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Evaluating brain signal of patients with mild Alzheimer in order to early separation of them from normal individuals

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Abstract

The purpose and incentive of this study is designing and providing a system for identifying mild Alzheimer. Alzheimer can be identified by losing neurons synapses in some brain regions, necrotic brain cells in different parts of the nervous system, creating globular form of protein structures called senile plaques outside of neurons in some brain regions and filamentous protein structures called spiral coils in the cell body of neurons. FlexComp is a device used to record brain signals. Two channels of Fz and Pz are used for the reference of electrode ear to record the signals. Brain signals were taken from individual with open eyes for 2 minutes and 2 minutes blindfolded. Best results were extracted in delta rf open oz ،beta coherence close with close ، wavelet Alpha sig close fz ،wavelet theta sig open oz و FD sig open fz modes..

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Introduction:

Alzheimer's is the most common form of dementia. The symptoms of the disease are beginning with loss of keeping information particularly short term memory in old age and gradually with losing time detection, depression, loss of speech, withdrawal and eventually it ends with death from respiratory distress. Death occurs after five to ten years from the onset of symptoms; but the disease has already started about twenty years before symptoms appear. Alois Alzheimer in 1906 could provide scientific definition of the after 20 years of study. This disease was named Alzheimer to appreciate a lifetime of research of Alois Alzheimer. Alzheimer is known as aging disease, in fact is something more than a simple forgetfulness (Güntekin et al, 2008). Alzheimer is a degenerative and rationalization progressive disease is usually seen in older people. Obvious symptoms of this disease are loss of memory, judgment and reasoning, and changes in the person's behavior. Alzheimer can be identified by losing neurons synapses in some brain regions, necrotic brain cells in different parts of the nervous system, creating globular form of protein structures called senile plaques outside of neurons in some brain regions and filamentous protein structures called spiral coils in the cell body of neurons and memory impairment is progresses and creates gradually. Initially, memory impairment is limited to recent events and learning but gradually old memories are getting damaged. The patient forgets the answer of a question that he asked a few moments ago and asks the same question again. He loses his stuff and do not remember where he put them. He has problem in buying goods and paying them and cannot handle his financial affairs. Gradually he has problem in identifying friends and family and cannot remember their names. He has problem in finding his routes and path and if he gets out of home alone, he get lost. Alzheimer occurs with brain atrophy and loss of some brain neurons and it is causing changes in behavior and performance of individuals. Usually, analysis of the brain is causing brain dysfunction and has its effect on different performance parts (Chapman et al, 2007). Therefore, for the treatment of Alzheimer we require a process to compensate the disorders resulting from brain atrophy and loss of neurons in the brain. As we know, the process of making neurons in human brain stops at the age of 2 years old and all the changes that occur in the brain after this age onwards are due to changes in the relationship between synapses. Therefore, finding a process to compensate for lost neurons, by increasing synaptic connections in healthy neurons can

be used as a suitable solution for the treatment of Alzheimer. But unfortunately so far there is no definitive solution for the treatment of Alzheimer. The methods currently are used for the treatment of Alzheimer are based on methods for maintaining the patient status and preventing further weakening of the brain and loss of more brain neurons and improving mild effects of disease and behavioral approaches toward Alzheimer's patents.

Theoretical frameworks

Usually when people have memory problems or other symptoms of Alzheimer, they resist against that and deny the symptoms, in these case the family members should realize the symptoms and take the person to the doctor to detect the disease sooner and prevent the progress. We should confess that there is no exact method to detect the disease but a set of methods can help the doctor detection. According to research, a skilled physician can diagnose Alzheimer with accuracy more than 90%. Although the smart method can diagnose Alzheimer without a doctor but still a doctor is essential for final diagnosis. The diagnosis steps by a psychiatrist or psychologist can be summarized as follows.

Assessment of the mental state

At this stage, information such as the patient realization from his failures, date, time and place where the he is located, the ability to recall a short list of words or follow specific instructions or to do simple math calculations are collected from the patient. There is a Mini–Mental State Examination (MMSE) test to evaluate the intellectual performance of individuals; in this test some questions are asked from the patient and the answers are scored and based on his total score the disease statues will be diagnosed. The maximum score of MMSE test is 30; score 20-24 indicates mild dementia, 13-20 moderate dementia and score lower than 12 indicate severe dementia. Appendix A is a sample of this test and scoring method.

