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Review Research Paper

Voice Fingerprinting: A Very Important Tool against Crime

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Abstract

In the recent world of technology, there are many methods to determine the individuality of a person. One of them is the voice – unique individual characteristic. Each person's voice is different because the anatomy of the vocal cords, vocal cavity, oral and nasal cavities is specific to the individual. Comparison of two recorded speech by means of spectrogram or voice prints for the purpose of identification is called as Voice fingerprinting. Forensic voice analysis has been used in a wide range of criminal cases such as murder, rape, drug dealing, bomb threats and terrorism. Investigator has two complementary ways of making identification through voice analysis. First, he or she will listen to the evidence sample and the sample taken from the suspect, comparing accent, speech habits, breath patterns and inflections. Then a comparison of the corresponding voiceprints is made. In this paper we discussed about the history of sound spectrogram, basic method of recording the voice & comparison, its utility in the solution of crime & admissibility in the court of law.

Key Words: Voice fingerprinting, Forensic phonetics, Sound spectrogram

Introduction:

Sometimes voice is the only clue for police & Forensic Scientists to identify criminal. Especially in cases of telephoned bomb threat, demand of money in kidnapping cases etc. Speech sounds come from the vibration of the vocal cords inside the larynx or voice box. The cavities of the mouth, nose, and throat act as resonators, making the sounds louder. The teeth, lips, tongue, hard and soft palate are the articulators that shape the sounds into speech. [1] Each person's voice is different because the anatomy of the vocal cords, vocal cavity and oral and nasal cavities is specific to the individual. People in different parts of a country speak with different accents. Some people run their words together, while others talk with pauses between their words. Identification is done by analyst by comparison of two recorded speech by means of spectrogram or voice prints. [1]

Forensic specialists who examine spoken or written materials in relation to legal matters and crimes are known as Forensic stylists or forensic linguists.

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Suspects knowingly or unknowingly leave recordings of the voices on the telephone, voice mail, answering machines, or hidden tape recorders, and these samples can be used as evidence. Forensic voice analysis has been used in a wide range of criminal cases such as murder, rape, drug dealing, bomb threats and terrorism. [2]

History:

In 1867, Melville Bell (Father of telephone inventor Alexander Graham Bell), an expert on philology (the study of language) and phonetics (the study of spoken sounds), created a system of hand written symbols that could represent any spoken sound on paper. He called his system "visual speech." Lawrence G. Kersta, a physicist and engineer at Bell Telephone Laboratories in Murray Hill, New Jersey invented the sound spectrograph. [1]

Early form of the sound spectrograph, or automatic sound wave analyser was invented by Bell laboratory engineers in 1941. During World War II, it was used to identify voices making German military communications over the radio. [1]

Method:

In the classic sound spectrograph, sounds are recorded on a magnetic disk and sent to an amplifier, which makes the sound more intense. The sounds then go through a scanner or frequency analyser, which separates the sounds into different frequencies. Frequency is a measurement of how often the molecules of

the air vibrate as sound waves pass them. A filter selects a group of frequencies and, with the help of the analyser, converts them into electrical signals. These signals move the pen like stylus, which marks paper on the recording drum. The stylus produces a series of jagged lines that show both the frequency and the intensity or loudness, of the sounds.

The process is repeated with other groups of frequencies. Kersta's new sound spectrograph had four parts: a tape recorder-player, a scanner or frequency analyser, a filter, and a stylus. Today many parts of a sound spectrograph are computerized. [1]

The spectrograph's printout is called a spectrogram. Each spectrogram shows 2.5 seconds of spoken sounds, represented as a graph. The vertical axis indicates frequencies of the sound & horizontal axis shows the time. The spectrogram reflects the fact that each sound of the human voice actually consists of many sounds occurring at the same time. The most important of these sounds are called fundamentals. Fainter overtones called harmonics occur at pitches above those of fundamentals. The spectrogram shows the frequencies of both fundamentals and harmonics. [1]

