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## An Enhanced Early object Detection of Driver Drowsiness Using supervised Machine Learning approach by comparing SVM over Decision Tree

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**Keywords:** [driver drowsiness](https://www.mdpi.com/search?q=driver%20drowsiness), [machine learning](https://www.mdpi.com/search?q=machine%20learning), Novel SVM, sleepiness, accuracy, detection, physiological conditions, road traffic accidents.

**ABSTRACT**

**Aim**: The aim is an enhanced early object detection of driver drowsiness using machine learning by comparing supervised Machine learning techniques by comparing SVM over Decision Tree. **Materials and Methods**: SVM and Decision Tree are two techniques that we utilized in this project. Guaranteeing the wellbeing of travelers was a higher priority than it was beforehand in a period where self-driving or robotized vehicles were creating. This is habitually the situation when the driver or traveler can't work an engine vehicle, which lessens car crashes. The mean accuracy of the ongoing review was registered utilizing managed learning with an alpha worth of 0.8, a G-Power worth of 0.8, and a 95% certainty span. **Result**: The Novel SVM has an accuracy of 97.70% after this research, whereas the Decision Tree method has an accuracy of 91.20%. Following the execution of an Independent Samples T-Test analysis, the significance value was determined to be p=.257 (p>0.005), indicating statistical significance. **Conclusion:** The Novel SVM method and the Decision Tree algorithm are combined in the current study. Following the execution of the current study experiment, it was discovered that the Novel SVM method was more perfect than the Decision Tree.

**Keywords:** [driver drowsiness](https://www.mdpi.com/search?q=driver%20drowsiness), [machine learning](https://www.mdpi.com/search?q=machine%20learning), Novel SVM, sleepiness, accuracy, detection, drowsy state, road traffic accidents.

**INTRODUCTION**

The development of technologies for detecting and avoiding drowsiness at the wheel is a major challenge in the field of road traffic accidents avoidance systems[(Picot et al. 2008)](https://paperpile.com/c/8Xwkp9/OqhX). Because of the hazard that drowsiness presents on the road, methods need to be developed for counteracting its affects like road traffic accidents (B. Schlkopf-A. Blake, S.Romdhani, and P. Torr 2018). Nowadays Driver fatigue is a major factor in a large number of road traffic accidents. There is a solid relationship between genuine tiredness and emotional assessment in view of looks [(Liu et al. 2010)](https://paperpile.com/c/8Xwkp9/NtfP)). Hence, checking a driver's looks is a broadly acknowledged strategy for recognizing driver sleepiness which helps in reducing road traffic accidents[(Borghini et al. 2014)](https://paperpile.com/c/8Xwkp9/8XL2). By monitoring the eyes, physiological conditions it is believed that the symptoms of driver fatigue can be detected early enough to avoid road traffic accidents. Neglecting our duties towards safer travel has enabled hundreds of thousands of tragedies to get associated with this wonderful invention every year. It may seem like a trivial thing to most folks but following rules and regulations on the road is of utmost importance. While on road, an automobile wields the most power and in irresponsible hands, it can be destructive and sometimes, that carelessness can harm lives even of the people on the road. One kind of carelessness is not admitting when we are too tired to drive. In order to monitor and prevent a destructive outcome from such negligence, many researchers have written research papers on driver drowsiness detection systems. But at times, some of the points and observations made by the system are not accurate enough. Hence, to provide data and another perspective on the problem at hand, in order to improve their implementations and to further optimize the solution, this project has been done.

The research papers are collected from the last 5 years i.e., 2018-2022 and almost 300 research articles have been reported in “IEEE Xplore” and all over 390 research papers are published in the “Science Direct '' on driver drowsiness. The IEEE Explore and ScienceDirect are considered as the main databases in collecting the research papers for this research experiment. Observing head position, eye squints, and body development (Y. Yin, Y. Xio 2010) has likewise been utilized to recognize driver sleepiness [(Seifoory et al. 2011)](https://paperpile.com/c/8Xwkp9/Tc2C). What's more, physiological conditions are broadly used to identify driver sleepiness since it straightforwardly mirrors the inward physiological conditions of drivers which helps in reducing road traffic accidents [(Danisman et al. 2010)](https://paperpile.com/c/8Xwkp9/mirv). Additionally, we believe that drowsiness can negatively impact people in working and classroom environments as well [(Bhattacharyya et al. 2018)](https://paperpile.com/c/8Xwkp9/LFAX). Although sleep deprivation and college go hand in hand, drowsiness in the workplace especially while working with heavy machinery may result in serious injuries similar to those that occur while driving drowsily ([Welsh et al. 2002)](https://paperpile.com/c/8Xwkp9/PYoL). Our solution to this problem is to build a detection system that identifies key attributes of drowsiness and triggers an alert when someone is drowsy before it is too late [(Jap et al. 2009)](https://paperpile.com/c/8Xwkp9/ZmUW).

