UNIVERSITY OF FLORIDA

Team10 : MindView

UF - Electrical Engineering Design

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C.*EEG.*A.L.S.

Cognitive Electroencephalography Acquisition Laboratory System

Preliminary Design Report

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Project Abstract

Electroencephalography (EEG) is the acquisition and recording of brain signals from the scalp by means of electrodes placed on the head. Many curious electronics hobbyists have shown keen interest in EEG, although the steep cost of these apparatus usually places a barrier from exploiting their interest. The goal of our project is to build a Cognitive Electroencephalography Acquisition Laboratory System (CEEGALS) providing the end-users an affordable way to view and analyze their brainwaves. CEEGALS will allow the user to view these waveforms on a handheld LCD. The user will benefit from a beautiful separation of acquisition hardware and feedback hardware, since CEEGALS features wireless data transmission from the electrodes board to the display board.

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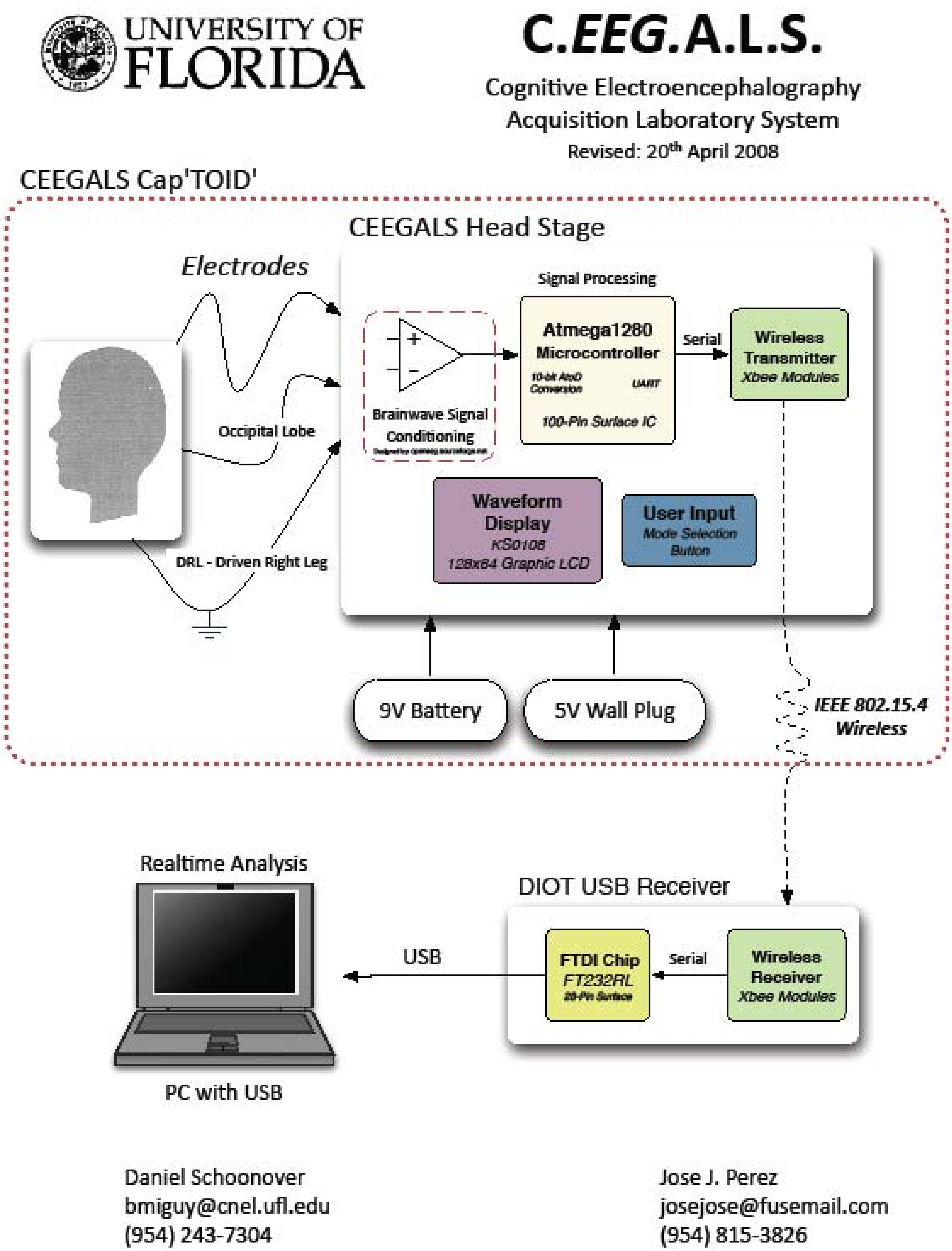
System-level block diagram



