EEGHUB.GE



Author: Irma Khachidze

Ivane Beritashvili Center of Experimental Biomedicine

EEGHUB.GE

Contents

1.	Introduction	. 2
2.	Methodology	. 3
3.	Description of the Program	. 4
3	1 Input	. 4
3	.2 Output	. 4
3	.3 Download Recordings	. 7
3	.4 Opening of EEG recording	. 8
4.	Bibliography:	10

1. Introduction

Overall description and scope of the service: studying the nature of alteration of basic characteristics of EEG (Electroencephalogram-Brain Electrical Activity) in healthy subjects and patients with different disorders of nervous system (NS) is important for understanding both normal and pathological brain condition. In addition, the accumulation the comparison of EEG in healthy subjects and patients with different disorders of central nervous system (CNS) helps to develop criteria for more adequate assessment of the degree of brain dysfunction.

Target user community and value provided for it: identifying EEG predictors during pharmacotherapy and finding EEG biomarkers in patients with CNS disorder (ADHD, epilepsy and etc.) in clinical settings. It will be especially useful in children for the assessment of brain maturation processes; it is particularly informative in psychiatry, neurology for diagnosis of different functional disorders (e.g. ADHD). We have collected large volumes of EEG data http://eeghub.ge/ (normal and pathological) in Georgia and share data with international partners at KTH Royal Institute of Technology (KTH), Stockholm, Sweden and Lesya Ukrainka Eastern European National University (EENU), Lutsk, Ukraine.

The service is free for European (or national) researchers following the FAIR (Findable, Accessible, Interoperable, and Reusable) principles. Service has convenient search engine, which allows users to identify any recordings that correspond to specific requirements. The recordings are easily accessible and can be downloaded for further exploitation. The target users are open-source groups of researchers/practitioners, lecturer/students, Scientific Organization, Hospitals, Universities, etc. It is envisaged that EEG collection http://eeghub.ge/ will support researchers in the field of neuroscience, psychophysiology, medicine, psychology, neurophysiology, cognitive and social science.

This work was initiated as part of the international collaborative project "Computational infrastructure for high-throughput analysis of large volumes of brain signal data", funded by the Swedish Research Council (Vetenskapsrådet, VR) within the framework of the Swedish Research Links (VR SRL) program.

EEG is informative both in the study of mental processes and in determining the mechanisms of various psychiatric/neurological disorders. The accumulation and comparison of EEG in healthy subjects and patients with different disorders of nervous system (NS) helps to develop criteria for more adequate assessment of the degree of brain dysfunction. The EEG collection allows us to comprehensively evaluate children for brain maturation processes. This can be particularly informative in pediatrics and neurology for the study of the processes of brain maturation. Comparison of the obtained EEG data before, during and after pharmacotherapy will allow to adequately assessing the quality of dysfunction of the brain's regulatory systems. Also in the diagnosis of various cognitive (functional, behavioral) disorders in the field of clinical psychology and in child neurodevelopmental disorders there is an opportunity to evaluate the effectiveness of monitoring of current treatment. The identification of EEG data and key EEG biomarkers for different disorders support effective implementation of therapeutic methodologies at the early stage. This facilitates the validation and potentially the correction of diagnoses and paves the

way for further development of therapeutic strategies increasing the quality of treatment. In addition, it is particularly useful in psychiatry, neurology for diagnosis of different functional disorders.

2. Methodology

This database includes EEG data, which has been collected for 15 years at Ivane Beritashvili Center of Experimental Biomedicine and David Tatishvili Medical Center, Tbilisi, Georgia. The data was recorded from healthy subjects (typically developed children, adolescences, adults and elder people) and subjects with different disorders of nervous system, 4087 subjects in total, from both men and women and varying age groups, ranging from 3 months to 75 years. Ethical aspects and privacy rights are protected in agreement with fundamental ethical standards in accordance with the ethical standards of research of the Helsinki Declaration. The identities of participants are anonymized and pseudorandomized. Personal information is removed to ensure full anonymization, there are no names, surnames or data births of the patients, instead pseudorandom numerical identifiers have been used.

