

MEASURING MECHANICAL VIBRATIONS USING AN ARDUINO
AS A SLAVE I/O TO AN EPICS CONTROL SYSTEM

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GOALS OF THE PROJECT

- Arduino Slave
 - Connect accelerometers
- Serial communication
 - Protocol design
- Matlab analysis of data
 - Transfer function
- EPICS integration



HARDWARE

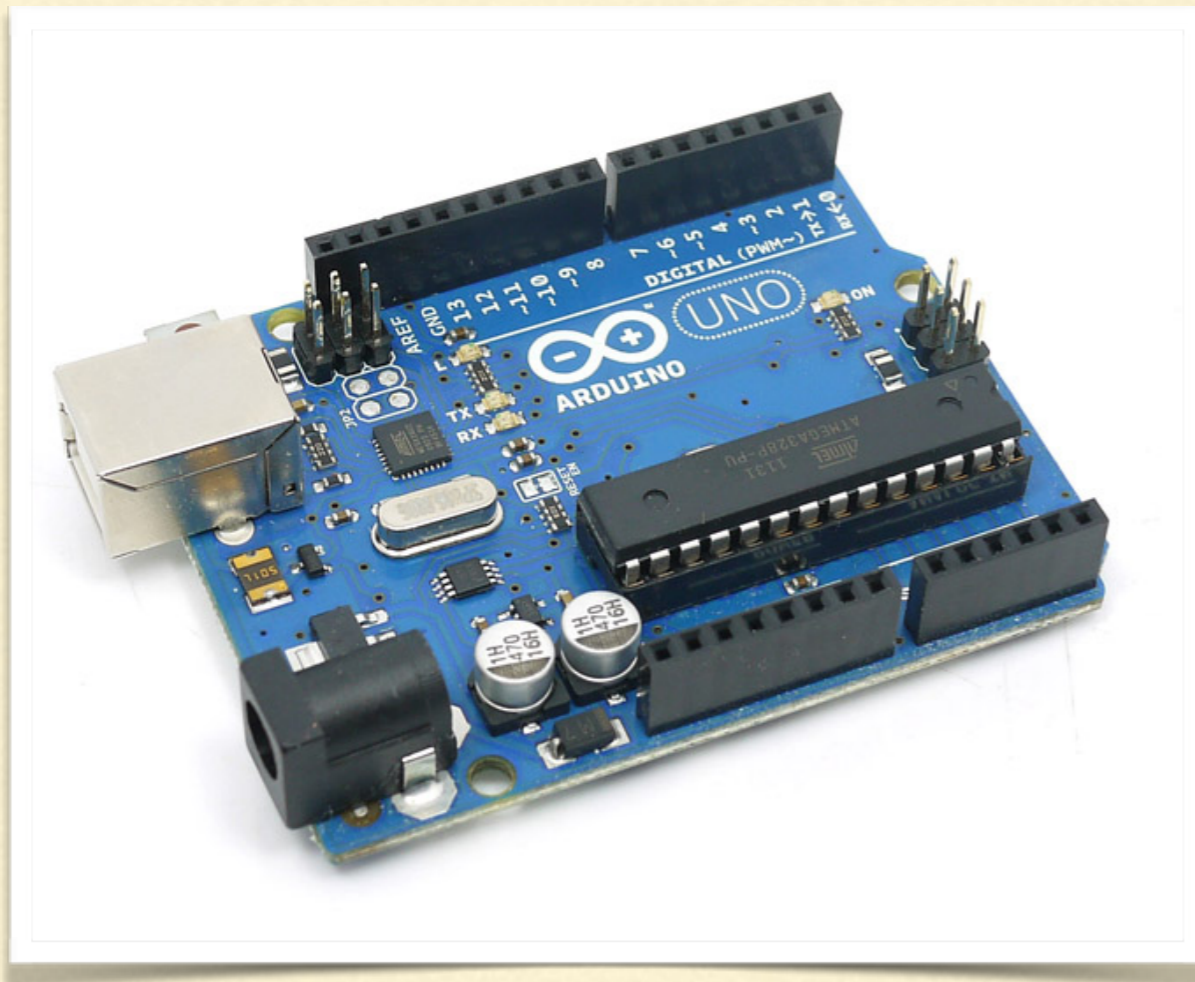


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ARDUINO SLAVE

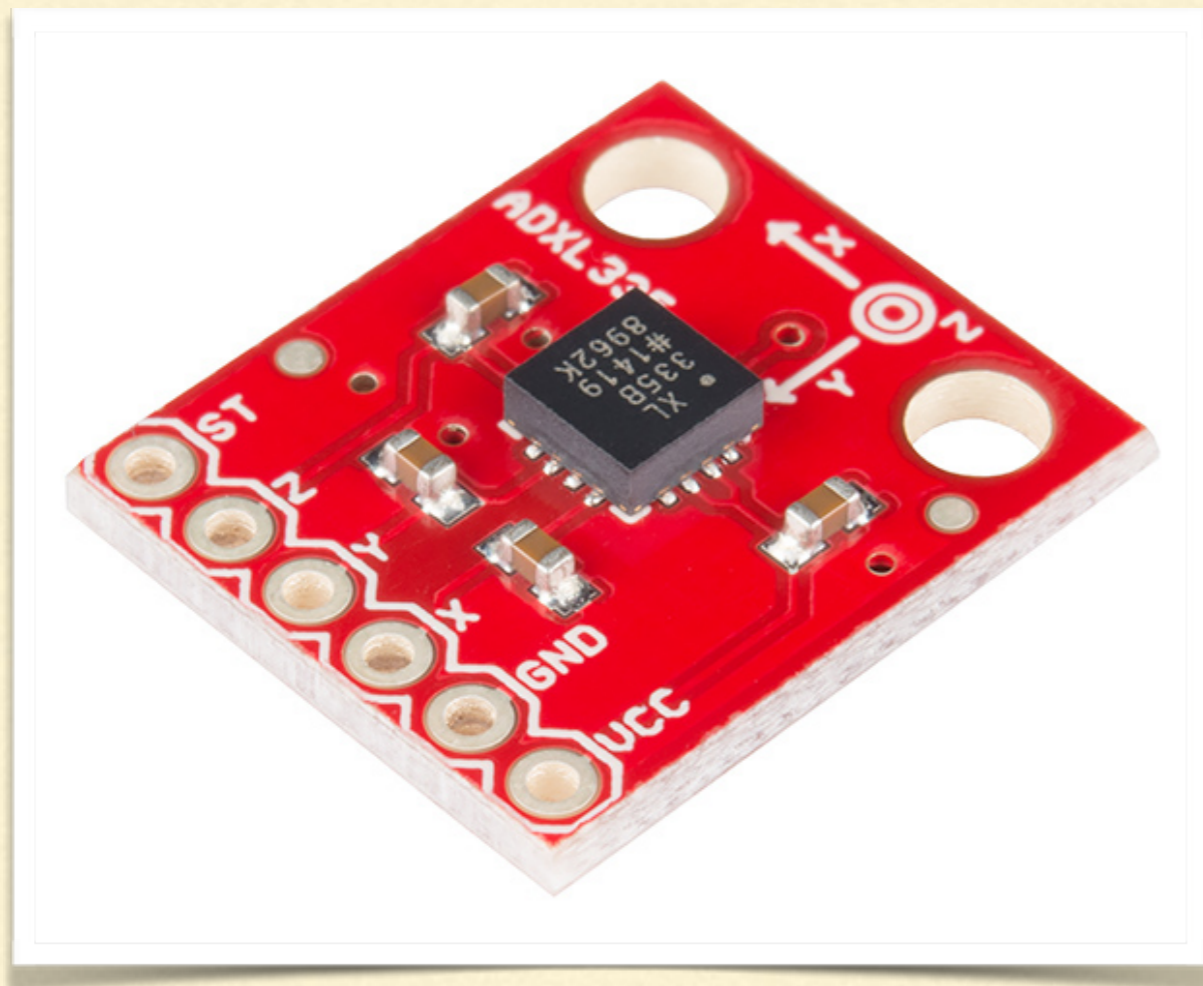


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- Arduino UNO
- 8-bit microcontroller
- ATmega328
- 2 kb SRAM memory 8-bit microcontroller
- Sampling frequency of 1 kHz
- Custom made serial protocol for easy implementation

