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Engine Oil Condition Monitoring using IoT and Predictive Analysis

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ABSTRACT: Engine lubrication oil should be maintained properlyso that the wear and tear, the heat generated and vibration produced from the engine is greatly reduced and hence the overall efficiency of the engine improves. If the engine oil is not changed at regular intervals as prescribed, then dirt and sludge would accumulate inside the engine which paves the way for poor lubrication of the moving parts inside the engine.The main objective of our project is to assess the condition of the engine oil using IoT technique and provide a detailed analysis of the same For assessing the condition of the oil conductivity sensor, Ph sensor and turbidity sensors are used and based on those values three differently colored LED's are used to indicate the oil condition. .Thus it helps the owner to change the engine oil when its condition degrades by employing this sensor based technology.

KEYWORDS: Engine oil,Conductivity sensor,ph sensor,turbidity sensor,LED.

I. INTRODUCTION

The most important component in lubrication systems is the lubrication oil that reduces friction between the rotation parts. However, there will always be a certain amount of friction, which results in wear and tear and as a result the presence of tiny particles in the lubrication oil.Here a solution for real time based condition monitoring of oil using IoT is provided. The digital oil monitoring can be used to produce a trend analysis of oil parameters like Temperature, viscosity of the liquid , ph measurement and water level indicator and maintenance can be most efficiently scheduled for known downtimes before a failure occurs.These parameters are being monitored and controlled according to their threshold values by using a microcontroller . If the values exceeds or precedes the threshold values , the lubricant oil which is present inside the machinery parts are being removed out by using pump motors. The outputs of these controlling actions can be seen on any IOT modules or LCD.

II. Existing system:

In two wheelers,we have see through galss through which level of the oil is seen, in cars we don't have see through glass instead we have dipstick which measures the level of oil.But in some high end cars Audi,BWM etc we have certain oil level indicators,oil pressure indicator or some warning lights.

Drawbacks:

In this method , only level of engine oil is measured not the condition or quality of the oil.Sometimes , dipstick pops out when the crankcase pressure is too high.

Proposed system: In our proposed system, we use different type of sensors,mainly conductivity and ph sensors measure the condition of the oil and turbidity sensor denotes the color change . Saybolt viscometer is used to measure the viscosity of the oil with accurate values.

Advantages: By this method, engine oil condition is monitored on a real time basis and deterioration of oil condition can be analyzed based on the sensor's data..Thus data from used oil can be analyzed to assist in identifying inherent mechanical shortcomings, in quality analysis of oil and also thebalance lifetime of the oil..

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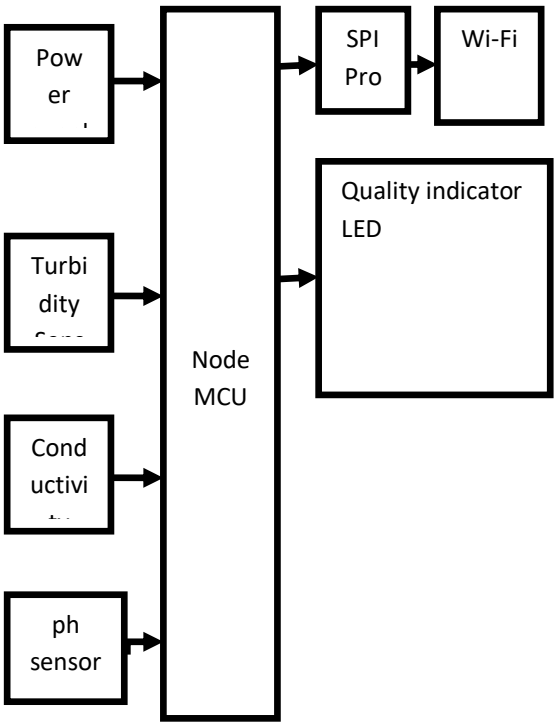
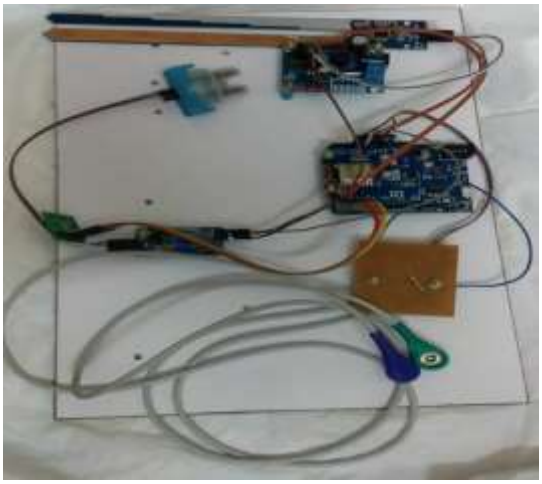
Block Diagram:



III. Experimental setup:



Node MCU:

NodeMCU is an open-source firmware.A Iot product can be build using these developmentkits.ESP8266 NodeMCU has a special feature compared to other as it as in-build wifi module in it , which is used to transfer the data using cloud.

