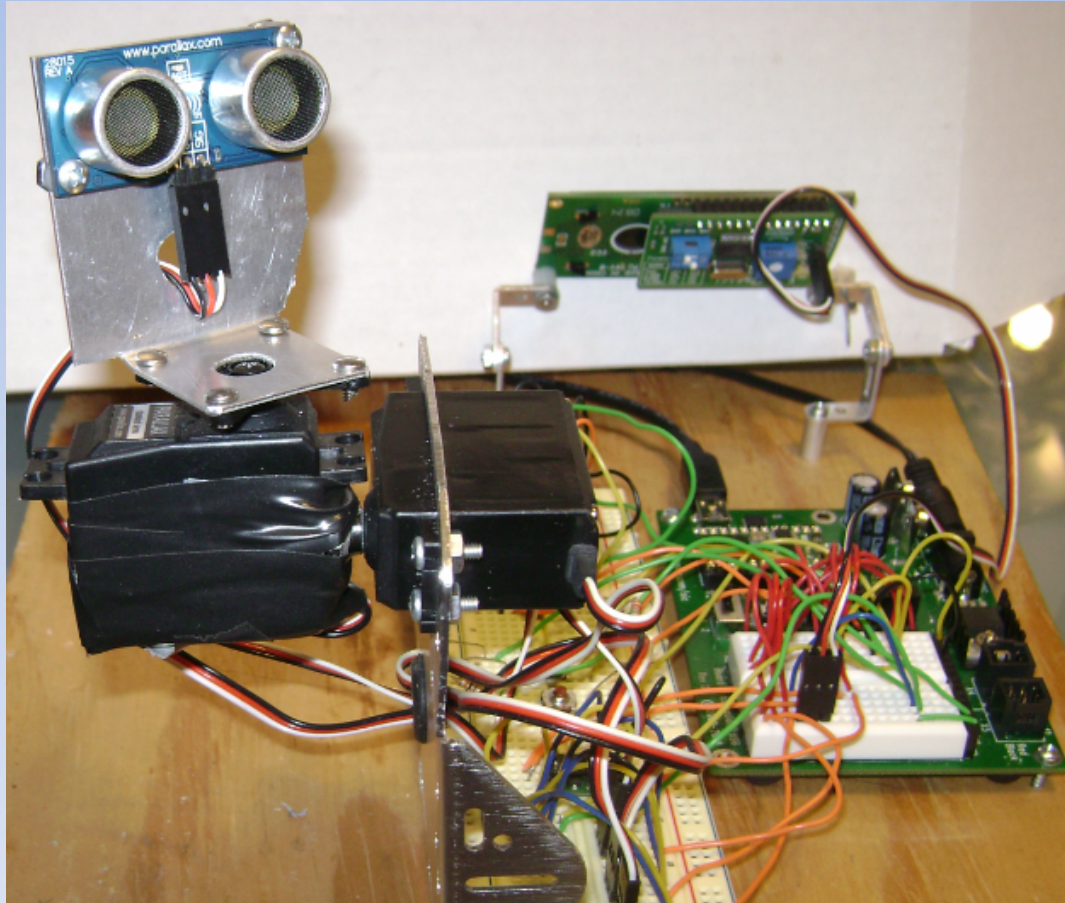
RADAR BASE - AIR PATROL



To
Operator



The hunter



Part used:

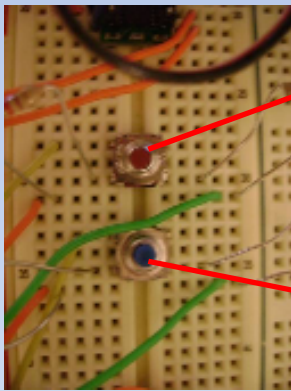
- Ping sensor
- 2 servo motors
- Compass module
- Lcd Display
- Piezo speaker
- 2 555 timers
- 2 push buttons

