

ECG Personal Information Lock

SC_07

Under supervision of:

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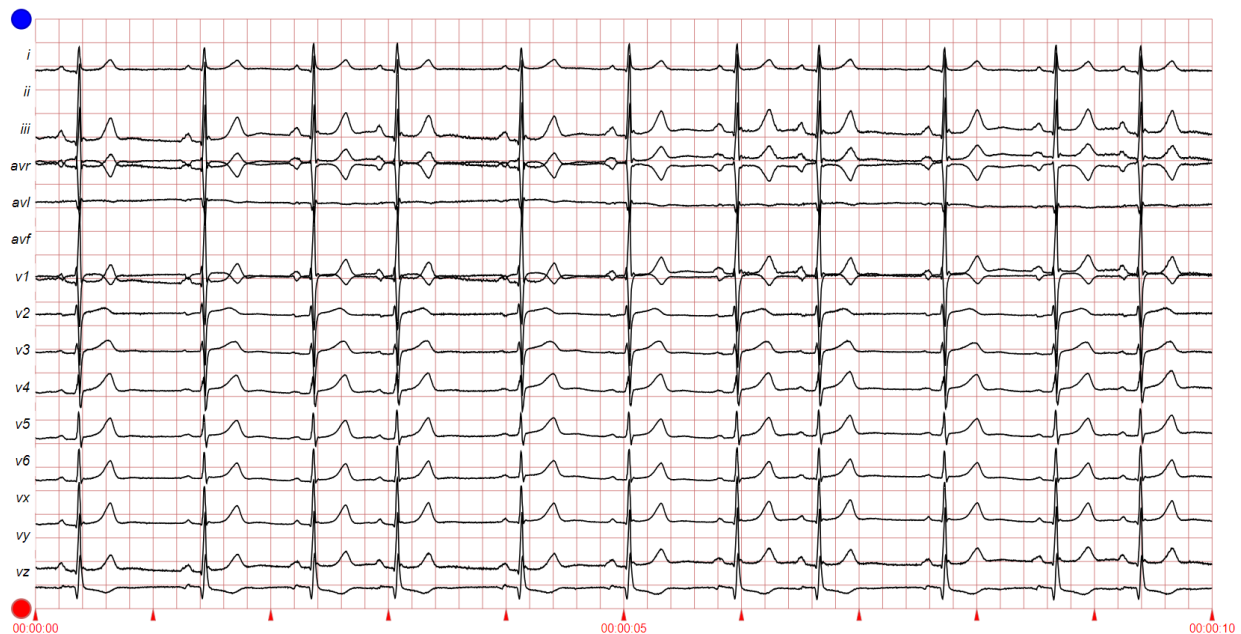
Name	ID	Department	Level
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Data Preparation

Test subjects selected for our system are:

- Test subject 173
- Test subject 182
- Test subject 234
- Test subject 238

They were selected because they are healthy patients admitted into the hospital only for health control based on the data in the controls file on the database's website, which can be confirmed through the patient's header file.



Visualization of patient 173's ECG recordings

The data can be found on the website through this [link](#).

The data was read from the files and split into train and test data by 70% and 30% respectively.

Two test data subjects were created for two scenarios, an identified subject and an unidentified subject.

For the identified subject, it should be recognized as test subject 182, we combined the signals of the four subjects, but most of the signals were from that test subject.

For the unidentified subject, it should not allow the subject to view any files, the signals were evenly collected from all four test subjects.

