

Crime Investigative Control in Nigeria Using Brain Fingerprinting as a Cyber Tool Technique

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ABSTRACT

The increasing level of crime in Nigeria is fast becoming a threat to socio-economic development in the country. Hardly is there any section of the country that is not plagued with one of these violent crimes either terrestrials or cyber in nature ranging from the financial malpractice or extortions, Boko Haram menace, to cultism, kidnapping, armed robbery, militancy to mention but a few. The authorities both at the federal and state levels have been unable to curb the trend. The seemingly twin issue of inadequacy of the personnel of the security forces, and the overstretched of these personnel coupled with the low intelligence gathering and inadequate cyber tools/techniques has continued to sustain the growth in strength of these vices. This paper exploits the use of technology particularly a new concept in proactively fighting crime – Brain fingerprinting to reduce the level of these crimes in the areas of intelligence gathering and synergy among security agencies; sufficiently adopting an investigative style of accounting involving the application of accounting concept and techniques, to uncover the involvement of either an individual or organisation in any illegal financial activities, providing suitable evidence that could form strong basis of evidence in the court of law and appropriate training in line with global best practices; logistics; motivation of members of the security agents; as well as addressing the issue of unemployment so as to reduce crime rate in the country and by implication enhanced the socio – economic development in Nigeria.

Keyword: Brain fingerprinting, Crime, Security, Cyber Tools, Financial Malpractice, Socio-Economic.

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1. INTRODUCTION

Brain fingerprinting is a concept that relies on the ability of the brain to interpret; keep and respond to situations it had experienced previously. It does this, by measuring electrical brain wave responses to words, pictures or objects displayed on the computer screen with a view to determine if an individual recognizes these details as it relates to an event previously occurred. It becomes helpful particularly when the investigators have adequate information about the event only known to the perpetrator. It is viewed as Guilty Knowledge Test in which case the “guilty party” is likely to respond to details pertaining to the event of activity. Whereas existing polygraph procedures relies on autonomic arousal (like palm swearing and heart rate) to determine suspect knowledge of the event, brain fingerprint relies on the false positives of traditional polygraph methods which is more accurate in determine culpability.

BrainFingerprinting as a part of digital forensic is expected to be capable of serving as a new spring board to criminal investigation and treachability of offenders in Nigeria economy. In other developed countries of the world the society growth has tendencies of complex activities as well as multiplexity of crime tendencies. As a case study, it was discovered that the financial crimes has left physical robberies of banks, breaking of houses to criminals using their expert knowledge through information technology to perpetrates fraud such as hacking of computer-base accounting system, internet fraud, bank operating system cracking which is known as artificial intelligent master-minded fraud.

Brain fingerprinting is an Information Technology driven concept to determine the culprit precisely through the use of Memory and Encoding Related Multifaceted Electro-encephalographic also known as MERMER by measuring the P300 emitted by the brain as recorded by electroencephalography to show positive turning in voltage with minuteness delay in response to the stimuli. It uses cognitive brain responses and it is not affected by emotions from neither the subject nor the responses. This technique can also be deployed in forensic accounting and the investigative audit for the detection of fraud related issues and also the misuse and diversion of funds supported strong evidence useful in the court of law; while these tool could be engaged towards refocusing, re-strategizing and repositioning the social structure, political system and the economy of a nation for greatness Uchehara & Ogbonna (2020).

1.1 Background of Study

It is a consensus that violent crime in Nigeria has been on a steady rise. This can be partly attributed to the worsening poverty situation in the country. These crimes range from Kidnapping, rape, murder, terrorism, armed robbery, ritual killings, degradation of the environment, attacks on national assets to mention but a few. This has caused deaths and sorrows on Nigerians and non-Nigerians with dire consequence for the nation's economic growth and development with an unprecedented dent on the image and pride of the country. Meanwhile, the major concern of the global economy of today with Nigeria inclusive, is how to put an efficient preventive measure and investigative techniques and procedures in place to reduce the tendencies of all these criminal activities using brainFingerprint as one of the effective techniques to ensure reliable traceability and detection.

It could also serve as an improved forensics accounting and investigative audit technique to reposition Nigerian economy and reduces tendencies of financial and other cyber related crime according to Uchehara(2012). In addressing the anomaly, Federal and States government have increased their funding assistance to the Nigerian Police and other security organizations saddled with the responsibility of maintaining law and order; protection and defence of the territorial integrity of the country. The Federal government in her 2019 budget proposed a whopping sum of N8.91 trillion(\$29 bln) expenditure on security to help the government combat terrorism, militancy and kidnapping across the country. This is a tremendous increase from the N932bn expended in 2014. It is sad, however, that with these spending, the result on ground belie the huge expenditure. As a way to improve the security, this paper is proposing the use of brain fingerprinting to control the rise of violent crime in the country.

