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(71) Name of Applicant(s):
Nervanik Ai Labs Pvt. Ltd.,

(72) Name of Inventor(s):
1. Apurve Yajnik
2. Kanaksvi Pacholi
3. Nisarg Pandya

(57) Abstract:

The present invention discloses dynamic road quality assessment system (100) for real-time detection, mapping, and communication of road surface conditions. The system comprises a Sensor Module (301) for acquiring GNSS Sensor Data (401) and IMU Sensor Data (402), and a Roadside Camera Module (302) for capturing Video Data (403). A Sensor Data Processing Module (303) and Vision Data Processing Module (304) process the data to generate Road Condition Data (405), which is analyzed by a Road Condition Identification Module (305). The Geo-referencing Module (306) associates road condition data with location, producing Geo-referenced Road Condition Data (406), which is mapped by the Road Condition Mapping Module (308). Updated data is stored in a Road Condition Database (501) and disseminated via a Driver Notification System (601) and Digital Sign Boards (602). The system enables proactive road safety and infrastructure maintenance. Fig. 1

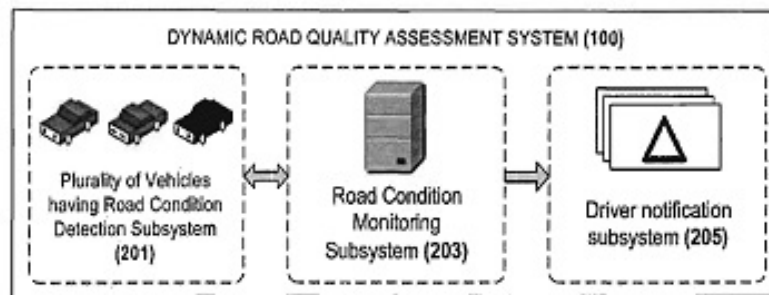


Fig. 1

FORM 2
THE PATENTS ACT 1970
(39 of 1970)
&
The Patents Rules, 2003
COMPLETE SPECIFICATION
(See section 10 and rule 13)

1. TITLE OF THE INVENTION: "INTEGRATED DYNAMIC ROAD QUALITY ASSESSMENT SYSTEM AND METHOD THEREOF"

2. APPLICANTS:

(A) NAME : NERVANIK AI LABS PVT. LTD.
(B) NATIONALITY : INDIAN
(C) ADDRESS : A – 1111, WORLD TRADE TOWER
OFF. S G ROAD,
B/H SKODA SHOWROOM, MAKARBA
AHMEDABAD 380 051
GUJARAT, INDIA.

PROVISIONAL

The following specification describes the invention.

☒ **COMPLETE**

The following specification particularly describes the invention and the manner in which it is to be performed.

Field of invention

The present invention relates to integrated dynamic road quality assessment system and method for monitoring and assessing road conditions that utilizes a combination of GNSS (Global Navigation Satellite System) data, IMU (Inertial Measurement Unit) data, and computer vision analysis of roadside video data to detect and map road quality and identifying specific road anomalies such as potholes.

Background of invention

Road infrastructure is critical for societal development and economic growth. However, road deterioration, caused by factors such as weather conditions, increasing traffic volume, heavy vehicles, and inadequate maintenance, poses significant safety risks and impacts vehicle longevity. Timely and accurate information about changing road conditions is crucial for accident prevention, efficient traffic management, and accurate travel time estimations. Drastic and often surprising weather events cause problems with the road conditions, can lead to severe accidents and loss of life. According to government data in the years 2021 and 2022, in India there were 3,625 and 4,446 accidents due to potholes alone, these lead to 1,481 and 1,856 persons killed.

Another significant cost is ongoing construction in and around pathways that has also led to significant accidents and loss of life. The real economic losses of not having pre-existent knowledge of the status of roads are difficult to know. In any case swift updates on changing road conditions

can prevent accidents, reduce vehicle wear, and enhance traffic efficiency. At the same time, in the world of quick deliveries and travel, existing knowledge of any issues on the road can be crucial and prevent delays and issues that cause significant losses.

5 Traditionally, road condition monitoring has been a labor-intensive process, often relying on manual inspections or expensive equipment like inertial profilers. These methods can be infrequent, costly, and may not provide real-time data on the dynamic changes in road surfaces. The inaccessibility of remote or rural areas further exacerbates these challenges,
10 leading to delays in identifying and addressing road maintenance needs.

 In recent years, there has been a growing interest in leveraging technology to automate and improve road condition monitoring. In patent application US20180068495A1, various approaches have been explored, including the use of sensors (e.g., vibration sensors, accelerometers) installed
15 in vehicles to detect road anomalies.

 Furthermore, Global Navigation Satellite Systems (GNSS), particularly GPS, have been used to track the location of vehicles and, in some cases, to infer road conditions based on variations in speed and trajectory. US5982325A describes a method for tracking road conditions using remote
20 units with GPS receivers and environmental sensors to transmit data to a central station.

 The integration of multiple data sources has shown promise in enhancing the accuracy and reliability of road condition monitoring.

Combining data from accelerometers and GPS has been explored to detect road anomalies by identifying unusual vehicle movements and correlating them with location.