ADXL335 - ACCELEROMETER

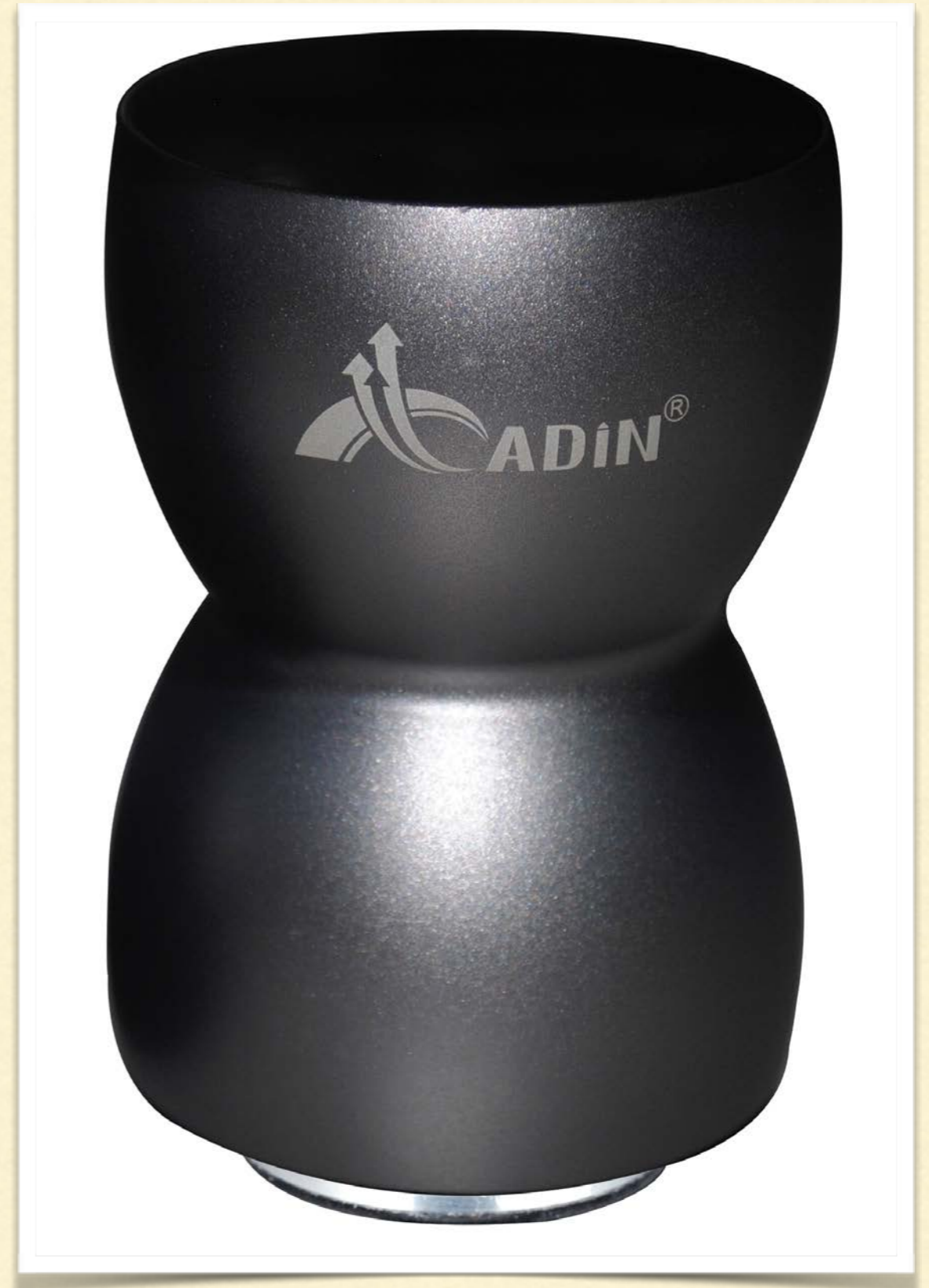


- 3 axis analog accelerometer
- ± 3 g
- 25-1600 Hz sampling rate
- Low cost (~15\$)



TONE GENERATOR

- Adin 26W vibration speaker
- Bluetooth



SOFTWARE



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ARDUINO PROGRAMING

```
ArduinoSlave
1 //
2 // Arduino Slave
3 //
4 // Author          Adam Hjort, Måns Holmberg
5 //
6 // Date            2015-03-11 00:00
7 // Version         1.0
8 //
9 // See            ReadMe.txt for references
10 //
11
12 // Include libraries
13 #include <MsTimer2.h>
14
15
16 // Define variables and constants
17 const int NUM_ANALOG = 6; // Total number of analog pins available
18 const int NUM_DIGITAL = 14; // Total number of digital pins available
19 const int BUFFER = 512; // Buffer size
20 int analogdataArray[BUFFER]; // Array to store waveform
21 int analogPin1;
22 int analogPin2;
23 int count = 0;
24 float in, out;
25 long period = 1; // Period of interupt (maximum period is 2.15 billion secor
26 // ...
```

Done compiling.

Sketch uses 10,658 bytes (33%) of program storage space. Maximum is 32,256 bytes.
Global variables use 1,412 bytes (68%) of dynamic memory, leaving 636 bytes for local variables. Maximum is 2,048 bytes.

39 Arduino Uno on /dev/tty.usbmodem1421

- User Friendly
- Based on C/C++
- setup() and loop()



ARDUINO INTERRUPTS

```
ArduinoSlave
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26 // ...
```

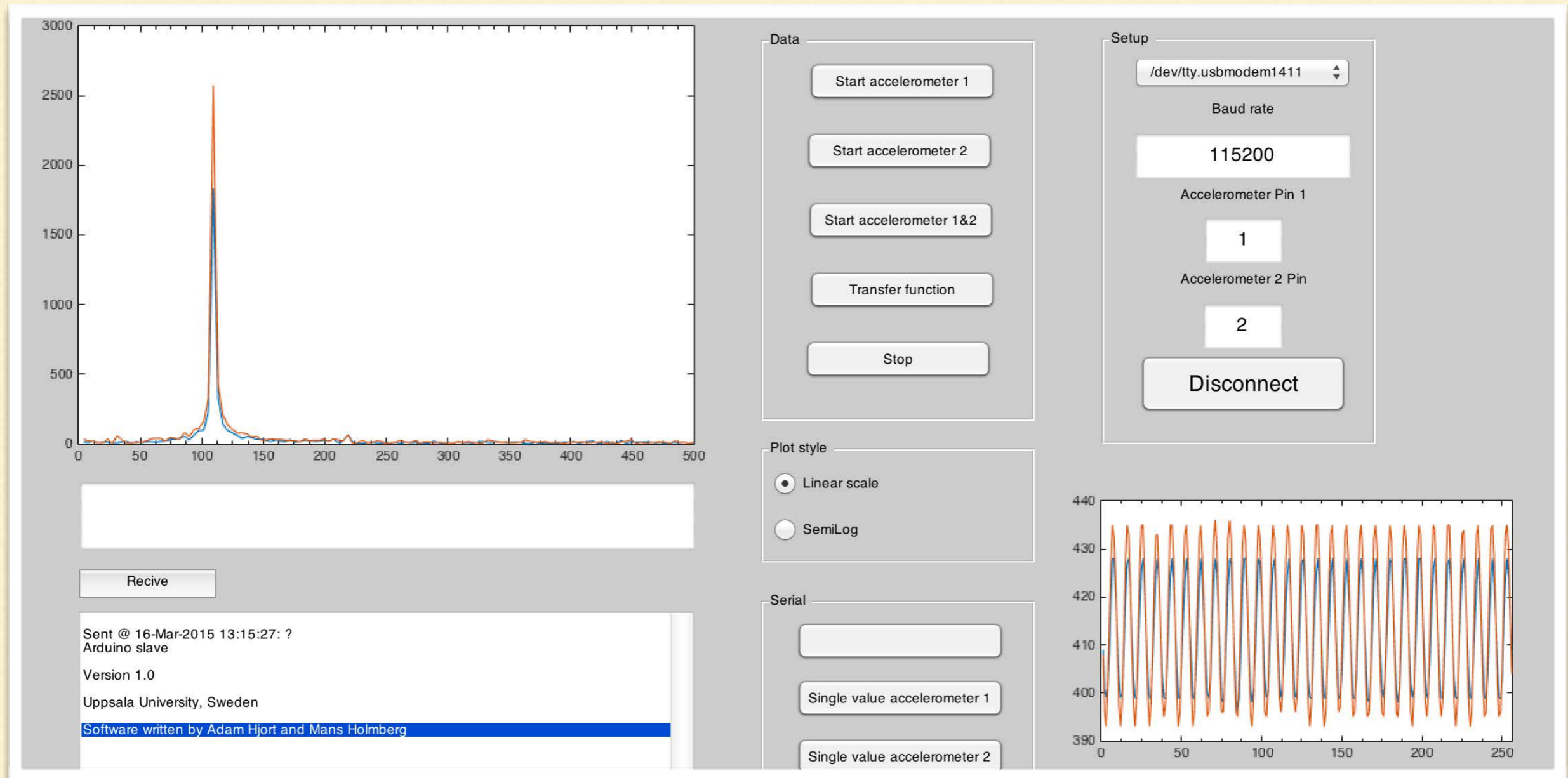
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39 Arduino Uno on /dev/tty.usbmodem1421