2. LITERATURE REVIEW

In the earliest times, psychologists, Forensics Accountant and psychiatrists attempted to profile criminals based on certain features exhibited by the accused persons. This practice led to the concept of criminal profiling which can be defined as a means by which certain probable features of an accused or a criminal exhibited during commission of the crime are measured. Nikitam A. Riya, P. and Sarika, K. (2018) describes Brain Fingerprinting as a controversial concept used in measuring electrical brain waves of suspected offender. It usually involves the development of construct of a known offender with the victims and observed the interactions between the duo at the crime scene in order to gain more information about the offender. The information so obtained will be carefully analysed and predicted under detailed examinations to be able to determine the real offender. This profiling often reveals information about the person's habit, employment, marital status and mental state.

The techniques reveals exciting information when the supposed offender exhibits some mental inconveniences when being subjected to torture. At times, at the crime scene also, the offender may cart away items of no value but could be of deep significance to the offender. In this circumstances, there may be no physical involvement or presence where this fraud is committed(Frimette and Vijay- 2011). This type of fraud is usually regarded as cyber crime. However, with time the criminal profiling technique was modified. Caitlin, B.(2019) explained that psychological profiling also known as criminal profiling has been in used since 1970 when the Behavioural Science Unit of the Federal Bureau of Investigation (FBI) had adopted it. The technique used by FBI relies on the belief that apart from the observed interactions between the duo of supposed offender and the victim, the features exhibited by the supposed offender could be a reflection of the person identity type that can be used for the purpose of identification and categorization.

This modified technique of the FBI has transitioned into the era of polygraph testing and brain fingerprinting embolden by research that considers the interviews feedback of jailed offenders in line with application of standardized analytical protocols and training methodologies. The FBI approach assist in profiling traits into whether it is an organised or disorganized offender. The organized offenders are usually intelligent with IQ scores of above average who are very skilled and competent in their chosen profession and were in controlled mind during the commission of the crime and has a high interest in what goes on in the news while disorganised offenders are usually of average intelligence, immature, not skilled in their chosed field of life and were in anxious mood during the crime commission and has a low interest in what goes on in the news.

Polygraph Testing is a technique that was developed after discovering that systolic blood pressure has a strong link to lying. It measures physiological changes in blood pressure and pulse rate in the suspect during police investigation. It measures continuous blood pressure in determining deception. It also considers changes in parasympathetic nervous system like respiration, heartbeat, pulse-rate and skin conductance. When a person lies, the lying causes certain amount of stress that produces changes in the involuntary physiological reactions i.e. heart rate, pulse rate, respiration and skin conductance. The lie is calculated during the switch in the involuntary reactions at the time of answering the questions.

Brain fingerprinting is a significant, objective, non-invasive approach that considers the correlation of the electrical waves generated by the brain of an individual on a computer screen through the electroencephalographic response to an incoming stimulus that is remarkable when confronted with crime scenes and financial & investigative audit practice previously experienced. Farwell, L.A., (1994) discovered the electrodes response that occurs within a second after the stimulus presentation, and can be readily detected using EEG electrodes, amplifiers and a computerized signal-detection algorithm.

It is hinged on the fact that when a crime is committed, information about it are stored in the brain of the perpetrator since the brain is central to all human activities being the powerhouse that plans, executes and record happenings at any instance. It provides an accurate, timely and cost-effective solution to a key issue in the fight against terrorism. Now you can scientifically determine whether a person is engaged in terrorist training and terrorist information. McGorry, P. (2017) explains it as a technique to read subconscious signals in the brain and identify deception. It is a technology that had been exposed to criticisms.

The P300 wave is a positive deflection in the human event-related potential. It is most commonly elicited in an "oddball" paradigm when a subject detects an occasional "target" stimulus in a regular train of standard stimuli. The P300 wave only occurs if the subject is actively engaged in the task of detecting the targets. Its amplitude varies with the improbability of the targets. Its latency varies with the difficulty of discriminating the target stimulus from the standard stimuli. A typical peak latency when a young adult subject makes a simple discrimination is 300 ms.

