PBL2: FINAL REVIEW:

DETECTING THE EXTENT OF HYPERTENSION THROUGH VOICE

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INTRODUCTION

Hypertension is one of the most pressing medical problems in existence because it cannot be truly cured. There are more than 700 million hypertension cases in existence. It can only be controlled by medication. Thus, the quick and early detection of Hypertension is of utmost significance.

The project is based on speech analysis technology, machine learning, and deep learning algorithms and its applications. The project code has tested and trained the data according to the ranges of the features to detect the extent of hypertension. So, if we input an audio clip, using the project model we can detect if the person is hyper tensed or not.

RELEVANCE OF OUR PROJECT

The motivation behind our project is to get useful information from the voice samples we collect from a variety of sources and make use of different Python libraries and machine learning techniques to analyze the collected data and detect(with some accuracy) if a particular individual might have Hypertension.

REVIEW OF LITERATURE

- Saloni, & Sharma, Rajinder & Gupta, Anil. et.al [1] have defined a methodology which uses voice parameters for the detection of Hypertension. Since voice has a lot of different characteristics, they use different feature extraction techniques to extract those characteristics and then apply different ML algorithms such as K-means clustering, ANN, etc. to predict which samples have hypertension. They also visually demonstrate the difference between the parameters of a normal person and a hypertension patient, with the help of graphs and probability density distribution.

- Despotovic V, Ismael M, Cornil M, Call RM, Fagherazzi G, et.al [2] analyze not only the voice parameters but the cough and breathing patterns as well, so naturally there are more variables in play and that helps in a thorough analysis and prediction of Hypertension as well.

continued...

- Jiang, Nan & Liu, Ting. et.al [3] provides a way for improved speech segmentation and clustering using K means which really helps our project as we also make use of the same algorithm.

- Lenain, Raphael & Weston, Jack & Shivkumar, Abhishek & Fristed, Emil. et.al [4] gives us knowledge about the python library “Surfboard” which has in-built voice parameter analysis and is perfectly suited for our project.

- ankışhan, Haydar. et.al [5] in their study describe that speech recordings and blood pressure are closely related values. The feature vector indicates that high blood pressure symptoms can be tracked by the vowels of an individual. They make use of algorithms such as Multiple Linear Regression which helps us immensely in our project.

RESEARCH GAPS

- In a research paper titled, “ Classification of high blood pressure vs normal blood pressure using voice analysis”[1]; they classify the dataset into healthy person and hypertension patients and then use EDA and ML algorithms to extract features from the audio files and then compare the results and visualise them; thereby classifying the difference between normal vs high blood pressure.

- There is a research “Detection of COVID-19 from voice, cough and breathing patterns: Dataset and preliminary results”[2] where they have predicted if a patient is infected with COVID-19 through their voice.

OUR APPROACH

is slightly brief and unique. Instead of elongating the data wrangling process and using mathematical jargon in modelling process, we will be using the "surfboard" & "librosa" library available in python language to directly extract the audio features (feature extraction) required for classification.

Through those values, our model is trained-tested to detect hypertension patients with some accuracy. This way, we would not require to go the extra step to extract the value range from the audio features.

Further we have tried to quantify the extent of hypertension, through some function on the scale of 1-10.

PROBLEM STATEMENT / SCOPE

Purpose: This project primarily focuses on predicting and scaling the extent of hypertension in a person through his voice so that he can take preventive measures.

Segmentation:

- gender- men, since men are more prone to hypertension than women
- age group- 25 to 40 years of age

Through this project, we aim to help those with high blood pressure to avoid serious conditions such as heart failures.

OBJECTIVES

- Training and testing the model from a set of voice samples of the user itself, which in our project are the voices taken from characters from Netflix and Youtube series.

- Extracting the features which helps in spotting hypertension like jitter, shimmer, HNR etc. from the voices.

- Detecting if the user has hypertension or not.

- Quantifying the level of hypertension from which the user is suffering.

METHODS, TOOLS & TECHNIQUES:

- Programming Language: Python 3
- IDE: Jupytor Notebook
- Python Libraries: Librosa, Surfboard, IPython, Numpy, Pandas etc.
- Datasets: taken from youtube, netflix.

DESCRIPTION OF DATA

- 5 male characters aged from 25 to 40.
- length 7-15 seconds
- total 50 audios, to of each character
- 60% data is positive to hypertension
- converted into .wav and then combined to create a csv file

MODELS:

- Logistic regression is a process of modeling the probability of a discrete outcome given an input variable. The most common logistic regression models a binary outcome; something that can take two values such as true/false, yes/no, and so on.

