International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

Vehicle Monitoring using IoT and Automatic Stop - Start System

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Abstract - *Electric vehicles are being widely used in recent times and thus their efficient operation mainly concerns when it is being manufactured. Thus a vehicle has to be monitored on regular intervals of time and hence their life and efficiency has to be increased. Automatic Stop - Start System is a new energy-saving product, which can obtain a good fuel economy and reduce emissions for the car. The work principle and mechanical structure are analyzed in this project. The key technologies of idle-stop-start system are analyzed based on this. Then the idle-stop-start system is modeled and analyzed.*

The project aims to develop an Automatic Stop – Start System for the Electric vehicle to save the energy consumed by the vehicle. This method helps in increasing the efficiency of the EV and the life of various components such as Batteries, Power electronic components increases.

The project also aims to build a system which can monitor various parameters such as Voltage, Speed, Temperature, Battery charge level, etc of an Electric vehicle (EV). It helps in assisting the owner to frequently checking the status of the vehicle and maintaining the vehicle whenever there are changes in the operating conditions of the vehicle. This project presents an implementation of a Wireless Internet of Things (IoT) system applied to the traction motor drive condition monitoring in electric vehicles (EVs). The design and testing of the prototype using an RL78 microcontroller module to acquire battery's voltage, current, and temperature information for the motor condition monitoring application is presented.

Key Words: Internet of Things (IoT), Electric Vehicles (EV's), Renases microcontroller, Battery, Sensor

1. INTRODUCTION

1.1 Electric Vehicles:

Plug-in electric vehicles (also known as Electric vehicles or EVs) are widely used for pollution free transportation. They can reduce emissions and even save you money. Fueling with electricity offers some advantages not available in conventional internal combustion engine vehicles. Because electric motors react quickly, EVs are very responsive and have very good torque.

EVs are often more digitally connected than conventional vehicles, with many EV charging stations providing the option to control charging from a smart phone app. Since the electric grid is available almost anywhere, there are a variety of options for charging: at home, at work or on the road. By charging often, you may never need to go to a gas station again. But EVs provide more than just individual benefits.

EVs can help India have a greater diversity of fuel choices available for transportation. India uses nearly five billion barrels of petroleum last year, two-thirds of which went towards transportation. Our reliance on petroleum makes us vulnerable to price spikes and supply disruptions.

EVs help reduce this threat because almost all India electricity is produced from domestic sources, including coal, nuclear, natural gas, and renewable sources. EVs can also reduce the emissions that contribute to climate change and smog, improving public health and reducing ecological damage. Charging your EV on renewable energy such as solar or wind minimizes these emissions even more.

1.2 Vehicle Monitoring System:

Traction motor drive system is an essential and critical component for an electric vehicle (EVs). The traction motor must be efficient and reliable as it is required to provide both speed and torque in wide operating range while maintaining precise control of the motor drive safely. To prevent the traction motor's abnormalities, improved reliabilities and effective operation with an early warning with instant notification is desirable and motor's vibration, current and temperature are practically three parameters that are well studied and widely accepted in detecting motor's failures due to electrical and mechanical faults.

According to the survey done by Institution of Electrical and Electronic Engineer (IEEE), 44% of motor's faults are from bearing and 24% are from stator. The majority of mechanical failures in motor are mechanical imbalance, rolling and bearings because a continuous stress on them can result in the major failure. Factors such as improper lubrication, improper installation, contamination and corrosion often contributed into rolling and bearings faults. A vibration sensor and current sensor are able to detect motor's rough running of bearing increasing vibration and unbalance shaft current due to the flux disturbance caused by rotor eccentricities. Bearing failure also causes temperature rise to exceed motor's predetermined load temperature.

Compared with wired system, IoT system offers many advantages such as relatively low cost, ease of installation, remote upgradeable software, and automates real-time data analysis and warning notifications to operators. In addition, the preventive maintenance of traction motor can be effectively and remotely planned at the right time with rich data collection and analysis. lt is changed from time-based or run-based maintenance to on-line predictive maintenance. The main benefits are such as cost reduction of maintenance, increased reliability, optimized traction motor performance, and improvement of accuracy in failure prediction.

This project presents a development and implementation of a Vehicle condition monitoring system based on Renases microcontrollers and various sensors.