In patients with decreased cognitive ability, the P300 is smaller and later than in age-matched normal subjects. The intracerebral origin of the P300 wave is not known and its role in cognition not clearly understood. The P300 may have multiple intracerebral generators, with the hippocampus and various association areas of the neocortex all contributing to the scalp-recorded potential. The P300 wave may represent the transfer of information to consciousness, a process that involves many different regions of the brain. A comparison was carried out between P300 and P300-MERMER event-related brain potentials for accuracy in real life studies. It was discovered that out of the tests carried out, 76 of such identified presence or lack of information relating to felony crimes; crimes with substantial consequence; knowledge peculiar to FBI and knowledge associated with explosives experts. Farwell, L.A., (1992) explains that the result showed that P300 and P300-MERMER, error rate was 0 % and determinations were 100 % accurate, no false negatives or false positive.

2.1 Concept of Study

Nikitam A. Riya, P. and Sarika, K. (2018) describes Brain Fingerprinting as a controversial concept used in measuring electrical brain waves of suspected offender when familiar objects including writings and image previously had knowledge of. The response from the brain as measured from the waves generated on the P300 complex can be used to detect a lie detector. Brain Fingerprinting is seen as an interaction between the brain and the computer based on the principle that for every stimulus there is corresponding reaction in the brain based on the very last memory of the same stimulus. It helps to identify innocence in lie detection. A person who commits crime has details of the crime saved in his memory while an innocent person does not.

McGorry, P. (2017) explains it as a technique to read subconscious signals in the brain and identify deception. It is a technology that had been exposed to criticisms. However, it has the ability to infringe on individual rights and researchers had argued that it could be deceived through intentional suppression of memories; Inc. US Legal (2019) mentions that the technique is not widely accepted as evidence in court. However, it was used as evidence to assist a man convicted of murder on 1978 get a new trial. Regardless, though, it is still hotly debated as evidence in court of law.

3. METHODOLOGY

Scalp Electroencephalography (EEG) activity oscillates at multiple frequencies having different characteristic spatial distributions associated with different states of brain functioning such as waking and sleeping. These oscillations represent synchronized activity over a network of neurons. The neuronal networks underlying some of these oscillations are understood (such as the thalamocortical resonance underlying sleep spindles) while many others are not (e.g. the system that generates the posterior basic rhythm). The recording is obtained by placing electrodes on the scalp. Each electrode is connected to one input of a differential amplifier and a common system reference electrode is connected to the other input of each differential amplifier. These amplifiers amplify the voltage between the active electrode and the reference (typically 1,000–100,000 times, or 60–100 dB of voltage gain). A typical adult human EEG signal is about 10 μ V to 100 μ V in amplitude when measured from the scalp and is about 10–20 mV when measured from subdural electrodes.

In digital EEG systems, the amplified signal is digitized via an analog-to-digital converter, after being passed through an anti-aliasing filter. Since an EEG voltage signal represents a difference between the voltages at two electrodes, the display of the EEG for the reading encephalographer may be set up in one of several ways. The process involves 4 phases and they include:

PHASE 1: Investigation The first phase in applying Brain Fingerprinting testing in a criminal case is an investigation of the crime. Before a Brain Fingerprinting test can be applied, an investigation must be undertaken to discover information that can be used in the test. The science of Brain Fingerprinting accurately determines whether or not specific information is stored in a specific person's brain. It detects the presence or absence of specific information in the brain. Before we can conduct this scientific test, we need to determine what information to test for.

This investigation precedes and informs the scientific phase which constitutes the Brain Fingerprinting test itself. The role of investigation is to find specific information that will be useful in a Brain Finger printing test. As with any scientific test, if the outcome of the Brain Fingerprinting test is to be useful evidence for a judge and jury to consider in reaching their verdict, then the information tested must have a bearing on the perpetration of the crime.

PHASE 2: Interview of Subject Once evidence has been accumulated through investigation, and before the Brain Fingerprinting test is conducted to determine if the evidence can be linked to the suspect, it can in some cases be very valuable to obtain the suspect's account of the situation. For example, if an investigation shows that specific fingerprints are found at the scene of a murder, a suspect can be interviewed to determine if there may be some legitimate reason that his prints are there.

If the suspect's story is that he was never at the scene of the crime, then a match between his fingerprints and the fingerprints at that scene would be highly incriminating. If, on the other hand, the suspect's story is that he was at the scene for some legitimate reason just before the crime, then fingerprints must be interpreted differently, particularly if there is corroborating evidence of the suspect's presence at the scene before the crime. The interview with the suspect may help to determine which scientific tests to conduct, or how to conduct the tests. For example, a suspect may say that he entered and then left the room where a murder was committed a short time before the murder, and that he never saw or handled the murder weapon.

