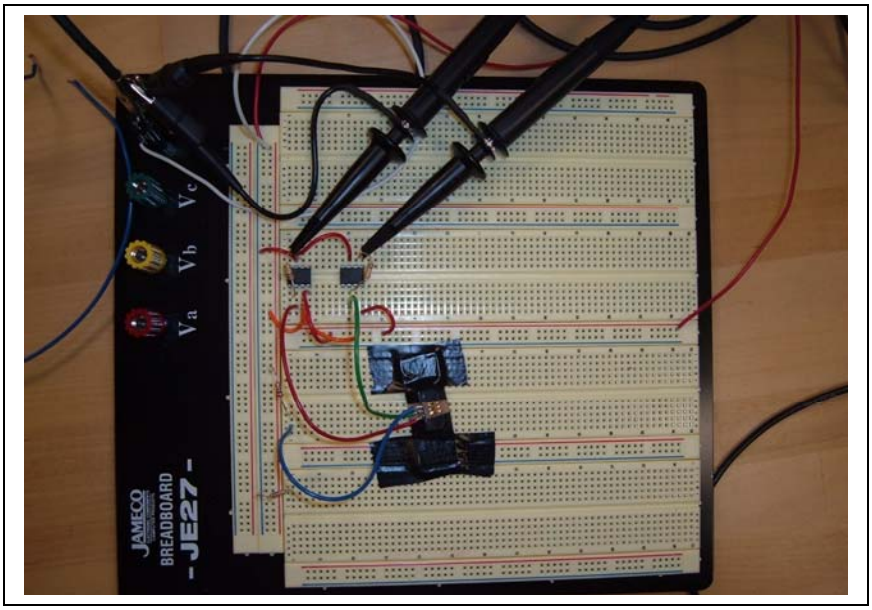
Project Identity

Accessible Blood Glucose Monitor Interface
Week # 1 (January 15 – January 21, 2006)
Mike Rivera

Work Completed

Week 1, overall, proved to be a successful week. According to the timeline we developed last semester, we are slightly ahead of schedule for the task of the glucose circuit. A working circuit was designed by Dave that allowed us to receive an output signal that we are measuring in volts. This measurement is done using oscilloscopes and is then implemented in LabView software for analysis. The relationship between the output voltage and the amount of glucose in the sample has yet to be determined. Figure 1 is a photograph of the test circuit. Figure 2 is an example of what the output signal generally looks like.