1.3 Automatic Stop – Start System:

Most of the transportation system is heavily reliant on a petroleum-based energy source that uses finite and non-renewable sources which cause harmful effects on health and climate. In recent few decades' energy conservation and to cut down greenhouse gases are the most center of interest. In this scenario reducing energy consumption in public transport will provide sustainable cost saving, for public transport that is struggling with funds shortfall and increased demand. Most of the public sector contributes towards idling. According to an estimate every year US passenger cars, light trucks, heavy-duty vehicles consume more than 6 billion gallons of diesel fuel and gasoline. AIR quality, public health, climate change has now started receiving more attention and is becoming a greater priority. 6 common air pollutants have been described by EPA Environment protection agency, USA.

I. SO2 ii. O3 iii. Particulate matter iv.CO v. NO_X vi. Lead

Almost all of above-mentioned pollutants are available in the exhaust of vehicle except lead that has been eliminated from fuel. Exhaust is a cause of serious illness including asthma, lungs cancer, debates [2]. NO_X and P.M are two major pollutants observed by EPA from diesel engine exhaust consumption. Many different technologies are being used but most effective is Idling Reduction technique. It majorly cut down the emissions and saves fuel & protects the environment. The idle condition is one of the engine main conditions. When the bus is running on the road of the larger traffic density, about 30% fuel is used at the idle condition. In the automotive conditions emission test method, CO and HC of the idle emissions is usually about 70% of total emissions. For city buses, the docking sites is more, coupled with traffic crossing the red light stopping, the start and stop are very frequent, which will cause the most engine generated energy is consumed by the heating form during braking friction. Also, because there is a long parking condition, the engine is in the idle state for a long time, resulting in many problems, for example, the low speed, high fuel consumption and serious pollution.

2. PROBLEM STATEMENT

Whenever the vehicle comes to rest, there are standby losses as power is consumed by the electric motor and other components of the vehicle which reduces the efficiency of the vehicle. Battery consumption increases without actual movement of the vehicle and thus battery has to be charged for shorter periods.

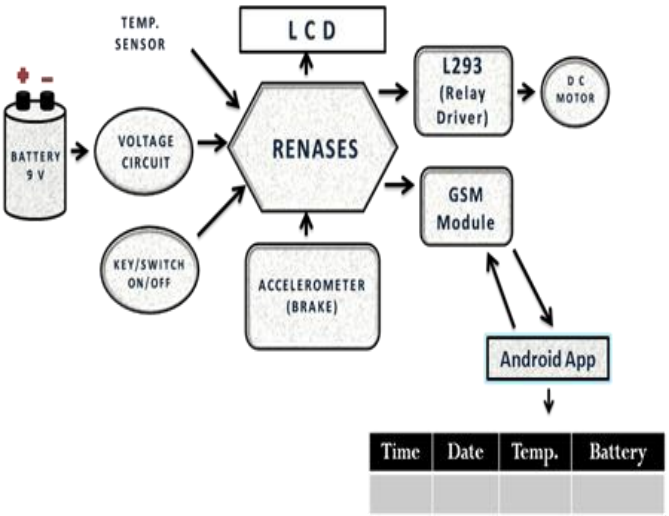
Electric vehicles are being used widely, but the owner of the vehicle may not know the condition of different components of their vehicle. This leads to poor maintenance from the user and overall life of the vehicle reduces. Thus the condition of the vehicle has to be monitored frequently or on a regular basis and the efficiency of the vehicle has to be increased whenever the vehicle is idle.

3. OBJECTIVE

The main objective of the project is to design an Automatic Stop-Start system for the Electric vehicle. Automatic Stop-Start system is used to turn the vehicle ON or OFF automatically when the vehicle is in rest condition. Stop-Start system helps to increase the overall efficiency of the vehicle.

Also monitoring various parameters in the vehicle such as voltage, temperature, speed, charge, current is carried out through IOT. Monitoring various parameters of the vehicle helps the owner of the vehicle to check the vehicle's condition on a day-to-day basis anytime and anywhere. IOT helps the user to check the status of the vehicle and gives an alert to the user either manually or automatically on various performance characteristics.

4. BLOCK DIAGRAM



When the vehicle is turned ON or turned OFF, the LCD starts to indicate that the vehicle is ON or OFF based on the vehicle's operating status.

When the vehicle is not running i.e., the vehicle is in standstill, The accelerometer does not detect any motion and thus Renases microcontroller will give an input to LCD as the vehicle is in "Standby condition".

When the vehicle is running i.e., the vehicle is in moving, The accelerometer detects the movement of the vehicle and thus Renases microcontroller will give an input to LCD as the vehicle is in "Running mode".

