Signal processing

ERG

Group 17

Farida Mohammed : 24230035

Neama Refaat Hamed : 24230055

Table of Contents

01
Data Description

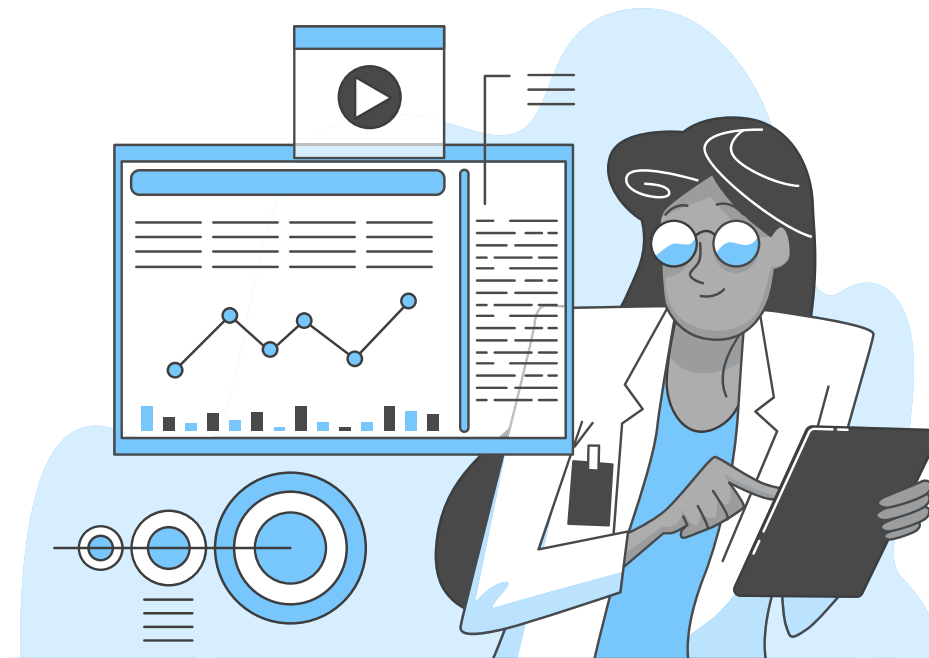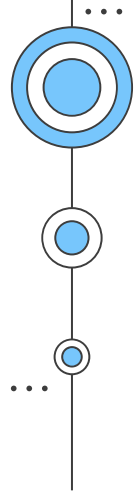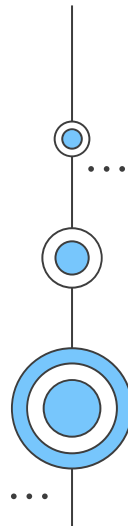# Patient's data

The data was gathered from both adults and pediatrics

Protocol	N. Adults	N. Pediatrics
Scotopic 2.0 ERG Response	23	53
Maximum 2.0 ERG Response	42	80
Photopic 2.0 ERG Response	32	74

The data consists of :

- The patient's age
- The Diagnosis
- The graph representing the response
- The potential difference after each half millisecond
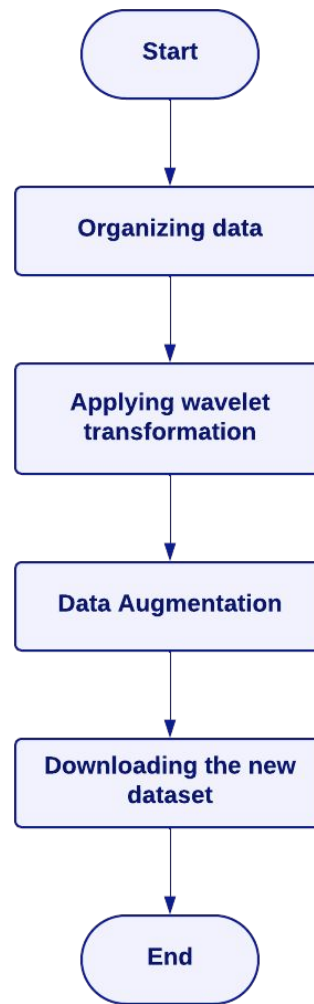
...

