



Autonomous Vehicles Disengagement Reports Analysis

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Abstract

Autonomous Vehicles today have plenty of reasons for disengagements due to the technology not being as advanced in the current times. The dataset used in this study contains reports of disengagements from California's Department of Motor Vehicles. Each report contains a multitude of information regarding each vehicle and each disengagement that was reported to the state department by various companies holding permits for the testing of self-driving vehicles from December 1, 2018 to November 30, 2019. The purpose of this study is to analyze and visualize this dataset as it can highlight where the technology is still struggling and allow for the discovery of various trends and inferences which would help in problem solving just by a look at a multitude of graphs. In this study, python and its libraries (pandas, matplotlib, numpy, and seaborn) were applied and used to plot various graphs and conduct detailed analyses while highlighting the various features of the reports.

Motivation

Kaggle is a great and well-known source for millions of datasets and allows for many users to engage, connect, and collaborate with others. By using this source to analyze the disengagement reports and bringing light to various trends in autonomous vehicles, this study can extend the research done not only in the IDS lab, but it would also allow for improvements in the vehicles in terms of their mechanical design and the software used in the AV systems through showcasing of where the vehicle is struggling.

Procedure

Go through dataset and clean it to make sure everything is uniform and there are no unknown anomalies that would mess up the analysis. For example, fixing tiny errors such as capitalization issues of "street" compared with "Street" through various python commands along with the use of pandas library.

Implement different analyses through the various visualization and aggregation options available to find the best fit.

Debug code after each visualization and make sure it matches up in terms of accuracy with the reports through comparisons.

Display various visualisations and draw inferences and identify various trends to discover strengths and weaknesses through the reports.

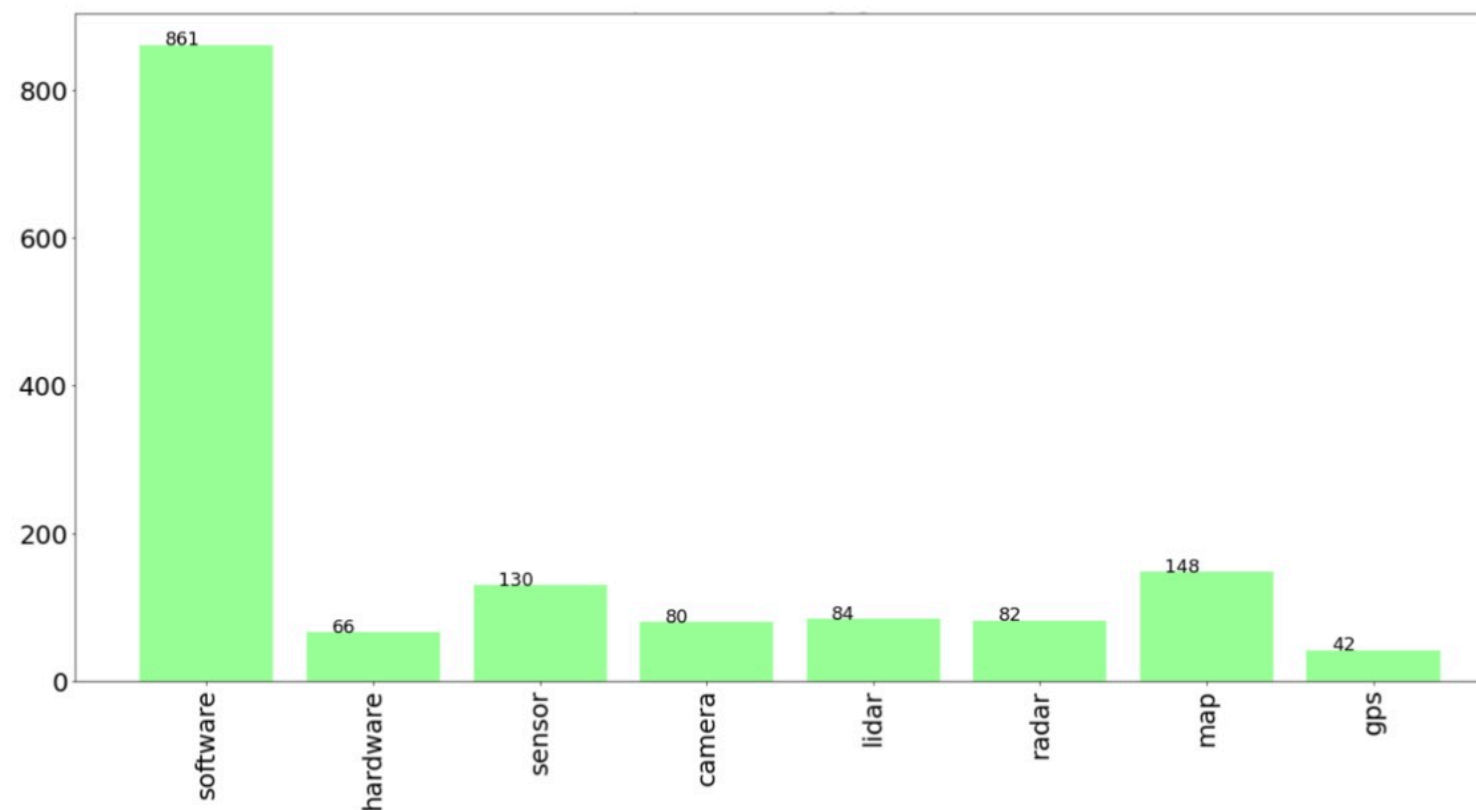


Figure 1. Comparison Of Different Causes of Disengagements

Results & Conclusion

Through the use of various libraries in python and their capabilities, a multitude of charts and plots were generated in order to visualize the various trends and problems reported by the dataset.

