ISSN:2348-2079

Volume-8 Issue-2

International Journal of Intellectual Advancements and Research in Engineering Computations

IoT based dipstick type engine oil level and impurities systems: portable online spectrophotometer

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ABSTRACT

This undertaking depicts the structure and improvement of an IoT based oil polluting influences, level observing instrument and its operational approach. The exploration work utilizes a special methodology with altered white LED spectrophotometry. The created instrument has done subjective and quantitative appraisal of oil in IC motor's sump. This thus is useful in doing definitive undertaking towards keeping up Engine life cycle and carbon impression. Light-needy sensor with affectability <90% and extend 500-600nm is utilized as an indicator for experimentation on four stroke IC Engine. The framework has focal points of moderateness and versatile structure

Keywords: IoT, Spectrophotometer, Dipstick, LED, Photometry, Light-dependent resistor, Engine oil.

INTRODUCTION

In order to avoid an engine's thermal fatigue failure or lowering the engine's exhibition due to engine oil deterioration, the oil must be changed when it loses its protective equities. Also, unnecessary oil varies should be avoided for environmental and economic aims as still active additives left in the oil may react with the environment. Today, no built-in system lives in the world which online can monitor an engine's lubricant oil condition. We change the lubricant oil based on experience by looking at oil's sample or after 3000 km of travel which is allusion set by the oil manufacturer. But with this we cannot forecast if the oil is contaminated, if additive packages are depleted, if it is low or still, they are active. Also, we have tested oil sample for each 500 km travel of vehicle and we noticed that lubricant oil losing its all properties after 1500 km travel which is far below what the oil manufacturer has set i.e. 3000 km.

The solution with which we come up to solve this problem is as follows: all the engines come up an oil filling cap or dipstick built of plastic or steel material and is dipped in crankcase oil, dipped in plastic or steel member of oil filling cap or dipstick can be replaced and made by shape memory composite base sensor. When we heat the shape memory composite, it reoccurs to its pre-deformed shape and based on this principal proposed oil monitoring system works. Now, after travelling a convinced distance oil in the crankcase getting heated up to a certain temperature and so the shape memory alloy-based sensor dipped in the oil will be getting heated. As oil is deteriorating day by day, its temperature also increases more than previously and so the rate of shape change of the sensor also increases swiftly. This rate of shape change is qualified on oil temperature. Now, oil viscosity talks about oil quality and its life and is directly corresponding to temperature. This shape memory-based Sensor desegregated with oil filling cap or dip stick can be put in the engine crankcase

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and temperature dependent rate of change in shape can be measure and so viscosity of oil. This can be converted into suitable signals with the help of programmable coding language and can be sent to the vehicle dashboard in the driver's cabin via Bluetooth where the driver can easily see the oil change signals colored with Green indicates oil is in good condition, Yellow indicates oil is about to degenerate and Red indicates oil requires to be replaced. This is a novel system for online monitoring of oil which upgrades engine and its components performance, public safety, vehicle/engine security and saves time, money and lives of animals and crops keeping the environment healthy. Above benefits can be achieved without any transform in existing design of the engine. Only the oil padding cap and dipstick need to integrate with the shape memory-based sensor which will be dipped into the engine oil.

OUR APPROCH

Next-generation IoT systems are expected to be enabled by compact, low-cost, low-power, smart sensing devices that provide a wealth of information to build new applications and potentialities. Among sensing modalities, optical spectrometry is one of the rapidly growing areas of interest due to its wide range of applications from environment monitoring, industrial and home applications to healthcare. Current optical spectrometers are large and bulky with non-integrated components that limit their application potential. In this paper, we present a fully integrated CMOS-based optical spectrometer in a 65nm bulk process that requires no external optical components. The spectrometer achieves nearly 10nm resolution and 1.4nm accuracy in peak forecast of continuous-wave (CW) excitations between 500 and 830nm [1].

High operating temperatures in engines produce a thermal humiliation promoting the oil oxidation that affects its tribological performance. In this paper, an alternative method is proposed to simulate engine oil humiliation by mixing breakdown oil with fresh oil to simulate a mileage. The simulated and real break down engine oils were compared by infrared spectroscopy analysis. The dynamic viscosities of mixed oils were measured by a rheometer at 50°C and 80°C and a block-on-ring tribometer was used to evaluate their tribological performance under mixed lubrication regime at these two temperatures. The results showed that the simulated humiliation is acceptable, the coefficient of friction decreased at higher temperature and reduced as the engine oil is close to its end of service life [2].