In addition to assessing the mental state of the patient, the doctor should be able to diagnose other mental diseases that have common symptoms with Alzheimer and cause memory problems in patient and separate them from Alzheimer.

Brain MRI

Nowadays brain scanning involves structural images such as MRI or CT scans and functional imaging such as PET and FMRI can be a big help in more accurate diagnosis of Alzheimer. Recent structural imaging studies have shown that by disease progresses, the brain of patients significantly depleted and gets small. The researchers also showed that the analysis of a specific area in the brain can detect the early signs of Alzheimer's. However, scientists still could not find an accurate correlation between brain atrophy and Alzheimer progresses over time. The researchers also used functional brain imaging techniques such as PET to diagnose the Alzheimer and follow the progression of disease in the brain and the effect of treatment method on brain function.

Smart detection methods of Alzheimer

According to the development of intelligent systems in various sciences and their applications, they can also help doctors in automatic detection of diseases. However, given the long history of the discovery of Alzheimer as degenerative brain disease and memory destruction, scientists have conducted many researches for the early detection of this disease and due to advances in biological signal recording and medical imaging devices, and development of processing capabilities, intelligent systems made possible the diagnosis of Alzheimer with high accuracy. Smart Detection Methods of a disease based on brain imaging techniques and recording brain signals (EEG) can be divided into two categories. Methods based on brain imaging were briefly examined in the previous section are not considered here due to their expensive costs and need for special equipment, thus we ignore studying them here. The second categories based on brain signal recording methods are studied here due to their reasonable cost and lack of side effects for the patient.

Review of Literature

The communicative function of speech was used by Adlai four decades ago (1960), he pioneered in working on theta rhythms of the limbic system of cat brain. The scientists used the functions of speech and vision communication to investigate how the rhythmic potential of the cat brain is associated with its behavior. Using verbal communication in comparing activity of EEG in various brain cells of cats one of the essential steps in dispelling the view that EEG is a secondary symptoms of the disease. The induced theta rhythm and increased work-related communication in the limbic system is a milestone in EEG researches. When we do a

behavioral task, hippocampus activity shows a transfer of irregular activity to induced rhythms activity of verbal communication. Adler's results (2003) were a decision making factor in the selection of hippocampus as a model for a resonance process in the brain, for Basar research group. Based on numerous tests about cat behavior, Basar assumed that if the brain receives sensory stimulation and if a structure has its own distinct activities, so the structure will respond with its natural frequency. There is some evidence that midline of a region before frontal cortex can generate theta activity in specific cognitive states. These results were reported by Mizuki (1980): EEG rhythms of 5 Hz frequency became apparent during simple tasks such as counting mentally. Miller (1991) proved that all data are consistent with the hypothesis that theta activity in the frontal areas is associated with theta activity in the hippocampus. Zheng (2005) investigated the EEG verbal communication among and within the hemisphere of the brain at rest and during optic stimulation of the patients with AD. The authors found that the overall decline in AD patients in EEG verbal communication, within the hemisphere, compared to normal resting EEG monitoring, were more significant and more prominent decrease were seen in alpha bands 1 and 2. Adler (2003) studied the EEG verbal communication at rest in 31 AD patients. These authors reported that verbal communication and verbal communication of left temple Alpha and verbal communication of Theta within the hemisphere decreased in AD group.

Locatelli (1998) studied the EEG verbal communication in patients affected by possible AD and they reported that the large relationship between alpha band in AD group decreased compared to the control group. It was more obvious in electrodes of temporal-parietal regions. The decline was more pronounced for verbal communication within the hemisphere of posterior regions. Decrease of Alpha verbal communication was more common in patients with pathological loss. Meanwhile, verbal communication of Theta and Delta within the hemisphere was tended to almost increase in all the analyzed electrodes apart from F7-F8 and T5-T6. Locatelli also reported that in electrodes F7-F8 and T5-T6, there is a decrease in verbal communication in delta, theta and alpha bands of AD group compared to control group.

Van D. Hill (2007) investigated the relationship between EEG measures of performance general cognitive tests, memory, language and executive function and realized that there is no difference between alpha-verbal communication of the AD and control groups and it is not related to cognition. The most common results of all these studies are the reduction of beta and alpha bands verbal communication between separate structures. Zheng Yan (2005) stated that during optical stimulation, EEG verbal communication within and between hemispheres of AD patients have lower levels of the alpha band than the control group. The authors report that during 5 Hz optical stimulation, AD patients had significantly less amounts of verbal communication between the hemispheres in C4-P4 and C3-O1 pairs for theta band, in C3-P3 and C3-O1 and T6-O2 pairs for alpha band and in P3-O1, P4-O2, C3-O1, C4-O2 and T6-O2 pairs for Beta Band.

