gPod Accessible Blood Glucose Meter

Week 10
March 27- April 1
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Work Completed

The beginning of the week was spent getting the speech module to work with the microprocessor. The speech module requires hexadecimal characters to be sent prior to the text to be spoken. The command sequence is shown in Table 1.

Command	Description
0x80	Start command
0x00	Full Volume
0x05	Speech Pitch (Level 5)
0x00	Speech Speed (Level 0)
ASCII text	Text phrase sent as a string of characters
0x1A	Stop command
0x00	Speak phrase

Table 1, Speech module command sequence.

The microprocessor sends each command and each character of the phrase individually. Once the speech module receives the '0x00' command, the phrase is spoken. The speech module's text buffer is limited to an 80 character string. Testing proved the speech module to work correctly and speak the glucose results as measured.

The rest of the week was spent working out problems with the glucose trigger, power supplies, and voltage regulators. We were experiencing trouble with the gPod whenever the switch on the protoboard was used to turn the meter on and off. The meter would not take a measurement or would read an incorrect result. The problem rarely occurred when the switch was not used and the bench power supply was connected directly.

Dave also wired in the voltage regulators to test the circuit while using battery power. He first connected the voltage regulators to the bench supply set to +9 and -9 volts. The voltage regulators produced accurate voltages of +5 and -5 volts. The positive regulator was introducing noise into the glucose signal. The problem was solved by adding capacitors to the inputs and outputs of the voltage regulators. Figure 1 shows the configuration of the positive voltage regulator.

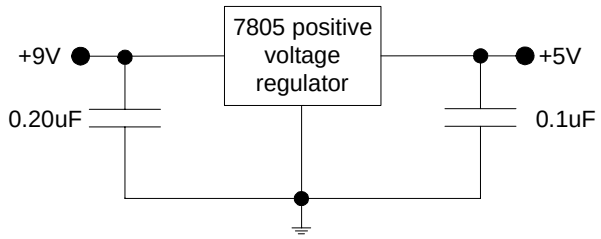

Figure 1, Voltage regulator schematic.

There was also a problem with the glucose trigger. When the switch or voltage regulators were used the glucose trigger would not rise above 200 mV. If the power supply was used the trigger would pulse to 5 V as expected. The problem turned out to be a software issue. The datasheet Dave was using from Microchip.com was for an older version of the 16F874A microprocessor. The A/D initialization routine was not correctly configuring the A/D to work with the 5 MHz clock. He made the changes to the code and the A/D and glucose trigger worked correctly with the voltage regulators and switch.

The changes in the code allow the microprocessor to accurately take glucose measurements, display them on the LCD screen, and speak them. The entire circuit works on battery power and is ready to be put onto a printed circuit board. A comparison test with the gPod and OneTouch Ultra showed a difference of 8 mg/dL. The OneTouch Ultra showed a result of 128 mg/dL and the gPod displayed 136 mg/dL. The percent error between the results is 6.25%. Figure 2 shows the gPod and OneTouch Ultra results side by side.

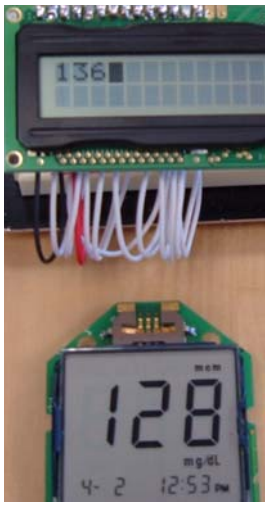

Figure 2, gPod and OneTouch results.

Also this week, Matt worked on the finalizing the PCB board layout and finishing the circuit. This PCB board can be seen below in Figure 4. Figure 3 below, shows the circuit schematic.