In this context, a finding that the suspect's fingerprints matched the fingerprints on the doorknob would have little value, but a finding that his fingerprints matched those on the murder weapon would provide incriminating evidence. Prior to a Brain Fingerprinting test, an interview of the suspect is conducted. The suspect is asked if he would have any legitimate reason for knowing any of the information that is contained in the potential probe stimuli. This information is described without revealing which stimuli are probes and which are irrelevant. For example, the suspect may be asked, "The newspaper reports, which you no doubt have read, say that the victim was struck with a blunt object. Do you have any way of knowing whether that murder weapon was a baseball bat, a broom handle, or a blackjack?" If the suspect answers "No," then a test result indicating that his brain does indeed contain a record of which of these is the murder weapon can provide evidence relevant to the case.

PHASE 3: Scientific Testing with Brain Fingerprinting It is in the Brain Fingerprinting test where science contributes to the process. Brain Fingerprinting determines scientifically whether or not specific information is stored in a specific person's brain. Brain Fingerprinting is a standardized scientific procedure. The input for this scientific procedure is the probe stimuli, which are formulated on the basis of the investigation and the interview. The output of this scientific procedure is a determination of "information present" or "information absent" for those specific probe stimuli, along with a statistical confidence for this determination. This determination is made according to a specific, scientific algorithm, and does not depend on the subjective judgment of the scientist. Brain Fingerprinting tells us the following, no more and no less: "These specific details about this crime are (or are not) stored in this person's brain." On the basis of this and all of the other available evidence, a judge and jury make a determination of guilty or innocent.

PHASE 4: Adjudication of Guilt or Innocence The final step in the application of Brain Fingerprinting in legal proceedings is the adjudication of guilt or innocence. This is entirely outside the realm of science. The adjudication of guilt or innocence is the exclusive domain of the judge and jury. It is not the domain of the investigator, or the scientist, or the computer. It is fundamental to our legal system that decisions of guilt or innocence are made by human beings, juries of our peers, on the basis of their human judgment and common sense.

The question of guilt or innocence is and will always remain a legal one, and not a scientific one. Science provides evidence, but a judge and jury must weigh the evidence and decide the verdict.

4. FINDINGS AND DISCUSSION

Brain fingerprinting can help address the critical elements in the fight against terrorism including assisting in determining who has participated in terrorist acts, directly or indirectly, assisting in identifying trained terrorists with the potential to commit future terrorist acts, even if they are in a "sleeper" cell and have not been active for years; Assisting to identify people who have knowledge or training in banking, finance or communications and who are associated with terrorist teams and acts; Helping to determine if an individual is in a leadership role within a terrorist organization. Brain fingerprinting technology is based on the principle that the brain is central to all human acts. In a terrorist act, there may or may not be peripheral evidence such as fingerprints or DNA, but the brain of the perpetrator is always there, planning, executing, and recording the crime. The terrorist has knowledge of organizations, training and plans that an innocent person does not have. Until the invention of Brain Fingerprinting testing, there was no scientific way to detect this fundamental difference. In a case where a suspect claims not to have been at the crime scene and has no legitimate reason for knowing the details of the crime and investigators have information that has not been released to the public, brain fingerprinting can determine objectively whether the subject possesses that information.

Brain Fingerprinting testing provides an accurate, economical and timely solution to the central problem in the fight against terrorism. It is now possible to determine scientifically whether a person has terrorist training and knowledge of terrorist activities.

COMPARISON ANALYSIS BETWEEN P300 AND P300-MERMER EVENT RELATED BRAIN POTENTIAL TEST(%)					
		HeartBeat	Respiration	Pulse Rate	Skin Conductance
1	P300-MERMER	60	65	43	92
2	P300	42	86	76	80
3	PolygraphicTesting	57	82	76	54

Table 1:Comparative analysis between P300 and P300-MERMER Using brain Potential Test with Metric Variables.