02

Roadmap

Preprocessing roadmap

Start

↓

Organizing data

↓

Applying wavelet transformation

↓

Data Augmentation

↓

Downloading the new dataset

↓

End

processing roadmap

03
Data Preprocessing

MR before organizing

						Maximum...
Quantity	80 children, 42 adults					
Type	Maximum 2.0 ERG Response	Maximum 2.0 ERG Response	Maximum 2.0 ERG Response	Maximum 2.0 ERG Response	Maximum 2.0 ERG Response	Maximum 2.0 ERG Resp
#	368	360	360	363	363	
Diagnosis	The functional ac	The functional ac	The functional ac	The functional ac	The functional ac	The funct
Age	9.50	15.83	15.83	16.55	16.55	
	1 - 18	- children	18+	- adults		
a-wave amplitude, ьV	41.40446617	36.36334441	39.29430409	41.7362935	43.85744978	44.45
b-wave amplitude, ьV	52.30848728	60.34751823	74.18806126	55.66441905	59.13828863	41.1
a-wave latency, ms	21	21.5	21	20.5	21	
b-wave latency, ms	43.5	45	45	42.5	43	
a-wave amplitude, ьV	28.63	60.29	- healthy children		41.61	50.0
b-wave amplitude, ьV	55.69	83.19	- healthy children		89.68	104.
a-wave latency, ms	13.29	28.71	- healthy children		16.86	17.4
b-wave latency, ms	39.08	56.92	- healthy children		37.94	39.5
Graph						
Time, ms	Signal, ьV	Signal, ьV	Signal, ьV	Signal, ьV	Signal, ьV	Signal, ьV
0	-3.335315569	-2.701023959	-4.064932455	7.181184174	1.120552042	25.42

MR before organizing

	Unnamed: 0	Unnamed: 1	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unnamed: 7	Unnamed: 8	Unnamed: 9	...
0	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...
1	Quantity	80 children, 42 adults	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...
2	Type	Maximum 2.0 ERG Response	Maximum 2.0 ERG Response	Maximum 2.0 ERG Response	Maximum 2.0 ERG Response	Maximum 2.0 ERG Response	Maximum 2.0 ERG Response	Maximum 2.0 ERG Response	Maximum 2.0 ERG Response	Maximum 2.0 ERG Response	...
3	#	368	360	360	363	363	368	372	372	373	...
4	Diagnosis	The functional activity of the retina in both ...	The functional activity of the retina in both ...	The functional activity of the retina in both ...	The functional activity of the retina in both ...	The functional activity of the retina in both ...	The functional activity of the retina in both ...	Hereditary rod dystrophy of the retina is not ...	Hereditary rod dystrophy of the retina is not ...	The functional activity of the central parts o...	...
...	...	...	...	...	...	...	...	...	...	...	...
518	248	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...
519	248.5	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...
520	249	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...
521	249.5	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...
522	250	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...

The data frames were modified through:

- Removing null values

- Taking the important data only

- Mapping the diagnosis into normal and abnormal

Data after organizing

|	Patient_id	Label	signal_type	img_Path
0	368	normal	MR	/kaggle/working/signals_MR/MR_1.png
1	360	normal	MR	/kaggle/working/signals_MR/MR_2.png
2	360	normal	MR	/kaggle/working/signals_MR/MR_3.png
3	363	normal	MR	/kaggle/working/signals_MR/MR_4.png
4	363	normal	MR	/kaggle/working/signals_MR/MR_5.png
...	...	...	...	...
267	362	normal	SR	/kaggle/working/signals_SR/SR_68.png
268	362	normal	SR	/kaggle/working/signals_SR/SR_69.png
269	365	abnormal	SR	/kaggle/working/signals_SR/SR_70.png
270	365	abnormal	SR	/kaggle/working/signals_SR/SR_71.png
271	366	abnormal	SR	/kaggle/working/signals_SR/SR_72.png

To get the signal:

- Plot the gathered data

- Convert the signals to images

- Apply Ricker wavelet transformation
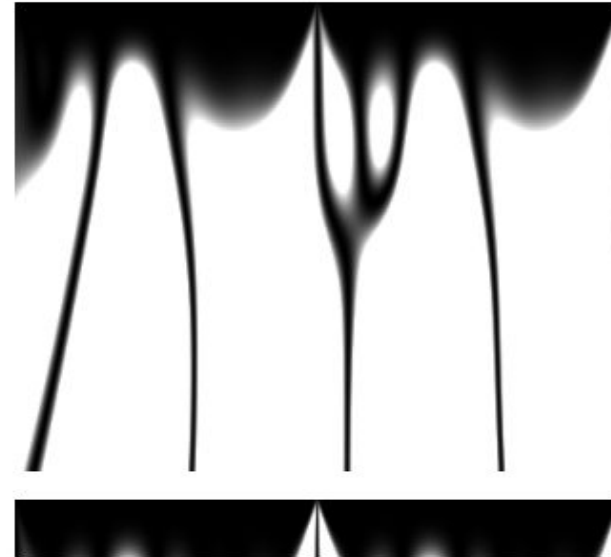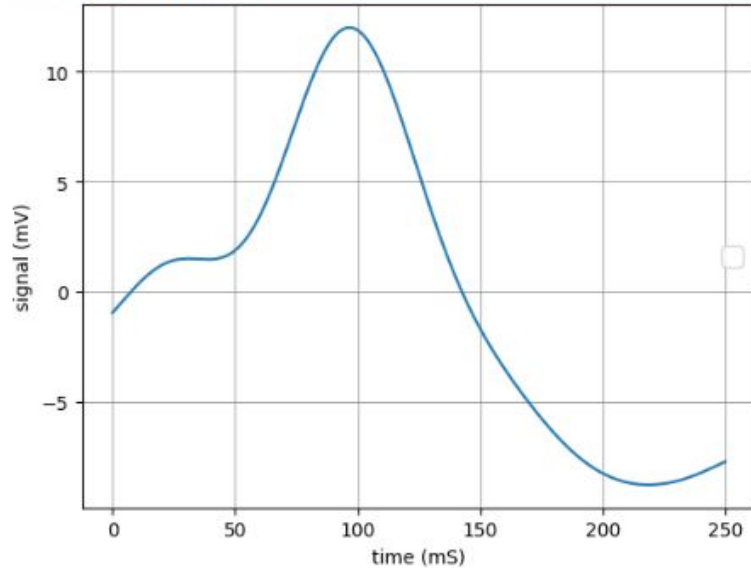
Repetition and data augmentation:

- Repeated some of the signals

- Applied 5 methods for data augmentation

- Results: **1380 normal** and **1284 abnormal** images
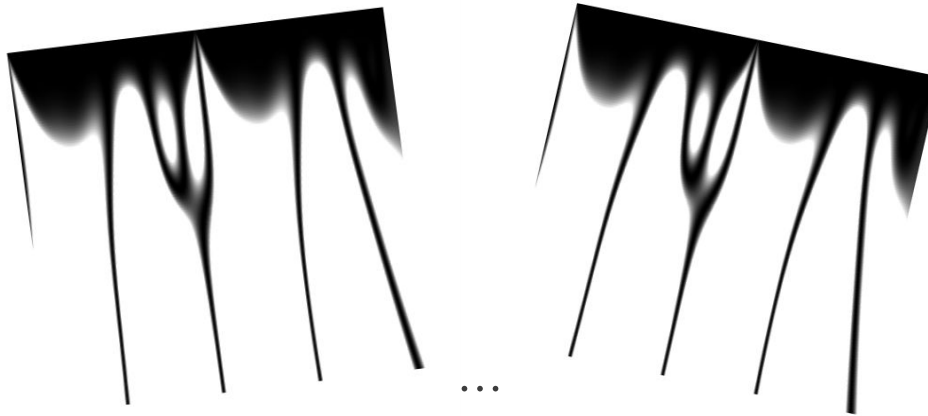
Final dataframe

	img_Path	Label	img_id
0	/kaggle/working/augmented_images//MR_1_0_f_rot...	0	MR_1_0_f_rotated
1	/kaggle/working/augmented_images//MR_1_0_f_she...	0	MR_1_0_f_sheered
2	/kaggle/working/augmented_images//MR_1_0_f_zoo...	0	MR_1_0_f_zoomed
3	/kaggle/working/augmented_images//MR_1_0_f_hor...	0	MR_1_0_f_horizontal_flipped
4	/kaggle/working/augmented_images//MR_1_0_f_bri...	0	MR_1_0_f_brightness_changed
...	...	...	...
2683	/kaggle/working/signals/SR_66_1_f.png	0	SR_66_1_f
2684	/kaggle/working/signals/SR_68_1_f.png	0	SR_68_1_f
2685	/kaggle/working/signals/SR_69_1_f.png	0	SR_69_1_f
2686	/kaggle/working/signals/SR_72_1_f.png	1	SR_72_1_f
2687	/kaggle/working/signals/SR_73_1_f.png	1	SR_73_1_f

