THE MULTIPARAMETER TESTER

SCOTT HAVARD

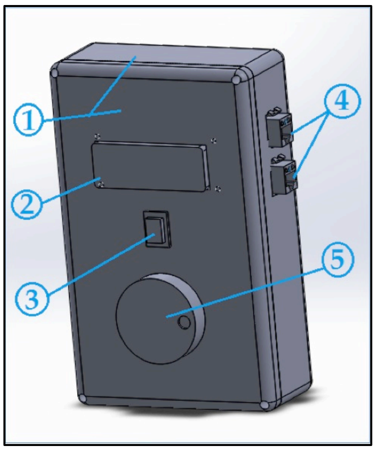
BACKGROUND

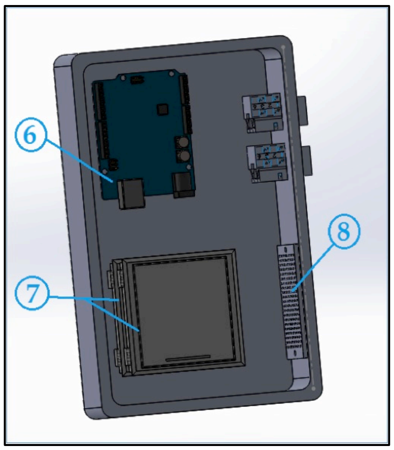
- Medical equipment in developing countries is often donated, not technologically innovative, and needs frequent maintenance. The equipment required for successful equipment repair, calibration, and maintenance is too expensive for these developing nations.

- This issue was evident following the 2010 earthquake in Haiti. Of the equipment donated, only 28% was used, 28% was working but not used, 30% was broken but repairable, and only 14% was irreparable.

- This problem can be mitigated with the development of an **affordable** and **effective** multi-parameter tester that can aid in equipment maintenance. Fortunately, this is possible due to the increasing capabilities and availability of inexpensive electronics and open-source software.

THE DEVICE





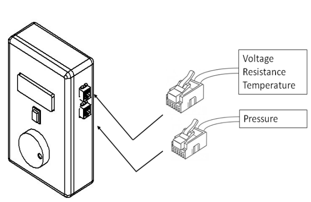
Device Components as Pictured:
1) ABS Plastic Enclosure (Lid and Body)
2) Standard LCD 16x2 White on Blue
3) Rocker Switch
4) Cat5E Keystone Jacks (2)
5) 1.25" Control Knob for 1/4" Shafts
6) Arduino Uno R3
7) Battery Holder 4xAA with Cover & Switch (2)
8) Perma-Proto Breadboard PCB Half-sized
9) Temperature Sensor Probe

Final Parameters That Can Be Tested:
Pressure, Temperature, Voltage, Resistance,

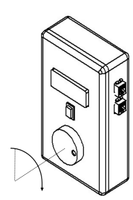
DEVICE USAGE

Basic Functionality:
1) Sensor/Transducer Probe (specific to each parameter) will be plugged into device.
2) When the device is turned on, Arduino identifies selected "mode" and processes the voltage signal coming from the probe.
3) Arduino will output the "mode" and the calculated parameter on the LCD display for the user.