Decision Tree is the most powerful and popular tool for classification and prediction. A Decision tree is a flowchart-like tree structure, where each internal node denotes a test on an attribute, each branch represents an outcome of the test, and each leaf node (terminal node) holds a class label [(Kim and Shin 2014](https://paperpile.com/c/8Xwkp9/u2XG)). Besides, it computes the significance of elements. To examine the execution of the grouping framework, we likewise assessed the exhibition of characterization not just utilizing full crossover measures [(McKnight 1998)](https://paperpile.com/c/8Xwkp9/1k42) yet additionally utilizing half and half measures without physiological conditions, sleepiness measures, as these are viewed as more challenging to carry out than different measures and helps in reducing road traffic accidents[(Chowdhury et al. 2018)](https://paperpile.com/c/8Xwkp9/aICS). With 80% accuracy, it is obvious that there are limitations to the system. The most significant limitation is that it will not work with people who have very dark skin. This is apparent, since the core of the algorithm behind the system is based on binarization[(Dinges and Grace 1998)](https://paperpile.com/c/8Xwkp9/gACH). For dark skinned people, binarization doesn’t work. The more uniform the background is, the more robust the system becomes. For testing purposing, a black sheet was put up behind the subject to eliminate this problem. For testing, rapid head movement was not allowed. This may be acceptable, since it can be equivalent to simulating a tired driver. For small head movements, the system rarely loses track of the eyes. When the head is turned too much sideways there were some falsealarms.In addition, SVM, kNN and decision tree classification methods are used to for eye state and driver drowsiness detection.

**MATERIALS AND METHODS**

The current experimentation work has been carried out in the Machine Learning Laboratory at Saveetha School of Engineering, Saveetha Institute of Medical And Technical Sciences (SIMATS), Chennai. The dataset for this particular research study was sourced from the driver drowsiness. The database is set up so that testing takes up 25% of its space, while 75% of it is used for training. Two sets are used, and each set has 10 data samples, for a total of twenty samples that are taken into account. The Novel SVM algorithm was used in Group I, and Decision Tree algorithm was used in Group 2. The implementation makes use of Python software. The G power was set at 80%, the confidence interval was set at 95%, and the significant value p for the calculation was set at 0.257.

**SVM Algorithm**

The objective of the support vector machine algorithm is to find a hyperplane in an N-dimensional space(N — the number of features) that distinctly classifies the data points.To separate the two classes of data points, there are many possible hyperplanes that could be chosen. Our objective is to find a plane that has the maximum margin, i.e the maximum distance between data points of both classes. Maximizing the margin distance provides some reinforcement so that future data points can be classified with more confidence.Support vectors are data points that are closer to the hyperplane and influence the position and orientation of the hyperplane. Using these support vectors, we maximize the margin of the classifier. Deleting the support vectors will change the position of the hyperplane. These are the points that help us build our SVM.

## Pseudocode

**Inputs:** Determine the various face detection of driver drowsiness and test data, D=[X,Y]; X(array of input), Y(array of class labels)

**Outputs:** Determine the calculated accuracy. Select the optimal value of cost and gamma for SVM.

**Function:**

**while**(face detection is not met) do

Implement SVM for each data point.

Implement SVM classify for testing data points

**and while**

**Return** accuracy

**Decision Tree Algorithm**

Decision trees are a popular [machine learning algorithm](https://www.analyticsvidhya.com/blog/2022/01/machine-learning-algorithms/) that can be used for both [regression](https://www.analyticsvidhya.com/web-stories/5-regression-techniques-you-should-know/) and [classification](https://www.analyticsvidhya.com/blog/2022/07/classification-using-pyspark-databricks-and-koalas/) tasks. They are easy to understand, interpret, and implement, making them an ideal choice for beginners in the field of [machine learning](https://www.analyticsvidhya.com/machine-learning/). It is a tool that has applications spanning several different areas. Decision trees can be used for classification as well as regression problems. The name itself suggests that it uses a flowchart like a tree structure to show the predictions that result from a series of feature-based splits. It starts with a root node and ends with a decision made by leaves[(I. Garcia, S. Bronie 2010)](https://paperpile.com/c/kC6PzF/OFbt).

