**WNR (Wireless Neural Recorder)**

Rice University

Weekly Progress Report 4

9/25/2015 - 10/1/2015

**Agenda for meetings**

Meeting I:

1. Discuss FOSS I goals (FOSS I check-in)

Mentor Meeting:

1. Clarify the intended design of the system with Dr. Tandon. Is it an array of 16 electrodes with 16 contact points each connected to a wireless chip, or is one electrode connected to a wireless chip each?
2. Discuss findings from surveying neural recording analog front-end technologies.
3. Discuss findings from surveying BLE and/or wireless technologies

**Activities this week**

1. Ordered TI CC2650 and CC2640 BLE chip development kits.
2. Read papers and surveying wireless BLE technologies.
3. Read papers on existing wireless neural recording systems and analog front-ends.

**Problems encountered**

1. When ordering parts through OEDK, our team was not listed as a team that could buy parts through the OEDK, so we directly emailed the technicians. However, they have yet to respond.

**Time devoted to project this week**

|  |  |  |
| --- | --- | --- |
| **Name** | **Tasks Accomplished** | **Hours Spent** |
| Stephen Xia | * Read papers regarding neural recording analog front-end | 4 |
| Tingkai Liu | * Read papers regarding neural recording analog front-end | 6 |
| Yuan Gao | * Install software required for developing on TI CC2650 and CC2640 | 1 |
| Xin Huang | * Read papers regarding neural recording system * Read papers on wireless technologies from TI website | 1.5 |
|  | **Team Total** | 12.5 |

**Meetings Minutes**

Meeting I – 9/29/2015, 4:00 PM - 4:30 PM

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

Completed objectives:

1. Revamped FOSS I goals based on input from Professor Woods.
   1. Get training on PCB Mill and 3D Printer
   2. Divide prototyping into the two systems: analog front-end and wireless transmission
2. Challenges for analog front-end
   1. AC coupling: you want a large capacitor with a low cutoff frequency
   2. Discrete components for first prototype
3. Challenges for wireless transmission
   1. How much throughput can you shove through with BLE?

Mentor Meeting – 10/1/2015, 12:30 PM - 1:30 PM

Attendees:

Completed objectives:

1. Clarified system architecture
   1. One electrode with 16 contact points will interface with one chip.
   2. There can be a variable number of electrodes implanted.
   3. System specifications:
      1. up to 8 mm radius.
      2. 1 cm tall maximum.
   4. Electrode specifications:
      1. 0.8 mm wide by 16 mm tall.
   5. Three more useful components
      1. Out of range indicator for receiver.
      2. End of battery indicator.
      3. Method for determining which channels to read from and which channels to ignore.
2. Possible methods and considerations for tackling system design
   1. Multiplexing: If sample rate is 1 kHz for each contact point, sample at 16 kHz one point at a time so that your aggregate sampling rate for each node is 1 kHz. You can also transmit from one node at a time and reduce power.
   2. Electrodes measure potential difference, so you need to pick one contact point as reference for each electrode.
   3. Ideally, you want to retain all low frequencies up to the kHz range. Requires a large capacitor, but a larger capacitor will cause more attenuation.
   4. Neural impulses occur as high as 500 Hz to 1 kHz, so you must sample at least twice that frequency.
3. Neural recording background
   1. Record from macroelectrodes the local field potential of 150,000 to 250,000 neurons.
4. For next time
   1. New competitor: Blackrock
      1. Creates a neural recording wireless transmission device.
      2. Chips are large.
      3. Uses wall power.
   2. Quantitatively list out power needs
      1. Survey battery capabilities.
      2. Quantify how much power you need to sample and transmit from one channel, which will be dominated by the power constraints of the chip used.

**Expenditures**

Vendor Vendor Part # Manufacturer part # Quantity Cost

Mouser 595-CC2650DK CC2650DK 1 $299

Mouser 595-CC2650STK CC2650STK 1 $29

* $6.99 Shipping fee
* Total: **$334.99**

**Action items list**

|  |  |  |  |
| --- | --- | --- | --- |
| **Action item** | **Owner** | **Due date** | **Status** |
| Research Wireless/BLE technologies | Xin Huang | 10/9/2015 | 40% |
| Development environment setup | Yuan Gao | 10/9/2015 | 40% |
| Survey analog front-end chips for neural recording | Tingkai Liu | 10/9/2015 | 70% |
| Research analog front-end circuits for high SNR amplification | Stephen Xia | 10/9/2015 | 70% |

**Additional Comments/Questions for Mentors**