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Fleet Automation Using IoT Logistics

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Abstract: Resource Management play a vital role in daily life of fleet management. Particular some of the resources like fuel, driver behavior, theft maintenance, etc. are must be managed to avoid financial defeat. Fleet (Trucks or heavy Vehicle) Resource Management Systems can expose the average mileage and speed for a particular based on fuel. The IoT logistics that equipped GPS to track the fuel usage, driver's behavior, sroutes, speed, temperature, etc for the fleet management. Location shared via GPS to the user interface can help truckers to find around the current areas. This work focuses on the key objective of the transportation management with minimum human resource so the management of the fleet with the development of IoT is employed in this work for the automatic fleet resource management, find driver behavior, health status of the vehicle.

Keywords: Fleet Automation, Fleet Health Statistics, IoT, Load Management, Live Tracking, Truck Monitoring,.

I. INTRODUCTION

These days support of an association is developing as a major issue. The fleet resource maintenance which holds huge number of vehicle requires huge resources. A smart answer for establishing out and keeping up the truck is the proposed procedure. Internet of things (IoT) in computerization industry is showing to be a distinct advantage for mechanization organizations. Modern automation organizations that utilization IoT arrangements can receive new rewards. The Internet of Things (IoT) creates new aptitudes to tackle challenges, improve activities, and upswing efficiency. The IoT can be explained as the association of solely conspicuous electronic gadgets utilizing Internet 'information plumbing' including Internet Protocol (IP), cloud computing and web administrations. Internet of Things (IoT) Impact on Industrial Automation is high and it makes us to utilize tablet PCs, PDAs, virtualized frameworks, and distributed storage of information, etc. With IoT coordinations, following products turns out to be quicker, increasingly exact, prescient and secure; while investigation from a related truck can detect resource disappointment and calendar preservation checks mechanically. The Smart Fleet Resource Monitoring System Using Internet of Things (IoT) utilizes modest sensors to screen the status of the truck.

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Existing Systems which maintains the truck with low of sensors, for example, fuel level monitoring, live driver activities tracking possibly a

II. REVIEW OF LITERATURE

couple. The client (Truck proprietor) has to know the most profound investigation about the each and every truck so far that the system proposed this structure to oversee wellbeing measurements, Live Status and Asset Management of each truck.DashmirIstrefi, Betimçiço[11] has clarified the utilization of fleet resource organization and cloud to convey between two machines. The vehicle is introduced with GPS, GPRS and sensors. The data from the truck is sent to the cloud and furthermore spared, with the goal that it could be gotten to from any gadget which approaches on the server cloud site page.s The paper [1] proposed an mtracker which is a Mobile application for the utilization of following the portable cell gadgets temporary on the land position of the gadget. This enables the program client to follow the mobile phone and send alarms and admonitions outside the topographical inclusion territory. [11], They have proposed and actualized a portable program to follow and examining the spatial information and data of a particular item dependent on route programming and GPS. For the drive of understanding this application in a perfect way, satellite pictures taken by satellite were gathered, put away and used to do the fundamental capacity. Engelbrecht, Booysen, Bruwer, & van Rooyen, 2015,have given a detailed survey of smartphone based solutions and futuristic ITS development. Driver behaviour analysis predicting a drunk driver behaviour to literature relevant to smartphone sensing in vehicle have been surveyed and revisited.ITS got improved with IEEE 802.11p standard which is p (5.9 GHz) band on Wi-Fiso that vehicles can communicate in its vicinity for V2X communication [2]. Lau [3] proposed modest transport following framework in UCSI University, Kuala Lumpur, Malaysia. The fleet tracking system offers understudies with the area data of a transport inside a static route. The understudies are furnishing with a status of the transport after distinct time interim using LED board and a Smartphone application. Constant transport management frameworks are useful to understudies who go to schools with enormous grounds. With the transport following framework, they can utilize additional time contemplating, napping, or unwinding as opposed to sitting tight for a late transport. Investing less energy sitting tight for a transport improves the agreeable and powerful time the board of the understudies also. Additionally, the transport following framework helps advance youngsters' wellbeing when it is prepared in school. Mrs. ManasiPatil, AanchalRawat, Prateek Singh, Srishtie Dixit [4], described an improved traffic maintenance framework misuse Raspberry pi and RFID technology.