Hardware



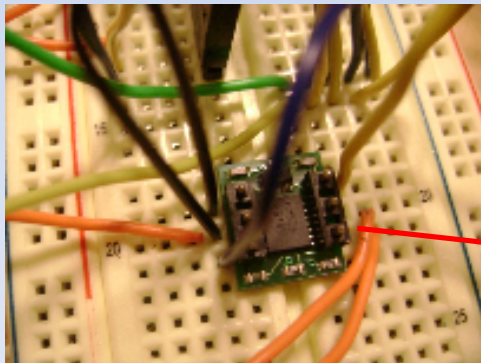
Angle (Relative to NORTH)

Target Distance (cm)



Kill Switch

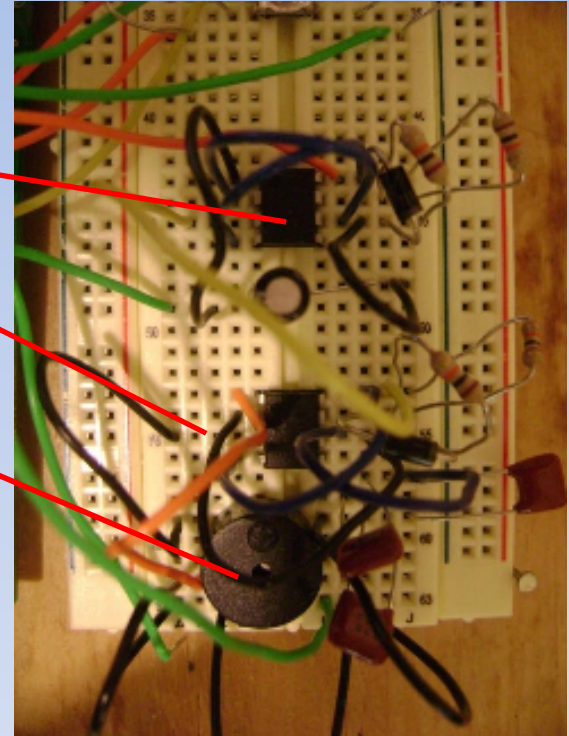
Display button



Compass module

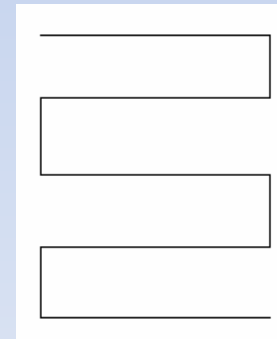
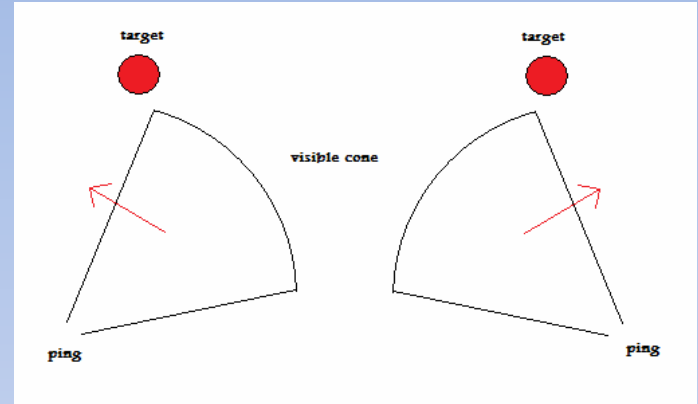
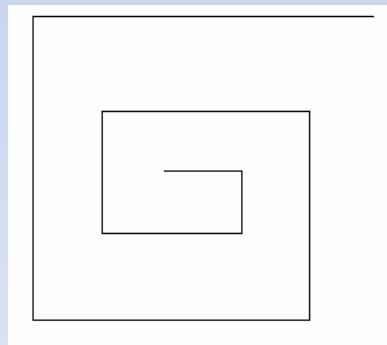
555 timers

Piezo speaker



Algorithm's approach:

- First 2D
- Implementation of the 2D algorithm adding the second axis
- 3D square spiral

