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Research paper

Mental health analysis on digital world with meditation using EEG

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Abstract

Internet, e-mail and other social networks like Myspace, Facebook, twitter, LinkedIn are the indispensable components in today's world. These social networking makes the human to addict into the digital world. Digital world has become the integral part of our society. Addiction to the digital world slowly develops the negative symptoms in the area of physical, physiological, emotional and psychological. The most affected of all is the change in Emotional behaviour of the Humans. Emotions plays an important role in our day today life. The existing research work, based on subjective self-reports shows prolonged use of Digital Media induce negative emotions for Humans. There are several techniques are used to extract the human emotions from brain such as Electroencephalography (EEG), functional Magnetic Resonance Imaging (fMRI), or Positron Emission Tomography (PET). Many of the researchers are extensively used to extract the brain waves using EEG. The negative emotions are controlled by human through meditation. In this paper, the Mind Wave device has been used to extract the EEG signal using different range of age people during they use the Digital Medias and after they perform mediation. The proposed method identify the stress level of the human while they are using social media with meditation and without meditation. It evidently proved that the meditation reduces the stress level of human.

Keywords: *Digital Medias, EEG, fMRI, PET, Mind Wave.*

1. Introduction

Social media has been creating a big impact on the teenagers these days. Social media has plenty of advantages where it allows them to connect to anyone in and around the world, share pictures and information, play online games etc. At the same time it has various drawbacks. Using social media for a long time leads to health ailments, disorders and illness.(eg-Alzehiemer) .Various research has proved that students using social networking sites in a regular basis has stomach pain, anxiety and depression. Therefore practicing meditation for a certain period of time will help in balancing their stress and depression level. Brain computer interface is a communication pathway between the human brain and the computer. It is distinguished into three types: 1. Invasive (Neurosurgery), 2. Semi invasive (ECoG), 3. Non invasive (EEG). In this project we have used the EEG approach. Electroencephalography (EEG) is used for recording the brain activity. The recording is done by placing the electrodes on the scalp. The neurosky device is used to sense the meditation level and the emotions of the subject.

2. Literature survey

Various research works has been carried out over the past few years. Roy Pea, Cliford Nass, Lyn Meheula, Marcus Rance, Aman Kumar, Holden Bamord, Matthew Nass, Aneesh Simha, Steven Yang and Micheal Zhou [8] has found the effect of technology on emotions of 8-12 year old girls in America and Canada. Their research has been done using online questionnaire asked to parents. They concluded that those who spent more time on social media have a very bad sleep and surrounded by less people.

The work done by Hygeia Casiano, D.Jolene Kinleyr, Laurence Y.Kartz, Mariette J.Chartie, Jitender Sareen [7] focuses on examining the association between the media use and health outcomes among teenagers. Playing video games leaded to negative health issues like depression, stress and alcohol dependence.

Javier SerranoPuche [5] has done a paper that focus on emotions to the use of mobile phones. He associated the socio cultural practices similar with the use of mobile phones. Research has been done using various methods interviews and diaries written by participants.

The work of Jiequan Li and M.Oussalah [1] focuses on facial emotion recognition. It involves the use of HAAR transforms and adaptive adaboost algorithm, PCA, NMF and KNN algorithms. PCA is obtained by finding the Eigen value of a covariance matrix of data. The K-dimensional representation is given by the $y=E^T(x-\mu)$.

NMF is used to depict the data using non negativity constraints. This algorithm decomposes the primary matrix.

Decho Surangsrirat and Apichart Intarapanich [3] has done a paper on analyzing the brainwave using the muse device. Vatsla Chauhan, M.Uma, S.Karthik, Vaibhav Nagpal [2] focuses on getting high beta waves from the subjects by extracting their EEG signals and also to generate alpha waves by playing music.

The work of Chandana, Vijayalakshmi, Vinod Kochupillai [4] shows the relaxed state of people after meditation. This paper also proves that right part of the brain work more than the left part after meditation.

3. Neurosky device

The neurosky device monitors the electric impulses released in the brain. The device consists of a headset(adjustable),ear cut and a sensor arm. The device sense on measure attention, meditation and the emotions of the subjects. The device removes all the noise and the artifacts from the data hence there is no need to preprocess the data. It uses a solitary AAA battery which lasts for 8 hrs. The data is recorded using the EEGid application via Bluetooth. The raw data is in the csv format.