The current EEG recordings in the database were performed at the same time of the day, in the morning. The mean duration of an EEG recording was 25-30 minutes including the resting-statebackground EEG activity, followed by functional samples (photo stimulation and hyperventilation). The background EEG was recorded with eyes closed (4 minutes), with eyes open (4 minutes), and once again with the eyes closed (4 minutes). Functional trials were performed with rhythmic photostimulation, at frequencies 3-5-10-15-20Hz; hyperventilation (three minutes) - with open, closed eyes and the breath hold (15-25sec) recording was finished with closed eyes. Besides the standard EEG scenario, there are sleep EEG recordings of children under the three year's old. The database consists also of the normal and pathological recording of humans EEG with different dysfunction of NS (for example: headaches, epilepsy, encephalopathy, stroke, ADHD, cerebral palsy and so on).

The ENCEPHALAN 131-03 software MEDICOM was used for digital recording 19 scalp electrodes according to the International 10-20 system. The bandpass of the amplifiers was 0.5-100Hz, and the notch filter was 50Hz. The signals from each input electrode were digitized with at a sampling rate of 256Hz with a resolution of 16 bits. Electrode (Ag/AgCl) impedance will be under $5k\Omega$.

A quantitative analysis of the EEG epochs is conducted using a fast Fourier transformation (FFT) algorithm. The Spectral analysis methods of brain functional activity are used, based on quantitative EEG spectral analysis paradigm and frequency-amplitude characteristics. The spectral analysis is used to calculate absolute value of power (AVP, μ V^2s) within 6 frequency bands: Delta (0.5 - 4.0 Hz), Theta-1 (4.0 - 6.0 Hz), Theta-2 (6.0 - 8.0 Hz), Alpha (8 - 13 Hz), Beta (13 - 30 Hz) Gama (30 >- Hz).

The collected EEG data was systematized, curated and stored in an online database in EDF format.

3. Description of the Program

3.1 Input

a. To search for data, first select filters of age, gender and normal/pathology. The user can also use each filter separately to search for data.

Age	Gender	Normal/Pathology
	~	~

b. After selecting appropriate filters, user should press the "Search" button.

3.2 Output

a. After pressing "Search" button the following database will appear.

The database involves EEG recordings with selected categories: age, gender, normal/pathology, number of visits, pharmacotherapy and recording date.

Patient code	Age	Gender	Normal Pathology	Number of visits	Pharmacotherapy	Recording date
55	4-6	Female	Pathology	1	Sonapax+Phenibut	2004-07-27
13	4-6	Female	Pathology	1	Depakine	2004-08-02
12	4-6	Female	Pathology	1		2004-08-03
140	4-6	Female		1		2005-01-13
146	4-6	Female		1		2005-01-17
152	4-6	Female	Pathology	1		2005-01-26
100	4-6	Female		1		2005-01-31
681	4-6	Female	Pathology	1		2005-02-02
697	4-6	Female	Pathology	1	Depakine+Finlepsin	2005-02-22
737	4-6	Female	Pathology	1		2005-02-26
715	4-6	Female	Pathology	1		2005-02-28
731	4-6	Female	Pathology	1	Luminal+Finlepsin	2005-02-28
461	4-6	Female		3		2005-04-07
215	4-6	Female		1		2005-05-05
179	4-6	Female	Pathology	1		2005-05-05
213	4-6	Female		2		2005-05-06
190	4-6	Female	Pathology	2	Depakine	2005-05-13
		1	1	1		

Note: Empty cells under the section of **"Normal/Pathology"** means EEG data of healthy subjects.

b. Number of visits

The section "Number of visits" indicates number of EEG recordings for each patient, with a specific numerical indicator (1 – for one EEG recording, 2 – for two and so on).