The vehicle consolidates a raspberry pi controller mounted in it which is interfaced with sensors like gas sensor, temperature sensor and stun sensor. These sensors are mounted at a foreordained cost before mishap. At the point when a mishap happens the value of one of the sensor changes and a message to a predefined number (of the emergency vehicle) is circulated through GSM. The GPS module whishes conjointly interfaced with the controller likewise sends the area of the vehicle. At the point when the message is gotten by the rescue vehicle, a reasonable course should be given to the emergency vehicle. The emergency vehicle includes a controller ARM that is interfaced with the RFID tag sends electromagnetic waves. When a car arrives at the light the RFID peruser that is set on the joints locate the electromagnetic influxes of the tag. In the event that the traffic sign is red, at that point the perusers experiences the database in portion of seconds and switch the red light green. What's more, precisely in such condition the RFID on inverse joints flip the contrary sign red. This gives an unmistakable course to the emergency vehicle In [5], the paper exhibits objective of fleet monitoring and management. The system has two units: the main is the security unit consisting of a GSM, GPS, relay, current sensor and microcontroller. The current sensor will communicate an analog signal to the controller whenever the car is moving and validation is done by sending SMS to the owner. In [6], motors of vehicles are organized using GSM and microcontroller. The secret word which has been declared needs to be sorted out for the vehicle to start. Right when the mystery word organizes at that point and at precisely that point start of the vehicle will start. Each time mystery key fails to coordinate to the three preliminaries then structure will begins the alarm and it will send the message to the proprietor through GSM framework. Paper [7] proposed a novel architecture that controls home appliances through GSM using IoT architecture.

III. PROPOSED MODEL

In this section, the generic framework for the IoT based fleet automation is described with the overall framework design is shown in Figure 1.1. The complete framework for the management of transportation resource management involved to provide efficient fleet management based on the user's requirements. The overall architecture includes mainly three layers for the resource management:

A. *Fleet IoT Layer*

The first layer of this framework includes the necessary sensors information of the truck and the configuration of the board with GPS. The information regarding the sensors with configuration of the circuit to represent the IoT information for the fleet management is described.

B. *Fleet Web Layer*

This layer of the framework describes the user interface and the cloud server configuration. The user interface for the communication among the users are managed in this layer. The information transmission among the IoT configuration and the user interface consume the input and output management among the cloud server and the IoT information of the truck. The information are stored and retrieved from the cloud server to the interface of the fleet web layer.

C. *Fleet Data Maintenance Layer*

The layer includes the truck information maintenance for the automatic updation of the necessary information to reduce the resource wastage. This layer provides information such as fuel observation, engine temperature, fuel consumption, location, etc. of the truck. Based on the provided information the fleet data is sustained among the cloud server and user interface.

The key objective of this work are as follows:

- The fuel level of the truck is monitored.
- To measure fuel utilization by the vehicle as for separation crossed.
- To limit the fuel wastage of the truck due to the unmaintained position.
- In an enormous association to limit the hardness in observing the whole vehicle.
- To fabricate a framework which is conceivable to do every one of the things referenced above with high unwavering quality and minimal effort.

3.1 Problem Statement & Objective

Intelligent real-time monitoring of trucks calibrates weight in the motion of cargo vehicle and its location through the GPS is to provide reliable and affordable intelligent truck monitoring system through the emerging technologies like Internet of Things (IoT) and Cloud Computing that supports the productivity, profitability, and safety for the commercial cargo industry.

A. Truck weight calculating without Load

Two conditions will be applied as per Einstein's Theory of Relativity to calculate the weight of the truck precisely without a load attached to it. Initially truck's weight is measured without any load attached to it when the truck is not in motion on the flat surface. Now, the truck's weight is calculated without any load attached to it but the truck should in motion. Weight calculation takes place on the flat surface.