04

Data processing

Preparing data:

- Uploading the dataset
- Initializing the hyperparameters
    - ⇒ image height & width, Batch size and n. Epochs
- Modifying the image paths
- Dividing data into train, test and validate datasets

train_df_aug

Label	Count
normal	1104
abnormal	1027

valid_df_aug

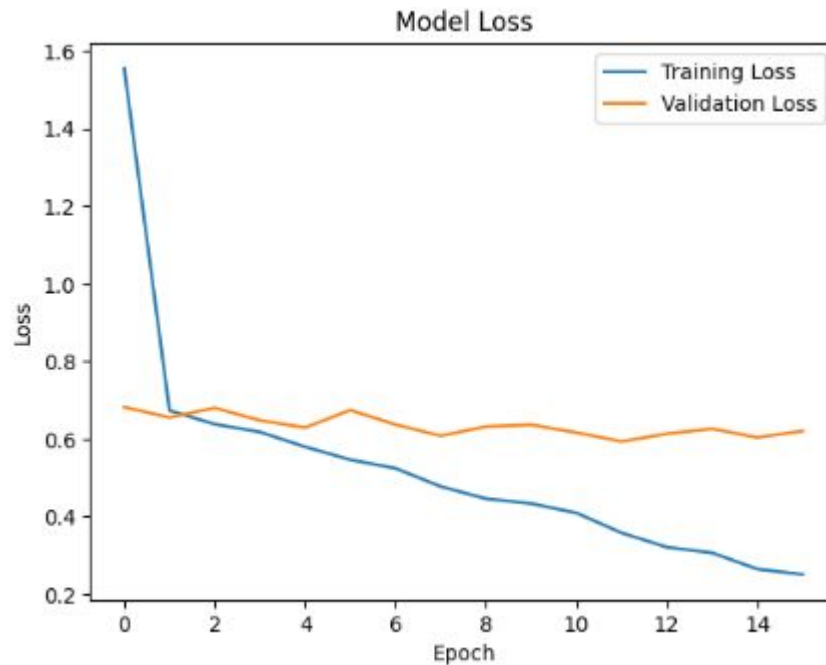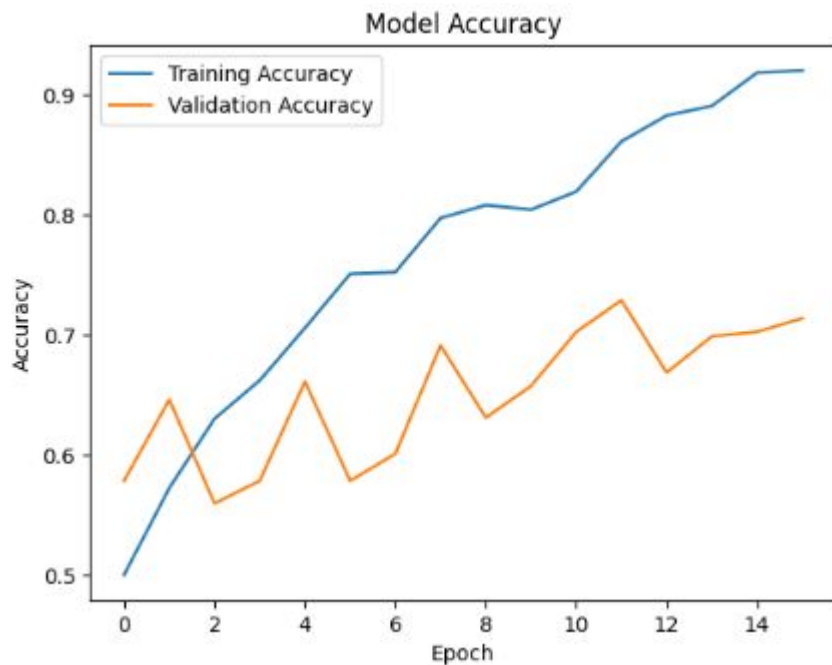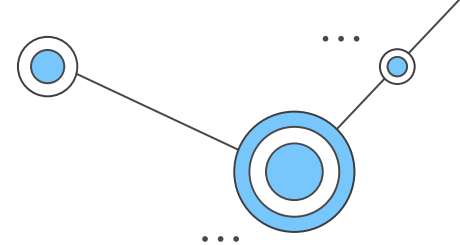| Label	Count
normal	138
abnormal	128