Attention eSense: This unsigned one byte value reports the current eSense attention meter of the user. It indicates the intensity of a users level of mental "focus" or "attention". It ranges from 0-100.Diversions,absence of center or uneasiness may bring down the attention level.

Meditation eSense This unsigned one byte value indicates the level of a users mental "calmness" or "relaxation". Its value ranges from 0-100.Diversions,meandering thoughts, tension may bring down the meditation level.

Figure 1: Neurosky mindwave device

4. EEG brain waves

The different brain waves obtained from the neurosky device are classified according to the frequency and amplitude. There are six types of brain waves:

1. Delta waves-These waves ranges between 0.5-4hz.They are mainly associated with deep sleep and coma stage.[6]
2. Theta waves-These waves ranges between 4-7hz.Normally associated with drowsiness and frustration.[6]
3. Alpha waves-They lie within a range of 8-13hz.These waves denote relaxed state.[6]
4. Mu waves-Ranges between 8-12 Hz. Closely associated with motor activities.[6]
5. Beta waves-These waves lie between the range of 13-30Hz.Low beta waves is related to thinking and mental activity and high beta waves is related to tension, excitement, stress [6].
6. Gamma waves-They range between 30-42Hz.Associated with learning and memory information.[6]
7.

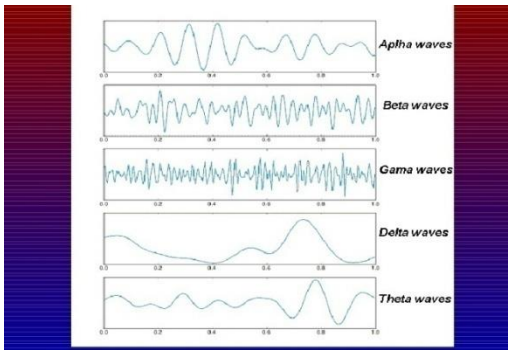

Figure 2: Different EEG brainwaves

5. Algorithm

5.1.Valence arousal model

The different emotions can be identified using the valence arousal values. It is a 2D model where the valence indicates the way one judges a situation and arousal indicates the excitement of a person [6]. Any emotion can be plotted using the valence arousal model.

The various emotions are grouped using Valence and arousal value. Based on the values the emotions are plotted on the quadrants.

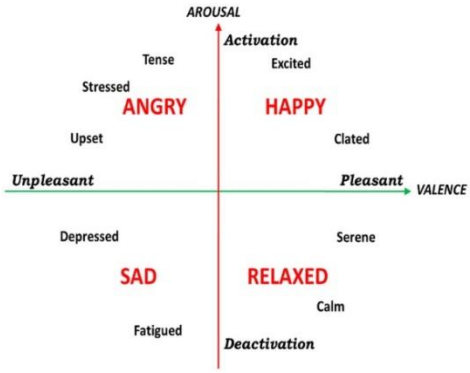

Figure 3: Valence arousal model

5.2.Support vector machine (SVM)

The Support Vector Machine is used to analyze the data for classification and regression. The SVM model is a illustration of points in space. They are divided into different categories and then mapped. In this algorithm each data item is a point in n-dimensional space. The new points are then mapped into the same space and predicted to the category they belong to. SVM are frontiers that are used for separating the hyper-plane. To identify the correct hyper plane select the hyper plane that separates the two classes better.SVM are mainly used for the classification of images. Hand written characters can be identified using svm.Support vector machine has proved to be a prominent method in the past research works.

