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Traffic controlling and monitoring using IoT

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Abstract. The population is increasing the number of vehicles and the number of highways day after day; the time spent travelling, waste fuel, air pollution and related transport problems are also increasing. The greatest challenge for traffic administration authorities is therefore to monitor and monitor traffic. The related work has shown the Internet of Things and the integration of artificial intelligence to facilitate techniques for better urban and decision-making. This document creates a system model for IoT-based traffic information collection, processing and storing in real time. The aim is to ensure smooth mobility by providing roadside communications updates and rare incidents in real time. In particular, pre-alerting messages prevent and delay road congestion and peak hours in emergencies. The system also sends traffic updates from the database of administrative sensors. The system proposed evaluates the feature of the model and shows expected accurate results for vehicle detection and the minimum error in the estimates of occupancy.
Key words: Traffic monitoring, Traffic Controlling, Sensors, Internet of Things.

1. Introduction
The number of road vehicles today creates very difficult heavy traffic, which can be controlled and safeguarded. For ordinary people, especially in big cities, this problem is much graver and uncomfortable. The intelligent traffic control system based on video processing is available to facilitate traffic flow at crossings. This system enables information on major traffic problems to be collected and helps us to improve transport policies. The objective of this project is to automatically implement a road and road control system.

The IoT internet has come into being in numerous applications [1-4]. Also, the concept of clever cities has been evolving. In an intelligent urban context, the physical infrastructure of the city is equipped with intelligent devices that consistently produce multi-dimensional data across different areas and use it to acquire infrastructural intelligence.

In order to gather road data in real time, global positioning systems, sensors, test vehicles and vehicles are some of them for communicating infrastructure. Economically efficient, powerful, and the

most popular sensors for automotive monitoring, sensors like acoustic and magnetic sensors [5]. For prediction and management of traffic congestion traffic data collected from multiple sources can be used. The majority of the solutions available offer updates on the urban road traffic in real time, in particular using smart mobile devices [6]. Thus, this study proposes an IoT system model that can deliver actual roadside traffic updates in real time. This system is not confined to its use on collector roads. The system proposed incorporates a four-layered layer architecture [7], [8].
The network layer is the communication mode

- Sensing layer protocols with active elements and sensors
- Includes analysis and data storage in the service layer
- The application layer describes the application for the end-user.

The sensing layers collect car data from the Wi-Fi-based microcontroller in real time through roadside sensors and data transmission to the service layer. Different cloud IoT platforms for the administration, storage and analysis of connected devices are available for open source. Thinger io acts as a service layer for data fusion systems integration in this survey. Roadside traffic updates and dashboards are available to end users. At selected intersections on the road, physical systems such as sensors and displays are installed. Instead of smarter equipment and driver's for real traffic, the communication units are installed at the major intersections of the road. In conjunction with expectation of clearance times or other route recommendations, authorities may also report unusual road incidents to help handle the emergency cars (if any). With Early Warning Messages, the proposed system will create public value by saving driver driving times. Briefly, the proposed system has the following features:

- Suitable for estimating road congestion by road
- Upgrade people with display messages on the roadside in real time
- Monitor smart campuses' density and mobility, particularly during peak times.
- Aid authorities report significant messages of incident
- Offer a traffic update in real time dashboard

2. Literature study

This section examines recent smart traffic management investigations such as traffic update models, traffic congestion measures, handling emergency vehicles and roadside message delivery applications. In cost-effective and efficient wireless nodes, current traffic monitoring technologies also.

2.1. Real-time traffic updates

Real-time traffic surveillance systems make the transition to intelligent cities possible. Intelligent IoT-based traffic management systems with significant literature have been published [8]–[11]. In order to measure traffic, foresee traffic congestion and adaptably control road traffic, smart city infrastructures use smart wireless sensors for autonomous traffic sensing. This effectively sensitises the resources and efficiency of infrastructure. Identification and congestion measurement are the first step in the road management process [12]. Traffic congestion measures, mainly taken from photographs or video images of visual systems, are widely used as flow, employment and density [13]. These measures are based on smartphone, radio, television, light, variable dynamic signs, or viewing units transmitting traffic warning messages. Including mobile web application [14], researchers have paid much attention to them.