B. Truck weight calculating with Load

Two conditions will be applied to calculate the weight of the truck precisely with the load attached to it. Here, weight measurement is done by the spring suspension method on various road conditions.Cargo is loaded on the truck first. Next, the truck's weight is measured when the truck is not in motion on a flat surface. A cargo is loaded on the truck. Next, truck's weight is measured but the truck should be in motion. Weight calculation takes place on the flat surface, hilly roads and various road conditions.

C. Weight Calculation

In spring suspension method, the weight measurement is done at the center of the axle groups where a precision sensor is placed. A truck has various axle groups such as a two axle, three axle, four axle, that depends on the weight capacity of the truck. The sensor detects strain in the axle groups. Then it is read by the IoT board and converts kilograms into digital data specifically to push the data into the cloud.

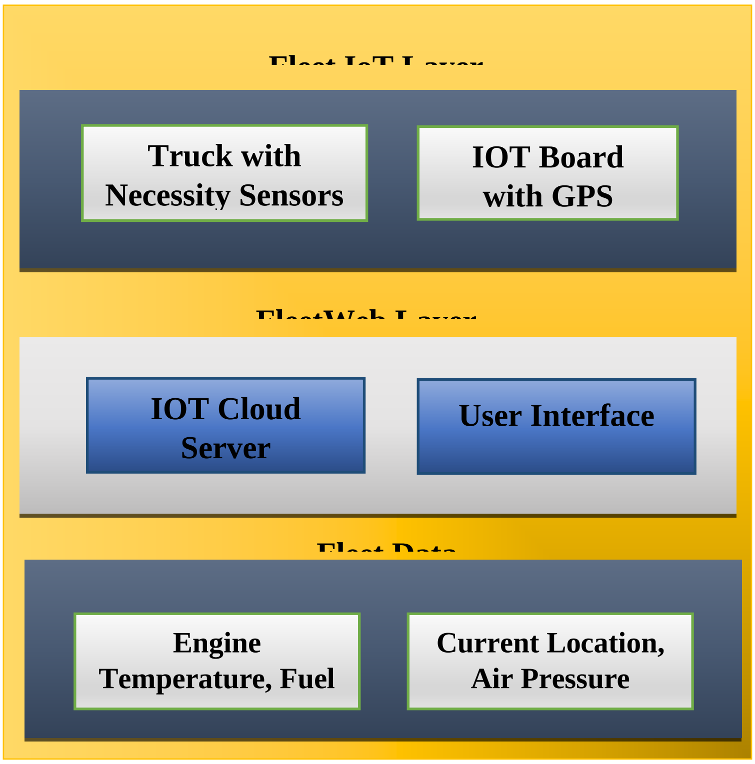

Figure 1.1 Architecture Diagram of the Fleet Automation System

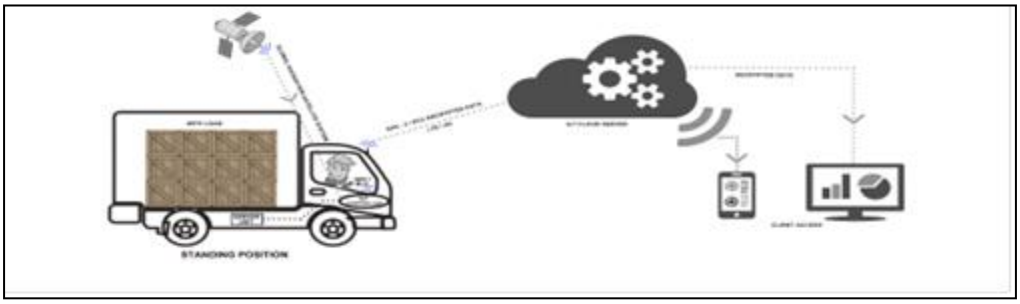

Figure 1.2 Truck on Standing Position

D. Weight Comparison

Here also after testing two conditions, the calculated weight parameters will be compared and programmed into the IoT board.