- MsTimer2
- Triggered by timer overflows
- 1 ms resolution
- 1 Khz sampling





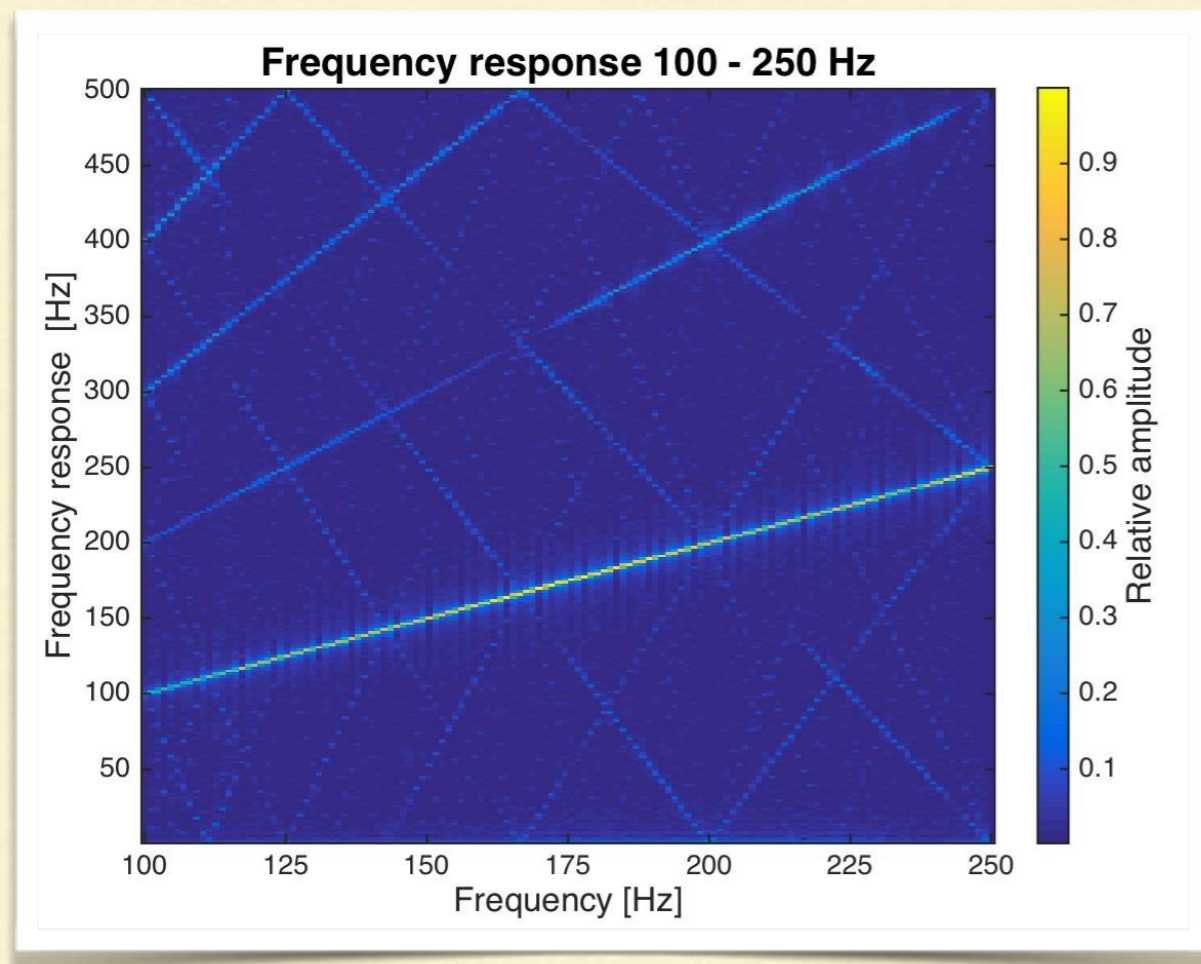
MATLAB ANALYSIS

GUI for easy testing



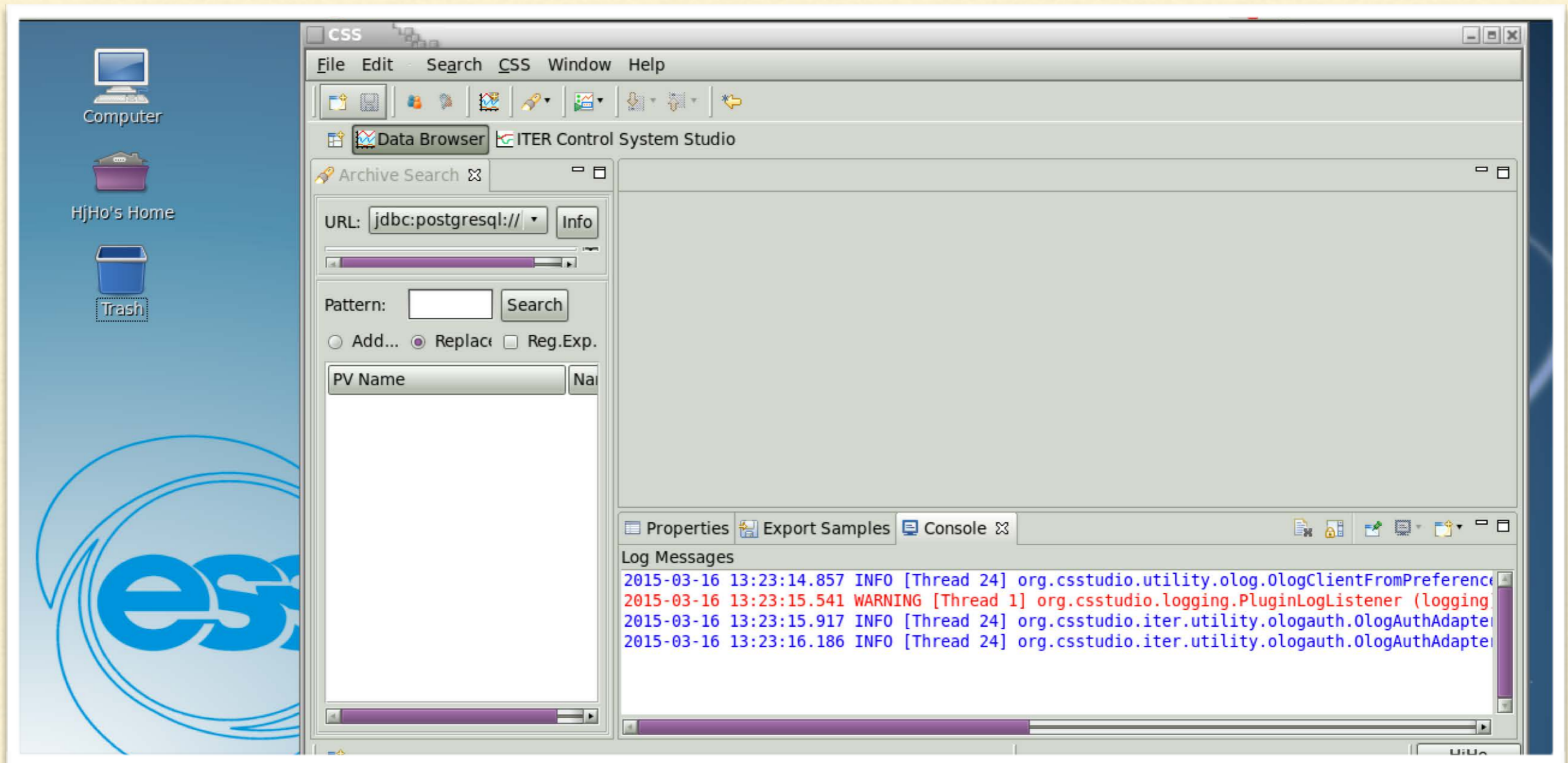
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ACCELEROMETER RESPONSE TEST