Hogan (2003) studied the relationship between verbal communication and memory-related EEG power in central and temporal recording locations in early Alzheimer's disease patients and normal control groups. While very average AD behavioral performance is not significantly different from the normal groups, AD patients decreased the upper alpha verbal communication between the temporal, right and center cortex. Our results are consistent with Hogan findings, although in current study, smaller amounts of alpha-verbal communication, was found only in the untreated group, because in Hogan study the patients were not divided in treated and untreated groups. It should be noted that drugs have effect on alpha verbal communication with long-distance.

Research method

Data collection

FlexComp is a device used to record brain signals. Two channels of Fz and Pz are used for recording the signals. Two reference electrodes were attached to the ears and according to international standards 10- 20 active electrodes are determined on the head. Brain signals were taken from individual with open eyes for 2 minutes and 2 minutes blindfolded. There were 10 participants in the test; 6 were normal and 4 had Alzheimer. The average of age of group was above 50 years.

Frequency range

The power spectrum is calculated by Welch method using a normalized Hanning window for 2 seconds and overlap of 50% for recorded brain signals for each channel.

Wavelet entropy

The brain signals are divided into 5 frequency levels by wave entropy. Due to the lack of scales with same length, the coefficients of each level is equal to the number of windows have been divided by one second of

main signal. In each of the windows respectively the average of wave entropy coefficients energy at each levels of d2 to d6 and finally the total energy is calculated. Finally, using the values of energy distribution probability obtained at each level and Shannon entropy with multiplication of values of energy distribution probability at each level with a minus sign in its natural logarithm and adding it for all frequency levels can be calculated.

Lyapunov exponent

It is a theory that presents geometry and dynamics description of a signal that determines the system order and if it is positive it means that the system is irregular.

$$\lambda = \frac{1}{n} \ln \frac{d_n}{d_o}$$

The method of finding □ is that we find two points in space of path and determine the difference of these two points. Lyapunov fractal is created by mapping the sustainability and chaos areas of point a & b in sequence of time, for example the yellow part (sustainability) is $\lambda < 0$ and blue part (chaos) is $\lambda > 0$.

Lyapunov fractal algorithm

$$\lambda = \lim_{N\to\infty} \frac{1}{N} \sum_{n=1}^{N} \log \left| \frac{dx_{n+1}}{dx_n} \right| = \lim_{N\to\infty} \frac{1}{N} \sum_{n=1}^{N} \log |r_n(1 - 2x_n)|$$

Fractal is geometrical structure which is made of components which each component is maximized with a certain proportion to make the first structure. In other words, fractal is a structure which each component is similar to whole structure. Fractals are shapes that contrary to Euclidean geometric shapes are not organized in any way. First these shapes are irregular completely, second, the irregularity in all of them is similar and the fractal object is seen identical from far and near, in other words, it is self-similar. Fractals are one of the most important tools in computer graphics but they play the most important role in this new concept of video compression files. The results of fractal and Lyapunov dimension are given in Table 3-11.

Table 1. Participants' features with individual alpha range

Iaf	Alpha high range	Alpha low range	Person's code	Person's condition	age	Last name	First name	row
10.2450	12.5000	8.0000	1	sick	60	abareshi	Zahra	1
9.7000	12.0000	8.0000	0	healthy	55	babania	maryam	2
10.6000	13.5000	7.0000	0	healthy	55	babania	ali	3
9.7000	12.5000	7.0000	1	sick	58	farshadi	mansureh	4
9.4700	12.0000	7.0000	0	healthy	50	sadegh pour	Parvin	5
9.4000	12.5000	7.0000	0	healthy	30	sedghi	pejman	6
10.3100	13.0000	8.5000	0	healthy	58	sedghi	sara	7
7.9800	10.0000	6.0000	1	sick	60	yousefi	zohreh	8
10.4900	13.0000	8.0000	0	healthy	60	naseri	Ali	9
10.9137	12.0000	8.0000	1	sick	65	soltanifar	Hasan	10