5 Despite these advancements, there remains a need for a more robust, cost-effective, and real-time system that can accurately detect and map various road conditions, including potholes, by effectively fusing data from different sensors. Such a system should be capable of not only identifying the presence of road anomalies but also potentially assessing their severity and providing up-to-date information to relevant users and authorities. The
10 ability to continuously validate and update road condition data is also crucial to address the dynamic nature of road infrastructure.

Hence, it is needed to invent integrated dynamic road quality assessment system and method.

Object of Invention

15 The object of the present invention is to provide an integrated dynamic road quality assessment system and method thereof.

Further object of the integrated dynamic road quality assessment system and method is to leverage the complementary strengths of different sensor modalities, enhancing the accuracy and robustness of road condition
20 assessment.

Another object of the integrated dynamic road quality assessment system and method is to eliminate the need for manual inspections and

provide up-to-date information on road conditions, facilitating timely maintenance and improving road safety.

Yet another object of the integrated dynamic road quality assessment system and method is to generate a geo-referenced map of road quality and anomalies for a spatial representation of road conditions, enabling efficient navigation, route planning, and targeted maintenance efforts.

Yet another object of the integrated dynamic road quality assessment system and method is to ensure the accuracy and reliability of the road condition information by accounting for dynamic changes in road surfaces due to factors such as weather, traffic, and construction.

Yet another object of the integrated dynamic road quality assessment system and method is to enable seamless integration of road condition information into various applications, such as navigation systems, Advanced Driver Assistance Systems (ADAS), logistics and delivery platforms, and public information displays, thereby improving road safety and efficiency for a wide range of users.

These and other objects will be apparent based on the disclosure herein.

Summary of invention

The present invention provides an integrated dynamic road quality assessment system designed for real-time detection, analysis, mapping, and dissemination of road surface condition data. The system integrates a sensor module for acquiring geo-location and inertial data, along with a roadside

camera module for capturing visual data of the road surface. The collected data is processed through dedicated sensor and vision data processing modules to identify anomalies and surface defects. A road condition identification module analyzes the processed inputs to generate accurate
5 assessments of road quality. This data is then geo-referenced using location information and mapped in real time to reflect current road conditions. The geo-referenced data is stored in a central database for future analysis and historical referencing. Finally, road condition alerts are communicated to vehicle operators and relevant infrastructure systems through driver
10 notification mechanisms and digital signage. The invention supports proactive road safety measures and infrastructure maintenance through intelligent, data-driven insights.

Brief description of drawings

Other objects, advantages and novel features of the invention will
15 become apparent from the following detailed description of the present embodiment when taken in conjunction with the accompanying drawings.

Fig. 1 illustrates a schematic block diagram of the dynamic road quality assessment system depicting subsystems.

Fig. 2 illustrates the data acquisition and processing workflow within
20 detection subsystem.

Fig. 3 illustrates the interconnectivity of detection subsystems by incorporating API and data interface module.

Figure 4 illustrates the step wise operations sequence.

Detailed Description of Invention

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of the construction and arrangement of parts illustrated in the accompany
5 drawings. The invention is capable of other embodiment, as depicted in different figures as described above and of being practiced or carried out in a variety of ways. It is to be understood that the phraseology and terminology employed herein is for the purpose of description and not of limitation.

It is to be also understood that the term "comprises" and grammatical
10 equivalents thereof are used herein to mean that other components, ingredients, steps, etc. are optionally present. For example, an article "comprising" (or "which comprises") components A, B, and C can consist of (i.e., contain only) components A, B, and C, or can contain not only components A, B, and C but also contain one or more other components.

15 The present invention discloses a dynamic road quality assessment dynamic road quality assessment system (100) that enables real-time detection, monitoring, mapping, and communication of road surface conditions using a combination of sensor-based and vision-based technologies. The system is particularly advantageous for intelligent
20 transportation systems, fleet operators, infrastructure maintenance authorities, and autonomous driving applications.

As used herein, a 'processor' includes any programmable system including systems using micro-controllers, reduced instruction set circuits

(RISC), application specific integrated circuits (ASICs), logic circuits, and any other circuit or processor capable of executing the functions described herein. The above examples are for illustration only, and are thus not intended to limit in any way the definition and/or meaning of the term “processor”.

5 Unless specifically stated otherwise, throughout this specification, terms such as "processing", "computing", "calculating", "selecting", "forming", "enabling", "inhibiting", "identifying", "initiating", "querying", "obtaining", "hosting", "maintaining", "representing", "modifying", "receiving", "transmitting", "storing", "authenticating", "authorizing", "hosting",
10 "determining" and/or the like refer to actions and/or processes that may be performed by a system, such as a computer and/or other computing platform, capable of manipulating and/or transforming data which may be represented as electronic, magnetic and/or other physical quantities within the system's processors, memories, registers, and/or other information storage,
15 transmission, reception and/or display devices.

A ‘Document or Data’ defines a digital record of some information that can be used as an authority or for reference, further analyses or study. Documentation refers to the on-going process of creating, disseminating, managing and using documents.

