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Voice Analysis on Mobile Phone's Voice Recorder Using Audio Forensic Method

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Abstract- This research provides an example scenario of applying digital forensic techniques for voice pain recognition. Greetings compare the sound in the evidence and the sound suspect on mobile phone media with a voice case study woman. In this study, PRAAT application was used to help with the audio comparison process from known samples and unknown samples. The results showed that there are no three F0's in the low, medium, and high tones of the word *"proyek"* from the same comparison speaker as the original speaker. Based on the F1-F4 analysis of the voice data with PRAAT, the difference between the original speaker's voice and the voice of the comparison speaker can be seen. No similarity was found between F1-F4 in the low, medium, and high-pitched voices of native speakers and comparison speakers. From these results, it can be seen that there are no F1-F4 vocal formants in the word *"terlibat"* from the same comparison speaker as the native speaker so that the difference becomes apparent.

Keywords: Audio forensic, PRAAT application, Voice.

I. INTRODUCTION

Development of multimedia technology is currently increasingly facilitating human activities in daily life, including how technology is able to store audio digitally. Digital audio storage is typically used for the need for interviews or education using which is commonly used for storage media is a sound recorder or use similar apps found on a cellphone. Voice recording is often used by someone to immortalize a conversation Directly or by telephone. In practice, voice recordings are used as evidence That can strengthen the law enforcement charges during the trial process. The ITE Law No. 19 of 2016 mentions that voice recordings are one of the pieces of evidence, as described in Article 1. It's just that sound recordings cannot be used as evidence without going through a fairly long analysis process, which is carried out by an expert in the field of audio forensics. AlAzhar Nuh, (2011) mentions in his book Audio Forensics: Theory and Analysis that sound recordings can be analyzed through the parameters of tone, formant, and spectrogram. This component can be used to identify the characteristics of a person's voice for speech recognition purposes by using the fragments of the analyzed voice recording. Digital forensic science is by definition a combination from the disciplines of law and computer science in collect and analyze data from computer systems, networks, wireless communications, and storage devices digital data for later use as evidence in problem-solving in the realm of law. (Binyamin Widi Prasetya, dkk, 2008)

Audio forensics is one of the sciences that juxtaposes science and scientific methods in the process of sound recording analysis to assist and support the disclosure of a crime required in the trial process. (Subki et al., 2018). The ITE Act No.19 of 2016 states that voice recording is one of the most valid digital instruments and can be used as an indictment. Voice recordings that are digital evidence are straightforward and prone to be manipulated, either intentionally or unintentionally.

The field is known as "forensic linguistics" has been growing in prominence in the past couple of decades. Forensic linguistics is all about taking linguistic insight, method, and knowledge in the context of law, judicial procedures, police investigations, trials, and in short, about studying the language of law and solving crimes. Olsson (2004) defines it as an application of linguistics in the context of crime, court proceedings, or arguments in law. Coulthard and Johnson (2010) mention that forensic linguistics ranges from courtroom discourse and legal language to plagiarism. Briefly, plagiarism is using another person's work for personal advantage without mentioning his/her name. Forensic linguistic experts proficient in plagiarism cases and copyright infringements provide evidence to find out which work is based upon another.

In its application, digital forensic science is often helpful to authorities in uncovering related crime cases the suspect is concerned about through the evidence that has been collected. The science of sound forensics focuses on efforts to analyze of suitability or originality of sound content material with the original content for later testing reliability and validity (Detik.com, 2011). With the increasing development of technology, more and more use increasing. One of which is the discovery of several cases of legal irregularities accompanied by evidence in the form of sound recording media. Case this indicates a possibility ahead of audio digital will be used more as evidence in legal cases. Legal considerations in using evidence in the form of digital files, including audio, are the ability of digital evidence to manage the impact associated with risk on the process law. One of the risks in question is using witnesses who have not known with certainty the truth, even though he has sworn to speak the truth. Using digital evidence that has been tested and analyzed will support the discipline of action and accuracy of guesses and help inaccuracy Decision-making. For that, the parties relevant law enforcement agencies need to understand and master digital forensic techniques considering the increasing use of sound recordings/good multimedia In terms of variety, quantity, and quality. One of the digital forensic techniques is Voice Recognition, namely digital forensic techniques for detecting records Voice. People who have conversations can identify through audio forensic examination for speech recognition by comparison method, namely, comparing the voices in the recorded evidence (unknown sample) with sound recorded as Comparison (known sample). Suppose the voice recognition result indicates that the sound of the unknown sample is identical to the known sample voice. In that case, the Voice in the conversation in the recording Evidence can be obtained from the owner of the vote Comparison. (Septiyansyah, 2015).

