

# Brain - computer interface

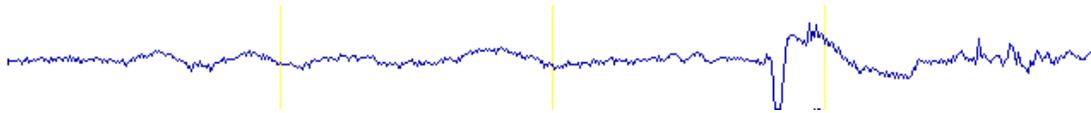
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## Theoretical considerations

The human brain presents some exterior electrical manifests from some intern cerebral activities and for chemicals processes generated by neuroses. The electrical manifests of the brain in some different parts of head as a standardized map and it is manifesting as a electrical tensions created from intern processes and it was indentified some areas for speaks, for walks, motorial activities for hands, legs and there are separated in areas(left, right)

## EEG Signal type

Examples of EEG signals:



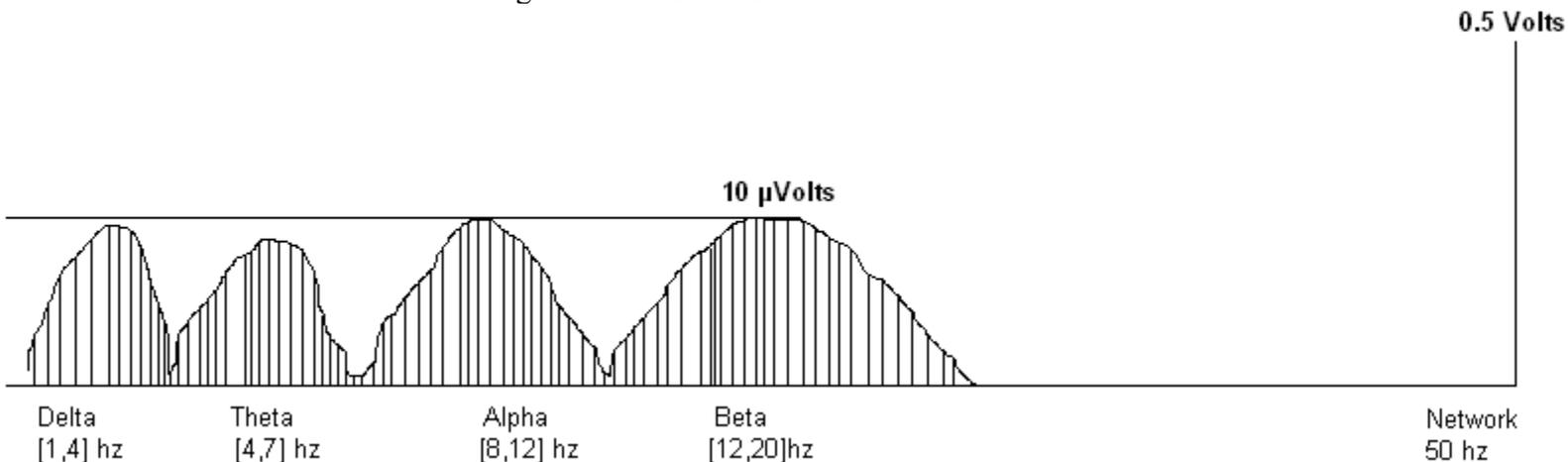
Alpha waves – dream state– 8hz – 12 hz

Beta waves– conscious – 12 hz – 20 hz

Theta waves – subconscious– 4hz – 7 hz

Delta waves – uncnsconscious – 1hz – 4 hz

The waves are combining are it creats states



The EEG signal is manifesting as a variable tensions in time with amplitude very small between 10-20 micro-volts, the values are useless for the current technology. In this signal there are 4 electrical signals with different frequency, named as cerebral waves.

These 4 spectral signals with different frequencies:

Alpha waves – dream state – 8hz – 12 hz

Beta waves – conscious – 12 hz – 20 hz

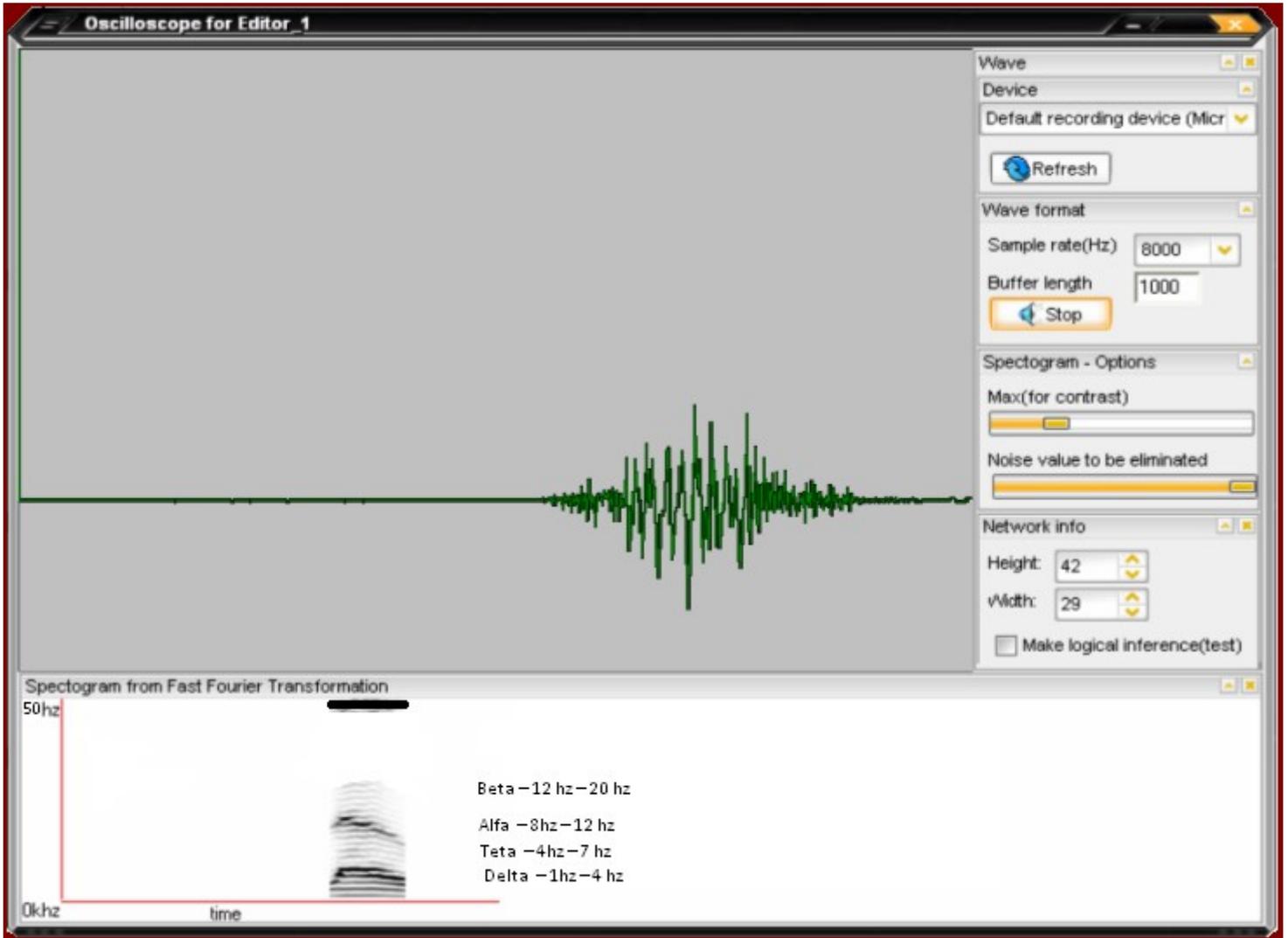
Theta waves – subconscious – 4hz – 7 hz

Delta waves – unconscious – 1hz – 4 hz

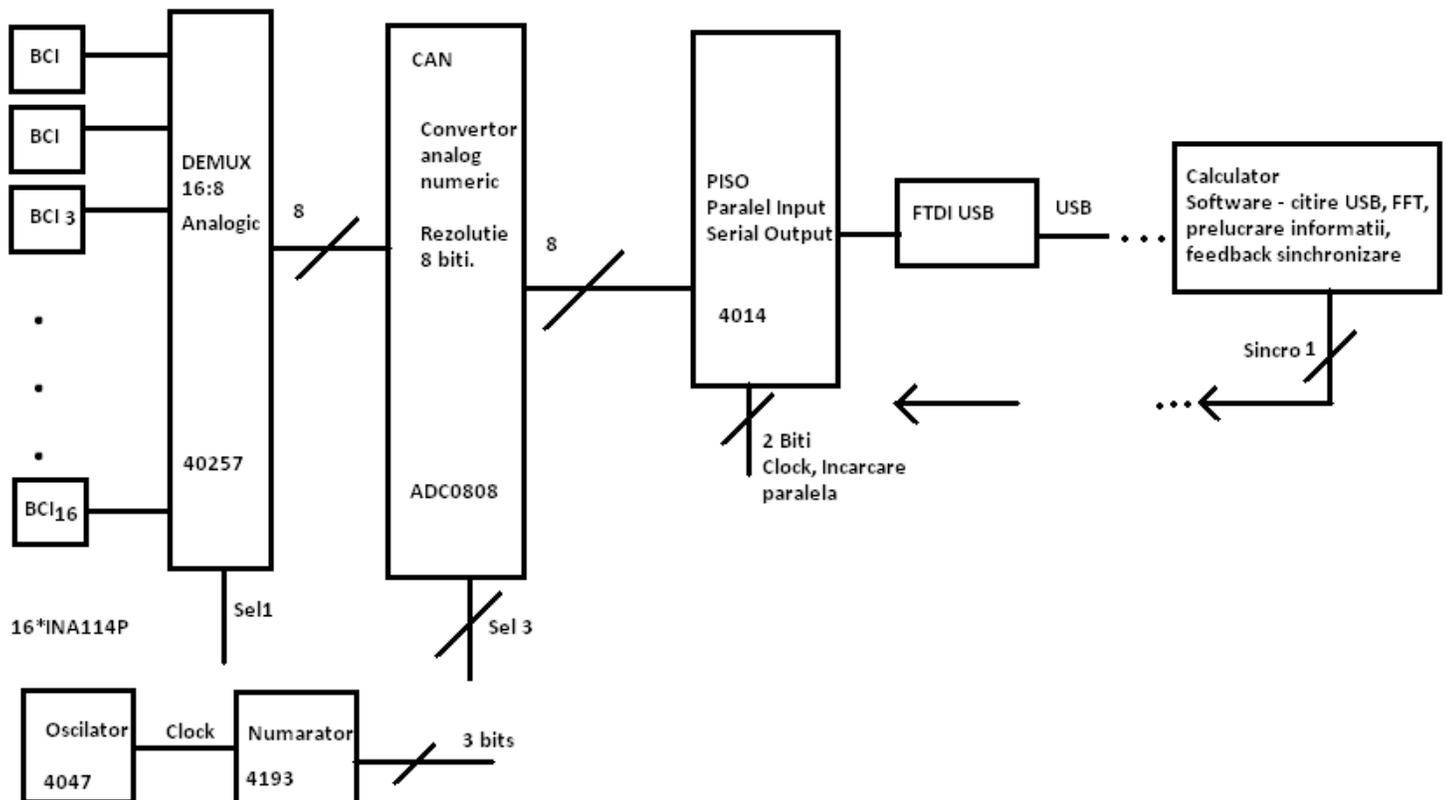
## **Technical problems to create an encephalograph**

The biggest problem in processing these is that the specters with information are very close with source network on 50 hz frequency, and the amplitude of the signal is very small. All of these equipment reject the 50 hz (signal noise generated by the supply voltage with an AC source). The equipments like computers, televisions, are using a rejection filter. The rejecter filter removes the power source noise and in a very small percentages the signal with frequencies between 30-60 hz, of course with other values. Of course it introduces an attenuation of values between 1-50 hz, and 50-1000 hz, in these case if we will apply this classical filter we will produce a distortions of the EEG signal (signal generated by the brain). The method used to take and process the EEG signal it uses some integrates circuits specialized named instrumentation amplifier produced only by a few chips factories, for example we used the Texas Instruments with INA11P, or Burn-Brown and using these in an electrical schema recommended by the producer, so we can not make any adjustment. The electrical schema is trying to maximize the CMRR and rejections of the common modal, so the signal of 50 hz, that we can take from the human body from the electromagnetic field made by the power source network AC220 from the building. Practically the human body is like an antenna and it takes the noise from the network, you can see the diagram with FFT, from the previous pages of the EEG signal with these 4 spectrums of the Alpha, Beta, Theta, Delta waves and the continuous component of 50 hz from the network taken by the body. The human body takes the wave that represents a manifesting in space of the electric field, the usual equipments neglect the comportment of the direct current (DC) wave, the manifestation of the wave comportation of the electric power and it is a manifestation of propagation and is used only the manifestation of the power electricity.