- Linear chirp 100-250 Hz
- Linear response
- Visible harmonics due to table





EPICS INTEGRATION

Implement protocol in EPICS database-file.

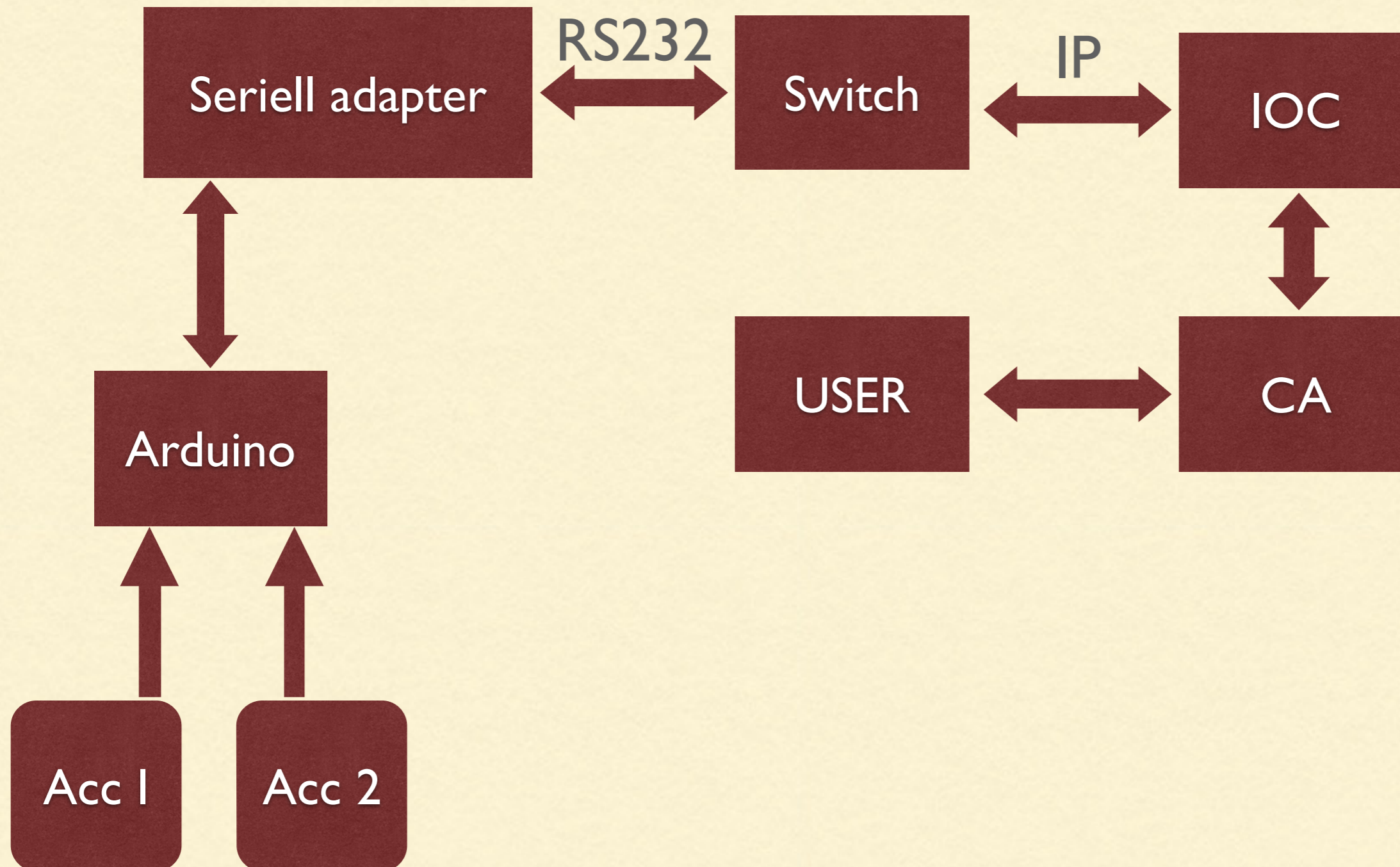


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EPICS



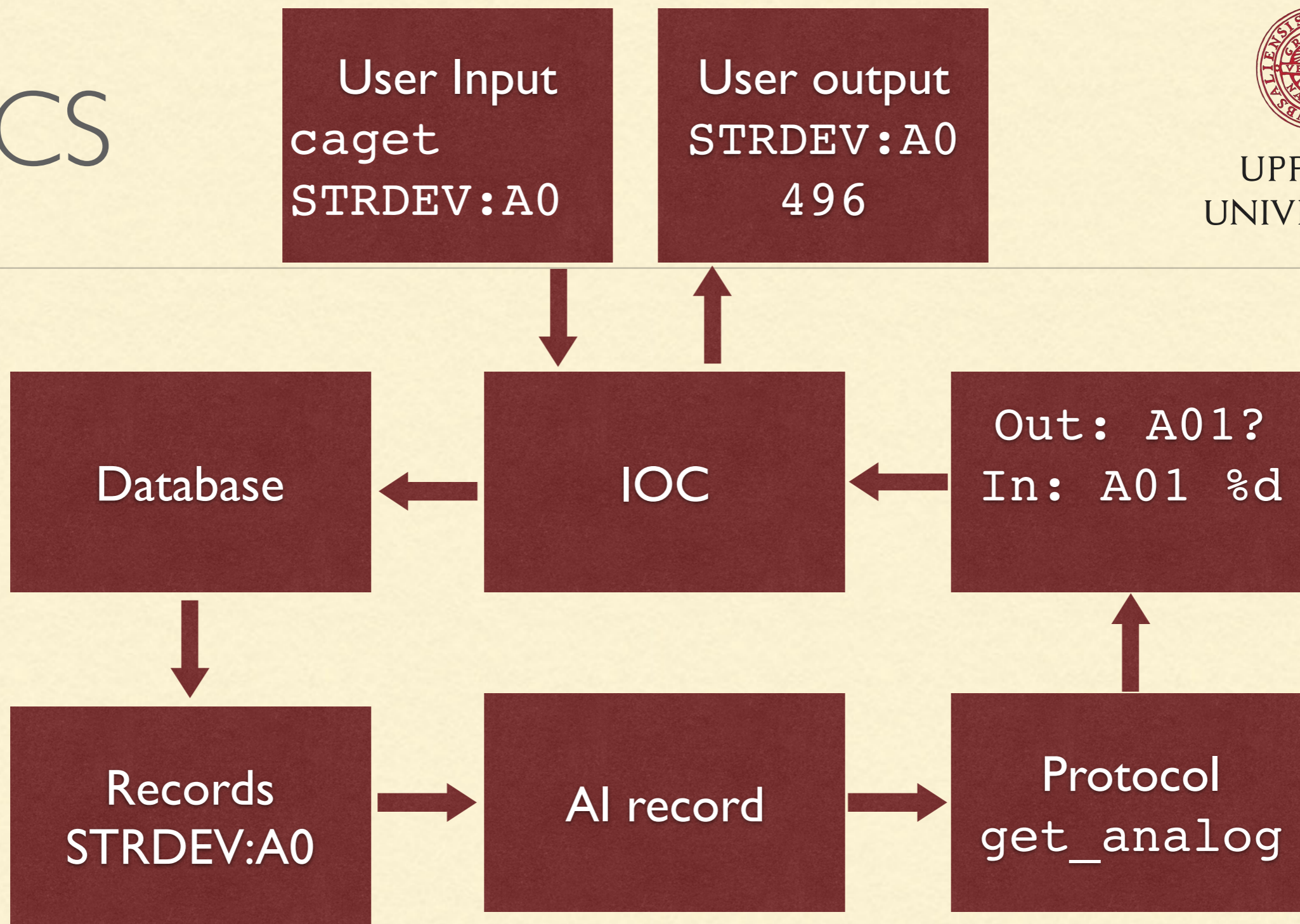
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EPICS