20 ‘Data storage’ or ‘database’ defines the use of recording media to retain data using computers or other infrastructure (cloud). The most prevalent forms of data storage are file storage, block storage and object storage, with each being ideal for different purposes. Data storage is the

recording (storing) of information (data) in a storage medium. Handwriting, phonographic recording, hard drive, magnetic tape, and optical discs are all examples of storage media.

A 'Server' is a computer program or device that provides a service to another computer program and its user. The Server's computer alternatively can be a workstation, minicomputer or microcomputer or other device. Although reference herein is made to information transfer via modem, it should be noted that cable, satellite, fiber optics, or other means for transferring information can also be utilized. The method of transferring the information is based on the current availability within the communities.

A 'Method' describes flow diagrams or otherwise, may also be executed and/or controlled, in whole or in part, by a computing platform. Method herein described as flow diagram is graphical or visual representation using a standardized set of symbols and notations to describe a business's operations through data movement.

As used herein, a 'module' refers to sections of hardware and large software packages to define its functionality. In the present invention module is used to make the combination of hardware and software easier to use for a specific purpose or to define where boundaries exist in functionality. The modules described minutely with sub-modules which merely differentiates detailed aspect of said module work to serve the purpose.

As shown in fig. 1, the dynamic road quality assessment system (100) comprises three main subsystems: a detection subsystem (201), a monitoring subsystem (203), and notification subsystem (205). The detection subsystem (201) is deployed in plurality of vehicles and is responsible for acquiring raw environmental and positional data, while the monitoring subsystem (203) is cloud or server based subsystem that handles data interpretation, mapping, and dissemination, and the driver notification subsystem (205) comprises on-board driver notification module (601) that may be embedded in infotainment system of vehicle or driver's mobile device and digital sign boards (602) installed on road that are responsible for notifying driver through both the methods.

As shown in Fig. 2, the detection subsystem (201) deployed in plurality of vehicles includes various modules to generate datasets for further processing. Said subsystem comprises a sensor module (301), a roadside camera module (302), a sensor data processing module (303), a vision data processing module (304), a road condition identification module (305), a geo-referencing module (306), an API (Application Programming Interface) and data interface module (307).

The data acquisition process is initiated with the sensor module (301) acquiring GNSS sensor data (401) from GPS Sensor (301a) that records live location and speed data for the vehicles and IMU (Internal Measurement Unit) sensor data (402) that uses an accelerometer to detect directional and angular acceleration values from IMU Sensor (301a). By combining these

sensor data, a user can track the location and the travel status of a vehicle including speed, acceleration etc. Both these sensors are acquiring data in real-time and constantly feeding updated inputs based on travel conditions. These sensor data values can be adjusted based on any road and vehicle
5 conditions or type of vehicle. For example, drastic acceleration or deceleration can be due to unexpected incidents on the road and can even point to risky or possible collision situations.

IMU (Internal Measurement Unit) sensor data (402) acquired by IMU Sensor (301a), while driving on potholes or deteriorating roadways, consist of
10 sudden changes in the Z axis acceleration values alongside X and Y, and the speed values can be read from the GNSS sensor data (401). This change in Z-acceleration and other simultaneous values can be used to detect possible situations of the vehicle being driven on potholes or deteriorated road. For training the models many historical cases where a driver has driven over
15 potholes are collected and identified that the Z, X and Y acceleration values for these cases and the changes in speed values, provided the statistical ranges for all these parameters, where it is evident that the vehicle is being driven on a possible deteriorating road or a pothole.

The Sensor Data Processing Module (303), which interprets GNSS
20 sensor data (401) and IMU sensor data (402) to detect vertical displacements, inertial variations and movement patterns and accelerometric disturbances indicative of road conditions.

Simultaneously, the roadside camera module (302) is deployed to acquire real-time video data (403) of the road surface. The roadside camera module (302) is useful in recording any and all conditions of the traffic, road and the environment.

5 The Vision Data Processing Module (304) processes the visual information to identify surface anomalies such as potholes, cracks, and unevenness or surface deformations. Continuous stream of video data (403) is being recorded by a roadside camera module (302) located at the windshield of the vehicle and records the full view in front of the vehicle. The Visual
10 Data Processing Module (304) utilizes vision deep learning-based object detection model to identify potholes or bad roads in the corresponding image frames. In said recorded frames, the view of the road could be obstructed due to the presence of traffic on the road in the form of cars, bikes, pedestrians etc., Such possibilities are taken in account when creating a deep learning
15 model for The Vision Data Processing Module (304) to effectively identify road quality from recorded data. The Vision Data Processing Module (304) utilizes YOLOv10 potholes detection model to identify potholes in roadside views. It is a pre-trained object detection model that is fine-tuned with potholes and deteriorated road data. Said YOLOv10 potholes detection model
20 is trained on images to consider cases when the road view might be obstructed by the traffic. The YOLOv10 potholes detection model is capable of Multi object detection in one frame. It provides real-time detection as the inference time is very small. A confidence threshold is set to consider only cases with highly confident predictions and sensor data are annotated for

model creation and updation. Accuracy can be improved by fine tuning YOLOv10 model on annotated road view data.

