DCM-ICV

Joint development of dual carbon management system for smart networked vehicles

Programm / Ausschreibung	IWI, IWI, TECXPORT: Bilaterale FTI-Calls Ausschreibung 2022	**Status**	abgeschlossen
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Zeitraum	2023 - 2025	**Projektlaufzeit**	26 Monate
Keywords	Edge computing; AI - Deep Learning; Big Data; Data Transmission Technologies; Climate-friendly mobility		

Projektbeschreibung

Die Förderung von Kohlenstoffspitzenwertreduzierung und Kohlenstoffneutralität ist zu einer der wichtigsten strategischen Entscheidungen in China geworden. Der gemeinsam vom Ministerium für Industrie und Informationstechnologie, der Entwicklungs- und Reformkommission und anderen Ministerien und Kommissionen herausgegebene "Implementierungsplan für Kohlenstoffspitzenwerte im Industriesektor" schlägt vor, "energiesparende und neue Energiefahrzeuge energisch zu fördern und die integrierte technologische Innovation von intelligenten, vernetzten Fahrzeugen zu stärken". Die UN hat mit Ihren Nachhaltigkeitszielen 2030 eine ähnliche Strategie für wohnenswerte Städte und Klimaaktivismus ausgerufen.
Speziell in China gibt es das Problem von fehlenden intelligenten Informationsmanagements in bestehenden Fahrzeugmanagementplattformen und hohe städtische Emissionsbelastungen. Es gibt, wenn überhaupt, nur Insellösungen mehheitlich ausländischer Hersteller für vernetze Sensorik in Fahrzeugen.
Ein intelligentes, netzwerkverbundenes Managementsystem für die Kohlenstoffemissionen von Fahrzeugen soll daher erforscht werden, um diese Problem zu lösen und nachhaltige, großflächige Aussagen über CO2 Belastungen und der Auswirkung auf das regionale Klima treffen zu können.
Dieses Projekt befasst sich mit den bestehenden Problemen heterogener Sensorgeräte im Fahrzeug und mehrerer Datenquellen und entwickelt ein intelligentes Gateway im Fahrzeug, um einen einheitlichen Zugang zu heterogenen Geräten und eine einheitliche Aggregation von Daten aus mehreren Quellen zu realisieren – edge level; entwickelt ein Modell zur Vorhersage von Kohlendioxidemissionen, um massive Datenmengen genau auszuwerten, vorherzusagen und um hoher Vorhersageschwierigkeiten im aktuellen Szenario intelligenter vernetzter Fahrzeuge zu begegnen – network level. Das Projekt beabsichtigt den Aufbau und Evaluierung eines dualen Kohlenstoff-Managementsdemontrators, um die Fusion von Endgerätedaten zu realisieren.

Wir stützen uns auf die theoretischen und industriellen Grundlagen des Edge Intelligence Institute im Bereich IoT und führen die fortschrittliche Datenverarbeitungstechnologie des österreichischen Partners DatenVorsprung mit ein. Die beiden Parteien werden gemeinsam das Dual-Carbon-Management-System als Demonstrator in Laborbedingungen für intelligente vernetzte Fahrzeuge entwickeln und Anwendungsdemonstrationen in relevanten Szenarien durchführen, um die Korrektheit und Machbarkeit des Systems zu verifizieren.

Abstract

Promoting peak carbon reduction and carbon neutrality has become one of the most important strategic choices in China. The "Implementation Plan for Peak Carbon Values in the Industrial Sector" jointly issued by the Ministry of Industry and Information Technology, the Development and Reform Commission, and other ministries and commissions proposes to "vigorously promote energy-saving and new energy vehicles and strengthen the integrated technological innovation of intelligent, connected vehicles." The UN has proclaimed a similar strategy for livable cities and climate actions with its 2030 Sustainable Development Goals.
Specifically in China, there is the problem of lack of intelligent information management in existing vehicle management platforms and high urban emission pollution. There are, if at all, only isolated solutions of mostly foreign manufacturers for networked sensor technology in vehicles.
An intelligent, network-connected management system for carbon emissions from vehicles is therefore to be researched in order to solve this problem and to be able to make sustainable, large-scale statements about CO2 loads and the impact on the regional climate.
This project addresses the existing problems of heterogeneous in-vehicle sensor devices and multiple data sources, and develops an in-vehicle smart gateway to realize unified access to heterogeneous devices and unified aggregation of data from multiple sources - edge level; develops a carbon emission prediction model to accurately evaluate massive amounts of data, predict and address high prediction difficulties in the current scenario of smart connected vehicles - network level. The project intends to build and evaluate a dual carbon management demonstrator to realize end-device data fusion.

We draw on the Edge Intelligence Institute's theoretical and industrial foundations in IoT and introduce the advanced data processing technology of Austrian partner DatenVorsprung. The two parties will jointly develop the dual carbon management system as a demonstrator in laboratory conditions for smart connected vehicles and conduct application demonstrations in relevant scenarios to verify the correctness and feasibility of the system.

Endberichtkurzfassung

This project explored the real-time training of artificial recurrent neural networks for carbon emission predictions and traffic control in urban cities.

Combining applied AI research with hardware-based demonstrators, the work aimed to enable adaptive, low-latency prediction and control in complex, real-world environments to enable Carbon emission monitoring, real time traffic control (in terms of pollution-reduction) driven by robust artificial intelligence affecting human life style and living quality. This projects connects European technical knowledge and innovation in the field of AI and robustness as well as Chinese governmental approaches for central control of carbon emissions.

Technically, this project dealt with online training of artificial recurrent neural networks and the verification of predictions. To this end, real-time algorithms for training continuous-time recurrent neural networks and state space models were selected and used for building prediction systems.

-based on a cyber-physical setup for measuring, predicting and possible controlling/supervising cars and traffic

-based on an alternative cyber-physical demo setup (for collecting big amounts of live data in short time on same chip and

online deployment architecture) for measuring, predicting and controlling an inverted pendulum

A wide range of diverse applications from reinforcement, imitation and supervised learning were investigated and evaluated and at the end newly developed.

A special focus was put on developing a carbon emission model that can be fine-tuned online using the online training method. The data used for training the carbon emission model was gathered from embedded vehicular hardware and provided by Edge Intelligence Institute Nanjing Ltd..

The following bullet-points summarize the results of this project.

The validity of a real-time training approach for recurrent neural networks was shown empirically for reinforcement, imitation and supervised learning tasks.
Collecting and augmenting data from sample data for getting the right amount of data suitable for the investigated tasks
A carbon prediction model was trained on data provided by our Chinese partner institution and fine-tuned using the real-time method that was evaluated beforehand.
A POC for robustness analysis was developed and implemented. Our procedure of stochastic verification of prediction results was evaluated empirically using an in-house inverted pendulum angle prediction task and the recurrent neural networks based carbon emission prediction model.

The results of the project are directly related with DatenVorsprung's core technology identity. We aim to be an European technology leader in AI verification suitable for minimum error industrial applications.

The goal of our Chinese partner is to be able to effectively use AI for improving urban living quality by reducing or more controlling carbon emissions can be inspiring for the European Union, where ongoing discussion about Carbon emission reductions while maintaining industrial growth and wealth are very controversial.

Projektpartner

- DatenVorsprung GmbH