Технічні науки

Zaitsev Oleksandr

Engineer and expert in the field of smart transport

DEVICE FOR DYNAMIC HOMOGENIZATION; DYNAMIC EMULSION

A dynamic homogenization device with no moving parts, designed for installation in the fuel pipeline between the fuel pump and the high-pressure pump

Summary. *When using gasoline-ethanol fuel blends, there is always a risk of phase separation into organic fractions and water (inherent in ethanol). The higher the ethanol content in the blend, the more significant the negative impact of phase separation into organic components and water.*

This paper proposes a device with no moving parts, installed in the fuel pipeline between the fuel pump and the high-pressure pump. The fuel pump outlet is connected to a splitting tee, which divides the fuel flow into two streams. These streams undergo turbulence-level homogenization within the device, and if water is present in the gasoline-ethanol mixture, it is dynamically emulsified during the homogenization process.

The dynamic emulsion exiting the device then enters the engine's high-pressure pump, where, under high-pressure conditions, it is further transformed into a nanoscale emulsion. Upon combustion in the cylinder's combustion chamber, this emulsion eliminates soot formation and nitrogen oxide emissions while maintaining engine power output. These effects have been confirmed through testing conducted by ***ROUSH****.*

Key words: *Engine fuel system, Fuel pipeline, Dynamic emulsion, Homogenization process, High-pressure pump, Cylinder combustion chamber,*

Turbulence-level homogenization, Fuel pump, Product description and characteristics, Flexible hydrodynamic structure, Flexible chemical structure.

Dynamic Homogenization Device; Dynamic Emulsion

When gasoline-ethanol blends are used as fuel, there is always a risk of phase separation, where the mixture decomposes into organic fractions and water (inherent to ethanol). The higher the ethanol content in the blend, the more significant the detrimental effects of this separation.

A proposed device, which contains no moving parts, is installed on the fuel pipeline between the fuel pump and the high-pressure pump. The outlet from the fuel pump is connected to a splitting tee, which divides the fuel flow into two streams. These streams undergo homogenization within the device through turbulence-level regulation. In cases where water is present in the gasoline-ethanol mixture, the homogenization process results in the formation of a dynamic emulsion.

After exiting the device, the dynamic emulsion enters the engine's high-pressure pump, where, under high pressure, it is transformed into a nanoscale emulsion. Upon combustion in the engine cylinder's combustion chamber, this nanoscale emulsion does not produce soot or nitrogen oxides and does not reduce the engine's power output (validated by tests conducted at ROUSH).

Upon signing a non-disclosure agreement, test protocols can be provided.

Product Description and Characteristics

The product, generally referred to as *Dynamic Emulsion*, exhibits the following key characteristics:

• **Rapid Formation:** The product is formed within an extremely short time frame, as little as a few milliseconds, during which it acquires all the necessary properties and characteristics, rendering it immediately suitable for further application.

• **Pressure Stability:** The product retains its properties over an extended period, provided the pressure under which it was formed remains constant or is increased.

• **High-Pressure Resilience:** The product demonstrates the ability to maintain its structural integrity and properties even under abrupt increases in pressure. During testing, the emulsion was subjected to pressures up to 2000 bar without any destructive changes in its structure or properties. In fact, combustion of the emulsion in diesel engine combustion chambers yielded results comparable to those observed with nanoscale emulsions.

• **Performance Under Injection Conditions:** The product significantly enhances and sustains its characteristics under extreme pressure variations during flow, particularly after component mixing. In tests conducted prior to injection into internal combustion engine cylinders, pressures reached up to 2000 bar. Microscopic imaging of the emulsion allowed for preliminary classification as a *nanoscale emulsion*. Additionally, exhaust gas analysis revealed structural and compositional changes consistent with theoretical combustion parameters of nanoscale emulsions.

• **Flexible Hydrodynamic Structure:** The product exhibits a highly adaptable hydrodynamic profile, allowing for stability and efficiency in various operational conditions.

• **Flexible Chemical Structure:** The chemical composition of the product is versatile, enabling compatibility with a wide range of additives and fuel types.

• **Homogeneous Liquid Composition:** The product can be composed entirely of liquids with uniform properties, with all liquid components capable of being mixed in various ratios and combinations.

• **Heterogeneous Liquid Composition:** The product can also consist of liquids with differing properties, maintaining stable mixtures across diverse proportions and combinations.

• **Post-Formation Additives:** Various chemical substances can be added to the product after its formation, integrating seamlessly into the dynamic emulsion structure.

• **Addition of Chemical Substances During Formation:** Various chemical substances not originally part of the dynamic emulsion composition can be introduced during the formation process.

