Novel Design of Gasoline Purity Meter in IC Engine Based Automobile Applications

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***Abstract* - In this survey paper we can see the comparison of density and temperature for petrol, diesel and crude oil,. Density is the mass of any material per unit volume. Most of the materials have lower density of liquid than the solid but this is not true in all condition. Water has a higher density in the liquid state than the solid and the temperature is related to the average kinetic energy of the atoms or molecules within the substance and it is proved that volume is directly proportional to temperature by the equation *PV=nRT*.**

I. SEPARATION OF GASOLINE BY-PRODUCTS

Fractional distillation is the separation of a mixture into its components part, or fractions separating chemical compounds by their boiling point by heating them to a temperature at which one or more fractions of the compound will vaporize. Fractional distillation is the most common form of separation technology used in petroleum refineries, petrochemical and chemical plant, natural gas processing and cryogenic air separation plant. It is performed in large vertical cylindrical column known as distillation with the diameter range of 65cm to 6mand height ranging from about 6m to 60m.the distillation towers have liquid outlets at interval up the column which allows the withdraw of different fractions or products having different boiling point or boiling range

- Have more carbon atoms
- Have higher molecular weights
- Are less branched chain alkanes
- Are darker in colour
- Are more viscous
- Are more difficult to ignite and to burn

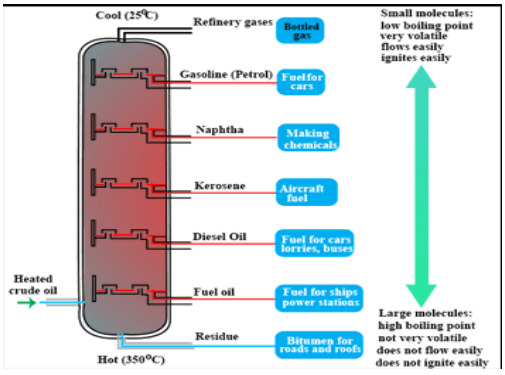


Figure 1. Separation of fractional distillation

II. PETROL (C_nH_{2n+2})

Petroleum is a naturally occurring yellow to block liquid found in geological formation Beneath the earth surface which is commonly refined into various types of fuels. Components of petroleum are separated using a technique called fractional distillation. It consist of hydrocarbon of molecular weight and other organic compound the name petroleum covers both naturally occurring unprocessed crude oil and petroleum products that are made up of refined crude oil. A fossil fuel, petroleum is formed when large quantities of dead organisms, usually zooplankton and algae are buried under earth sedimentary rock and subjected to both intense heat and pressure.

Petroleum, in one form or another, has been used since ancient times, and is now important across society, including in economy, politics and technology. The rise in importance was due to the invention of the internal combustion engine, the rise in commercial aviation, and the importance of petroleum to industrial organic chemistry, particularly the synthesis of plastics, fertilizers, solvents, adhesives and pesticides.

2.1 Chemical process

Petroleum is a mixture of a very large number of different hydrocarbons the most commonly found molecules are alkanes (paraffin's), cycloalkanes (naphthenes), aromatic hydrocarbons, or more complicated chemicals like asphaltenes. Each petroleum variety has a unique mix of molecules, which define its physical and chemical properties like colour and viscosity.

The alkanes, also known as paraffin's, are saturated hydrocarbons with straight or branched chains which contain only carbon and hydrogen and have the general formula CnH2n+2. They generally have from 5 to 40 carbon atoms per molecule, although trace amounts of shorter or longer molecules may be present in the mixture.

The alkanes from pentane (C_5H_{12}) to octane (C_8H_{18}) are refined into gasoline, the ones from nonane (C_9H_{20}) to hexadecane ($C_{16}H_{34}$) into diesel fuel, kerosene and jet fuel. Alkanes with more than 16 carbon atoms can be refined into fuel oil and lubricating oil. At the heavier end of the range, paraffin wax is an alkane with approximately 25 carbon atoms, while asphalt has 35 and up, although these are usually cracked by modern refineries into more valuable products.

The shortest molecules, those with four or fewer carbon atoms are in a gaseous state at room temperature.