Project Features/Objectives

Headstage features

- Sample 2 channels of data

- -Display each channel on a Graphical LCD

- Interface with the OpenEEG amplifier board
  - supply a noise-free 2V buffer signal

- Transmit the 2 channels of data in real time to receiver

Receiver Features

- Receive wireless data
- upload data to computer via USB

Analysis of Competitive Products

Neurofeedback devices are rare, and sold to niche markets. Most applications are research, and as such it is the norm for labs to pay upwards of thousands of dollars for a cumbersome high speed, precise data acquisition unit, along with amplifiers 'painstakingly taylored' to filter and amplify only eeg signals. The CEEGALS project utilized open source amplifier board designs, which cost around $70 to print and populate. Ceegals took the OpenEEG project and raised it a level or two with the addition of wireless data transmission and onboard graphical displays.

Comparing the sub-$200 price for parts (not including labor) to professional neuro-feedback lab equipment, our design stands out in terms of portability, ease of use and value.

Concept/Technology Selection

In EEG one of the most important objectives of the system is to provide clean signals. For this reason we chose to sample the analog data and immediately transmit to another location for further processing and display. By doing the processing in this way we can reduce the amount of components and clutter on the analog acquisition board (headstage) and allow freedom of movement and safety to the subject. The headstage will consist of the following components:

Electrodes (used for acquiring the raw analog signals)

OPENEEG amplifier/filter circuit board

Microprocessor AVR1280 for:

-sampling 2 channels of eeg

-displaying each waveform on GLCD

-wirelessly transmitting both waveforms

Xbee wireless module for wireless transmission

The receiver unit will receive the wireless EEG data from the headstage's Xbee transmitter. The headstage system will be worn on the head, with electrodes wired to the user. The graphical LCD on the headstage prompts the user if they wish to view the waveforms being acquired, or route the data to PC via USB. If the user decides to send the data to the PC we hope to interface this data with a number of open-source EEG programs that already exist. Both modules will be battery powered to allow for portability and comfort. The receiver unit will consist of the following components:

- Xbee wireless module for data reception
- FTDI controller to emulate USB PC interface

The graphical LCD will be interfaced using a parallel communication to allow for better frame rates than the serial alternative. We decided to use the CFAG12864MYYHTN GLCD module,


CRYSTALFONTZ
CFAG12864M
SMALL 6x8 TEXT

Project Architecture

Headstage

Electrodes provide 2 raw EEG signals to the OpenEEG amplifier board mounted in the headstage. The openeeg boards amplify and filter out wanted and unwanted signals, respectively. Also mounted in the headstage is our AVR1280 microprocessor. This gadget samples the 2 channels of EEG data from the OpenEEG boards and provides a graphical user interface to the user on the graphical LCD (also mounted on the headstage). The user can choose to view either sampled EEG channel, or send this data wirelessly to the receiver stage. If the user views a channel, the microprocessor scales the sampled signals to a large portion of the GLCD display memory space, and displays the signal. If 'send' is chosen, the GLCD blinds the plot, and the microprocessor sends packets to the Xbee's UART for wireless transmission.

Receiver Stage

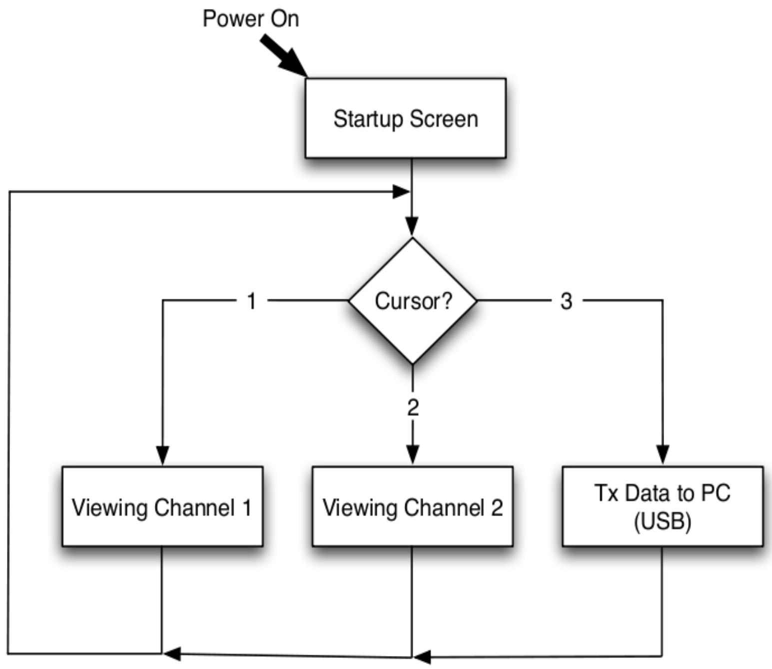
This stage only contains 2 important chips: the receiving Xbee and the FTDI chips. The Xbee chip receives the headstage's wireless packets and routes them to the FTDI's UART input. The FTDI board will contain a USB-B female receptacle(connector), which will connect to a computers usb jack. The computer sees this connection as a virtual COM port. A number of open source programs exist for manipulating the packets arriving at this port.