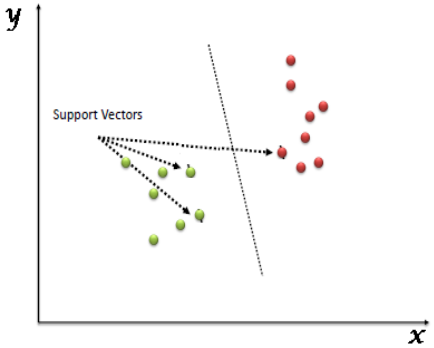

Figure 4: SVM

6. Data set collection

For this proposed work, the data's has been collected from 64 subjects from various age groups. The majority of the data is collected from the teenagers because they are the ones who use social media for a long time compared to the other age groups. The data's have been recorded using the neurosky device. The workspace where we conducted the experiment was completely quiet and had no external disturbances. We ensure that the subjects feel really comfortable with the environment. The experimentation is divided into two parts- The first part is where the readings will be taken while using digital media and the other readings are taken after the meditation has been performed. Before meditation the subject is alerted that the process is starting and is asked to calm down. Then they are asked to focus on a particular object to achieve a calm state. Sudharshanakriya is a strong breathing technique that integrates natural rhythms of breath, harmonizing mind, body and emotions [4].This strategy eliminates the negative emotions like stress, fatigue, anger, depression and makes the mind calm and relaxed.

The experimental procedure involves the following steps-Data acquisition, Feature extraction, Data classification.

The initial step is to alert the subjects that the process is starting and asked them to calm down. The readings are taken before and after performing meditation. These questions were asked to the subjects before they sit for the test:

1. What is your age?
2. Gender: M F
3. What is your profession?
4. Any meditation experience? If so how many years?

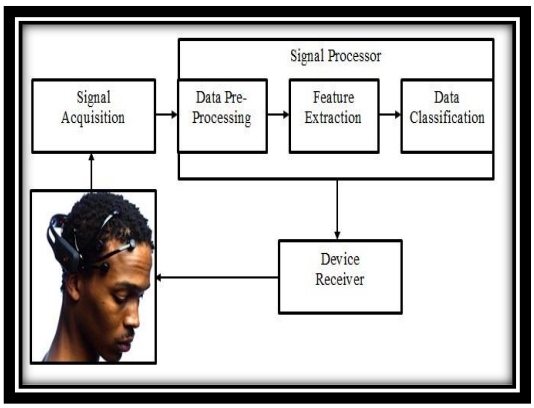

Figure 5: Architecture diagram

7. Experimentation

Firstly the subject is asked to sit in a quite environment. The device is fixed on the head and earclip position. The device is connected to a mobile via blue tooth. EEGid is a android application that is connected to the Neurosky Mindwave device.

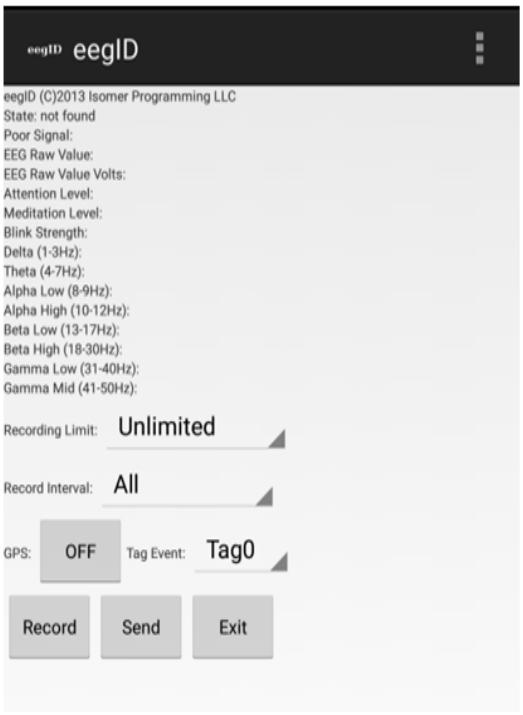

Figure 6: EEGid application

The time was set for 30 seconds and the readings were recorded. The first set of readings were taken when the subject is using digital media, and the next set of readings were taken after performing meditation. One of the advantages of neurosky device is that the unwanted signal or noise is removed. Neurosky consists of four sensors at the temporal and central lobes. This application records the readings taken from the device and is sent through email. The raw data is in CSV or excel format.

