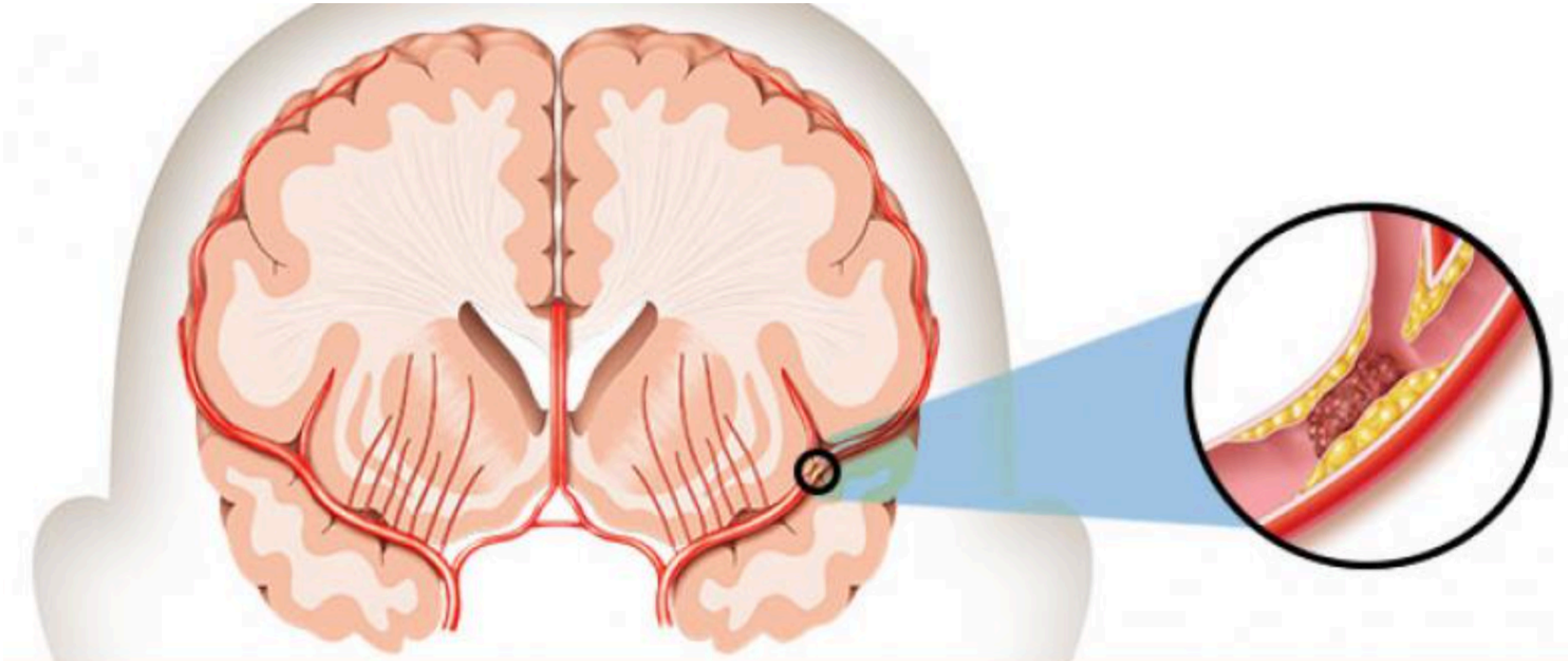
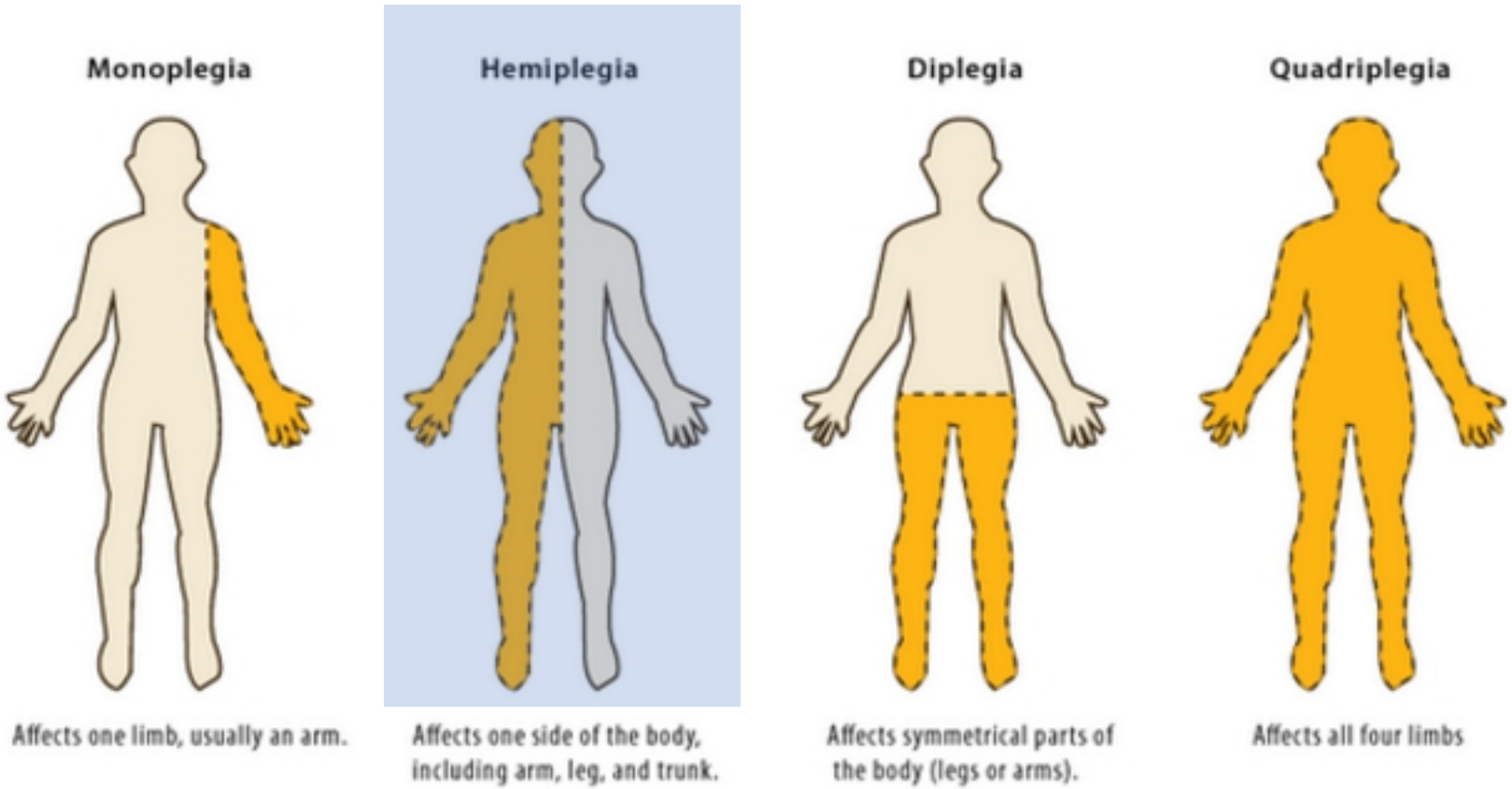
(Attempt of create a) Electrical Capacitance Tomography

MAS.836 . Lucas Cassiano _ Media Lab

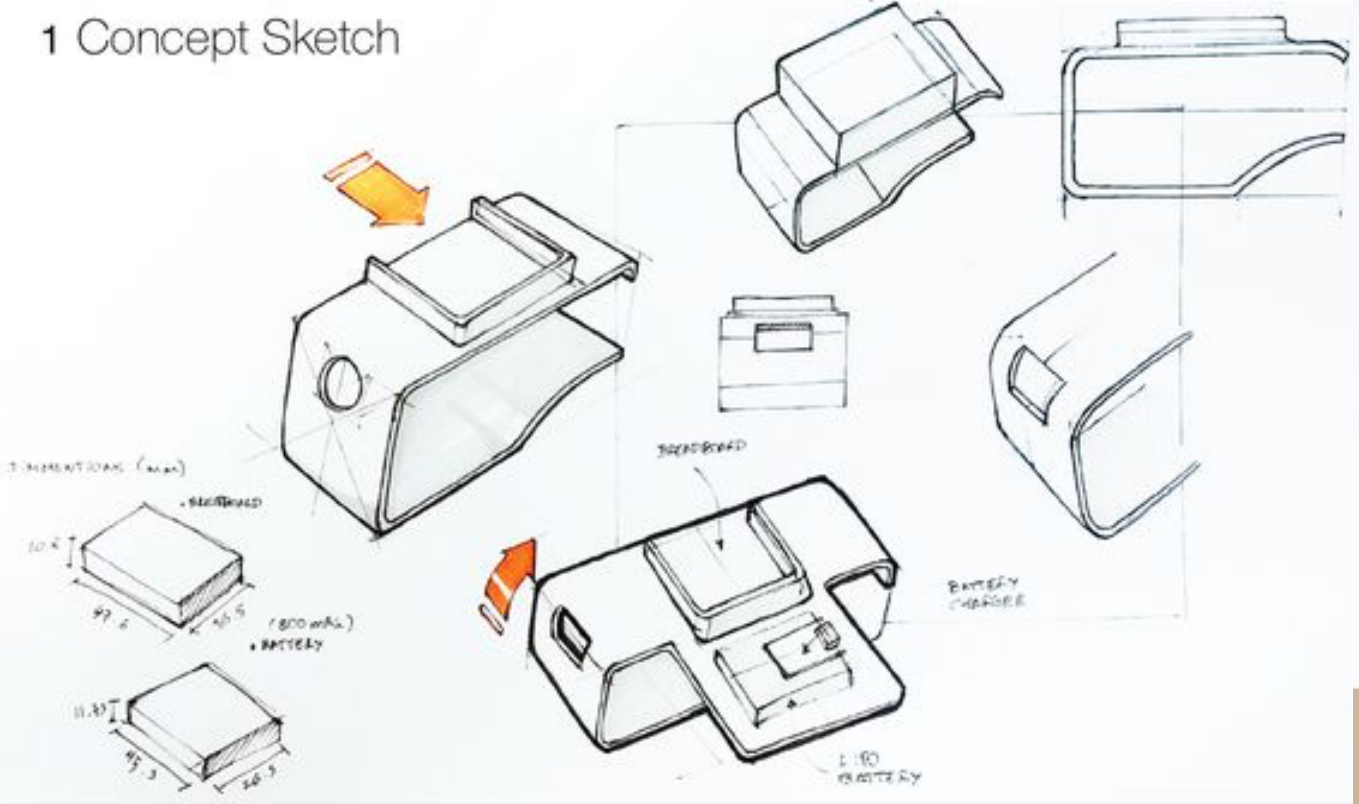
Motivation



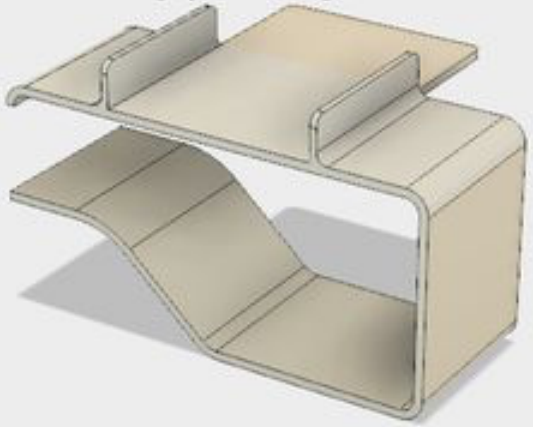

Monoplegia
Affects one limb, usually an arm.
Hemiplegia
Affects one side of the body, including arm, leg, and trunk.
Diplegia
Affects symmetrical parts of the body (legs or arms).
Quadriplegia
Affects all four limbs