Figure 1: Photograph of Glucose Test Circuit

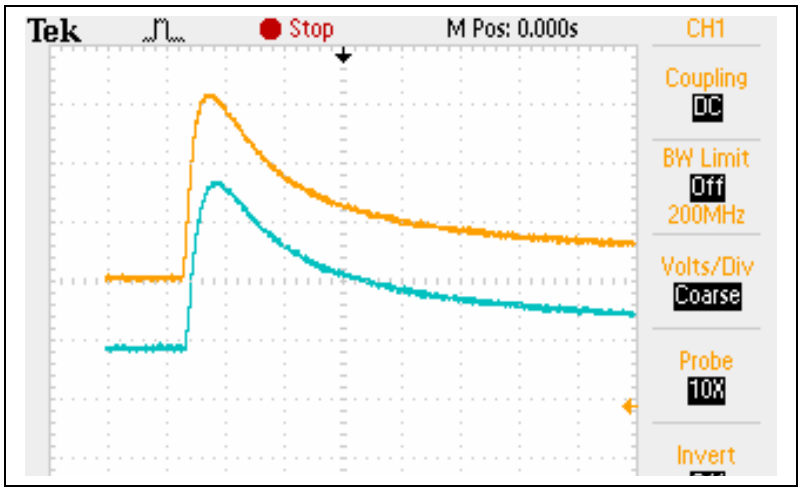


The test strip being used has three electrode leads that connect to the meter. Prior to receiving our budget, we ordered two Lifescan meters. One is our reference meter, which is used to give us the actual value of glucose for a given applied solution. This meter will be essential to determining our voltage-glucose relationship. The other meter was disassembled for early brainstorming and necessary parts. One such part is the 'strip holder', which holds the strip into the meter, but more importantly makes the connection with the three leads on the strip. This part is the taped down object on the circuit board in Figure 1. Two of the electrode leads are 'working' and are used for comparative measurement, while the third lead is a reference or ground. Not shown in Figure 1 is a dual 5 volt power supply. However, one of the 5 volts is wired to give a -5V to the circuit. These 5 volt signals are then stepped down to +-400 mV by means of a voltage

divider. The 400 mV potential is then applied across the two working leads constantly while the strip is inserted into the strip holder.

While the strip is in place, there is a constant output voltage which is the very beginning of the signal in Figure 2. Upon sample application, there is a rapid voltage drop, and then a gradual incline that approaches the initial voltage. Up to about 4 seconds immediately after the voltage drop (sample application) is the linear region in which a glucose level can be determined. It is hypothesized that the output voltage at about 2 seconds after sample application has a direct relationship to the concentration of glucose. Further testing and research needs to be done to prove this. Figure 2 is the resulting output for a glucose level of 114 mg/dL.

Figure 2: Sample Output Signal for Various Glucose Concentration



Note: The outputs of both working electrodes are shown

The entire week 1 was spent primarily on the design and understanding of the glucose test circuit. Consequently, we have not made much progress with the LCD display, and the speech chip. In fact, both components were re-submitted for ordering due to an initial ordering mistake, and inadequate equipment. The LCD display that was ordered and delivered has incorrect dimensions. It is about half the size we need. Therefore, a new purchase order was created to order a better, bigger screen. However, the small LCD screen is not a complete loss and will not be returned. This smaller screen is made from the same manufacturer, and therefore has similar commands and protocols as the bigger screen on order. This allows us to do some practice testing on the screen and attempt to still get it to work. Any progress that is made on the present screen should be easily transferable to the larger one. We have also considered the purchase of a demo-board which will assist in connecting with and programming the screen.

The inadequate equipment had to do with the soldering tools. The speech chip leads are physically too small and too close together to use a regular soldering iron. When the available soldering iron was used, the chip was fried, and therefore ruined. To overcome this, when the new chip is delivered, we will be using facilities available to us through Dave. These facilities have the necessary equipment needed to solder the speech chip to an adapter that can then be used on our design board.

Future Work

In the upcoming week, significant testing and analysis needs to be done. Currently, there are a couple issues with our circuit. For one, the output signal we get seems to be inverted, in comparison to those that were found in our research. Why this is happening, and its significance is still unknown. Another issue is the voltage values that make up our output. The signal consists of all negative values which cannot be measured by the microprocessor. We have brainstormed some possible solutions to these problems in which we will be testing in week 2.

With everything considered, it is still hopeful that by the end of week 2 we will have a relatively accurate and consistent glucose-voltage relationship. Once we have this trend, we can then incorporate the microprocessor and begin coding it to perform the necessary measurements and tasks. As well as refining the glucose-circuit, work can be started on the new speech chip when it arrives.

Project Review

Thus far, I feel like we made significant progress in the first week. We have a working circuit which outputs a clear response to sample application on the test strip. It is only a matter of more testing and data analysis before we can move onto incorporating the microprocessor. We originally allotted a considerable amount of time for the design of the glucose-circuit, which hopefully will end up as extra time for other areas. As far as the re-ordering of the speech chip and LCD screen, I do not consider that much of a set-back. With all the work that needs to be done in determining the glucose relationship, it is unlikely that we will be needing those parts before they will arrive. Also, we are still well under our budget even after the re-order. Our total purchasing has added to about $500 thus far, which includes almost everything we will need for the prototyping.

Hours Worked

Hours worked on project: 7