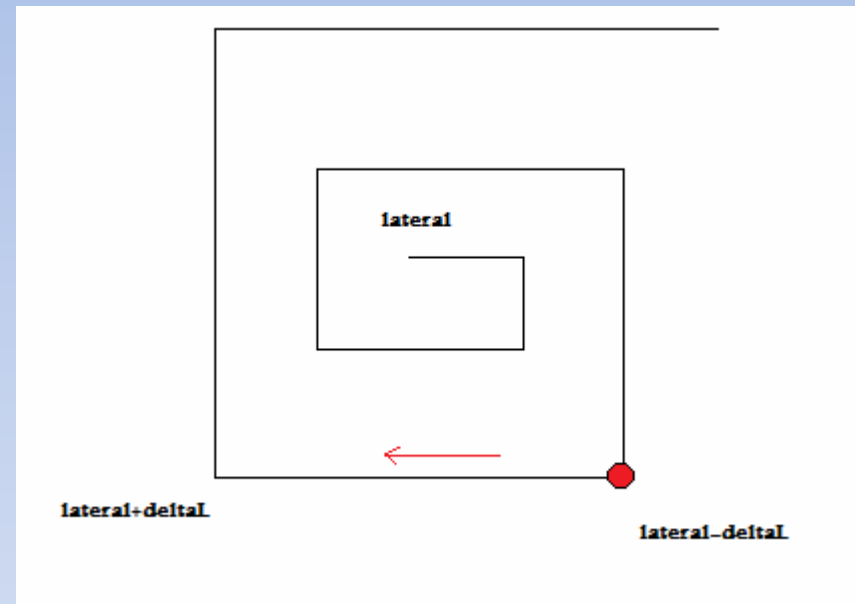


Monitoring the motors' position

```
FOR timer=1 TO maxtimerL
  [...]
  PULSOUT 14, lateral+deltaL
  PAUSE 30
  [...]
NEXT
```

Number of pulses

Duration

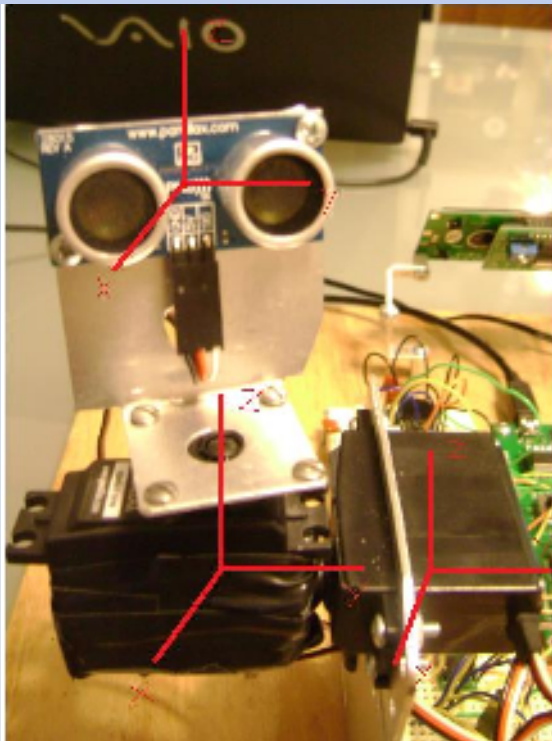
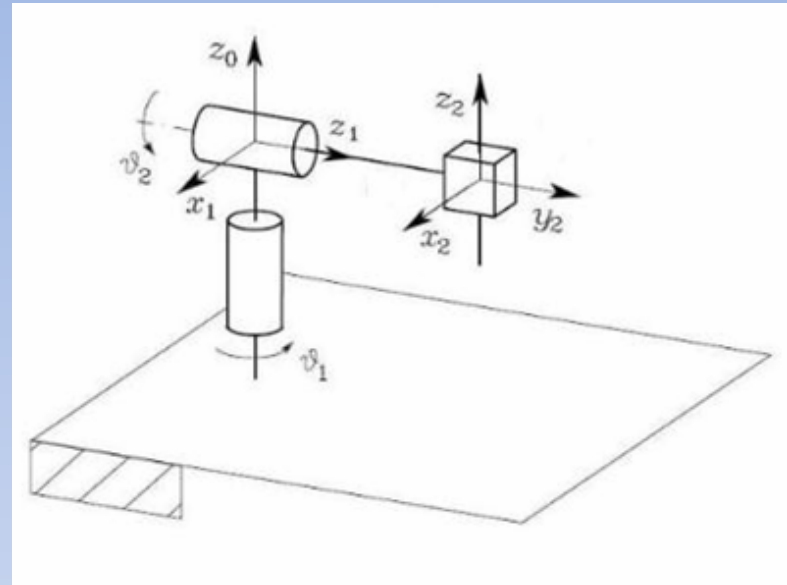