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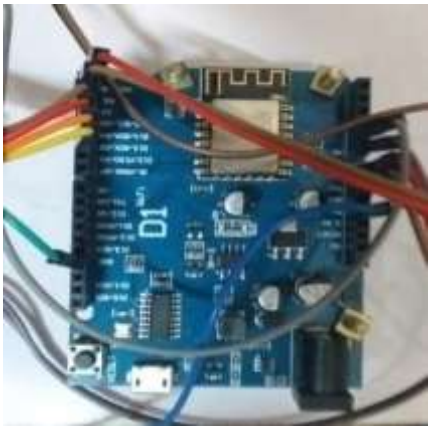
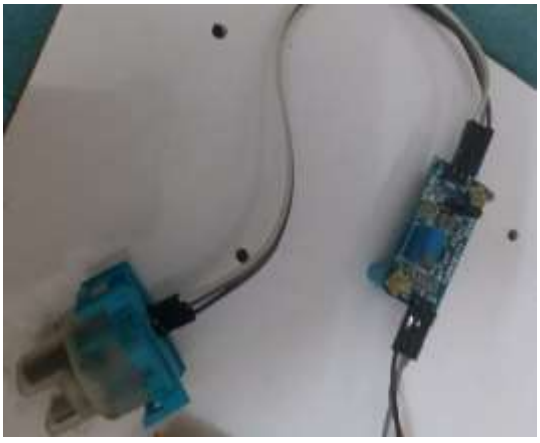


Turbidity sensor:

It works on the principle that as the total suspended solids(TSS) increases in the engine due to the contamination of oil by increasing in the temperature or the particles present in the oil due to continuous usage of engine oil over a particular period of time.This sensor works on the process that as the light is passed through the oil , depending upon the number of particles present in oil , the light is reflected back.The turbidity increases as the TSS increases.All these inputs are being given to Node MCU for further processing of the values.



Conductivity sensor:

The conductivity sensor works on the principle that it produces electric current between 2 electrodes (even 4 electrodes can also be used).As the electrodes are immersed in the oil the ion transplant takes place.Therefore , if they are large number of concentration of ions then the conductivity of the oil also increases respectively.Depending upon the suspended particles , the conductivity is being measured.

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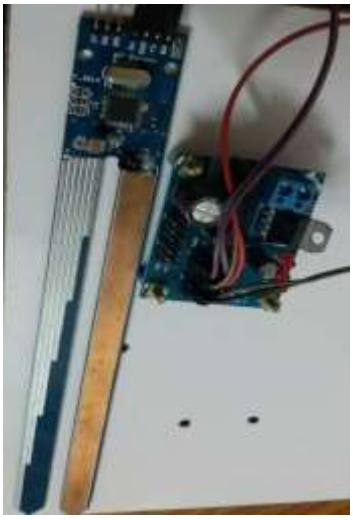
Ph sensor:

The Potentiometric pH meters consists of 2 electrodes and these are dipped into oil solution and the voltage between them is measured.These values are converted into respective ph values.



Saybolt viscometer:

Saybolt viscometer is generally used for the measurement of oilviscosity.Viscosity is basically the resistance offered by the fluid due to the friction between the parallel layers inside the fluid that tries to move with respect to each other. In our project40 ml of 5W30 oil is made to pass through the orifice at specified temperature. Higher the viscosity larger would be the time required for the fluid to flow through the orifice Here the sensor is used to find the viscosity values for three different types of oils and the cognitive block (predictive algorithm)describes which type of oil has been used.

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Table 1.

Sensors	Conductivity sensor	pH sensor	Turbidity sensor	Saybolt viscometer
Operating voltage	3.3-5V	5V per pH unit	5V DC	220 volts AC mains
Operating current	10-20mA	5-10mA	40mA(MAX)	6A
Response time	5-200µs	Depends upon oil	<500ms	5-10 mins
Operating temperature°C	-40°C to 90 °C	-10°C to 110°C	5°C to 90°C	50°C

Working:

In this system,we use NodeMCU(ESP8266) which is the vital part in the system, as the application program is stored in it.The turbidity sensor and conductivity sensor are used to monitor the engine oilcondition .The first sampleof 5W30 oil is taken which is infact a fresh oil in unused form(0 kms) with the second sample being taken at 5000 kms and subsequently the third sample is taken at 10,000 kms.

IV. Calculation of viscosity:

Viscosity

=> t<100 secs

v = (0.226t-(195/t))

1)NORMAL ENGINE OIL(5W-30):

t= 4.43s => 283 sec.

v = (0.226t-(195/t))

v = 63.26 cSt.