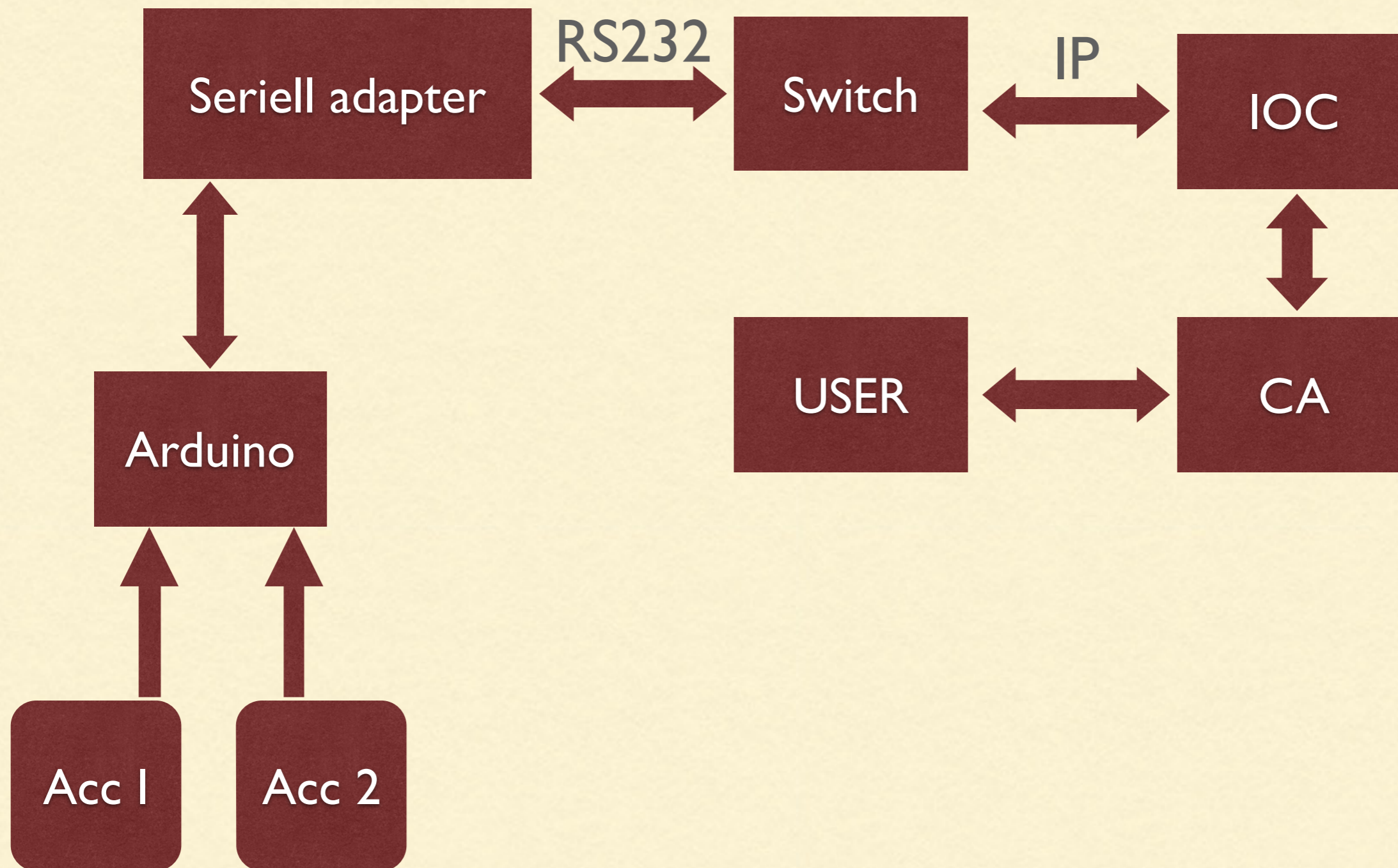
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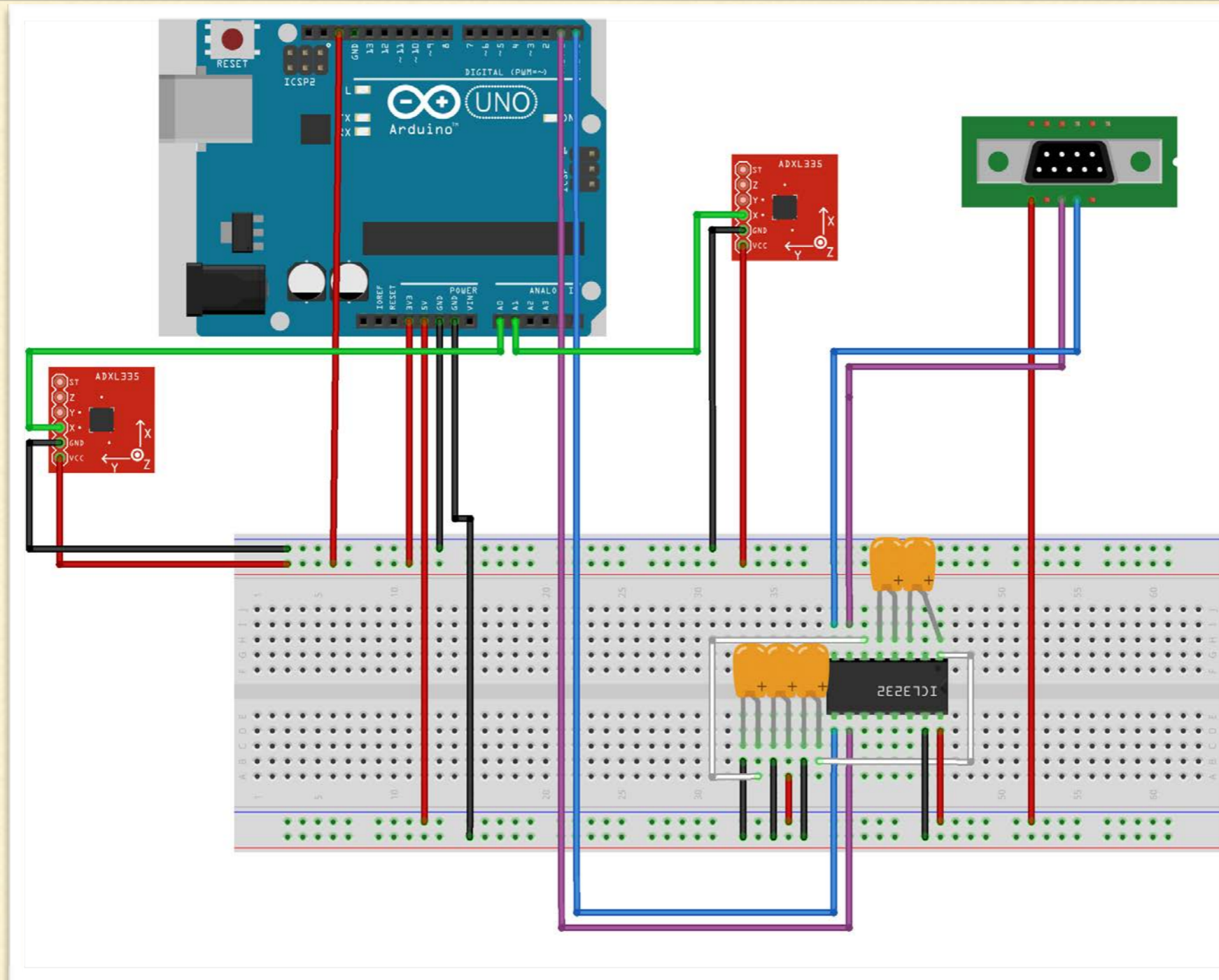