The output from the processing modules is aggregated in the road condition identification module (305), which evaluates both sensor-based and visual data to generate qualitative road condition data (405). The road condition identification module (305) synthesizes the information to generate road condition data (405). This data characterizes the condition of the road in terms of quality parameters such as smoothness, damage level, and hazard severity. For example, the video frames recorded in 1 to 10 seconds before a possible deteriorating road is detected by change in IMU Sensor data (302), the frames of that earlier duration may contain the view of the area that led to anomalous Z-acceleration values. The detection of such anomalies shall be seen in combination. The road condition identification module (305) processes the detected anomalies in vehicle's Z-acceleration values provided by sensor data processing module (303) and annotated corresponding images provided by visual data processing module (304).

The road condition data (405) undergoes geo-tagging through the Geo-referencing Module (306) using location information acquired from GNSS Sensor Data (401), producing Geo-referenced Road Condition Data (406). This data is structured and routed via the API and data interface module (307), which acts as a middleware for internal communication and external integration.

Acquired geo-referenced road condition data (406) of the detection subsystem (201) is directed to the monitoring subsystem (203) through the API and data interface module (307). The monitoring subsystem (203) includes road condition mapping module (308) and road condition database (501). The road condition mapping module (308) continuously updates real-time maps stored in road condition database (501) with the geo-referenced road condition data (406), offering dynamic visualization of road quality across various geospatial segments. The road condition mapping module (308) reads the location information tagged in geo-referenced road condition data (406) and nature of indentified anomalies and accordingly updates the road condition database (501) with updated maps with latest developments that driver should be aware of.

As shown in Fig. 4, the API and data interface module (307) provides facility of data transfer between all subsystems. The vehicle-on-go may comprise the detection subsystem (201) and on board driver notification module (601). The data interface facility provides fetching of the latest geo-referenced road condition data (406) and display it to through the on board driver notification module (601) for upcoming road conditions. This loop facilitates detection of road anomalies using the detection subsystem (201) and updating the driver of upcoming road anomalies through on board driver notification module (601) that was detected by previously passed vehicles. The Application Programming Interface (API) can be used for an input for a variety of applications. Another use case could be direct on-road signaling, the APIs can be used to send data to digital sign boards (602) to

notify in-coming traffic of the road conditions they might see ahead. These APIs can also be used by products that provide their own mobile navigation experience for example delivery applications, cab and bus providers, event planning applications or any generic navigation applications and notifies the driver by Driver Notification System (601).

As shown in Fig. 4, the execution of the system may be summarized in the following steps:

Step 1: Acquire GNSS Sensor Data (401) and IMU Sensor Data (402) through the Sensor Module (301), and simultaneously capture Video Data (403) through the Roadside Camera Module (302).

Step 2: Process the GNSS and IMU data via the Sensor Data Processing Module (303), and the Video Data via the Vision Data Processing Module (304).

Step 3: Analyze the processed data to identify road surface conditions through a Road Condition Identification Module (305), generating Road Condition Data (405).

Step 4: Geo-reference the identified road condition data via the Geo-referencing Module (306) in conjunction with GNSS Sensor Data (401) to generate Geo-referenced Road Condition Data (406).

Step 5: Map the Geo-referenced Road Condition Data (406) in real time using the Road Condition Mapping Module (308).

Step 6: Store the latest geo-referenced road condition data in the Road Condition Database (501) for historical analysis and reporting.

Step 7: Notify vehicle operator and traffic management system about the road conditions using the Driver Notification System (601) and Digital Sign Boards (602) deployed in relevant locations.

The dynamic road quality assessment system (100) helps in identifying the road conditions in real time that is mapped and stored in a centralized road condition database (501) that contains all the potholes information with detection times and locations of those deteriorated roads, the locations are read from GNSS part of the sensor data that contains latitude and longitudes of the vehicles movements.

This real time maps stored in centralized road condition database (501) are used in many ways to prevent and resolve road issues that might occur due to poor road quality. Drivers are given notifications regarding the road quality if their upcoming route lies on the poor-quality road patch. The planning of trips is also improved with this information. This data can also be shared with relevant authorities so they can priorities fixing the issues. This can make a huge difference in places that are especially vulnerable to weather and environment conditions, for example high altitude roads that are frequently affected by landslides need urgent fixes otherwise the flow of essential goods can be hampered.

The invention has been explained in relation to specific embodiment. It is inferred that the foregoing description is only illustrative of the present invention and it is not intended that the invention be limited or restrictive thereto. Many other specific embodiments of the present invention will be
5 apparent to one skilled in the art from the foregoing disclosure.

All substitution, alterations and modification of the present invention which come within the scope of the following claims are to which the present invention is readily susceptible without departing from the invention. The scope of the invention should therefore be determined not with reference to
10 the above description but should be determined with reference to appended claims along with full scope of equivalents to which such claims are entitled.