The analyst first listens to the two tapes repeatedly, trying to detect similarities and differences in the way the voices make single sounds and groups of sounds, the way breathing interacts with the sounds, and unusual speech habits, inflections, and accents. At the end of the examination, the analyst reaches one of five conclusions: The samples definitely match, the samples probably match, the samples probably do not match, the samples definitely do not match, or the test was inconclusive. An analyst must find 20 points of similarity and no unexplainable differences in order to declare a definite match. A definite non match requires 20 or more differences between the two tapes. [1]

However, there is no international standard for the minimum number of points of identity needed in this comparison. In brief, the investigator has two complementary ways of making identification through voice analysis. First, he or she will listen to the evidence sample and the sample taken from the suspect, comparing accent, speech habits, breath patterns, and inflections. Then a comparison of the corresponding voiceprints is made. [2]

Utility:

In 1960, device was used by New York City Police to solve the mystery of series of telephone calls threatening to place bombs on planes. Kersta claimed that sound spectrography could be used to tell one person's voice from another with accuracy greater than 99 percent. Even when professional mimics were asked to imitate others' voices, original voices from the imitations can be easily separated by looking at their spectrograms. [1]

It is use for studying language by scientists and helping people with speech or hearing problems by therapists. Voice identification is sometimes used for security purposes as well. Aside from helping to uncover information, phonetics can be helpful in interpreting meaning from the sound of speech. Again, a simple example would be the difference in meaning between the following statements: "*I* like it" versus "I like *it*" versus "I *like* it." All three are written the same but spoken quite differently and because of different emphasis carry a different meaning. [3]

Voice analysis has also been applied to the investigation of tapes said to be made by Osama bin Laden, the world's most wanted terrorist at one time. Since the terror attacks in New York and Washington on September 11, 2001, bin Laden has apparently issued a number of video and audiotapes. This signifies that Forensic voice analysis has been very useful in the current trend terrorism. [2]

Isshiki at al (1964) have presented classification system for hoarseness using spectrograms. Cooper (1974) reported spectrographic analysis as a tool to describe and compare fundamental frequencies & hoarseness in dysphonic patients before and after vocal rehabilitation. The voice spectrogram will have significant use in the evaluation of medical treatment for voice disorders too. [4]

Discussion:

Oscar Tosi of Michigan State University have said that they dislike the term voiceprint because it suggests a greater degree of precision than may be justified. Accurate voice identification is difficult because individual voices change constantly. No one says the same word or speech sound twice with exactly the same frequencies and intensities. Emotion, physical health, and changes such as the wearing of dentures (false teeth) can affect the sound of a person's voice. [1]

Voices also alter, sometimes strikingly, with age. Many phoneticians believe that the voice not only changes over time from aging and growth, but also from temporary factors such as stress, illness, and intoxication. If a person moves from one country or region to another, his or her accent may change. [5]

As computer scientists say, “Garbage in, garbage out”: If data being analysed are incorrect or unclear, conclusions drawn from the analysis will probably be incorrect as well. “Garbage” may come from sounds in the background, such as other voices, music, or the noise of machinery. Michael McDermott and Tom Owen say that some examiners reject up to 60 percent of the samples of unknown voices sent to them because the quality of the samples is too poor for accurate analysis. Experienced spectrographic analyst Tom Owen told Katherine Ramsland in an interview reprinted in Court TV’s online crime library, “When you’re comparing a known and an unknown voice using a verbatim exemplar [both voices speaking exactly the same words], there are no errors.” [1]

On the other hand, Jonas Lindh of the department of linguistics at Goteborg University in Sweden claimed in a 2004 paper, “Several experiments have shown that spectrograms are not reliable to verify identity.” [6]

However, in one analysis of 2,000 cases by the Federal Bureau of Investigation, the error rate in both false identification and false elimination of suspects was found to be very low. Voice identification played a key role in the investigation of the crimes of Peter Sutcliffe, the so called Yorkshire Ripper, who murdered several women in the North of England in the late 1970s. [2]

