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BRAIN FINGERPRINTING TECHNOLOGY (BFP) AND BRAIN ELECTRICAL OSCILLATION SIGNATURE (BEOS): WHICH UNIQUE TECHNIQUE IS BEST?

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ABSTRACT   Unlike conventional polygraph, which detects an emotional stress response on the theory that people are more stressed when lying, these brain mapping technologies detect brain responses which are measured non-invasively to determine the presence or absence of information stored in the brain. Brain Fingerprinting technology (BFP) and Brain Electrical Oscillation Signature (BEOS) are the only two technologies at present. Internationally, Brain Fingerprinting technology had gained recognition among government security agencies worldwide. FBI and CIA and US Navy had given an accuracy of 99.9% for Brain Fingerprinting Technology. As for, BEOS the percentage of accuracy has not been revealed yet except through the TIFAC project accuracy was given as 95%.

KEYWORDS : Brain Mapping, Brain Fingerprinting, BEOS.

Introduction

Brain mapping is a set of neuroscience techniques predicated on the mapping of (biological) quantities or properties onto spatial representations of the (human or non-human) brain resulting in maps. Brain mapping can be conceived as a higher form of neuroimaging, producing brain images supplemented by the result of additional (imaging or non-imaging) data processing or analysis, such as maps projecting (measures of) behaviour onto brain regions. Brain Mapping and use of Electroencephalography (EEG) has many advantages from the relative ease of use, lower total cost of ownership, and high resolutions. It is a highly advanced technology apparatus that offers an objective and knowledge-based means of identification. By analyzing specific brain responses called the P300 and P300 MERMER, the solution safely and non-invasively verifies whether the information contained in the person's account is present in his/her brain.

Brief history of work done in India related to Brain Mapping Technology

Initially, collaborative work with MIT was reported to be in progress between Forensic Science Laboratory, Bangalore, Karnataka and Prof. C.R. Mukundan of the Neuropsychology Laboratory of the NIMHANS, Bangalore. The laboratory facilities of NIMHANS were used for this purpose. In a current status of research in the investigation of crime, it was essential to setup this facility in Forensic setting. Thus, Forensic Psychology Division of Forensic Science Laboratory, Gandhinagar, Gujarat, took this research project.

Director, Directorate of Forensic Science, Gandhinagar and Director, NIMHANS agreed to initiate Brain Fingerprinting work at Forensic Psychology Division of Forensic Science Laboratory, Gandhinagar, Gujarat on 11th April, 2003.

Ethic committee was formed under the chairmanship of High court sitting Judge with Director NIMHANS; Director, DFS; NIOH, one S.P.; one Additional S.P., One advocate, Deputy Director Judicial Academy as members of the committee.

Project proposal was presented by Dr. C.R. Mukundan as Principal Investigator and Dr. S.L. Vaya as Co-Investigator along with the live demonstration of the recording procedure at DFS, Gandhinagar. Ethics committee unanimously approved the project on July 17th, 2003.

Thus, the first brain laboratory was set up with Brain Electro Scan System (BESS) at DFS, Gandhinagar. BESS was the first 24-channel EEG-ERP system installed in 2003. Later, an up gradation was given to BESS by giving the technology with a 32-channel system. This technology was called as Brain Electrical Activation Printing (BEAF). A two day workshop was also conducted on 24th and 25th July 2004 as BEAF technology is different from Farwell's technique of Brain Fingerprinting. Thus, BEAF was used to conduct examination at Forensic Psychology Division, DFS, Gandhinagar.

Later on, a commercial version of the BEAF technology was developed by Dr. C.R. Mukundan, a former professor of psychology, National Institute of Mental Health and Neuro Sciences (NIMHANS), Bangalore, who was the principal investigator in the development of BESS technology at DFS, Gandhinagar. And the technology was known as Brain Electrical Oscillation Signature (BEOS). He had formed a company known as Axxonet System Technologies Pvt. Ltd, Bangalore and later installed the BEOS at DFS, Gandhinagar. And later on at Mumbai Forensic Science laboratory, Kalina.

BEOS technique is tested at DFS, Gandhinagar for real life cases as well as generating normative data. A project was sponsored by DST's Technology Information Forecasting and Assessment Council (TIFAC), and conducted in the Gujarat Forensic Science Lab. The study, conducted in 2007, essentially says that on a sample of 120 people who participated in a validation study of the experiment, the brain mapping exercise returned an accuracy of 95%.

India's First Brain Fingerprinting Lab:

India's First Brain Fingerprinting Lab was established at Institute of Research & Development (R&D), Raksha Shakti University (RSU), Ahmedabad on 28th September, 2015. Institute of Research & Development, took the initiation to validate this technology in India. Starting with simulation studies, which included different case scenarios and still the testing, is in progress. Meanwhile, with the inception of this technology at Institute of Research & Development, real cases were also being referred from the Central

Bureau of Investigation (CBI), the highest investigating agency in the country. CBI is utilizing this technology and reported to have charge-sheeted in the referred few cases at the jurisdictional Courts utilizing Brain Fingerprinting examination report. In some cases, the Brain Fingerprinting expert of Institute of Research & Development, Raksha Shakti University visited the respective branch/unit of CBI concerned for conducting the Brain Fingerprinting Examination. Till date, the validation of this technology is providing satisfactory and positive results in India.