EPICS



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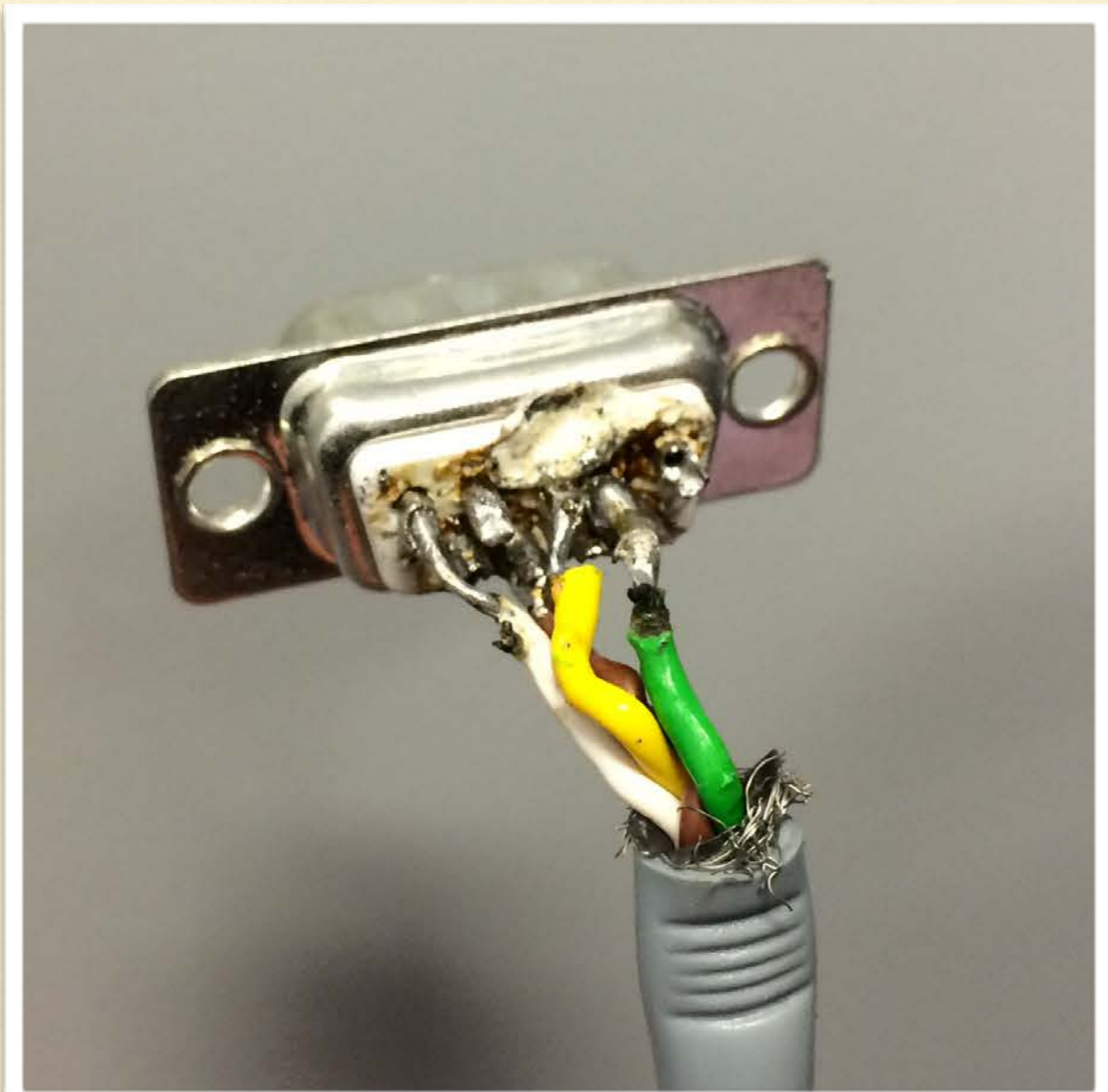
ELECTRONIC SCHEMATIC

MAX232 IC to connect to serial switch



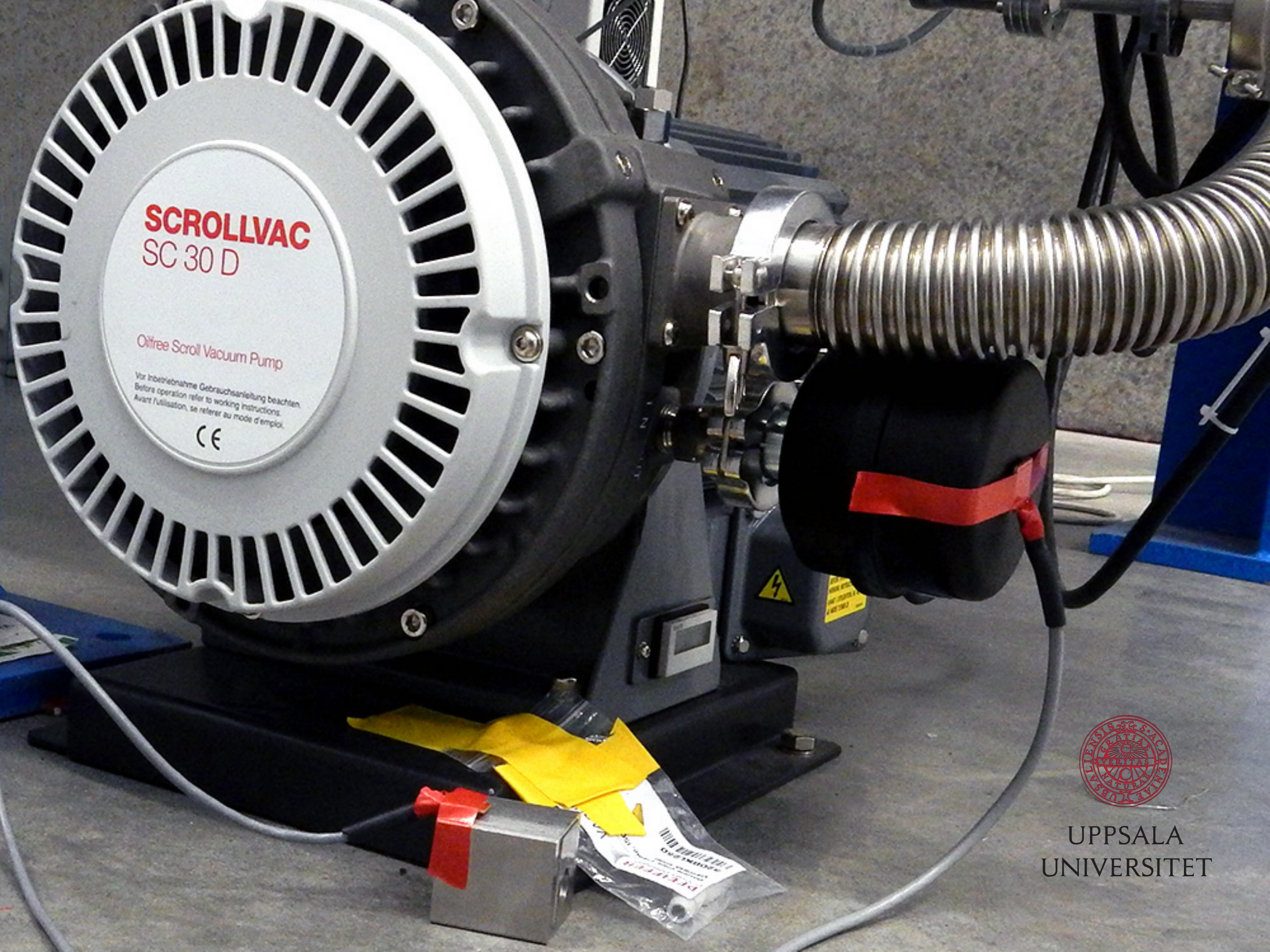
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FOR FUTURE STUDENT TO DO



