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Senior Design A

Project Description and User Requirements Report

Multimeter "Minimeter"

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Team 11

Omar Almatar   822092122

Hannah Galocy   821490742

Justin Hajjiri   819389994

Daniel Vazquez   819815855

Cade Walton   819833957

Summary

Our device is an easy-to-use, pocket-size digital multimeter that connects to and is powered by your computer via USB. A downloadable graphical user interface (GUI) shows real time voltage, current and resistance data measured from the multimeter and allows you to switch modes at a click of a button. The multimeter will have 3 detachable connectors to allow for better user modularity and transportation: 2 banana plug connectors for multimeter probes (+ and -) and 1 USB port to provide a serial interface to a computer. The device will be able to measure and record resistance in addition to DC and AC RMS voltage and current.

The GUI will be used to switch the device between different modes and will provide a graphical representation of measured values as shown in the device sketch below. The GUI will also indicate whether the multimeter is connected and powered on in addition to any device health statistics the user may need. The user will be able to start, pause and resume data logging to computer memory at the click of a few buttons. Additionally, the device will include an optional SD card slot that will automatically log probe measurements on power startup, this function does not require a computer connection.

The device itself will have 2 physical buttons: a reset button and a power button. The power button turns on the device when powered by a computer via the 5V USB bus or an external source. When powered on, an indicator led will be lit. In order to better protect the sensitive measurement equipment, the device will include overcurrent protection that, when enabled, will report an error message on the GUI until the reset button is pushed.
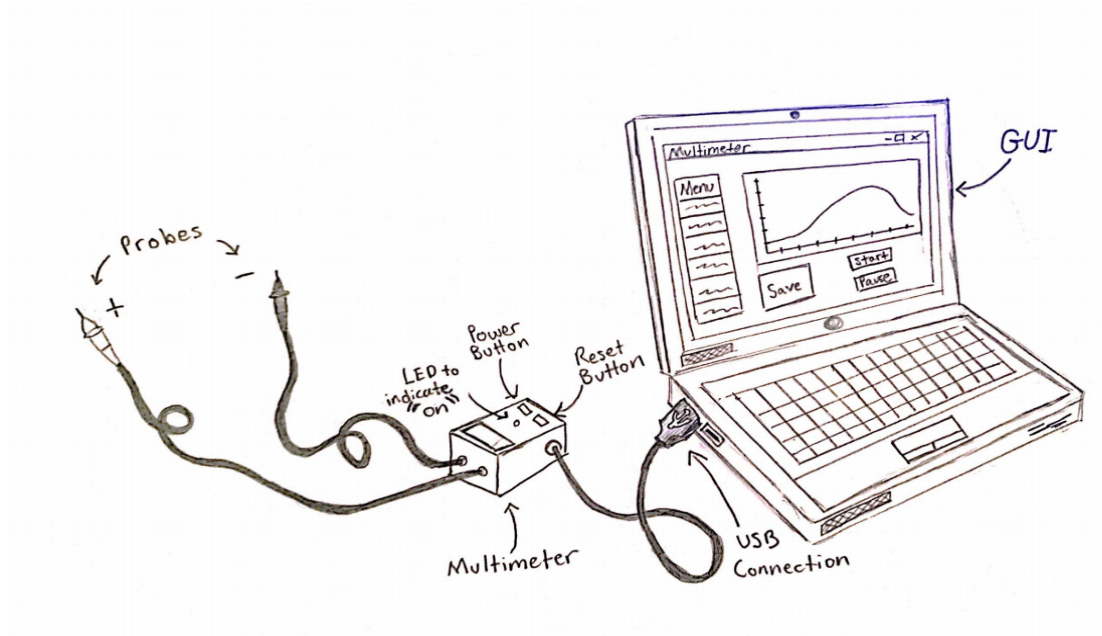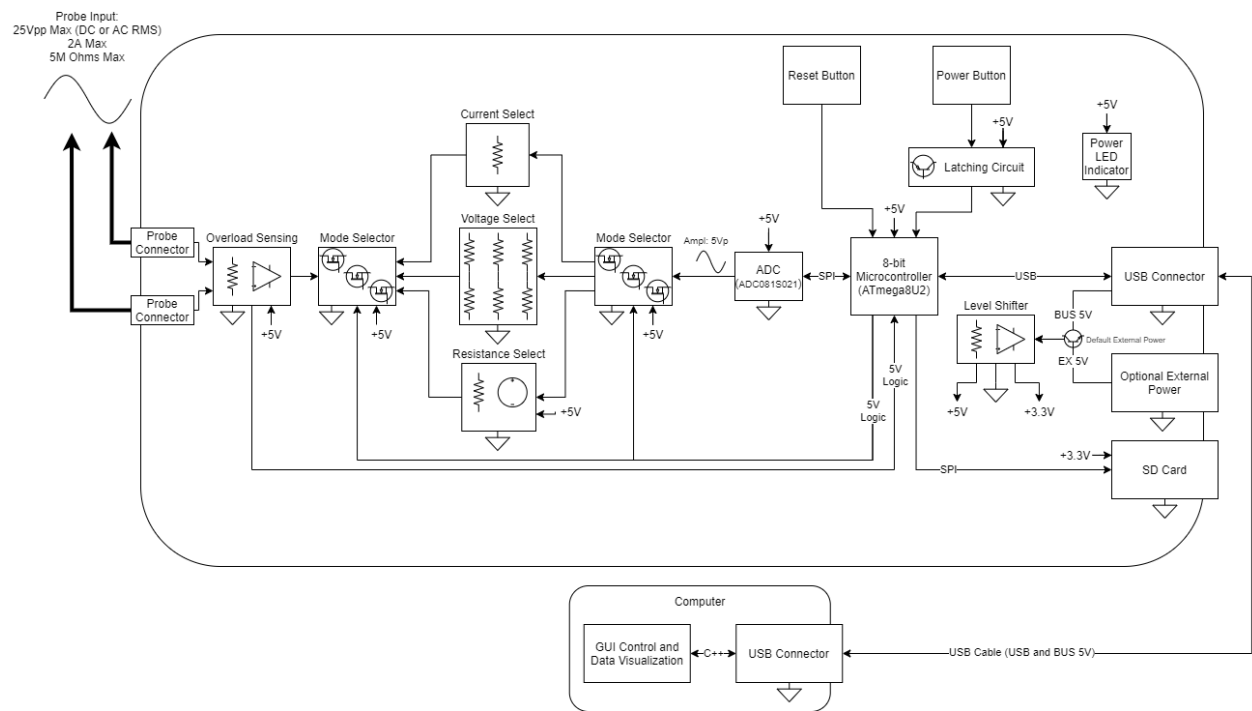
Figure 1: Final Product Concept sketch

