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Next Service Date Forecasting for Commercial Vehicles

- Using Large Amount of Time-Series Connectivity Data from Global Tractor Fleet -

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Nowadays, modern commercial and agricultural machines are often equipped with sensors and connectivity devices, which can send selected information from the vehicle to the cloud environment of the vehicle manufacturer. This large amount of data coming from different vehicles spread around the world opens a wide range of possibilities in terms of data driven analytics that can support users, dealers, and manufacturers in their decision-making process. If this large amount of time series data is properly processed and interpreted, it can be exploited to derive for example preventive technical actions to mitigate the risk of specific failures or to prevent higher down time of the product.

In the automotive sector, significant efforts are dedicated to after sales activities. As products degrade with usage and environmental influences, predictive maintenance is widely employed to estimate the state of health of various components and consequently predict when their maintenance should be performed. Knowing when maintenance will be needed enables better planning of the activities, workload and needed service parts.

Although this proactive scheduling of the vehicle services is beneficial for all types of vehicles, and the methodology would not change significantly, we here focus on agriculture vehicles. The objective of the proposed methodology, developed for an agriculture OEM, is to support the dealers for commercial and agriculture vehicles in efficiently planning workload and resources in view of upcoming maintenance tasks. In fact, every vehicle is entitled to regular services. The frequency of these services usually depends on the vehicle configuration, and it is defined in terms of engine hours. Consequently, these services do not happen at intervals which are equally spaced in time. The date of the upcoming service strictly depends on how extensively the vehicle is operated between services. However, being able to predict in advance the date the vehicle will arrive to the workshop is very beneficial for the dealer. By planning in advance resources, it can provide a more efficient service and increase customers satisfaction. In fact, as a consequence, the service can be carried out without delays and the customer work routine is not affected significantly.

More specifically, the main objective of this machine learning based model is, to be able to predict (1) six weeks in advance the correct week the vehicle will go to the workshop and (2) one week in advance the correct day. The predictive model is developed considering not only the telemetry data collected and sent by the vehicles, but also historical weather conditions data collected by weather stations in the surrounding of the operation area of these vehicles. . As shown in Figure 1, these two datasets are then merged into a single prepared dataset and split into train and test datasets to train and evaluate the performance of the model. Feature ranking is then applied to select the most informative aggregation to use as inputs to the machine learning model and the actual model is developed and evaluated. Of course, the results of the evaluation phase can trigger changes to the initial dataset preparation as well as the feature selection and modelling. Once the final model is selected and deployed, we can infer the future behavior of the vehicle in terms of operating hours per day and consequently predict the date the upcoming service is due.

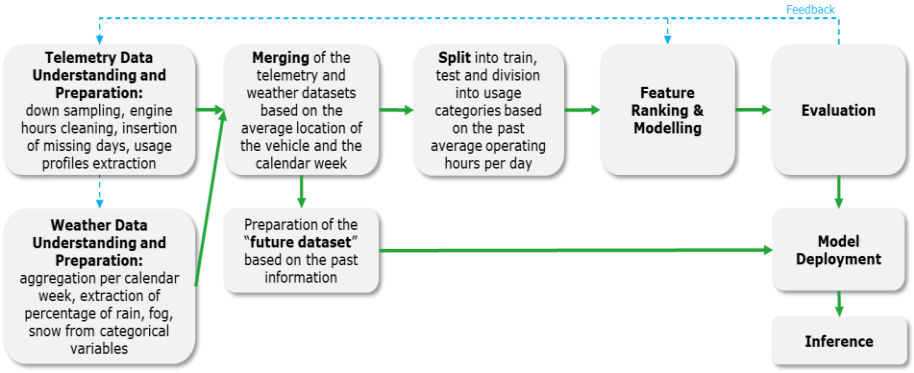

Figure 1: Process Overview.