$$partialAngleL = (2 * deltaL * timer) / max timerL + lateral - deltaL$$

Rotation matrixes

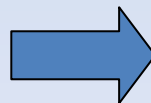
$$x' = R^z x''$$

$$\begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} = \begin{bmatrix} \cos \vartheta & -\sin \vartheta & 0 \\ \sin \vartheta & \cos \vartheta & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x'' \\ y'' \\ z'' \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ l_2 \end{bmatrix}$$



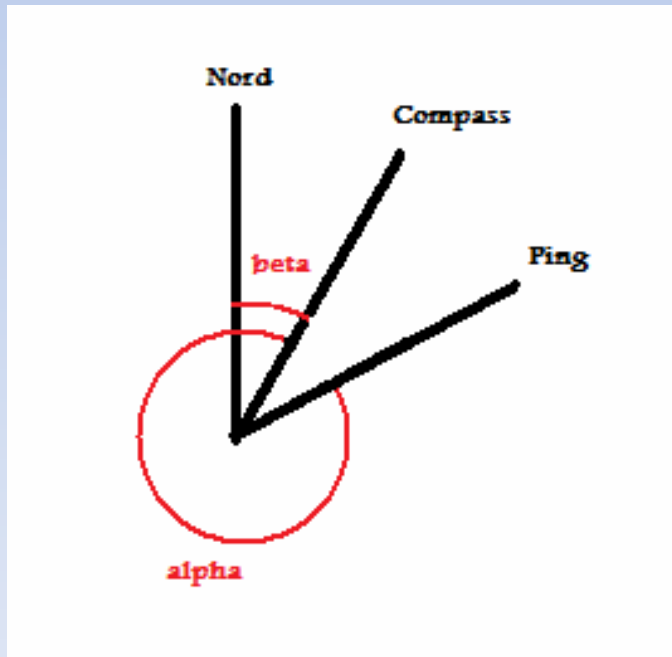
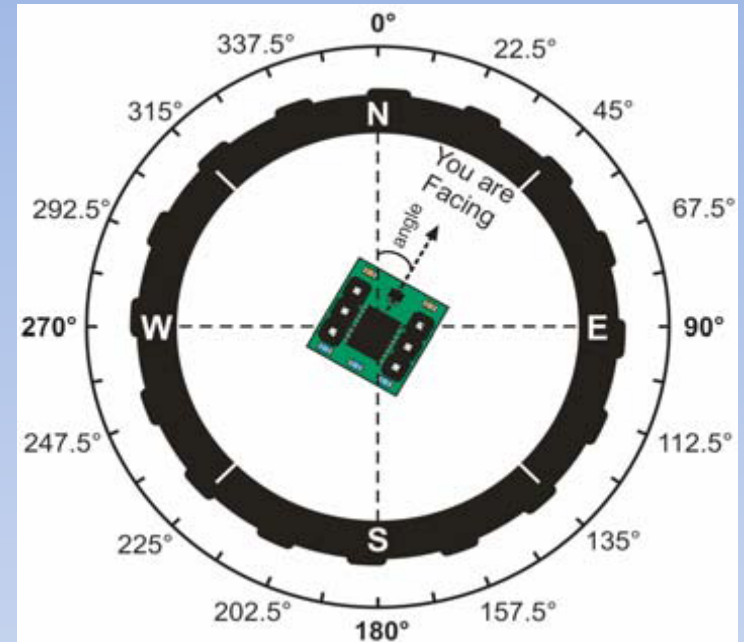
$$x = R^y x'$$