Table 2. Frequency features related to the brain waves (calculation of power and energy spectrum)

Frequency features fz									
f open					f close				
Gama	beta	alpha	theta	Delta	Gama	beta	alpha	theta	Delta
34.8386	41.1076	28.6853	24.9289	57.5434	36.3032	55.5266	165.9348	26.6890	20.3648

18.5250	19.7253	47.2474	19.2225	23.7729	21.4751	23.9920	77.0244	18.2651	27.2976
6.5987	8.1007	7.4190	14.6517	25.6559	12.5590	11.8493	37.4300	17.5759	39.9226
20.6735	34.1214	37.4883	32.0841	54.3805	17.8962	29.7352	61.3142	21.3761	27.8875
27.2668	50.6267	83.3150	48.8559	42.9864	17.4305	49.6491	127.9188	52.7064	34.0531
12.5411	11.2746	24.7493	24.7629	56.0748	10.1709	14.9897	44.3771	45.7211	97.1984
15.4638	17.0632	14.5162	18.9895	67.5189	12.4665	15.1617	21.3153	21.7571	45.5004
7.5082	13.7435	60.6196	35.0109	14.2776	7.3816	18.7000	65.9802	42.6901	18.2426
10.1272	7.1550	8.0960	8.8403	13.9832	11.6122	7.2398	12.8490	10.8790	16.5401
13.0989	14.1634	7.5879	8.9236	24.0970	15.2957	19.4000	8.2684	9.7431	24.4937

Table 3. Frequency features related to the brain waves (calculation of power and energy spectrum)

Frequency features Fz									
rf open					rf close				
Gama	beta	alpha	theta	delta	Gama	beta	alpha	theta	delta
0.1940	0.2289	0.1597	0.1388	0.3204	0.1251	0.1913	0.5718	0.0920	0.0702
0.1388	0.1477	0.3539	0.1440	0.1781	0.1256	0.1403	0.4505	0.1086	0.1597
0.0706	0.0867	0.0794	0.1568	0.2746	0.0944	0.0891	0.2814	0.1321	0.3001
0.1180	0.1948	0.2140	0.1832	0.3104	0.1160	0.1927	0.3974	0.1385	0.1807
0.1063	0.1974	0.3326	0.1944	0.1676	0.0644	0.1835	0.4727	0.1948	0.1258
0.0935	0.0841	0.1845	0.1846	0.4180	0.0486	0.0716	0.2121	0.2185	0.4646
0.1106	0.1221	0.1038	0.1358	0.4830	0.1081	0.1314	0.1848	0.1886	0.3945
0.0617	0.1129	0.4980	0.2876	0.1173	0.0516	0.1307	0.4613	0.2985	0.1275
0.1179	0.0833	0.0943	0.1029	0.1628	0.1538	0.0959	0.1702	0.1441	0.2190
0.1990	0.2152	0.1153	0.1356	0.3661	0.2066	0.2620	0.1117	0.1316	0.3308

Table 4. Frequency features related to the brain waves (calculation of power and energy spectrum)

Frequency features Oz									
f open					f close				
Gama	beta	alpha	theta	delta	Gama	beta	alpha	theta	delta
14.0542	21.6330	25.8208	32.5990	27.8291	18.0374	31.3463	118.4254	28.8005	20.1194
56.7676	20.4027	34.5516	9.3660	7.5793	53.5344	24.3995	107.8586	11.5504	6.7896
17.6601	18.5115	15.3506	19.6768	16.7522	18.4343	23.5217	43.6135	21.2731	12.9922

12.7082	22.2228	32.6496	25.5680	31.2369	7.0869	18.5341	60.4566	19.5166	28.7821
32.6484	69.6886	116.3989	40.4695	24.8874	18.4337	71.7480	212.0194	46.2392	22.2571
36.9690	23.9271	44.2069	25.3160	41.1345	27.7598	26.3276	85.3345	45.4925	45.9330
32.6849	24.8688	19.9081	13.0786	60.3481	26.4550	26.1572	50.2229	14.0871	27.2944
13.9957	18.8956	20.1217	11.9083	7.7592	10.7467	16.1400	61.5107	11.5284	9.2951
17.2904	9.1713	9.9884	6.5021	7.1125	13.0839	7.8329	10.8258	6.5169	6.5114
34.5773	11.1228	5.8068	7.1926	11.7080	29.8331	12.6292	6.2414	6.8618	13.7249