- Support Vector Machine or SVM is one of the most popular Supervised Learning algorithms, which is used for Classification as well as Regression problems. The goal of the SVM algorithm is to create the best line or decision boundary that can segregate n-dimensional space into classes so that we can easily put the new data point in the correct category in the future.

RESULTS

Model 1: SVM Classifier

Accuracy = 70%

In [11]:

```
from sklearn.utils import shuffle
X,Y = shuffle(X,Y, random_state=20)
```

In [12]:

```
from sklearn.model_selection import train_test_split
```

In [25]:

```
X_train, X_test, Y_train, Y_test= train_test_split(X,Y,test_size=0.2)
```

In [26]:

```
from sklearn.svm import SVC

model= SVC(kernel='linear')
```

In [27]:

```
model.fit(X_train,Y_train)
```

Out[27]:

```
SVC(kernel='linear')
```

In [28]:

```
model.score(X_test,Y_test)
```

Out[28]:

```
0.7
```

RESULTS

Model 2:
Logistic Regression

In [29]:

```
from sklearn.linear_model import LogisticRegression
model1 = LogisticRegression(random_state=0).fit(X_train,Y_train)
```

In [30]:

```
model1.score(X_test,Y_test)
```

Out[30]:

```
0.7
```

Accuracy = 70%

We used two models here:

1. Support Vector Machine (SVM)
2. Logistic Regression

The models were trained and tested with the dataset with a train_size= 80%

Both the models gave an accuracy of 70%.

PREDICTIONS

[0] : no hypertension

[1] : hypertension

EXTENT OF HYPERTENSION

on the scale of 1-10

Both predictions gave [1] which means the character is suffering from hypertension which is correct. The extent was calculated to be 2 out of 10.

In [33]:

```
path2="/Users/somaaymaheshwari/Desktop/PBL-2/bojack.wav"
sound2= Waveform(path2,sample_rate=44100)
name= "bojack"
j= sound2.jitters()["localJitter"]
s= sound2.shimmers()["localShimmer"]
hnr= sound2.hnr()
d=[[name,j,s,hnr]]
N=pd.DataFrame(d,columns= ["Name","Jitter","Shimmer","HNR"])
Nin= N.drop(['Name'],axis="columns")
```

In [34]:

```
model.predict(Nin)
```

Out[34]:

```
array([1])
```

In [35]:

```
model1.predict(Nin)
```

Out[35]:

```
array([1])
```

In [45]:

```
print("The extent of hypertension: " + str(pt//10))
```

```
The extent of hypertension: 2.0
```

CONCLUSION

In this system the extent of Hypertension is detected by extracting features from audio clips. Major components of the proposed system are: extracting features from voice, detecting whether the person is suffering from hypertension or not, and further quantifying the extent of it on the scale of 1-10. This project is based on various python libraries and machine learning algorithms.

This project successfully demonstrates how voice features like jitter, shimmer, HNR, etc can be used to predict whether a person is hypertensed or not with the accuracy of around 70%.

FUTURE SCOPE

Using the results and learning of this project we can say that voice plays an important role in determining any disease in a person based on its features. These observations can be used in future and the efficiency of this project can be increased.

As a future study, we will develop a mobile app or web application in which users can provide their medical details and their voice data will be fed. The functionalities will be such that it will record the voice of the user and determine if their BP is shooting high and will inform the user through notifications and other family or friends in extreme cases. This will help them prevent any kind of emergencies as the phrase says, ‘Prevention is better than cure’.

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[1] Saloni, & Sharma, Rajinder & Gupta, Anil. (2013). Classification of High Blood Pressure Persons Vs Normal Blood Pressure Persons Using Voice Analysis. International Journal of Image, Graphics and Signal Processing. 6. 10.5815/ijigsp.2014.01.07.

