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Characterizing electric scooter riding behavior to detect unsafe and non-compliant use

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ABSTRACT

The growing popularity of electric scooters has resulted in surfacing individual and public safety concerns associated with riding them. Many of these safety issues are associated with unsafe riding behaviors. While the terms of the riding agreements of scooter companies explicitly prohibit potentially unsafe riding behaviors, automatic and dynamic detection of unsafe riding is not easily possible simply from the location and speed data typically collected by the scooters. This disclosure proposes fitting an electric scooter with a weight-detecting mechanism that allows dynamic determination of riding behavior that indicates unsafe and/or impermissible use. Pattern recognition and/or machine learning is applied to process aggregated weight measurements to identify riding patterns in different riding positions and situations. The scooter provider can then take appropriate action to deter unsafe or non-compliant riding, thus incentivizing safe and responsible riding habits and improving street safety.

KEYWORDS

- Electric scooter
- Riding behavior
- Reckless riding
- Unsafe riding
- Riding violation
- Strain gauge
- Weight distribution

BACKGROUND

Electric scooters are increasingly becoming a common mode of transportation in many cities and towns across the world. The growing popularity of electric scooters has resulted in surfacing individual and public safety concerns associated with riding them. Many of these safety issues are associated with unsafe riding behaviors, such as riding under the influence of alcohol, maneuvering recklessly, overloading the scooter with multiple riders, etc. The danger of unsafe riding to individual and public safety is amplified in areas with high population densities and/or at nighttime, which are common use situations for scooters.

While the terms of the riding agreements of the scooter companies explicitly prohibit such potentially unsafe riding behaviors, automatic and dynamic detection of unsafe riding is not easily possible simply from the location and speed data typically collected by the scooters. Therefore, detecting and stopping the unsafe riding behaviors that violate these terms currently relies on a manual approach, requiring an intervention from an authoritative figure such as a police officer or security guard.

DESCRIPTION

This disclosure presents techniques to perform dynamic characterization of electric scooter riding behavior, with the rider’s permission. The characterization can then be used to determine if the riding behavior indicates unsafe and/or impermissible use of the electric scooter. To this end, an electric scooter is fitted with a weight-detecting mechanism that uses one or more weight-measuring scales distributed under and/or within the base of the scooter.

The scales include multiple load cells, such as strain gauge load cells, in a distributed grid pattern placed across different sections of the scooter. Each load cell reports the weight it detects. The weight detected by each cell is dependent on the rider’s riding position and posture. As a result, each cell detects and reports different weights based on how the rider is situated on the scooter, thus creating a heatmap-like dataset of weight measures. Based on these measurements, the overall weight-detection mechanism can be used to measure the distribution of the rider's footing and weight across the base of the scooter based on the placement pattern of the weight-measuring scale(s) under and/or within the base. Additionally, the mechanism can take into account objects, such as a backpack, grocery bag, etc. that may be placed on the scooter.

With permission from the rider, the measured weight patterns are recorded and analyzed either locally onboard the scooter itself or remotely via a cloud-based system. An analysis module is used to apply pattern recognition and/or machine learning techniques that process the aggregated weight measurements to identify common riding patterns of riders in different riding positions and situations. The analysis can be performed by combining the weight measurements with corresponding speed and location data obtained from the electric scooter.

The identified riding patterns can then indicate if the riding scenario is potentially undesired or impermissible, such as riding while inebriated, carrying multiple riders, riding recklessly, etc. Detection of such scenarios is based on corresponding weight measurement patterns. For instance, inebriated riders may frequently shift their weights, may lean toward the front, may take a foot off the scooter to maintain balance, etc. A training set of weight measurements associated with specific riding behaviors can be generated by having one or more riders simulate the behavior under safe controlled conditions. Once sufficient training data needed for detecting riding behavior with a reasonable level of confidence is gathered, a pattern recognition model is applied in real time to identify real-world riding behavior.

An alert is raised in real time when the analysis module indicates that the rider is riding in a manner that is potentially dangerous to the safety of the rider and/or others in the vicinity and/or engaging in riding actions that violate the terms of riding described by the provider of the electric scooter. Such riding behavior can include scenarios such as drunk riding, overloading, carrying multiple riders, speeding, performing riding stunts, etc. The alert is passed on to the provider of the electric scooter along with the corresponding reason. The provider can then take appropriate mitigating action based on the circumstances that resulted in the alert. For instance, for relatively minor transgressions, the rider can be shown a warning and asked to remedy the issue. On the other hand, for major violations, the scooter can be made to come to a gradual halt in a safe manner. Further, the rider's access to the scooter service can be turned off temporarily or permanently.