Preprocessing

1. Bandpass filter

Low cutoff frequency = 1

High cut-off frequency = 40

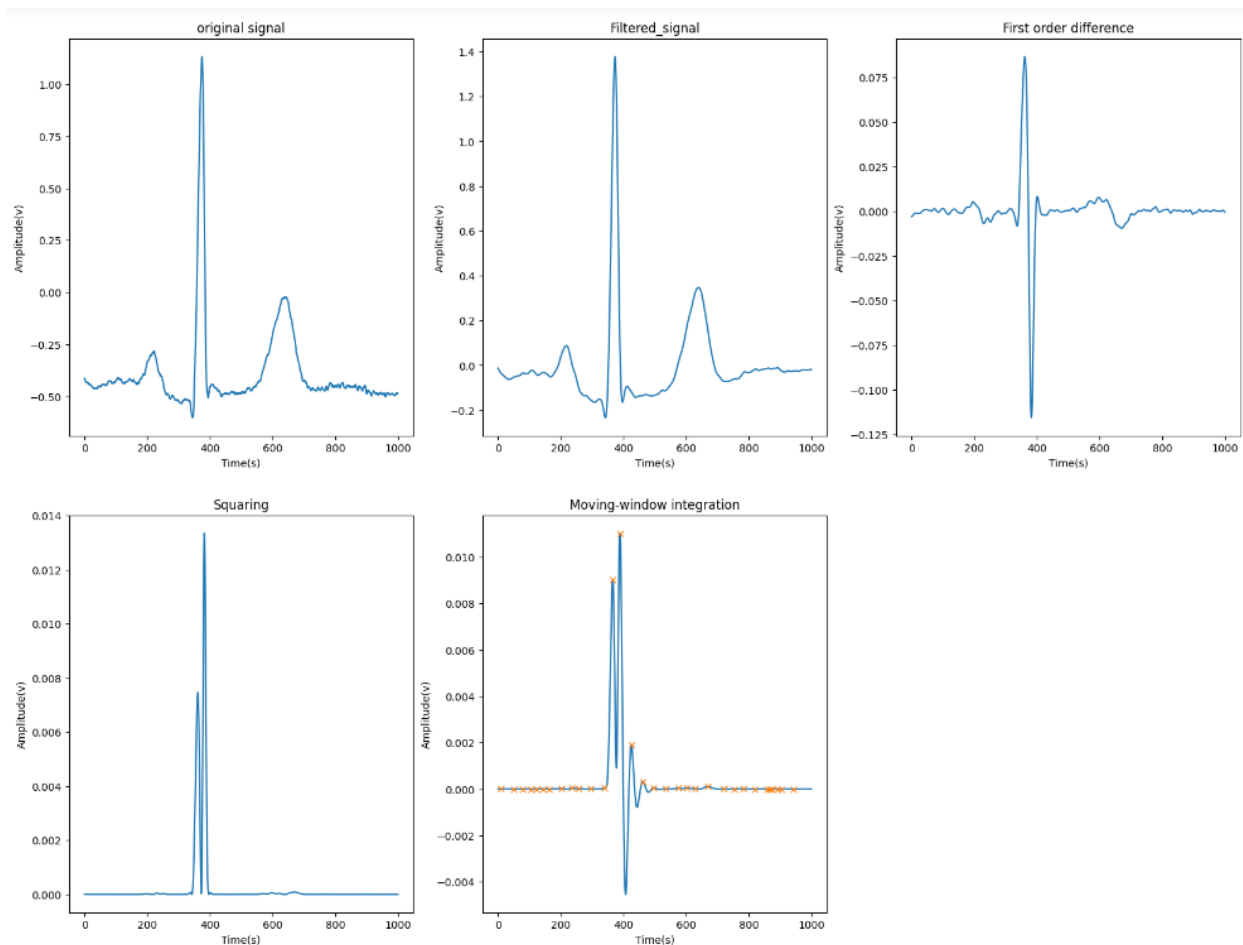
Sampling rate = test subject's sampling rate

