

Background

- Device used to determine the probability of lightning strike occurring
- Measures and records changes in the strength of atmospheric electric fields
- Used in safeguarding electronic instruments, scientific studies, human safety

"If any of the mills within 5 nautical miles (NM) of the launch pad registers 1,000 volts per meter or greater, a launch is postponed." (Source: NASA, Marshall Space Flight Center)

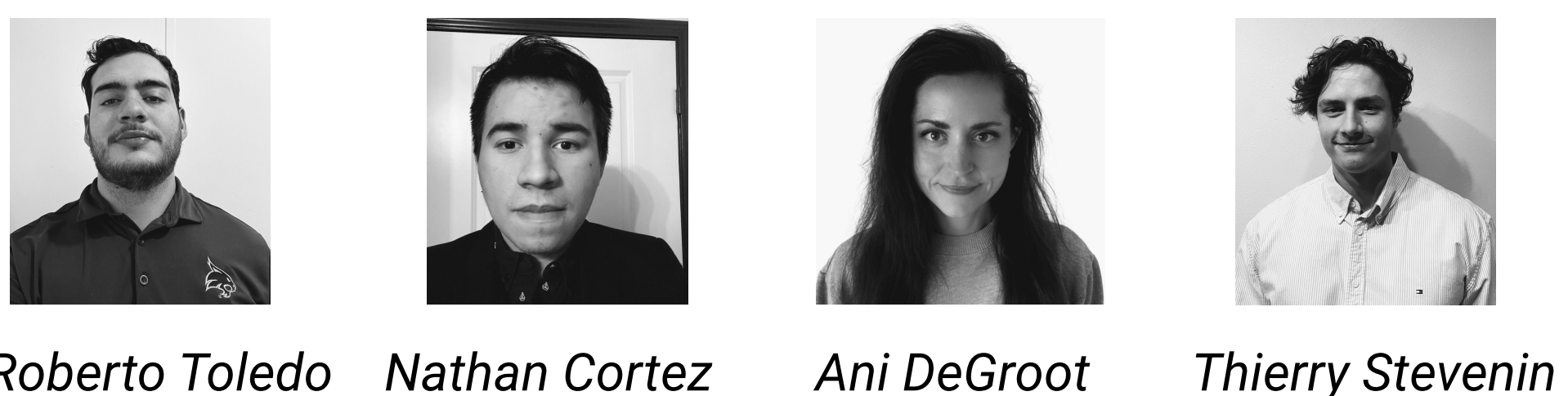
Design Requirements

- Contained within one cubic foot
- Power: 12 VDC, less than 0.5 A total power consumption
- Outputs:
 - analog voltage (-3 V to +3 V)
 - periodic data written to removable SD card in .csv format
 - Ethernet connection to internet enabling a GUI showing a graph of E-field over time and producing downloadable data