Patient code	Age	Gender	Normal Pathology	Number of visits	Pharmacotherapy	Recording date
55	4-6	Female	Pathology	1	Sonapax+Phenibut	2004-07-27
13	4-6	Female	Pathology	1	Depakine	2004-08-02
12	4-6	Female	Pathology	1		2004-08-03
140	4-6	Female		1		2005-01-13
146	4-6	Female		1		2005-01-17
152	4-6	Female	Pathology	1		2005-01-26
100	4-6	Female		1		2005-01-31
681	4-6	Female	Pathology	1		2005-02-02
697	4-6	Female	Pathology	1	Depakine+Finlepsin	2005-02-22
737	4-6	Female	Pathology	1		2005-02-26
715	4-6	Female	Pathology	1		2005-02-28
731	4-6	Female	Pathology	1	Luminal+Finlepsin	2005-02-28
461	4-6	Female		3		2005-04-07
215	4-6	Female		1		2005-05-05
179	4-6	Female	Pathology	1		2005-05-05
213	4-6	Female		2		2005-05-06

c. Pharmacotherapy

This section provides information about pharmacotherapy. Below is shown what type medication the patient was taking. Blank cell means the patient without pharmacotherapy.

Age	Gender	Normal Pathology	Number of visits	Pharmacotherapy	Recording date
4-6	Female	Pathology	1	Sonapax+Phenibut	2004-07-27
4-6	Female	Pathology	1	Depakine	2004-08-02
4-6	Female	Pathology	1		2004-08-03
4-6	Female		1		2005-01-13
4-6	Female		1		2005-01-17
4-6	Female	Pathology	1		2005-01-26
4-6	Female		1		2005-01-31
4-6	Female	Pathology	1		2005-02-02
4-6	Female	Pathology	1	Depakine+Finlepsin	2005-02-22
4-6	Female	Pathology	1		2005-02-26
4-6	Female	Pathology	1		2005-02-28
4-6	Female	Pathology	1	Luminal+Finlepsin	2005-02-28
4-6	Female		3		2005-04-07
4-6	Female		1		2005-05-05
4-6	Female	Pathology	1		2005-05-05
4-6	Female		2		2005-05-06
	Age 4-6	AgeGender4-6Female	AgeGenderNormal Pathology4-6FemalePathology	AgeGenderNormal PathologyNumber of visits4-6FemalePathology14-6Female </td <td>AgeGenderNormal PathologyNumber of visitsPharmacotherapy4.6FemalePathology1Sonapax+Phenibut4.6FemalePathology1Depakine4.6FemalePathology1Depakine4.6FemalePathology14.6FemalePathology14.6FemalePathology14.6FemalePathology14.6FemalePathology14.6FemalePathology14.6FemalePathology1Depakine+Finlepsin4.6FemalePathology1Depakine+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1</td>	AgeGenderNormal PathologyNumber of visitsPharmacotherapy4.6FemalePathology1Sonapax+Phenibut4.6FemalePathology1Depakine4.6FemalePathology1Depakine4.6FemalePathology14.6FemalePathology14.6FemalePathology14.6FemalePathology14.6FemalePathology14.6FemalePathology14.6FemalePathology1Depakine+Finlepsin4.6FemalePathology1Depakine+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1Luminal+Finlepsin4.6FemalePathology1

3.3 Download Recordings

a. After pressing on the number of "Patient code", a new window is provided specifically for one particular patient data.

Patient code	Age	Gender	Normal Pathology	Number of visits	Pharmacotherapy	Recording date
55	4-6	Female	Pathology	1	Sonapax+Phenibut	2004-07-27
13	4-6	Female	Pathology	1	Depakine	2004-08-02
12	4-6	Female	Pathology	1		2004-08-03
140	4-6	Female		1		2005-01-13
146	4-6	Female		1		2005-01-17
152	4-6	Female	Pathology	1		2005-01-26
100	4-6	Female		1		2005-01-31
681	4-6	Female	Pathology	1		2005-02-02
697	4-6	Female	Pathology	1	Depakine+Finlepsin	2005-02-22
737	4-6	Female	Pathology	1		2005-02-26
715	4-6	Female	Pathology	1		2005-02-28
731	4-6	Female	Pathology	1	Luminal+Finlepsin	2005-02-28
<u>461</u>	4-6	Female		3		2005-04-07
215	4-6	Female		1		2005-05-05
179	4-6	Female	Pathology	1		2005-05-05
213	4-6	Female		2		2005-05-06

Note: "**Number of Visits**" section indicates that each particular patient has got more than one EEG recording. The program automatically appear all the recordings in sequence according to number of visit and recording date (year, month, and day).