- GUI
- Wireless





SCROLLVAC
SC 30 D

Oilfree Scroll Vacuum Pump

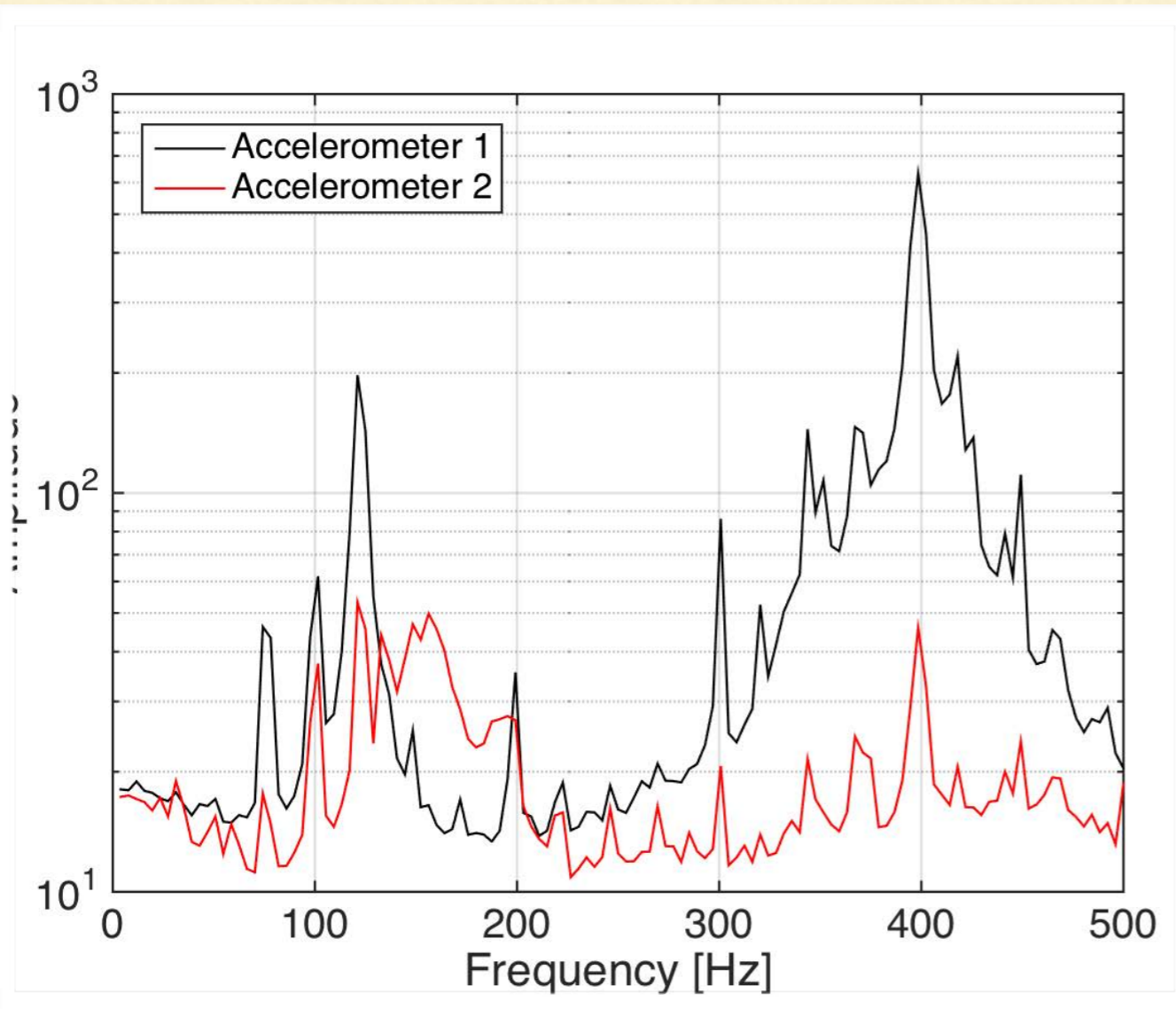
Vor Inbetriebnahme Gebrauchsanleitung beachten.
Before operation refer to working instructions.
Avant utilisation, se référer au mode d'emploi.

CE



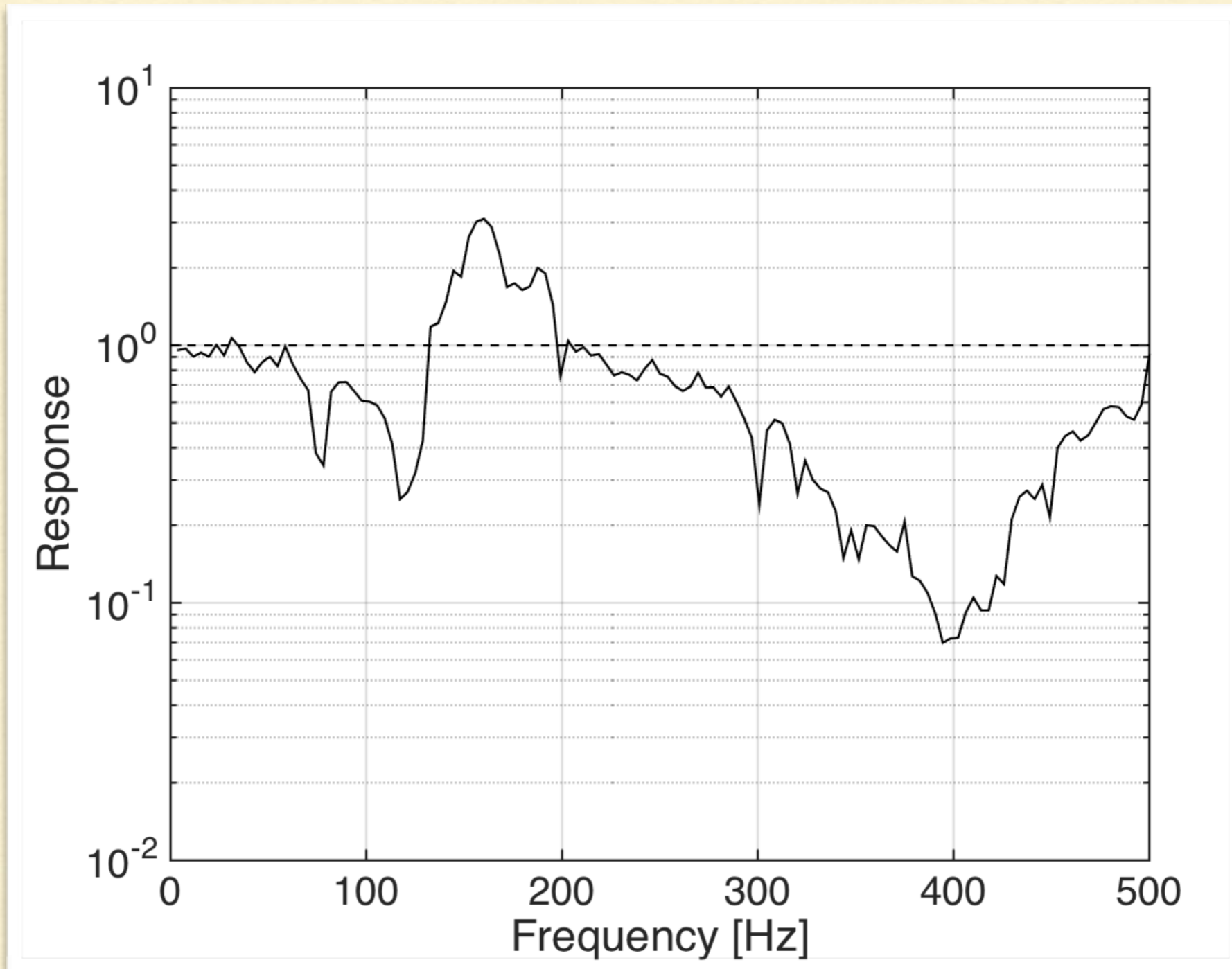
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VACUUM PUMP