Aligarh (2016) was researched to create the environment as natural as possible, conditions retrieval, and results of the forensic method used. In this study, forensic testing of sound evidence is carried out using pitch, formant, and spectrogram values, then

comparing the sound of the evidence (unknown samples) with recorded sound as a comparison (known samples).

This study aims to provide an example scenario of applying digital forensic techniques for voice pain recognition. Greetings compare the sound in the evidence and the sound suspect on mobile phone media with a voice case study woman. So it is hoped that the output of this research can become a reference or enrichment material for law enforcement agencies, law, and academics who wish to continue their research related to digital forensics. In this study, PRAAT application was used to help with the audio comparison process from Known Samples and Unknown Samples. PRAAT is a computer program used to sound analysis, synthesis, and manipulation. This app was developed in 1992 by Paul Boersma and David Weenink at the University's Institute of Phoenix Sciences Amsterdam. Several versions are released with customization for some common operating systems used: Mac, Windows, and Linux. Since 2001, it has been 5000 registered users in 99 countries have been using PRAAT. Septiyansyah (2015) stated that the PRAAT application could record sound from a microphone or other audio devices. Besides that, this application can also read sound from an input file or disk. Using PRAAT, the user can see into the audio. This research uses the Forensic audio method. Based on the background above, the formulation of the problem in this research is What are the results of each sample of digital evidence of native speakers' voices and recorded comparisons on the two assessment factors, namely pitch and formant, the researcher can distinguish between the original speaker's voice and the comparison voice?

II. METHODS

In the method, this research uses the forensic audio method. In Audio forensics: Theory and Analysis, namely Pitch Statistical Analysis, Forman and Bandwidth Statistical Analysis, Graphical Distribution Analysis, and Spectrogram Analysis. However, in this study, researcher only focus on identifying pitch and formants in the data to be analyzed. This research uses software, such as PRAAT application and Microsoft excel. This app PRAAT is used to search for information from comparing native speakers' voices and recorded comparison voices. Microsoft Excel to measure each word spoken original and comparison the formant pitch of each word spoken.

III. RESULT

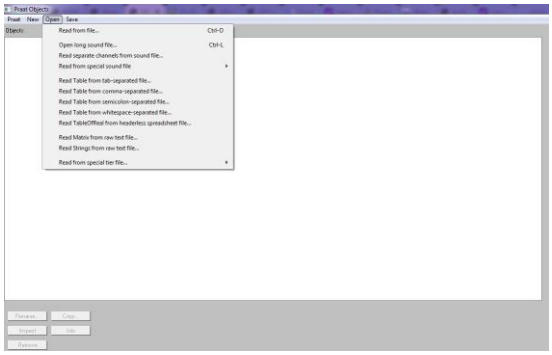
3.1 Process with Praat

This process is the core process of this research. With the Praat application, you can find out the pitch, formant and spectrogram of each sound recording. The following is the implementation of the pitch, formant and spectrogram:

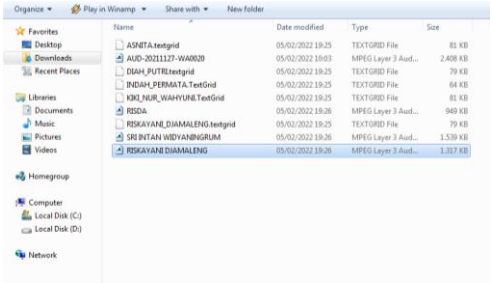
3.1.1 Pitch

Pitch analysis can be used to perform voice recognition on a person's voice, that is, through statistical analysis of minimum pitch, maximum pitch, and average pitch. Pitch is the frequency vibrating vocal cords (Jose R.L Batubara, 2010). One of the parameters of the sound signal is the frequency fundamentals. Fundamental frequency in terms of musical instrument known as pitch or frequency value of a tone type. The faster the vibration of the vocal cords, the higher the pitch, and vice versa.