Order = 2

2. First order difference

3. Squaring

4. Moving-Window Integration



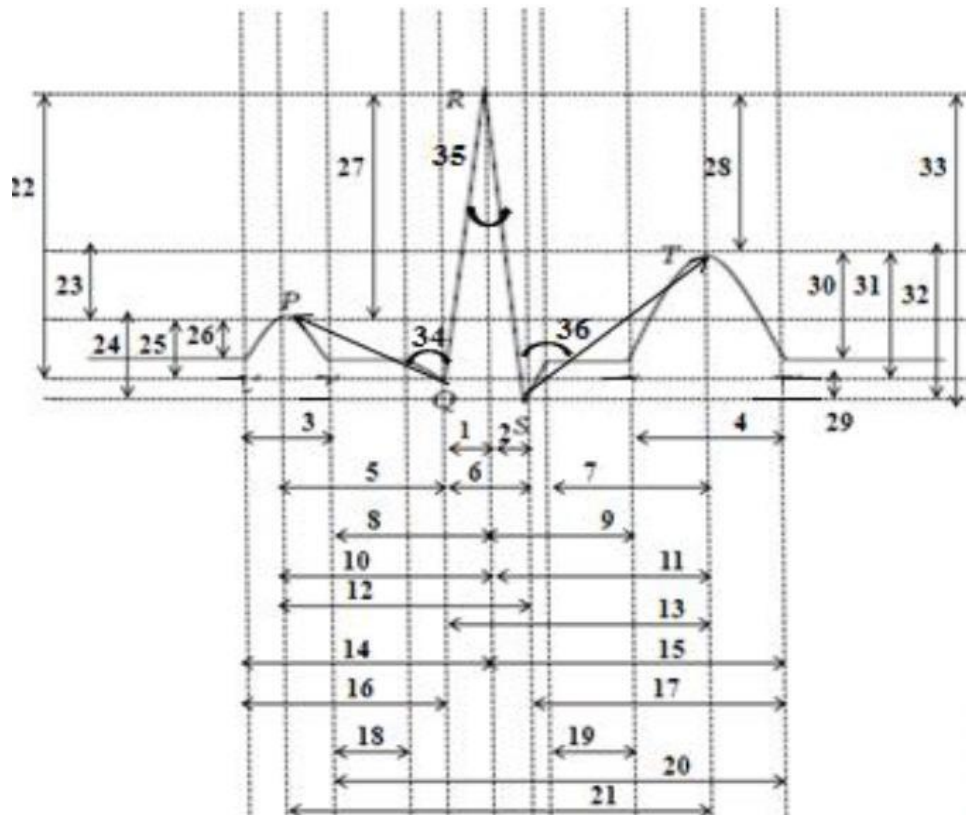
Visualization of the signal from the first test subject during the preprocessing steps