Old Project (as reference)

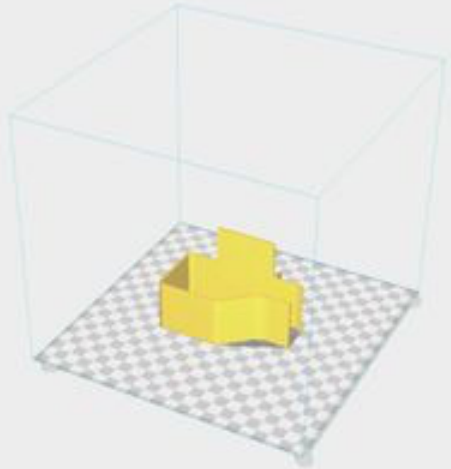
1 Concept Sketch



2 3D Modeling | Slicing

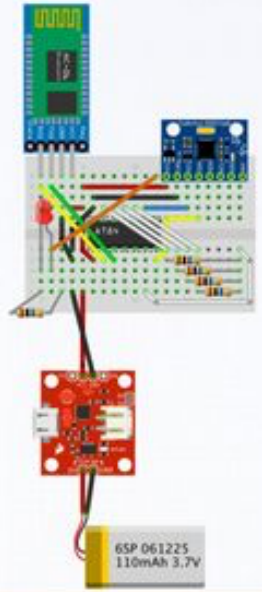


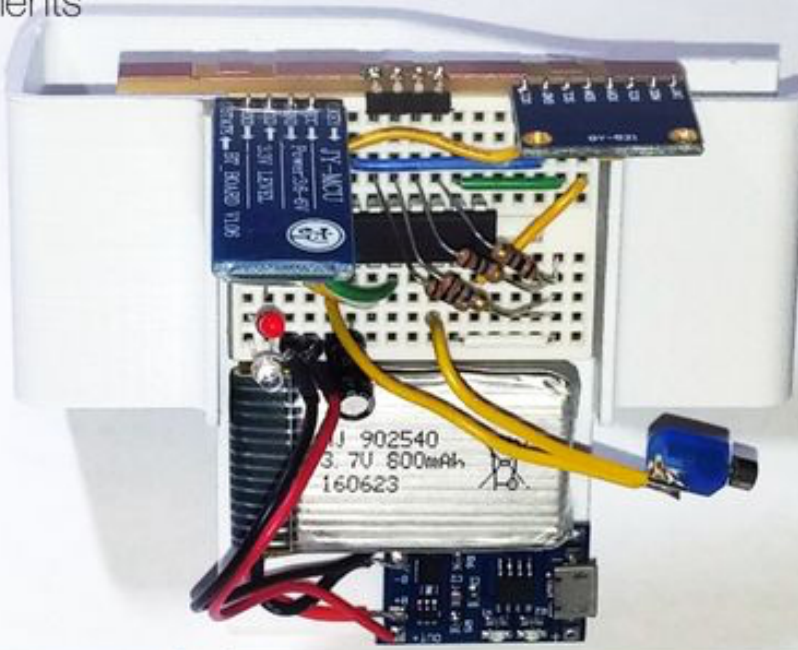
AUTODESK® FUSION 360™



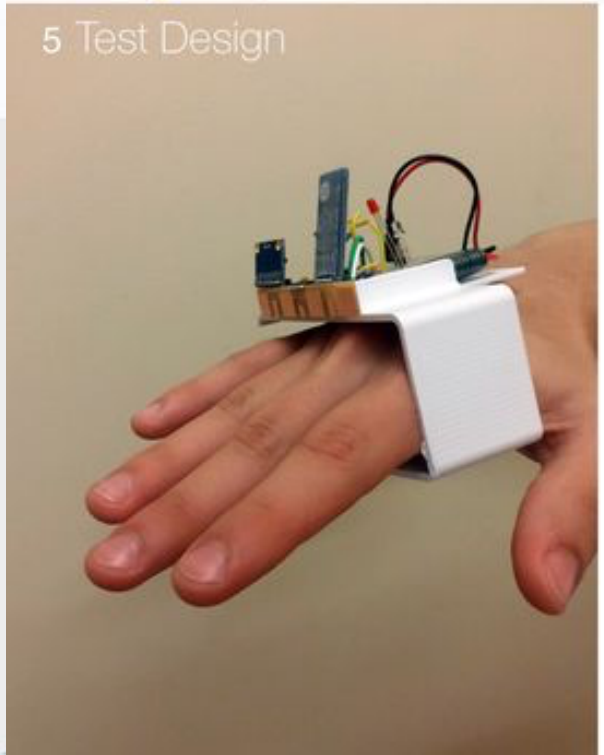
cura.

4 Electronic Components





5 Test Design



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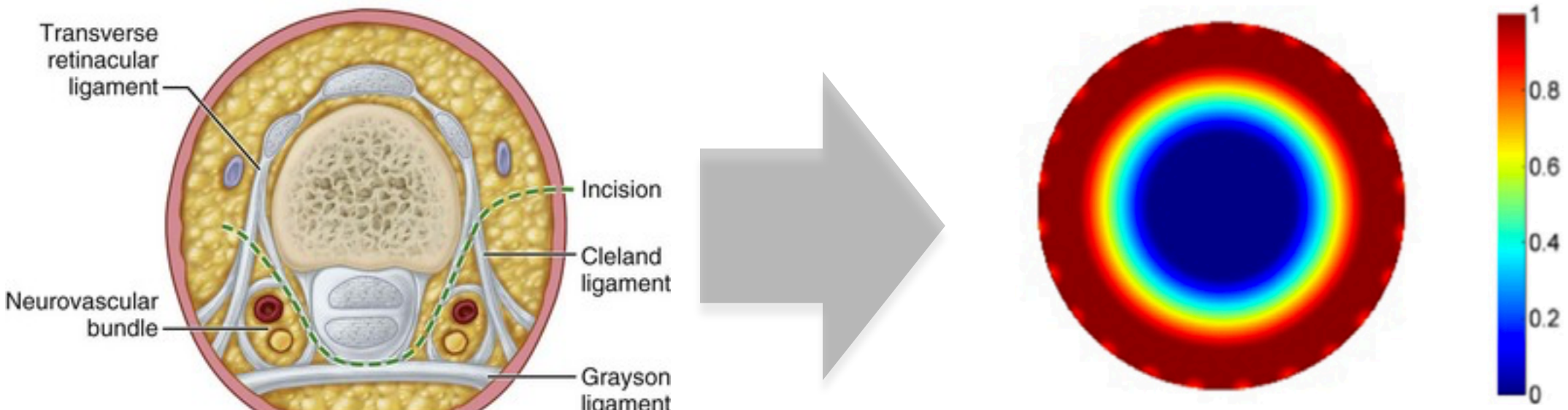
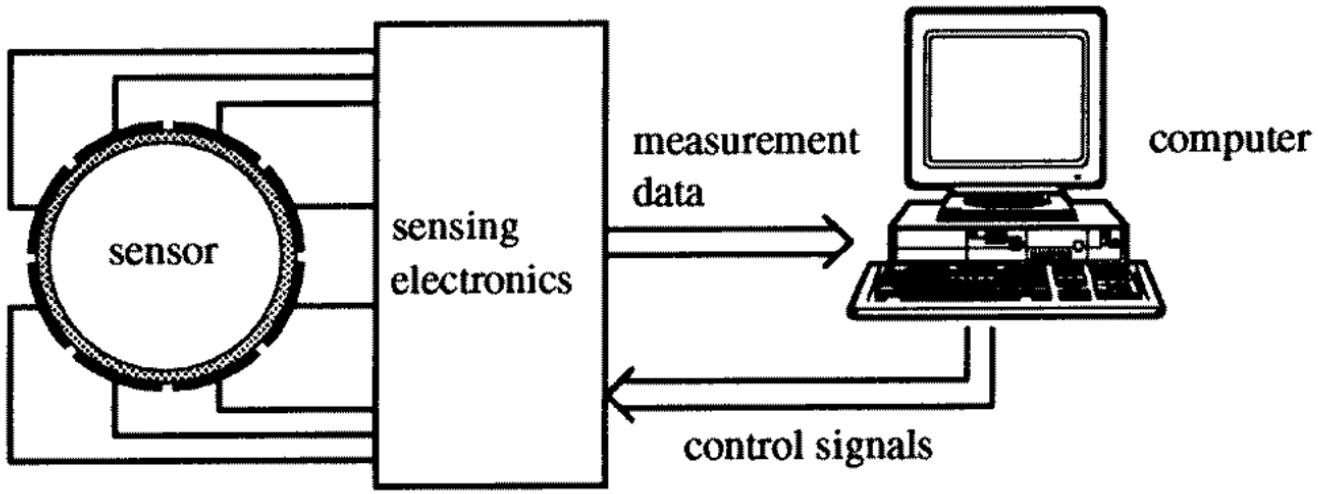
cassiano@mit.edu
Dec 26, 2016

Old Project (as reference)