The congestion estimates used for the dynamic monitoring of a traffic signal [15]–[20] are the latter trend for upgrading in real time. In order to manage traffic signals dynamically on the basis of density a traffic monitoring system based on IoT is proposed. The proposed system uses two modules for the implementation of a series of ultrasonic sensors, one for automotive monitoring and one for priority management. The ultrasonic sensors are used for vehicle detection and transmission of an LCD to highway density levels and for future use transmission to the server. The authors suggested an ultrasonic system model for the specific intersections of the sensors in similar studies. The system warns against any fake engine acts as the crossing of red signals in addition to traffic signals. Further research is being proposed on the real time management of traffic through intelligent Traffic Management Systems based on IoT via local and central servers. The data is collected by sensors, cameras and RFIDs. The layer controls the traffic signal automatically on the basis of traffic density and produces a daily report for a web application. In addition to sensors, video monitors measure traffic congestion densities, and traffic density update in real time.

2.2. Wireless sensors for vehicle data collection

This section discusses the sensors used for vehicle detection and classification. Smart traffic monitoring systems can be used with on-road or in-car sensors. Intrusive and nonintrusive traffic sensors on the highway are two new models. In comparison to non- intrusive sensors, the road sensors are paved and expensive. The intrusive sensors are accurate, but the prices for installation, maintenance and repair are questioned [7].

Apart from different sensor types there have been several research efforts to develop PCBs, adapted directly for detection/speed estimates/classifying sensors, including PRS, LCTS, iVCCS, and CPIUS. PRS PCBs, LCTS and iVCCS sensor nodes. All these studies have the main objective of developing cost-effective and portable sensor nodes.

PRS is an estimated speed sensor and a portable vehicle detection, scanning, classification [20]. For vehicle detection, PRS uses the magnetic sensor. Two magnetic PRS sensors are on the PCB board (HMC2003). For wireless communications the sensor uses the XBee module. The accuracy of the PRS for vehicle detection is 99 percent and estimates a maximum error rate of 2.5 percent. The system also recognises the correct crossroads. Due to the magnetic length, vehicle length and height are calculated.

LCTS is an additional low-speed traffic node which is specifically connected to one magnetic sensor lane [16]. The HMC5883L magnetic sensor is developed for the node. The node has a sound sensor, four infrared sensors and a magnetic sensor. The magnetic sensor detects and categorises the car itself. The validation results show an accuracy of 99.05% and 93.66% accuracy.

iVCCS is a smart node and classification sensor that features different temperature sensors, accelerometers, sensors, GPS, real-time clocks, memory units etc. There are several sensors and components in the iVCCS. The iVCCS is a small 6-axis magnetic and battery node accelerometer, FXOS8700. Zigbee is used for wireless communication. The iVCCS Node has been validated in several tests and is 99.98% accurate, 97% accurate, 97.11% accurate and at estimated speeds. The consistency of the sensor output is tested and demonstrated to be very similar in different conditions. Furthermore, both on road and on roadsides, the sensor node is portable[21].

CPIUS is the combined CPIUS sensor for classifying the vehicle and estimating speed. For vehicle classification measurements are used from passive infrarot sensors and ultrasound sensors. Vehicle detection is extremely accurate (99 per cent), the average absolute speed estimate error is around 5.87 km/h, and the estimated average vehicle length is around 0.73 million. The multi-controller with different components such as an SD card reader is joined by two sets of 5 passive infrastructural sensors (Melexis MLX 90614) with electric power tracks and flash memory.

The review shows that magnetic sensors can be categorised according to length. This is extremely important as the collector roads mainly use smaller vehicles and there is no correct volume-to-power ratio. That's extremely important.

3. The proposed system

A robust research methodology is essential in order to achieve the research goals. Research is carried out under the design science methodology in the five main phases [19]. The five phases are shown in Fig 1: (i) Research background analysis; (ii) objective definition; (iii) design and development; (iv) demonstration; and (v) evaluation.

Figure 1. Research Methodology

A research background study is performed as part of an objective definition. The wireless sensor grids have proven common in transport projects and play an important role in detecting and reducing traffic congestion. Different types of sensors are used for real-time traffic monitoring. For energy consumption, cost, sensitivity, reliability, etc., sensors can be selected. In addition to traditional traffic monitoring sensors such as magnetic, infrared and ultrasonic sensors, special sensors are also available for vehicle detection and classification in the associated field.