The difference between these 2 spectrums (the utility spectrum and the network spectrum) is about of thousands times higher, and is variable in function of the position of the man in space, practically some amplifier about 10 times (gain 10) will take of saturation of the amplifier. The single technology that exists and it use in the schema an instrumentation amplifier, and differential one, that is trying to maximzare CMRR, pratically the small signals are amplified and the smalls one are rejected



Schema Diagram proposed by me



## **Necessary software**

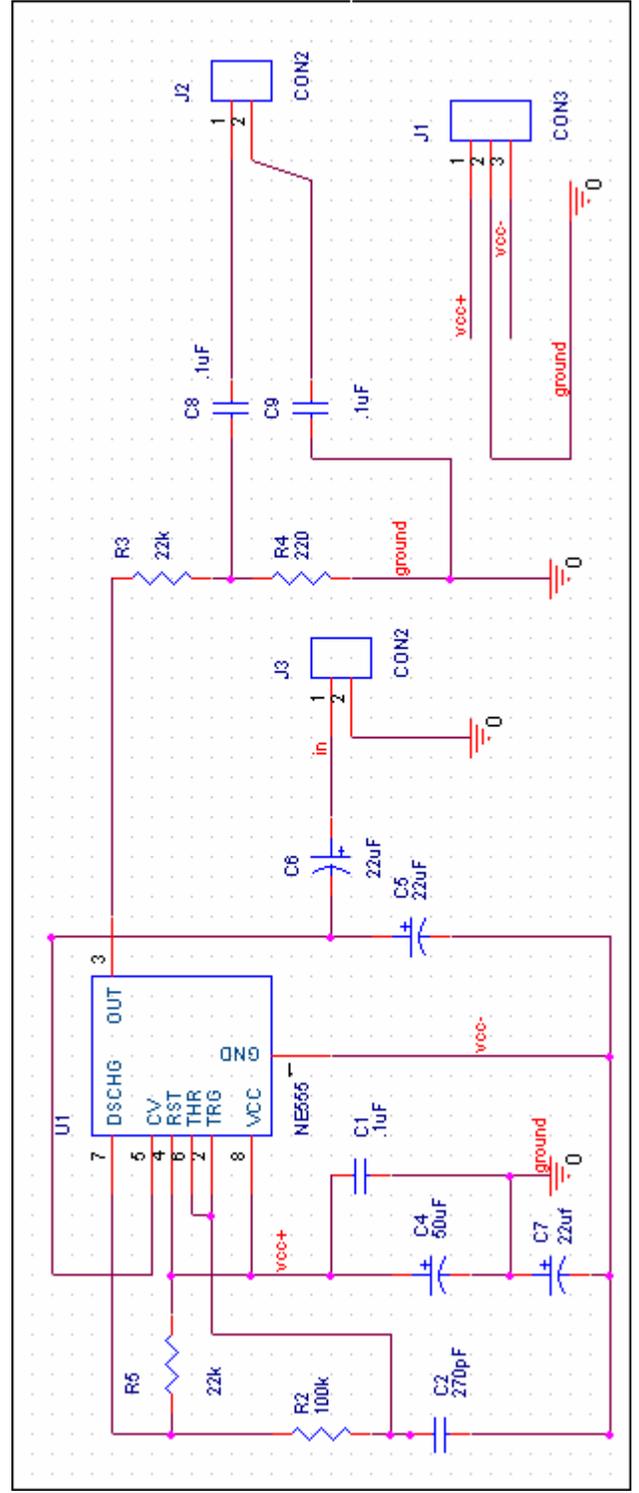
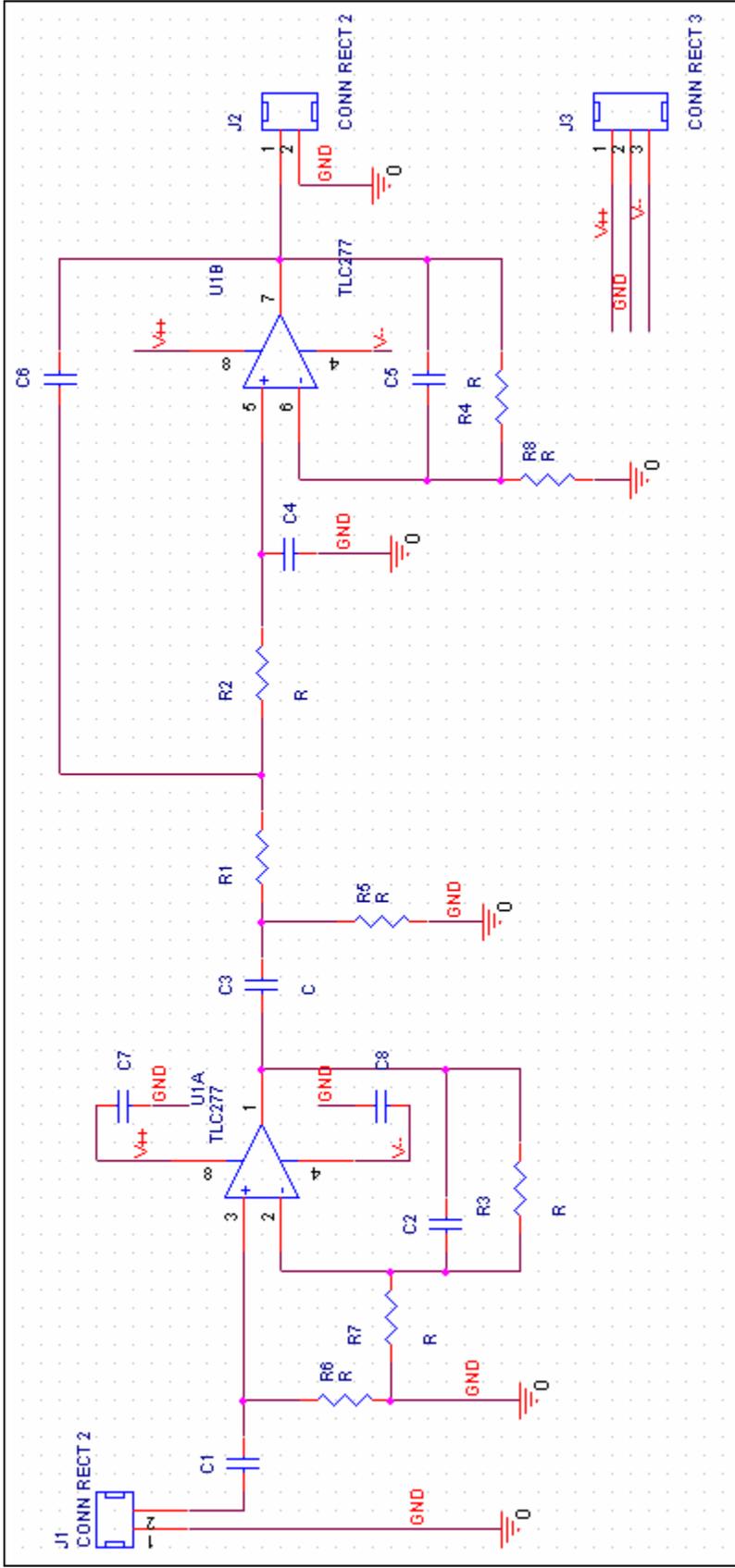
To take the signal, we read the information on a serial port on USB, the recovery of the data, the separation on the 16 channels is made with the softwares and generation a synchronization signal with the interface. The software process the information with FFT discrete, to make a fine-frequency spectrogram of the signal from the encephalograph. I will remember you that the received by the encephalograph is a signal in time-amplitude, and is created from 4 different spectrums, Alpha, Beta, Delta, Theta. The recovering of the spectrums is made from the software, with creating some spectrograms and calculating numeric this matrix. The recognition of the pattern in the spectrogram, it is made with the perceptron paradigm. We use a neural classifier, with Multi Layer Perceptron networks. This software was made by me, and presented in a lot of contest (softwares NeurosLab, and AILab). Practically the data set is made as: The person create some different activities with the right hand, and the software can see the cerebral activity, it saves the spectrograms, and it saves only the spectrograms with the hand that in the future can be recognised with only the cerebral activity to think to move the hand to generate in the same activity and the neural software to recognise the pattern