3.2 Fleet – IOT Kit

Truck data can be more easily gathered and examined by simply equipping vehicles with IoT sensors. The information gleaned from the sensors can then be used to track, monitor, analyze, and maintain a complete fleet and in real-time. IoT board is made of Qualcomm new generation processor of multimode Smart LTE Cat 4 module. This board gives 150Mbps downlink and 50 Mbps data rates at maximum based on LTE and it supports wireless communication via Wi-Fi and BLE. It is applicable for industry and user applications which requires high data rate and high-speed internet access. This circuit backings Multi Input Multiple Output (MIMO) innovation which suggests the utilization of various radio wires at the collector end simultaneously on a similar recurrence that limits and improves the information speed. It joins high-speed wireless connectivity with embedded multi-constellation and high sensitivity GNSS receiver for positioning the object. This board has inbuilt Android OS, Wi-Fi connectivity, Bluetooth and GNSS receiver which are packed into one module. It supports LTE (Long Term Evolution), UMTS/HSPA+ and GSM/GPRS/EDGE coverage. It has technology of MIMO as it meets loads for information rate and connection consistency in modem remote correspondence frameworks. GNSS beneficiary is promptly possible for applications requiring quick and accurate fixes in any condition. This board is made with Leadless Chip Carrier and Land Grid Array package which ensure reliable connectivity with applications. The general characteristics of IoT kit for the fleet automation resource management is depicted in Table 1.1. Table 1.2 shows the enhanced features on board of the IoT kit for the configuration of the fleet IoT board. The specifications of the sensors and its features are included in the Table 1.3 for the IoT configuration board.

Table 1.1: General Characteristics

Configuration	Features
Frequency Band	**SC20-E**
	FDD LTE: B1/B3/B5/B7/B8/B20
	TDD LTE: B38/B40/B41
	WCDMA: B1/B5/B8
	GSM: 850/900/1800/1900MHz
Memory	8GB eMMC+1GB LPDDR3
	16GB eMMC+2GB LPDDR3
Temperature Range	-40°C ~ +75°C
Dimensions	40.5 x 40.5 x 2.8mm
Package	LCC + LGA
Weight	Approx. 9.8g

Table 1.2: Enhanced Features on Board

Configuration	Features
WLAN	**2.4G/5G, 802.11 a/b/g/n (SC20-E/-A/-AU/-J, SC20-CE/-W R1.1)2.4G, 802.11 b/g/n (SC20-CE/-W R1.0)**
Bluetooth	BT2.1+EDR/3.0/4.1 LE (BT4.2)
GNSS	GPS/GLONASS/BeiDou Support 3GPP E-UTRA Release 10
Bandwidth	1.4/3/5/10/15/20MHz

Table 1.3: Specifications

Data	**LTE**
	LTE-FDD: Max 150Mbps (DL)/Max 50Mbps (UL)
	LTE-TDD: Max 130Mbps (DL)/Max 30Mbps (UL)
	UTMS
	DC-HSDPA: Max 42Mbps(DL)
	HSUPA: Max 5.76Mbps
	WCDMA: Max 384Kbps (DL/UL)
	TD-SCDMA
	Max 4.2Mbps(DL)/Max 2.2Mbps(UL)

	CDMA2000
	EVDO: Max 3.1Mbps(DL)/Max 1.8Mbps(UL)
	1X Advanced: Max307.2Kbps (DL/UL)
	GSM
	GPRS: Max 107Kbps(DL)/Max 85.6Kbps(UL)
	EDGE: Max 296Kbps (DL)/Max 236.8 Kbps(UL)
Antenna	4 Solder Pads for Main/Diversity/GNSS/Wi-Fi & BT Antenna, Respectively

