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1 %-----
2 %Movisens Processing for
3 %MultiModalBioSignalAnalysis MMBSA
4 %Bachelor Thesis Guillermo Hidalgo Gadea
5 %Fatigue detection based on multimodal biosignal analysis
6 %-----
7
8     %% load Metadata for StartDriving and Microsleep
9     clc;
10    FILENAME = 'F:\Recordings\MetaData\MetaData.xlsx';
11    DELIMITER = '\t';
12    [num, txt, raw] = xlsread(FILENAME);
13    METADATA = raw;
14    SUBJECTS = raw(:,1);
15
16    %% Movisens HRV
17    fprintf('Reading Movisens Files...\n');
18    PATH = 'F:\Recordings\HeartRate\forMatlab\';
19    folders = dir(PATH);
20    folders = strvcats(folders.name);
21    x = size(folders);
22    for i = 3:x(1) %first outputs . and .. so start with 3
23        %start timer
24        tic
25
26        %look for XML in folders
27        PATHi = strcat(PATH, folders(i,:), '\*.xml');
28        files = dir(PATHi);
29        files = strvcats(files.name);
30        PATHi = strcat(PATH, folders(i,:), '\', files);
31
32        %folder beeing alanyzed
33        name = folders(i,:);
34        fprintf('Filenumber: %d', i-2);
35        fprintf('\n');
36        fprintf('Filename: %s', name);
37        fprintf('\n');
38
39        %get ecg starttime and samplerate
40        fprintf('Creating Timeline...\n');
41        CLOCK = unisens_get_timestampstart(PATHi);
42        HOURS = CLOCK(4);
43        MINUTES = CLOCK(5);
44        SECONDS = CLOCK(6);
45        STARTTIME = SECONDS + MINUTES*60 + HOURS*60*60;
46        SAMPLERATE = unisens_get_samplerate(PATHi, 'ecg.bin');
47
48        %get start driving from MetaData
49        SUBJECT = strcmp(name(end-9:end-5), SUBJECTS); %search subject name in
50
51        %get ecg data
52        DRIVINGTIME = ENDDRIVINGTIME - STARTDRIVINGTIME; %driving time in seconds
53        POS = (STARTDRIVINGTIME - STARTTIME) * SAMPLERATE; %difference between
54
55        %number of measures equals driving time
56        LENGHT = DRIVINGTIME * SAMPLERATE; %number of measures equals driving time

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multiplied by measures/second

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58     RANGE = [POS, LENGHT];
59     C = unisens_get_data(PATHi,'ecg.bin', RANGE);
60
61     %create Timeline
62     TIME = C;
63     for j = 1:LENGHT
64         TIME(j) = [STARTDRIVINGTIME + j/1024];
65     end
66
67     % create Matrix
68     D = horzcat(TIME, C);
69     DHEADER = 'TIME ecg';
70
71     %write to csv
72     fprintf('Writing file...\n');
73     CSVfile = strcat('F:\Processed\Movisens\',name(end-9:end-5),'_ecg','. ↵
csv');%where to store the outputs...
74     dlmwrite(CSVfile, D,'precision','%10.5f'); %missing header
75     fprintf('Done!\n');
76
77     %look for XLSX in folders
78     PATHj = strcat(PATH, folders(i,:), '*.xlsx');
79     files = dir(PATHj);
80     files = strvcats(files.name);
81     PATHj = strcat(PATH, folders(i,:), '\', files);
82
83     %folder beeing alanyzed
84     name = folders(i,:);
85     fprintf('Filenumber: %d', i-2);
86     fprintf('\n');
87     fprintf('Filename: %s', name);
88     fprintf('\n');
89
90     %get hrv data
91     [num, txt, raw] = xlsread(PATHj);
92     DATE = datestr(num(:,5));
93     CLOCK = DATE(:,13:20);
94     x = datetime(CLOCK);
95     [h,m,s] = hms(x);
96     TIME = s+m*60+h*60*60; %TIME is Timeline in seconds
97
98     %extract relevant Parameters analyzed by movisens
99     HR = num(:,10);
100    HrvHf = num(:,11);
101    HrvLf = num(:,12);
102    HrvLfHf = num(:,13);
103    HrvPnn50 = num(:,14);
104    HrvRmssd = num(:,15);
105    HrvSd1 = num(:,16);
106    HrvSd2 = num(:,17);
107    HrvSd2Sd1 = num(:,18);
108    HrvSdnn = num(:,19);
109    HrvSdsd = num(:,20);
110
111    %create matrix
112    HRV = horzcat(TIME, HR, HrvHf, HrvLf, HrvLfHf, HrvPnn50, HrvRmssd, HrvSd1, ↵
HrvSd2, HrvSd2Sd1, HrvSdnn, HrvSdsd);
113
114    % get start driving from MetaData
```

```

115         SUBJECT = strcmp(name(end-9:end-5), SUBJECTS); %search subject name in ✓
MetaData
116         SUBJECTROW = find(SUBJECT == 1);
117         STARTDRIVINGTIME = METADATA{SUBJECTROW,3};
118         ENDDRIVINGTIME = METADATA{SUBJECTROW,4};
119
120         %find STARTDRIVINGTIME and ENDDRIVINGTIME in Timeline
121         TIME1 = find(TIME <= STARTDRIVINGTIME); %if no direct match, find next ✓
best measurement
122         TIME1 = max(TIME1); % find element directly before STARTDRIVINGTIME
123         if STARTDRIVINGTIME < TIME(1) %in cases recording starts after ✓
STARTDRIVING or stops before ENDDRIVING
124             TIME1 = TIME(1);
125         end
126         TIME2 = find(TIME >= ENDDRIVINGTIME); %if no direct match, find next best ✓
measurement
127         TIME2= min(TIME2); % find element directly after ENDDRIVINGTIME
128         if ENDDRIVINGTIME > TIME(end) %in cases recording starts after ✓
STARTDRIVING or stops before ENDDRIVING
129             TIME2 = TIME(end);
130         end
131
132         %cut matrix
133         HRV = HRV(TIME1:TIME2,:); %Matrix contains NaN, use ~(isnan(HRV)) for ✓
later calculations
134
135         %write to csv
136         fprintf('Writing file...\n');
137         CSVfile = strcat('F:\Processed\MovisensAnalyzer\',name(end-9:end- ✓
5),'_hrv','.csv');%where to store the outputs...
138         dlmwrite(CSVfile, HRV,'precision','%10.5f'); %missing header
139         fprintf('Done!\n');
140
141         %elapsed time in loop
142         toc
143
144         %clear variables after loop
145         clearvars -except i PATH folders x DELIMITER METADATA SUBJECTS
146
147     end
148
149     fprintf('Data Processing completed!');
150

```