Spring 2021

Senior Design A

System Description and Work Breakdown Structure

Multimeter "Minimeter"

3/19/2021

Team 11

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System Description

Our team is working to create 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) will show real time data measured from the multimeter on your computer and will allow switching between the different modes with a mouse click.

In the voltmeter mode, the device will measure DC and AC_{RMS} voltages between 0 and 25Vpp to within 2% resolution. In the ammeter mode, the device will measure DC and AC_{RMS} current between 0 and 2A to within 2% resolution. Resistances from 10 to 5MΩ can be measured in the ohmmeter mode to within ±10% of the true resistor value.

The GUI will be used to switch the device between the different modes as indicated by 3 leds on the multimeter device itself. The GUI will also provide a graphical representation of measured values in addition to indicating whether the multimeter is connected and powered on. The user will be able to start, pause and resume data acquisition/logging on the computer via the GUI. The device itself will have 2 physical buttons: a reset button and a power button. The power button turns on the device when connected to a computer supplying 5V via USB. When powered on, an indicator led will be lit. In order to better protect the sensitive measurement equipment, the device will include 3A DC overcurrent protection that, when enabled, will report an error message on the GUI until the reset button is pushed.

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.

Key technologies in this device include an overcurrent sensing circuit that utilizes an op amp and comparator to draw a digital pin high when overcurrent is detected. The mode selector circuit will use 6 mosfet transistors to switch between three distinct measurement configurations and to isolate the sensing circuit from the probe input when necessary. The power button will utilize a latching circuit to allow for a toggle switch like behavior. The 8-bit microcontroller will take measurements from an external ADC and communicate with the computer using the Universal Serial Bus electrical standard and communication protocol. Our team will be responsible for microprocessor