List of Reference Numerals

	100	Dynamic Road Quality Assessment System
	201	Detection Subsystem
	203	Monitoring Subsystem
5	205	Notification subsystem
	301	Sensor Module
	301a	GPS Sensor
	301b	IMU Sensor
	302	Roadside Camera Module
10	303	Sensor Data Processing Module
	304	Visual Data Processing Module
	305	Road Condition Identification Module
	306	Geo-referencing Module
	307	API and Data Interface Module
15	308	Road Condition Mapping Module
	401	GNSS Sensor Data
	402	IMU Sensor Data
	403	Video Data
	405	Road Condition Data
20	406	Geo-referenced Road Condition Data
	501	Road Condition Database
	601	On Board Driver Notification Module
	602	Digital Sign Boards

We Claim:

1. An integrated dynamic road quality assessment system (100) comprising:

a detection subsystem (201), configured for detecting road anomalies;

5 characterized in that,

a sensor data processing module (303) for processing the GNSS sensor data (401) being collected by a GNSS sensor (301a) and IMU sensor data (402) being collected by IMU sensor (301b) for acquiring location and acceleration data, wherein the sensor data processing module (303) analyzes Z-axis acceleration values in conjunction with X and Y acceleration data along with speed values from GNSS sensor data to detect road anomalies based on trained statistical ranges;

10

a vision data processing module (304) for analyzing the video data (403) being collected by roadside camera module (302) to detect surface-level road defects, wherein the vision data processing module (304) employs a YOLOv10 object detection model trained to identify potholes and road defects even when the road view is obstructed by traffic;

15

a road condition identification module (305) configured to generate road condition data (405) based on outputs of the sensor data processing module (303) and the vision data processing module (304), wherein the road condition identification module (305) performs temporal cross-validation by analyzing video frames recorded before detection of anomalous Z-acceleration values to visually confirm road defects; a geo-referencing module (306) configured to associate the road condition data (405) with location coordinates through inputs from the GNSS sensor data (401) providing a geo-referenced road condition data (406),

20

25

a road condition mapping module (308) of a monitoring subsystem (203) configured to generate and update real-time road condition maps based on the geo-referenced road condition data (406);

a road condition database (501) of the monitoring subsystem (203)
5 configured to store the geo-referenced road condition data (406);

a driver notification system (601) and digital sign boards (602) of the Notification subsystem (205) configured to disseminate road condition alerts to vehicle operators; and

an API and data interface module (307) configured to facilitate data
10 transfer between all subsystems.

2. The integrated dynamic road quality assessment system (100) as claimed in claim 1, wherein the sensor data processing module (303) detects inertial anomalies such as vertical displacements, vibrations, and directional shifts indicative of potholes or uneven surfaces by analyzing IMU sensor data
15 (402).

3. The integrated dynamic road quality assessment system (100) as claimed in claim 1, wherein the vision data processing module (304) employs YOLOv10 object detection model to identify surface defects including cracks, potholes, debris, and water logging.

20 4. The integrated dynamic road quality assessment system (100) as claimed in claim 1, wherein the road condition mapping module (308) is configured to interface with external navigation systems or municipal maintenance dashboards via the API and data interface module (307).

5. The integrated dynamic road quality assessment system (100) as
25 claimed in claim 1, wherein the driver notification system (601) is configured

to issue alerts based on road hazard severity thresholds using visual, auditory, or haptic feedback mechanisms.

6. A method for integrated dynamic road quality assessment, comprising:

5 acquiring GNSS sensor data (401) and IMU sensor data (402) via a sensor module (301), and video data (403) via a roadside camera module (302);

processing the GNSS sensor data (401) and IMU sensor data (402) through a sensor data processing module (303) to detect physical
10 irregularities in the road surface, wherein processing includes analyzing Z-axis acceleration values in conjunction with X and Y acceleration data along with speed values to detect road anomalies based on trained statistical ranges;

processing the video data (403) using a vision data processing module
15 (304) to detect visual anomalies on the road, wherein the vision data processing module (304) employs a YOLOv10 object detection model trained to identify road defects even when the road view is obstructed by traffic;

identifying road conditions via a road condition identification module (305) based on inputs from the sensor data processing module (303) and the
20 vision data processing module (304) to generate road condition data (405), wherein identifying includes performing temporal cross-validation by analyzing video frames recorded before detection of anomalous Z-acceleration values to visually confirm road defects;

geo-referencing the identified road condition data (405) via GNSS
25 sensor data (401) through a geo-referencing module (306) to generate geo-referenced road condition data (406);

mapping and storing the geo-referenced road condition data (406) in real-time by a road condition mapping module (308) in a road condition database (501); and

5 notifying vehicle operators of upcoming road conditions based on updated road condition database (501) via an onboard driver notification module (601) and digital sign boards (602).

7. The method for integrated dynamic road quality assessment as claimed in claim 6, wherein processing the GNSS sensor data (401) includes calculating sudden deceleration and processing the IMU sensor data (402)
10 includes calculating deviation patterns to detect abrupt vertical motion as the Z-acceleration values corresponding to potholes or speed breakers.

8. The method for integrated dynamic road quality assessment as claimed in claim 6, wherein identifying road conditions includes extracting edge and texture features from the video data (403) for identifying road
15 cracks and structural wear using YOLOv10 object detection model.