8. Results

The experiment was conducted to 64 subjects on various age groups, but majority of the readings were taken from the teenagers. The brain waves of each subject was recorded. The raw values were then normalised using the formula:

$$= \frac{\text{x-min}}{\text{max-min}}$$

	name	blood group	attention	meditation	delta	theta	alpha low	alpha high	beta low	beta high	gamma low	gamma mid
2	akilesh		21	43	168173	1.7E+07	10718	2621	5983	8124	5165	2868
3	akshatmattur		54	57	78576	3953	268	810	16777206	348	93	15
4	akshaykumar		41	43	233072	99954	20116	16749741	15245	19355	9014	3702
5	ankikit		16	44	840305	1.7E+07	11369	18093	8713	6095	6190	2519
6	anirudh		23	43	750481	1027045	396042	47395	48442	44127	16756571	18652
7	anudeep		0	0	367450	2200245	177124	385881	121463	481664	171409	160602
8	avinash		53	93	1.7E+07	16326	11179	1024	2439	2445	635	1085
9	dharshan		75	27	637279	101007	3201	15787	27723	28481	13047	3449
10	divakar		57	54	575971	12519	4581	2606	1989	1241	630	307
11	gopinath		43	44	1.7E+07	20723	7432	6882	1702	4159	2121	230
12	harikrishna		47	29	1116574	79750	18957	10750	14742	20228	9087	11215
13	harish		43	8	1498750	382084	76325	16765330	9179	19744	25984	20134
14	jatin verma		44	87	266242	3798	5989	5133	3202	2088	567	127
15			51	75	362694	23459	2809	9912	2435	3169	1722	389
16	koushik		54	77	124014	65708	25134	16280	9795	18854	15020	5388
17	krishana		48	77	841018	1.7E+07	29072	3531	5073	5547	3949	388
18	krithikaran		41	88	64507	31256	12896	7822	3240	8357	7777	6713
19	lakshmikanth		77	51	3385	5786	1382	2367	3210	3587	1029	1297
20	mahesh		41	70	376334	77838	1.7E+07	7023	11517	4411	2687	2153
21	manish		44	34	591330	24296	18164	7983	11708	6722	2682	1161
22	mcchandu		13	41	625981	915847	277745	189547	91107	54594	6976	4281
23	naveenprasad		88	74	88	74	10513	5404	6873	15183	3752	903
24	nikhil manohar		61	83	61	83	1.7E+07	16756318	3735	20652	8304	2517
25	prashanth		56	66	56	66	92901	12737	11652	9843	3611	4567
26	pratyush		74	48	74	48	1.7E+07	16753800	24684	23339	17022	5336
27	raghavendra		78	47	364489	12056	6600	9625	20004	8022	4599	878
28	rahulvarma		43	78	8640	1.7E+07	7816	5592	7040	3506	4684	711
29	rajmohanreddy		78	35	78	35	18450	22610	12374	20792	6391	972
30	reshwanth		17	44	17	44	12296	20251	4727	6360	4857	1183
31	rohit		37	35	1230325	54149	7178	17896	17636	22901	2131	3770
32	satish		51	53	1281569	302499	200123	16745031	16756323	88020	13546	4703
33	shashank		41	61	90583	18701	14392	2310	6971	6542	4191	1126
34	shreyash		77	43	29906	1.7E+07	7432	19035	20426	9057	4205	3080
35	siranjeevi		75	100	75	100	1.7E+07	2813	793	4911	3334	16271
36	suryakumar		4	38	909957	300133	33526	10161	16744707	16237	31202	4641
37	tarun		60	64	791987	99890	1.7E+07	16747857	21418	11820	28131	7738
38	thameez		21	60	27203	1.7E+07	8557	18776	1927	8915	4791	1941
39	vaibhav		69	37	69	37	4329	7889	9339	5608	3374	2096
40	vanshi		75	56	23478	24345	7044	7989	15244	7366	5310	3748
41	varshith		40	67	40	67	1.7E+07	9791	6710	9286	4120	1544
42	vikas gupta		70	53	70	53	17626	15582	7582	7343	2950	1529
43	yeshwanth		43	64	122055	1.7E+07	13172	11455	20698	5772	2379	892
44	leel		0	0	464585	29863	11178	14254	5457	7919	1816	1250
45	raghav		10	78	10	78	1.7E+07	16755760	15521	12788	6782	4758
46	rishi		74	75	74	75	4779	23940	11898	8214	15968	13164
47	sailesh		0	0	1588477	1.7E+07	1.7E+07	16757184	28386	14090	13509	10991
48	santhosh		0	0	2141345	52055	11125	6053	5177	4912	3657	1276
49	roopkiran		0	0	1706670	180854	1.7E+07	16777007	1676291	147122	144589	30155
50	vishal rao		0	0	1346710	425140	59794	16752152	211311	213582	154399	44729
51	jaya		0	0	775966	1012872	589534	507477	448227	209307	16763345	16763184
52	seetharaman		0	0	628628	1.7E+07	6365	19420	27016	29645	4077	16758907
53	meena		0	0	961720	7677	754	1974	1077	875	1677127	233
54	shankari		0	0	822834	35683	8519	30798	16762355	16761345	16745885	11930
55	pragadeesh		30	40	1119372	1009947	170494	16769713	51641	43545	33796	5131
56	shruthi		53	48	143513	87886	4522	10762372	11878	16333	8746	972
57	aishish		0	0	1028403	1.7E+07	11433	6232	21297	19200	5083	2063
58	thara		0	0	775966	1012877	589534	507477	448227	209307	16763345	16763184
59	akbar		0	0	629011	658954	227245	395728	105546	457307	142298	96515
60	joswin		0	0	629011	658954	227245	395728	105546	457307	142298	96515
61	karthi		0	0	314315	139296	83689	58160	240316	110277	59561	63572
62												
63		max=	88	100	1.7E+07	1.7E+07	1.7E+07	16777007	16777206	16761345	16763345	16763184
64		min=	0	0	10	35	268	810	793	348	93	15
65		max-min=	88	100	1.7E+07	1.7E+07	1.7E+07	16776197	16776413	16760997	16763252	16763169