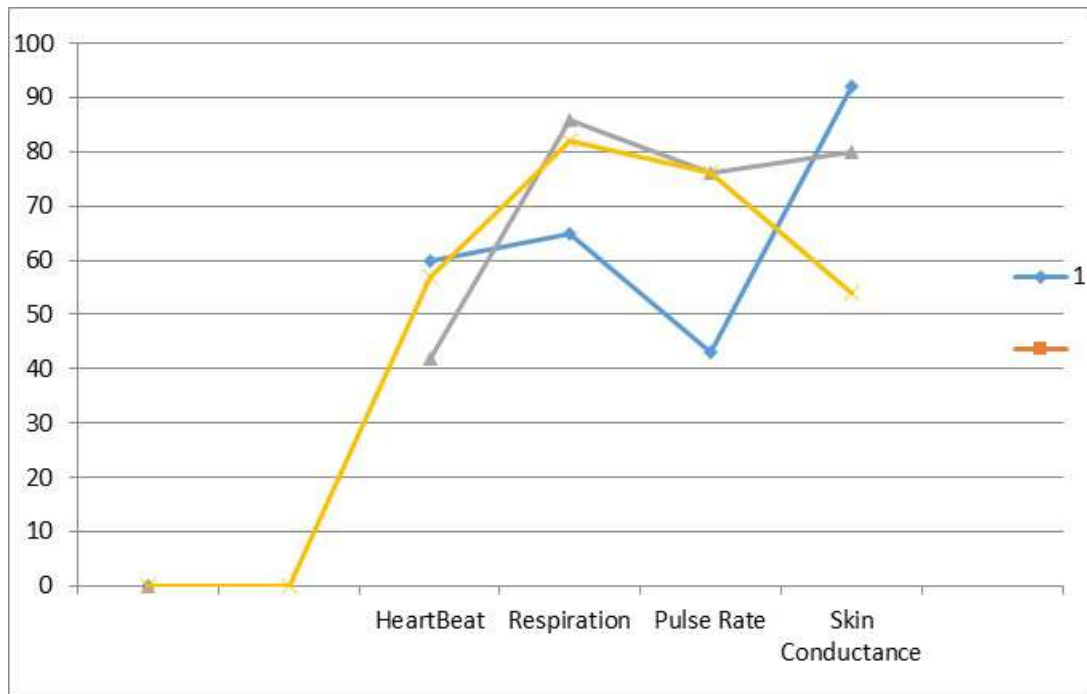


Fig 1: The performance of Metric Variables with Brain Potential Test

No longer should any terrorist be able to evade justice for lack of evidence. In addition, there is no reason why an innocent individual should be falsely imprisoned or convicted of terrorist activity. A Brain Fingerprinting test can determine with an extremely high degree of accuracy those who are involved with terrorist activity and those who are not.

5. CONCLUSION

It was observed that in the process of using the appropriate techniques (Brain Fingerprinting), the skin conductance is the most effective source of reliable result followed by respiration, Heartbeat and lastly pulse rate using P300-MERMER, P300 and Polygraphic testing Brain Fingerprinting is a revolutionary new scientific technology for solving crimes, identifying perpetrators, and exonerating innocent suspects, with a record of 100% accuracy in research with US government agencies, actual criminal cases, and other applications and therefore recommended for Nigeria Government especially the security agencies. The technology fulfils an urgent need for governments, law enforcement agencies, corporations, investigators, crime victims, and falsely accused, innocent suspects.

5. AREAS FOR FURTHER RESEARCH

The limitations of this technique are discussed with examples (in crime scenarios) as follows:

1. Brain fingerprinting detects information-processing brain responses that reveal what information is stored in the subject's brain. It does not detect how that information got there. This fact has implications for how and when the technique can be applied. In such a case, brain fingerprinting could provide useful evidence. If, however, the suspect knows everything that the investigators know about the crime for some legitimate reason, then the test cannot be applied. There are several circumstances in which this may be the case. If a suspect acknowledges being at the scene of the crime, but claims to be a witness and not a perpetrator, then the fact that he knows details about the crime would not be incriminating. There would be no reason to conduct a test, because the resulting "information present" response would simply show that the suspect knew the details about the crime – knowledge which he already admits and which he gained at the crime scene whether he was a witness or a perpetrator.
2. Another case where brain fingerprinting is not applicable would be one wherein a suspect and an alleged victim – say, of an alleged sexual assault – agree on the details of what was said and done, but disagree on the intent of the parties. Brain fingerprinting detects only information, and not intent. The fact that the suspect knows the uncontested facts of the circumstance does not tell us which party's version of the intent is correct.
3. In a case where the suspect knows everything that the investigators know because he has been exposed to all available information in a previous trial, there is no available information with which to construct probe stimuli, so a test cannot be conducted. Even in a case where the suspect knows many of the details about the crime, however, it is sometimes possible to discover salient information that the perpetrator must have encountered in the course of committing the crime, but the suspect claims not to know and would not know if he were innocent. This was the case with Terry Harrington. By examining reports, interviewing witnesses, and visiting the crime scene and surrounding areas, Dr. Farwell was able to discover salient features of the crime that Harrington had never been exposed to at his previous trials. The brain fingerprinting test showed that the record in Harrington's brain did not contain these salient features of the crime, but only the details about the crime that he had learned after the fact.