Temp. (^{0}C)	Density (Kg/m^3)	API
-10	760.97	0.96878
0	751.47	0.98103
10	741.97	0.99359
15	737.22	1.00000
20	732.47	1.00648
30	722.97	1.01971
40	713.47	1.03328
50	703.97	1.04722

Table 1: Density and Temperature of Petrol

They are the petroleum gases. Depending on demand and the cost of recovery these gases are either flared off, sold as liquefied petroleum gas under pressure, or used to power the refinery's own burners. During the winter, butane (C_4H_{10}), is blended into the gasoline pool at high rates, because its high vapour pressure assists with cold starts. Liquefied under pressure slightly above atmospheric it is best known for powering cigarette lighters but it is also a main fuel source for many developing countries. Propane can be liquefied under modest pressure and is consumed for just about everyapplication relying on petroleum for energy from cooking to heating to transportation.

The density of crude oil varies, depending upon the amount of heavy and light components. Typical values, in Kg per cubic meter are:

- Mexican Crude Oil 973
- Texas Crude Oil 873
- Gasoline 737
- Kerosene 817
- Diesel 840
- Automobile Oil 940
- Pure Water (At 4□C) 1000

Substance	Temp. (°F)	Density (Kg/m^3)
Petroleum Ether	20 to 68	640
Petrol (Natural)	60°F	711
Petrol (Vehicle)	60°F	737
Phenol	25 to 77	1072

2.2 Chemical equation of petrol

$$8C + 9H_2 \longrightarrow C_8H_{18}$$

III. DIESEL ($C_{12}H_{24}$)

Diesel fuel in general is used in any liquid fuel used in diesel engines whose fuel ignition takes place, without any spark, as a result of compression of the inlet air mixture and then injection of fuel. Diesel engines have found broad use as a result of higher thermodynamic efficiency and thus fuel efficiency. This is particularly noted where diesel engines are run at part-load as their air supply is not throttled as in a petrol engine, their efficiency still remains very high.

The most common type of diesel fuel is a specific fractional distillate of petroleum fuel oil, but alternatives that are not derived from petroleum, such as biodiesel, biomass to liquid (BTL) or gas to liquid (GTL) diesel, are increasingly being developed and adopted. To distinguish these types, petroleum-derived diesel is increasingly called petro diesel. Ultra-low-sulphur diesel (ULSD) is a standard for defining diesel fuel with substantially lowered sulphur contents.As of 2016, almost all of the petroleum-based diesel fuel available in UK, Europe and North America is of a ULSD type. In the UK, diesel fuel for on-road use is commonly abbreviated DERV, standing for *diesel-engine road vehicle*, which carries a tax premium over equivalent fuel for non-road use in Australia diesel fuel is also known as distillate and in Indonesia, it is known as Solar a Trademarked name by the local oil company PERTAMINA

3.1 Biodiesel

Fatty-acid methyl ester (FAME), more widely known as biodiesel, is obtained from vegetable oil or animal fats (bio lipids) which have been Trans esterified with methanol. It can be produced from many types of oils, the most common being rapeseed oil (rapeseed methyl ester, RME) in Europe and soybean oil (soy methyl ester, SME) in the US. Methanol can also be replaced with ethanol for the transesterification process, which results in the production of ethyl esters.

The transesterification processes use catalysts, such as sodium or potassium hydroxide, to convert vegetable oil and methanol into FAME and the undesirable by products glycerine and water, which will need to be removed from the fuel along with methanol traces. FAME can be used pure (B100) in engines where the manufacturer approves such use, but it is more often used as a mix with diesel, BXX where XX is the biodiesel content in percent FAME as a fuel is specified in DIN EN 14214and ASTM D6751.

Fuel equipment manufacturers (FIE) have raised several concerns regarding FAME fuels, identifying FAME as being the cause of the following problems: corrosion of fuel injection components, low-pressure fuel system blockage, increased dilution and polymerization of engine sump oil, pump seizures due to high fuel viscosity at low temperature, increased injection pressure, elastomeric seal failures and fuel injector spray blockage. Pure biodiesel has an energy content about 5–10% lower than petroleum diesel. The loss in power

when using pure biodiesel is 5–7%.

Unsaturated fatty acids are the source for the lower oxidation stability; they react with oxygen and form peroxides and result in degradation by products, which can cause sludge and lacquer in the fuel system. As FAME contains low levels of sulphur, the emissions of sulphur oxides and sulphates, major components of acid rain, are low. Use of biodiesel also results in reductions of unburned hydrocarbons, carbon monoxide (CO), and particulate matter. CO emissions using biodiesel are substantially reduced, on the order of 50% compared to most petro diesel fuels.

The exhaust emissions of particulate matter from biodiesel have been found to be 30%lower than overall particulate matter emissions from petro diesel.

