# A Decision Tree Optimised SVM Model for Stress Detection using Biosignals: Implementation

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## 1 Implementation Details

This project involves proposing a machine learning model based on human bio signals to detect human stress. It compares Cubic SVM with Gaussian model and a Decision Tree Optimized SVM model for stress prediction by comparing their accuracies and gives the most accurate model for better stress prediction.

### 1.1 Preprocessing

After importing required libraries, the ECG signals are extracted from data and are preprocessed which involves:

- Baseline Correction of the given ECG signals for elimination of negative peaks
- Wavelet decomposition of the baseline corrected signals using 4 levels, for smoothening the signals
- Defining function for labeling stress in the original dataset since stress labels are not available in the dataset.

### 1.2 Feature Extraction

From the ECG signals, detection of R-peaks and localisation of Q and T waves are done to get QT, RR and EDR intervals. Once all the 3 features are extracted, it is made into a feature vector. Using these, every data sample is labeled 'Stressed' or 'Not Stressed' according to the function defined above.

The dataset is shown below:

dataset.csv

1 to 18 of 18 entries Filter

| QT | RR | EDR | Decision |
|---|---|---|---|
| 0.4469283681214421 | 2.129343930185445 | 0.005497153678424998 | Not Stressed |
| 0.38058597218111867 | 2.2453885018984128 | 0.002796222930501101 | Stressed |
| 0.045314900153609824 | 1.3396808378395175 | 0.008144596000595998 | Stressed |
| 0.6100131752305664 | 2.3239875389408096 | 0.0036769125194748863 | Stressed |
| 0.5801627157299182 | 2.307997219387378 | 0.00638129472763807 | Stressed |
| 0.5733888410819359 | 2.455752975677074 | 0.005101538060106689 | Not Stressed |
| 0.557280159080866 | 2.3441334424013944 | 0.0044660710592284904 | Not Stressed |
| 0.5313002835031797 | 2.2764839191860746 | 0.0036392795429995312 | Stressed |
| 0.52053725175066 | 2.219313708208473 | 0.004405620095102461 | Not Stressed |
| 0.5337039610840861 | 2.229988594156699 | 0.0026990996827468074 | Not Stressed |
| 0.5367062321542345 | 2.236549261339221 | 0.003345261416707141 | Not Stressed |
| 0.5271753362694916 | 2.221535098442466 | 0.0021530302948497807 | Not Stressed |
| 0.3744740532959327 | 2.164559525531607 | 0.003866482683338727 | Not Stressed |
| 0.6008195860039928 | 2.3689839572192515 | 0.0034755452584493704 | Not Stressed |
| 0.5386104218362282 | 2.2676178055717044 | 0.0020958493491688795 | Stressed |
| 0.5369453391663862 | 2.3073536156550984 | 0.002738185938410814 | Stressed |
| 0.3744740532959327 | 2.164559525531607 | 0.003866482683338727 | Not Stressed |
| 0.32594086021505375 | 2.141658834169785 | 0.004125388321719691 | Not Stressed |

### 1.3 Training, Testing and Analysis

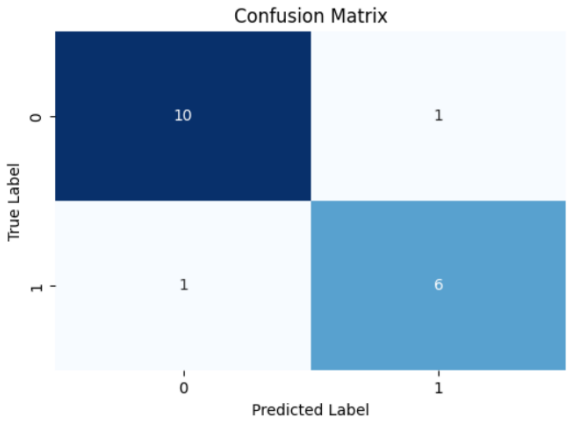
Models (Cubic SVM with Gaussian and Tree Optimized SVM) are trained on synthetic data samples generated using SMOTE and tested on the original data to get accuracy and confusion matrices.