Current Device

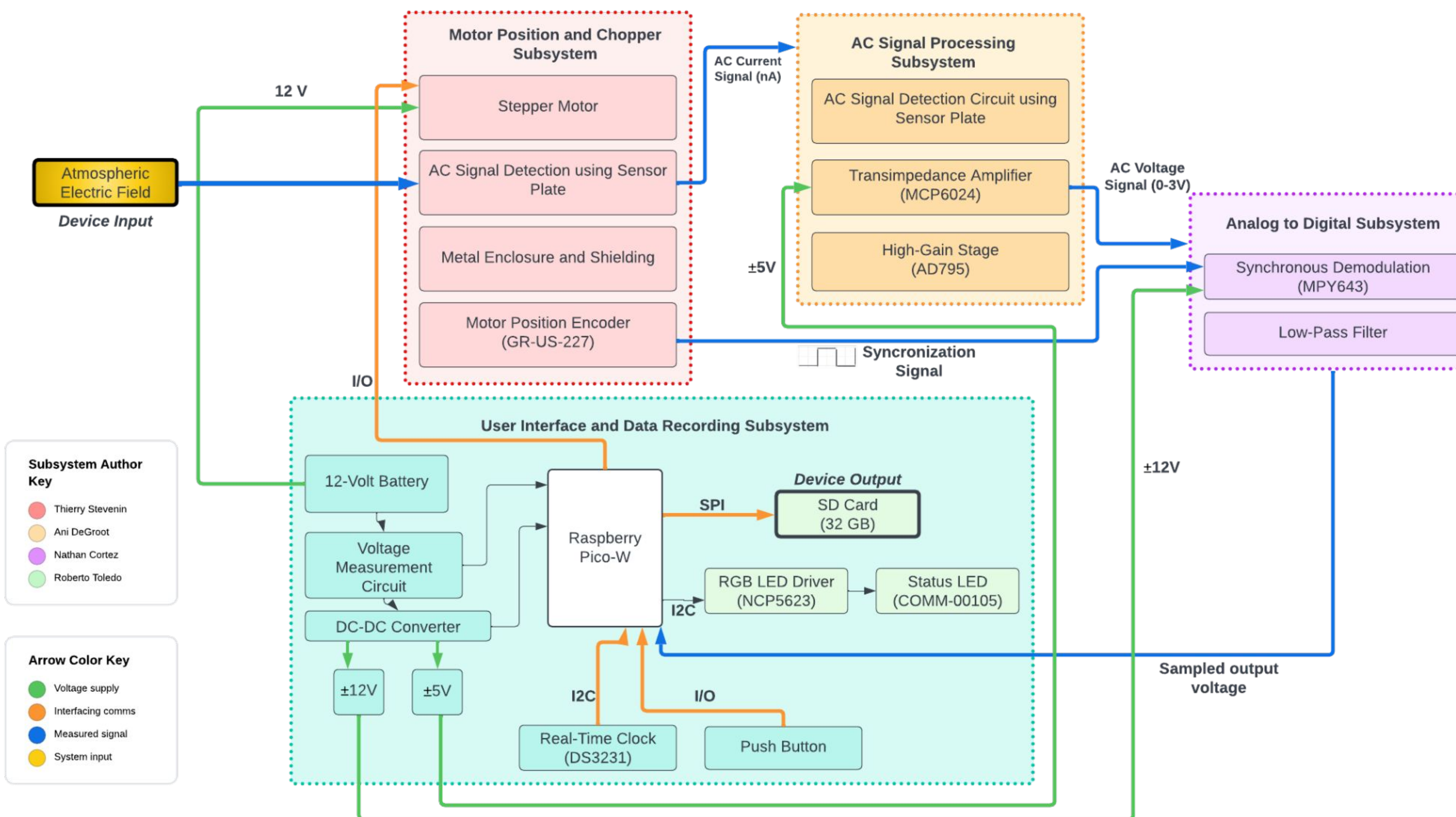
- Includes:
- Stepper motor and chopper-regulated sensor plate
 - Stainless steel housing
 - Small AC signal processing circuitry
 - Analog-to-Digital signal processing circuitry
 - Status LED
 - Microprocessor and SD card