Figure 7: Raw data

	name		attention	meditatio	delta	theta	alpha	beta	gamma
2	akilesh		-0.18011	0.008	-0.0526	0.820646	-0.04377	0.051071	0.018672
3	akshatmattur		0.194886	0.148	-0.05794	-0.17739	-0.04326	-0.94908	0.018805
4	akshaykumar		0.047159	0.008	-0.04872	-0.17166	0.953933	0.051189	0.018492
5	ankikit		-0.23693	0.018	-0.0125	0.821536	-0.04289	0.050787	0.01859
6	anirudh		-0.15739	0.008	-0.01786	-0.11639	-0.06408	0.050688	-0.97968
7	anudeep		-0.41875	-0.422	-0.04071	-0.04645	-0.03085	0.07244	0.018165
8	avinash		0.183523	0.508	0.936392	-0.17665	-0.0439	0.050943	0.018836
9	dharshan		0.433523	-0.152	-0.02461	-0.1716	-0.04254	0.050989	0.018237
10	divakar		0.228977	0.118	-0.02827	-0.17688	-0.04341	0.050898	0.01879
11	gopinath		0.069886	0.018	0.937372	-0.17639	-0.04332	0.051089	0.018696
12	harikrishna		0.115341	-0.132	0.003984	-0.17287	-0.04378	0.051271	0.018936
13	harish		0.069886	-0.342	0.026783	-0.15484	0.951511	0.051573	0.01846
14	jatin verma		0.08125	0.448	-0.04674	-0.17739	-0.04334	0.050876	0.018783
15			0.160795	0.328	-0.04099	-0.17622	-0.04287	0.050987	0.01873
16	koushik		0.194886	0.348	-0.05523	-0.1737	-0.04382	0.051484	0.018235
17	krishana		0.126705	0.348	-0.01246	0.821143	-0.04481	0.050971	0.018597
18	krithikaran		0.047159	0.458	-0.05878	-0.17576	-0.04359	0.051248	0.018746
19	lakshmikanth		0.45625	0.088	-0.06243	-0.17728	-0.04323	0.050965	0.018825
20	mahesh		0.047159	0.278	-0.04018	-0.17298	-1.04145	0.050519	0.018777
21	manish		0.08125	-0.082	-0.02735	-0.17617	-0.0439	0.050646	0.018718
22	mcchandu		-0.27102	-0.012	-0.02528	-0.12302	-0.04855	0.048769	0.018648
23	naveenprasad		0.58125	0.318	-0.06262	-0.17762	-0.04359	0.051439	0.018639
24	nikhil manohar		0.274432	0.408	-0.06262	-0.17762	-0.0434	0.051952	0.018464
25	prashanth		0.217614	0.238	-0.06262	-0.17762	-0.04807	0.050835	0.018866