Measuring occupancy on roads and roads is accurate. There are mainly small vehicles available on collector roads and therefore longitudinal occupancy measures are provided for. The vehicle length, safety distance between cars, and buffer length is taken into account when measuring the space of road space. The two cars are 2 metres away safely. When a vehicle enters a street zone, the vehicle length is increased and decreased when the vehicle leaves that area. This research has based on literature review, since it demonstrated its high precision in vehicle detection, decided to use magnetic sensors for the collection of traffic information's (or magnetic sensor-based PCBs). In the following sections you can learn how to design, demonstrate and evaluate the system [13-27].

4. System design and development

This section describes the proposed system model, software components required for the system and the algorithms needed to implement it. A proposed system communication model is provided by roadside components and a cloud-based central server. The roadside is equipped with sensors and message panels. Two intersections of the road segment are connected to the sensors and panels. Data storage, cloud services and interfaces are the main server. The components can be accessed through WiFi.

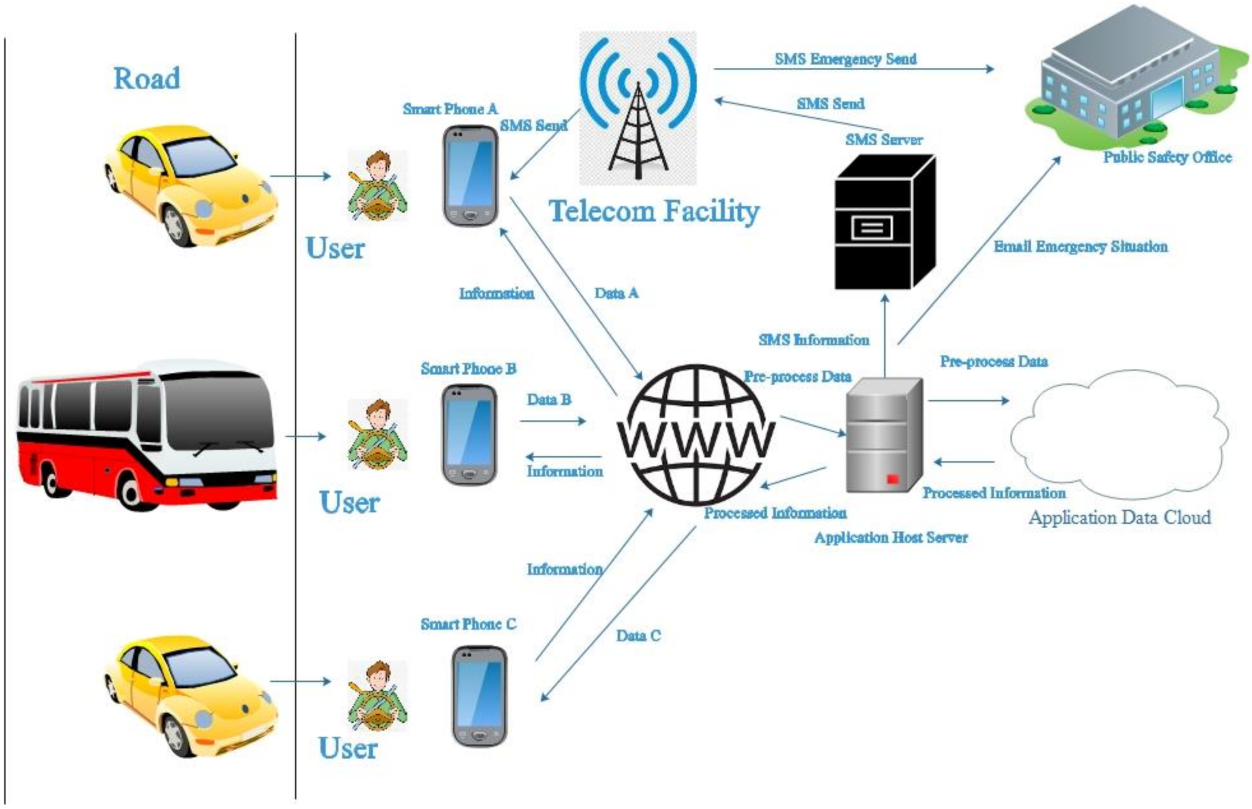


Figure 2. System Communication Model

4.1 System Development

An application layer and network layer are mainly part of the IoT system architecture. Data is collected from the sensing layer and the network layer transfers data from the equipment to the service layer and the service layer monitors the equipment and analyses the information collected and the application levels.