test_df_aug

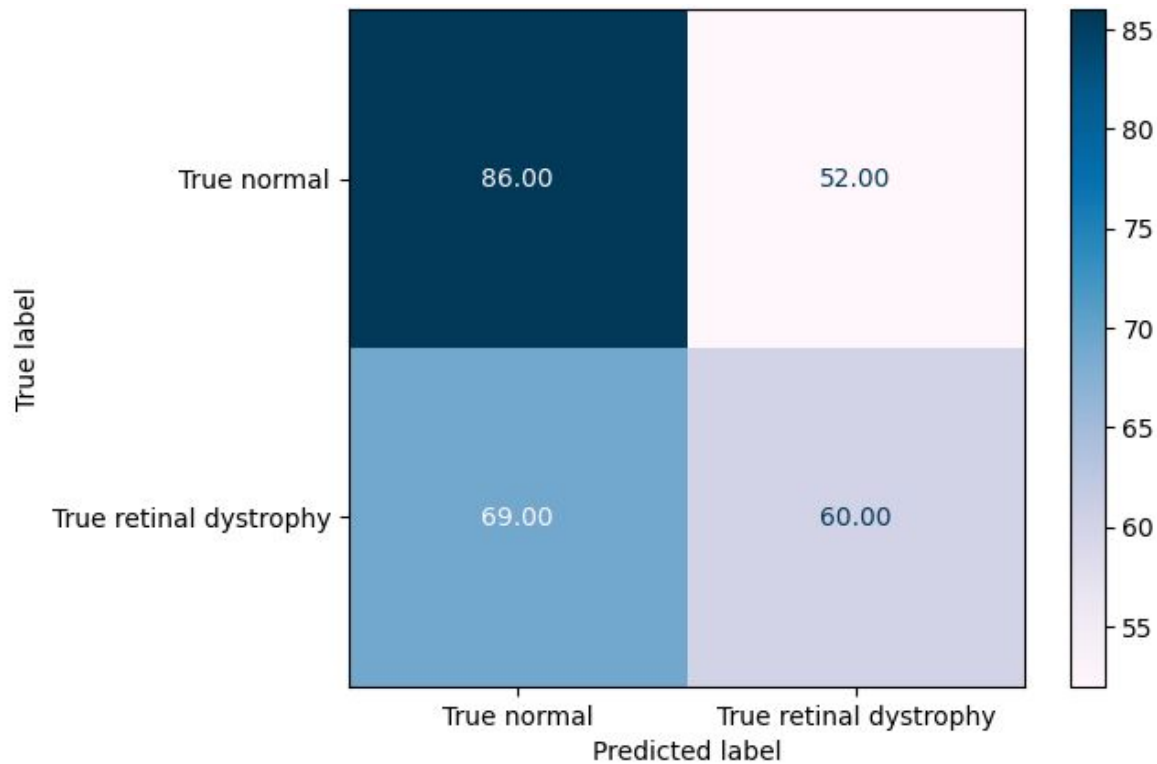| Label	Count
normal	138
abnormal	129

Applying VGG16

- We modified the input layer so that we can specify the inputs

- For the outputs, we applied the sigmoid function to get binary results

...

Results of VGG16

Confusion matrix

Report

	precision	recall	f1-score	support
normal	0.55	0.62	0.59	138
retinal dystrophy	0.54	0.47	0.50	129
accuracy			0.55	267
macro avg	0.55	0.54	0.54	267
weighted avg	0.55	0.55	0.54	267

ROC curve

Receiver Operating Characteristic (ROC) Curve

ROC curve (area = 0.54)