Figure 8: Data before normalisation

	name	attention	meditation	delta	theta	alpha	beta	gamma
2	akilesh	0.133793	0.1315517	-0.16436	-0.17569	0.052497	4348.742	0.016936
3	akshatmattur	0.573793	0.3615517	-0.16452	-0.17609	0.051419	4348.742	0.018171
4	akshaykumar	-0.21621	0.2715517	-0.16453	-0.17567	0.052975	4348.741	0.016708
5	ankikit	0.383793	0.0315517	0.833599	-0.17503	0.052426	4348.741	0.016506
6	anirudh	0.473793	-0.068448	-0.12282	-0.15469	0.056042	4348.737	0.016808
7	anudeep	-0.41621	0.3615517	-0.16451	-0.17598	0.05751	4348.742	0.016566
8	avinash	0.233793	-0.028448	-0.16474	-0.17467	0.052066	4348.741	0.016759
9	dharshan	0.313793	-0.158448	-0.1278	-0.17526	0.052084	4348.741	0.016134
10	divakar	-0.21621	0.0515517	-0.1591	-0.17496	-0.94203	4348.741	0.016832
11	gopinath	-0.13621	0.3615517	-0.16481	-0.17589	1.051068	4348.741	0.016761
12	harikrishna	0.113793	0.1415517	-0.16408	-0.17465	-0.94546	4347.743	0.016396
13	harish	0.143793	0.1315517	0.83435	0.822389	0.051567	4348.741	0.016872
14	jatin verma	0.263793	-0.208448	-0.11438	-0.17099	0.053572	4348.742	0.018192
15		0.173793	0.1615517	-0.16423	-0.17489	0.052877	4348.741	0.016697
16	koushik	-0.04621	0.2615517	-0.09187	-0.1758	0.05353	4348.74	0.016456
17	krishana	0.053793	0.1315517	-0.11481	0.822909	0.050937	4348.742	0.016619
18	krithikaran	0.043793	0.1415517	-0.1644	-0.17579	0.052504	4348.742	0.016702
19	lakshmikanth	-0.31621	0.3615517	-0.16399	-0.17522	-0.94652	4348.741	0.016774
20	mahesh	0.053793	-0.208448	0.009624	-0.17445	0.051812	4348.742	0.016257
21	manish	0.143793	0.1315517	-0.16356	-0.1751	0.052276	4348.741	0.016791

Figure 9: Data after normalisation

After normalisation there is a variation in the alpha and beta waves. After meditation the subject is said to be in relaxed state.

The graph obtained from the data's is displayed below:

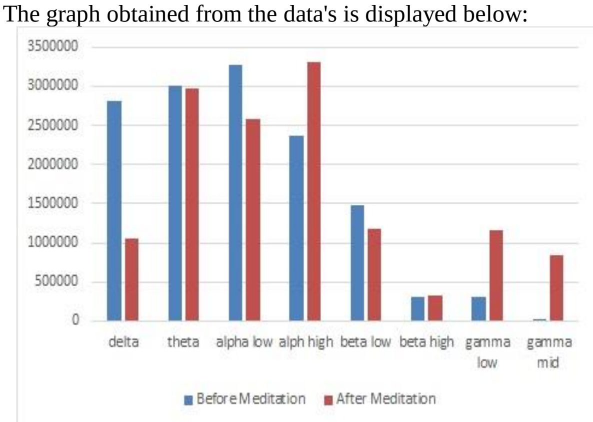

Figure 10: Variation in alpha and beta values before and after meditation

9. Future enhancements

This project is successful in reducing the negative emotions of the subjects. The subjects seem to be in a calm state after performing meditation. Hence using EEG a person's brain activity can be monitored and a solution can be provided. Individuals having stress and depression can perform meditation regularly to bring them to relaxed state.

10. Conclusion

The world is slowly transforming into the digital world. Though social media has lots of drawbacks we cannot stop using it, as it has become a necessary part of our life. Hence to overcome negative emotions, meditation is the best therapy. The obtained results shows that performing meditation regularly heals stress and depression. Altogether the subject seems to be in relaxed state after meditation.

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