The thermal humiliation, under oxidative pyrolysis conditions, of two synthetic lubricating base oils, poly-α-olefin (PAO) and di-ester (DE), was investigated. The main objective of the study was to characterize their behavior in simulated "areo-engine" conditions, i.e. compared the thermal stability and identified the products of thermal decomposition as a function of exposure temperature. Particular characterizations of products were executed with Fourier Transform Infrared Spectrometry (FTIR), Gas Chromatography/Mass Spectrometry (GC/MS), viscosity experiments and four-ball tests. The results displayed that PAO had the lower thermal stability, being break down at 200°C contrast from 300°C for DE. The humiliation also effected the tribological properties of lubricating oil. Several by-products were identified during the thermal humiliation of two lubricants. The majority of PAO products consisted of alkanes and olefins, while more oxygen-containing organic compounds were detected in DE samples according to the observation of GC/MS analysis. The related reaction mechanisms were discussed according to the experimental results [3].

The degradation analysis of three classifies the synthetic lubricating oils during operation of the vehicle engine was accepted according the number of kilometers covered, using the evaluation of viscosity, basicity, pour point, flash point, formation of heavy metals from the engine abrasion phenomena, that will detect by Inductively Coupled Plasma Optical Emission Spectrometry (ICP/OES), and the differentiation of the chemical composition of virgin and degraded lubricating oil using Gas Chromatography connected with Mass Spectrometry (GC/MS). These analyzes detect the regular decrease of the viscosity, the basicity, the flash point and the significant evolution of the iron and lead content and the formation of polycyclic aromatic hydrocarbons. Thus, the important humiliation of the additives tends to thicken the lubricating oil and accordingly the continuous increase in the pour point [4].

Divergent exhibit of a piston ring-cylinder liner couple may happen after 9 min hot tests of interior combustion engines, while the engine performance parameters were interior settled threshold ranges. Few contrasts were observed among oil samples from the engines with or without divergent wear in the spectrometric and Kittiwake Analex PQ analysis. Therefore, a manual confirmation by disassembling the oil pan was often needed. In this work, an oil monitoring method for friction evaluation of the engines was proposed. The oil samples were rapidly examined on site by On-Line Visual Ferro graph (OLVF). For the divergent engines, it was found that the Index of Particle Coverage Area (IPCA), characterizing the wear debris concentration, was low. Moreover, large debris was barely observed on OLVF ferro grams, which was predictable with the results obtained from analytical ferrography, and the reason was examined and discussed. In addition, an on-site divergent wear evaluation course of action for the 9 min hot tests was proposed based on a trained Naive Bayes Classifier. As observed from the results of 27 engines, 4 divergent engines were found. Among one of them, longitudinal scratches were established on the cylinder wall, which were evaluated as divergent wear by the classifier. This method can cut down the quantity of disassembly inspection and is more efficient [5].

DESIGN IMPLEMENTATION AND EVALUATION

Software design implementation

Frameworks configuration is the way toward characterizing the design, segments, modules, interfaces and information for a framework to fulfill determined necessities. Frameworks config could be viewed as the use of frameworks hypothesis to item improvement. A fundamental methodology is required for a rational and well-running framework. Base Up or Top-Down methodology is required to consider every related variable of the framework. A planner utilizes the demonstrating dialects to express the data and information in a structure of framework that is characterized by a predictable arrangement of rules and definitions. The plans can be characterized in graphical or literary demonstrating dialects.

List of modules

- Designing of the circuit diagram
- Interfacing
- Interfacing PIC microcontroller with temperature sensor
- Interfacing PIC microcontroller with density sensor
- Interfacing PIC microcontroller with ultrasonic sensor
- Interfacing PIC microcontroller with LCD
- Interfacing PIC microcontroller with GSM modem
- Programming and burning the code
- Testing the project

MODULES DESCRIPTION

Designing of the circuit diagram

The Software that have used for this project is “Proteus” version 7.8. Proteus is one of the easy to use software in simulation world. For both electrical and electronics-based circuit simulation and execution can be done very easily with this software. Before starting the execution and the simulation of the project circuit it is requisite to make an algorithm. Because a fruitful algorithm can make the path easier to execute a circuit both virtually and practically.

Dhanalakshmi R et al., Inter. J. Int. Adv. & Res. In Engg. Comp., Vol.–08(02) 2020 [266-274]

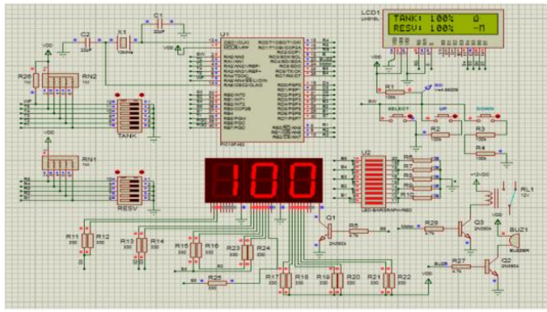

Fig.1. Circuit diagram

INTERFACING

Interfacing pic microcontroller with temperature sensor

In this project, we will sense the temperature utilizing LM35. LM35 Temperature Sensor is accurate and economical and doesn't require any external calibration. The output voltage is proportional to Celsius temperature scale and varies by 10mV per °C.

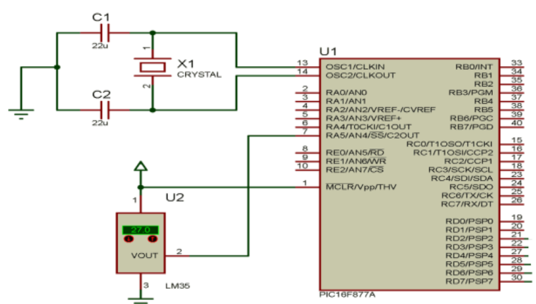

Fig. 2. PIC with temperature sensor

INTERFACING MICROCONTROLLER WITH DENSITY SENSOR

The main heart of this system is microcontroller. Density sensors are connected to the PORT C (PC0, PC1, PC2, and PC3) of the microcontroller and lights are connected to PORT B and PORT D. If there is an indication then that particular sensor output becomes logic 0 otherwise logic 1. By receiving these density sensor outputs, we have to write the program to control the system.

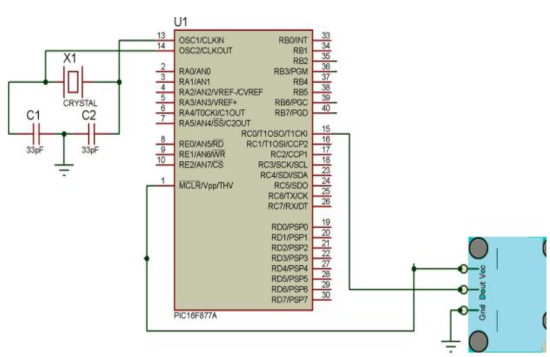

Fig. 3. PIC with density sensor

INTERFACING PIC MICROCONTROLLER WITH ULTRASONIC SENSOR

The HC-SR04 is an ultrasonic sensor which may be wont to measure distance anywhere between 2cm to 450cm (theoretically). This sensor has proved itself worthy by fitting into many projects which involves obstacles detection, distance measuring, environment mapping etc. At the end of this article you will learn how this sensor works and how to interface it with PIC16F877A microcontroller to measure the distance and display it on the LCD screen.

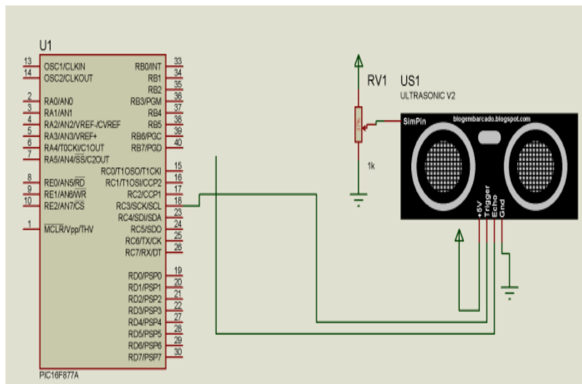

Fig.4 .PIC with ultrasonic sensor

INTERFACING PIC MICROCONTROLLER WITH LCD

The resistor R1 is employed for giving the contrast to the LCD. The quartz oscillator of 12 MHz is connected to the OSC1 and OSC2 pins of Pic microcontroller PIC18F4550 for system clock. The capacitor C2 and C3 will act filters to the crystal oscillator.

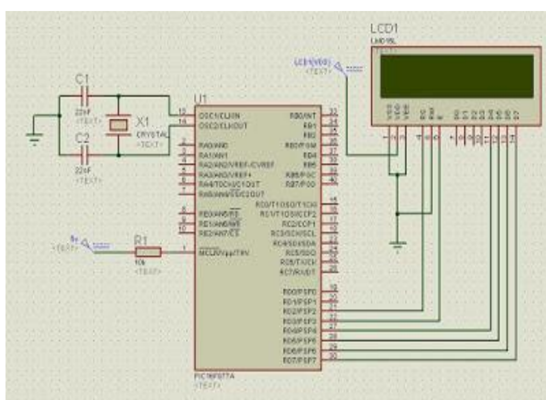

Fig.5. PIC with LCD display

INTERFACING PIC MICROCONTROLLER WITH GSM MODEM

GSM modules are extremely interesting to use especially when our project make necessary remote access. These modules could form all actions that our normal mobile could do, like making/receiving a call, sending/receiving a SMS, bring together to internet using GPRS etc.

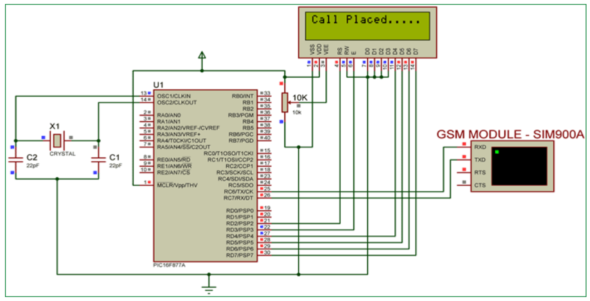

Fig .6. PIC with GSM Modem

PROGRAMMING AND BURNING THE CODE

The method of transferring compiled. HEX (machine code) file to the memory of microcontroller using microcontroller burning software is named burning or programming of a microcontroller. Once a program is burned into the memory of the microcontroller, it then works with reference to the program logic [6-10].

Simulating the circuit

The simulation may be a decision analysis and support tool, which is employed to understand the performance of the circuit. The hardware is that the cost-effective equipment, therefore the proposed action can't be directly observed by the hardware. The simulation software allows you to understand the circuit performance and find & rectify the errors of the program. There are differing types of simulating software's available within the marketplace for checking the circuit performance. Here Porteous software is employed to see the circuit performance.

Hardware design implementation

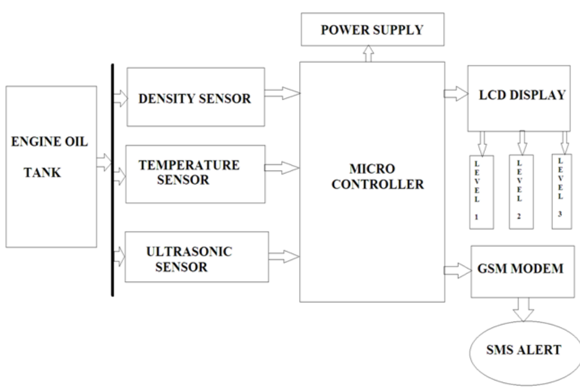

Fig. 7. System Architecture

HARDWARE SPECIFICATION

- PIC Microcontroller
- Power supply
- Density sensor
- Temperature sensor
- Ultrasonic sensor
- LCD display
- GSM modem

SOFTWARE SPECIFICATION

- Operating System : Windows 7
- Language : Embedded C.

- Programming Environment: PIC programmer, PIC C- COMPILER.

The proposed system aims in the measurement of the engine oil in the vehicle tank using ultrasonic sensor. The ultrasonic sensor has a better accuracy and it is easy to calibrate and interface it with controller which is used. The ultrasonic sensor sends ultrasonic waves and express it back to the receiver unit of the ultrasonic sensor. In this way we can find the level of engine oil in the tank if we know the time required by the ultrasonic sensor to travel. In addition to this we have used density sensor which can calculate the mileage of the vehicle. The density sensor will count the number of rotations done by the wheel and accordingly it will calculate the mileage of the vehicle. And when the vehicle tank goes in reserve mode the GSM will indicate the nearby petrol pump in the prescribed area. The ultrasonic sensor is directly connected to the engine oil tank of the vehicle. Accordingly, the ultrasonic sensor will find the output that is the level of engine oil in tank in liters. The Density sensor is connected to the wheel of the vehicle with magnet on one of the spoke of the vehicle. So, it will simply calculate the number of rotations easily. And the distance covered can be easily calculated by knowing the rotations with the temperature sensor that is used to indicate the temperature of the engine [11-12].

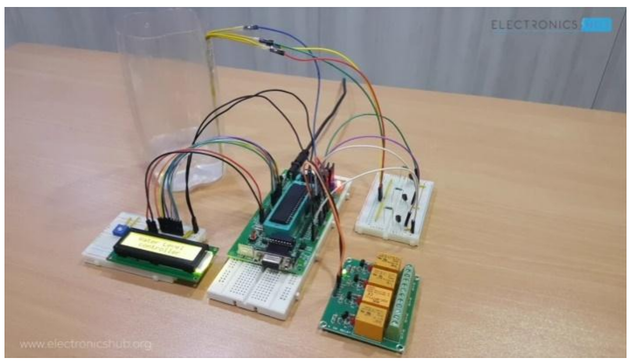

Fig.8.Electronic setup shows the IOT model

The trial setup used to lead this investigation is represented. There are two sections of the experiment which are i) Quality Grading and ii) Quantity Grading. This investigation was done on six different types of engine oils are used in these experiments, which belongs from fresh and degraded samples of a SAE 10W30 engine oil category. This oil was deteriorated by running 4 stroke motor bike engines for 0 Km, 84Km, 196 Km, 832 Km, 3117 Km, and 4000 Km travel. So as to guarantee no predisposition on the capacity impact, all the oil tests were kept in the organizer at room temperature for each section, six samples are utilized. Therefore, 12 samples altogether are set up for the two trials which are Quality and Quantity Grading.

A rigorous experimentation has been conducted for the qualitative measurement of engine oil. At initial stage total empty engine sump with filled with new engine oil. Therefore, the sample oil is considered as reference oil. In every experimentation reference value was measured by dipping the developed dip-stick instrument and after specific kilometer run the test was repeated. Quantitative analysis was performed using the difference of Lux values obtained by two detectors in order to evaluate the quantitative assessment of engine oil. Based on the result obtained, it can be observed that Quantity of engine oil in engine sump are successfully classified. For better result of quantification two sensor systems were used. Precision level of this instrument can also be increased by using alteration of sensors [13-15].

EVALUATION

The proposed framework point in the estimation of the motor oil in the vehicle tank utilizing ultrasonic sensor. The ultrasonic sensor has a superior precision and it is anything but difficult to align and interface it with controller which is utilized. The ultrasonic sensor sends ultrasonic waves and reflects it back to the recipient unit of the ultrasonic sensor. Along these lines we can locate the degree of motor oil in the tank on the off chance that we realize the time required by the ultrasonic sensor to travel. Notwithstanding this we have utilized thickness sensor which can ascertain the mileage of the vehicle. The thickness sensor will check the quantity of revolutions done by the haggle it will figure the mileage of the vehicle. Also, when the vehicle tank goes available for later mode the GSM will show the close by oil siphon in the recommended zone. The ultrasonic sensor is legitimately associated with the motor oil tank of the vehicle. As needs be the ultrasonic sensor will discover the yield that is the degree of motor oil in tank in liters. The Density sensor is associated with the wheel of the vehicle with magnet on one of the discussed the vehicle. So, it will effortlessly figure the quantity of revolutions effectively. Also, the separation secured can be effectively determined by knowing the turns with the temperature sensor that is utilized to show the temperature of the motor.

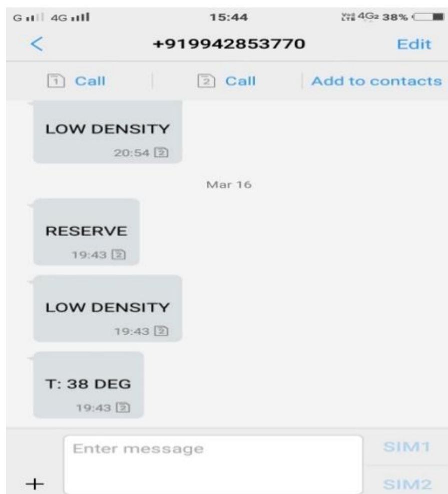

Fig.9. shows the mobile screen or user interface for indication of oil quality

CONCLUSION AND FUTURE SCOPE

Results show the device used a very much cost effective and reliable method of detecting the impurities and level of oil. Instrument is working properly. Output resolution of this instrument is up to satisfactory level also data can be remotely accessed. It is very useful for statically analysis. This instrument can be used for different grades of oil like vegetable, edible oil, reagent solution, organic solvent for their adulteration analysis.

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