programming, software and circuit design, PCB and enclosure design, assembly and testing/validation.
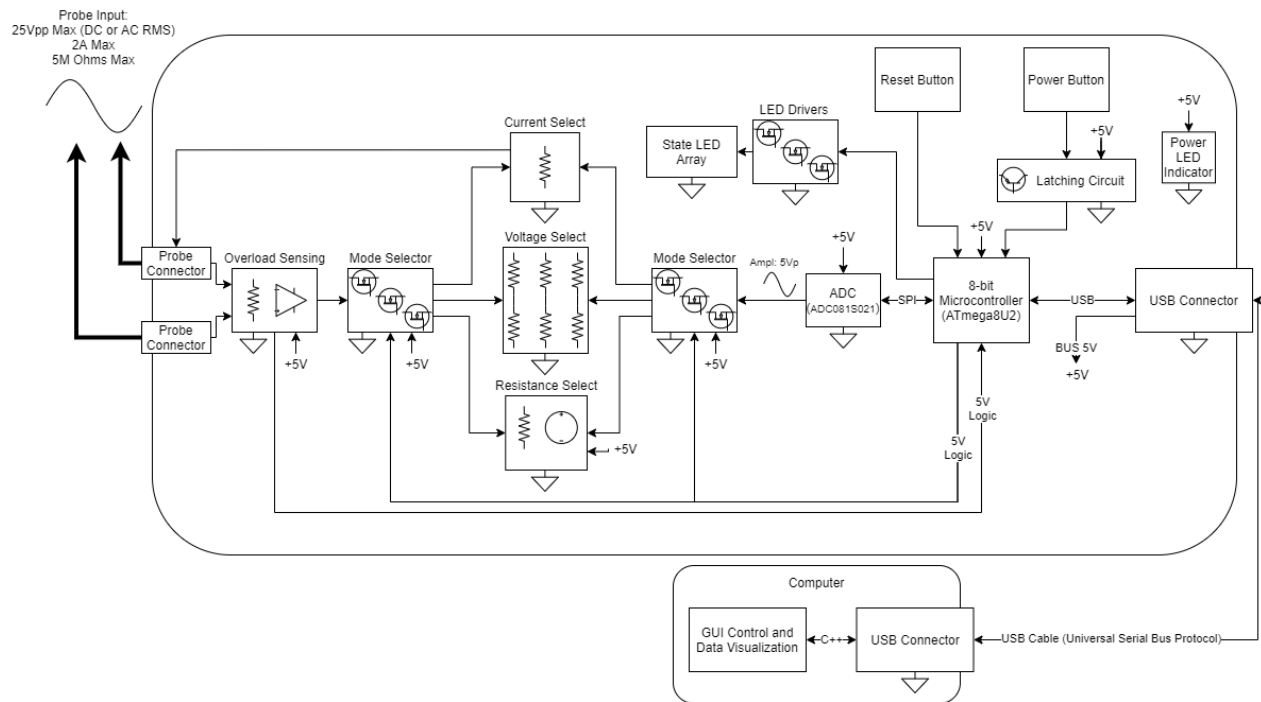
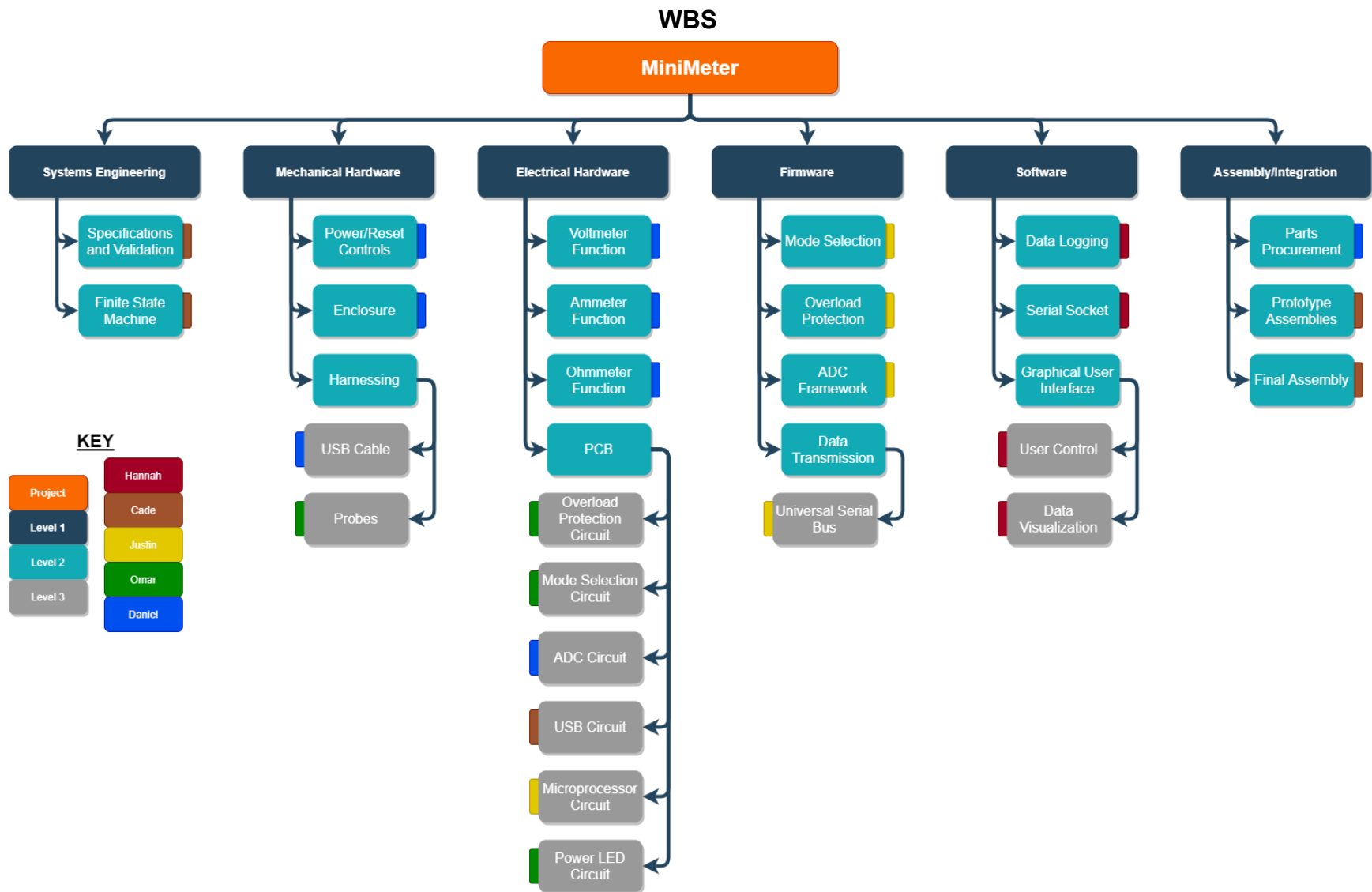## Updated Block Diagram

Figure 1: Revision 2 Block Diagram for Minimeter

Figure 2: Work Breakdown Structure for Minimeter