3.3 Fleet- Automotive Web System with IOT Data Server

Intelligent Truck Application is an Android mobile application, it can track the route of the vehicle at any given moment adapted by the Internet of Things technology. To know the exact location and load capacity of the truck by the customer while the truck is in motion and It can show us time delay, load weight variation and live traffic in which truck crosses by. The user can access the information about the truck like its travelling time, load capacity, arrival time and departure time, destination and this history can be retrieved whenever It needs from the Cloud Server. The following features will be delivered by this application to our customers. This application is deliberately embodied with SHA-2 and ECC encryption algorithm. For example, if particular data sent from the truck via communication protocols like MQTT, HTTPS, COAP are encrypted first, then when the data reach destination, it is decrypted by the applied algorithm and gives the correct particulars of the vehicle.A multi-level sensor more than once faculties the fuel level in the tank, live area, temperature, for example, the detail send the data to the controller. The acknowledged information will be changed over to a transmittable structure and the sent to the control database which will be worked with web in an appropriate and helpful medium (likely air is the medium) utilizing REST API. A similar transmitter is utilized in transmitting the separation crossed data all the while. The database gets every one of the information identified with status of the vehicle. Likewise to the control component it looks at the fuel utilization to predefined sum as referenced by the association. According to the state of the vehicle beginning control measures are sent to the driver and the status related data is sent to the control association. The fleet resource management association gives serious control measures to the driver in keeping up the state of the vehicle in a legitimate manner. The interface to the association with the vehicle can be given in any helpful stage (for example it tends to be a versatile stage or any online interface) for the association.

A) Weight Variation Identified with IoT board – Asset Management

Weight variation will be indicated by the IoT board in a timely manner. After testing the above conditions successfully, IoT board will set the various conditions on the basis of road types.

Case I

In case the load weight of the truck is reduced sometimes because of varying road conditions. The reduced data will be read by the IoT board and compared with already existing data which is tested initially. The user and truck driver will get notified that contains weight diminished and type of road where the truck goes on. Therefore, the notification will be sent deliberately which will have the weight deviation from the originally tested weight and will have the reason for the weight reduced. Hence, it enables user to understand the cause for the weight loss. Weight reduced will be expressed in terms of kilograms.

Case II

In case the weight of the truck is decreased to certain level which is set and programmed inside the IoT board. Then, the obtained data will be processed by itself. In case the data is not matched with the tested conditions, then an alert message will be given to the authorized person and the driver. It helps them to find out the weight loss precisely and gets rectified as well.

Case III

In case the half of the load capacity is reduced and it is identified by the IoT board. This instructs the authorized person to have rights to stop the truck engine remotely with the support of Internet of Things (IoT). This option is internally programmed for the person especially who owns the truck.

B) Live Tracking

Truck's route can be traced as the IoT board contains inbuilt Global Positioning System (GPS) and it is programmed with Google API to fetch the location of the truck which is currently travelling. This particular feature not only gives the exact location but also determines time delay, live traffic for the truck to avoid the traffic jams.

C) Work Flow of Real-Time Monitoring

- The endpoint device known as load weighing transducer placed at the center of the axle inside the truck that calculates the strain in the axle.
- Once the precision sensor detects the strain which is then gauged and converted the data which may be obtained in terms of pounds or kilograms.
- Next, the computed kilograms will get modified into digital pulses (commonly referred as digital signals), by the IoT board attached with the endpoint device.
- Once data is read from the endpoint device, the data get encrypted with either SHA-2 encryption or ECC encryption. The data may then be collected by the gateway from the IoT board. The gateway may be either LTE data connectivity or Wi-Fi connectivity.
- LTE provides data transmission service to send the data from endpoint to the authorized person.
- The gateway aggregates data first and includes a web server which forwards data to cloud via HTTPS protocol to internetwork using the MQTT protocol.
- The gateways always forward responses between the endpoint device and the user or authorized person.
- After the data reach at the user location, It is then decrypted with either of the algorithms above mentioned. Finally the data get converted into appropriate form to view on the web server as well as mobile application.