The exhaust emissions of total hydrocarbons (a contributing factor in the localized formation of smog and ozone) are up to 93% lower for biodieselthan diesel fuel. Biodiesel also may reduce health risks associated with petroleum diesel. Biodiesel emissions showed decreased levels of polycyclic aromatic hydrocarbon (PAH) and nitrite PAH compounds, which have been identified as potential cancer-causing compounds.

In recent testing, PAH compounds were reduced by 75–85%, except for Benz (a) anthracene, which was reduced by roughly 50%. Targeted nPAH compounds were also reduced dramatically with biodiesel fuel, with 2-nitrofluorene and 1-nitropyrene reduced by 90%, and the rest of the nPAH compounds reduced to only trace levels.

Hydrogenated oils and fats. This category of diesel fuels involves converting the triglycerides in vegetable oil and animal fats into alkanes by refining and hydrogenation, such as H-Bio. and are free from the many disadvantages of FAME.

3.2 Chemical properties

Most diesel fuels freeze at common winter temperatures, while the temperatures greatly vary Petro diesel typically freezes around temperatures of **−8.1 °C (17.5 °F), whereas biodiesel freezes between** temperatures of 2°to 15 °C (35° to 60 °F. The viscosity of diesel noticeably increases as the temperature decreases, changing it into a gel at temperatures **of −19 °C (−2.2 °F) to −15 °C (5 °F),** that cannot flow in fuel systems.

Conventional diesel fuels vaporise at temperatures between 149 °C and 371 °C Conventional diesel flash points vary between 52 and 96 °C, which makes it safer than petrol and unsuitable for spark-ignition engines like petrol, the flash point of a diesel fuel has no relation to its performance in an engine nor to its auto ignition qualities.

Temp. (°C)	Density (Kg/m^3)	API
-10	857.640	1.0210
0	850.584	1.0126
10	843.528	1.0042
15	840.000	1.0000
20	836.472	0.9958
30	829.332	0.9873

Table 3: Density and Temperature

3.3 Chemical equation of diesel

$$4C_{12}H_{23}+71O_2 \longrightarrow 48CO_2+46H_2O$$

IV. CRUDE OIL (C_NH_2)

Crude oil, commonly known as petroleum is a liquid found within the earth comprised of hydrocarbons, organic compounds and small amount of metal. While hydrocarbon are usually the primary component of crude oil, their composition can vary from 50% -97% depending on the types of crude oil and how it is extracted.

Crude oil is created through the heating and compression of organic materials over a long period of time, the organic compounds like nitrogen, oxygen and Sulphur. Over time this organic material combined with mud and was then heated to high temperatures from the pressure created by the heavy layers of sediments, this process is known as diagenesis.

Temp. (°C)	Density (Kg/m^3)
-10	991.75
0	984.25
10	976.75
15	973
20	969.25
30	961.75
40	954.25
50	946.75

Table 4: Density of Crude Oil

The most common method of crude oil extraction is drilling. Geologist will first identify a section of land they believe has oil flowing beneath it.

There are a numbers of ways this can be accomplished, the most frequently used methods are satellite imagery, gravity meters and magnetometers. Once a steady stream of oil is found, underground the drilling can begin.

Substance	Temp. (°F)	Density (Kg/m3)
Crude Oil, 48° API	60°F	790
Crude Oil, 40° API	60°F	825
Crude Oil, 35.6° API	60°F	847
Crude Oil, 32.6° API	60°F	862
Crude Oil, California	60°F	915
Crude Oil, Mexican	60°F	973
Crude Oil, Texas	60°F	873

Table 5: Density of Crude Oil at 60°F

4.1 Chemical equation of crude oil

$$C_2OH_{42} \longrightarrow C_8H_{18}+C_3H_6+C_9H_{18}$$

V. PROBLEM IDENTIFICATION

The main aim of processing this project is to avoid the major problems in the environment the petrol is mixed with the lead this cause the major problems like brain damage and the engine life time gets out. The petrol is mixed with lead and forms leaded petrol goes to the engine with a no proper ratio it get burned suddenly that time the piston can't control the action so that it gets moves suddenly down that time the crankshaft will get damage. By the sudden force given by the piston crankshaft it will stop working for a several mill second this may causes sudden stop of our automobile application when we are driving and forms a sudden stock while driving this may reduce our engine life time.

5.1 Comparison of various liquids

Molecules of nonpolar compounds, such as oil and gasoline, even when mixed well into water, tend to separate from the water when the mixing stops. Water molecules tend to hold on to each other and squeeze out nonpolar oil and gasoline. Because of density differences between water and oil, this means that they form two separate liquid layers. For example, in oil-based salad dressings, the oil and water components separate into two layers and require mixing before being used.