In one case, referred from Special Crime Branch (SCB) Unit, CBI, Mumbai. The SCB team had charge-sheeted and accused was arrested only on the basis of Brain Fingerprinting Examination report. Accused had confessed of committing the crime. Now, waiting for the final verdict from honorable High of Rajasthan.

The Central Bureau of Investigation (CBI), Special Crime Branch (SCB), Mumbai had given an "**Appreciation Certificate**" to the expert for conducting of the Brain Fingerprinting Examination in three cases that led to find the solution as early as possible. This proved that Brain Fingerprinting Technology is valid in India scenario, when other forensic tools proved futile in the above mentioned examined cases.

Difference and similarities between BEOS and Brain Fingerprinting Technology.
- BEOS is not a portable instrument whereas, Brain Fingerprinting Technology is a portable instrument that comes in a pelican case.

Here, advantage is for Brain Fingerprinting technology as it can be taken to anywhere and can conduct the examination, as in some sensitive cases subjects' cannot be transported due to security reasons.
- BEOS uses 32- electrodes, whereas Brain Fingerprinting Technology uses only just 2- electrodes.

Here also, advantage is for Brain Fingerprinting Technology as it would give comfort to the subject.
- BEOS uses a fully conventional mode with wires connecting each electrodes, whereas, Brain Fingerprinting Technology, uses the Bluetooth mode.

Here also, Brain Fingerprinting Technology had gained the advancement.
- In BEOS, each electrode is placed by applying a gel in the scalp of the subject, whereas in Brain Fingerprinting Technology, electrodes are kept without any gel.

Here also, Brain Fingerprinting Technology had advanced more by giving comfort to the subject.
- In BEOS, two separate rooms are required with electromagnetic shielding with sound proof, whereas, Brain Fingerprinting technology just require a room with air-conditioner and proper wiring with switch and a socket.

Here also, the Brain Fingerprinting Technology again gained the first place against BEOS, as it is easy to install and can be conducted at any place in short span of time.
- In BEOS, there is no system analyzed result with aggregate percentage of a particular individual in a crime. Whereas, in Brain Fingerprinting Technology a system generated performance analysis is given with a quantified percentage as a result in a minute's time.

Here, also the Brain Fingerprinting Technology had achieved a greater step where no human interference is required for the analysis.
- In BEOS, minimum two certified experts (human resource) are required for preparation and conducting the examination. Whereas, in Brain Fingerprinting Technology, only a single certified expert is required.

Here also, Brain Fingerprinting technology had advanced furthermore with one expert, preparation and examination can be conducted.
- BEOS mostly uses auditory mode (without language barrier) of examination. Whereas, Brain Fingerprinting Technology uses visual mode as well as textual mode (without language barrier) of examination.
- BEOS takes more time for setup and preparation, whereas, Brain Fingerprinting Technology takes a few minutes for setup and examination can be conducted within 5minutes.

Here also, Brain Fingerprinting Technology gained more score than other technology.
- In BEOS, long sentences are used as probes. Whereas, in Brain Fingerprinting Technology, small phrases or 1-2 words are used.
- Here also, Brain Fingerprinting Technology proved that, the technology requires less preparation time to design relevant probes.
- BEOS is used by DFS Gandhinagar but the percentage of accuracy has not been revealed yet except through the TIFAC project accuracy was given as 95%. Whereas for Brain Fingerprinting Technology, FBI, CIA and US Navy had given an accuracy of 99.9%.

Here also, the Brain Fingerprinting Technology acquired more accuracy than BEOS. Brain Fingerprinting Technology moved further with more advantages.

In similarity aspect, both the technology speaks the same method of operation but in different terms.

- In BEOS, they use specific/core probes, and neutral probes. In Brain Fingerprinting Technology, they use three items, as probes, targets and irrelevants.
- In BEOS, analysis is done based on P300 wave pattern. In Brain Fingerprinting Technology, analysis is done based on P300MERMER. Both are technically the same.
- In BEOS, they speak about experiential knowledge whereas in Brain Fingerprinting Technology, it speaks about 'Guilty Knowledge'. Though both are the same.

Conclusion:
Brain mapping technology stands poised to exert a tremendous impact on the presentation and outcome of selected legal cases in the near future.

Brain Fingerprinting Technology is an advanced means of getting intelligence by detecting memory records of terror plans, training or crime stored in the brain of suspects. It eliminates number of suspects and its highly accurate tool used to corroborate / cross verify assumptions and leads.

A technology which FBI and CIA claim to have above 99% accurate. As for, BEOS the percentage of accuracy has not been revealed yet except through the TIFAC project accuracy was given as 95%.

Brain Fingerprinting technology has gained recognition and sparked the interest of government security agencies worldwide and has undergone through a series of software updates and validation testing to improve on user experience and processing speed. Thus, the Brain Fingerprinting Technology will pave a path for a new scientific method in the field of Investigative Psychology.

Now, which technology is the best has to be decided by the law enforcement and investigating agencies as well as the Forensic laboratories of the country.

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