Each person has a distinctive pitch (habitual pitch) strongly influenced by physiological aspects of the human larynx. In normal conversation conditions, habitual pitch levels range from 50-250 Hz for men and 120-500 Hz for women (M. Nuh AL-Azhar, 2012). To analyze the pitch on the praat, the first thing to do is import sound files that have been noise filtered into the praat app. Open the Praat application, select the Open menu, select Read from a file, and select the sound recording file you want to download analysis.



Pitch Analysis Steps (1)

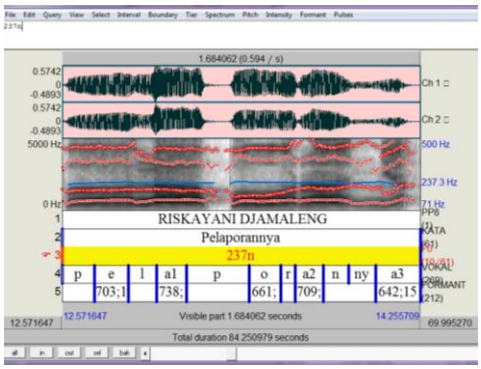


Pitch Analysis Steps (2)

After that select *view and edit*. Then a window like the one below will appear.

View and edit menu window

Because the analysis carried out is the word for word, which includes the vowels of the recorded sound, then listen carefully to the words you want to analyze, then do the blocks on the graph.

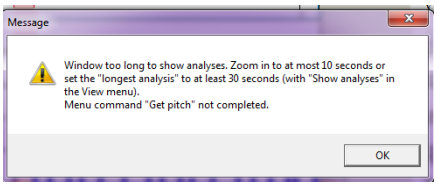


To get the right block, click the enter button in the left corner to zoom in. here is a brief explanation button located in the left corner.

Zoom Button

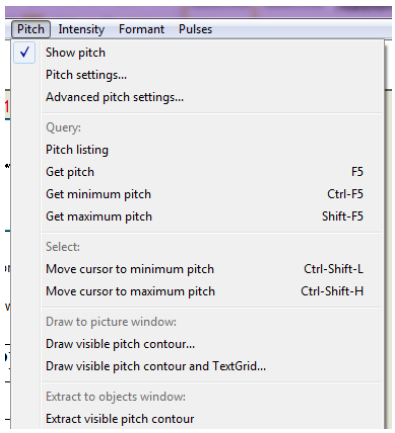
All	All selection (to see the whole chart)
in	Zoom in (to enlarge the graphic view)
out	Zoom Out (to zoom out the graphic)
sel	Selection (to view block graphs only)
back	Back (back to the previous initial view)

After the one-word graphic block, click File – Save the selected sound as a WAV file. In other words, that way, cut or partition each word on each record. If a record contains 30 words, there will be 30 save files as wav. After snipping each word, open the saved file snippet of the word to know its pitch value. Do not forget to turn on the pitch to see pitch value by checking the Show pitch option. The method to find out if the option is checked is to click the pitch menu tab. If you have not already checked, click Show pitch. Because if not enabled or check show pitch on the menu tab Pitch, then the pitch value will not come out.



Pitch Value Warning Window

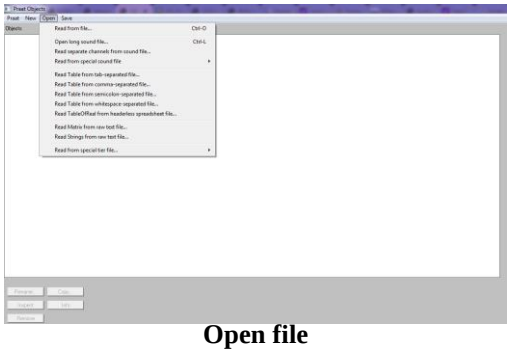
To view the minimum, maximum and mean, select the menu tab Pitch.