Example: Patient Code – 461, age - 4-6, gender – female, number of visits – 3, without pharmacotherapy, recording date – 2005-04-07.

b. To see EEG recording of a particular patient, the recording needs to be downloaded separately. Download requires pressing on the number of EDF file under the column of "Title".

Title	Age	Gender	Normal Pathology	Pharmacotherapy	Recording date
<u>667.EDF</u>	4-6	Female			2005-04-07
846.EDF	4-6	Female	Pathology	Depakine+Benzonal	2005-10-20
485.EDF	7-12	Female			2006-04-18

3.4 Opening of EEG recording

a. For opening the EDF file use program "EDFbrowser"

Link for downloading EDFbrowser can be found on <u>EEGHUB</u>.

EEGHUB	GEO
Normal and pathological brainwave electrical activity recording, registered with the background activity and functional samples of EEG Manual Video example EDFbrowser (teuniz.net)	
Check these boxes to search age gender and normal/pathological appropriate data Age Gender Normal/Pathology Image Image Image Image Image <	

- b. Steps for opening downloaded EEG data in EDFbrowser
 - File \rightarrow open
 - Select downloaded file

ļ.	EDFbrowser	r												-	٥	×
File	Signals	Times	ale Amplit	tude F	ilter M	lontage	Tools	Settings	Timesync	Window	Help	 	 			_
	Open		Ctrl+O													
	Open strea	am	Ctrl+Shift+	0												
	Start video	0	Ctrl+Shift+	v												
	Playback fi	ile	Ctrl+Space													
	Save as		Ctrl+S													
	Recent file	s		•												
	Print			•												
	Info															
	Close			•												
	Close all		Ctrl+F4													
	Exit															
ŀ	(=)	~	~ <	> >		•										
						_										_

• When the browser opens the file, press Add signal(s)

Fle Signals Timescale Amplitude Filter (Montage Tools Settings Tim	esync Window Help				Annotations ? X	0:00:00	More
	C:/Users/user/Downloads/25.E Subject 01-JAN-1601 F Recording Start 28.jul 2004 6:14:55 Signals in file 1 EEG EPJ 2 EEG EPJ 3 EEG F2 4 EEG F4 5 EEG F3 6 EEG C3 7 EEG C4 9 EEG C4 9 EEG F4 10 EEG F5 11 EEG P3 12 EEG F4 13 EEG F4 13 EEG F4 13 EEG F4 13 EEG F4	P Duration 0:14:30 250 Hz 250 Hz	Add>> Subtract>> Remove <- Trace color	Signal Composition Signal Label Factor	Samplerate	Нер	0:00:00 0:00:07.724 0:02:53.458 0:04:01.812 0:05:06.048 0:05:56.854 0:05:56.854 0:05:55.564 0:05:15.864 0:05:27.464 0:06:27.464 0:06:25.768 0:07:20.256 0:07:20.256 0:07:20.164 0:06:53.78	
Break markers 000:00 Background 0:00700 Duration: 7.724 sec	Select All	Add s	ignal(s)	Make derivation	n: 165.764 sec	Close		

