Comparative Study on Classification of Depressed and Non-Depressed Subjects using Tree based Ensemble Models

Abstract: With increasing technology in the 21st-century use of sensors in our daily life is also increasing, Most of the devices we use in our daily life are equipped with different types of sensors like gyro sensors, motion detection sensors, etc. These sensors provide useful data which can be used not only to count the calories burnt or the number of steps taken but also can be used to measure mental health issues such as changes in mood, personality, inability to cope up with daily problems, stress, etc. In this study, we will try to analyse a unique dataset containing sensor data of 23 subjects having unipolar and bipolar depression and 32 subjects having no sign of depression using different tree-based ensemble models (Machine learning) to identify if a person is suffering from depression or not. Moreover, we will try to classify the subject into three different classes namely no-depression, mild-depression, and severe-depression based on MADRS (Montgomery-Åsberg Depression Rating Scale scores). This research work can be used as a basis for new applications in smartwatches to warn users regarding their mental health.

Highlights:

- Using Synthetic minority oversampling technique (SMOTE) to balance the dataset segmented in uniform length of 1440 mins.
- Comparing the performance of different tree based ensemble model to classify subjects into two classes namely depressed and non-depressed.
- Comparing the performance of different ensemble model to classify subjects into three classes namely no-depression, mild-depression, and severe-depression.
- CatBoost model tends to perform better than other ensemble models.

Proposed Work:

- **Dataset Preparation:** The dataset consisted of motor-activity data of each subject of non-uniform length also the number of control samples were greater than condition samples. So we first segmented the data samples into uniform length of 1440 mins (1 Day) and labelled them accordingly for each experiment. For binary classification subjects were labelled 0 for control group and 1 for condition group, for multiclass classification subjects were labelled 0 for no-depression, 1 for mild-depression and 2 for severe depression. After segmentation we over-sampled the minority classes for training set using SMOTE to balance the dataset.
- **Modeling:** We fed the prepared dataset to different tree based ensemble model to compare their results and find out the best performing model. The models we choose included AdaBoost, XGBoost, CatBoost and GBM.

Results & Discussion:

- **Binary Classification:**

Ensemble Model	Accuracy	F1-Score	Precision Score	Recall Score
AdaBoost	0.70	0.70	0.70	0.71
XGBoost	0.72	0.72	0.72	0.73
CatBoost	0.78	0.78	0.78	0.78
GBM	0.76	0.76	0.67	0.76

- **Multiclass Classification:**

Ensemble Model	Accuracy	F1-Score	Precision Score	Recall Score
AdaBoost	0.89	0.89	0.89	0.89
XGBoost	0.87	0.87	0.87	0.87
CatBoost	0.89	0.89	0.89	0.89
GBM	0.88	0.88	0.88	0.88

From results it is quite clear that CatBoost beats other ensemble models in binary classification and In case of multiclass classification AdaBoost and CatBoost performed same in all four metrices.

Output:

- Overall for binary classification task we got the best accuracy of 0.78 and F1-score of 0.78 using CatBoost ensemble model.
- For multiclass classification we got the best accuracy of 0.89 and F1-score of 0.89 using CatBoost ensemble model.

Conclusion:

In this study, we presented a comparative study of the performance of different ensemble models on the depressjon dataset. We carried out two different experiments, one to classify the subjects into depressed and non-depressed and the other to classify subjects based on average MADRS value into three different classes namely no-depression, mild depression, and severe depression. We found out that ensemble model tends to perform well to detect depression in both the experiment but due to small size of data the performance of these model were not exceptional. If more data can be collected then the performance of these models can further be improved and these models can be used in applications developed for smartwatches and smartphones to continuously monitor motor activity of the user and warn them if there is some sign of depression.

Reference:

Shivam Kasat, Sonali Agarwal, Sanjay Kumar Sonbhadra, Narinder Singh punn: Comparative Study on Classification of Depressed and Non-Depressed Subjects using Tree based Ensemble Models.