ECG Diabetes Detection

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Diabetes

Diabetes Mellitus (diabetes for short) is a clinical condition characterized by hyperglycemia which is widespread. Hyperglycemia is the condition in which there is not enough insulin in the body to deal with large amount of glucose present.

- The number of people with diabetes rose from 108 million in 1980 to 422 million in 2014
- In 2019, diabetes was the ninth leading cause of death with an estimated 1.5 million deaths directly caused by diabetes.
- The timely diagnosis of diabetes is of great importance.

Motivation

Now, when the usage of wearable devices, such as smartwatches or fitness trackers is widespread, it is easy to obtain biomedical data in non-invasive fashion.

We should probably analyze ECG data because it is relatively easy to obtain.

For example, we can measure ECG with Apple Watch or another device daily.

ECG and Diabetes

Often enough cardiovascular autonomic neuropathy (CAN) is caused by diabetes. It affect heart rate and blood pressure which leads to diminished Heart Rate Variability (HRV). In general, we can say that diabetes has significant negative effect on blood-vascular system. So, it is reasonable to use HRV (obtained from ECG) to detect diabetes, because HRV is indicative of blood-vascular system disorder either caused or exacerbated by diabetes.

Data Description

Dataset is collected in the context of the D1NAMO project, and consists of a set of **Electrocardiogram** (ECG -- signal of our interest), **Breathing**, **Accelerometers** signals, information about glucose levels and annotated food pictures. This project claims to aim at providing non-invasive diabetes management through analysis of data (signals) obtained by wearable devices.

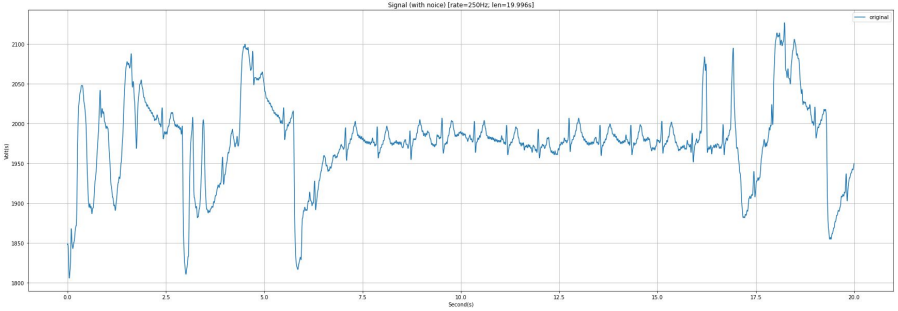
Dataset was acquired on study conducted on 29 patients:

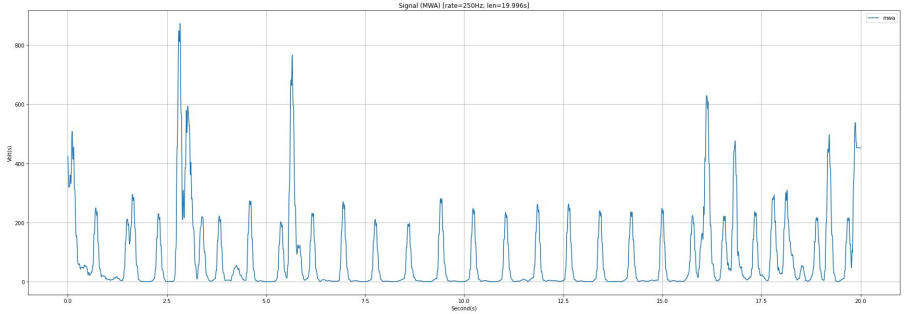
- 20 healthy
- 9 diabetes (Type 1)

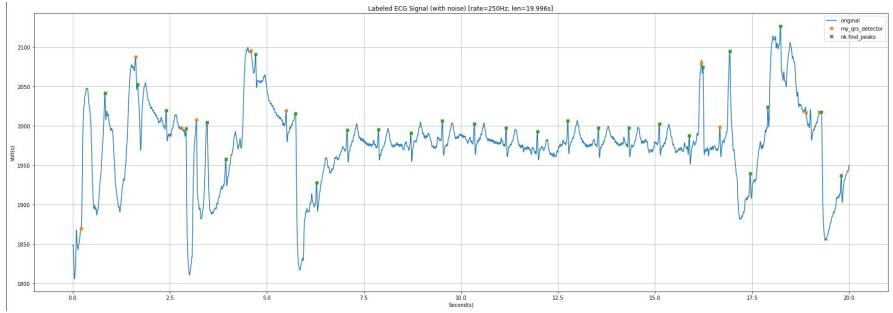
Related Work

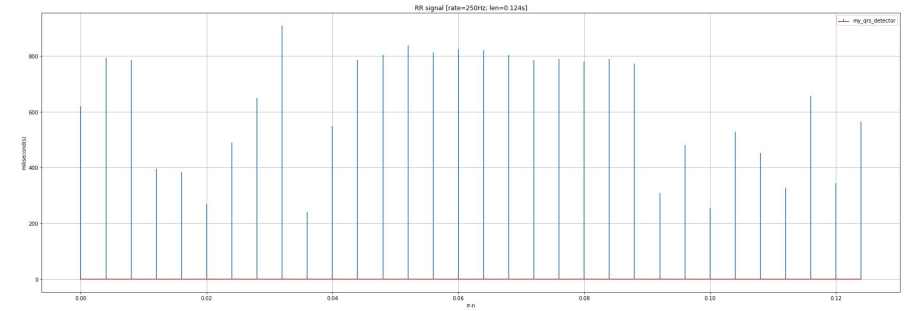
- Implement Heart Beat Detection Algorithm
- Modify it and tune if needed
- Implement and Train CNN on the dataset