The four main operations for system development include: (i) identifying and assessing a truck for geographical location, ii) extending the queue, and iv) updating traffic displays. Includes: geographic map I, sensors iii) IoT platforms, (v) electronic display units and (v) databases. System components include: Components of the system are: In Fig.4, each activity's activities, software, and hardware is shown.

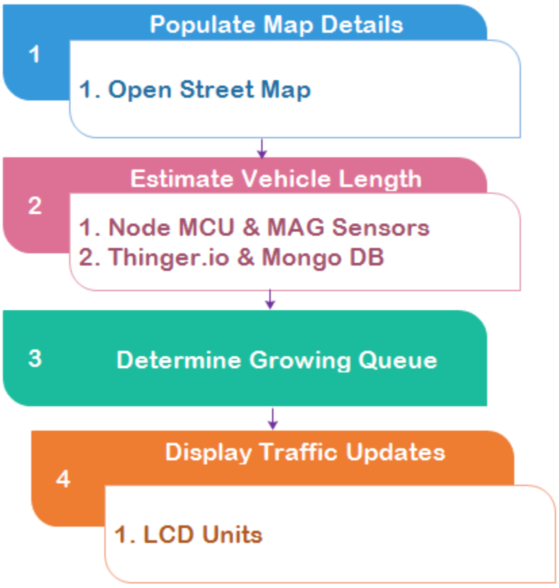


Figure 3. System Activities

4.2. Hardware and software components

A literary examination has been undertaken of different components of the system and technologies. Below are the software and hardware components used to develop the system.

OpenStreetMap is one of the practical map data projects for OpenStreetMap. Free use of the data for the OSM map (wiki.openstreetmap.org). Individual users develop the OSM and its geographical contribution to information is essential for the OSM. OSM offers functionality to edit, export and upload. You can produce row map data or images using the export function. Other systems using geographical data can process the raw data. The OSM has a java interface which resembles traditional geographic data edits and maps like Java OpenStreetMap (JOSM).

MongoDB: JSON data is documented by MongoDB (www.mongodb.com). MongoDB offers flexible access to data and supports objects as values. For both the community and the enterprise, MongoDB has versions. This research uses the community version of MongoDB. The field and value pairs for a record in MongoDB is basically a document. The MongoDB documents are collected and stored like tables. The OpenStreetMap has been downloaded into a Geojson format and saved for experimentation in the MongoDB. Because of its efficiency and rich query language, we selected MongoDB.

The advantages of the magnet sensor are that (i) it is easy to install on the side of road, (ii) it reduces the detection error, and (iii) it has no climate influence. Magnetic sensors: Because it has a high sensitivity and cost efficiency, For several traffic monitoring surveys, Honeywell HMC5883L is a three axis magnetic sensor. The HMC5883L magnetic sensor was used to gather automotive data as a basis for this research. As mentioned in the literature study, there are numerous PCBs with all required vehicle detection and classification elements. It is important to note that The physical and firmware sensors are provided on these boards. The idea to move these ready-made nodes forward is also good because they are cost-effective, and the cost estimated of one node is less than $50.

NodeMCU: NodeMCU is a WiFi chip-based firmware ESP8266 (SoC). It's also a platform for open sources. NodeMCU supports IoT products prototyping. The overall input/output interface [12] of ESP8266 makes it possible to easily integrate sensors/devices. WiFi is available on the NodeMCU Board with digital (D0-D8) and analogue pins (A0) (I2C, UART, etc.). For expressive systems, the ESP8266 Chip (www.espressif.com). The ESP8266 is equipped with the WiFi 2.4GHz, ROM boot

64kB, RAM 96kB and RAM 64KB. The ESP8266 module can be used for IoT end-to-end system development.

Thinger.io: Thinger.io is an open source IOT data collection, management, analytics and display platform for the collection of sensor data. Thinger.io (www.thinger.io) offers cloud, IoT and Big Data Integration application for data fusion. It supports remote sensing, control and connectivity devices from any sensor. Thinger.io is unique to its optimised Protoson encoding programme in terms of transmission efficiency. Thinger. io is extremely interoperable and provides two-way communication in real time. Io is known as data pads and supports documents storage, such as MongoDB. The mechanism for the Thinger storage control. The Thinger.io platform provides an interface for the development of data buckets and modelling equipment for devices.