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} \cos \varphi & 0 & \sin \varphi \\ 0 & 1 & 0 \\ -\sin \varphi & 0 & \cos \varphi \end{bmatrix} \begin{bmatrix} x' \\ y' \\ z' \end{bmatrix} + \begin{bmatrix} 0 \\ -l_1 \\ 0 \end{bmatrix}$$



$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} d \cdot \cos \vartheta \cdot \cos \varphi - l_2 \sin \varphi \\ d \cdot \sin \vartheta - l_1 \\ d \cdot \cos \vartheta \cdot \sin \varphi + l_2 \cos \varphi \end{bmatrix}$$

The position in space

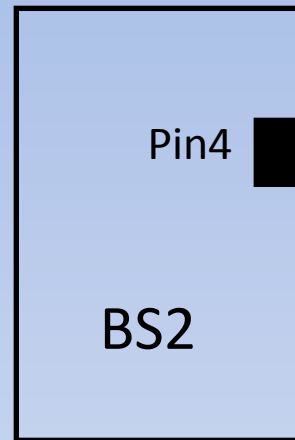
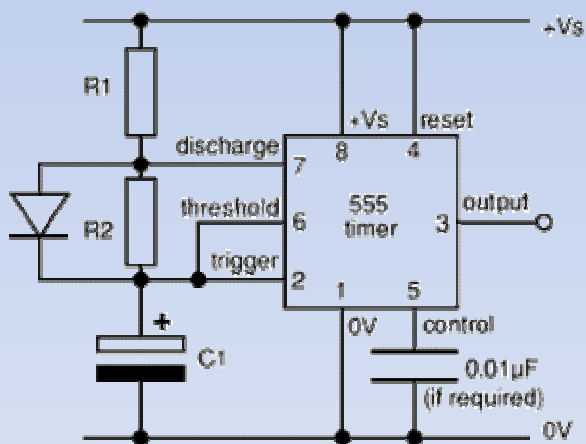


$$TotalAngle = (360 - \alpha) + \beta$$

555 timers' cascade and piezo-speaker

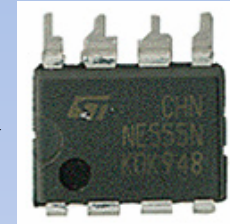
- $R1 = R2$
- Duty cycle: 50%
- First 555: beeping rate (7Hz)
- Second 555: Piezo frequency(4kHz)

(both 555 are in astable configuration)