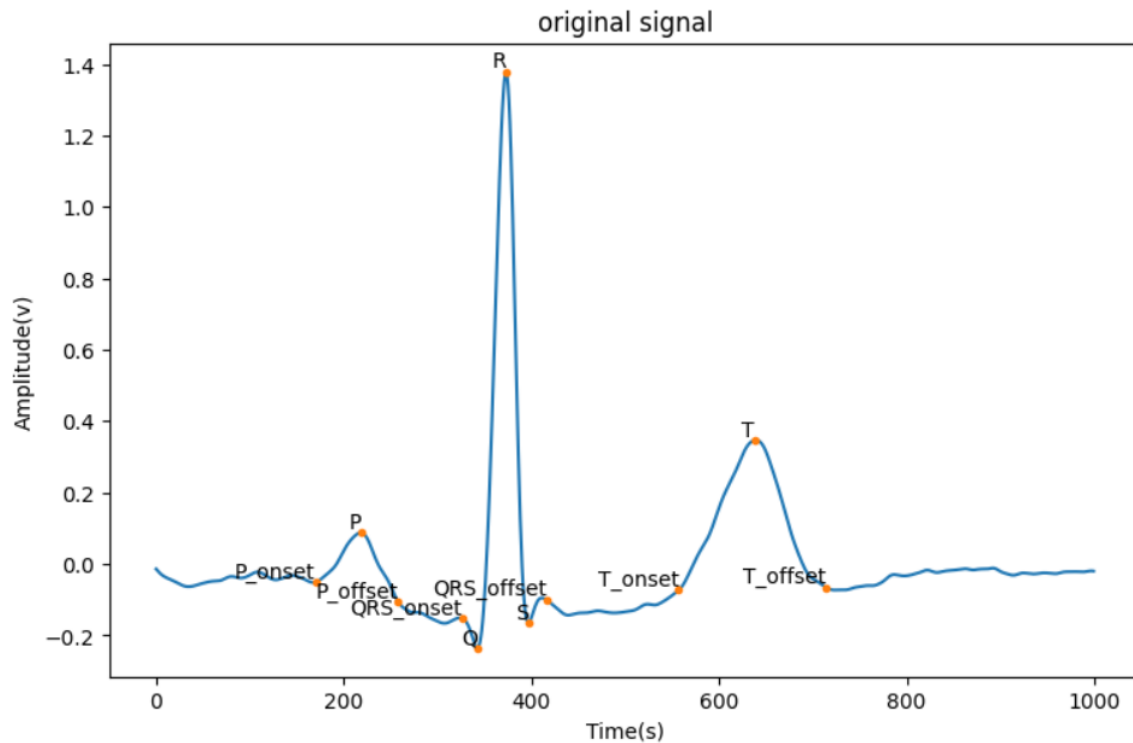
Feature Extraction

Fiducial features were used.

By detecting the peaks of each wave P, QRS, and T. In addition to their onsets and offsets.

The features can be calculated as such through the following:





The onset & offset of each wave can be computed by defined using the method of minimum radius of curvature. The onset is defined by tracking downhill from the right side, the X and Y fixed then the minimum radius of curvature is found by maximizing the value of δ using the vector cross product between the two directed line segments a and c.

The offset is defined in the same way but this time by tracking downhill from the left side of the P wave. For M shape P wave, to define the onset we track downhill before left peak, while for the offset we track downhill after the right peak. In the case of the negative T wave (inverted), the same algorithm is applied but this time we are climbing up the valley not tracking downhill as in the positive case.

Classifiers

SVM Classifier:

Hyperparameters tested:

- C (Error): 0.001, 0.01, 0.1, 1, 10.
- max_iter (Maximum number of iterations): range from 1 to 1000.

Hyperparameters used:

- C = 0.001
- max_iter = 10

Logistic Regression Classifier:

Hyperparameters tested:

- C (Error): 0.001, 0.01, 0.1, 1, 10.
- max_iter (Maximum number of iterations): range from 10 to 100.
- solver (Type of classifier used): 'newton-cg', 'lbfgs', 'liblinear'