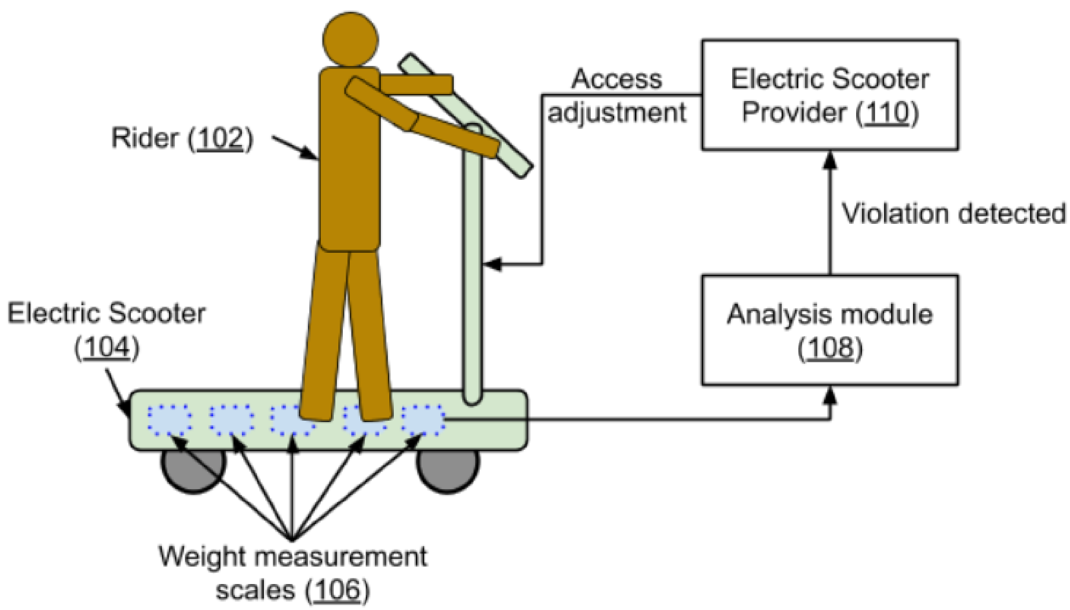

Fig. 1: Using weight measurement scales to detect electric scooter riding behavior

Fig. 1 shows a rider (102) on an electric scooter (104) fitted with weight measurement scales (106) as described above. The weight measurements recorded by the scales are analyzed by an analysis module (108) to examine whether the measurement patterns indicate that the riding behavior of the rider is potentially unsafe and/or in violation of the terms of service of the electric scooter provider (110) describing the agreement between the rider and the provider regarding permissible use of the electric scooter. When riding behavior that is potentially unsafe and/or in violation of the agreement is detected, the electric scooter provider is alerted (110). Depending on the nature of the riding situation that caused the alert, the provider can take appropriate mitigating action, such as slowing down or stopping the scooter.

The described techniques enable electric scooter providers to monitor compliance with the riding parameters specified in the terms of service for the use of the scooter, thus ensuring safety for the rider and other parties, such as pedestrians, car drivers, bikers, etc. The system can utilize regularly updated measurements that allow dynamic real-time operation. Moreover, the automated nature of the operation obviates the current reliance on detection and intervention by external human actors, such as law enforcement. Implementation of the described techniques can thus incentivize safe and responsible riding habits and increase street safety for all stakeholders.

In addition to real-time applications, the weight measurements obtained by the system with rider permission can serve as a source of riding history. If the rider permits, such historical record can provide a characterization of riding behavior during the rider's past rides. The characterization can then be used for various purposes, such as determining situational details in the case of an accident. For instance, the historical data may indicate that the rider's feet were off the scooter in an attempt to avoid a collision. Further, with rider permission, historical riding data pertaining to specific incidents, such as accidents, can be utilized to train a machine learning model. The trained model can then be deployed for real-time prediction of accident-prone situations, thus providing an opportunity to mitigate the situation.

If the rider permits, the riding analytics produced by the application of the techniques described in this disclosure can be combined with other relevant data to enable additional insight on patterns of riding behavior that cannot be derived from the data currently recorded by the scooters. Moreover, with rider permission, riding data can be combined across riders to surface common riding patterns based on the riding behavior of the collective.

Weight measurements as described herein are obtained with specific permission from the rider. For example, a scooter provider can include such permission in terms of service and obtain user consent before each ride. Further, the weight measurements can be treated such that no user-specific data is stored, e.g., by storing relative weight values for different sensors, but not storing the actual weight value.

Further to the descriptions above, a user may be provided with controls allowing the user to make an election as to both if and when systems, programs or features described herein may enable collection of user information (e.g., information about a user's social network, social actions or activities, profession, a user's preferences, or a user's current location), and if the user is sent content or communications from a server. In addition, certain data may be treated in one or more ways before it is stored or used, so that personally identifiable information is removed. For example, a user's identity may be treated so that no personally identifiable information can be determined for the user, or a user's geographic location may be generalized where location information is obtained (such as to a city, ZIP code, or state level), so that a particular location of a user cannot be determined. Thus, the user may have control over what information is collected about the user, how that information is used, and what information is provided to the user.

CONCLUSION

Electric scooters are fitted with a weight detection mechanism that allows dynamic determination of the riding behavior that indicates unsafe and/or impermissible use with rider permission. Pattern recognition and/or machine learning techniques are applied to analyze aggregated weight measurements to identify riding patterns in different riding positions and situations. A scooter provider can then take appropriate actions to deter unsafe or non-compliant riding, thus incentivizing safe and responsible riding habits and increasing street safety.

REFERENCES

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