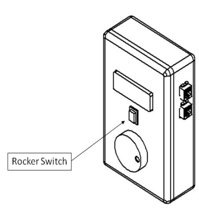
1-SELECT AND PLUG IN DESIRED PROBE



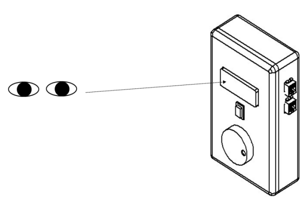
2-SELECT MODE BY ROTATING KNOB



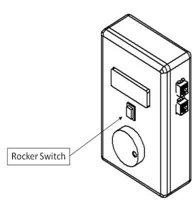
3-TURN ON DEVICE



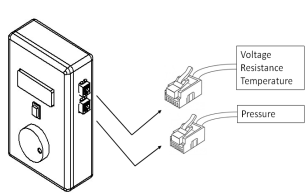
4-OBSERVE AND RECORD DISPLAYED VALUES



5-TURN OFF DEVICE



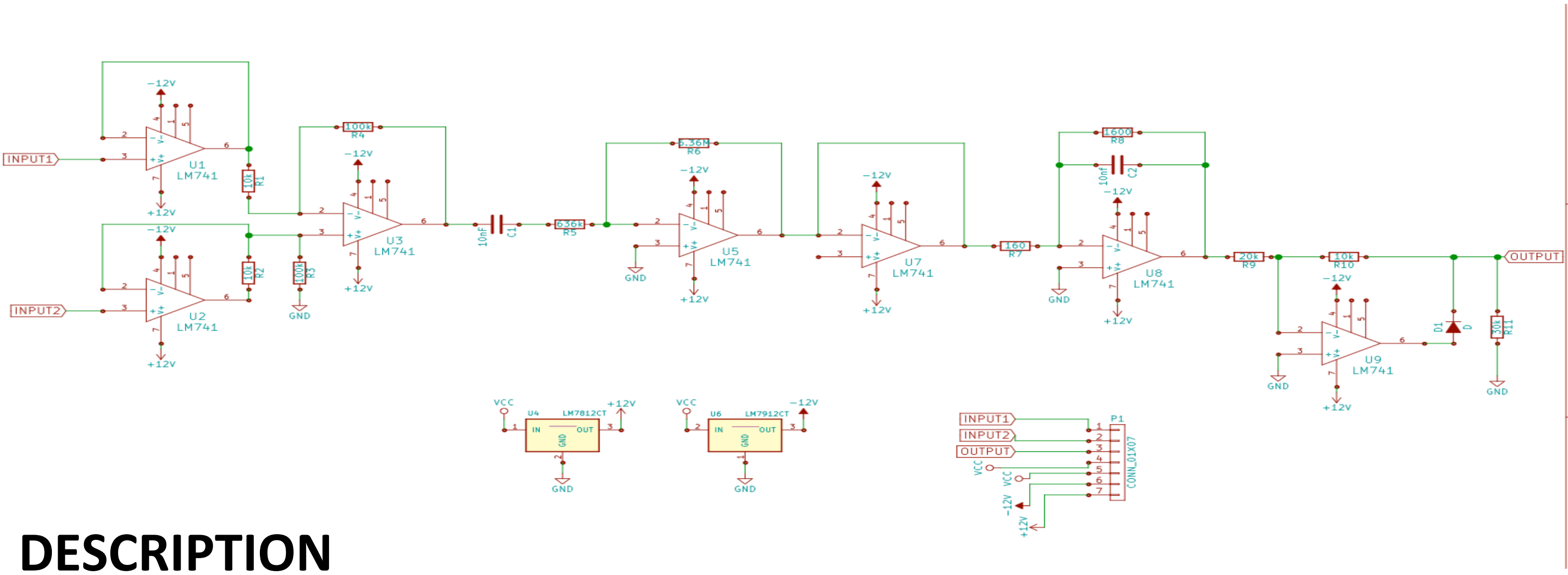
6-REMOVE PROBE



ELECTROMYOGRAPH [FRONT END]

SCOTT HAVARD

SCHEMATIC



DESCRIPTION

Capturing a human muscular action potential is a difficult feat, yet valuable due to its applications in diagnostic medicine and research. Well designed analog circuitry must be implemented in order to acquire a muscle generated signal that can be processed and of any use. The following circuits were linked in series in order to output an intelligible representation of an action potential.

Differential Amplifier:
The amplitude of an action potential is small (around the order of ~100µV-90mV). Coupled with the noise picked up by the electrode, it is important to amplify the action potential while eliminating the noise.

Active High Pass Filter:
The frequency of an action potential is no less than 25Hz. Therefor noise will be eliminated by filtering out frequencies below 25Hz.

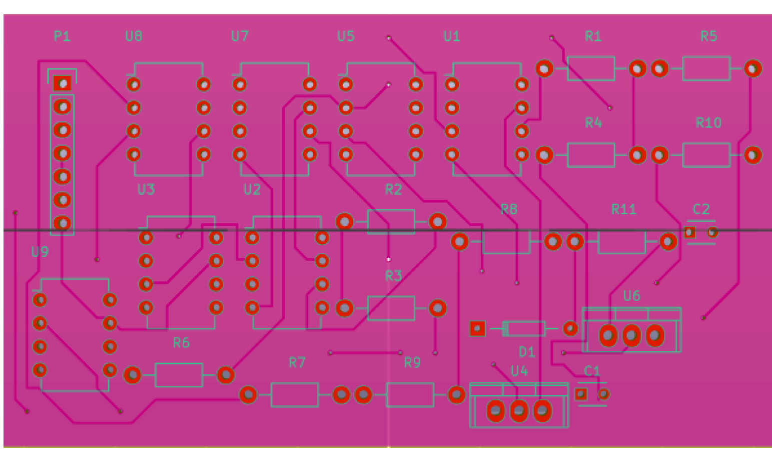
Active Low Pass Filter:
The frequency of an action potential is no more than 10kHz. Therefor noise will be eliminated by filtering out frequencies above 10kHz.

