ESU CSIDC Project

.
CSIDC Bluetooth™ Project
Emporia State University
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Project Abstract

System overview

a. a statement of what the system (hardware and software) is meant to accomplish;

b. a statement of the performance requirements it is intended to meet;

c. a summary of the design methodology used and why was it chosen; and

d. a statement of what is unique or innovative about this project and any novel ideas that the design includes.

Implementation and engineering considerations

a. a detailed specification of the system and a description of the algorithms involved;
b. tradeoffs that were considered to optimize the design and its implementation and a discussion of what optimizations were actually used (place emphasis on why you did't you did);
c. a description of any tools that were developed in the context of this project; and,
d. verification and testing--how did you assure that the system worked as specified and how did you test the software? Actual test and performance results should be summarized.

Testing the EKG and the Analog to Digital Converter:

To test the EKG the first thing that was done was a continuity test across all the connections on the board. This test showed which connections were not secure and decreased the chances of the EKG not working correctly. Also, it was imperative that all the connections were correct since this was to be attached to a human being. Afterwards, the two 9-volt batteries were attached to the board. A voltage meter was used to test these batteries ensuring they had enough power to work the EKG and to produce an adequate signal. Now that the possibility of a petty mistake has been eliminated (or greatly reduced) the input leads of the circuit were attached to a test subject using banana clips and EKG tape. The output leads were attached to a voltage meter to test the signal coming off the circuit. The meter showed voltages ranging from 2.0 volts to 0.1 volts with the voltage constantly changing, which is what was expected.

Next it was decided that the analog to digital converter needed to be tested. An oscilloscope was used to generate a known signal. First, however, the oscilloscope was attached to a voltage meter to make sure it worked correctly. Next the input leads of the digital converter were attached to the output leads of the oscilloscope. The digital converter used a serial port to talk to the computer using the program written to decode it. The signals from the oscilloscope allowed the team to vary the signal constantly or keep it the same.

Once it was determined that the computer was receiving the correct data, the converter was then hooked up to the EKG. The computer recorded several minutes of data. The data was then put through the EKG display program to see what the signal looked like. The signal resembled that of a heart rate, so it was determined that the EKG and the analog to digital converter both were working correctly.

Testing of Data Collection Module

Since the data collection module is made up of several components it was easier to find any errors that came up by just testing each component separately before testing all the components together. The First component to be tested was the naming convention for the files. To test this component the program was executed without it having any data to manipulate. After a couple of second of execution of the program. The files were looked at to assure the file has the proper name for the program on the server side. The file looks like this after the file name component is executed properly.

041220_053043PM.txt

The second component to be tested was the Data manipulation. In order to test this component a dummy file was created. This dummy file was filled with random numbers that closely resembled the actual data the program would get from the ekg circuit. The component was then altered so it could read the input from the file instead of from a serial port where the circuit would be attached. After gathering all the data from the dummy file, the new file was looked at to make sure the data format followed with the format we wanted. Which is most recent data first followed by the older data. After testing it with the dummy file. It was then tested with ekg circuit to ensure the serial port was working properly and giving the correct data we wanted.

The third and final component to be test was the interval component. To test this component. A time of one second was allowed for the gathering of data before the program was terminated. The data points that was collected in the file were counted and were divided by one second to estimate the interval between each sample. This number was then compared to the number that was calculated from the interval component.

After testing all the components, the program was then tested with all the components working together to confirm there were no conflicts between any of the components.

BlueTooth Software Testing and Verification

The testing of the Bluetooth software began with the acquisition of test data from the external data source, in our case the EKG circuit. Once this test data was gathered we were able to test the file transferring capabilities of bluetooth as pertaining to our project. We began by starting

the appropriate software on both server and client computers, this software included the bluetooth security interface, and the client or server interface. Once this software was started we began recording the time it took for the bluetooth client software to create a connection with the bluetooth device attached to the server. Once the connection was made we timed how long it took transfer the test data files from the client to the server. We expected that with these values we would be able to determine the minimum amount of time that the two bluetooth devices should be in range of each other so that the necessary data would be completely transferred.

The major problem that we encountered during this testing phase was the instability demonstrated by the bluetooth software in making a connection. Since we are using a modified version of the test application that were distributed with the bluetooth equipment, and since we did not modify any of the code that was used in connection creation process, we came to a conclusion that the bluetooth software stack that was distributed with the contest package was inherently unstable. This instability caused the times needed for creating a connection to vary widely, enough so that we could not get an accurate measurement of the time required to create a connection. Thus the only reliable timing information we received was the time it took to send the data file to the server.

The average time it took to transfer the data file from the client to the server was approximately 10 seconds per file. This time is a fairly accurate measure of the true time as long as one realizes that there will always be some element of human error.

Testing of the display module

Since the display module is independent from other modules within the project, so it also can be tested independently.

Due to various reasons, the data collection module wasn't finished by the time to test this module. So we must use another piece of equipment called LabPro to collect the data. Also using LabPro helped us decide on the property of functionality that the data collection module has, i.e., what sampling rate is appropriate: 50/sec or 100/sec.

As we've mentioned before, one problem was how to make the graphing as real-time as possible. We've modified the algorithm to address this problem and the testing was to determine whether those modifications would actually work (we have complete confidence in its graphing capability).

We decided to test the module on three computers, all with the similar operating system (Win 95 or 98) but different speed. The CPUs they have are P200, PII350 and PIII550. After extensive testing (graphing two-hour-worth of data on each computer), all results are listed in the next table.

Computer	Average time to graph a point (ms)	Total time to graph 7201-second-worth of data (second)	Difference (second)
P200	5.5	7200.5	-0.5
PII350	1.5	7202	+1
PIII550	0.9	7201.5	+.5

As we can see, the results were pretty satisfying. It's worth mentioning here that 486 series may not be sufficient for the software, since it may take more than 20 milliseconds to go through the loop once.

e. The cost and implications of the use of any resources used in addition to those supplied in the CSIDC Project Kit should be documented and described.

Summary

The portion of the report summary should present conclusions and give recommendations for further work.

References

1. Nam H. Tran, An Electrocardiograph, Laboratory Exercise from the UCSD Physics Department, http://www-physics.ucsd.edu/was-sdphul/labs/1B/ekg1.pdf.