- 30 minutes of sampling
- Accelerometer 1 on pump
- Accelerometer 2 on floor
- FFT
- Corelate





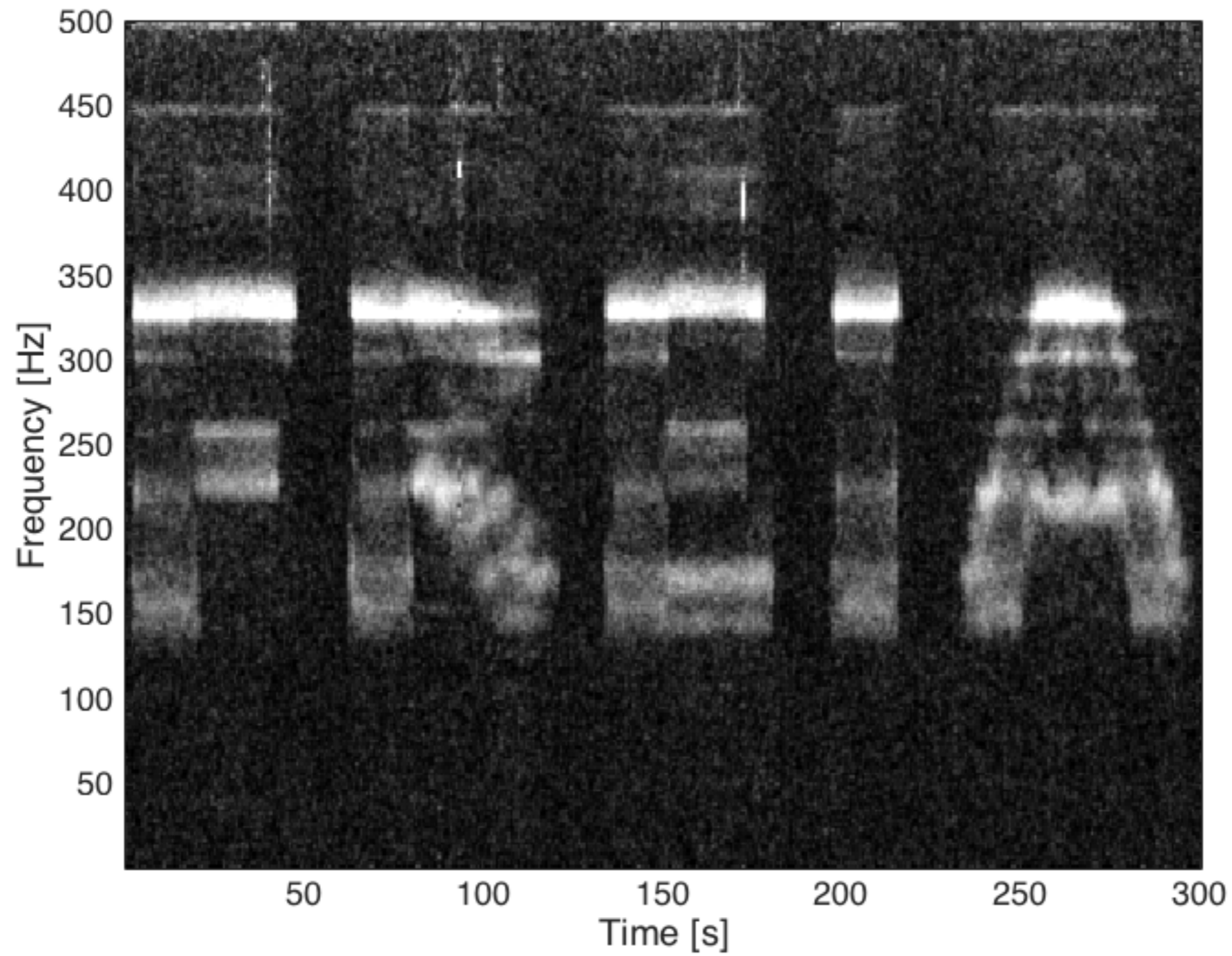
TRANSFER FUNCTION

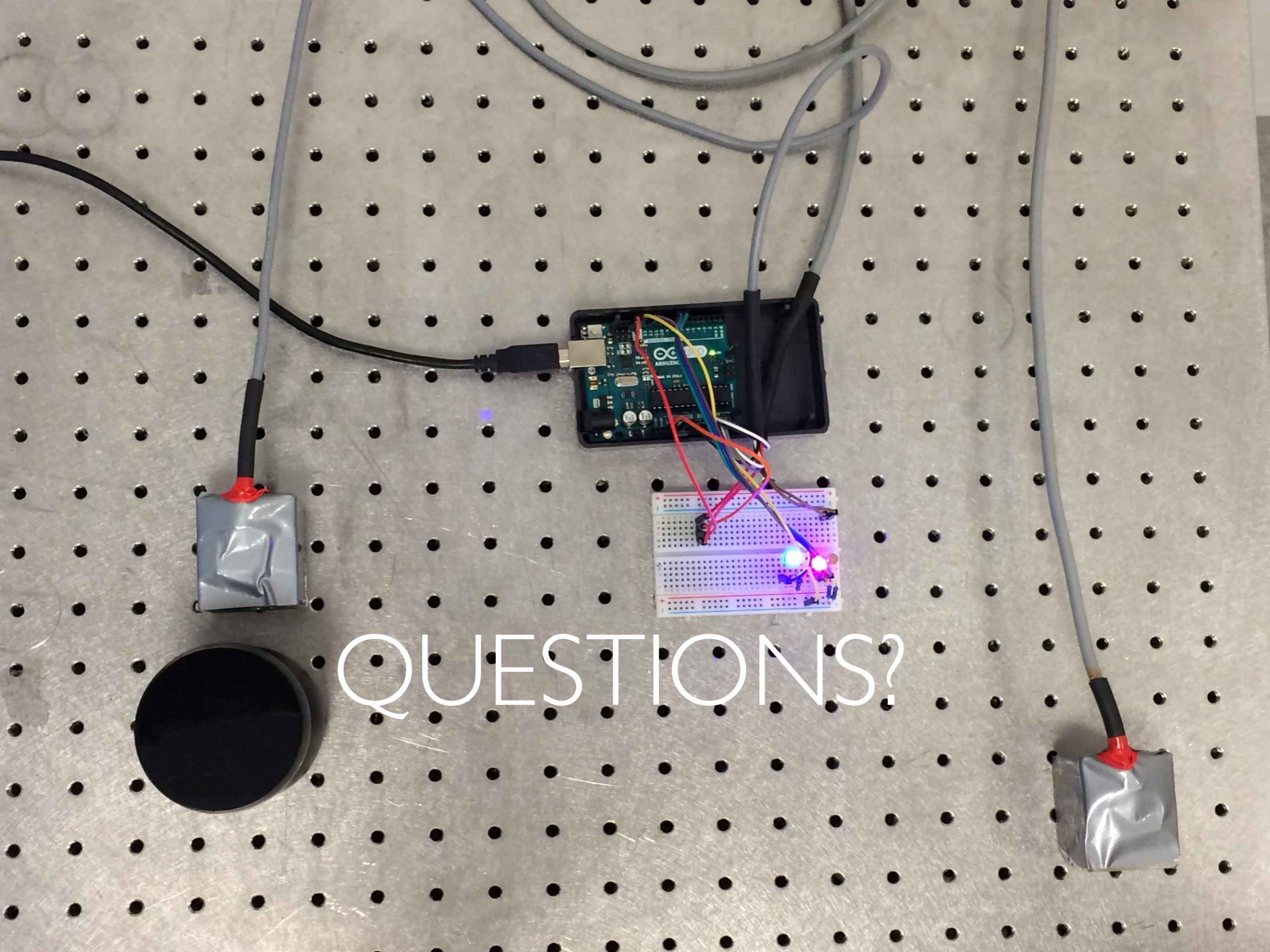


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QUESTIONS?