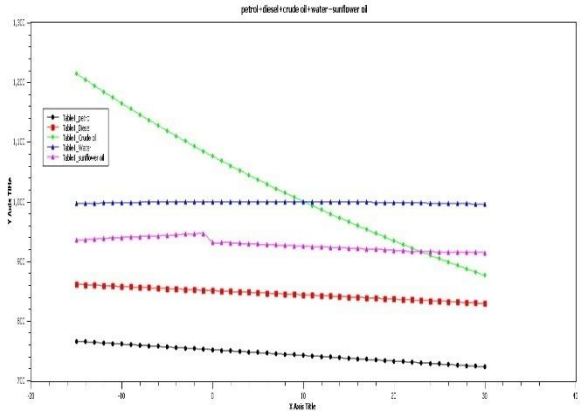
Although water will not dissolve oil, gasoline readily dissolves oil. This is because both gasoline and oil are nonpolar; they easily slide between each other when mixed. We can therefore make the generalization that like molecules dissolve like molecules**.**

5.2 Tabulation

Temperature	Petrol	Diesel	Crude Oil	Vegetable Oil	Water
-15	765.72	861.084	1214.5923	935.7	996.406
-14	764.77	860.412	1204.2553	936	996.8217
-13	763.82	859.74	1194.0928	937	997.2058
-12	762.87	858.984	1184.1004	938.04	997.5597
-11	761.92	858.312	1174.2739	939.22	997.8848
-10	760.97	857.64	1164.6091	939.82	998.1824
-9	760.02	856.884	1155.102	940.42	998.4536
-8	759.07	856.212	1145.749	941.02	998.6996
-7	758.12	855.54	1136.546	941.62	998.9213
-6	757.17	854.784	1127.49	942.22	999.1198
-5	756.22	854.112	1118.577	943.1	999.2959
-4	755.27	853.44	1109.803	944	999.4505
-3	754.32	852.684	1101.167	945.16	999.5844
-2	753.37	852.012	1092.664	945.48	999.6984
-1	752.42	851.256	1084.291	946.08	999.7931
0	751.47	850.584	1076.045	932	999.8692
1	750.52	849.912	1067.924	931	999.9274
2	749.57	849.156	1059.925	930.7	999.9682
3	748.62	848.484	1052.044	929.8	999.9922

4	747.67	847.812	1044.280	929.1	1000
5	746.72	847.056	1036.63	928.5	999.992
6	745.77	846.384	1029.090	927.8	999.9687
7	744.82	845.628	1021.660	927.1	999.9305
8	743.87	844.956	1014.336	926.4	999.8779
9	742.92	844.284	1007.117	925.7	999.8113
10	741.97	843.528	1000	925	999.7311
11	741.02	842.856	992.9824	924.4	999.6375
12	740.07	842.1	986.0627	923.7	999.5311
13	739.12	841.428	979.2387	923	999.412
14	738.17	840.672	972.5085	922.3	999.2807
15	737.22	840	965.8703	921.88	999.1374
16	736.27	839.328	959.3220	921.3	998.9824
17	735.32	838.572	952.8619	920.08	998.816
18	734.37	837.9	946.4882	919.8	998.6383
19	733.42	837.144	940.1993	919.1	998.4498
20	732.47	836.472	933.9934	918.12	998.2506
21	731.52	835.716	927.8688	917.26	998.0409
22	730.57	835.044	921.8241	916.12	997.8209
23	729.62	834.288	915.8576	915.84	997.591
24	728.67	833.616	909.9678	915.7	997.3511
25	727.72	832.86	904.1533	915.42	997.1017
26	726.77	832.188	898.4127	915.28	996.8427
27	725.82	831.432	892.7444	915	996.5744
28	724.87	830.76	887.1473	914.86	996.297
29	723.92	830.004	881.6199	914.72	996.0107
30	722.97	829.332	876.1609	914.28	995.7155

Graphical Structure for various liquids



The above graphical structure shows the density will change for various liquids according to its characteristics of liquid with respect to temperature.

5.3 Leaded Petrol Vs Unleaded Petrol

Different types of petrol can be bought at the pump. Although some may be self-explanatory, there are still some that many find confusing like leaded and unleaded petrol. The main difference between leaded petrol and unleaded petrol is the additive tetraethyl lead. There were other types used previously, but this is the most popular. [10] This additive, used in leaded petrol and not in unleaded petrol, contains the element of lead.

5.4 Why Unleaded Petrol Is Introduced?

Lead is a highly dangerous pollutant. Long term exposure to even low levels of lead can affect mental development in

children. Government air pollution experts recently concluded that the most substantial evidence of effects of low levels of lead on health relates to effects on the central nervous system and, in particular, on the developing brain of children" and went on to say that "the higher the average blood lead concentration in a population, the lower that population's average IQ. Cars using leaded petrol also have higher emissions of highly dangerous particulates, because of the lead content of their fuel.

5.5 Chemical Properties of Leaded Petrol

TEL is the weakness of its four C–Pb bonds. At the temperatures found in internal combustion engines, $(CH_3CH_2)_4Pb$ decomposes completely into lead and lead oxides as well as combustible, short-lived ethyl radicals. [7] Lead and lead oxide scavenge radical intermediates in combustion reactions. Engine knock is caused by a cool flame, an oscillating low-temperature combustion reaction that occurs before the proper, hot ignition. Lead quenches the pyrolysed radicals and thus kills the radical chain reaction that would sustain a cool flame, preventing it from disturbing the smooth ignition of the hot flame front. Lead itself is the reactive antiknock agent, and TEL serves as a gasoline-soluble lead carrier. When $(CH_3CH_2)_4Pb$ burns, it produces not only carbon dioxide and water, but also lead: $(CH_3CH_2)_4Pb + 13\ O_2 \rightarrow 8\ CO_2 + 10\ H_2O + Pb$

This lead can oxidize further to give species such as lead(II) oxide:

$$2\ Pb + O_2 \rightarrow 2\ PbO$$

Pb and PbO would quickly over-accumulate and destroy an engine. For this reason, the lead scavengers 1,2-dibromoethane and 1,2-dichloroethane are used in conjunction with TEL these agents form volatile lead(II) bromide and lead(II) chloride, respectively, which are flushed from the engine and into the air.

VI. PROPOSED METHOD

The overview of the project is gasoline purity meter using peripheral interface controller. The main aim of this project is to find the purity of gasoline by the customer side itself by placing the meter near to the speedometer which contain both led and lcd display. The peripheral interface controller was interfaced with two sensors they are temperature sensor and density sensor. The temperature sensor scene the value when the petrol goes inside the tank within a fraction of second similarly the density sensor also act and gives the accurate value to the microcontroller. [5] Which compare both the value and gives the output which has been placed near the speedometer and lcd display also placed which shows the value of temperature and density of the petrol so that the customer can get an idea where the pure petrol is available. A quality product is one that complies with prescribed specifications and is free from any contamination or adulteration. To ensure that our consumers get contamination free products, personnel at our outlets check the products regularly. In addition sales officers carry out regular checks at all the outlets to prevent any malpractices. Club Mobile Labs and Industry Mobile labs also conduct surprise inspections in the Retail outlets on a regular basis. The petrol supplier can mix the petrol with lead.

6.1 Block Diagram

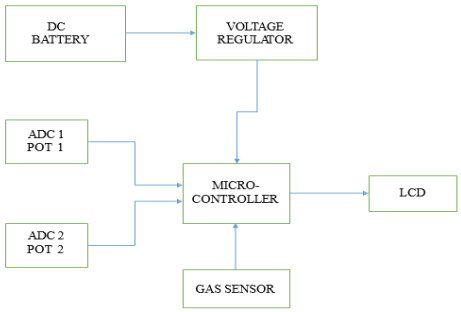
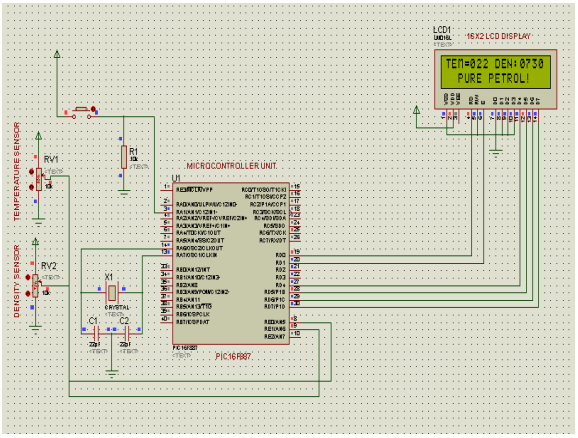