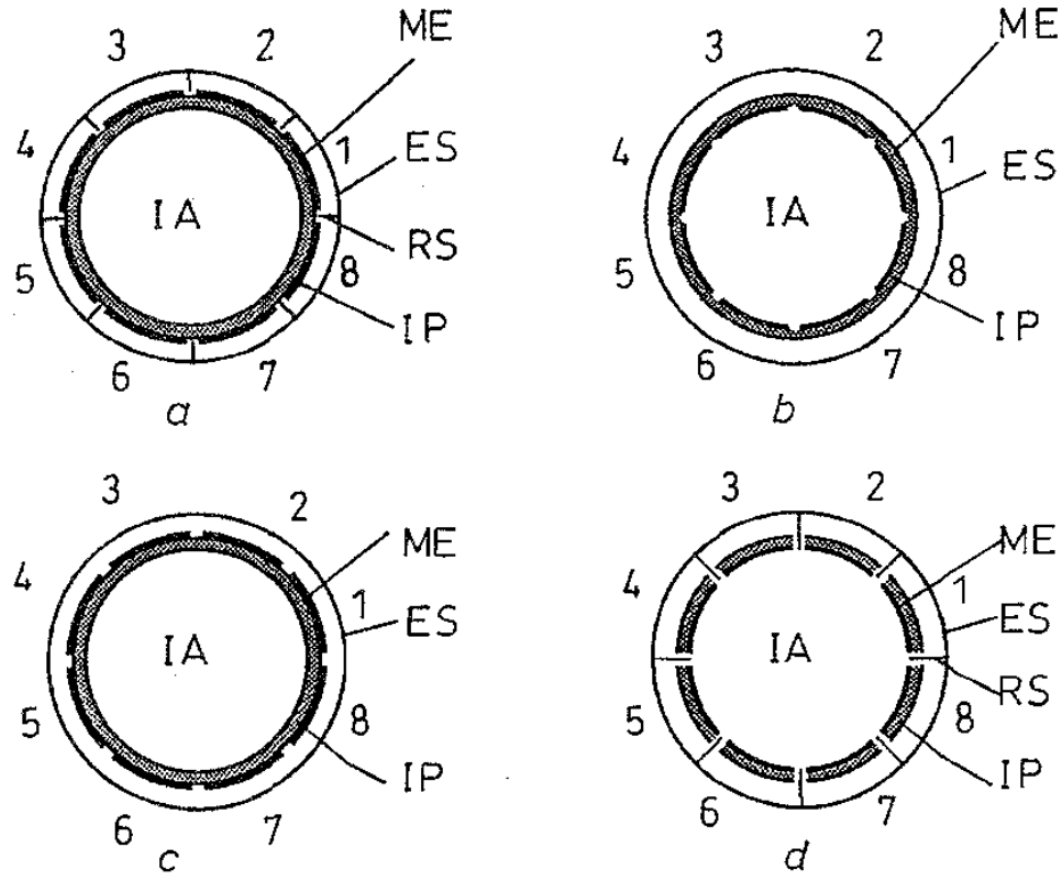
Current **Goal**



Related Work



Electrical Capacitance Tomography


3
2
ME
4
1
ES
IA
RS
5
8
IP
6
7
a
3
2
ME
4
1
ES
IA
5
8
IP
6
7
b
3
2
ME
4
1
ES
IA
5
8
IP
6
7
c
3
2
ME
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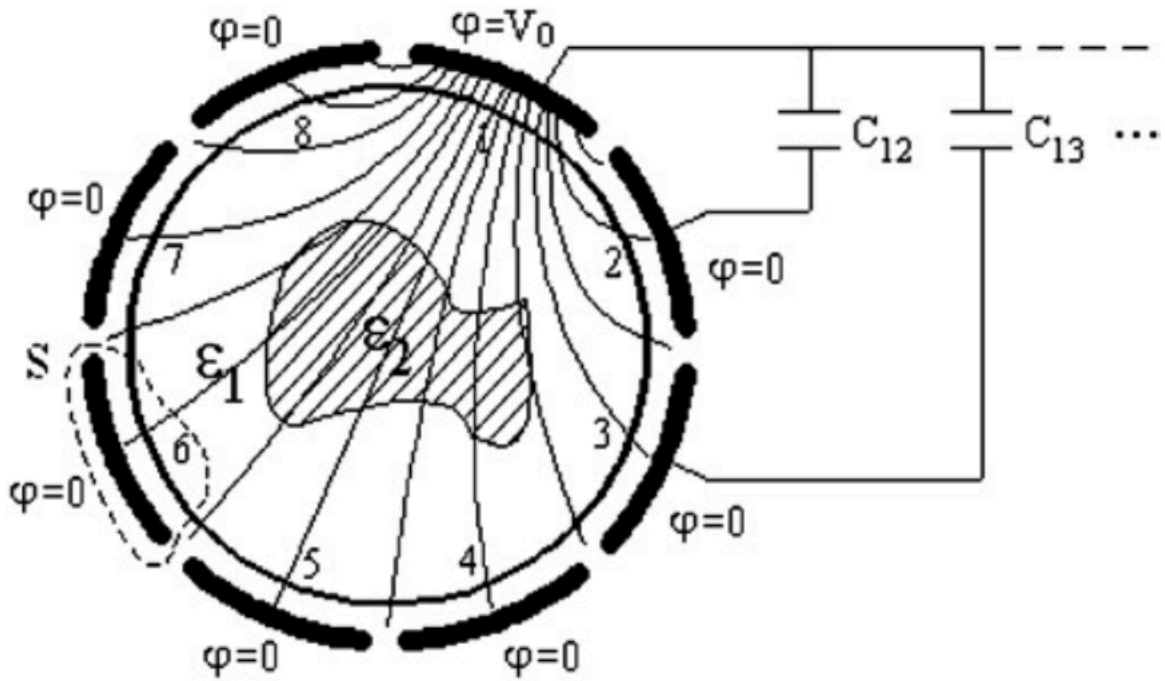
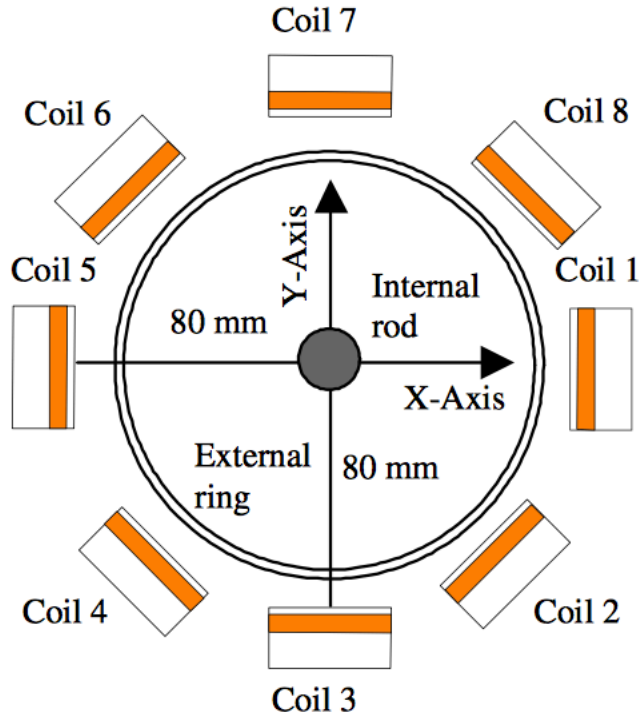
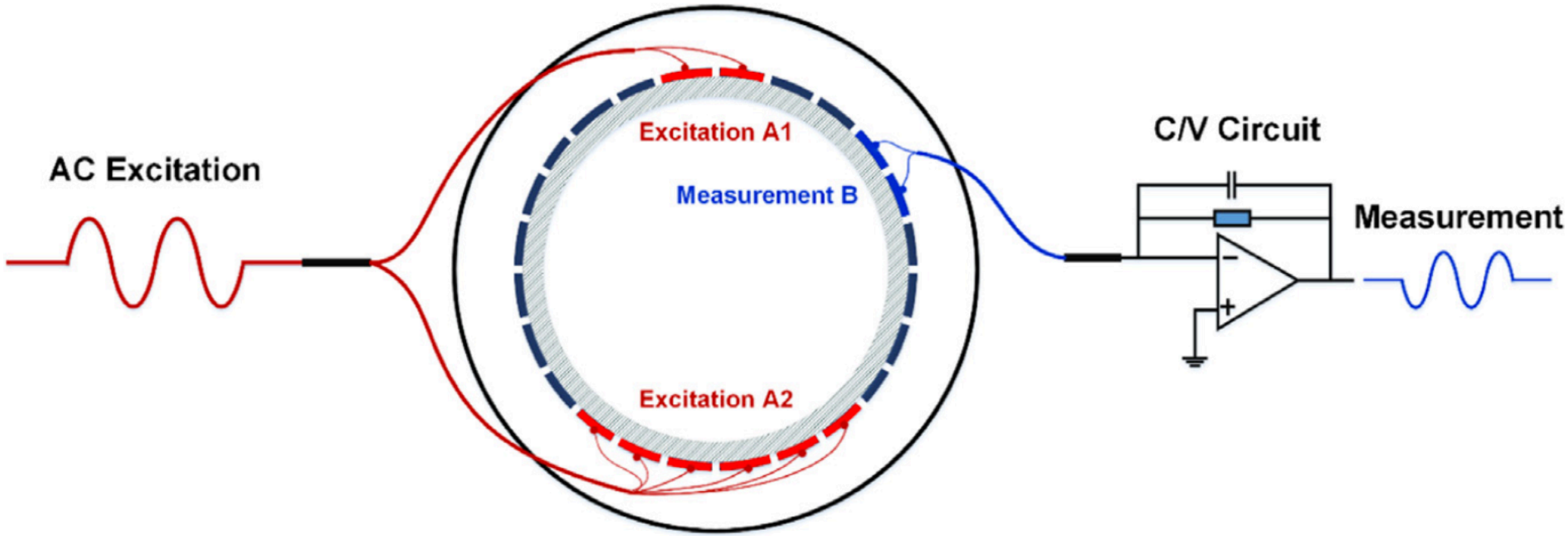
1
ES
IA
RS
5
8
IP
6
7
d

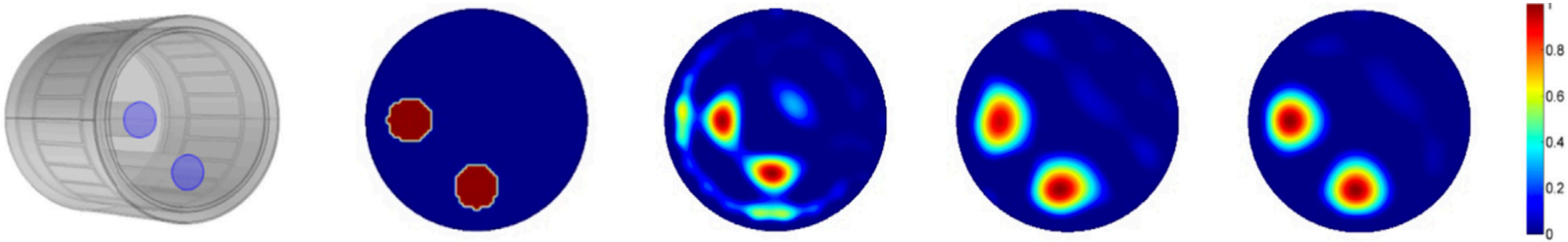

φ=0
φ=V0
φ=0
φ=0
φ=0
φ=0
φ=0
φ=0
C12
C13
ε1
ε2
1
2
3
4
5
6
7
8

(*a*)