LCD unit: A WiFi-enabled LCD type character unit can be a messageboard unit. However, only 32 characters can be tested with an LCD unit with 16 x 02.

4.3. System Development Activities

This section discusses about the proposed system development algorithms in Fig. 4.

Geographical map data processing: The geographical map shows tracks, intersections and highways. The maps are used for loading and extracting information from the message board to the data base. You can choose the position of a message board using the user-generated map [23]. The best places to display alarms are those road intersections with more road sections. In order to maximise message visibility, the locations of the board are chosen based on their exposition. Selection of the message board shall be considered as a problem of maximisation, since the aim is to maximise message visibility.

Vehicle detection and physical length estimation: For detecting and estimating the length of the vehicle the data gathered by magnetic sensors in real time for the vehicle. The vehicle's predicted speed is a parameter used to determine the vehicle length. Magnetic sensors detect the distortions induced by cars and measure the magnetic length of the vehicle in the Earth magnet field. In order to evaluate the length of the vehicle, magnet longitude (MLV) is used. The trials show that the vehicle detection can be using a single magnetic sensor at 99 percent accuracy

Road occupancy and growing queues: The measurement of traffic congestion depends largely on speed, time and time, confidence, maintenance, space etc. One such step is the use of roads to determine the growing street queue. The sensors estimate the VPL The physical length of an occupancy measurement is increased if the vehicle passes through sensor nodes and deletes the length when the vehicle leaves the exit points. The sensor D determine the duration of a vehicle and sends it to the B sensor when a car is detected by the C-sensor. The Sensor-B Microcontroller maintains the usage measurement in real time.

Display warning messages: There are two different types of traffic warning messages: (i) traffic density updates in real time, (ii) authorities messages of extraordinary road incidents. Drivers can access these updates in different modes, such as intelligent mobile apps, radio and TV. The use of message panels at key intersections is an alternative method. These units reach the public as much as possible and help them to take alternative routes. [24]

5. Discussion

The system has three basic functions: (i) map handling, (ii) collection of traffic data, (iii) display and storage. It collects information on the route and removes the message unit locations from the free Wiki map. The collection of information is based on magnetic sensors for detection and measurement of vehicle length and road use. The feasibility of the system is shown by a prototype. All modules are evaluated individually, with accurate results. In the system architecture, a wireless communication model is developed between the sensors and the IoT platform. The WiFi client server is followed by magnetic sensors along the road and by the microcontroller.

This work aims mainly to assess the length of the vehicle's road occupancy. The test shows 100% accuracy in vehicle detection. The experiments further confirmed that the high speed and length rates are 97% high and the relative low error rate is estimated in the road usage. But for vehicles between 1.5 and 5.48 M in length estimates have been made as they are common at such universities. The route segments are assessed between 200 and 500 m. Test results show that the distance to the error rate is the opposite. Consequently, in real world road scenarios, the proposed system model will work well.

6. Evaluation

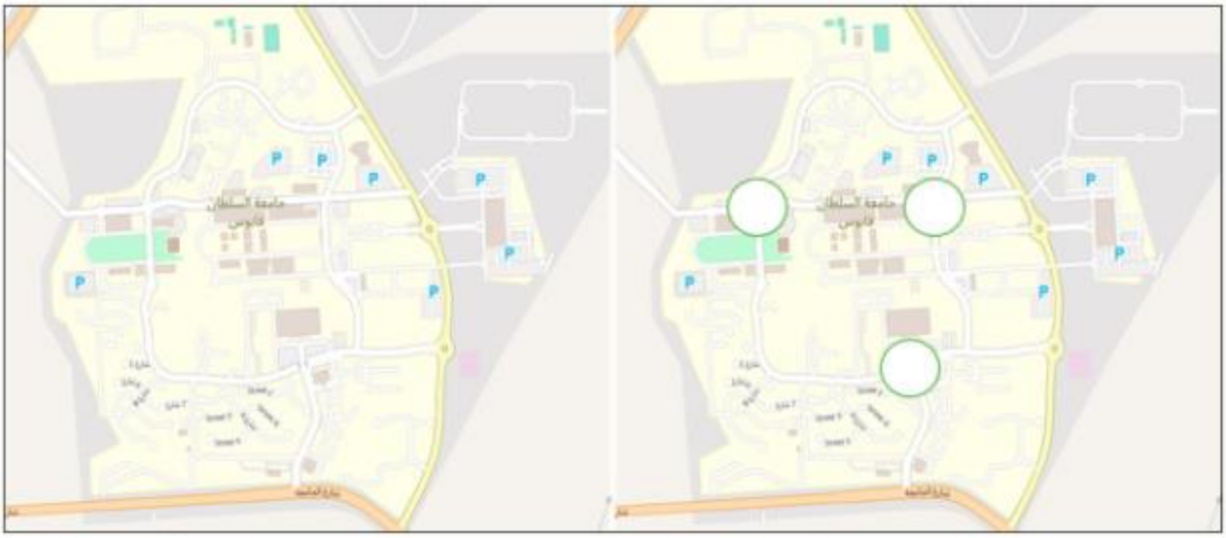
Three key features, i.e.: (i) the processing and positioning of maps, (ii) collection and processing of information for vehicles and (iii) dashboard, are validated by the graduating process.