D) Truck History

Truck history maintains two year data of every truck transport details by every single service, it maintain routes, weights, on-time diesel and other detail also

i) Off Line Weight Scaling

- It initially scales size of the load which carries by the truck. It determines the measurements like truck is empty, fully loaded, half-loaded, or overloaded. It is done when the truck is not in motion.

ii) On Line Weight Scaling:

- This application keeps updating data on concerning weight scaling by collecting data from the weighing sensor only when the truck is going on flat surfaces.
- One of the main features of this application is the user can deliberately control the truck's engine remotely to start or to stop functioning of the truck.
- It has a potential to calculate the weighing measurements precisely and determines whether it is fully loaded with cargo or not, even when the truck is in motion. It makes updating concurrently to the authorized party since this application has featured and supported by Internet of Things (IoT) technology.
- Showing the real time activities of the track is given with integration of Global Positioning System (GPS), which updates information to the application through Google API.
- It updates even the traffic which faces by the truck while travelling to the destination with the load behind it. It enables the user to get the alternate way to get rid of the traffic.
- It keeps updating the timing of the truck to know the destination time coming or delayed time due to some specific reasons. So, the retailer or owner who receives the load will come to know the reason for the delay.
- It also has a feature to fetch the previous detailed information about the each truck drivers efficiency which adapts this application. This feature will be more useful for the clients to choose the particular truck to send to the definite location.

E) Maintaining Vehicle Health

Engine diagnostic with internet of Things (IoT) is a system to overcome the shortcomings of the traditional engine diagnostic systems. Specifically, it is a system that sends information over the On Board diagnosis (OBD-II) connection employing a wireless system that connects to the web. The device used for accessing and transmitting the data is easy, low-cost, and easy-to-install. Stakeholders worldwide are troubled to terminate standards to permit specialized wireless on- board units (OBUs) to directly act with the control area network (CAN-bus) and to speak with alternative OBUs and with roadside units, underneath any propagation condition, intermittent property, and traffic density [11]. As for this project, there are three system platform is considered. CAN-bus knowledge collection for the purpose of collecting data from ecu to Arduino with mistreatment CAN-bus converter. CAN-bus conversion for changing byte data that receive by Arduino into decimal raw data which will be processed, calculate and easy to grasp by human. additionally the part of sending converted CAN-bus data to cloud storage via IoT.

The ECU will transfer data in CAN-bus communication to the Arduino UNO microcontroller via MCP2515 CAN-bus converter. MCP2515 CAN-bus converter will connect to the Arduino through Serial Peripheral Interface (SPI) and CAN Hi/Low to the ECU Haltech Sprint 500. Data from ECU will be in form data packet that consist CAN-id and another data in Hex value. The Arduino will be need to separate that data packet to obtain the engine raw data. Data that obtain from ECU will be sending to cloud by using ESP8266 wifi module in REST architecture method. Our IOT Board is communicating with Arduino by software serial that can make algorithm sending the data by HTTP request script that will fill **truck.ggiitinfo.com** cloud. Using this process the Air Pressure, Engine Temperature, Fuel Level Transferred to the Cloud.

i) Driver Details and Live Camera

This section provides the information regarding the behavior of the driver with live camera monitoring. The behavioral information provided by this aspect is useful in monitoring the unnecessary activities of the driver or theft activities made by the driver are also avoided. By avoiding those activities should preserve the resource wastage and alert the driver to change their behavior.

ii) Truck Current Location Map

This facet of this section provides the present location of the truck with the map representation. To represent the present location map of the truck is conferred exploitation Leaflet technology. Leaflet is the leading open-source JavaScript library for mobile-friendly interactive maps. It works with efficiency across all major desktop and mobile platforms, may be extended with various plugins. Google Maps API is unquestionably the titan of interactive mapping online. They are typically the first platform that new interactive mappers learn, due to the benefit of obtaining started, the ubiquitous nature of Google Maps, and the huge popularity of Google generally. Leaflet is a platform that people usually hear regarding once they need done some mapping — it's an open-source, freely offered mapping plugin for JavaScript that has several add-ons and plugins at users' disposal. It needs a little more developer knowledge to induce started, however it's a favorite of open-sources. This work live tracking maintained by Leaflet map output is show within the following figure one.6