Figure 2: Block Diagram of Circuit Function

User Requirements

Specification	Validation
The device shall be powered by a laptop USB port	Plug the device into a laptop USB port and press the "Power" button. The device indicator LED will be lit and visible in a well lit room.
The device shall automatically connect to your laptop via USB on device power up	After downloading and running the available GUI script, the connection status will read "connected" once the device is attached and "disconnected" otherwise.
The device shall measure DC and AC (RMS) voltage from 0 to 100V with at least 2% resolution within ±5% error of max range setting	Switch the device to the DC voltage mode using the GUI. Connect the device probes to a signal generator. Apply DC power from 0-100V in 5V increments. Switch the device to the AC voltage mode. Apply AC power from 0-100V (RMS) in 5V increments. Verify on the GUI that the resulting measurements match the output of the signal generator to within ±5% error.
The device shall measure DC and AC (RMS) current from 0 to 2A with at least 2% resolution within ±5% error of max range setting	Switch the device to the DC current mode using the GUI. Connect the device probes to a power supply. Apply DC current between 0 to 2A at 0.5A increments. Verify on the GUI that the resulting measurements match the output of the power supply to within ±5% error.
The device shall measure resistances from 10 to 5M Ohms to within ±10% of true resistor value	Switch the device to the resistance mode using the GUI. Connect the device probes to a resistor with a known value. Verify that the result is within ±10% of the true resistor value being measured.
Overcurrent protection shall turn on when device input exceeds 3A. Overcurrent protection failure expected at 5A	Using a DC power supply, modulate current control incrementally to 3A and check if current protection is enabled as indicated by the GUI. Do not test to 5A circuit failure!

Size of device shall be small enough to fit into a typical mens' size pocket	Place the device into a mens' size pants pocket.
GUI allows for functional changes between voltage, current and resistance measurement.	While the device is unconnected, switch between the different modes and verify proper corresponding GUI feedback.
When overcurrent protection is enabled, the reset button shall set the device back to its initial functioning state.	Overload the circuit by applying 3A to the device in the current mode. Press the reset button to reset the device to initial functioning state.
Device shall log data to SD card when disconnected from computer	Switch device to DC voltage mode and unplug USB cable. Apply 5V DC signal to the device then power off. Check SD card for most recent logged values being 5V.