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Laboratory Innovation

COMPARATIVE ANALYSIS OF ANOMALY IN HORMONAL BEHAVIOR IN HYPOTHYROIDISM USING ARTIFICIAL INTELLIGENCE

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Background

Detection of anomaly in hormonal behavior in hypothyroidism is essential to predict the disease among new patients. .In many cases an out of range TSH does
not always mean that the person suffers from the disease .Other tests for T3 and T4 must be conducted as well. Blood thinners such as Heparin cause over production of thyroid hormones leading to inaccurate results.

The present study to uses two Artificial Intelligence models using previously known and classified data to predict the diseases - Neural Networks and SVM Classifiers.

Methods

The objective of the work is to use of artificial intelligence for the detection of anomaly in hormonal behavior in hypothyroidism. A sequential type neural network is used with three layers having multiple nodesto effectively increase accuracy. ReLu activation function is used for the first two layers and sigmoid for the third one..

For 1519 values a batch size of ten is made and fitted into the neural model having 150 epochs. Each epoch describes the number of times a single batch passes through the neural network algorithm. After fitting into the function, accuracies with test data is calculated along with losses. Along with result graphs, confusion matrices are provided to measure the sensitivity and specificity of the test set. By creating a confusion matrix, we obtained a higher sensitivity in the neural network in comparison to the Support Vector Machine (SVM) classifier. method.

For the SVM method, the data is fed into a linear classifier. Through the calculation of cost function and the minimization of squared error by gradient descent, the correct weights are added to each of the five parame ters of the train set.

Results

Training is performed using a “labeled” dataset of inputs in a wide assortment of representative input patterns that are tagged with their intended output response. The hormones measured are TSH T3 TT4, T4U and FTI (Free Thyroid Index). The clinical data was labeled as Support-vector clustering (SVC) ‘linear’ type classifier and also a sequential neural network. .

Results

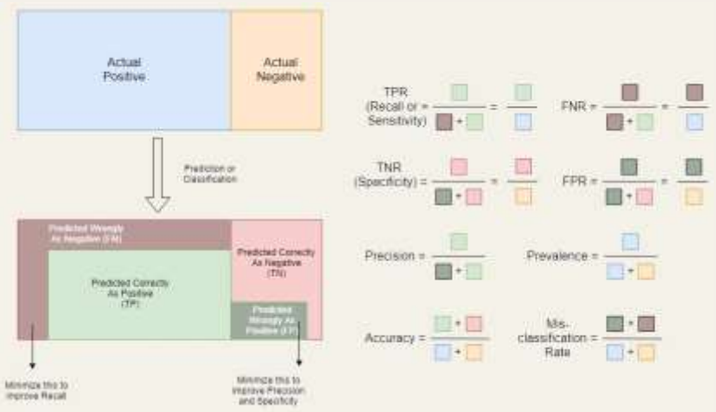

Figure 1: Illustrating the confusion matrix. source: Devopedia 2019.

Confusion matrix - Neural network design

[513, 2]
[3, 16]

We have calculated its specificity as 99.41% and sensitivity as 88.8%

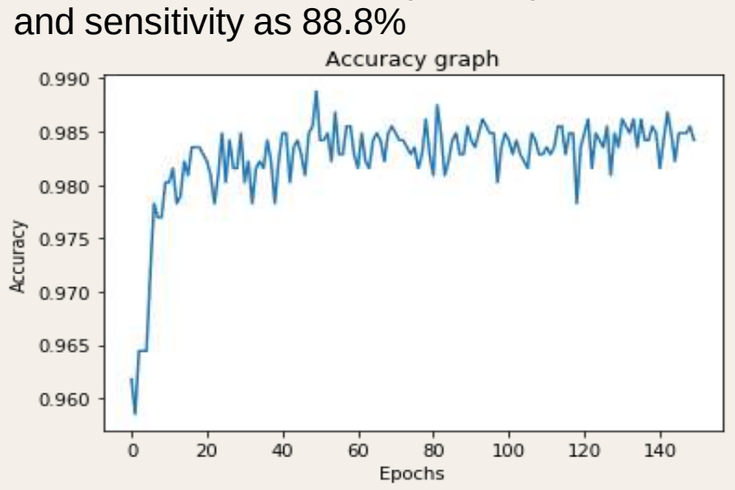

Figure 2:Using SVC, the accuracy improved to 98.7%

Training set accuracy of 98.55% is obtained and this is improved for the test data set(99.88%)

Confusion matrix - SVM Classifier

[512 3]
[3 14]

We obtain specificity 82.35% and sensitivity 99.03%. Using a predict function we map our predicted values to real test data values and obtain an accuracy of 98.5%..