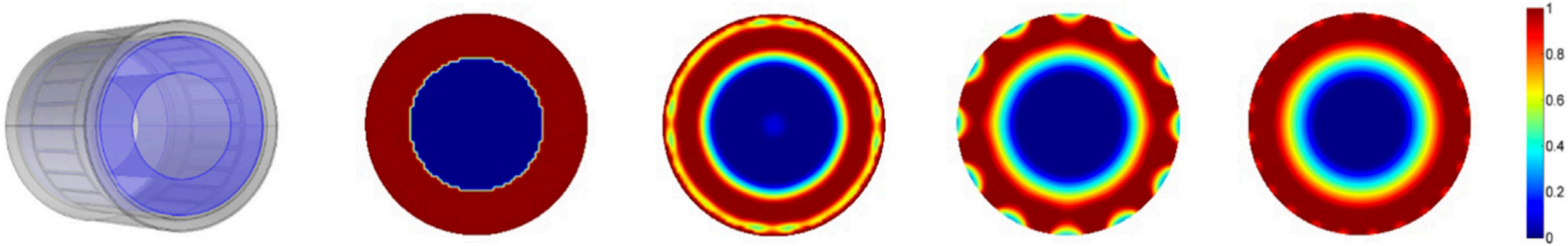

Coil 7
Coil 6
Coil 8
Coil 5
Coil 1
Coil 4
Coil 2
Coil 3
Y-Axis
X-Axis
Internal rod
80 mm
External ring
80 mm

(*b*)


AC Excitation
Excitation A1
Measurement B
Excitation A2
C/V Circuit
Measurement



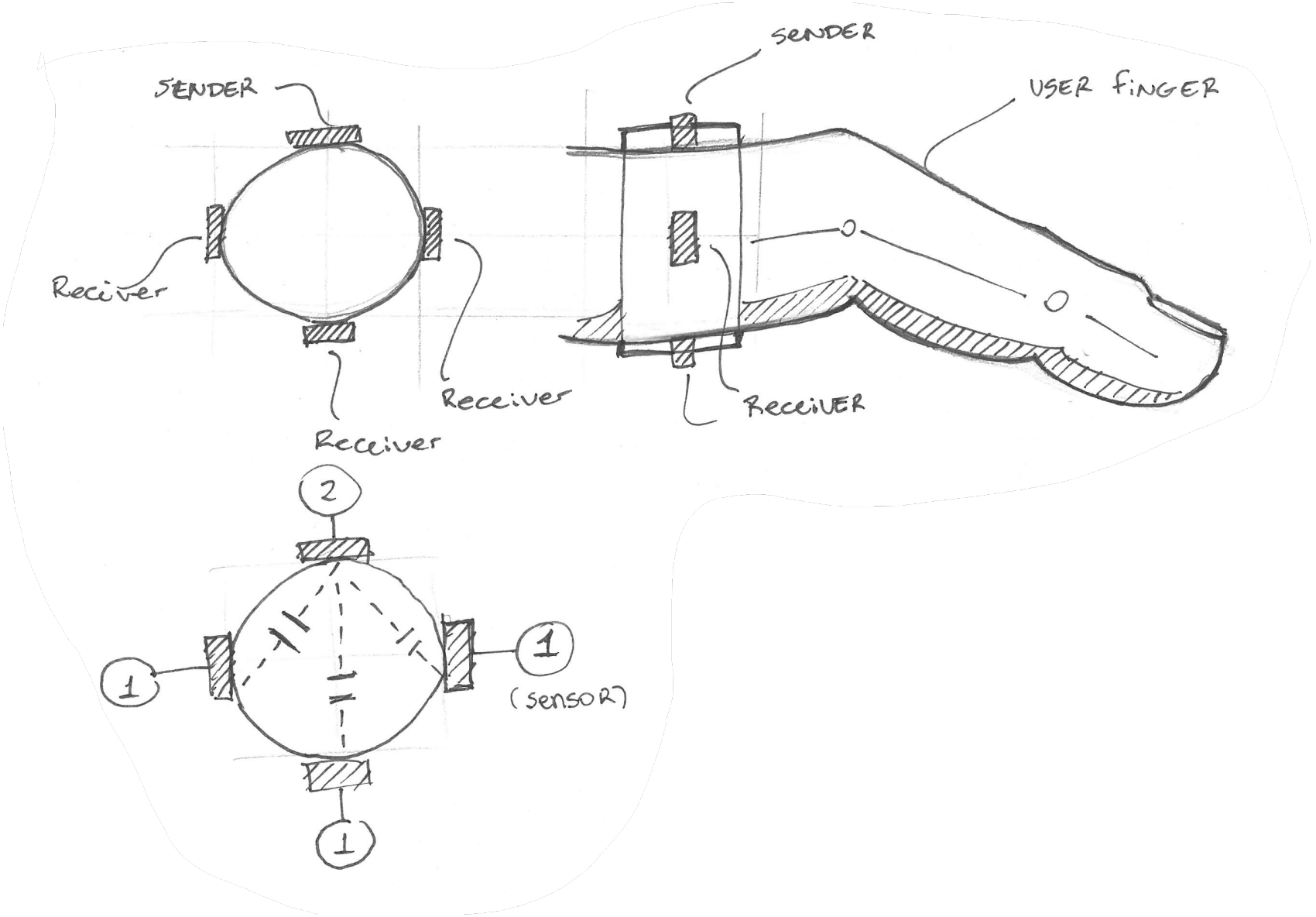
μ in Eq. (7)	0.001	0.001	0.001
Image error [%]	80.86	52.95	47.76
Correlation coefficient	0.5570	0.8393	0.8736



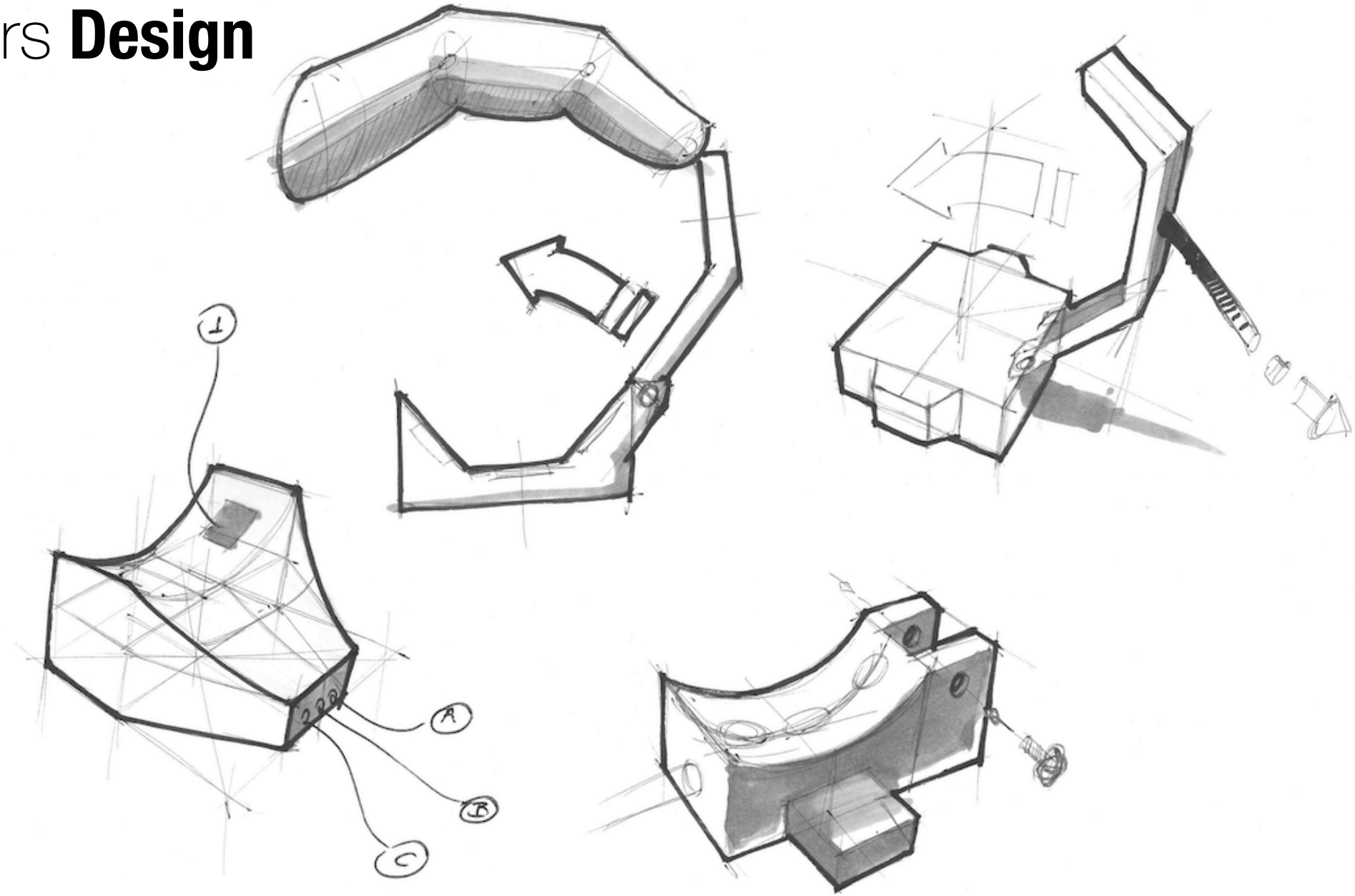
μ in Eq. (7)	0.001	0.001	0.001
Image error [%]	24.19	26.58	23.49
Correlation coefficient	0.9290	0.9076	0.9257