9. The method for integrated dynamic road quality assessment as claimed in claim 6, wherein notifying vehicle operators includes generating location-based warnings via onboard driver notification module (601) or digital sign boards (602) based on real-time hazard detection.
20

Dated this 03rd day of June, 2025



Dr. Omkar Rajeshkumar Acharya
Advocate & Patent Agent
For and on Behalf of Applicant
IN/PA – 4341

Abstract

A DYNAMIC ROUTE OPTIMIZATION SYSTEM AND METHOD THEREOF

The present invention discloses dynamic road quality assessment system (100) for real-time detection, mapping, and communication of road surface conditions. The system comprises a Sensor Module (301) for acquiring GNSS Sensor Data (401) and IMU Sensor Data (402), and a Roadside Camera Module (302) for capturing Video Data (403). A Sensor Data Processing Module (303) and Vision Data Processing Module (304) process the data to generate Road Condition Data (405), which is analyzed by a Road Condition Identification Module (305). The Geo-referencing Module (306) associates road condition data with location, producing Geo-referenced Road Condition Data (406), which is mapped by the Road Condition Mapping Module (308). Updated data is stored in a Road Condition Database (501) and disseminated via a Driver Notification System (601) and Digital Sign Boards (602). The system enables proactive road safety and infrastructure maintenance.

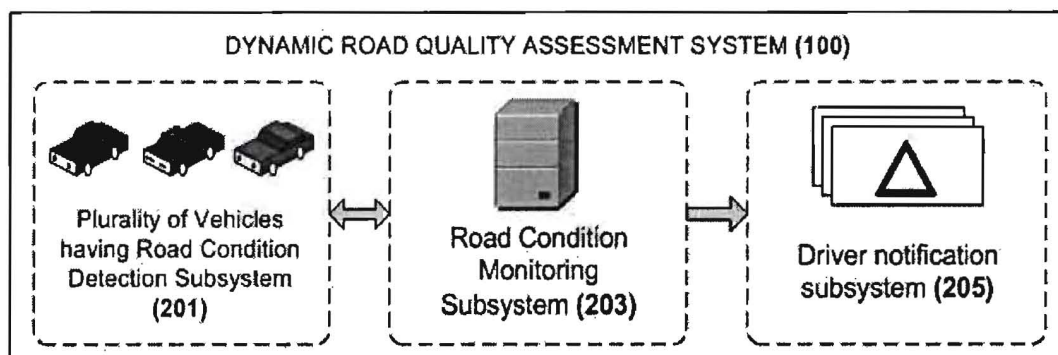


Fig. 1

COMPLTETE SPECIFICATION

NERVANIK AI LABS PVT. LTD.

APPLICATION NO.

TOTAL SHEETS: 4

CURRENT SHEET NO.: 1

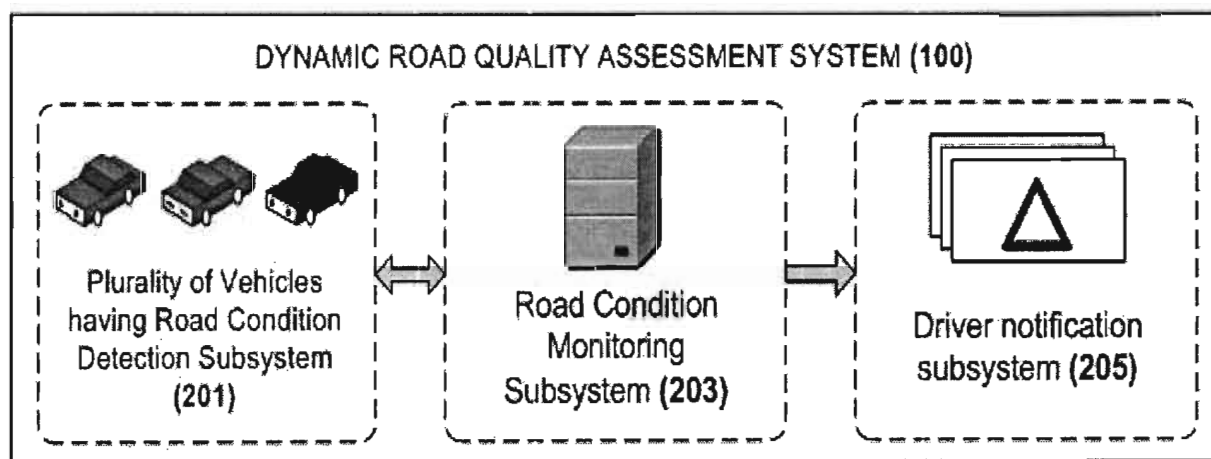


Fig. 1

Dr. Omkar Rajeshkumar Acharya
Advocate & Patent Agent
For and on Behalf of Applicant
IN/PA - 4341

COMPLTETE SPECIFICATION

NERVANIK AI LABS PVT. LTD.

TOTAL SHEETS: 4

APPLICATION NO.