The Team

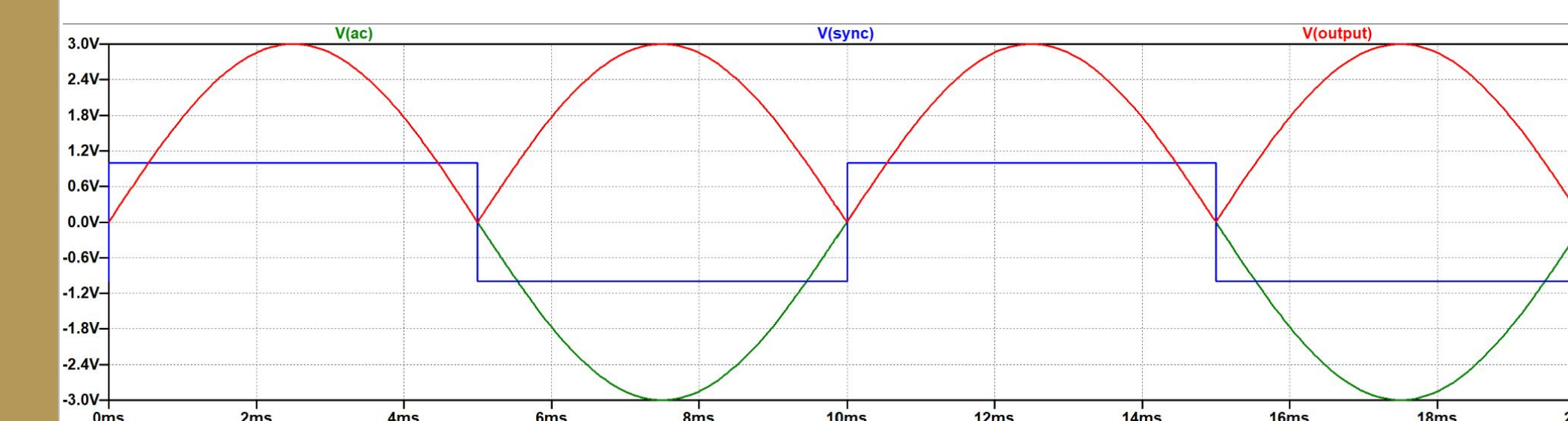


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System Block Diagram



Simulation Results

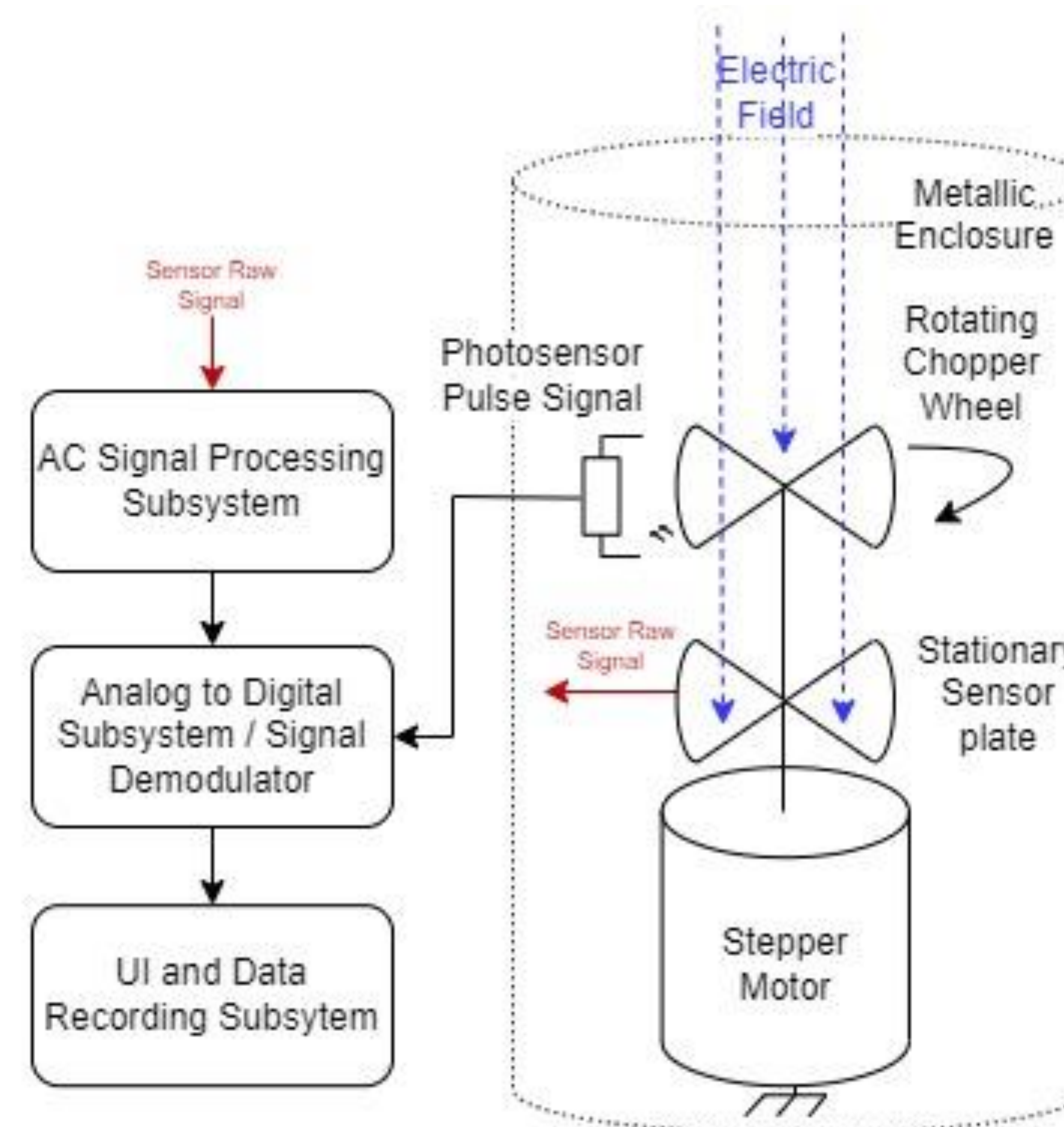


- The small AC signal detected at the sensor plate is fed through a transimpedance amplifier and amplified to produce a sinusoidal voltage signal (green).
- The synchronization signal is sent by the motor position encoder (blue).
- The resulting signal is the product of both the signals going through an analog multiplier to rectify the AC signal to make a DC signal (red).
- The DC signal will pass through a low-filter to reduce the ripple voltage and noise to be sampled.

The signal in red is sent to the microcontroller to be processed. The microcontroller will convert the amplitude values electric field readings and they will save the value to an SD card.

Example output: 1,000 V/m at 10:20:10 AM

Electric Field Mill Structure



Plans for D2

- Characterization Requirements
 - Calibration constant (volts DC output per (volt/meter) of electric field)
 - Estimated accuracy (percent)
 - RMS noise level (in equivalent volts/meter)
 - Resistance to moisture and rain (qualitative)
- Design PCB board to house circuitry
- Improve device structure using higher quality materials

Acknowledgments

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