Description of Processes and Outcomes in Dynamic Emulsion Production

Dynamic emulsions can exist in a wide range of forms, depending on their composition and intended application. The following classifications outline the potential varieties of dynamic emulsions:

• **Homogeneous Liquid Emulsion:** A dynamic emulsion composed of at least two homogeneous liquids.

• **Heterogeneous Liquid Emulsion:** A dynamic emulsion composed of at least two heterogeneous liquids.

• **Gas-Liquid Homogeneous Emulsion:** A dynamic emulsion comprising at least two homogeneous liquids and at least one gas.

• **Gas-Liquid Heterogeneous Emulsion:** A dynamic emulsion consisting of at least two heterogeneous liquids and at least one gas.

• **Solution-Liquid Emulsion:** A dynamic emulsion composed of at least one liquid solution and at least one additional liquid.

• **Homogeneous Solution Emulsion:** A dynamic emulsion containing at least two homogeneous liquid solutions.

• **Heterogeneous Solution Emulsion:** A dynamic emulsion composed of at least two heterogeneous liquid solutions.

• **Gas-Solution Homogeneous Emulsion:** A dynamic emulsion consisting of at least two homogeneous liquid solutions and at least one gas.

• **Gas-Solution Heterogeneous Emulsion:** A dynamic emulsion comprising at least two heterogeneous liquid solutions and at least one gas.

Chemical Reagent Integration:

Chemical reagents may be introduced into the dynamic emulsion both during and after its formation. This capability allows for further customization of the emulsion's properties depending on specific operational or performance requirements.

Additional Varieties of Dynamic Emulsions with Post-Formation Additives:

• **Post-Formation Modified Homogeneous Liquid Emulsion:** A dynamic emulsion composed of at least two homogeneous liquids, with additional chemical reagents introduced after formation.

• **Post-Formation Modified Heterogeneous Liquid Emulsion:** A dynamic emulsion consisting of at least two heterogeneous liquids, with additional chemical reagents incorporated after formation.

• A dynamic emulsion consisting of at least one solution of liquids and at least one liquid with the addition of chemical reagents after formation

• A dynamic emulsion consisting of at least two homogeneous solutions of liquids with the addition of chemical reagents after formation

• A dynamic emulsion consisting of at least two heterogeneous solutions of liquids with the addition of chemical reagents after formation

Explanation of the Technology's Essence

The essence of the technology underlying the formation of the new product—**dynamic emulsion**—is as follows:

• At the moment of dynamic emulsion formation, the turbulence level across all cross-sections of the base component flows is equalized, achieving the necessary uniformity throughout the entire volume and the required particle size distribution of the emulsion components.

• The kinetic energy of all dynamic emulsion component particles is conserved and released when the pressure applied to the emulsion decreases or returns to atmospheric levels.

• The release of the kinetic energy of the emulsion components facilitates processes such as maximum atomization of the fuel dynamic emulsion during combustion.

• The number of components in the dynamic emulsion is virtually unlimited, as the apparatus for emulsion formation can be adapted for the required number of components without altering the fundamental principles of the technology.

• When one or more components are gases or gas mixtures, the fundamental principles of the technology allow for the production of an aerosol as a type of dynamic emulsion or for mixing the dynamic emulsion with compressed gas or air.

• The technology enables the sequential introduction of additional components into the dynamic emulsion, with no limitations on the number or chemical composition of such components.

• Since all parameters of the dynamic emulsion depend on the pressure within the component flow, the properties and characteristics of the emulsion can be regulated by adjusting the pressure.

List of references and patent materials used:

Appendix 1

United States Patent Application	**20190069225**
Kind Code	**A1**
NATHANSON; Martin	**February 28, 2019**

VEHICLE COMMUNICATIONS VIA WIRELESS ACCESS VEHICULAR ENVIRONMENT

Abstract

A vehicle heads-up display (HUD) includes a ***smart*** phone or tablet computer with at least one processor running at least one computer program adapted to enable the HUD to: (i) establish a connection to an on board unit (OBU) of the

vehicle using the mechanisms provided by ICMPv6 for IPv6 router discovery, and acquire an IPv6 address through the mechanism of Stateless address auto configuration (SLAAC); (ii) process an authentication challenge from a Roadway Authorization Server (RAS); and (iii) respond to an authentication challenge from said Roadway Authorization Server (RAS).

Appendix 2

United States Patent Application	**20190051167**
Kind Code	**A1**
Malkes; William A. ; et al.	**February 14, 2019**

SYSTEM AND METHOD OF ADAPTIVE TRAFFIC MANAGEMENT AT AN INTERSECTION

Abstract

A traffic control system and a method of automatic zone creation and modification for a ***smart*** traffic camera to be used in adaptive traffic management at an intersection are disclosed. One aspect of the present disclosure is a method including applying default zone parameters to define detection zones at one or more sensors installed at an intersection, the detection zones being used by the one or more sensors for monitoring and detecting traffic conditions at the intersection; determining a current vehicular traffic flow rate and a current pedestrian traffic flow rate at the intersection; determining if a triggering condition for adjusting one or more of the default zone parameters; and adjusting the one or more of the default zone parameters if the triggering condition is met.