Algorithm based on Wavelet Transform

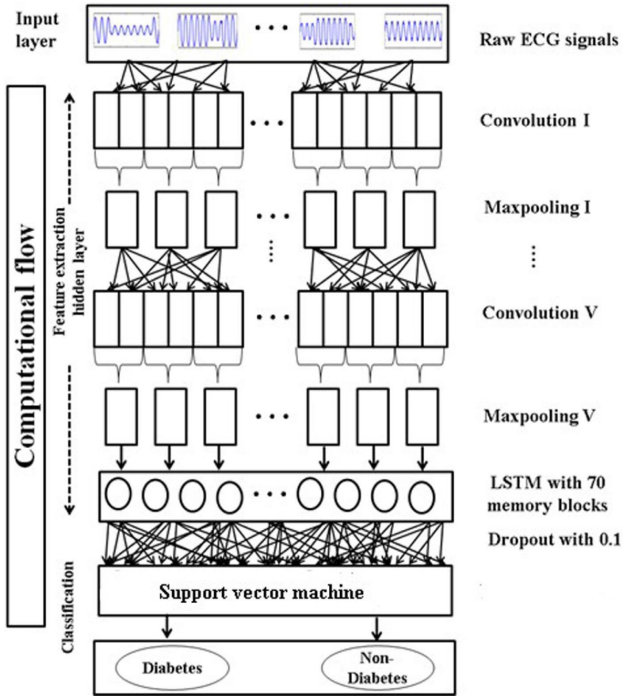








CNN with LSTM layer



Results

```
Model: "sequential_4"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_20 (Conv1D)           (None, 180, 64)           256
_________________________________________________________________
max_pooling1d_20 (MaxPooling (None, 90, 64)            0
_________________________________________________________________
conv1d_21 (Conv1D)           (None, 90, 128)           24704
_________________________________________________________________
max_pooling1d_21 (MaxPooling (None, 45, 128)           0
_________________________________________________________________
conv1d_22 (Conv1D)           (None, 45, 256)           98560
_________________________________________________________________
max_pooling1d_22 (MaxPooling (None, 15, 256)           0
_________________________________________________________________
conv1d_23 (Conv1D)           (None, 15, 512)           393728
_________________________________________________________________
max_pooling1d_23 (MaxPooling (None, 5, 512)            0
_________________________________________________________________
conv1d_24 (Conv1D)           (None, 5, 1024)           1573888
_________________________________________________________________
max_pooling1d_24 (MaxPooling (None, 1, 1024)           0
_________________________________________________________________
lstm_4 (LSTM)                (None, 70)                306600
_________________________________________________________________
dropout_4 (Dropout)          (None, 70)                0
_________________________________________________________________
dense_4 (Dense)              (None, 1)                 71
=================================================================
```

```
Epoch 1/10
791/791 [==============] - 101s 125ms/step - loss: 0.6384 - accuracy:
0.6917
Epoch 2/10
791/791 [==============] - 104s 131ms/step - loss: 0.5925 - accuracy:
0.7113
Epoch 3/10
791/791 [==============] - 117s 148ms/step - loss: 0.5957 - accuracy:
0.7111
Epoch 4/10
791/791 [==============] - 119s 151ms/step - loss: 0.5945 - accuracy:
0.7089
Epoch 5/10
791/791 [==============] - 111s 140ms/step - loss: 0.5822 - accuracy:
0.7151
Epoch 6/10
791/791 [==============] - 124s 156ms/step - loss: 0.5888 - accuracy:
0.7110
Epoch 7/10
791/791 [==============] - 130s 163ms/step - loss: 0.5957 - accuracy:
0.7075
Epoch 8/10
791/791 [==============] - 119s 151ms/step - loss: 0.5847 - accuracy:
0.7132
Epoch 9/10
791/791 [==============] - 120s 152ms/step - loss: 0.5864 - accuracy:
0.7122
Epoch 10/10
791/791 [==============] - 114s 144ms/step - loss: 0.5811 - accuracy:
0.7150
```

```
339/339 - 13s - loss: 0.5792 - accuracy: 0.7135
Accuracy:  0.713534951210022
Loss:  0.5791746973991394
```

Github

Thank you for attention :)

References

1. Diabetes
2. Diabetes Detection using ECG signals: An Overview
3. Real-time QRS detector using Stationary Wavelet Transform for Automated ECG Analysis
4. Real-time QRS detector using Stationary Wavelet Transform for Automated ECG Analysis