Table 5. Frequency features related to the brain waves (calculation of power and energy spectrum)

Frequency features Oz									
rf open					rf close				
Gama	beta	alpha	theta	delta	Gama	beta	alpha	theta	delta
0.1202	0.1850	0.2208	0.2887	0.2379	0.0863	0.1500	0.5668	0.1378	0.0963
0.3499	0.1258	0.2130	0.0495	0.0467	0.2296	0.1046	0.4626	0.0577	0.0291
0.1251	0.1312	0.1088	0.1394	0.1187	0.1074	0.1371	0.2542	0.1240	0.0757
0.1040	0.1819	0.2672	0.2093	0.2557	0.0540	0.1413	0.4608	0.1487	0.2194
0.1170	0.2498	0.4172	0.1450	0.0892	0.0512	0.1993	0.5889	0.1284	0.0618
0.1988	0.1317	0.2433	0.1393	0.2263	0.1189	0.1127	0.3654	0.1948	0.1967

Table 6. Features related to the spectrum of the brain signals conformity

coherence open with open					coherence close with close				
Gama	Beta	Alpha	Theta	Delta	Gama	Beta	Alpha	Theta	Delta
0.6086	0.1231	0.0945	0.1056	0.0788	0.4457	0.1257	0.0456	0.0649	0.0788
2.1169	0.2515	0.1832	0.1938	0.1289	9.3729	0.4424	0.7630	0.2695	0.5708
14.6753	6.1255	2.8229	1.9504	2.2691	3.5332	0.8665	0.7717	0.1814	0.6441
9.0870	3.0135	2.6290	2.3097	0.9581	19.5609	4.5520	4.6327	2.5838	2.3479
0.6128	0.2262	0.1229	0.1037	0.1486	0.6143	0.2035	0.1598	0.1164	0.0767
0.7836	0.1212	0.1364	0.0716	0.0766	0.2647	0.1981	0.1166	0.1102	0.1005
0.5058	0.2397	0.1334	0.1222	0.1037	11.3014	0.4537	0.4812	1.2505	2.6593
4.5958	0.7285	0.2884	0.3240	0.7190	1.7514	0.4882	0.3286	0.1552	0.1914
1.8107	0.3614	0.1492	0.1692	0.2642	6.0413	0.2961	0.3225	0.2312	0.2709
19.7499	4.3134	2.8288	4.0037	4.7548	16.0870	2.7901	2.5590	2.8252	4.1054

Table 7. Features of Violet waves

Wavelet									
sig open fz					sig close fz				
Gama	beta	alpha	theta	delta	Gama	beta	alpha	theta	delta
-0.0031	-0.0310	0.1346	-0.4213	-0.3033	-0.0041	0.1006	-0.1435	-0.3154	-0.0410
0.0023	-0.0409	0.1940	0.5202	-0.2032	1.3657e-04	0.0223	-0.0303	0.4227	-0.9020
-1.3135e-04	-0.0647	0.0532	-0.0828	-0.0526	-1.4289e-04	0.0141	0.0060	-0.2446	0.0304
-0.0015	-0.0536	-0.2810	0.1196	-0.2051	1.2186e-04	-0.0324	-0.2535	-0.3684	-0.1219
0.0099	-0.0922	0.0724	-0.0262	-0.1865	-0.0015	-0.0945	0.5202	0.5107	-0.0863
-0.0051	-0.1471	-0.0278	0.2406	-0.2553	0.0031	0.0219	-0.1477	-0.2047	-0.2452
-0.0041	-0.0601	0.3734	-0.1343	-0.4618	2.5677e-04	0.0660	0.1153	-0.3460	-0.0782
0.0034	-0.0576	0.0315	0.0763	-0.1890	-0.0014	-0.0901	0.0202	0.3866	-0.2667
-6.7275e-04	-0.0506	-0.0622	-0.1286	-0.1332	-2.4443e-04	0.0029	-0.0055	-0.1041	-0.0437
5.3065e-05	0.0042	0.0086	0.1368	-0.1016	1.4470 e-04	-0.0656	0.2498	0.1679	-.1164