Of things to come..

The project as it stands is skeleton, a foundation of possibilites for EEG acquisition as many more channels of eeg data could be added for much more precise spatial measurement. The temporal restrictions are set by the speed of the microprocessor's clock(7.3728MHz), yet should make too much difference as the fastest known (significant) eeg waveforms reside in the 300 hz spectrum. The xbee's transmit packets at ______, so there is no speed constraint from our choice of wireless boards.

Flowcharts & Diagrams

Software Flowchart



Seperation of Work

Task Name	Danny	Jose
Idea brain storming	50	50
Abstract	50	50
Part research, selection, & purchase	50	50
Preliminary design report	50	50
FTDI Breakout Board and Coding	30	70
Breakout Boards (FTDI/ ATMEL) w/ ISP	0	100
Analog Data Acquisition	70	30
Xbee Module Testing	30	70
Finalize Headstage Module Board	0	100
Graphical LCD Interface	80	20
User Interface Programming	70	30
Design Display Module Package	70	30
Final Product Testing	50	50
Final Design Report	50	50
Demo	50	50

Bill of Materials

GLCD (CFAG12864MYYHTN) $36.20

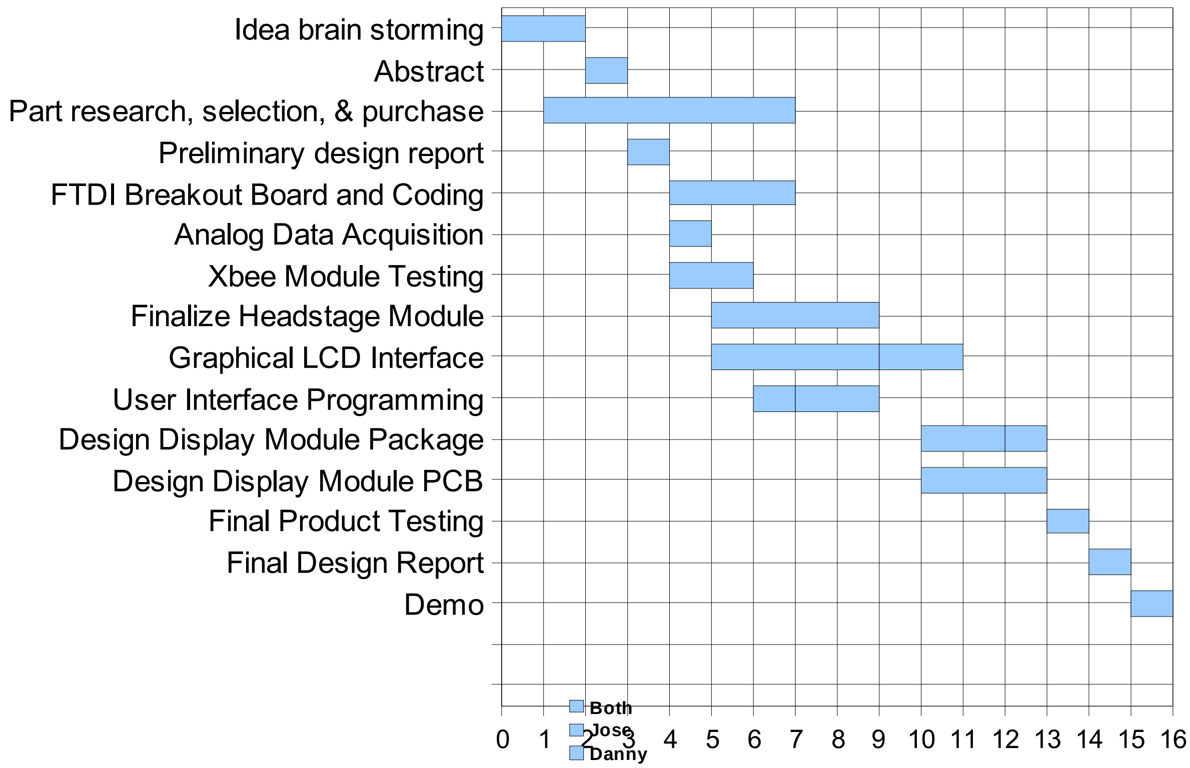
1	8	495-3266-ND	CAP CER 10PF 100V C0G 5% RAD	10pf c0g analog_2	0	0.31000	$2.48
2	14	495-3268-ND	CAP CER 100PF 100V C0G 5% RAD	100pf c0g analog_4	0	0.21100	$2.95
3	10	445-2625-ND	CAP CER 10000PF 100V X7R 10% RAD	10nF X7R analog_2 digi_3	0	0.19600	$1.96
4	20	445-2628-ND	CAP CER 1000PF 250V X7R 10% RAD	1nF X7R analog_6	0	0.18900	$3.78
5	7	490-3834-ND	CAP CER 33000PF 50V X7R RADIAL	33nf 5% analog_2	0	0.19000	$1.33
6	15	445-2855-ND	CAP CER 0.22UF 50V X7R RAD,	220NF DIGITAL_6 ANALOG_2	0	0.19300	$2.90
7	13	495-1119-ND	CAP 1.0UF 63V METAL POLY	1uF Film analog_4	0	0.32200	$4.19
8	2	718-1204-ND	CAP TANT 1.0UF 35V 10% RADIAL	1uF tantalum digital_2	0	0.65000	$1.30
9	6	718-1178-ND	CAP TANT 10UF 16V 10% RADIAL	10uF tantalum digital_6	0	0.92000	$5.52
10	6	399-4549-ND	CAPACITOR TANT 47UF 10V 10% AXL	47uF tantalum digital_3 analog_1	0	1.64000	$9.84
11	5	100XBK-ND	RES 100 OHM 1/4W 1% METAL FILM	100R digital_1 analog_1	0	0.09800	$0.49
12	20	P470CACT-ND	RES METAL FILM 470 OHM 1/4W 1%	470R digital_12	0	0.17100	$3.42
13	20	P1.00KCACT-ND	RES METAL FILM 1.00K OHM 1/4W 1%	1k digital_5 analog_2	0	0.17100	$3.42
			RES METAL FILM				