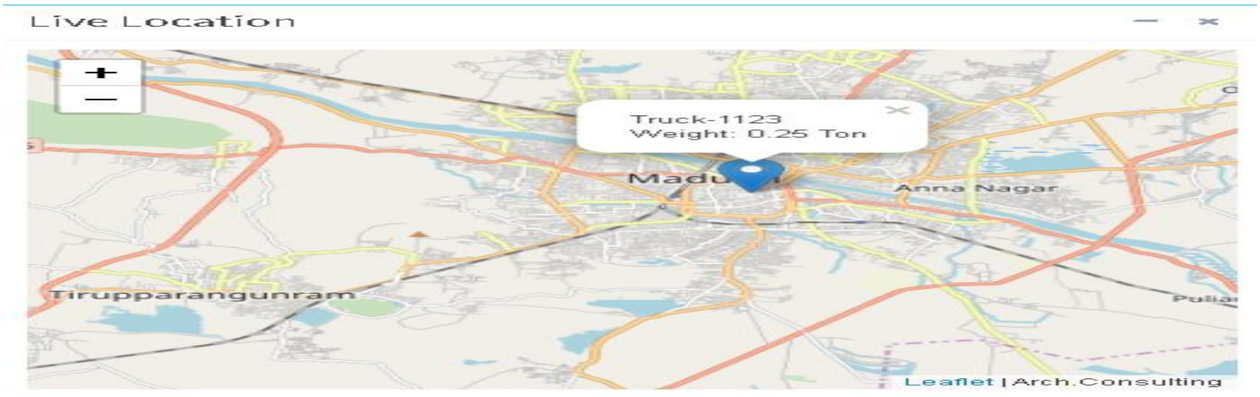

Figure 1.6 Live Location with Truck Weight

iii) Live Status

This factor depicts the live status of the truck with the description. The live status of the truck includes the current status of the particular truck with status description. The below Table 1.4 notice the sample live status of the truck

Table 1.4: Sample Live Status

Status Code	Status Description
IDLE	Engine off Status
MOVING	Engine Running , Location Changing
PARKING	Engine Running Location Not Changing

IV. RESULTS AND DISCUSSION

In this section shows the result of sensor values converted into the user easy accessing format. The following figure 1.7 shows the coolant temperature, Air Flow level, Fuel Level in gallon value, and the Truck Moving Status in the First row with list of trucks in live or idle mode. In second row it shows the Engine speed, Temperature, RPM and Live Camera Details.

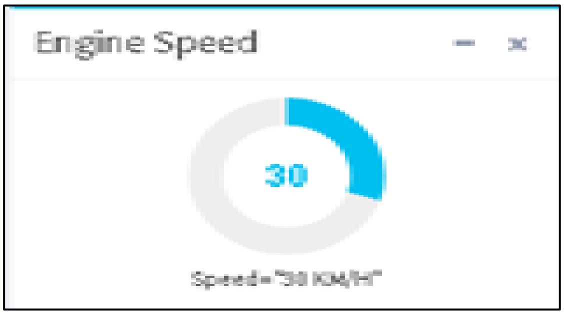

Figure 1.7 Sample Screenshot of Engine speed.

The information of the cloud server is depicted in Table 1.5. The table depicts that the configuration includes hardware and specifications of the cloud server.

Table 1.5: Shared Cloud Information

Hardware	Details
Server	Apache Server
CPU	Shared CPU
Hosting	Deluxe
Disk Usage	Unlimited
Bandwidth Usage	Unlimited
Primary Server	ggiitinfo.com

Cloud Site	http://truck.ggiitinfo.com

V. CONCLUSION & FUTURE ENHANCEMENT

The work of the fleet automation based on the IoT Logistics is employed to manage the resources with the minimum amount of human resource. The monitoring of fuel level of the truck will check the separation crossed by the truck and furthermore checks the fuel utilization regarding the separation crossed. Consequently by giving preliminary control measures to the driver for the correct support of the truck. This will be actualized in the courses where efficiency is required. It will lessen asset for keeping up countless vehicles and furthermore confines fuel, speed, temperature, and so on tapping by driver. It mostly gives accommodation and practicality which is primary worry in the day today life.

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