BİOMEDİCAL SİGNAL ANALYSİS AND ARTİFİCAL LEARNİNG

#ASSİGNMENET 2# 02-PPG dataset key point marking

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1.Importing Libraries:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from scipy.signal import find_peaks, filtfilt, butter
```

2.Reading CSV File:

df = pd.read_csv(r"C:\Users\Admin\Desktop\yedinci dönem\biyomedikal sinyal analizi\mimic_perform_af_csv\mimic_perform_af_016_data.csv")

3. Defining Parameters:

```
ppg_signal = df["PPG"].to_numpy()
time = df["Time"].to_numpy()

fs = 125
window_size = fs *5
start_index = 0
end_index = start_index + window_size
```

4.While Loop for Windowed Analysis:

```
while end_index < len(ppg_signal):
```

5.Peak Detection:

```
  pwe, _ = find_peaks(-window_ppg, distance=60)

  pwsp, _ = find_peaks(window_ppg, distance=fs/2)
```

6.PWDP Detection:

```
  pwdp=[]
  s_points = []
  for r in pwsp:
      right_segment = window_ppg[r:]
      PWDP, _ = find_peaks(right_segment, width=5)
      if PWDP.size > 0:
          if PWDP[0] < r + 1:
              pwdp.append(PWDP[0] + r)
          else:
              continue

      s, _ = find_peaks(-right_segment, distance=3
                        )
      if s.size > 0:
          s_points.append(s[0] + r)
```

7.Time and Duration Calculations:

```
#times
pwd = np.diff(window_time[pwe])
min_length = min(len(pwe), len(peaks))

systolic_phase = np.diff(window_time[pwe[:min_length]]- window_time[peaks[:min_length]])
diastolic_phase = np.diff(-(window_time[pwe]-window_time[pwe[:min_length]] - window_time[peaks[:min_length]

min_length = min(len(pwdp), len(pwsp))
ppt = abs(np.diff(window_time[pwsp[:min_length]] - window_time[pwdp[:min_length]]))
```

8.Amplitude Extraction:

```
#amplitudes
pwa_values = window_ppg[pwe]
dicrotic_notch_values = window_ppg[pwdp] if len(pwdp) > 0 else None
pwsp_values = window_ppg[pwsp]
pwdp_values = window_ppg[pwdp] if len(pwdp) > 0 else None
```

9.Features calculate Heart Rate:

```
#Features heart rate
heart_rate = 60 / np.mean(pwd)
```

10.Print Results:

```
print(f"PWD: {pwd}")
print(f"Systolic Phase Duration: {systolic_phase}")
print(f"Diastolic Phase Duration: {diastolic_phase}")
print(f"PPT : {ppt}")

print(f"Pulse Wave Amplitude (PWA): {pwa_values}")
print(f"Dicrotic Notch Amplitudes: {dicrotic_notch_values}")
print(f"Pulse Wave Systolic Peak (PWSP) Amplitudes: {pwsp_values}")
print(f"Pulse Wave Diastolic Peak (PWDP) Amplitudes: {pwdp_values}")
print(f"Heart Rate: {heart_rate} bpm")
```

11.Plotting:

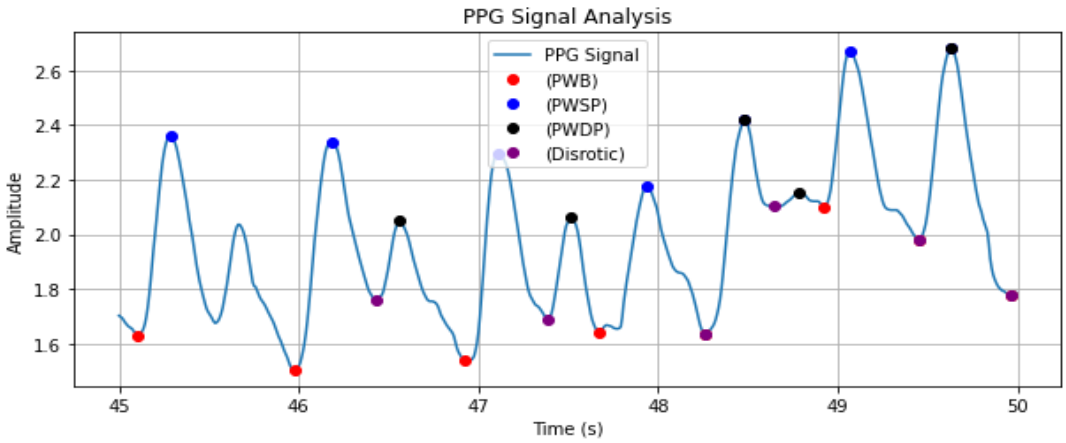
```
plt.figure(figsize=(10, 4))
plt.plot(window_time, window_ppg, label='PPG Signal')
plt.plot(window_time[pwe], window_ppg[pwe], 'ro', label='(PWB)')
plt.plot(window_time[pwsp], window_ppg[pwsp], 'bo', label='(PWSP)')
plt.plot(window_time[pwdp], window_ppg[pwdp], 'o', color="black", label='(PWDP)')
plt.plot(window_time[s_points], window_ppg[s_points], 'o', color="purple", label='(Disrotic)')

plt.title('PPG Signal Analysis')
plt.xlabel('Time (s)')
plt.ylabel('Amplitude')
plt.legend()
plt.grid(True)
plt.show()
```

12.Window Sliding:

```
input("Press Enter to slide the window...")
start_index += window_size
end_index += window_size
```

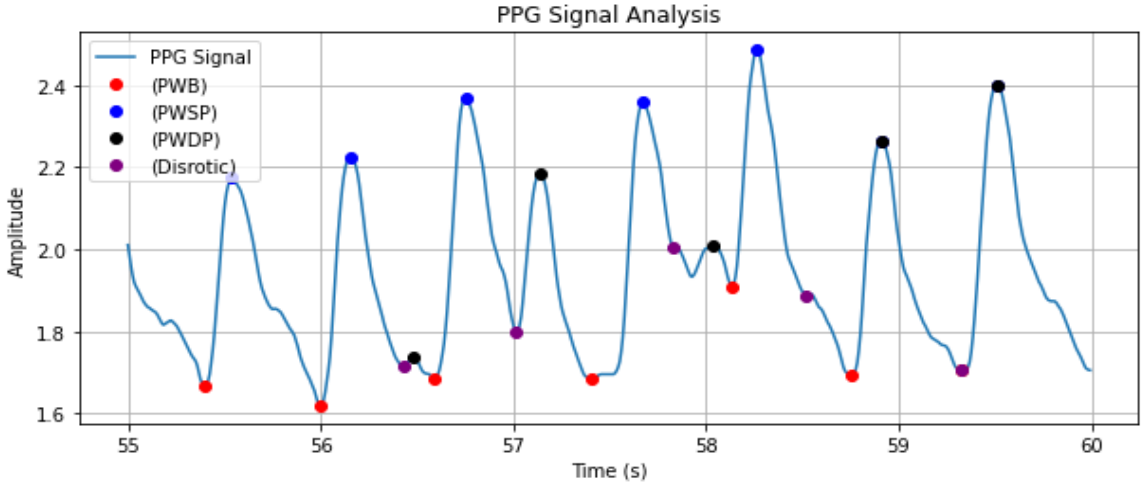
Outputs:

1)




```
PWD: [0.872 0.944 0.752 0.592 0.656 0.528 0.512]
Systolic Phase Duration: [0.496 0.424 0.376 0.216 0.48  0.128 0.312]
Diastolic Phase Duration: [0.376 0.52  0.376 0.376 0.176 0.4   0.2  ]
PPT : [0.056 0.04  0.52  0.304]
Pulse Wave Amplitude (PWA): [1.62952102 1.50342131 1.53665689 1.6402737  1.63245357
2.09970674
 1.98044966 1.77517107]
Dicrotic Notch Amplitudes: [2.04887586 2.06158358 2.42033236 2.15053763 2.68132942]
Pulse Wave Systolic Peak (PWSP) Amplitudes: [2.36265885 2.33822092 2.2971652  2.1769306
2.42033236 2.67057674
 2.68132942]
Pulse Wave Diastolic Peak (PWDP) Amplitudes: [2.04887586 2.06158358 2.42033236 2.15053763
2.68132942]
Heart Rate: 86.49093904448102 bpm

Press Enter to slide the window...
```

2)




```
PWD: [0.6   0.592 0.816 0.728 0.616 0.576]
Systolic Phase Duration: [0.288 0.368 0.416 0.408 0.344 0.184]
Diastolic Phase Duration: [0.312 0.224 0.4   0.32  0.272 0.392]
PPT : [0.04  0.304 0.048 0.008]
Pulse Wave Amplitude (PWA): [1.6686217  1.61974585 1.68719453 1.68719453 1.91006843 1.69599218
 1.70576735]
Dicrotic Notch Amplitudes: [1.73802542 2.18475073 2.01075269 2.26490714 2.39882698]
Pulse Wave Systolic Peak (PWSP) Amplitudes: [2.17399804 2.22482893 2.36852395 2.35777126 2.485826
2.26490714
 2.39882698]
Pulse Wave Diastolic Peak (PWDP) Amplitudes: [1.73802542 2.18475073 2.01075269 2.26490714 2.39882698]
Heart Rate: 91.64969450101823 bpm
```