The interface can be used to write on the computer without using a the keyboard, the idea is to write with only brain (with thought). Some universities that study the same domain have obtained about 10 characters per minute. The idea is the next: It generates lines and columns in a matrix with different characters, and the software is watching about our cerebral activity in the moment when the character is selected from a set of letters. From a lot of lines selected, it is founded the common line. From more letters is select only the one so the software recognise the letter on what I was thinking. The software can recognise. The software can recognise the letter in from the neuronal activity

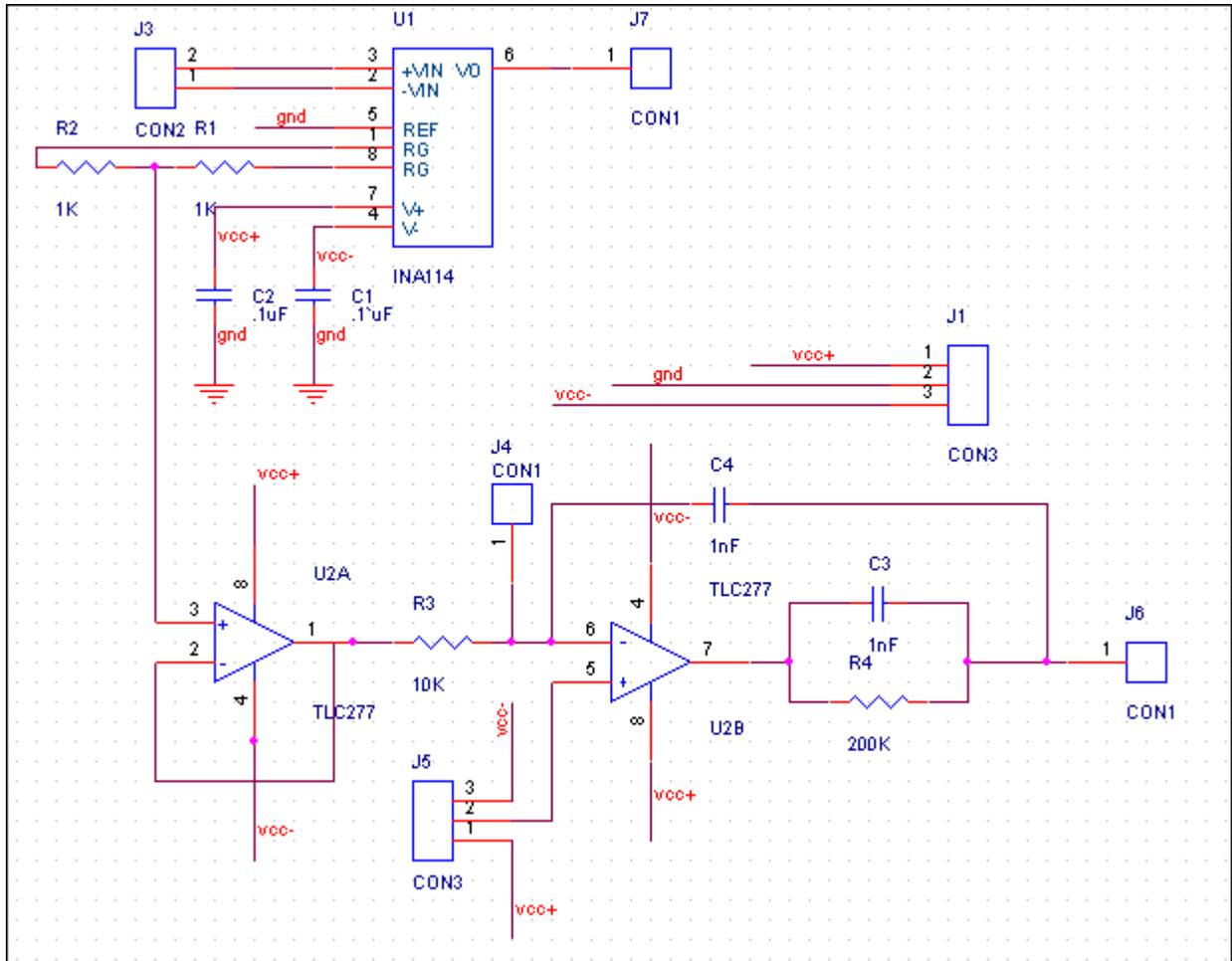
## **The hardware schema**

There are 3 files

1. EEG (encephalograph) with one channel that contain instrumentation amplifier and active filter
2. Amplitude modulation