6.1. Selection of message board location

The university map can be found on the website of OpenStreetMap. OSM files can be converted to MongoDB and loaded. The precise map script treatment is accurately measured and remembered. These measurements are used to assess the efficiency of data collection.
Precision percent = (Collected junction quantity/Junction quantity) = 100%
Remember percent (this map contains a number of junctions) = 100% = 100%.
The script finds the location for the number of threshold paths on the message board. The OSM map is comparable to another Mapcarta tool manually (www.mapcarta.com).

6.2. Vehicle detection and road occupancy estimation

A single roadside node was used to test vehicle detection. Fig. 5 shows the Renault Duster car's experimental configuration and magnetic field swings when the sensor is 100 cm. Fig. 5 illustrates the intensity of magnet f and x, y and z components in the geomagnetic field when the sensor detects a veit.



For vehicle detection as well as for road occupancy estimates, both RE metrics are used. The detection accuracy is 100% and 30 cars were identified. Sensor Node B calculates and transmits data on the vehicle speed, magnetic length, physical longitude, and occupancy of road. The validation of the speed/length estimate was detailed, as already shown in this study.

6.3. Dashboards
Different user viewpoints such as information consumers, managers and developers can be assessed from the dash boarding tools. This section is based on the criteria defined by the dashboard evaluation [4] in a user-view of the dashboard. Depending on if or not the compliance value = {0,1} is supported, the compliance value may or may not be true.

7. Conclusion
This paper presents an innovative IoT approach to safe and intelligent travel by roadside messaging units for smart cities. The system uses sensors and communications devices that use the internet to communicate the road conditions messages to the public and to save time on the roads. Smart Drive logically connects every passenger on a particular road by collecting and sharing information on passengers, such as road congestion, weather updates, etc., in real time and dynamics.

The system is designed to collect real-time vehicle information using magnetic sensor nodes. The data is processed and sent to an IoT platform in real time via Wi-Fi compatible micro-controllers. By contrast, no clever, well-equipped devices such as sensors, GPS, wifi, etc are in place in the proposed model of vehicles or cars. The proposed system should be considered in all intelligent urban initiatives, such as the intelligent university campus and the closed intelligent facilities. In order to demonstrate the feasibility of the proposed model, results of the prototype demonstrations show a high precision of vehicle detection and a relatively small error in estimates of road occupancies. The system is designed to provide passengers with dynamic information and remove barriers to information that permit users in real time to choose smart transport.

8. Future work
The Smart Drive system has too many opportunities to develop in the future through the acquisition of real time and dynamic data. Currently, smart phones are used as sensor devices, and more suitable sensor devices could be used in future. The data generated by users can be useful in vehicle communication with infrastructure such as traffic lights, communication with vehicles patroling law enforcement, ambulances, etc. The system proposed currently requires more user interaction, but it must be minimised. More self-driven automated features of the system than manual, requiring minimal interaction between people and machines. The Range calculation algorithm is not optimised, but should be more optimised and precise in the first version of the proposed system. Currently, in future, Smart Drive can be upgraded to vehicle communication via internet and GSM communications using Vehicle to Infrastructure architecture. The use of Bluetooth signals and Wi-Fi can enable short-range vehicles to communicate with the owner and vehicle with the vehicle. This communication with a short range can also be used to detect vehicle crashes. In the absence of, or low coverage zone of internet signals, bluetooth and Wi-Fi signals would be better alternative. The enormous amount of data collected by the data cloud can also be utilised to generate useful patterns in large-scale data analysis and data mining.

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