Appendix 3

United States Patent Application	**20190027018**
Kind Code	**A1**
Corpus; Roy C. ; et al.	**January 24, 2019**

ARTIFICIAL INTELLIGENCE BASED SERVICE CONTROL AND HOME MONITORING

Abstract

In some examples, artificial intelligence based service control and home monitoring may include ascertaining, from a monitoring tool, an alert related to

operation of a device or service monitored by the monitoring tool, and generating, based on the alert, a support call that includes a phone call, an e-mail, a Short Message Service (SMS), and/or ***smart*** device notification to a support personnel. Based on an issue addressed in the alert, an incident ticket may be generated, and based on a response to the support call, and determination of a resolution to the issue addressed in the alert, the incident ticket may be modified to include the resolution. Further, a service level agreement may be analyzed, and based on an analysis of the alert, the support call, the incident ticket, and the service level agreement, metrics related to the resolution to the issue addressed in the alert may be generated.

Appendix 4

United States Patent Application	**20190012909**
Kind Code	**A1**
MINTZ; Yosef	**January 10, 2019**

SYSTEM AND METHODS TO APPLY ROBUST PREDICTIVE TRAFFIC LOAD BALANCING CONTROL AND ROBUST COOPERATIVE SAFE DRIVING FOR SMART CITIES

Abstract

Apparatuses, systems and methods applying an innovative non-discriminating and anonymous car related navigation driven traffic model predictive control, producing predictive load-balancing on road networks which dynamically assigns efficient sets of routes to car related navigation aids and which navigation aids may refer to in dash navigation or to ***smart*** phone navigation application. The system and methods are may enable, for example, to improve or to substitute commercial navigation service solutions, applying under such upgrade or substitution a new highly efficient proactive traffic control for city size or metropolitan size traffic.

Appendix 5

United States Patent Application	**20180376305**
Kind Code	**A1**
Ramalho de Oliveira; Patricia Cristina	**December 27, 2018**

METHODS AND SYSTEMS FOR DETECTING ANOMALIES AND FORECASTING OPTIMIZATIONS TO IMPROVE SMART CITY OR REGION INFRASTRUCTURE MANAGEMENT USING NETWORKS OF AUTONOMOUS VEHICLES

Abstract

Methods and systems are provided for detecting anomalies and forecasting optimizations to improve ***smart*** city or region infrastructure management using networks of autonomous vehicles. An autonomous vehicle may receive initial information relating to infrastructure utilized by a plurality of autonomous vehicles, and may acquire, during operation in the infrastructure, real-time information relating to the infrastructure and/or to other ones of the plurality of autonomous vehicles. The acquired information may be processed, and based on the processing of the acquired information and the initial information, anomalies and/or problems affecting the infrastructure and/or operation of the plurality of autonomous vehicles in the infrastructure may be detected.

Appendix 6

United States Patent Application	**20180330307**
Kind Code	**A1**
Anderson; Evelyn R. ; et al.	**November 15, 2018**

METHOD AND SYSTEM TO ASSIST PEOPLE TRAVELING TOGETHER THROUGH A TRANSPORT HUB

Abstract

The present invention is a method and system to assist people traveling together through a transport hub from a current location to a destination location using a ***smart*** portable personal computing devices which provide personal data, travel data and transport hub data. The method provides for sub-groups of traveler's having common travel preferences, and it maps routes according to those preferences for the group members to travel through the transport hub together. Continuous monitoring of values provides an alert on each sub-group member's personal computing device when the personal data, travel data, transport hub data, or predetermined parameters change.

Appendix 7

United States Patent Application	**20180330294**
Kind Code	**A1**
Anderson; Evelyn R. ; et al.	**November 15, 2018**

PERSONAL TRAVEL ASSISTANCE SYSTEM AND METHOD FOR TRAVELING THROUGH A TRANSPORT HUB

Abstract

The present invention is a method and system to assist a person traveling through a transport hub from a current location to a destination location with a ***smart*** portable computing device which provides personal data, travel data and transport hub data. The method maps a route according to personal preferences for the person to travel through the transport hub. Continuous monitoring of values provides an alert when the personal data, travel data, transport hub data, or predetermined parameters change.