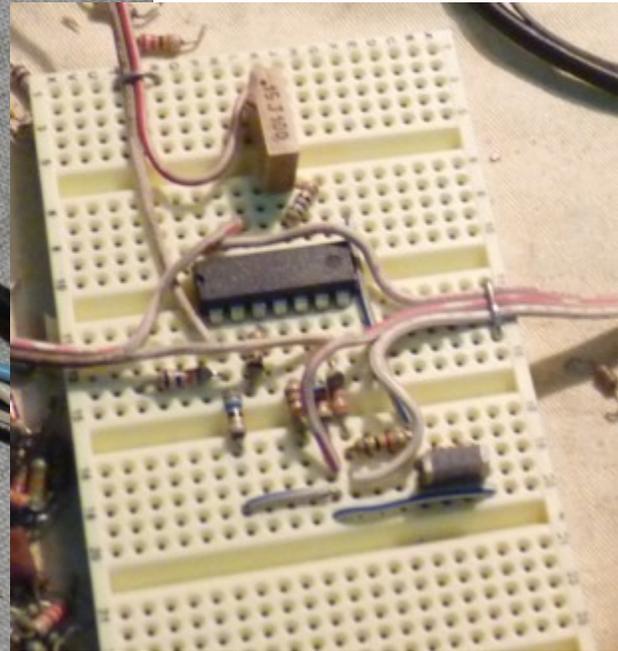
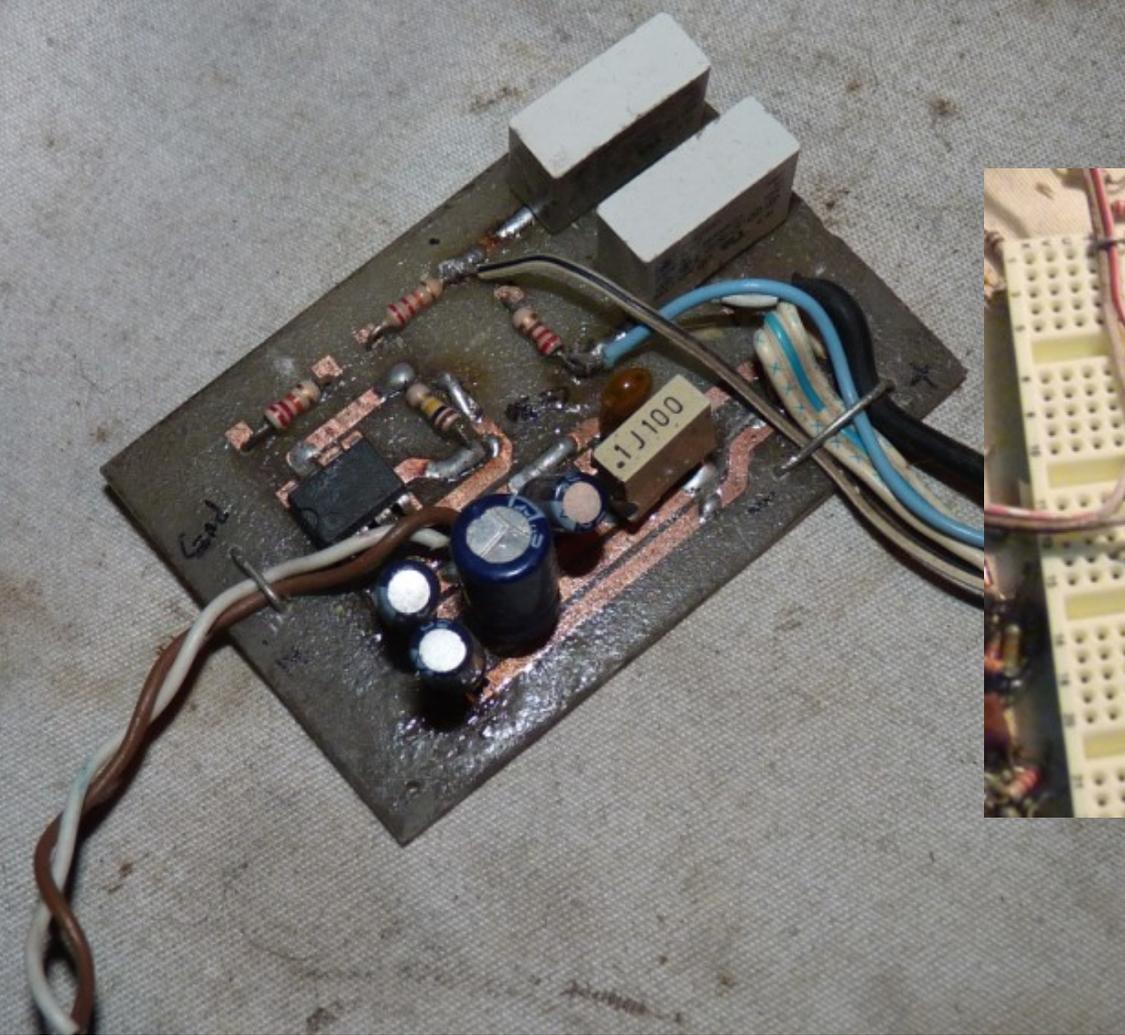
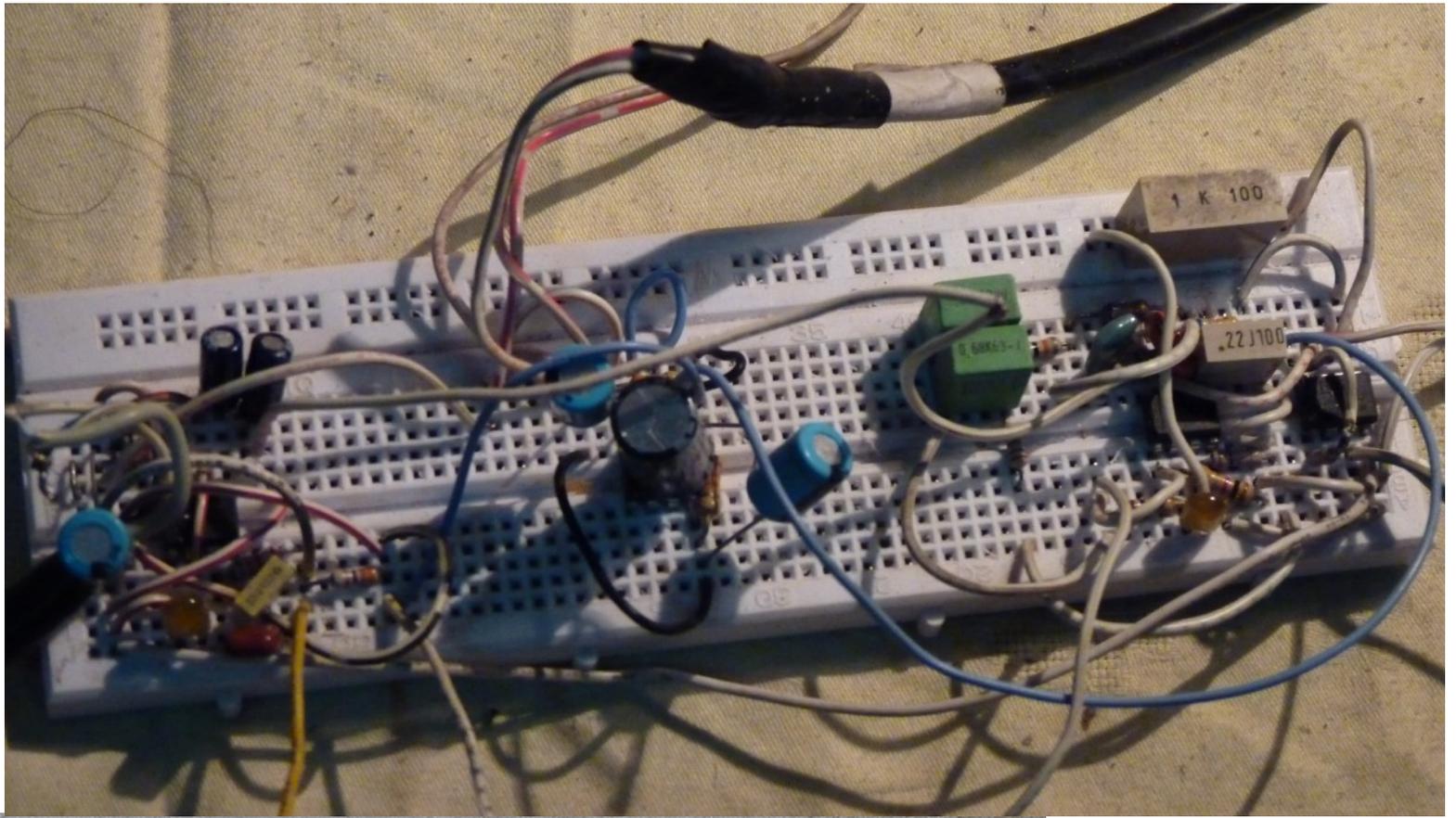






### State of the work

- The software is made 90%
- The device is 90% without the DRL
- The analogic part INA114P is used by a popular encephalograph made in hundreds of samples by the internet users <http://openeeg.sourceforge.net/doc/>



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For further queries related to this project contact us through the Giga-Software website at [www.giga-software.com](http://www.giga-software.com) or you can e-mail us at: [ibudisteanu@acm.org](mailto:ibudisteanu@acm.org) , [ibudisteanu@giga-software.com](mailto:ibudisteanu@giga-software.com)

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