c. EDFbrowser opens EDF file

71.EDF - EDFbrowser		_	σ×
File Signals Timescale Amplitude Filter Montage Tools Settings Timesync Window Help			
	Annotations		×
58 realized the the delates when when we were a second and we are also been also been also been and a market of a second			
ha Maa Maa Maa ka k	Relative Filter:	Inv.	More
33 metric N a day than when you are in a new other survey and the same and the same same of an inclusion of	P	0.00.00	
Filter that the standard was a standard we shall be also also also also also also also also	Fon Break markens	0:00:00	<u>^</u>
Ream atter men where the men and an area areas areas in a man and a same	Break markers	0:00:53 196	
That An he should be a set of a	Break markers	0:01:26.196	
Receive the me the process of property of the property of the second sec	Break markers	0:01:32.396	
What we are a low a way we have a set of the	Break markers	0:01:32.996	
The same strend and a solution on the solution of the source of a strend as the solution of the	Break markers	0:01:34.596	
	Break markers	0:01:48.396	
To show a the rate of the free free free free free free and back of the second and a show of the show had	Break markers		
	Break markers	0:01:59.596	
A matter march shaked Marchard and allow allow and a marchard and marchard when and adapted the and allow	Break markers		
	OG	0:02:02.308	
And a the and a the a marked a second of the second of the second and a second and the second and the second and	Break markers	0:02:09.796	/ I
	Break markers	0:02:25.996	/ I
France and some the stranger than the second and the second and some and the second second second the second s	Break markers	0:02:44.396	
Hrs I I I I I I I I I I I I I I I I I I I	Break markers	0:02:51.396	
$ \label{eq:constraints} \end{tabular} = \end{tabular} \e$	ZG	0:03:15.46	
	Break markers	0:03:52.396	
many was a second of the second of the second and the second of the second s	Break markers	0:03:58.196	
	FT_3	0:04:36.396	i
᠕ᡧᢌ᠆᠂ᠣᠯᡄᡐᠬᢦ᠋ᢙᡑ᠕ᢂ᠕᠕ᠺᠺ᠕ᢔᡧᡊᢂᢢᡄᠴᢂ᠕᠆᠕᠕ᢘ᠕ᠰᠴᢧᢛᡥᡧ᠕᠕ᡧ᠕ᢣᠬᡡ᠆ᢑ᠆᠕᠕᠕ᡧᢍᠰ᠆ᠬᢣ᠕᠕᠕᠕᠕᠕᠕᠕᠕	pp	0:05:10.476	/ I
	FT-5	0:05:34.556	/ I
-	Break markers	0:05:44.396	/ I
	Break markers	0:05:53.396	i
᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆᠆	PP	0:05:56.18	/ I
92. A here reported to the rescaled in the rescaled in the rescaled in the rescaled field in the rescaled in the	FT-10		/ I
ዀ፝ዀጞዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀዀ	Break markers		/ I
	PP	0:06:39.74	/ I
¹ . A has a harden of the second of the sec	FT-15	0:06:52.496	/ I
Arbaix markers	Break markers	0:06:55.596	
	Break markers	0:06:58.796	
0891930 D((nation(o)) 22, 308 sec 10 sec	Break markers	0:07:10.196	Ŷ

If you encounter problems, please feel free to contact us at: <u>eeghub@gmail.com</u>

4. Bibliography:

- 1. I Khachidze. Chapter title: The dynamic of EEG characteristics in epileptic children during the treatment with valproic acid. Book title "Epilepsy" IntechOpen. 2020.
- 2. Khachidze I, Gugushvili M, Makashvili M, Maloletnev V: The investigation of EEG specificity in epileptic children during Depakine therapy. International Journal of Neuroscience 126(10), 912-921, 2016.
- Khachidze I, Maloletnev V, Gugushvili M: Antiseizure drug and EEG in epileptic patients. Systemic, cellular and molecular mechanisms of physiological functions and disorders. Proceedings New Development Medical Research (pp.75-80). NY: NOVA, 2016.
- 4. Khachidze I, Gugushvili M, Kapanadze N, Koreli A, & Maloletnev V: Analysis of EEG dynamics in epileptic children during carbamazepine therapy. Journal of Asian Biomedicine 4(1), 37-49, 2010.