LOW
if sweeping

HIGH
if target
acquired



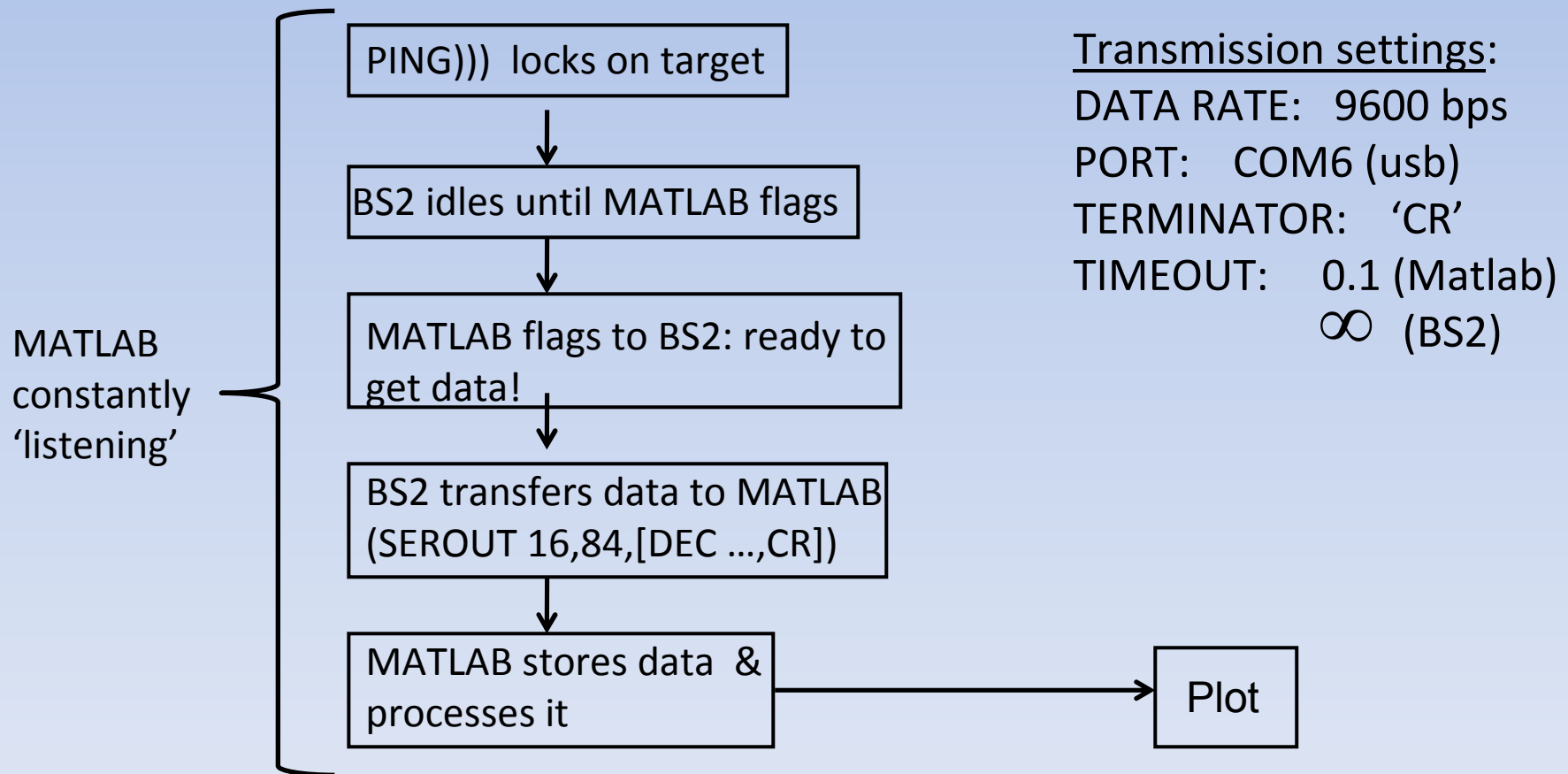
~ 4 kHz
square wave