CURRENT SHEET NO.: 2

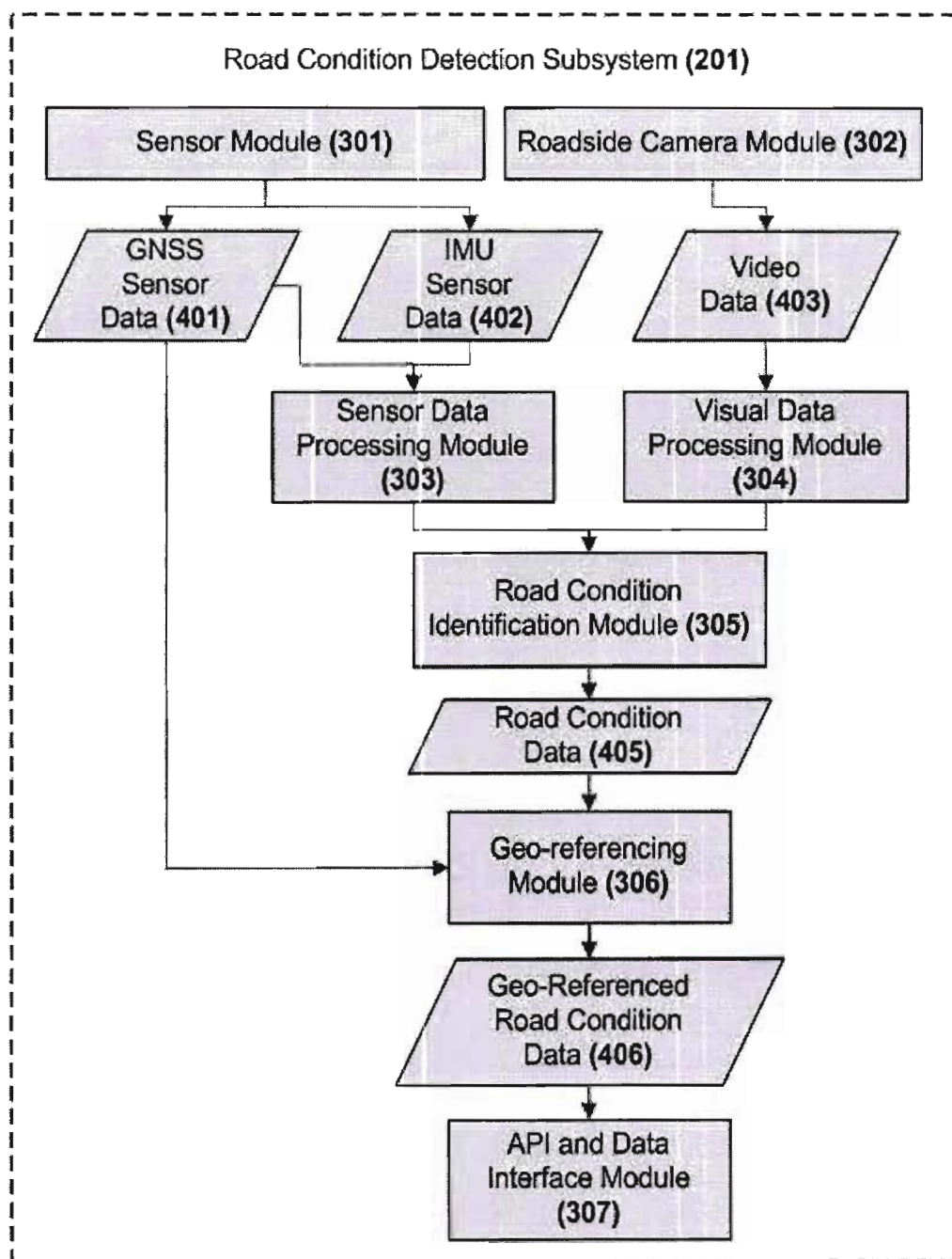


Fig. 2

Dr. Omkar Rajeshkumar Acharya
Advocate & Patent Agent
For and on Behalf of Applicant
IN/PA - 4341

COMPLTETE SPECIFICATION

NERVANIK AI LABS PVT. LTD.

TOTAL SHEETS: 4

APPLICATION NO.