Full Wave Rectifier:
The signal is rectified in order to obtain an absolute value of the muscle generated action potential

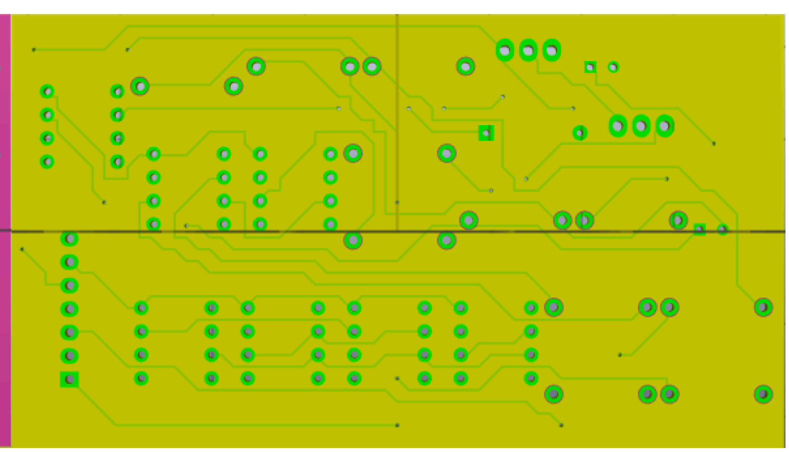
Gain Considerations:
Each circuit was designed to include signal amplification that accumulated into an overall gain of 500.

PCB LAYOUT

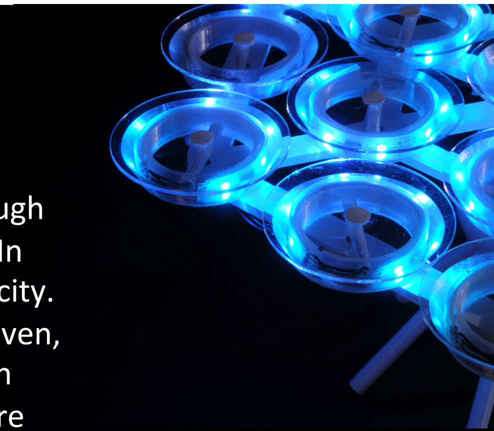
[FRONT]



[BACK]



ARCHITECTURE THESIS [ELECTRONICS DESIGN]



BACKGROUND

The realization of metaphysical constructs in a physical medium requires the development of tangible experience. An architecture student decided that through light there lies an extended understanding of a novel approach to architecture. In order for this to become reality, there needed to be an understanding of electricity. As with the many hackers, innovators, and curious individuals of today have proven, digital electronics are incredibly approachable. Regardless of the ease to start an electronics project, there is a large learning curve. In addition, when the goals are set high and deadlines are present, completing the project becomes increasingly difficult. The task thus was shared with an engineer, and through cooperative effort a thesis model was created.

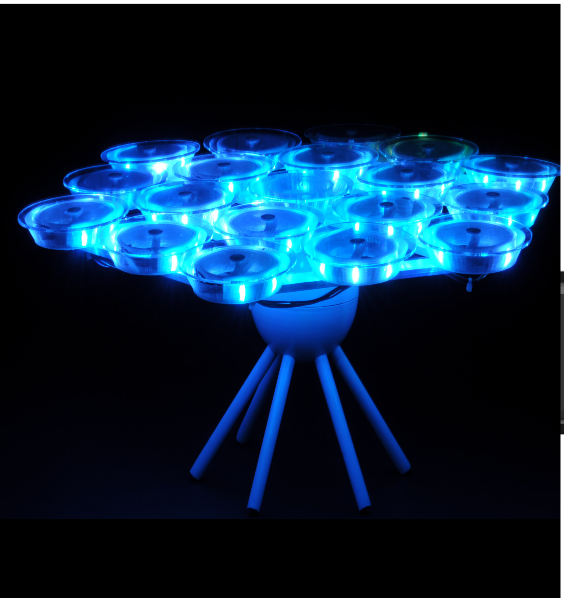
DESCRIPTION

The lights needed to fade slowly from white to blue and back in a seemingly random manner. It was easy to determine the need for RGB LED's, but it was a challenge determining how to control the lights. Luckily, it was not difficult to find an LED strip that also contained embedded circuitry (namely an LED driver) that allowed for easy programming. Once the necessary hardware was gathered, the efforts were focused on hardware design and firmware development. An Arduino Uno was selected as the controller after some deliberation about available digital outputs. A 9V battery pack was used to power the project, and due to the voltage regulator built onto the Arduino Uno it could simply be plugged into the V-in input on the board. The LED strip was cut and soldered so that portions of the strip could be placed in a 3D-printed fixture and programmed as needed. Half of the LED strips were powered through the Uno while the other half were powered by directly by the battery pack.

Hardware:

- Arduino Uno
- Adafruit Digital RGB LED Weatherproof Strip
    - LPD8806
    - 32 Light Emitting Diodes
- LM7805 (+5V Voltage Regulator)
- 0.33µF
- 0.1µF
- Breadboard (for ease of alteration)
- Wire

PCB LAYOUT



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