

CLAIMS

1. One or more non-transitory computer-readable media storing computer-executable instructions that upon execution cause one or more processing systems on-board a vehicle to perform acts for measuring a performance of a driver of a vehicle, comprising:

monitoring performance data relating to a handling of a vehicle by a driver, wherein the performance data includes selected data from one or more of: a plurality of sensors, a diagnostic module, an engine control unit module, and a self-driving module;

identifying at least one risky event by analyzing the performance data, wherein the performance data fails to meet at least one predetermined threshold during the at least one risky event;

analyzing the performance data and the at least one risky event using a trained machine learning model to determine a severity level for the at least one risky event, the trained machine learning model employing machine learning algorithms to analyze the performance data;

when the trip is complete, assigning a trip severity level using the severity level of the at least one risky event and determining a trip score using the trip severity level;

generating at least one driver score using at least the trip score and the trip severity level for presentation via a user interface; and

refining the machine learning model using the at least one driver score, the refining including retraining the machine learning model based on at least one of a training corpus that is modified based on the performance data.

2. The one or more non-transitory computer-readable media of claim 1, wherein the acts for measuring the performance of the driver of the vehicle further comprise:

notifying at least one user of the at least one driver score via the user interface.

3. The one or more non-transitory computer-readable media of claim 1, wherein the performance data includes data from one or more of: a plurality of sensors, a diagnostic module, an engine control unit module, and a self-driving module.

4. The one or more non-transitory computer-readable media of claim 1, wherein the acts for measuring the performance of the driver of the vehicle further comprise:

triggering recording of video using a camera on-board the vehicle;

utilizing, via the vehicle module, an object detection algorithm to draw object bounding boxes around identified objects in the recorded video;

transmitting coordinates of the bounding boxes to the one or more processors, via a communication link between the camera and the one or more processors, for processing the at least one risky event;

analyzing, by the one or more processors, the performance data and recorded video data using vehicle threshold events to identify the at least one risky event, wherein the recorded video data includes the identified objects in the recorded video and the coordinates of the bounding boxes for the identified objects; and

transmitting using the communications interface the recorded video data to a data platform.

5. The one or more non-transitory computer-readable media of claim 4, wherein a memory device on-board the vehicle saves 10 seconds of the recorded video before and after the at least one risky event.

6. The one or more non-transitory computer-readable media of claim 4, wherein the acts for measuring the performance of the driver of the vehicle further comprise:

identifying an object outside the vehicle from the recorded video using the object detection algorithm; and

transmitting latitude and longitude coordinates of the identified object to a diagnostic module processor for further processing to determine an effect of the identified object on the at least one risky event.

7. The one or more non-transitory computer-readable media of claim 4, wherein the acts for measuring the performance of the driver of the vehicle further comprise:

triggering storing of vehicle data from a diagnostic module, an engine control unit module, and a self-driving module; and

analyzing the stored vehicle data, the performance data, and the recorded video data to identify the at least one risky event.

8. The one or more non-transitory computer-readable media of claim 1, wherein the acts for measuring the performance of the driver of the vehicle further comprise:

determining an occurrence of an accident from the performance data; and
transmitting information related to the accident to a third party.

9. The one or more non-transitory computer-readable media of claim 1, wherein the at least one driver score is generated on-board the vehicle using the trip severity level and the trip score.

10. The one or more non-transitory computer-readable media of claim 1, wherein the acts for measuring the performance of the driver of the vehicle further comprise:

updating the least one driver score after the severity level has been assigned to the at least one risky event;

storing the updated driver score on an on-board memory device located on the vehicle; and

transmitting the updated driver score to a remote data database.

11. The one or more non-transitory computer-readable media of claim 1, wherein the at least one driver score is generated on-board the vehicle using at least the trip score, the trip severity level, the at least one risky event, the assigned severity level of the at least one risky event and the performance data for the trip.