Menu minimum, maximum and mean pitch

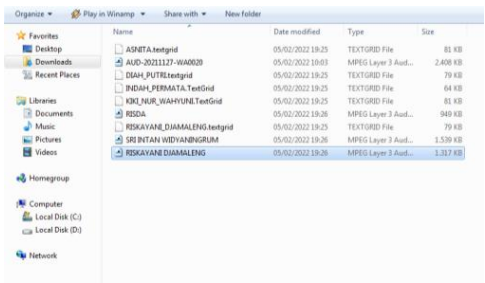
3.1.2 Formant

To analyze formant, open praat app, import file audio that has been per-worded by clicking the open menu and select read from file

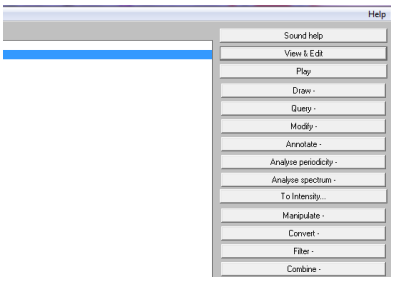


Open file

So a dialog box will appear to select a file as following:

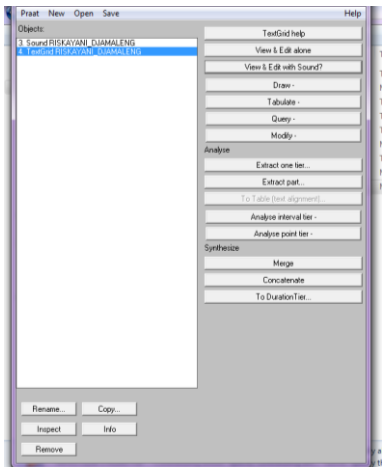


After selecting a file, the file will be listed in the left field but still in audio/sound format. Meanwhile, the required data must be in informant format to process formants. To change it, click on the right menu of Analyze Spectrum and select formant.



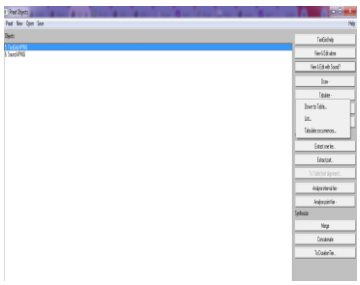
Pre-Praat Window

After that, the file will change its format, as shown In the following image. After the file changes the format, what is done is to find the value of the formant numerically in the form Month so that it can be compared statistically later.

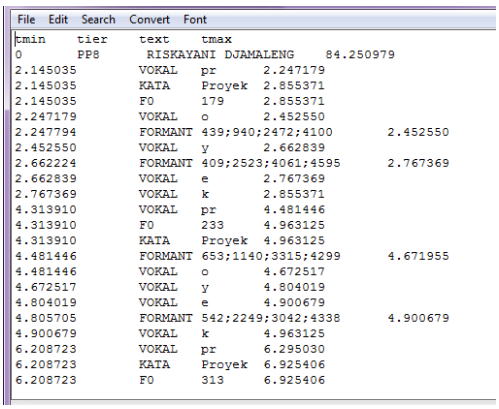


Output Forman

To find the value, click on the file that has been formant, then on the right menu, select tabulate – list.

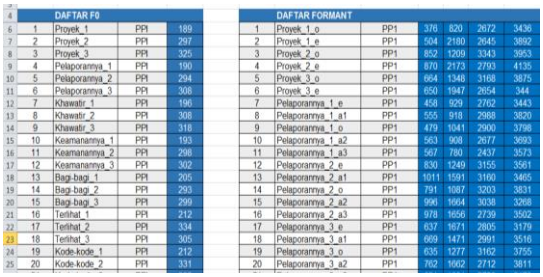


Selecting Tabulate-List Menu



Forman Values in Numeric

Copy and paste the results into Microsoft Excel, so that the tabular formant results can be processed in Microsoft Excel as shown below:

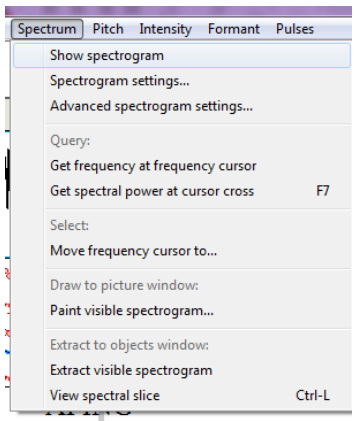


Ms. Excel

After all the data is summarized, the next step is to compare which suspect voices have a formant value close to that of a native speaker.