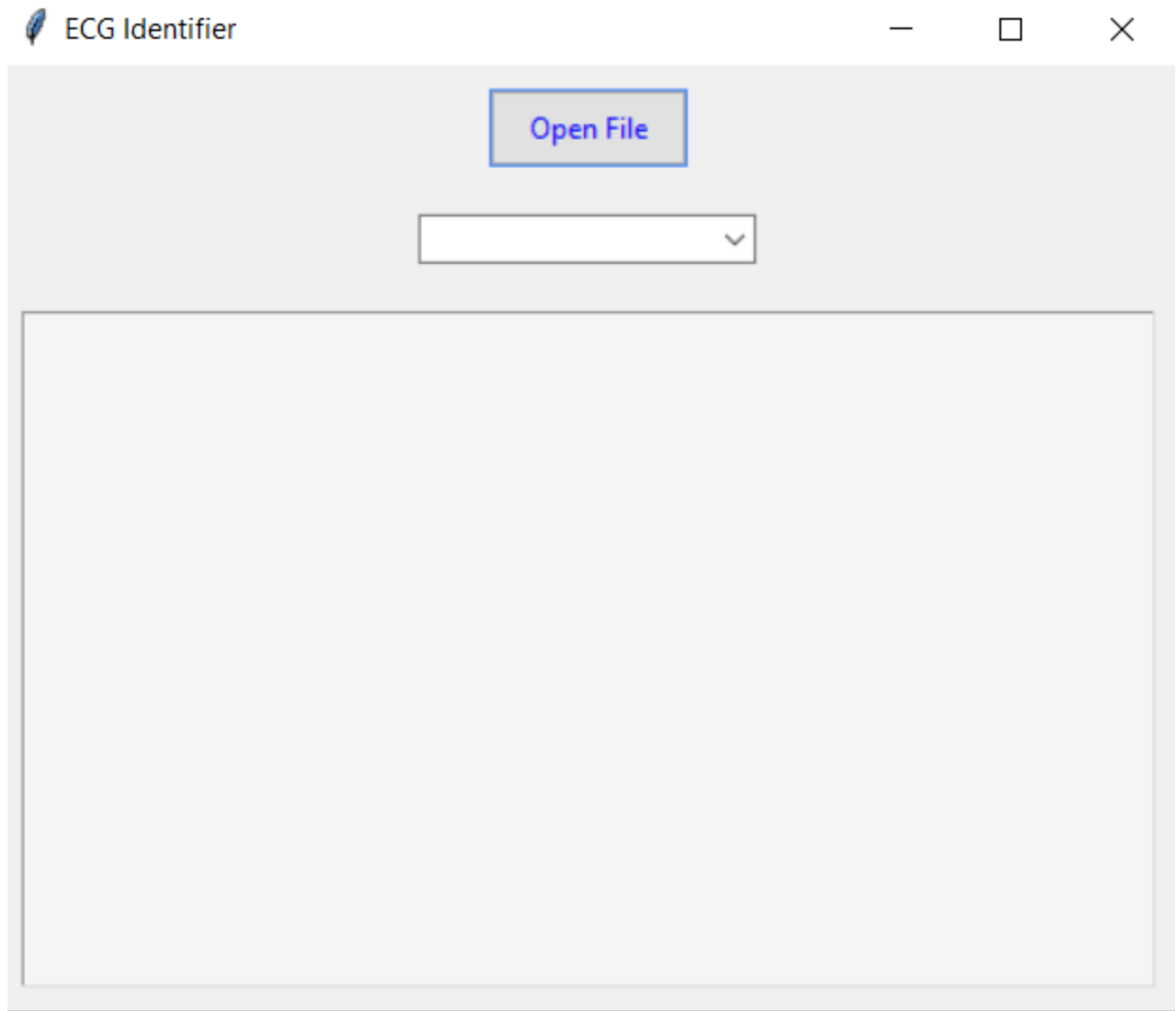
Hyperparameters used:

- C = 1
- max_iter = 12
- solver = liblinear

Results

Model	Accuracy	Hyperparameters
SVM	99.36%	<ul style="list-style-type: none">- C = 0.001- max_iter = 10
Logistic Regression	99.36%	<ul style="list-style-type: none">- C = 1- max_iter = 12- solver = liblinear

Interface



Scenario 1:

The test subject is identified, using the logistic regression classifier:



The screenshot shows a window titled "ECG Identifier" with standard window controls (minimize, maximize, close). Inside the window, there is an "Open File" button. Below it is a dropdown menu currently set to "Model 1". The main area of the window displays patient information and diagnosis results in a text box. The patient information is in blue text, and the diagnosis results are in green text. There is also a section for hemodynamics in orange text.

test subject: 1
age: 29
sex: male
ECG date: 16/07/1992

Diagnose:
Reason for admission: Healthy control
Acute infarction (localization): no
Former infarction (localization): no
Additional diagnoses: no
Smoker: unknown
Number of coronary vessels involved: unknown
Infarction date (acute): n/a
Previous infarction (1) date: n/a
Previous infarction (2) date: n/a

Hemodynamics:
Catheterization date: n/a

The test subject is identified, using the support vector machine classifier:



The screenshot shows a software window titled "ECG Identifier". At the top, there is a blue "Open File" button. Below it is a dropdown menu currently set to "Model 2". The main area of the window displays patient information and a medical diagnosis. The patient data includes test subject ID, age, sex, and ECG date. The diagnosis section lists various clinical findings, and the hemodynamics section shows catheterization data.