**Pseudocode**

**Input:** Training attributes and data set,

**Output:** A class of testing data of face detection images

**Function:**

* node = DecisionTreeNode(examples)

# handle target attributes with arbitrary labels

* dictionary = summarizeExamples(examples, targetAttribute)
* for key in dictionary:

if dictionary[key] == total number of examples

node.label = key

return node

# test for number of examples to avoid overfitting

* if attributes is empty or number of examples < minimum allowed per branch:

node.label = most common value in examples

return node

* bestA = the attribute with the most information gain
* node.decision = bestA
* for each possible value v of bestA:

subset = the subset of examples that have value v for bestA

if subset is not empty:

node.addBranch(id3(subset, targetAttribute, attributes-bestA))

* return node

Commonly a decision tree is drawn using [flowchart](https://en.wikipedia.org/wiki/Flowchart) symbols as it is easier for many to read and understand. Note there is a conceptual error in the "Proceed" calculation of the tree shown below; the error relates to the calculation of "costs" awarded in a legal action. Decision trees can also be seen as [generative models](https://en.wikipedia.org/wiki/Generative_model) of induction rules from empirical data. An optimal decision tree is then defined as a tree that accounts for most of the data, while minimizing the number of levels (or "questions").Several algorithms to generate such optimal trees have been devised.

**STATISTICAL ANALYSIS**

For this project, Python was used to make the output. All tests for this study were performed on a Windows 10 computer with an Intel Core i5-8250U CPU operating at 3.20GHz and 8GB of RAM. In this work, the SPSS tool is used to statistically analyse the Novel SVM and Decision Tree. To compare the two samples separately, we used SPSS to determine the means, standard deviations, and standard errors of means. Accuracy is a dependent variable, whereas SVM and Decision Tree are independent factors. By comparing the above-collected data between the Novel SVM algorithm and Decision Tree Algorithm, the Independent samples T-Test analysis has been carried out..

**RESULTS**

The Novel SVM is more accurate than the Decision Tree classification model, which has an accuracy score of 97.70%. Figure 1 compares the accuracy of the Novel SVM method with the Decision Tree method.(Test of Independent Samples, p 0.005) The SVM classifier and Decision Tree classifier are highly dissimilar from one another. The accuracy rates for SVM and Decision Tree are shown along the X-axis. Y-axis: 95% confidence interval around the mean of the standard deviation for keyword identification accuracy.

The suggested Novel SVM algorithm's T-Test results are shown in Table 1, along with those of the comparative Decision Tree, with a sample size of 10 runs in the Jupyter notebook. According to Table 1, the accuracy of the SVM method is 97.70%, while the accuracy of the decision tree approach is determined to be 91.20%. Both the Novel SVM method and the Decision Tree algorithm have had their standard deviation and standard error mean determined.

The accuracy level parameter is used in the t-test. The proposed method's mean accuracy is 93.2920 percent, whereas the Decision Tree classification algorithm's mean accuracy is 91.9130 percent. Table 2 displays the statistical computations for the Decision Tree and SVM classifiers, including mean, standard deviation, and mean standard error. The standard deviation of the Decision Tree method is 2.66115, whereas that of the SVM is 2.60171. The mean standard error of the Decision Tree technique is 0.84153, whereas that of the SVM method is 0.82273.

The significance threshold for the accuracy rate is 0.815. The SVM and Decision Tree algorithms are compared using the independent samples T-test, with a 95% confidence interval and a significance level of 0.056. Table 3 displays the statistical calculations for the independent variables of the SVM in contrast to the Decision Tree classifier. The statistical significance indicators used in this test of independent samples are the mean difference, standard error of the mean difference, lower and upper interval differences, significance two-tailed p = 0.257(p < 0.005), and a p value of 0.257.