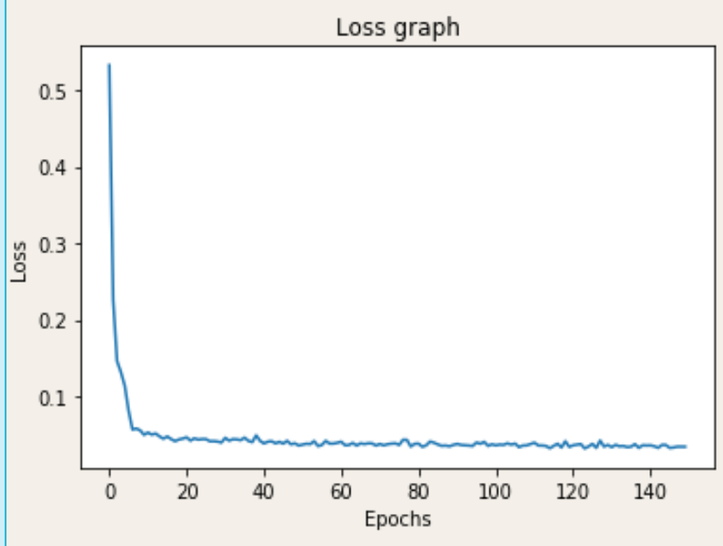

Figure 3: Loss Graph

We can conclude that the neural network serves as a better fit to diagnose hypothyroidism among patients owing to its higher accuracy and sensitivity. This may help in detection of otherwise undetected cases of hypothyroidism.

Results

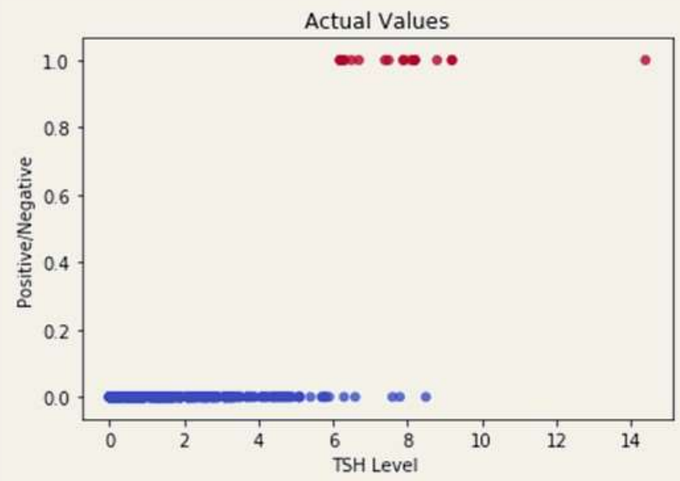

Figure 4: Result of collected (overall) data

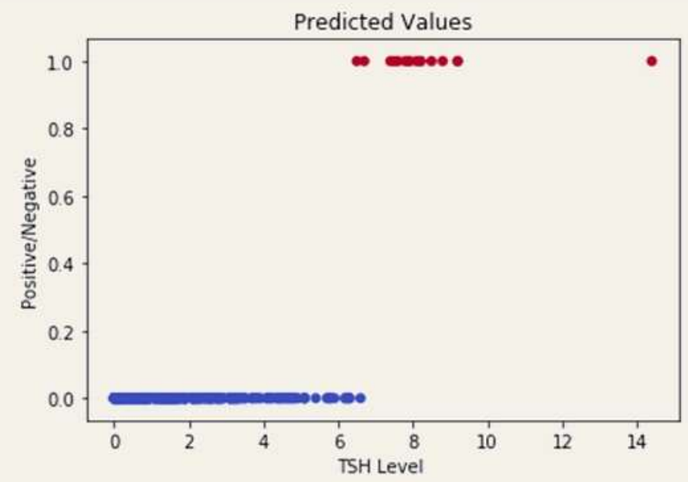

Figure 5: Results of AI Predicted

Figure 4 and 5 illustrates the difference between the predicted and actual values based on TSH levels through the SVM classifier.

We can notice that the difference in prediction and actual values are very low. Hence the AI method can be used for detection of anomaly in hormonal behavior in hypothyroidism.

Conclusion

All too often the routine blood tests fail to detect a significant percentage of low thyroid cases. The present work is an attempt to use AI to reduce dependency of human effort intensive methods. Simple mobile based applications developed using AI may help in early screening of hypothyroidism in point of care for laboratories.

References

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