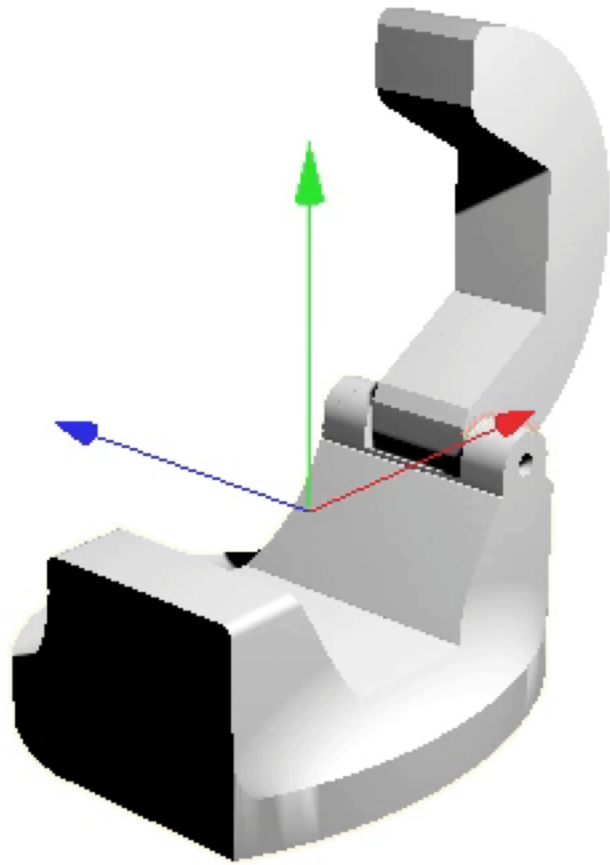
Sensors Design

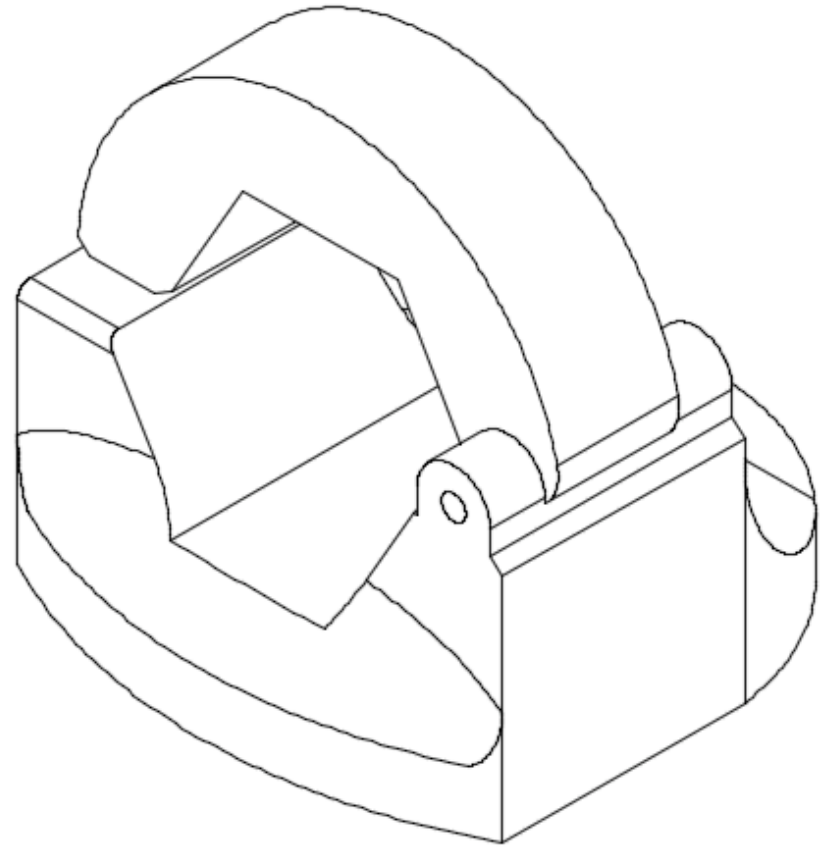
Sensors Design



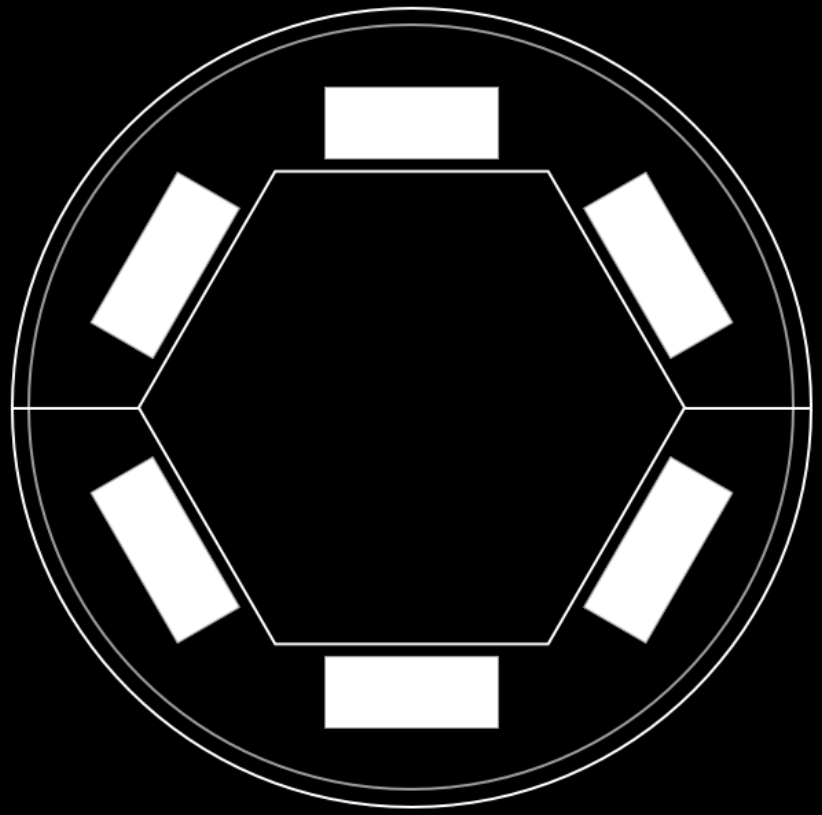
Sensors **Design**

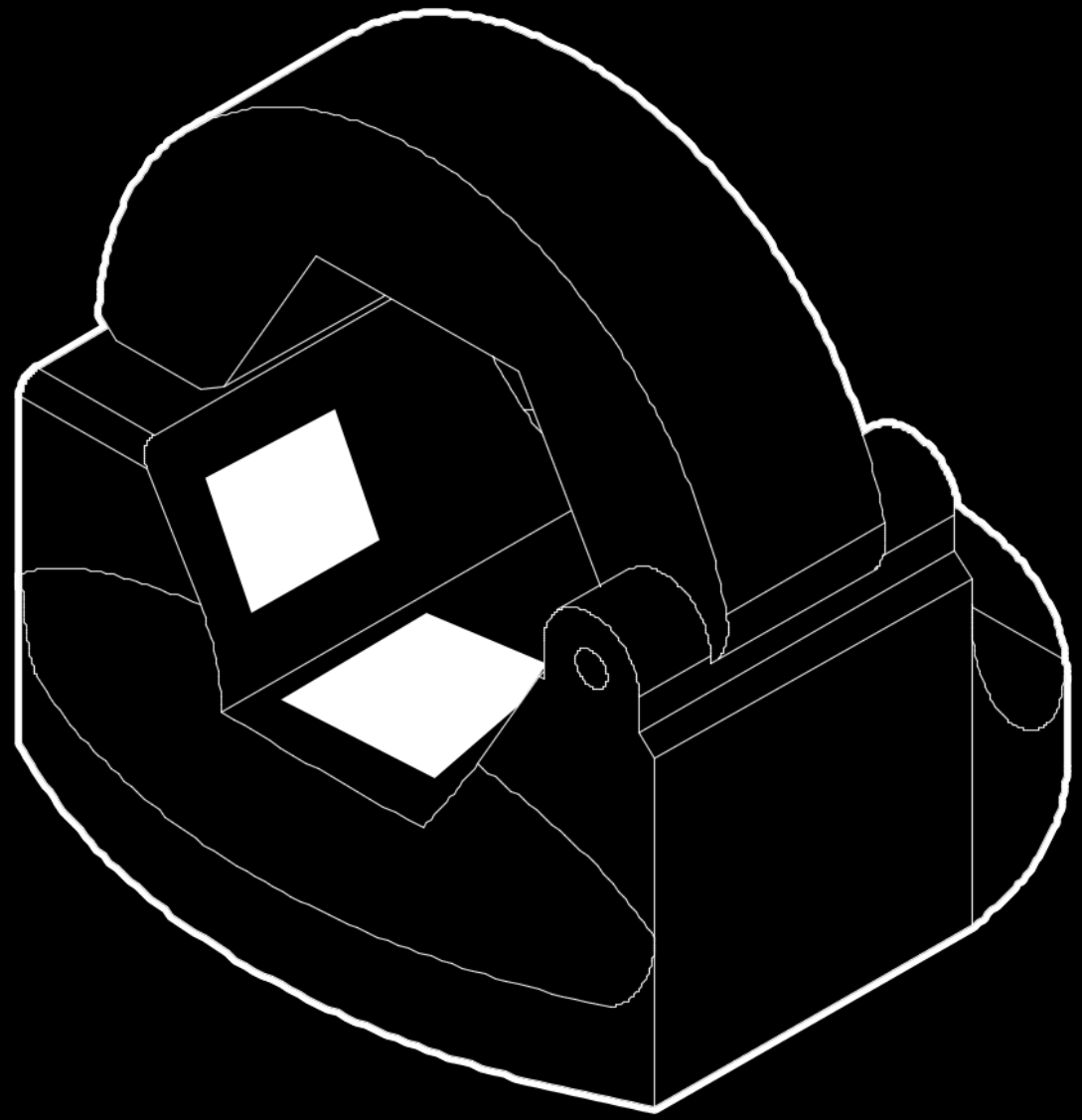






Sensors **Design**





Capacitive **Sensors**

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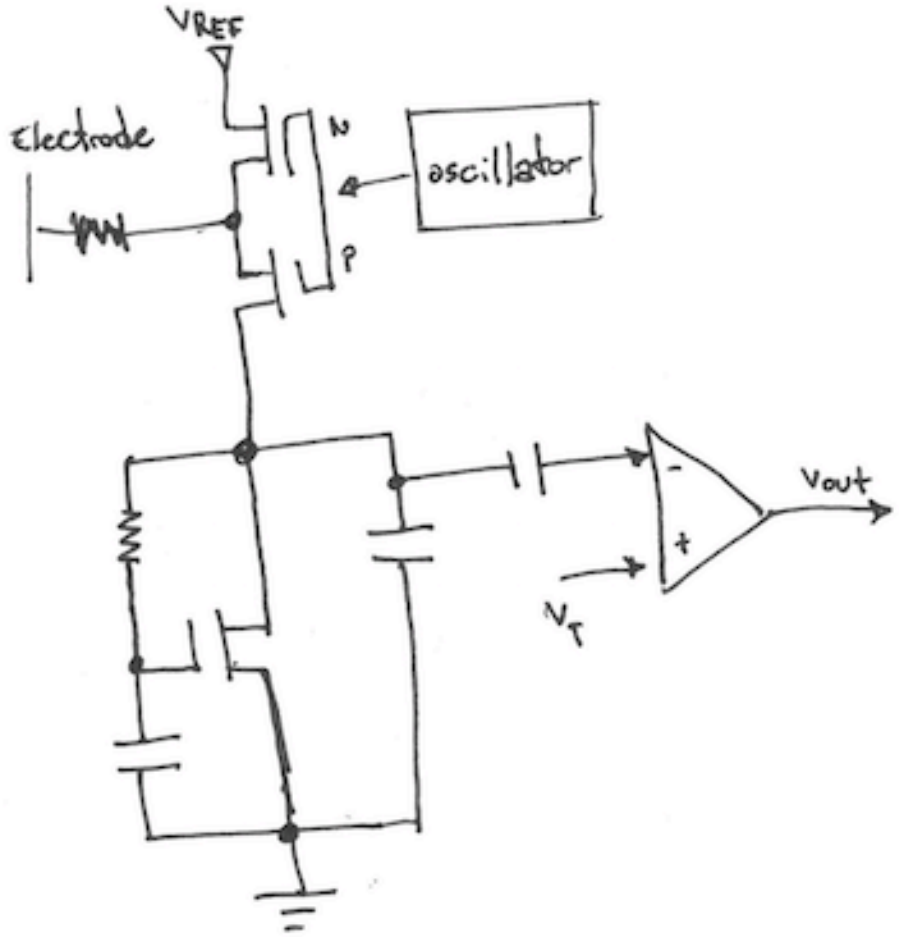
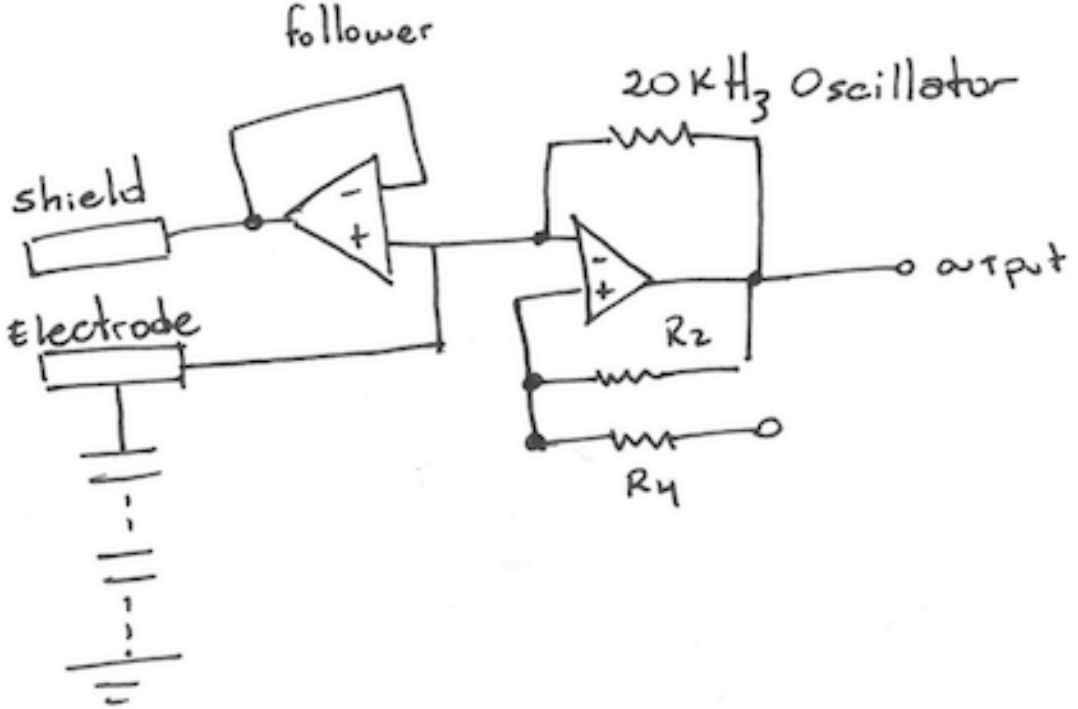