Katherine Ramsland writes in her series of articles about Voiceprints in the Court TV online crime library, “All of the studies that have been done on spectrographic accuracy, including a 1986 FBI survey, show that those people who have been properly trained and who use standard aural and visual procedures get highly accurate results. The opposite is true where training and/or analysis methods are limited.” [7]

Voice analyst Steve Cain calls the technology “a very important tool in the arsenal against crime.” Voice can be altered electronically as man’s voice can be altered to sound convincingly like a woman’s. There are several different electronic means of voice alteration. One type is known as speech inversion. Here, the frequency signal is in effect turned inside out around a designated frequency. Put another way, the parts of the speech that are ‘‘high’’ are made to sound ‘‘low,’’ and vice versa. Another means of electronic voice alteration is known as speech encryption. Here, speech is digitized and the digital signal manipulated to make the text of the speech unrecognizable to the listeners ear. But the speech can be decoded, or decrypted, at the receiving end to yield the original recognizable speech. [2]

Application in the court of law:

The Michigan state police set up a voice identification unit in 1966. Sound spectrograph evidence was first admitted into a court in 1967 during a military trial (court-martial), United States v. Wright. Judge Ferguson wrote a lengthy dissent, saying that voice identification by sound spectrograph did not meet the Frye standard of general acceptance by the scientific community. [1]

The first reported application of the voiceprint technique in a criminal proceeding occurred in the 1966 case of People v. Straehle. The defendant, a police officer, had telephoned the operator of an illicit gambling enterprise to warn him of an impending police raid. Later, during a grand jury inquiry, the police officer denied making the call. At the ensuing perjury trial, the prosecution introduced voiceprints of the telephone calls and sample voiceprints of the defendant's voice, supported by the expert opinion of Lawrence Kersta that all recordings were of the defendant's voice. [8]

When voiceprint evidence is admitted, it is used mainly to support other evidence. Law enforcement personnel may even, with court permission, tap a phone to acquire information that can potentially be useful in a prosecution. [2] Voice print analysis is inadmissible in the federal system. Under the proposed fusional framework, this Forensic Linguistic Analysis Techniques (FLATs) fails under the Daubert standard of expert testimony. [9]

In 1976 the New York Supreme Court pointed out, in the case of People v. Rogers, that fifty different trial courts had admitted spectrographic voice identification evidence, as had fourteen out of fifteen U. S. District Court judges, and only two out of thirty- seven states considering the issue had rejected admission. The Rogers court stated that this technique, when accompanied by aural examination and conducted by a qualified examiner, had now reached the level of general scientific acceptance by those who would be expected to be familiar with its use, and as such, has reached the level of scientific acceptance and reliability necessary for admission. [10]

The Indian Evidence Act, prior to its being amended by the Information Technology Act, 2000, mainly dealt with evidence, which was in oral or documentary form. Nothing was there to point out about the admissibility, nature and evidentiary value of a conversation or

statement recorded in an electro-magnetic device. Being confronted with the question of this nature and called upon to decide the same, the law courts in India as well as in England devised and developed principles so that such evidence must be received in law courts and acted upon. [10]

In India at Chandigarh Forensic Science laboratories voice identification techniques are regularly conducted and the Supreme Court has held that voice identification data is admissible in court. In India at Bangalore, SRC Institute of Speech and Hearing has the facility for voice analysis. The All India Institute of Speech and Hearing, Mysore, which has been working in the field for many years now, even wants to start a one-year PG Diploma course in forensic voice analysis. [10]

Conclusion:

The introduction of spectrographic identification in criminal proceedings raises significant evidentiary problems, primarily concerning the question of relevancy but its utility can't be neglected against the crime. However, acceptance of voiceprints has never obtained the acceptance that fingerprints have, and voiceprint analysis remains a controversial subject. The technique of voice identification by means of aural and spectrographic comparison is still an unsettled topic in law. Although the spectrographic voice identification method has progressed greatly since it was first introduced to a court of law back in the mid 1960's, it still faces stiff resistance on the issue of admissibility in the courts today.

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