The microcontroller monitors the value of temperature from the temperature sensor continuously, if the temperature of the vehicle exceeds a preset or a standard value then the microcontroller sends an Alert to the user through an Android App and through an SMS.

The microcontroller monitors battery conditions i.e., voltage, charge level of the battery. If the battery voltage falls below or exceeds the rated value, then there is an alert sent to the user.

If the charge of the battery is low, then the user gets an alert with the help of GSM module and an Android App.

The LCD present in the circuit also displays the above parameters in a cyclic manner.

5. COMPONENTS USED

The design of "Vehicle Monitoring System Using IoT and Automatic Start – Stop System" includes the following components:

RL78 Renases Microcontroller: It is used to perform different functions in the project.

Accelerometer: It is used to detect the movement of the vehicle.

Temperature Sensor: It is used to measure the temperature of the drive and the battery.

GSM Module: It is used to send SMS alert to the owner of the vehicle.

Liquid Crystal Display (LCD): It is used to display the status, temperature, charge level, etc of the vehicle.

Battery: 12 V battery is used for demonstration purpose.

Voltage Measuring Circuit: It is used to measure the battery voltage.

Switch: It is used to sense acceleration and braking actions when the owner is using the vehicle.

Motor driver: It is used to supply required current to drive the motor.

DC Motor: 12 V, 100 RPM motor is used for demonstration purpose.

Voltage Regulator: It is used to supply constant voltage across the circuit.

6. CONCLUSIONS

Electric vehicles are widely used for pollution free transportation. The main advantage is the high efficiency in power conversion through its proposition system of electric motor.

In the growing market for vehicles, pollution of the environment and increasing energy crisis causes an increased demand for the development of Automatic stop – start system and vehicle monitoring system.

Almost every day a large number of vehicles stop on a traffic signal, in a traffic jam for almost an average 2 minutes and sometimes even more. During this stop, the engine is running while the vehicle is not moving this process of idling wastes a large amount of fuel as well as emits a lot of harmful emissions. Hence to obtain high efficiency and better operation of the vehicle, the vehicle parameters is monitored and energy consumption is minimized when the vehicle is idle by implementing an Automatic stop – start system.

The GSM and Android application system allows the user to monitor provided by the sensors available on the vehicle, and to control processes such as battery charging, either manually and automatically, anytime and anywhere. By monitoring the various parameters of an electric vehicle, the maintenance of the vehicle can be carried out on a regular basis or whenever there is a requirement.

By establishing the Electric vehicles with Automatic stop-start system model, the Automatic stop - start system can save fuel greatly, so the emission can be improved greatly.

7. FUTURE SCOPE

There is always chance to improve any system as research & development is an endless process. Our system is no exception to this phenomenon. Apart from the simulation of the software and hardware of the project, we can further extend or upgrade the operation of this system in the following ways:

1) Although we are using a small prototype of an Electric vehicle in our project, the implementation of the hardware can also be done on an on – road Electric vehicle.

2) The concept in the future can be extended by using Bluetooth modules and Wi – Fi modules in the place of GSM Modules.

3) Different sensors such as vibration sensors, acoustic noise sensors, magnetic flux sensors, etc can be used to detect the operating conditions in the traction motor drive of the Electric vehicle.

4) Vehicle monitoring system and Automatic stop – start system can be implemented in all the sorts of vehicles that are available in the market.

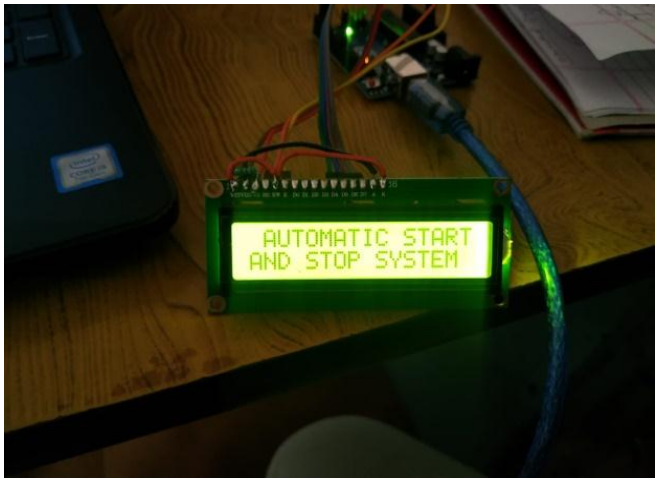


Fig: LCD displaying Name of the Project

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