ECG Identifier

Open File

Model 2

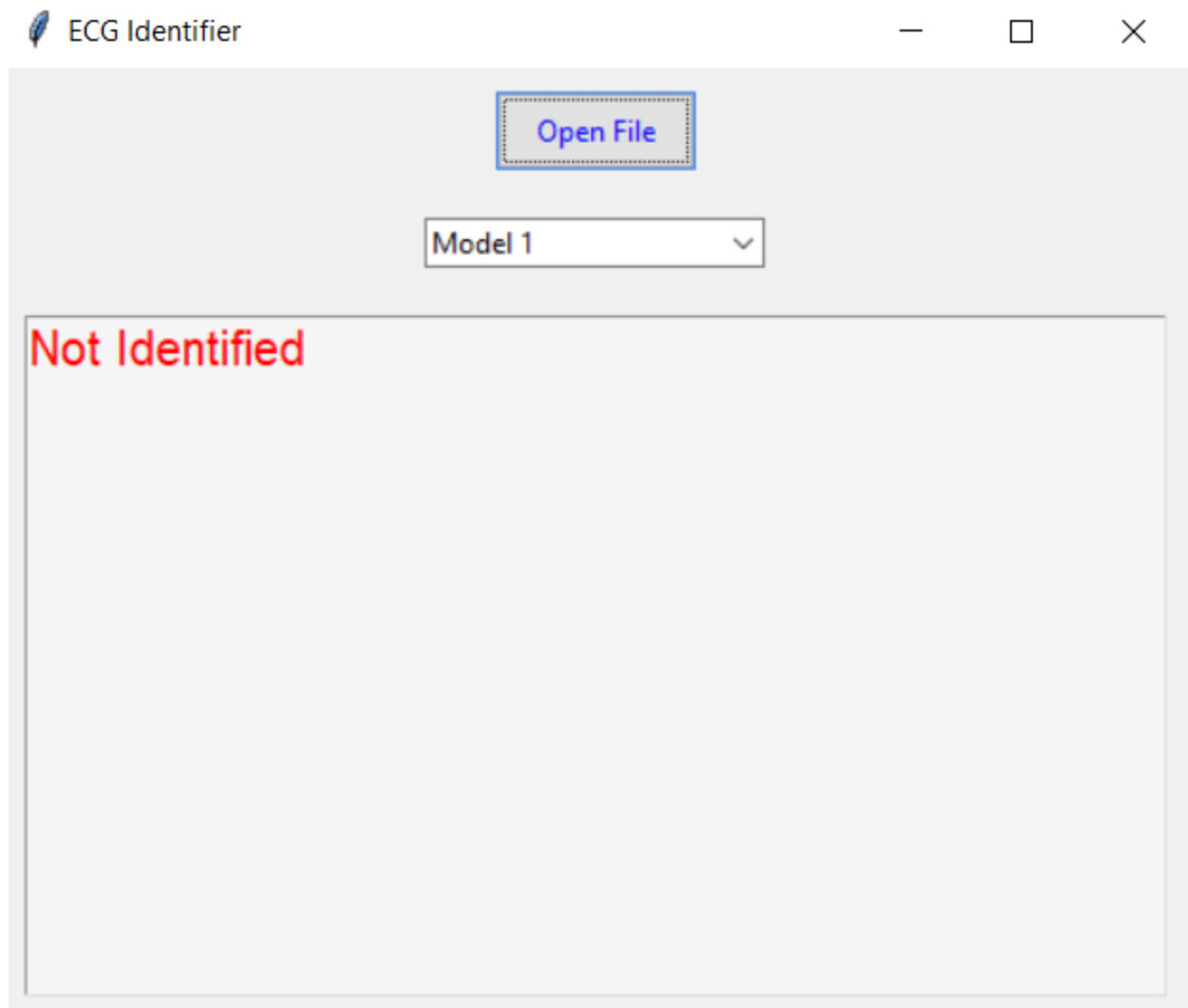
test subject: 1
age: 29
sex: male
ECG date: 16/07/1992

Diagnose:
Reason for admission: Healthy control
Acute infarction (localization): no
Former infarction (localization): no
Additional diagnoses: no
Smoker: unknown
Number of coronary vessels involved: unknown
Infarction date (acute): n/a
Previous infarction (1) date: n/a
Previous infarction (2) date: n/a

Hemodynamics:
Catheterization date: n/a

Scenario 2

The test subject is unidentified, using the logistic regression classifier:



The test subject is unidentified, using the support vector machine classifier:

