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Android Application for Driver Assistance Using Strain Guage Load Cell and Motion Sensors

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Abstract: Considering the increase in a number of vehicles being used over the globe, we hereby look into some of the problems being faced by the drivers and also present a survey on the methods and remedies which are in practice today. The problems that are in the lime light in this paper include Fuel quantity measurement, fuel theft detection, driver drowsiness, air pressure sensing in vehicle tyres etc.

The amount of fuel can be measured either by using fuel level sensors or fuel quantity detection sensors in the fuel tanks. There are various fuel level sensors currently in use in the market, for eg: ultrasonic sensors. And the fuel quantity detection sensors include load cells, which give the amount of fuel in the tanks. Driver drowsiness can be detected using motion sensors or cameras and image processing. Also, there are various sensors and methods available for measuring the tyre pressures in vehicles.

Keywords: Fuel Level Indicator, Android Application, Bluetooth, and Drowsiness Detection System.

I. INTRODUCTION

At present, in most of the vehicles, an analog fuel indication meter is widely used. In these meters, the position of needle determines the remaining amount of fuel which is present in the fuel tank. But the fuel level indicated is not displayed in liters. Hence, it becomes a bit difficult to predict the exact amount of fuel in the tank. Nowadays, the cases of petrol pump frauds are increasing with time. There is the difference between the amount of fuel filled in the fuel tank and the amount which is displayed on the filling machine and most of the times that are lesser than the quantity of fuel filled in the customer's fuel tanks. Because the pump owner makes the arrangements which lead to the benefit of the owner of the pump. In this way, customers are being cheated by such people. Hence, the need of the hour is a system in which the amount of fuel is indicated by using digital circuit so user or vehicle's owner can know the exact amount of the added fuel from the fuel pumps. This calculation can also be used to calculate the mileage of the vehicles.

There are two types of measurement techniques available, those are intrusive and nonintrusive methods. The liquid level is an accurately measured by nonintrusive optical sensing method.

The liquid level is measured by using conventional based measurement which is mostly included resistive capacitive, transducers. But this conventional method not suited for fuel measurement. Because they having poor sensitivity, and susceptibility. External noises also affect them. To the next of that and overcome the disadvantage of that measurement, fibre - optic liquid level sensors were introduced. Fibre-optic liquid level sensors having better sensitivity, and also reliable to measure the liquid level. The basic principle of the sensor is that light is transmitted to the media and reflected back. In the intrusive method, light is transmitted and reflected back to same media. The intrusive probe is used to transmit the light to the media. Contact and Contactless are the two methods of Liquid-level. These methods are used to measure liquid level directly by placing a sensor that comes into contact with the liquid.

Driver Drowsiness is another issue which leads to major road accidents. A driver who falls asleep at the wheel loses control of the vehicle, an action which often results in a crash with either another vehicle or stationary objects. The German Road Safety Council (DVR) claims that one in four highway traffic fatalities are a result of momentary driver drowsiness.
In order to prevent these devastating accidents, the state of drowsiness of the driver should be monitored. The following measures have been used widely for monitoring drowsiness: Vehicle-based measures: A number of metrics, including deviations from lane position, movement of the steering wheel, pressure on the acceleration pedal, *etc.*, are constantly monitored and any change in these that crosses a specified threshold indicates a significantly increased probability that the driver is drowsy.

1. Behavioral measures: The behavior of the driver, including yawning, eye closure, eye blinking, head pose, *etc.*, is monitored through a camera and the driver is alerted if any of these drowsiness symptoms are detected.

2. Physiological measures: The correlation between physiological signals (electrocardiogram (ECG), electromyogram (EMG), electrooculogram (EOG) and electroencephalogram (EEG)) and driver drowsiness has been studied by many researchers.

Other than these three, researchers have also used subjective measures where drivers are asked to rate their level of drowsiness either verbally or through a questionnaire. The intensity of drowsiness is determined based on the rating

Many times it happens, the driver doesn't realize that the air pressure in tyres has reduced and sometimes it leads to damaged tyres. Using Air pressure sensors for vehicle tyres will help people prevent tyre burst and avoid accidents due to this reason by notifying the driver when the tyre pressure reaches down a threshold value. There are various types of sensors available in the market for this purpose.

II. AIR PRESSURE SENSING

The tyre pressure system presents an economical and efficient way to monitor the tyre pressure. The present methods to keep a track on the tyre pressure are implemented using piezoelectric materials, which comparatively are costlier. The system proposed here is much more economical. It uses four Ultrasonic Ranging Modules HC-SR04, facing towards the ground, with one placed on the axle near to each of the four tyres [12]. Since these modules have a very high accuracy of about 3mm and a range as low as 2 cm, they are ideally suited for this purpose. When the tyre pressure falls, the car level goes down. The ultrasonic sensor senses the change in the distance from the ground. When this distance falls below 15cm, after a delay of 15 seconds, the microcontroller displays me. The time delay eliminates the discrepancies due to speed breakers and other things lying on the road.

The algorithm used for the programming the Tyre Pressure Alert System is as follows:
1. Power ON
2. Check distance measured by the ultrasonic sensor
3. If distance is less than or more than threshold, go to next step, otherwise, go to step 2
4. Notify the user through the app.

III. FUEL DETECTION SYSTEM

The Proposed system overcomes the drawbacks of existing systems and it will measure the accurate level using load cell and displays with help of digital display. It is capable of transmitting information to vehicle owner via an android app.

It is an efficient and accurate method of measuring the amount of fuel adding to the vehicle tank. Initially, the load cell is fixed under the fuel tank with the help of vehicle base. The display unit which is fixed on the Dash Board. While we enter into the fuel bunk, click the reset button which is present in the display unit. Then the load cell measures the weight of tank with initial fuel and sends the value to the Controller LPC2148.This converts the weight value into liters and displayed in the display unit. After that, the adding fuel will automatically measure and displayed in the unit as added level.

This will help us to find the exact amount of fuel added to our vehicle tank at the time of fuel filling in bunk [5]. At the same time, Speedometer will interface for measuring the remaining Kilometers to run with remaining fuel. The system reduces fraud in the petrol bunk.

Here conversion of weight into liter process is carried out by the ARM processor. This had some formula to calculate the exact value of fuel level. Each fuel having some density value, on depending upon these density value the conversion process is taken place. This density value which may vary depending upon the current temperature level. Fuel such as petrol, diesel, gasoline are using for the vehicles in our daily.

ALGORITHM

1) Calculate the amount of fuel in the tank using the Load Cell.
2) Pass the value to the System (Processor).
3) The processor sends the value to the android app.
4) The calculated value (in kg) is converted to the desired value(in liters)
5) Display the value on the android app.

IV. MILEAGE CALCULATION

One of the important parameters is mileage of that particular vehicle. Because of depending on the mileage only we can derive how much kilometer to run with remaining fuel for current speed. Consider the vehicle which gives the mileage of 20 km/liter, then that vehicle running at the average speed of 70 km/hr, this gives the correct kilometers with the remaining fuel. Suppose if it goes more than 100 km/hr, then the mileage gets dropped. Hence it displays very fewer kilometers to run.

V. DROWSINESS DETECTION

Driver drowsiness is one of the most common problems faced by the drivers in the real world. A number of a traffic collision or car crash occurs frequently and become the hotspot of people care. There are many factors contribute to the risk of the accident, such as road environment, vehicle design, and driver's behavior. The driver's behavior factor seems to be the most common reason contributing the accident such as drowsiness while driving alone for a long trip. Drowsiness driving denotes a situation when the driver is in a state of mental and physically fatigue, which includes a decrease in mental alertness and sensation of weariness and reduction in eye scanning behavior. A severely drowsy driver will exhibit extended incompetence to safely perform a driving maneuver, be unaware of the vehicle's turning radius, perform driving maneuver under the incorrect assumption, experience eye lid closures and repeated yawning. When the driver impaired by fatigue, driving ability, behaviors, proficiencies, and decisions are adversely affected and, in this situation, the risk of the accident such as car crash that may result in property damage, severe injury, of even death is highly increased due to the fact that sleepy drivers fail to take a proper decision prior to a collision.

Here, for this purpose i.e., for detecting the driver's drowsiness, motion sensors which include heart rate monitoring sensors and eye blink sensors are being used. Heart Rate sensor will detect the change in heart rate and will send a signal to the system regarding the same. After sensing the change in heart rate, the system will confirm the drowsiness after verifying it using the eye blink sensor. Once the drowsiness is confirmed, an alert signal will be given to the user about the same using the android application notifications.

ALGORITHM

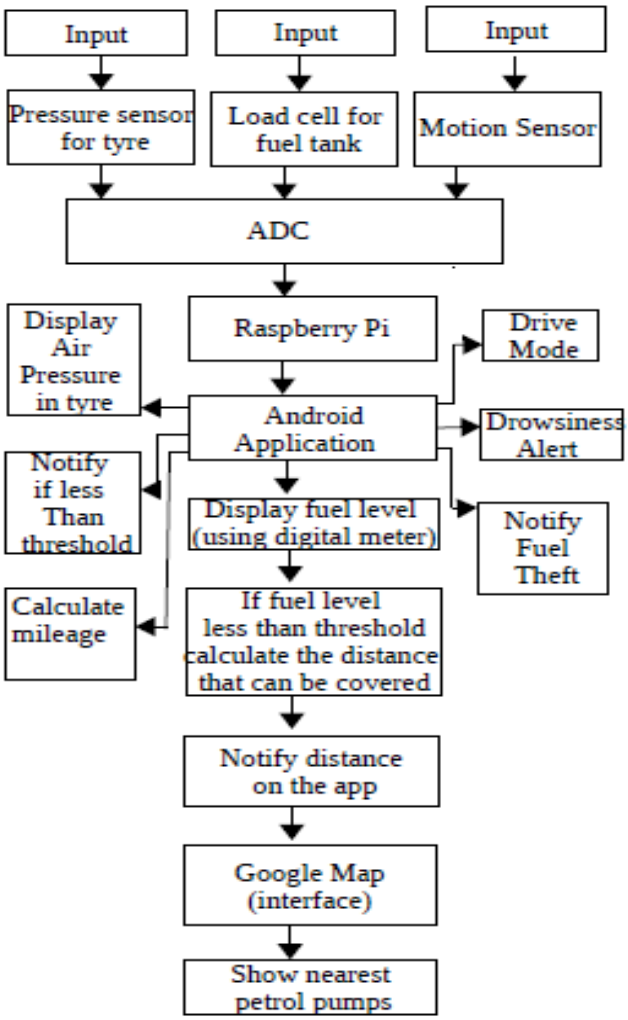
1) Check for Driver's heart rate using the heartrate monitoring sensor.
2) If the heartrate level is below the threshold value, goto step 3, else goto step 1(keep monitoring the heart rate)
3) Send an alert signal to the system and verify the drowsiness using the eye-blink sensor.
4) In case the drowsiness is confirmed, send an alert signal to the user informing him about the drowsiness, else goto step 1.

COMPONENTS USED

Following are the components used in building this System.

1) Raspberry pi 3.0 module B
2) HCSR04 Ultrasonic sensor (for tyre pressure monitoring)
3) Strain Guage Load cell (for measuring fuel quantity)
4) Heart rate monitoring sensor &Eye-Blink sensor (for drowsiness detection)

Flow Chart



VI. MATHEMATICS INCLUDED

1. Driver Drowsiness Detection:
Heart rate signals are analyzed by Fast Fourier Transform.
There are two models in this transform:

1**. POLYNOMIAL MODEL**

$$A= a7\ x7 +a6\ x6+a5\ x5+ a4\ x4+ a3\ x3 +a2\ x2 +a1\ x1 + a0$$

Where, A is alertness level a is the coefficient needs to be calculated using the collected data.

2. **SINUSODIAL MODEL**

$$A=B_1 \sin (w_1t+O_1) + B_2 \sin (w_2 + O_2)$$

Where, the values of B_1, B_2 are amplitude of 24, 12 hrs
w_1, w_2 is the frequency of the two components
O_1, O_2 is a phase shift of the two components.

2. In Fuel Detection Module:
Fuel volume ratio = Fuel Mass Ratio / Fuel Density
Tank mass=Tank pressure * 3.0 /effective tensile* X Where,
X = Fuel Ratio + Oxidizer Ratio + Propellant Ratio (Consider all ratios in volumes)

For Petrol:

$$L = \{(W - T)/0.7372199 \} \text{ Liters}$$

W indicates Weight measured by Load Cell,
T indicates Tank Weight,
L indicates Liters which are calculated.
Here Petrol having the density,
Hence the proportional values are, of 737.22 kg/m^3
1 Kilogram of vehicle petrol = 1.3564472 Liters
0.7372199 Kilogram = 1 Liter

For Diesel:

$$L = \{(W - T)/0.885\} \text{ Liters}$$

Where,
W indicates Weight measured by Load Cell, T indicates Tank Weight,
L indicates Liters which are calculated.
Here Diesel having the density hence the proportional values are, of 885.0 kg/m^3.
1 Kilogram of Diesel = 1.1299435 Liters
0.885 Kilogram = 1 Liter

VII. CONCLUSION

In our Project, we have made Digital Fuel Meter, Which shows the level of fuel digitally and also theft detection can be done. It gives the high accuracy than the Analog Meter.
In the present days, even the cheapest liquid is according to the standard of measurement but the costly fuel which is most required for day to day life is not according to the standard measurements. Our project is very useful for a common man as it avoids him by getting cheated. This measuring unit should be fixed to the entire vehicle so that we get an exact quantity of fuel to measure the inflow. Presently all the vehicles are using a fuel gauge which gives an approximate quantity of fuel, but an exact measuring tool should be made available.

Also, this work will provide enough ease to the user through rough mileage calculation and digitally displaying the fuel quantity. It will also help him to prevent accidents by detecting his drowsiness and monitoring the air pressure in the tyres. It will prove to be beneficial for the users.

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