12. A computer-implemented method for measuring the performance of the driver of the vehicle, comprising:

receiving, at a processor on a vehicle module on-board the vehicle, performance data relating to a performance of a vehicle from multiple sources on-board the vehicle, wherein the performance data is communicated over a controller area network;

detecting, by the processor on the vehicle module, at least one risky event, wherein the performance data fails to meet at least one predetermined threshold during the at least one risky event or matches a risk pattern model;

triggering, by the processor, recording of video using a camera on-board the vehicle;

identifying, by the processor, one or more objects outside the vehicle in the recorded video and determining coordinates of the one or more identified objects;

analyzing, by the processor, the performance data and recorded video data using vehicle threshold events to identify the at least one risky event, wherein the recorded video data includes the one or more identified objects and the coordinates of the one or more identified objects;

analyzing the performance data and the recorded video data using a trained machine learning model within the processor on the vehicle module to determine a severity level for the at least one identified risky event;

when the trip is complete, assigning, by the processor, a trip severity level using the severity level of the at least one identified risky event and determining, by the processor, a final trip score using the trip severity level; and

generating, by the processor on the vehicle module, at least one driver score using at least the trip score and the trip severity level; and

refining the machine learning model, on the processor of the vehicle module, based on the at least one driver score, the refining of the machine learning model including retraining the machine learning model using at least the performance data.

13. The computer-implemented method of claim 12, wherein identifying, by the processor, the one or more objects outside the vehicle in the recorded video and determining coordinates of the one or more identified objects, comprises:

identifying in the recorded video, by a diagnostic module in communication with the on-board vehicle module, the one or more objects affecting the performance data using an object detection algorithm;

determining latitude and longitude coordinates of the identified one or more objects.

14. The computer-implemented method of claim 12, wherein the one or more vehicle devices on-board the vehicle include at least a diagnostic module, an engine control unit module, and a self-driving module, the method further comprising:

triggering, by the processor, storing of the performance data from the diagnostic module, the engine control unit module, and the self-driving module in response to detecting the at least one risky event; and

analyzing, by the processor, the stored performance data to identify the at least one risky event.

15. A computing system on-board a vehicle, comprising:

a communication interface on-board the vehicle coupled to a controller area network (CAN) bus;

a diagnostic module, an engine control unit module, a plurality of sensors, and a self-driving module on-board the vehicle, wherein the diagnostic module, the engine control unit module, the plurality of sensors, and the self-driving module are coupled to the CAN bus; and

a processing circuit on-board the vehicle and coupled to the CAN bus and wherein the computing system is configured to:

obtain and store performance data relating to a vehicle from the diagnostic module, the engine control unit module, the plurality of sensors, and the self-driving module;

identify at least one risky event, wherein the at least one risky event negatively impacts the performance data to fall below a predetermined threshold or matches a risk pattern model;

determine whether the driver during the at least one risky event is a human driver or the vehicle in a self-driving mode;

analyze video from one or more cameras in the vehicle to identify one or more objects outside the vehicle and determine coordinates of the one or more identified objects;

analyze the performance data and recorded video data using a trained machine learning model to determine a severity level for the at least one ~~each~~ identified risky

event, wherein the recorded video data includes the identified one or more objects and the coordinates of the one or more identified objects

when the trip is complete, assign a trip severity level using the severity level of the at least one risky event and determine a trip score using the trip severity level;

determine a score for risk and safety using at least the trip score and the trip severity level, wherein the score for risk and safety includes a driver score when the vehicle is not in self-driving mode and includes a vehicle score when the vehicle is in self-driving mode; and

notify at least one user of the score for risk and safety via a user interface on the vehicle; and

refine the machine learning model based on the score for risk and safety, the refining of the machine learning model including retraining the machine learning model based on a training corpus that is modified based on the performance data, the recorded video data, and the severity level of the at least one risky event.

16. The computing system of claim 15, wherein the computing system is further configured to:

trigger recording of the video from the one or more cameras in the vehicle for the at least one risky event.

17. The computing system of claim 15, wherein the computing system is further configured to:

identify the one or more objects outside the vehicle from the recorded video using an object detection algorithm; and

transmit the latitude and longitude coordinates of the bounding boxes around the one or more identified objects outside the vehicle to a diagnostic module processor for further processing to determine an effect of the one or more identified objects on the at least one risky event.

18. The computing system of claim 15, wherein the computing system is further configured to:

trigger storing of the performance data from the diagnostic module, the engine control unit module, the plurality of sensors, and the self-driving module; and

analyze the stored performance data to vehicle threshold events to identify the at least one risky event.

19. The computing system of claim 15, wherein the computing system is configured to identify the at least one risky event as one or more of: an accident, braking over a predetermined speed or force, acceleration over a predetermined speed or force, tailgating with an estimated time to collision less than a predetermined time, and no stop or rolling stop.