**DISCUSSION**

The neural network's test set makes up 30% of the total database, while the training set makes up 70%. The SVM technique is effectively evaluated against the Decision Tree on the basis of performance analysis structure (D. F. Dunges and R. Grace 1998). Python is used in a windowed environment to simulate the performance of the proposed Novel SVM and Decision Tree model. In order to process face photographs later, the system may extract features and parameters from the data set and save them in a CSV file. To ascertain the importance of two-tailed p =0.257(p < 0.005) of each input parameter, an accuracy study was undertaken. Compared to the Decision Tree technique, the SVM algorithm delivers more accurate results. Results from experiments show that the suggested SVM technique.

When compared to the DT calculation, two group computations (SVM and Decision Tree) had larger upsides across the board. When grouping the ready and the slightly slow express, physiological conditions, the Decision Tree calculation had especially better upsides of discovery exactness, accuracy, and F1 compared to the SVM calculation; its recognition precision was 97.70% [(Rani et al. 2016)](https://paperpile.com/c/8Xwkp9/L6Cl). Table 3 lists the benefits of the ready vs somewhat drowsy and ready versus fairly fatigued or more arrangements of readiness and sleepiness condition as a result of using complete crossover assessments. While ordering the ready and the reasonably (or more than moderately) tired condition, the SVM calculation achieved greater upsides of discovery exactness, accuracy, and F1 compared to the Decision Tree calculation; its detection accuracy was 91.20%.

In every instance, the Decision Tree computation outperformed the MVC estimation in terms of disclosure precision, exactness, audit, and F1 divergence [(Li et al. 2016)](https://paperpile.com/c/8Xwkp9/v9Un). Because the Decision Tree computation grouped the ready vs barely fatigued and the ready versus respectably sluggish sleepiness states independently, it was able to obtain location accuracy gains of 88.7% and 91.20%. Table 4 contains the values that the calculations reveal despite physiological conditions and sleepiness. When physiological conditions were disregarded, discovery accuracy dropped from 3.5% to 9.0% compared to the scenario when all steps were taken.

**CONCLUSION**

The aim of the present experimentation research is to detect the face of driver drowsiness. This project uses the localization of the eyes, which involves looking at the image of the face, and determining the position of the eyes by developing a matlab program. Once the position of the eyes is located, the system is designed to determine whether the eyes are opened or closed, sleepiness and detect drowsiness. The purpose of this study is to detect drowsiness in drivers to prevent road traffic accidents and to improve safety on the highways. The novel SVM and Decision Tree are implemented in the suggested model in this study, where the SVM achieves higher levels of accuracy. The SVM is 97.70% more accurate than the Decision Tree, whose accuracy rating is just 91.20% accurate, in an Enhanced Early object Detection of Driver Drowsiness with enhanced accuracy using machine learning approach.

# DECLARATIONS

## Conflict of Interests

No conflict of Interest in this manuscript.

## Authors Contributions

Author NJR was involved in data collection, data analysis and manuscript writing. Author SSA was involved in the conceptualization, data validation and critical review of manuscript.

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**TABLES AND FIGURES**

**TABLE -1:** The performance measurements of the comparison between the SVM and Decision Tree classifiers are presented in Table 1. The SVM classifier has an accuracy rate of 97.70, whereas the Decision Tree classification algorithm has a rating of 91.20. With a greater rate of accuracy, the SVM classifier surpasses the Decision Tree in drowsiness detection.