Appendix 8

United States Patent Application	**20180328079**
Kind Code	**A1**
LIM; Chee Kean ; et al.	**November 15, 2018**

SMART SECURITY DEVICE AND SYSTEM

Abstract

A ***smart*** security device comprising: a housing, and electronics provided in the housing, the electronics comprising a tag uniquely associated with the ***smart*** security device and configured to automatically and periodically emit a first signal, the first signal being a Bluetooth signal configured to be sent and received via a Bluetooth low energy wireless personal area network; and a NB-IoT module configured to send and receive signals via a NB-IoT network.

Appendix 9

United States Patent Application	**20180308045**
Kind Code	**A1**
ARENA; DAVID	**October 25, 2018**

MOBILE APPLICATION WITH ENHANCED USER INTERFACE FOR EFFICIENTLY MANAGING AND ASSURING THE SAFETY, QUALITY AND SECURITY OF GOODS STORED WITHIN A TRUCK, TRACTOR OR TRAILER AND ASSESSING USER COMPLIANCE WITH REGULATIONS AND QUALITY OF PERFORMANCE

Abstract

A system and method for ensuring the safety of goods transported via highway, particularly humanly consumable goods, is taught by the present invention. Three main aspects include a ***smart*** phone hub, a portable sensor for monitoring the transported goods and a physical locking mechanism to lock the trailer. According to the present invention, a truck driver uses a ***smart*** phone to interface between a trailer payload supervisor and the payload itself, to insure the safety of the transported goods. Upon loading a trailer, a truck driver uses a smartphone to activate an internal sensor and snap an image of the locked trailer (with an electronic padlock and a license plate, for example). According to the present invention, an enhanced user profile includes information or ratings based on past driver performance and a loyalty program to reward driver's effective and safe (perishable cargo safety) usage of the invention.

Appendix 10

United States Patent Application	**20180320402**
Kind Code	**A1**
Evans; Michael Steward	**November 8, 2018**

Intelligent POD Management and Transport

Abstract

An exchange station has openings for drones, a passenger check-in/check-out bay for processing passengers, a drone connect/release bay, having apparatus adapted to manage passenger pods mounted on ***smart*** chassis, and a computerized control system in wireless communication with control circuitry in the drones and ***smart*** chassis, guiding ***smart*** chassis with mounted passenger pods and drones, to make the exchange of pods from the ***smart*** chassis to drones. A passenger entering the passenger check-in bay is loaded into a pod mounted on a ***smart*** chassis, the pod with passenger is transported to the drone-connect/release bay, and the pod is there joined to a bare drone and disconnected from the ***smart*** chassis, the drone leaving with the passenger pod

to a destination, and the ***smart*** chassis traveling away from the drone connect-release bay.

Appendix 11

United States Patent Application	**20180308087**
Kind Code	**A1**
MAIMON; MOTI	**October 25, 2018**

SYSTEM AND METHOD FOR MANAGEMENT OF A SMART OBJECT

Abstract

A system and method for performing an operation on a ***smart*** object, the system including at least one user interface, having access to the Internet, including a ***smart*** object reader/writer and a processor, a universal, multi-platform "dumb" SDK (Software Development Kit), supporting multi-platform communication, embedded in each user interface, a central management unit disposed in the Cloud, configured to operate under multiple platforms and to communicate over multiple standards, in two-way communication with each ***smart*** object via its SDK, at least one provider backend in communication with the at least one user interface and with the central management unit, a secure encryption unit proving a physical key for each communication between each SDK and the central management unit, and a web services managing server configured to provide secure two-way communication between each user interface, the secure encryption unit, the provider backend and the central management unit.

Appendix 12

United States Patent Application	**20180315011**
Kind Code	**A1**
Clarke; John ; et al.	**November 1, 2018**

Limited Spatial Digital Directory with Physical Navigation for Optimizing Smart Carts

Abstract

The present disclosure relates to a program or system for navigating a store or handling and locating inventory within a store. This application has several embodiments including but not limited to those where the program operates on a computerized console directly docked on a store cart, a mobile device tethered

to a store cart, or any combination of the two. Security features, charging features (using energy including but not limited synergistically charged batteries or solar panels) scanning features, geospatial features and other peripheral device enabled features are disclosed in the multiple embodiments of the disclosure. For use with a ***smart*** cart the invention disclosed herein can greatly enhance a shopping experience, allowing for efficient shopping, with features like phone charging, simplified item location and purchasing for shoppers and ease of inventory management, cart-maintenance, and security for shop keepers.

Appendix 13

United States Patent Application	**20180326291**
Kind Code	**A1**
Tran; Bao ; et al.	**November 15, 2018**

SMART DEVICE

Abstract

An Internet of Thing (IoT) device includes a transceiver coupled to a processor. Blockchain ***smart*** contracts can be used with the device to facilitate secure operation.