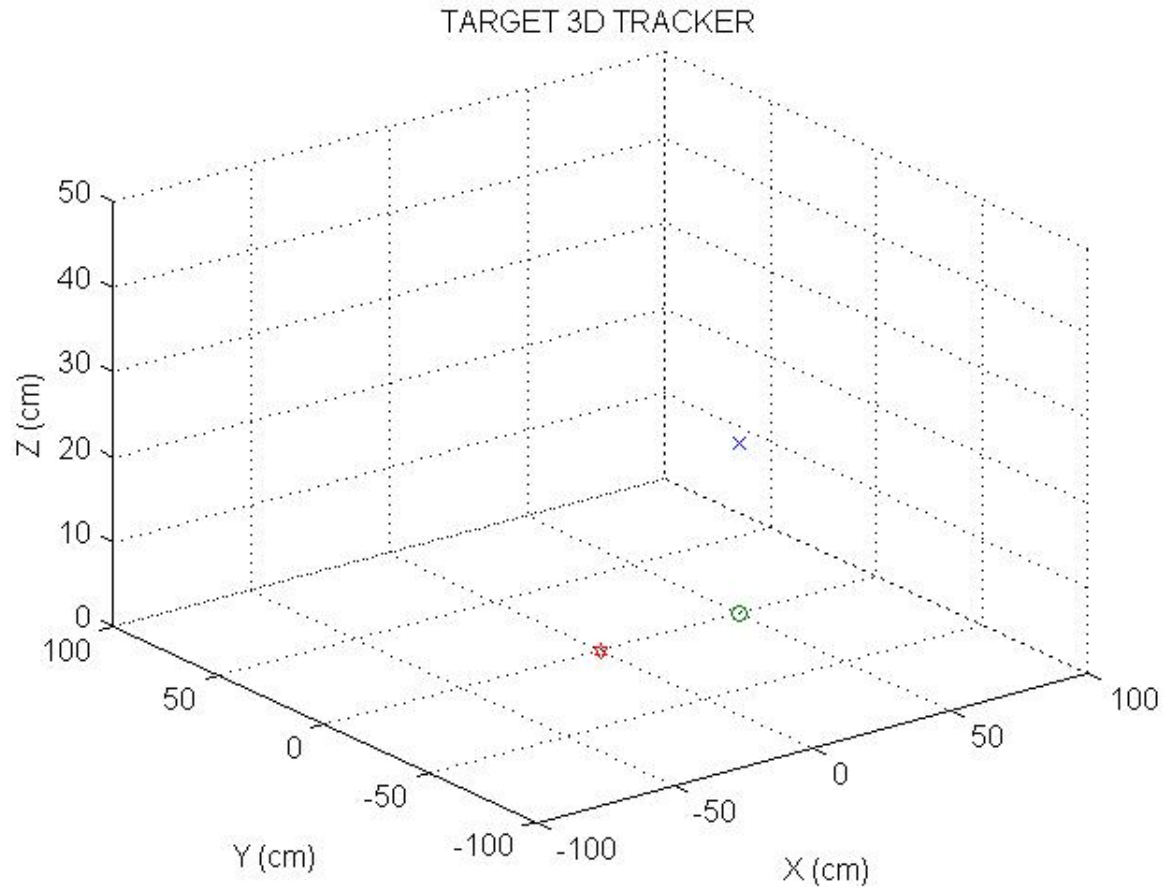
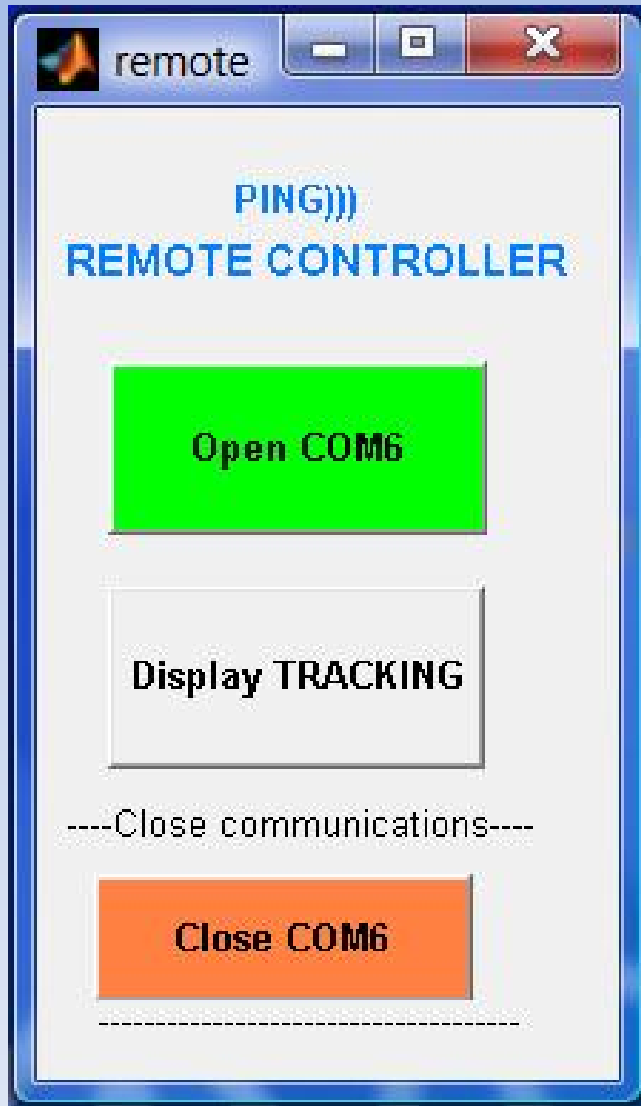
7 Hz
square wave