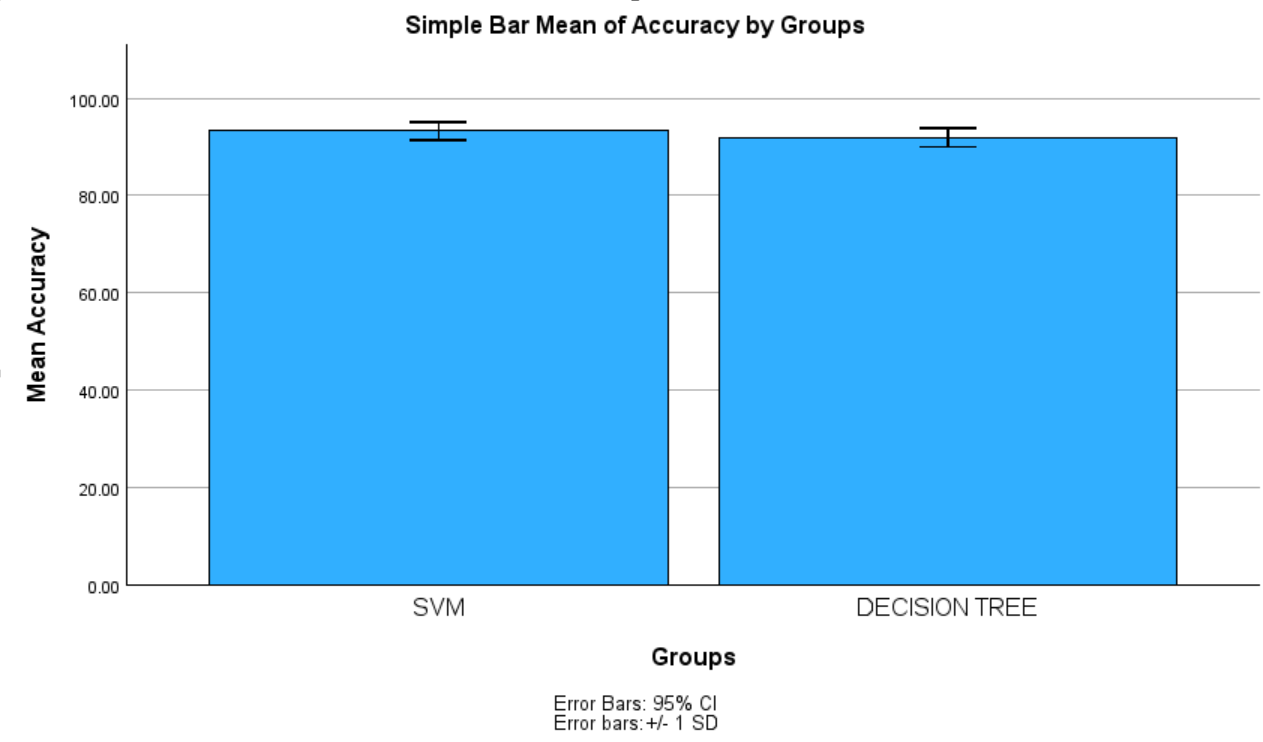
| S.0 | SVM | DECISION TREE |
| --- | --- | --- |
| 1 | 97.7 | 91.20 |
| 2 | 97.30 | 90.86 |
| 3 | 96.50 | 89.90 |
| 4 | 96.80 | 89.40 |
| 5 | 96.35 | 88.76 |
| 6 | 95.90 | 88.16 |
| 7 | 95.28 | 87.86 |
| 8 | 94.86 | 87.23 |
| 9 | 94.16 | 86.97 |
| 10 | 93.69 | 86.44 |

**Table-1 :** Presents the statistical analysis results of the Novel SVM algorithm and the Decision Tree algorithm, comparing the mean accuracy, standard deviation, and standard error mean values across 10 sample datasets.

|  | **Algorithm** | **N** | **Mean** | **Std.**  **Deviation** | **Std. Error Mean** |
| --- | --- | --- | --- | --- | --- |
| **Accuracy** | Novel SVM  Decision Tree | 10  10 | 93.2920  91.9130 | 2.60171  2.66115 | .82273  .84153 |

**Table 2.** An independent sample T-Test was conducted to determine the significance of the difference between the two groups, using a significance level of p=0.257 (p > 0.005), indicating that the difference is statistically significant.

|  | **Leven’s Test for Equality of**  **Variances** | | **T-Test for Equality of Means** | | | | | **95%**  **Confidence Interval of the Difference** | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **F** | **Sig.** | **t** | **df** | **Sig.(2-**  **tailed p value)** | **Mean Differ ence** | **Std. Error Differe nce** | **Lowe r** | **Upper** |
| **Accuracy** |  |  |  |  |  |  |  |  |  |
| Equal Variances assumed | .056 | .815 | 1.172 | 18 | .257 | 1.37900 | 1.17689 | -1.09355 | 3.85155 |
|  |  |  |  |  |  |  |  |  |  |
| Equal Variances not assumed |  |  | 1.172 | 17.991 | .257 | 1.37900 | 1.17699 | -1.09364 | 3.85164 |

**Fig. 1.** This figure shows the comparison between the SVM algorithm and the Decision Tree algorithm in terms of Mean Accuracy. The Mean accuracy of the Novel SVM is better than the Mean accuracy of the SVM algorithm. X-axis: Novel SVM algorithm vs Decision Tree algorithm, Y-axis: Mean Accuracy. Error Bar +/-1SD