CAPACITIVE Intrusion Detector



FREQUENCY modulator controlled by the input capacitances

Capacitive **Sensors**

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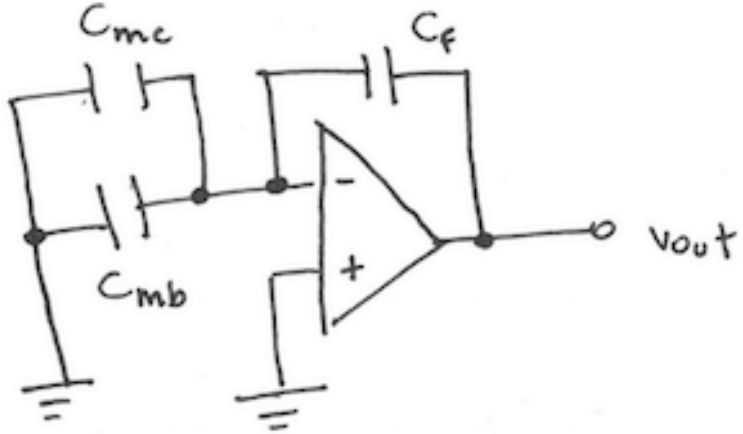
CAPACITANCE - to - Voltage conversion



- C_{mc} = top plate
- C_{mb} = bottom plate

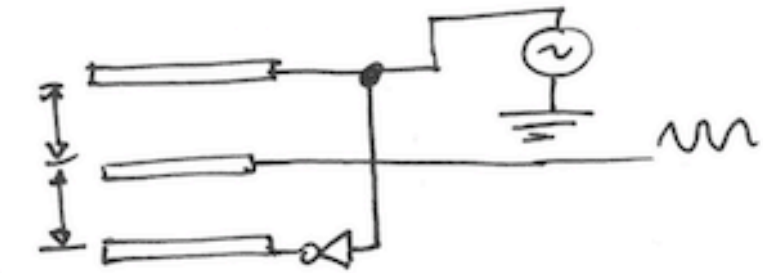
TODO

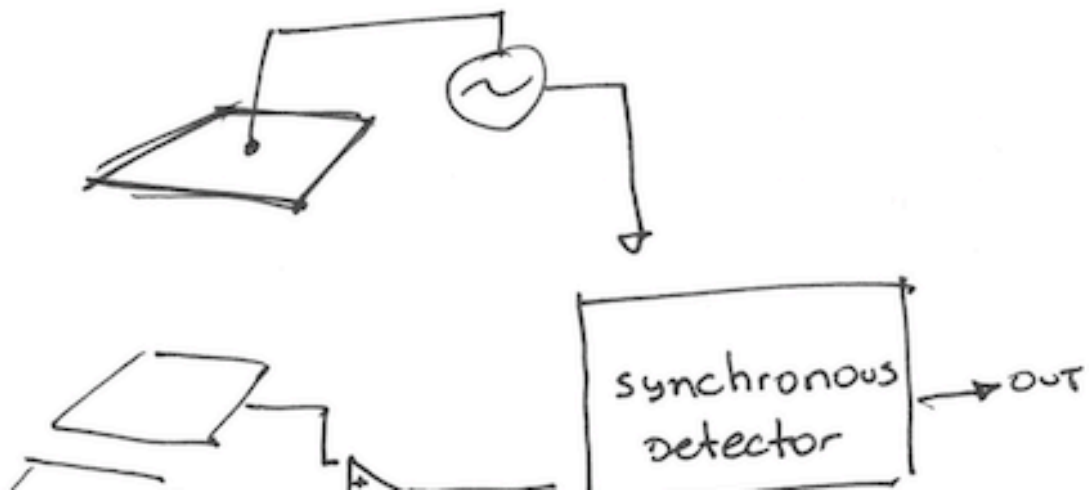
→ get dielectric constants (k)

