**WNR (Wireless Neural Recorder)**

Rice University

Weekly Progress Report 9

10/30/2015 - 11/05/2015

**Agenda for meetings**

Mentor Meeting:

1. Go over power feasibility of the entire system: AFE + Wireless Transmission
2. Discuss bandwidth constraints: sampling rate and precision
3. Discuss the purchase of Intan Chip and what else we require to use it
4. BLE CC2650 development updates
5. Nordic nRF52 BLE development updates
6. Discuss TCP/UDP transmission protocol for data error correction
7. Compression and Huffman Encoding preliminary results
8. Request EEG Data and obtain probes

**Activities this week**

1. Began looking into compression and transmission error correcting protocols (TCP/UDP)
2. Purchase Intan Chip analog front-end
3. Continue BLE development
   1. Managed to get transmission of custom messages working on the Nordic nRF52 BLE board, so we will be switching to this development board, which also has a lower current draw.

**Problems encountered**

1. On the Intan Chip, the LVDS signalling mode is used by default and cannot be changed because the pin to disable LVDS is permanently disabled. We will be required to get a LVDS to standard CMOS converter.
2. One of the two CC2650 boards stopped working, so we cannot continue testing transmission with CC2650 until we get another board, but this should not matter too much because we managed to figure out transmission with the Nordic nRF52 chip. We are permanently switching over development to the nordic board and **abandoning the CC2650**.

**Time devoted to project this week**

|  |  |  |
| --- | --- | --- |
| **Name** | **Tasks Accomplished** | **Hours Spent** |
| Stephen Xia | * CC2650 BLE development * Nordic nRF52 BLE development | 15 |
| Tingkai Liu | * Confirm and purchase Intan Chip * Nordic nRF52 BLE development | 15 |
| Xin Huang | * TCP/UDP research | 5 |
| Yuan Gao | * Huffman Encoding/Compression test and effectiveness characterization | 8 |
|  | **Team Total** | 43 |

**Meetings Minutes**

Undergraduate Member Meetings – 11/3/2015, 6:30PM - 7:30 PM

Attendees: Stephen Xia, Tingkai Liu, Xin Huang, Yuan Gao

Location: Lovett College Commons

Completed objectives:

1. ECoG Data: We must take the training module to be certified for access to ECoG Data
2. AFE:
   1. Intan Chip has two signalling modes: LVDS and CMOS
      1. We want to use CMOS, which can be achieved by pulling a specific pin on the chip high.
         1. Should inquire about whether or not we can use standard CMOS
      2. 64-channel chip uses double data rate, which transmits data on the falling and rising clock edge; this chip requires a FPGA to run
         1. Since we cannot afford to use an FPGA, we should only get the 32-channel chip
3. Compression:
   1. Yuan has code for Huffman Encoding compression algorithm, and will get sample data to test the compression ratio
4. Wireless Transmission
   1. We should look into TCP/UDP for transmission error correction: Xin will look into this
      1. Try to get an example running on a microcontroller.
      2. What should we do if we lose a packet or encounter an error?
      3. What will be the overhead size?
   2. Continue CC2650 development
   3. Work in parallel and begin Nordic nRF52 development

Mentor Meeting – 11/05/2015, 12:30PM - 1:30 PM

Attendees: Stephen Xia, Tingkai Liu, Xin Huang, Yuan Gao, Gary Woods, Hamed Rahmani, Dr. Nitin Tandon

Location: OEDK big classroom

Completed objectives:

1. Power Feasibility Discussion
   1. For a battery, can we get a higher density readily available non-commercial battery (high energy density batteries that are already being produced for other applications)? Dr. Tandon will try to see if he has contacts in this field.
2. Bandwidth Discussion
   1. BLE does not seem to provide enough bandwidth for what Dr. Tandon is willing to compromise in terms of sampling rate
   2. For each transmission power, what is the effective range of transmission?
      1. We can live with less than +0 dBm power, which will give more than a few meters of range
   3. To test if we can use lower sampling rate, we need to obtain EEG data and sample it at different rates and see what features we lose.
3. Dr. Tandon brought some 8-channel probes for us to view
4. Compression: Huffman Encoding
   1. Cannot compress by more than 2x
5. Compromises that Dr. Tandon is willing to live with
   1. 12 probes with 16 channels each
   2. 500 Hz is the lowest sampling rate
      1. If we can use wifi and still sample at the full 1 kHz, Dr. Tandon is willing to reduce the battery life to 6 or 12 hours.
   3. 1 cm x 15 mm size
      1. It is better to have taller height than a bigger width
6. Items to send to Dr. Tandon
   1. Meeting presentation slides
   2. Come up with overall system design as well as how the proposed final module will look.

**Expenditures**

* 1 x RHD2000 6-ft Standard SPI interface cable: $295.00
* 1 x RHD2132 amplifier board with 32 unipolar inputs: $895.00
* 1 x wire adapter for 36-pin connector: $190.00
* 1 x RHD2000 SPI cable adapter board: $98.00
* Shipping and Handling: $33.85
* 2 x nRF51-Dongle: 2 x $48.75
* 2 x CY5670: 2 x $16.88
* Total: **$1643.11**

**Action items list**

|  |  |  |  |
| --- | --- | --- | --- |
| **Action item** | **Owner** | **Due date** | **Status** |
| Research Wi-Fi Protocol and Components | Xin Huang | 11/12/2015 | 0% |
| Intan Chip/Analog front-end power consumption research | Tingkai Liu | 11/12/2015 | 50% |
| Wireless transmission power consumption research | Stephen Xia | 11/12/2015 | 50% |
| Research compression algorithms | Yuan Gao | 11/12/2015 | 50% |
| CC2650/CC2640 BLE Development | Xin Huang | 11/12/2015 | 100% |
| Nordic Labs BLE Development | Tingkai Liu | 11/12/2015 | 50% |
| TCP/UDP and other error control mechanisms | Xin Huang | 11/12/2015 | 80% |

**Additional Comments/Questions for Mentors**