

Creating a System to Remotely Monitor the Impedance Change in Cement

UNIVERSITY of HOUSTON

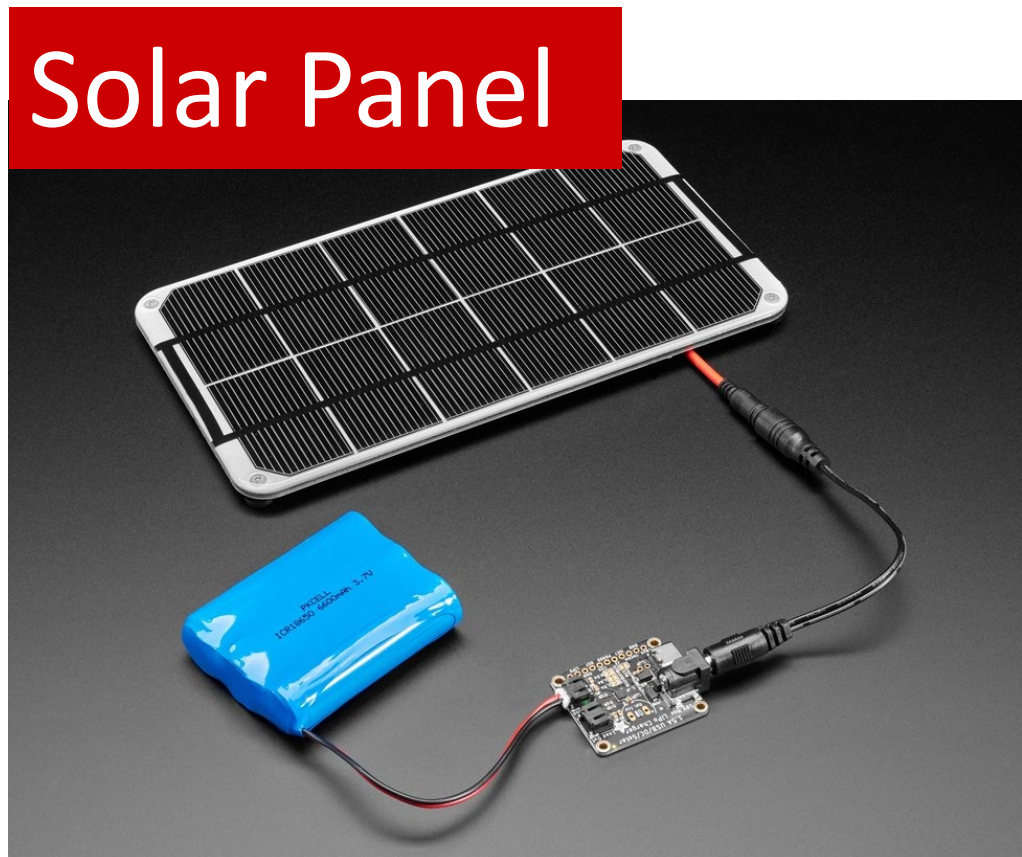
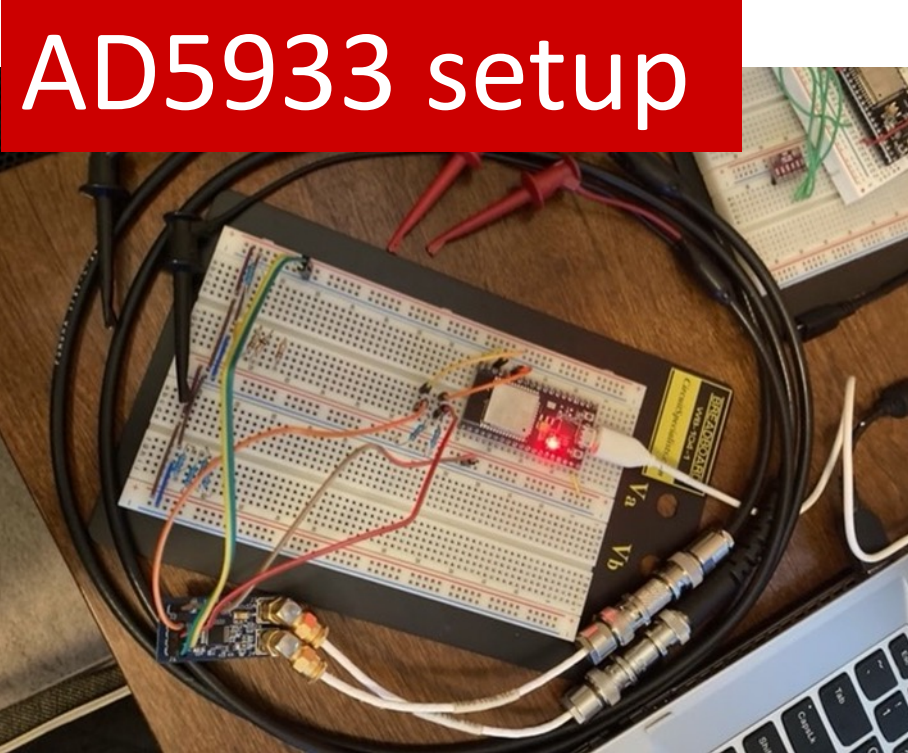
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Background

