Using Machine Learning on Naturalistic Driving Data to Predict Mild Cognitive Impairment

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Objective
To implement machine learning models in Python using extracted turning data to seek the answer to this question: does naturalistic driving signature data aid cognitive diagnosis and Alzheimer Disease risk?

Background
Due to the lack of FDA-approved medications for controlling Alzheimer’s Disease, it would be optimal to treat Mild Cognitive Impairment (MCI) [1]. One promising approach is to collect continuous data from individuals in what is known as “free-living conditions”, such as driving [2].

Feature Engineering-Identifying Turns

- Calculation of peaks in latitude and longitude data
- Isolated gradients that met a 30° angle threshold
- Used Numpy and Pandas

Ablation Study Results

<table>
<thead>
<tr>
<th>Category 1</th>
<th>Category 2</th>
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<tbody>
<tr>
<td>V, Cat 4, X</td>
<td>V, Cat 4, Y</td>
</tr>
<tr>
<td>V, Cat 4, Z</td>
<td>V, Cat 4, R</td>
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<tr>
<td>V, Cat 4, S</td>
<td>V, Cat 4, T</td>
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<tr>
<td>V, Cat 4, U</td>
<td>V, Cat 4, W</td>
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</tbody>
</table>

| Best | 51% | 65.4% | 68% |

Top Performing Experiment: V, Cat 4
Increased accuracy by a min of -0.3% to a max of 4.2% with a mean of 0.61% and std of 1.49%.

Conclusion

- Experiment V is the best performing, which includes the accelerometer sensor in the x, y, z direction along with the radial acceleration, speed, and gyroscope in the z direction.
- Utilizing the medians in testing groups positively impacts the prediction, implying that more descriptive statistics help.
- Excluding the turn number improved accuracy, showing that driving patterns for prediction are independent of trip progression.

Acknowledgements

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Future Work

- Add descriptive statistics to each parameter: avg, std dev, range, coefficient of variation
- Test one by one into the models of the best experiments
- Find combinations that lead to significant results
- Make new conclusions to perform additional experiments
- Honors Thesis: develop my own models using these findings in hopes to attain better results that can help accurate prediction of MCI

Acknowledgements

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References