BS2 - MATLAB serial communications

- Purpose:
MATLAB to get data from BS2

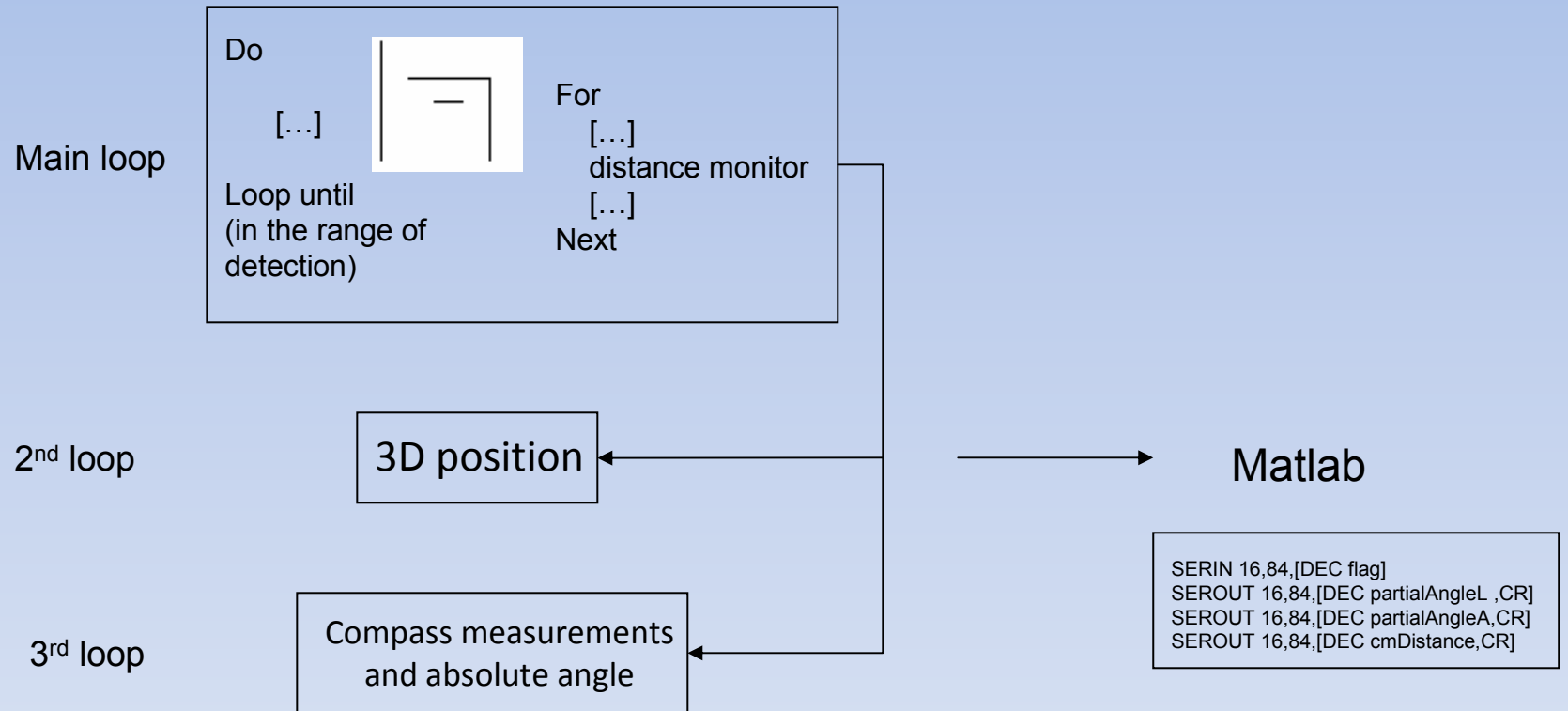


MATLAB-BS2 GUI interface



$$X = 50 \quad Y = 0 \quad Z = 20$$

Algorithm



Conclusions

The main limitations of our project are basically due to:

- Wide cone of the Ping sensor
- Inertia of servos
- Approximation while computing the variables

Wide range of applications:

- Alarm and position detection
- On a robot to monitor surrounding space
- Monitoring an open space