- It is becoming increasingly important to be able to measure the integrity of concrete structures.
- Sensytec has created a cement which changes impedance as the pressure changes.
- Our goal is to create a device which can measure the impedance of the concrete and monitor the changes remotely.

Methodology

- Our device uses the AD5933 chip to measure the impedance. This chip must be calibrated with a known impedance every time measurements are made, which was accomplished by using a CD4053 multiplexer chip.
- To make the device able to be used remotely, the microcontroller is powered by a solar panel and a Lithium-Ion battery.
- We used a Raspberry Pi to host an SQL database of the data and display the data with an html webpage.



Acknowledgements

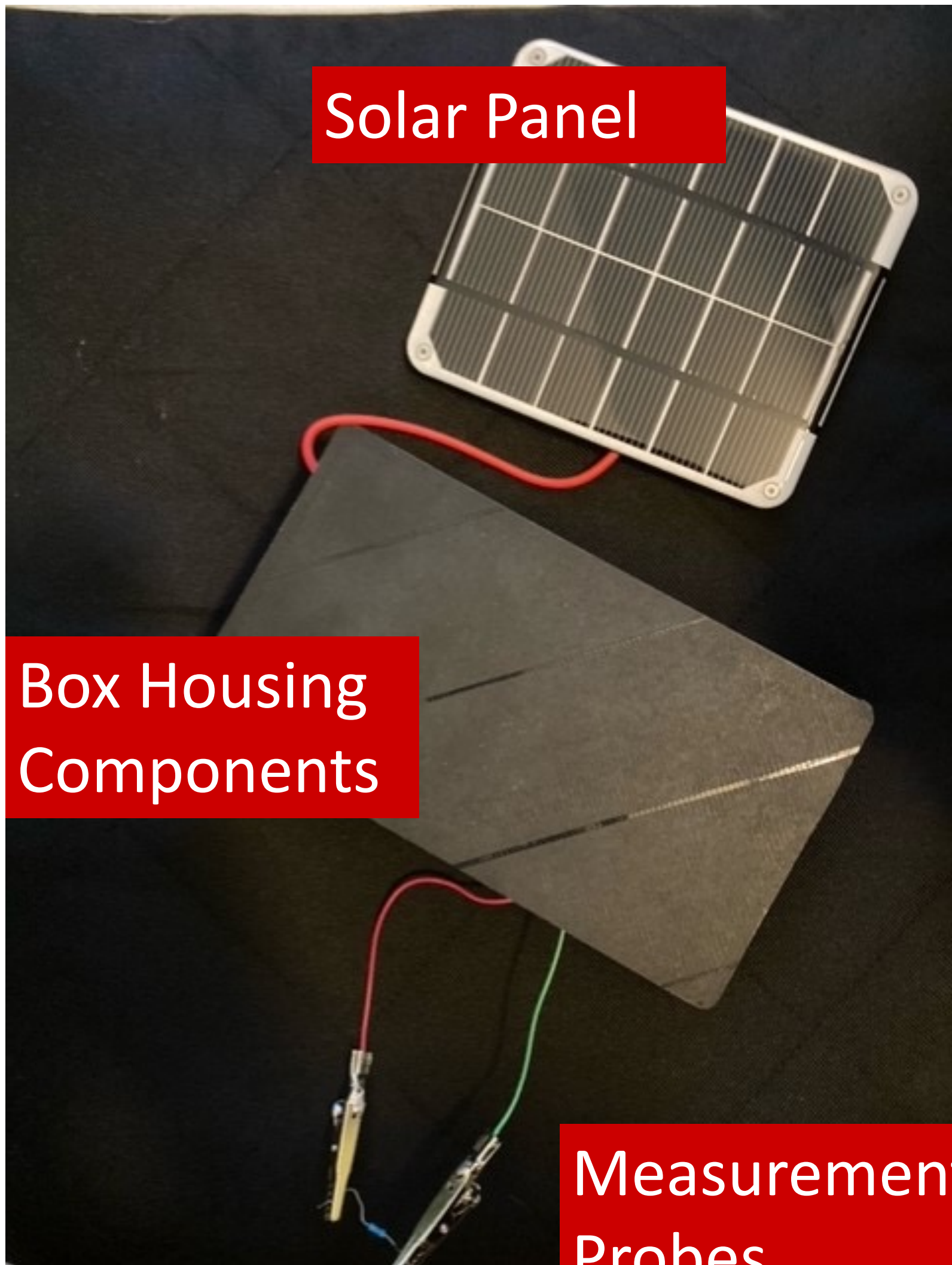
- University of Houston Summer Undergraduate Research Fellowship