CURRENT SHEET NO.: 3

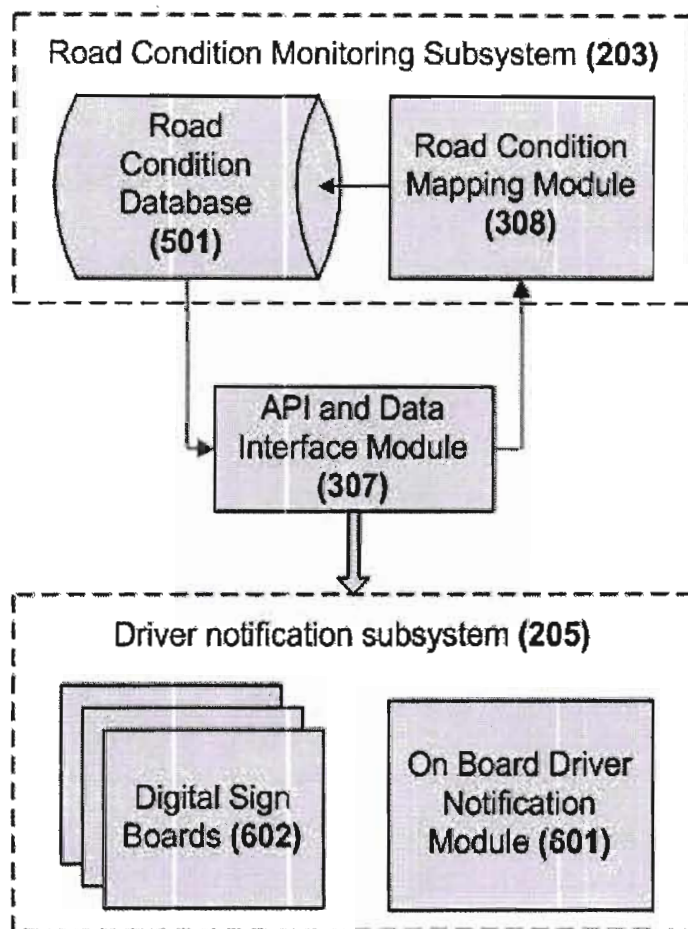


Fig. 3


Dr. Omkar Rajeshkumar Acharya
Advocate & Patent Agent
For and on Behalf of Applicant
IN/PA - 4341

COMPLTETE SPECIFICATION

NERVANIK AI LABS PVT. LTD.

TOTAL SHEETS: 4

APPLICATION NO.

CURRENT SHEET NO.: 4

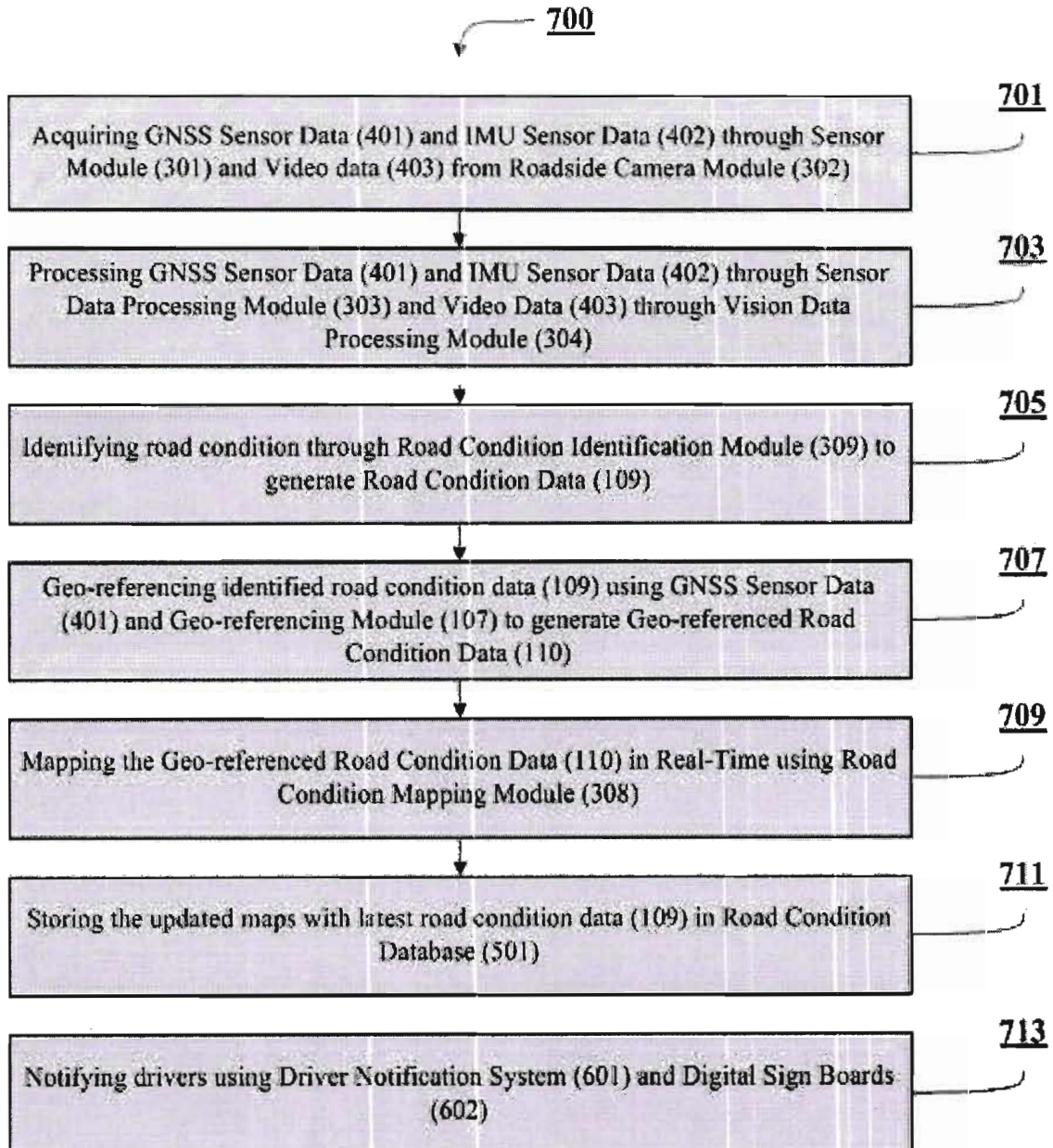


Fig. 4


Dr. Omkar Rajeshkumar Acharya
Advocate & Patent Agent
For and on Behalf of Applicant
IN/PA - 4341