Development of IoT Based Logistic Vehicle Maintenance System

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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.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.

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.

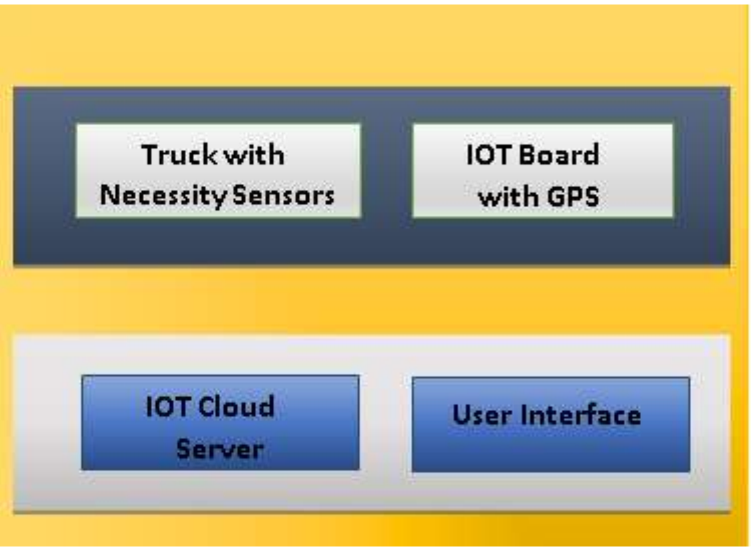

Figure 1.1 Architecture Diagram of the Fleet Automation System

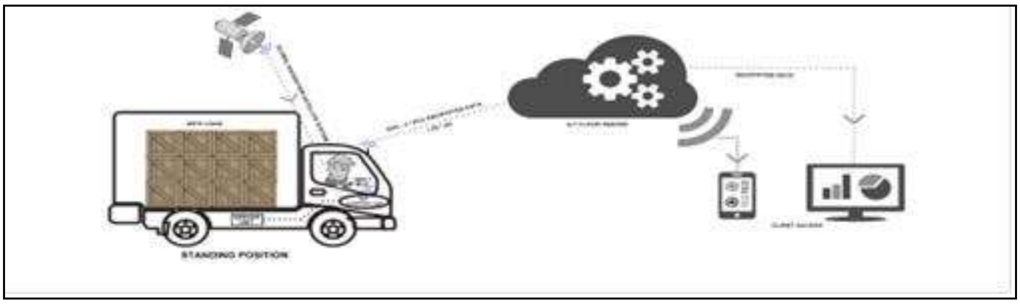

Figure 1.2 Truck on Standing Position

A) 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.

A. Grafana GUI

The data from the THINGSPEAK database will be visualized by using Grafana. By visualizing the data, the service manager can monitor the condition of the logistic vehicle easily. Fig.
12 shows the Grafana GUI for the whole system. Few widgets can be seen through the Grafana dashboard such as graph, gauge, alert list, and clock widget. These widgets are used to visualize the data that has been pulled out from the THINGSPEAK database.

B. Grafana Graph Widget

The first widget that is used to visualize the data is the Grafana graph. The Grafana graph has the functionality to allow the user to create an alert state to monitor the sensor reading. Fig. 13 shows the GUI for the Grafana graph displaying the lubricant level. From the figure, there are few elements of the graph that has been observed. First, the alert state line. Alert state line is the minimum or maximum reading that has been assigned to trigger the alert through the notification channel if the reading surpasses the maximum or minimum value of the readings. Second, Grafana's observation. Once the reading has surpassed the alert state line, the Grafana will start to observe the consistency of the reading for 5 minutes. It will trigger the alert state from 'OK' to 'Pending'. After 5 minutes of observing, if the reading still surpasses the alert state, it will change the state from 'Pending' to 'Alerting'. The third element is the heart indicator. The heart indicator is changing depending on the alert situation, green for 'OK', yellow for 'Pending', red for 'Alerting', and grey for No Data. From the figure, the color of the heart indicator is yellow indicating that it is in a 'Pending' state.

C. Gauge Widget

The second widget is a Gauge widget. Fig.14 shows the Gauge widget of the coolant level, the lubricant level, and the engine temperature. The gauge widget is the indicator that will move within the range that had been set. For this project, the average reading was set in percentage form. The reading displayed in the gauge widget is the current reading of the sensors.

Fig.14: Gauge widget

D. Alert List Widget

The third widget used in this project is the alert list widget as shown in Fig. 17. This widget has the functionality to show the status of the parameters. This widget is the extended function from the Grafana graph. The lifecycle of alert lists are OK, Pending, Alerting, and No Data. After the alert state is changing from Pending to Alerting, it will send an email notification through the notification channel that has been created.

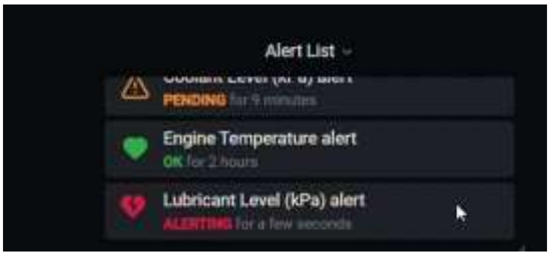

Fig.15: Alert list widget

E. Email Notification

The final output of the project is the service manager receives the email notification once the alert state is changing from Pending to Alerting. Fig. 18 shows a sample of the email notification received by the service manager from Grafana. Inside the email notification, it will include the graph of the current situation as well as the average reading. The average reading that appears on the email is the average reading that had been calculated by the Grafana observation.

Fig. 16: A sample of email notification informing the service manager on coolant level status.

I. CONCLUSION

The need for changing the maintenance routine from periodic maintenance to predictive maintenance is necessary since there are a lot of drawbacks that arise from the periodic maintenance routine. However, to do predictive maintenance is quite challenging in an industry that has a large number of vehicles. This paper develops a prototype system that can help the service manager to monitor the current situation of each vehicle. Apart from that, this paper also proposes a system that can help the service manager to make an efficient schedule for the vehicle to undergo maintenance.

The project prototype of the maintenance system was successfully developed. The sensor reading was successfully processed by both microcontrollers and the data was successfully saved inside the local THINGSPEAK database. Every output from this project has been fully analyzed. The private webpage that acts as the data log can be the reference to a service manager if the vehicle is having a problem. Apart from that, the data log also can be used in the future as a reference to claim warranty and insurance. With the record, the company can prevent from being manipulated by the service center. The data also will be displayed in an interactive mode. Through the Grafana dashboard, the newly hired service manager can easily understand either the technical part of the system or the maintenance system itself. Apart from that, this project also features the capabilities to notify the service manager if any part of the vehicle starts to show signs of a problem. Thus, the possibility of vehicle a breakdown in the middle of the road can be minimized. Some recommendations can be added to further improve the functionality of the system. For example add a function to track and record the driver's behavior. A few sensors such as an alcohol sensor to detect drunken drivers and GPS to detect the speed of the vehicle can be used to identify the driver's behavior. Another improvement is developing an android application for the system. This way, the service manager or the driver can monitor the vehicle through their smartphone. In this era, the use of smartphone application is very crucial since most people have a smartphone for their daily tasks. In the current development, the sensor reading from the vehicle is being sent to edge computing. For future development, it is recommended the system to able send the data from the local database to the cloud-hosted database. Through the cloud-hosted database, the company can easily access the system through an internet connection with a different network. Thus, it will make the project more enhanced and useful.

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