Taking a look at all the graphs separately and together, the results show that the autonomous vehicles are still in an introductory stage due to:

- Majority of disengagements initiated by the test driver rather than the av system, showing that the driver has to identify when a disengagement should occur rather than the system itself
- Number of disengagements increasing along with number of vehicles being tested increasing
- Multitude of disengagements occurring due to weather conditions and in construction zones, showing that av systems still need to adjust to various conditions.

Moreover, the majority of issues have been found in the software part of the autonomous vehicle systems rather than the hardware, locating where improvement in the systems is required. Within the software systems, trajectory and planning are the parts that caused the most disengagements, signaling that the estimation part of the software system requires a lot of work. We will continue to work on more rigorous analyses to uncover more and more problems as the autonomous vehicle community progresses.

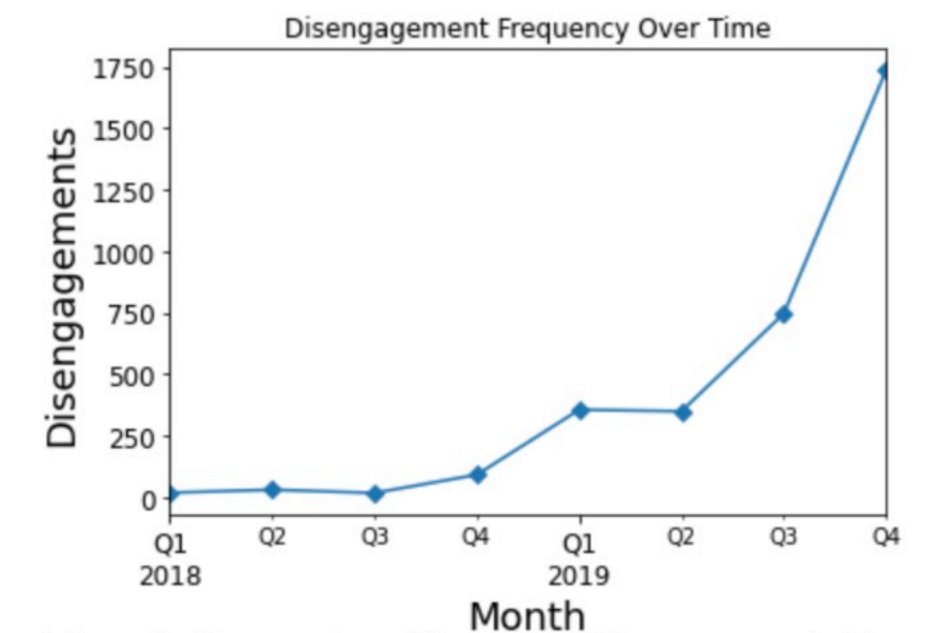


Figure 2. Progression of Number of Disengagements By Quarter

```
#Disengagement Initiated By
catinitiate = df['Disengagement Initiated By'].unique().tolist()
catinitiate.pop()
plt.figure(figsize=(25,6))
plt.title('Disengagement Initiated By', fontsize = 18)
vcountinitiate = df['Disengagement Initiated By'].value_counts().tolist()
colors = ['#66b3ff', '#ff9999', '#99ff99', '#ffcc99']
plt.pie(vcountinitiate, labels= catinitiate, autopct = '%0.2f%', colors= colors)
plt.axis('equal')
centre_circle = plt.Circle((0,0),0.70,fc='white')
fig = plt.gcf()
fig.gca().add_artist(centre_circle)
plt.show()
```

Figure 3. Code Snippet Portraying A Bar Graph

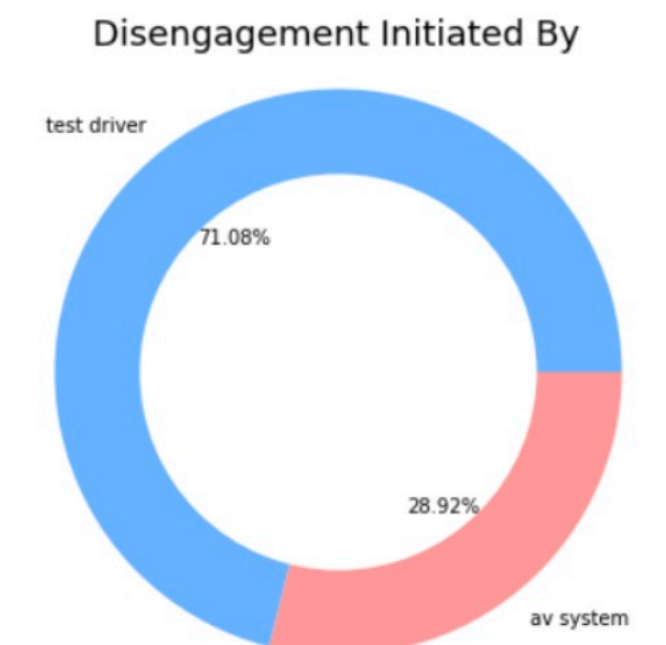


Figure 4. Percentages of Disengagements Initiated By