@ 40MHz

- skin, blood, muscle = 97
- fat, bone = 15

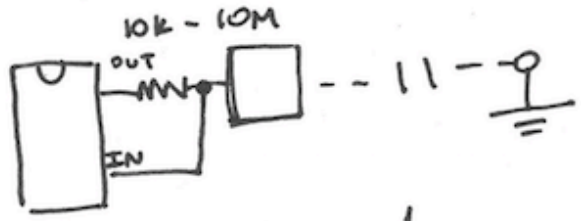
P. 259 Capacitive Sensors





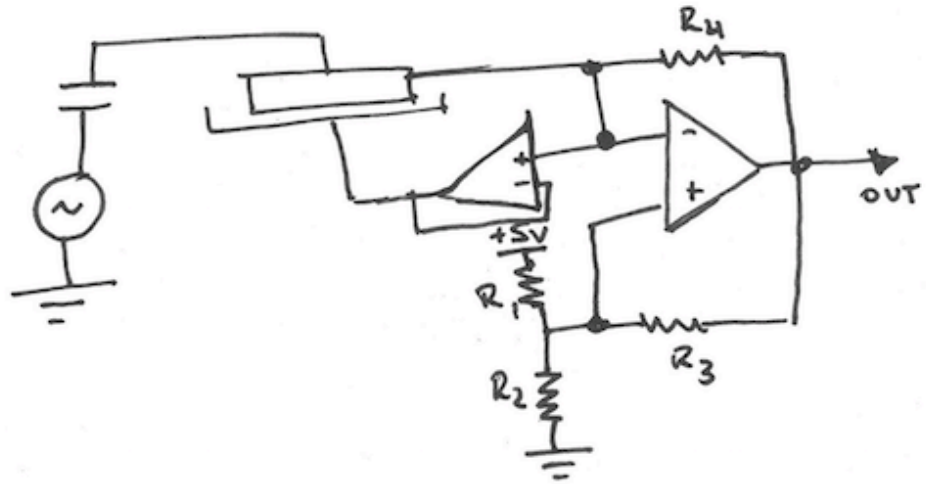
CAPACITIVE SESSING TECHNIQUES

→ LOADING MODE SENSING



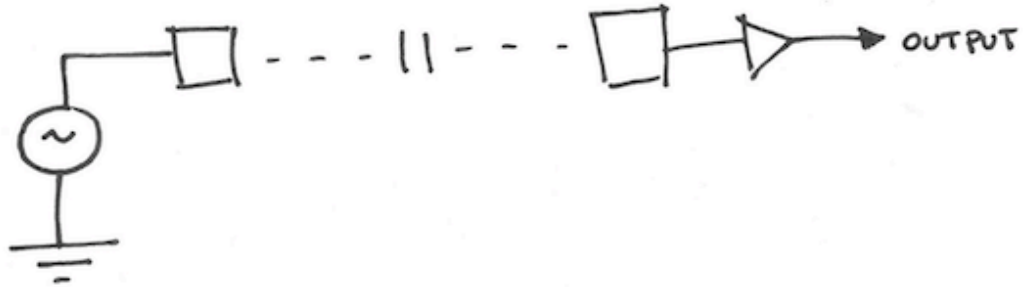
$$\Delta T = \frac{1}{RC}$$

→ CAPACITIVELY CONTROLLED MULTIVIBRATOR

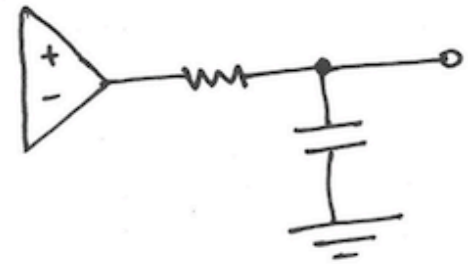


frequency = f_{CC}

→ TRANSMIT MODE

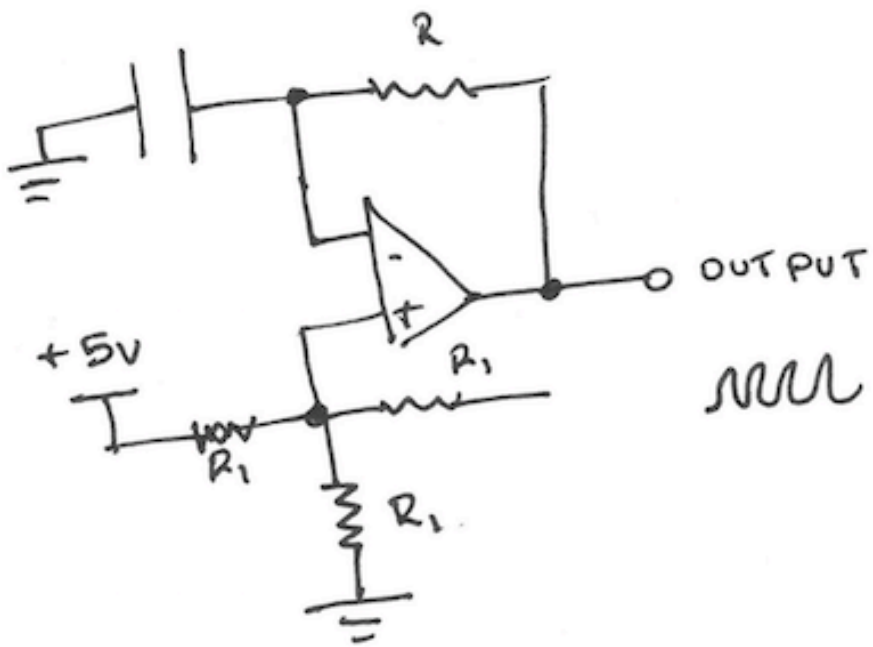


→ ALTERNATING CURRENT BRIDGE

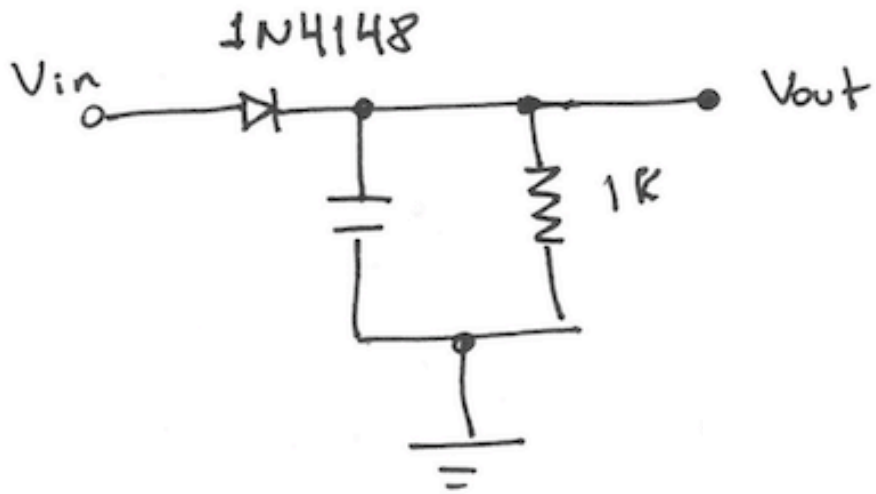


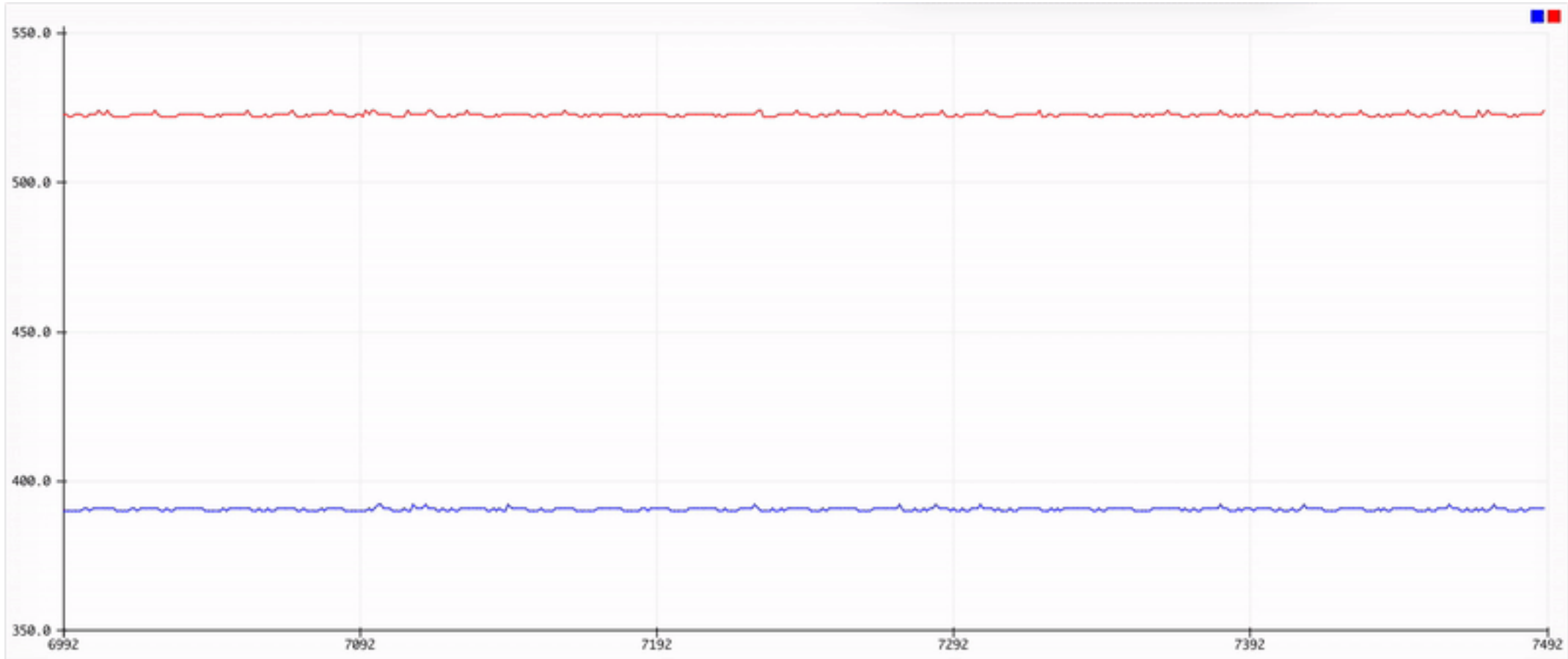
Final **Schematics**

→ Relaxation oscillator