## 2 Dataset Description

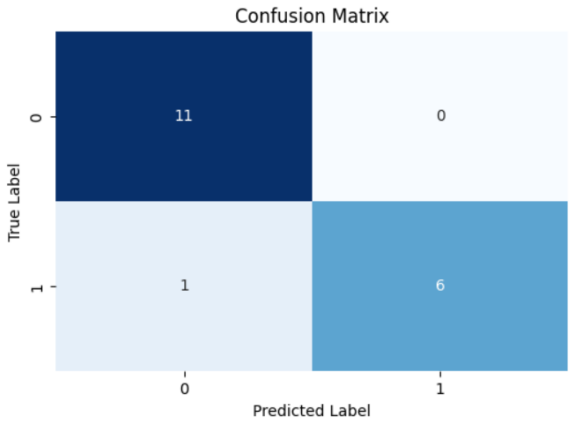
The database "drivedb" [Stress Recognition in Automobile Drivers] is used from the website Physionet. Based on the protocol, the first data were recorded during regular route of the vehicles. Then the drivers were taken in different road conditions with variable traffic conditions where there is possibility of various stress level changes. A total of 18 subject's data are considered. The ECG signal is used for the study. Dataset Link

## 3 Results

The confusion matrices for the two models are given below:




(a) Cubic SVM with Gaussian



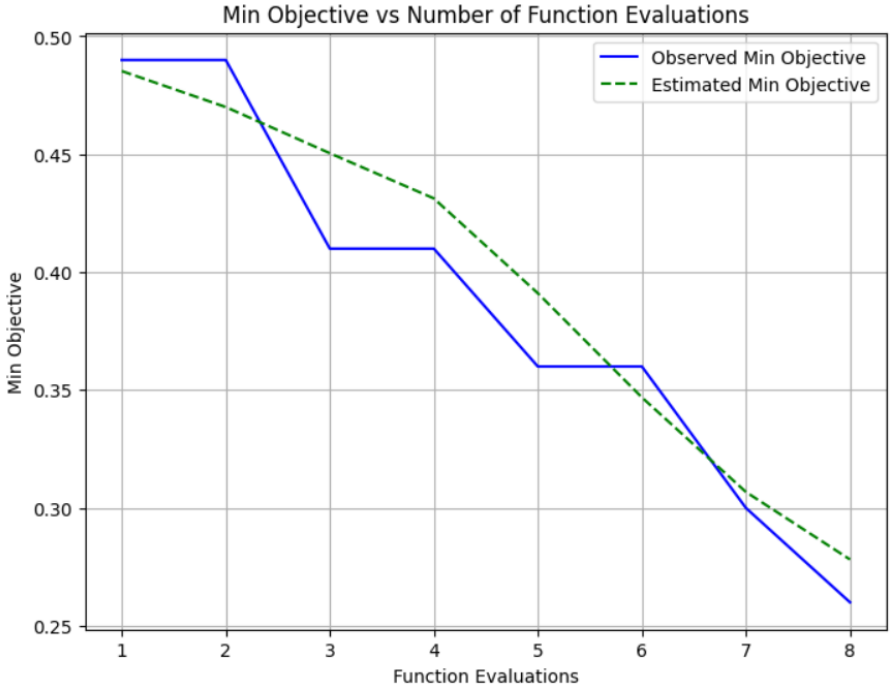

(b) Tree Optimized SVM

The table for accuracies of the two models are given below:

| Model Type | Accuracy |
|---|---|
| Cubic SVM with Gaussian | 88.89% |
| Tree Optimized SVM | 94.44% |

Tree Optimised Cubic SVM is providing the better accuracy which is demonstrated in above table.

The plot of Minimum Objective versus Number of function Evaluations for cubic SVM is shown below:




As objective value become less, it denotes a better optimised SVM model.