Table 8. Features related to Violet waves

Wavelet									
sig open oz					sig close oz				
Gama	beta	alpha	theta	delta	Gama	beta	alpha	theta	delta
1.7438e-04	0.0083	0.0665	-0.0533	0.0647	-0.0034	-0.1137	0.3099	0.3400	0.0572
0.0010	0.3328	-0.0997	0.0694	-0.0488	-2.7407e-04	-0.0432	-0.1407	0.3045	-0.0460
-4.7210e-04	-0.1005	0.0169	0.0987	-0.0540	-4.2435e-04	-7.7196e-04	0.2099	0.0334	-0.0673
-5.3340e-04	0.0513	-0.0582	-0.3212	-0.0187	9.9460e-04	-0.0729	-0.4062	-0.2568	0.0217
1.1783e-04	0.1263	0.3529	0.5130	-0.0646	0.0050	-0.0391	-0.3474	-0.5707	0.0823
-2.5577e-04	0.0098	0.0808	-0.1911	-0.0215	0.0011	0.0814	-0.0386	-1.0157	-0.1004
-0.0011	0.1430	3.9392e-04	0.1377	0.4471	5.1332e-04	-0.0729	-0.0035	0.0808	-0.0477
-3.4415e-04	-0.0299	0.0308	0.0904	-0.0386	7.2484e-04	0.0555	-0.0305	0.0780	-0.0221
-2.2693e-04	-0.1447	0.0197	0.0302	-0.0522	-5.5022e-04	0.0485	0.1719	-0.1992	-0.0423
-6.8460 e-04	-0.1866	0.0667	-0.0093	0.0202	-1.9132 e-04	0.0922	0.0221	0.3697	0.0021

Table 9. Features related to entropy violet waves

wave entropy											
sig open fz						sig close fz					
swt	Gama	beta	alpha	theta	delta	Swt	Gama	beta	alpha	theta	delta
1.3457	0.1057	0.3466	0.3213	0.1489	0.0775	0.9958	0.0498	0.2200	0.6301	0.0826	0.0175
1.3007	0.1304	0.2421	0.4243	0.1592	0.0440	1.2305	0.0993	0.2199	0.5047	0.1378	0.0383
1.4380	0.3264	0.1578	0.2200	0.2060	0.0897	1.3228	0.1676	0.1429	0.4260	0.1784	0.0851
1.3757	0.0892	0.2948	0.3428	0.1880	0.0852	1.2238	0.0593	0.2383	0.5062	0.1456	0.0507
1.3031	0.0894	0.2047	0.4466	0.2052	0.0540	1.1418	0.0410	0.1648	0.5507	0.2023	0.0412
1.4324	0.1451	0.1551	0.3430	0.2283	0.1285	1.3446	0.0725	0.1064	0.3942	0.2710	0.1559
1.4685	0.1490	0.2555	0.2542	0.2127	0.1285	1.4150	0.1028	0.2287	0.3377	0.2235	0.1073
1.1476	0.0533	0.0934	0.3957	0.4084	0.0492	1.1283	0.0434	0.0894	0.4368	0.3718	0.0586
1.3272	0.4491	0.1852	0.1877	0.1310	0.0470	1.4197	0.2947	0.2064	0.2841	0.1604	0.0544
1.3607	0.0935	0.3880	0.2576	0.1648	0.0960	1.3637	0.0826	0.4205	0.2417	0.1599	0.0953

Table 10. Features related to entropy violet waves

wave entropy											
sig open oz						sig close oz					
swt	Gama	beta	alpha	theta	delta	Swt	Gama	beta	alpha	theta	delta
1.3586	0.0865	0.2283	0.3658	0.2587	0.0606	1.0178	0.0472	0.1644	0.6384	0.1268	0.0233
1.2720	0.3763	0.2716	0.2599	0.0758	0.0164	1.1911	0.2278	0.2153	0.4807	0.0649	0.0113
1.4010	0.3591	0.1997	0.2467	0.1572	0.0374	1.3113	0.2834	0.1713	0.3860	0.1327	0.0267
1.3841	0.1012	0.2368	0.3748	0.2118	0.0755	1.1466	0.0389	0.1683	0.5704	0.1599	0.0625
1.2180	0.0902	0.2178	0.5038	0.1552	0.0329	0.9991	0.0317	0.1644	0.6350	0.1453	0.0237
1.4130	0.2301	0.1951	0.3564	0.1479	0.0705	1.2953	0.1250	0.1383	0.4791	0.1984	0.0592
1.4390	0.2337	0.2971	0.2518	0.1248	0.0927	1.3066	0.1640	0.2752	0.4118	0.1041	0.0449
1.3924	0.1722	0.2230	0.3451	0.2198	0.0399	1.1482	0.0879	0.1231	0.5207	0.2413	0.0270
1.3393	0.3703	0.2604	0.2360	0.1019	0.0315	1.3750	0.2913	0.2474	0.3012	0.1285	0.0316
1.3268	0.3767	0.3308	0.1528	0.1011	0.0386	1.3516	0.3282	0.3528	0.1785	0.0950	0.0455

Table 11. Features related to fractal dimension and Lyapunov exponent of the brain waves

FD				Liayapunov			
sig close fz	sig open fz	sig close oz	sig open oz	sig close fz	sig open fz	sig close oz	sig open oz
1.0101	1.0114	1.0103	1.0119	0.0556	0.5001	0.3351	0.6670
1.0129	1.0129	1.0130	1.0140	0.5778	0.5090	0.7715	0.7388
1.0121	1.0127	1.0137	1.0149	0.4810	0.7852	0.0900	0.8628
1.0109	1.0117	1.0103	1.0121	0.6801	0.6160	0.5867	0.6608
1.0103	1.0122	1.0082	1.0113	0.0019	0.2001	0.0019	0.0011
1.0121	1.0139	1.0131	1.0146	0.1937	0.5512	0.0687	0.6376
1.0121	1.0131	1.0129	1.0140	0.5462	0.6655	0.7003	0.6265
1.0109	1.0110	1.0126	1.0136	0.5530	0.5650	0.7722	0.8338
1.0132	1.0132	1.0143	1.0148	0.7694	0.8499	0.8434	0.8631
1.0113	1.0116	1.0141	1.0146	0.7312	0.7288	0.8755	0.8408

Findings

SPSS software and t-test analyze were used to conclude that the following 5 features separate normal people from mild Alzheimer patients in way that we used 0 for healthy people and 1 for mild Alzheimer patients and the results are presented in table 4-1 and 4-2.

Table 4-1 the results of data analysis

	Function
	1
Delta rf open oz	-15.855
Beta coherence close with close	3.692
Wavelet Alpha sig close fz	-53.550
Wavelet Teta sig open oz	106.379
FD sig open fz	23938.680
(Constant)	-24238.091

Table 4-2: Separating healthy people from the patients

		Patient	Predicted Group Membership		
			0	1	Total
Original	Count	0	6	0	6
		din2 1	0	4	4
	%	0	100.0	.0	100.0
		Dime 1	.0	100.0	100.0

Cross-validateda	Count	Dime 0	6	0	6
		1	0	4	4
	%	dim2 0	100.0	.0	100.0
		1	.0	100.0	100.0

Conclusion

FlexComp is a device used to record brain signals. Two channels of Fz and Pz are used for the reference of electrode ear to record the signals. Brain signals were taken from individual with open eyes for 2 minutes and 2 minutes blindfolded. Best results were extracted in delta rf open oz ،beta coherence close with close ، wavelet Alpha sig close fz ،wavelet theta sig open oz و FD sig open fz modes.

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ارزیابی سیگنال مغزی بیماران مبتلا به آلزایمر خفیف به منظور جدایی زود هنگام آنها از افراد عادی

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چکیده:

هدف این مقاله طراحی و ارائه سیستمی برای شناسایی آلزایمر خفیف است. آلزایمر را می توان با از دست دادن سیناپس های سلول های عصبی در برخی مناطق مغز ، سلول های نکروزه مغز در قسمت های مختلف سیستم عصبی ، ایجاد یک شکل کروی از ساختارهای پروتئینی به نام پلاک های پیر در خارج از سلول های عصبی در برخی مناطق مغز و ساختارهای پروتئینی رشته ای به نام اسپرایل کویل در سلول های عصبی شناسایی کرد. FlexComp دستگاهی است که برای ضبط سیگنال های مغزی استفاده می شود.

از دو کانال Fz و Pz به عنوان مرجع الکترود گوش برای ضبط سیگنال ها استفاده گردید. سیگنال های مغزی از افراد با چشم باز به مدت ۲ دقیقه و ۲ دقیقه با چشم بند گرفته شد. بهترین نتایج در حالت delta rf open oz، beta coherence close with close، wavelet Alpha sig close fz، wavelet theta sig open oz و FD sig open fz modes استخراج شد.

واژه‌های کلیدی :آلزایمر، سیگنال های مغزی، موجک