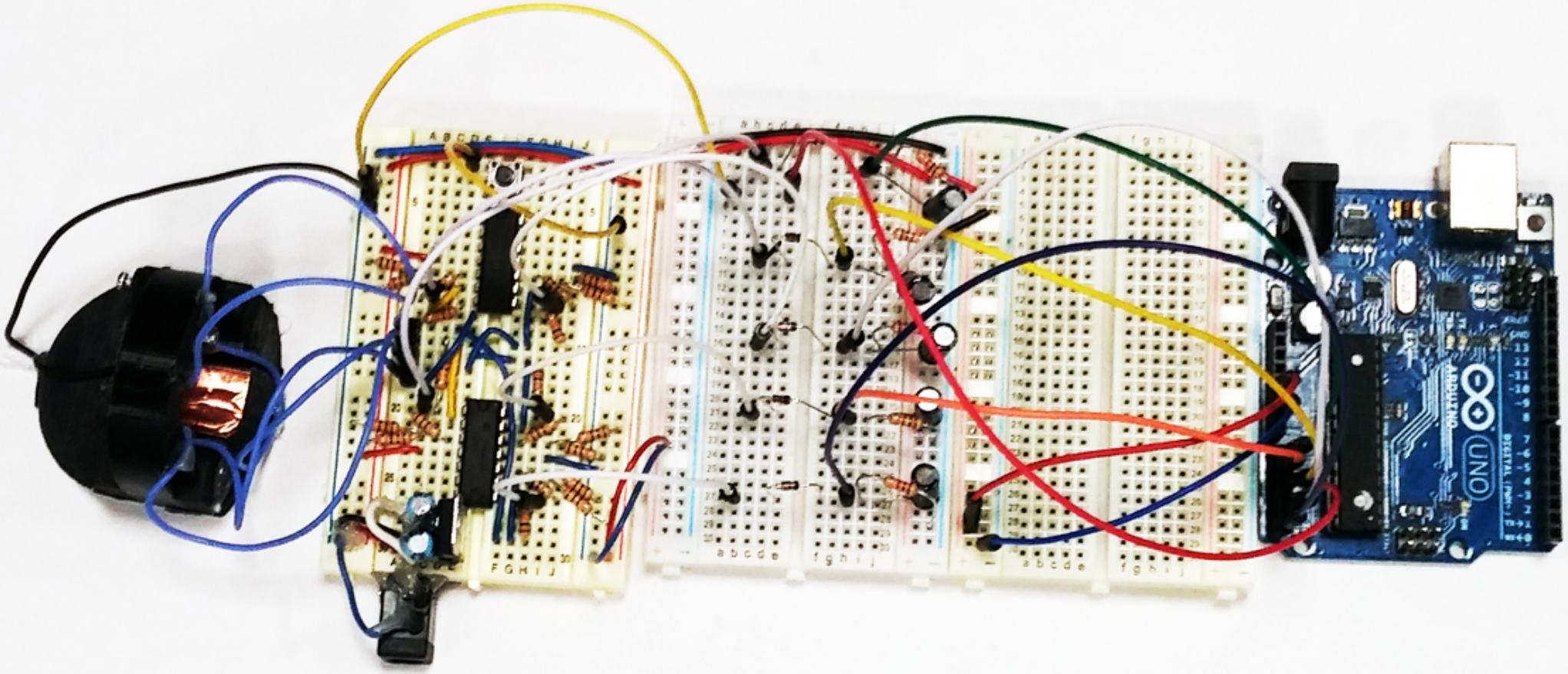
→ Envelope Follower

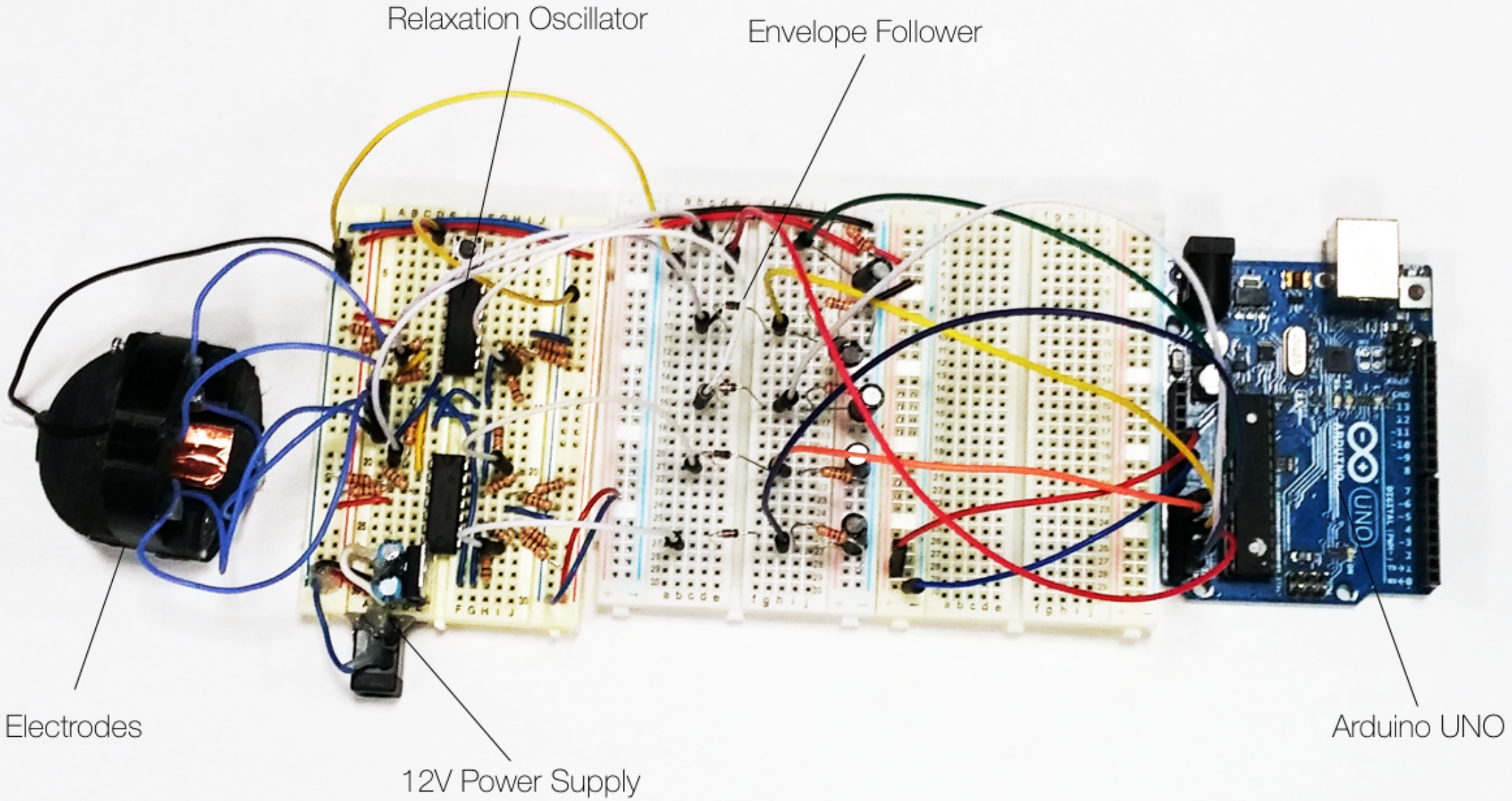




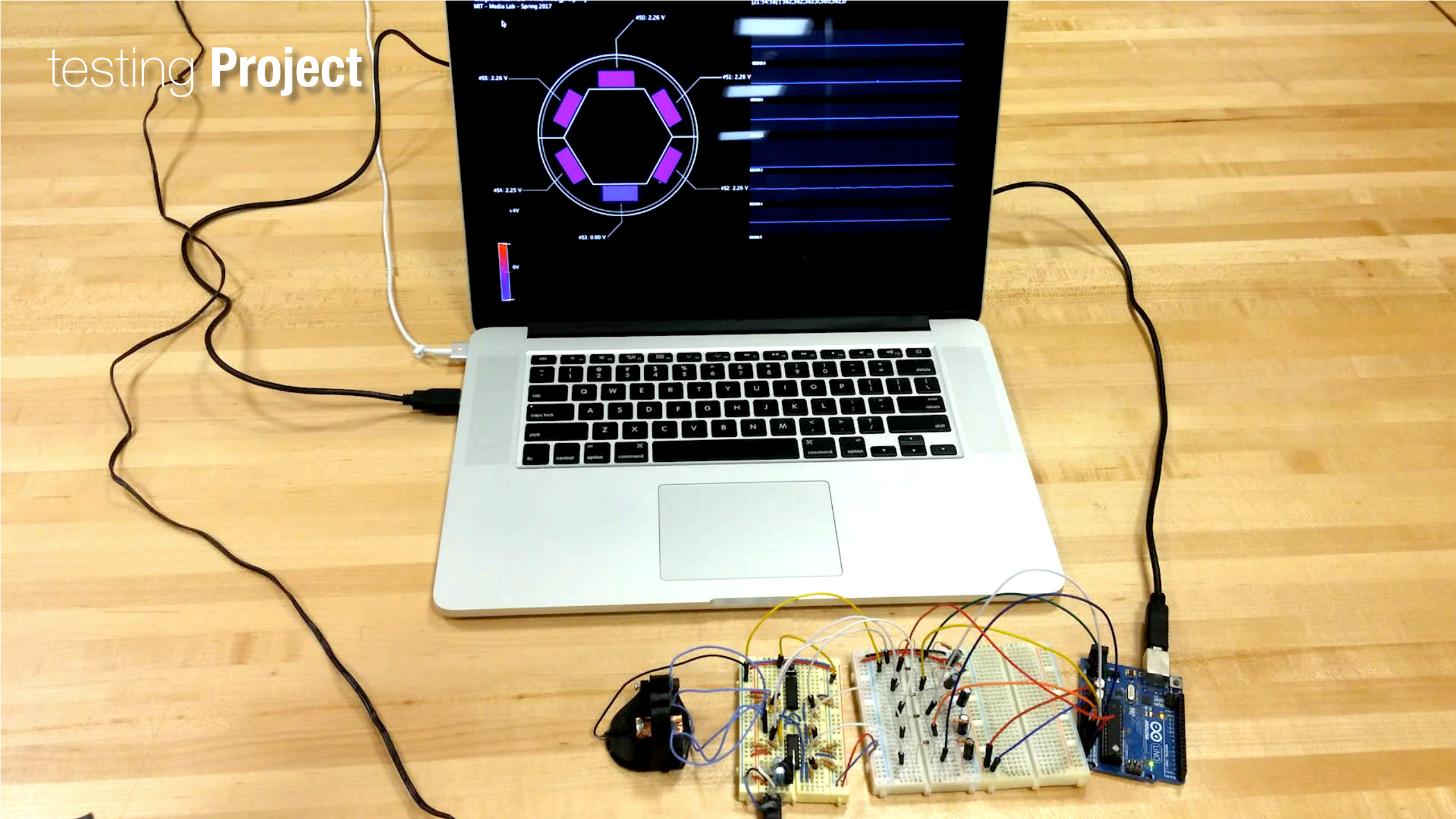
Signal From Oscillator

Signal after Envelope Follower

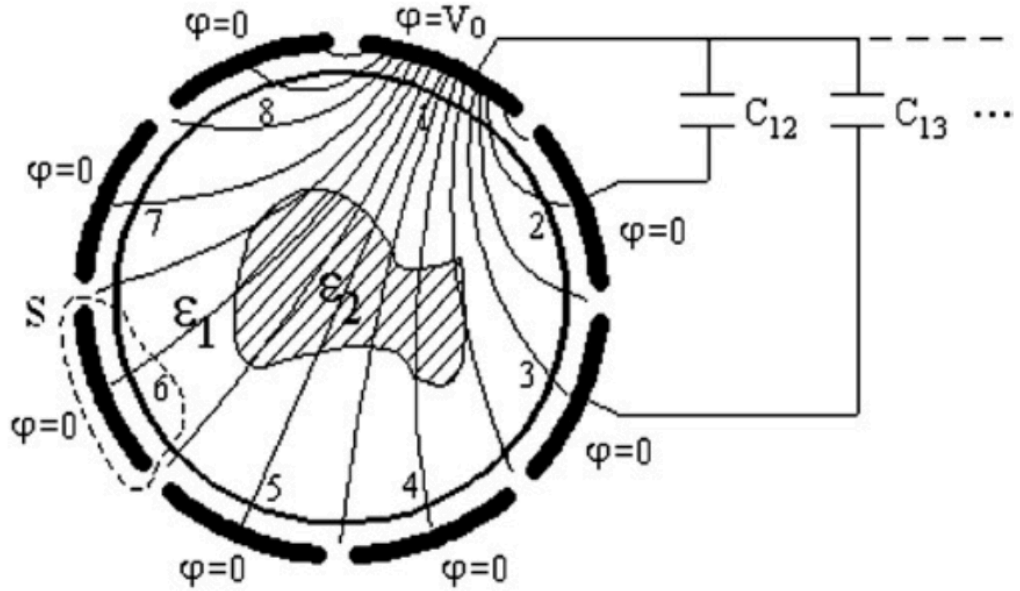

UNO


Relaxation Oscillator
Envelope Follower
Electrodes
12V Power Supply
Arduino UNO

testing **Project**



Main **Mistakes**



(*a*)

References

- http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=620456
- http://iopscience.iop.org/article/10.1088/0957-0233/7/3/003/pdf
- http://iopscience.iop.org/article/10.1088/0957-0233/18/11/004/pdf
- http://www.scielo.br/pdf/eagri/v31n2/a06v31n2.pdf