2) INTERMEDIATE ENGINE OIL(5W-30):

t = 3.56s => 236 sec.

v = (0.226t-(195/t))

v = 52..50 cSt.

3) **BAD OIL(5W-30):**

t = 3.11 => 191 sec

v = (0.226t-(195/t))

v= 42.12cSt.

Tabulation:

Oil quantity : 40ml.

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Table 2. Viscosity values

Oil type	Temp ©	Viscosity(cSt)
Normal oil	50	63.26
Intermediate oil	50	52.50
Bad oil	50	42.14

Output 1:Conductivity values

Fig 1.1:Normal engine oil:

Fig 1.2:Intermediate engine oil:

Fig 1.3:Bad engine oil:

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Output 2:ph values

Fig 2.1:Normal engine oil:

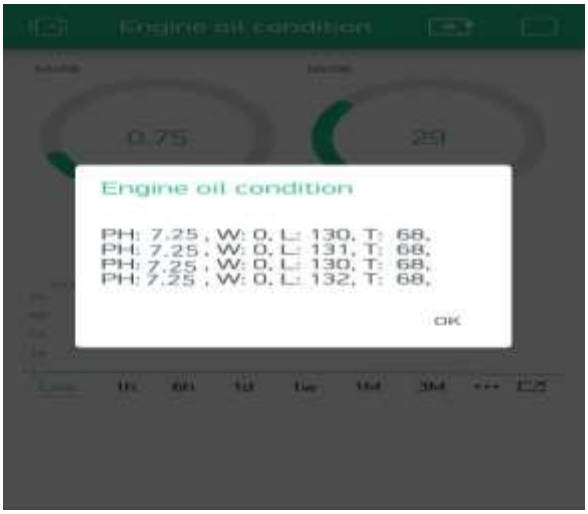


Fig 2.2:Intermediate engine oil:

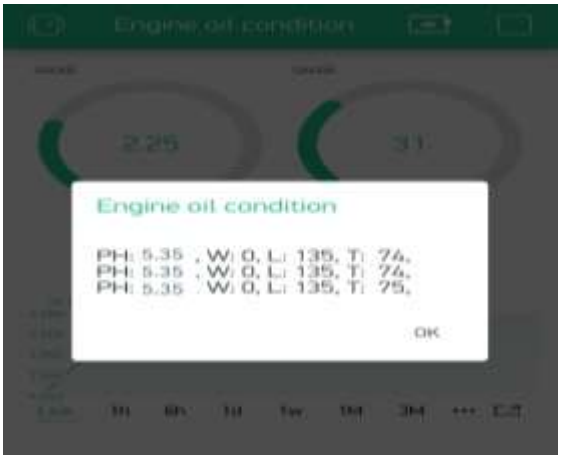
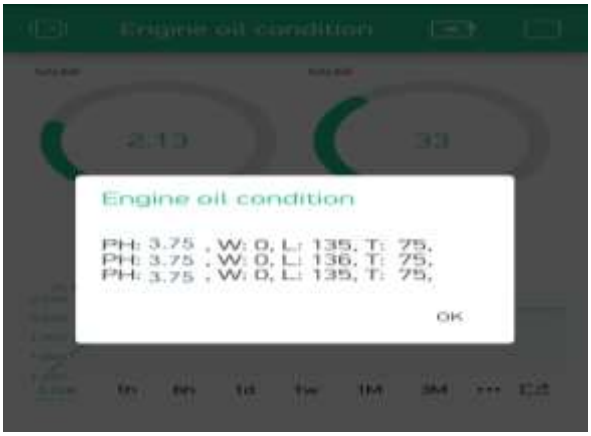


Fig 2.3:Bad engine oil:



Comparative study and graphs:

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Stages of 5W-30 diesel engine oil	Conductivity sensor values (ns/m)	Turbidity sensor values (NTU)	Viscosity Values (cSt)	Ph values
New engine oil (0 kms)	0.35 to 0.75 ns/m	25 NTU	63.26 cSt	7.25
Intermediate engine oil (5000 kms)	1 to 1.75 ns/m	27 NTC	52.50 cSt	5.35
Bad engine oil (10000kms)	2 to 2.5 ns/m	33 NTC	42.14 cSt	3.75

From the above inference , by measuring the readings from all the sensors , we can make a comparative study by comparing those values. This helps to monitor the engine oilcondition .This is used to reduce the oil scams and depending upon the values of each sensors we can identify it as normal or intermediate or bad engine oil therefore it indicates whether oil should be changed or not in order to avoid the engine ceasing. The drawback with the present existing system is it indicates only level of the oil but not condition of the oil.The major problem is that the oil level is indicated high irrespective to the its viscosity consistency as when temperature increases the viscosity of the oil decreases.It is used to reduce the oil scams like replacing the existing oil with different kind of engine oils , in order to reduce all these sorts of problems, condition monitoring of the car engine oil is very important and should be made mandatory in near by future.

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