Final Setup

- Shown below is the prototype of our device. The components are housed in a 3D printed box.
- The code written for this device first calibrates the AD5933 chip by sending a high input to the MUX, which allows the chip to first measure our known impedance. After the device is calibrated, it measures the impedance between the two alligator clips located outside of the box. The data is sent to an SQL database hosted on a Raspberry Pi every 5 seconds and displayed on an html webpage.

Database

ID	Sensor	Location	Value 1	Value 2	Value 3	Timestamp
74	AD5933	Project Box	21828.62	22348.62	22692.29	2021-08-02 01:18:53
73	AD5933	Project Box	21636.23	22294.09	22678.56	2021-08-02 01:18:22
72	AD5933	Project Box	21881.36	22211.70	22609.63	2021-08-02 01:17:50
71	AD5933	Project Box	21867.29	23082.42	22643.13	2021-08-02 01:17:18
70	AD5933	Project Box	21796.59	22209.43	22565.64	2021-08-02 01:16:47
69	AD5933	Project Box	21638.00	22214.59	22658.66	2021-08-02 01:16:15
68	AD5933	Project Box	21580.81	22216.50	22596.25	2021-08-02 01:15:43
67	AD5933	Project Box	21756.70	22320.45	22675.91	2021-08-02 01:15:12
66	AD5933	Project Box	21698.70	22178.17	22633.19	2021-08-02 01:14:40
65	AD5933	Project Box	21618.59	22129.43	22722.73	2021-08-02 01:14:08
64	AD5933	Project Box	21890.88	22093.87	22660.25	2021-08-02 01:13:37
63	AD5933	Project Box	21651.56	22195.59	22674.36	2021-08-02 01:13:05
62	AD5933	Project Box	21854.59	22301.79	22685.96	2021-08-02 01:12:33
61	AD5933	Project Box	21585.03	22333.04	22646.32	2021-08-02 01:12:02
60	AD5933	Project Box	21817.38	21733.48	22588.27	2021-08-02 01:11:30
59	AD5933	Project Box	21844.86	22353.04	22586.35	2021-08-02 01:10:58
58	AD5933	Project Box	21691.01	21864.03	22680.48	2021-08-02 01:10:27
57	AD5933	Project Box	21709.39	22016.89	22701.40	2021-08-02 01:09:55
56	AD5933	Project Box	21578.84	22285.47	22634.82	2021-08-02 01:09:23
55	AD5933	Project Box	21700.07	22160.68	22700.48	2021-08-02 01:08:52



Conclusion/Next Steps

- Currently, the device successfully sends data to a database and can be monitored remotely. However, the device is not finished and there are still several things to improve.
- The impedance measurement system currently has a bug which causes incorrect measurements.
- When taking rapid measurements, the microcontroller consumes too much power for the solar panel to supply consistently.
- The MUX chip used to calibrate the device may have some leakage current causing the impedance measurements to be inaccurate. A mechanical relay can be implemented to improve this area.