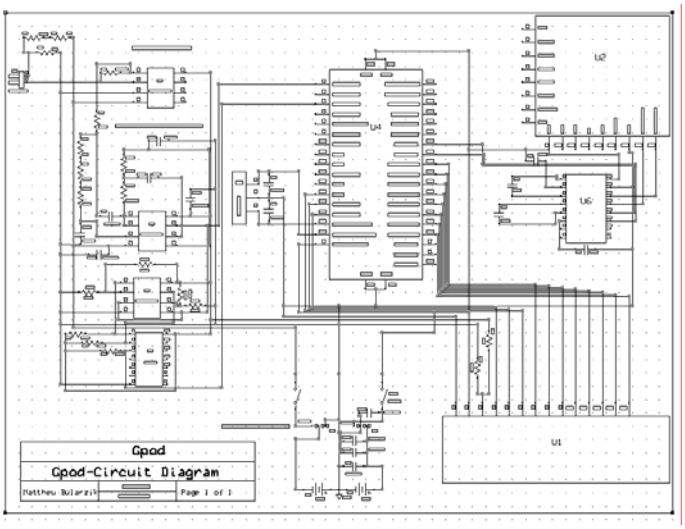

Figure 3: Circuit Schematic

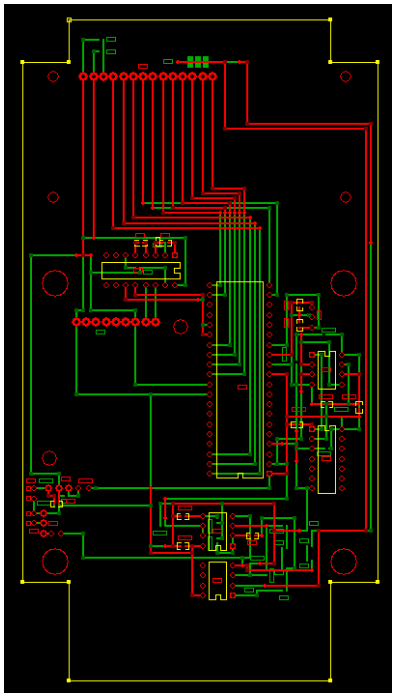

Figure 4: PCB Diagram

The changes that were made to the circuit from the previous design were:

- Voltage divider added to pin 5 of the microprocessor
- Voltage divider added to pin 3 of the LCD
- Another LM358 was added as a comparator along with a 7486 and/or gate with associated resistors.

The new LCD screen and OKW casing also arrived. The new screen was added in place of the old screen and worked. The OKW order that arrived was not quite right. The wrong size handheld case was delivered and the 9V leads were backordered. Matt called the company and the right case was sent right out along with one of the leads.

Matt also began thinking about how to mount the SP03 module in the case. There are no PCB mounts close enough on the bottom of the case so he decided to mount the module straight to the PCB board. Also, the 9V batteries are not secure in the batter compartment and the will rattle around. A 9V holder should work once modified since on their own they won't fit in the case.

Mike primarily spent this week working with the vial scanner circuit. After the circuit was built, it would give the scanner power, but the scanner would not emit the IR to scan anything. The setup of the circuit allowed the scanner to be bus powered meaning it would draw its power from the USB port. After having difficulties with this, Mike tried a different power circuit that would make the scanner self powered. This setup didn't work either, so it was quickly unassembled and the original was put back together.

In trying to trouble shoot the bus-powered circuit, Mike opened the scanner and began to poke around with the oscilloscope to see what voltages were at what pins. He then plugged the scanner into the USB of the computer, where it works properly, and compared. What he noticed was that some of the wires coming straight off of the cord where not being powered correctly. When the scanner is plugged into a PC, all of the pins are powered with +5 volts. However, when plugged into the bus-powering circuit, only 3 of the 5 pins had a voltage on them. This brought forth a few questions. Mainly, why is this happening, but also, not every pin had a wire going to it. This means that the 5 volts on that pin must be coming from somewhere in the scanner and not through the cord. And if so, why isn't that happened with the circuit.

Much time was spent trying to get the scanner to work, but little success was made. After a few hours, the scanner even stopped scanning completely. Due to time constraints, and the fact that the scanner was just a nice option, it was decided that the vial scanner may not be necessary for the project.

Future Work

This week will be spent finalizing the parts order and printed circuit board. While we are waiting for the parts to arrive Dave will be working on the software to improve the user interface. The user interface will be made more accessible for our clients. More software features can be added now that the hardware is finished. Matt will finalize the PCB board layout when the voltage regulators finished. If the vial scanner circuitry gets finished he will add that setup to the PCB board as well. Mike will spend the main portion of the week on the casing layout and modification. The battery compartment needs to be worked on to make the batteries fit. The spot for the switch and the strip insert has to be measured and marked also.

Review

The problems with the project at the beginning of the week delayed the printed circuit board order another week. We plan to have the PCB board and necessary components ordered by Tuesday. After much work, the problems have been resolved and the hardware is working correctly and consistently. We will have a circuit board by next week and will begin assembling and troubleshooting the final design. We are confident that the project will be finished and working correctly by the end of the semester. Total costs to date are $895.67.

Hours Worked

Matt: 37
Mike: 18
Dave: 38