14	50	P2.20KCACT-ND	2.20K OHM 1/4W 1%	2.2k analog_16	0	0.09900	$4.95
15	10	7.50KXBK-ND	RES 7.50K OHM 1/4W 1% METAL FILM	7.5k digital_6	0	0.09800	$0.98
16	10	P8.20KCACT-ND	RES METAL FILM 8.20K OHM 1/4W 1%	8.2k analog_2	0	0.17100	$1.71
17	10	P9.10KCACT-ND	RES METAL FILM 9.10K OHM 1/4W 1%	9.1k digital_1	0	0.17100	$1.71
18	25	10.0KXBK-ND	RES 10.0K OHM 1/4W 1% METAL FILM	10k digital_3 analog_6	0	0.09800	$2.45
19	10	15.0KXBK-ND	RES 15.0K OHM 1/4W 1% METAL FILM	15.0k digital_1 analog_2	0	0.09800	$0.98
20	15	100KXBK-ND	RES 100K OHM 1/4W 1% METAL FILM	100k analog_4	0	0.09800	$1.47
21	5	200KXBK-ND	RES 200K OHM 1/4W 1% METAL FILM	200k analog_1	0	0.09800	$0.49
22	20	1.00MXBK-ND	RES 1.00M OHM 1/4W 1% METAL FILM	1.0M analog_6	0	0.09800	$1.96
23	4	516-1601-5-ND	OPTOCOUPLER DARL-OUT 8-DIP	6N139 optocoupler digital_2	0	1.35000	$5.40
24	2	296-1290-ND	IC ADJ SHUNT REG TO-92	TL431CLP adjust vref digital_1	0	0.40000	$0.80
					Subtotal		$66.48

Dipped Radial Tantalum Capacitors 20V 47uF 20% 4@ $2.38 each $9.32
Multi turn trimpots 10@ $1.77 each $17.70
Very Low Power (250mW-1W) DC-DC Converters 1@ $10.97
OpenEEG amplifier board from OLIMEX 1@ $11.70
XBee Module to 0.1" spacing DIP Adapter $4.50 + $7.98 = $12.48
Atmel AVR1280 microprocessor sample = free :)
Bicycle helmet (headstage 'enclosure') $8.88

Stickers, decoration etc.		$5
total:	**173.73**	

Gantt Chart



CEEGALS Design Project - Spring 2008