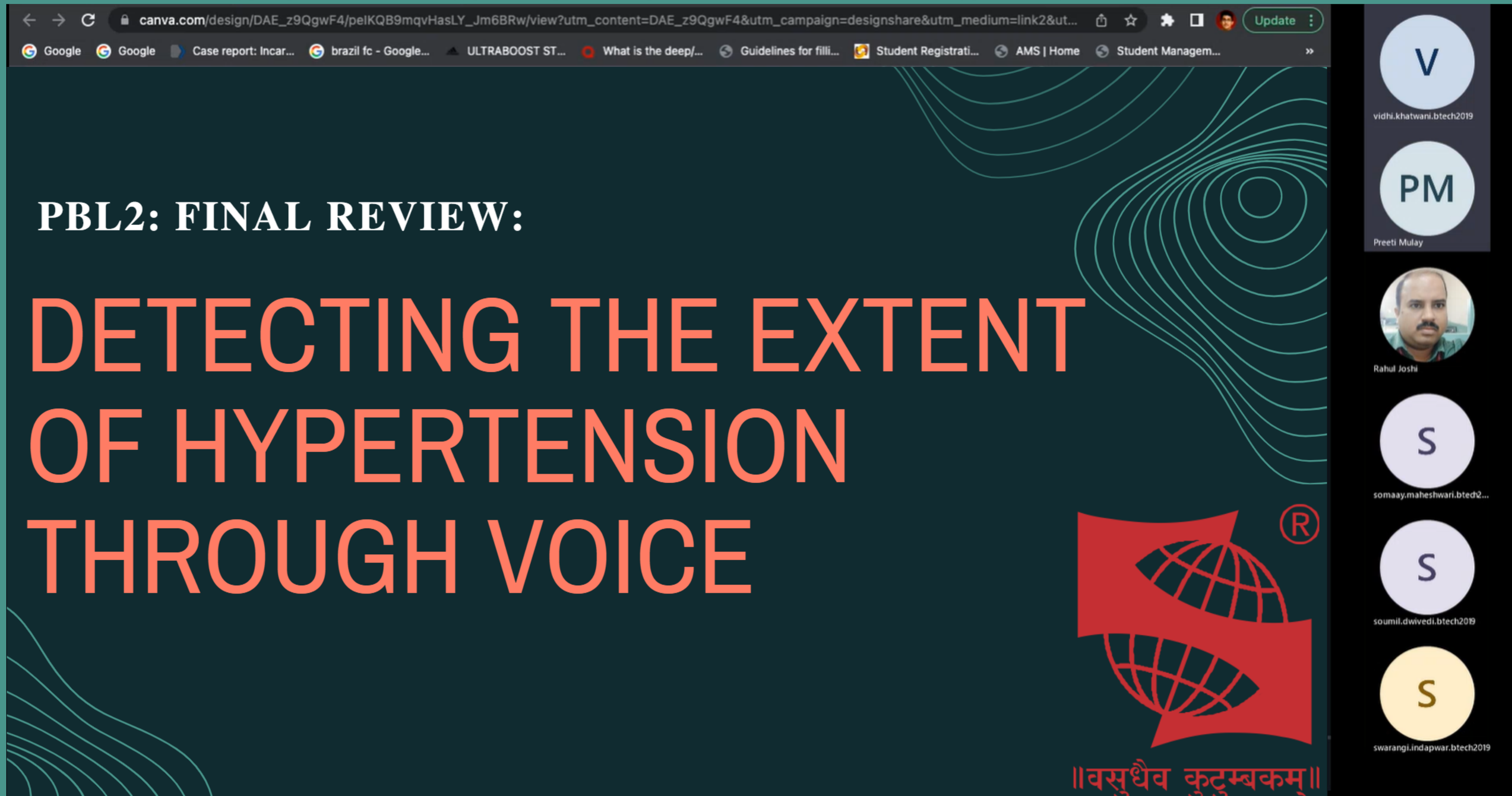
[2] Despotovic V, Ismael M, Cornil M, Call RM, Fagherazzi G. Detection of COVID-19 from voice, cough and breathing patterns: Dataset and preliminary results. Comput Biol Med. 2021;138:104944. doi:10.1016/j.compbiomed.2021.104944

[3] Jiang, Nan & Liu, Ting. (2020). An Improved Speech Segmentation and Clustering Algorithm Based on SOM and K -Means. Mathematical Problems in Engineering. 2020. 1-19. 10.1155/2020/3608286.

[4] Lenain, Raphael & Weston, Jack & Shivkumar, Abhishek & Fristed, Emil. (2020). Surfboard: Audio Feature Extraction for Modern Machine Learning.

[5] ankışhan, Haydar. (2020). Blood pressure prediction from speech recordings. Biomedical Signal Processing and Control. 58. 101842. 10.1016/j.bspc.2019.101842.

SCREENSHOT OF THE PRESENTATION



THANK YOU

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