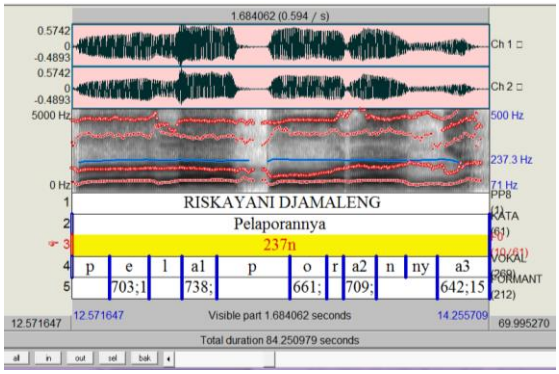
3.1.3 Spectogram

Open the praat application, then open the file you want to view the spectrogram (file that has been partitioned word by word from the original recording). Select the View & Edit menu, select the tab menu Spectrum and make sure the Show spectrogram option is checked.



Selecting the Show Spectogram Menu

Then a window will appear as below:



Then screenshot the spectrogram section to compare with the Spectrogram of the evidence manuscript. With the way, after opening the sound file, select Analyze Spectrum, then select To Spectrogram. Then click views. Perform this process on all evidence files with suspect voice. Then compare which suspect voices have a Formant value close to that of a native speaker.

Sample data:

Based on the F0 analysis of the voice data with PRAAT, the difference between the original speaker's voice and the voice of the comparison speaker can be seen. There is no similarity F0 in the low, medium, and high pitch voices of native speakers with comparison speakers. The results of the analysis are as follows:

The word "proyek" sounds low, medium, high

F0 native speaker: 256; 323; 378
F0 Comparative speakers 1: 189; 297; 325
F0 Comparator 2: 220; 259; 270
F0 Comparative speaker 3: 239; 277; 329
F0 Comparative speaker 4: 213; 248; 335
F0 Comparative speaker 5: 277; 292; 357
F0 Comparative speaker 6: 257; 304; 362
F0 Comparative speaker 7: 177; 249; 255
F0 Comparative speakers 8: 179; 233; 313
F0 Comparative speaker 9: 243; 305; 257
F0 Comparator speaker10: 275; 342; 381

From these results, it can be seen that there are no three F0's in the low, medium, and high tones of the word *"proyek"* from the same comparison speaker as the original speaker. Based on the F1-F4 analysis of the voice data with PRAAT, the difference between the original speaker's voice and the voice of the comparison speaker can be seen. No similarity was found between F1-F4 in the low, medium, and high pitched voices of native speakers and comparison speakers. The results of the analysis are as follows:

F1-F4 word "Terlibat" Native speaker

Terlibat_1_e	819	1937	3094	4318
Terlibat_1_i	338	2925	3415	4725
Terlibat_1_a	867	1683	3155	3901
Terlibat_2_e	938	1684	3043	4274
Terlibat_2_i	548	2592	3386	4625
Terlibat_2_a	1049	1692	3287	4222
Terlibat_3_e	851	1766	3024	4053
Terlibat_3_i	580	2361	2971	3759
Terlibat_3_a	900	1977	3363	3505

From these results, it can be seen that there are no F1-F4 vocal formants in the word "terlibat" from the same comparison speaker as the native speaker so that the difference becomes apparent.

IV. CONCLUSION

The results showed that very clear results could be seen in words spoken with high intonation. In contrast, in words with low and medium intonation, the results of pitch analysis do not show significant differences. Based on the F0 analysis of the voice data with PRAAT, the difference between the original speaker's voice and the voice of the comparison speaker can be seen. There is no similarity F0 in the low, medium, and high pitch voices of native speakers with comparison speakers. From these results, it can be seen that there are no three F0's in the low, medium, and high tones of the word *"proyek"* from the same comparison speaker as the original speaker. Based on the F1-F4 analysis of the voice data with PRAAT, the difference between the original speaker's voice and the voice of the comparison speaker can be seen. No similarity was found between F1-F4 in the low, medium, and high-pitched voices of native speakers and comparison speakers. From these results, it can be seen that there are no F1-F4 vocal formants in the word *"terlibat"* from the same comparison speaker as the native speaker so that the difference becomes apparent.

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