4. Obviously, in structuring a brain fingerprinting test, a scientist must avoid including information that has been made public. Detecting that a suspect knows information he obtained by reading a newspaper would not be of use in a criminal investigation, and standard brain fingerprinting procedures eliminate all such information from the structuring of a test. News accounts containing many of the details of a crime do not interfere with the development of a brain fingerprinting test, however; they simply limit the material that can be tested. Even in highly publicized cases, there are almost always many details that are known to the investigators but not released to the public, and these can be used as stimuli to test the subject for knowledge that he would have no way to know except by committing the crime.

REFERENCES

1. Arica, N.& Yarman-Vural, F.T. (2015). Optical character recognition for cursive handwriting. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 24(6), 801–813.
2. Gilloux, M. (2014). Research into the new generation of character and mailing address recognitionsystems at the French post office research centre. *Pattern Recognition Letters*, 14(4), 267–276.
3. Adeyemi B.M; Oloyede A.O; Longe E.O; Olaoye O.J; Ogunjimi L.A & Adegunwa O.S(2018):Off-line Signature Verification and Forgery Detection System using Fuzzy Modeling Technique in Forensics Investigation. www.cisdijournal.org.
4. Kapp, M.N., de Almendra Freitas, C., & Sabourin, R. (2017). Methodology for the design of NN-based month-word recognizers written on Brazilian bank checks. *Image Vision Computing*, 25(1), 40–49.
5. McGorry, P. (2017). A further critique of brain fingerprinting: The possibility of propranolol usage by offenders. *Alternative Law Journal*, 42(3), 216–220.
6. Adeyemi B.M; Oloyede A.O; Adegunwa O.S; Olaoye O.J; Ajilore O.O(2018): Unified Data recovery for both Volatile & Non-Volatile Data in Digital Forensics using Imaging Techniques“Caleb International Journal of Development Studies Vol.1, No.2pp135-147 Sept., 2018. Caleb University Imota, Lagos.
7. Farwell L.A, Donchin E (1986) The brain detector: P300 in the detection of deception, *Psychophysiology* (pp424:434. 2) Farwell LA, Donchin E. The truth will out: interrogative polygraphy ("lie detection") with event-related brain potentials. *Psychophysiology* (1991;28:531- 541. 3).
Farwell L.A(2014) inventor. Method and apparatus for multifaceted electroencephalographic response analysis (MERA). US patent 5,363,858. (1994 Nov 15. 4)
8. Adeyemi B.M; Oloyede A.O; Idowu S.O; Adeyemi B.A; Mosud O.Y(AJSCDF-2019): Adoption of Multi-modal fusion segmentation strategies for off-line Cursive Handwriting Recognition in forensics investigation, *Journal of Forensics Institute(African Journal of Cyber security and Digital Forensics)*
www.cfinonline.com.
9. Farwell LA (2012) Two new twists on the truth detector: brain-wave detection of occupational information. *Psychophysiology* 1992;29(4A):S3. 5) Durban well LA, inventor. Method and apparatus for truth detection. US patent 5,406,956.(1995 Apr 18. 6).
10. Uchehara, C.C(2012). A Comparative study of the Challenge Facing Statutory Auditors in Nigeria Public and Private Sector.(unpublished) M.sc Thesis submitted to Unilag.

11. Picton, T.W. (2018) Handbook of electroencephalography and clinical neurophysiology: human event-related potentials. Amsterdam.
12. Uchehara, C.C. (2017). The challenges Confronting Public Sector Accounting and Financial Management: A Perspective of Professional Accounting Practice in Nigeria. *European Journal of Scientific Research*, 71(5), 4-10.
13. Uchehara, C.C & Ogbonna, P.J. (2020). The challenges and prospects of Forensic Accounting and investigative audit as an effective tool to repositioning Nigeria *economy. Lasu Journal of Accounting and Finance*. 4(1), 42-60.