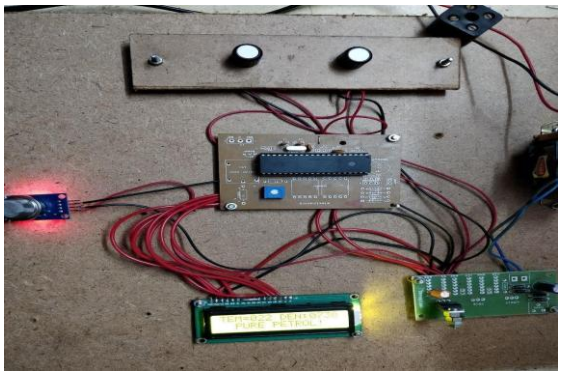
Fig. 6.1 Block Diagram of Proposed Method

VII. PROTOTYPE

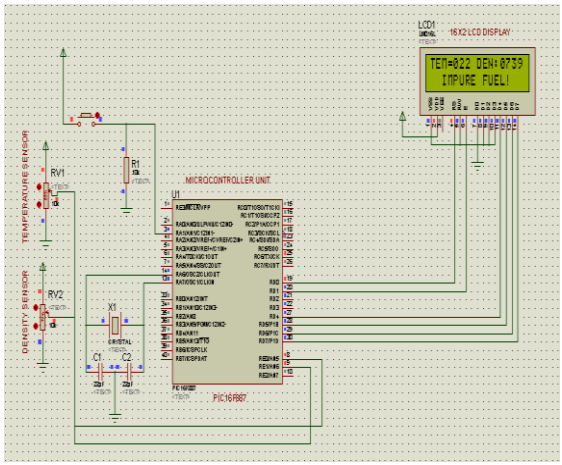
7.1(a) Simulation for pure petrol



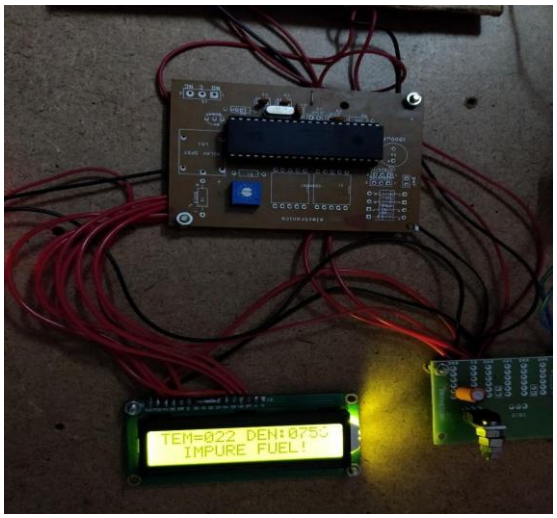
7.1(b) Hardware for pure petrol



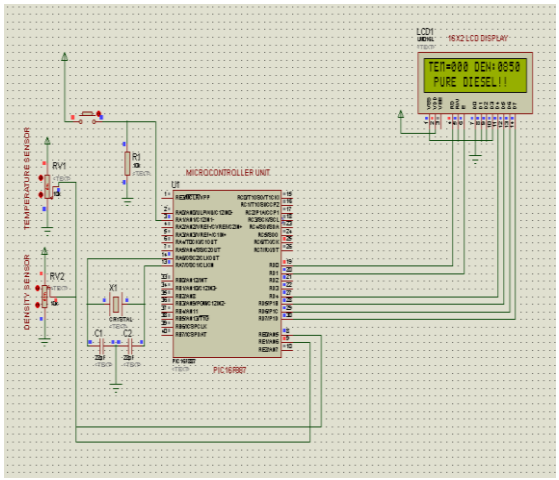
7.2(a) Simulation for impure fuel



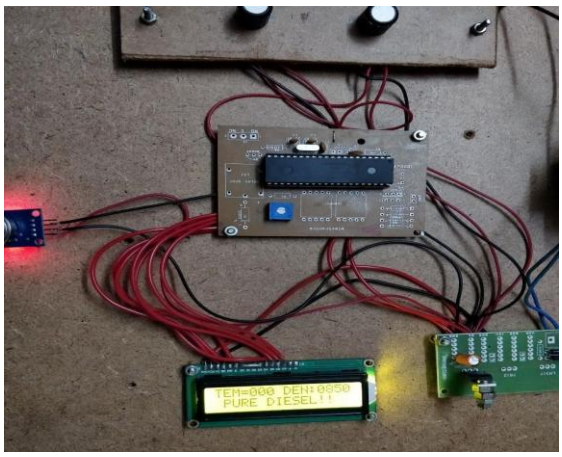
7.2(b) Hardware for impure fuel



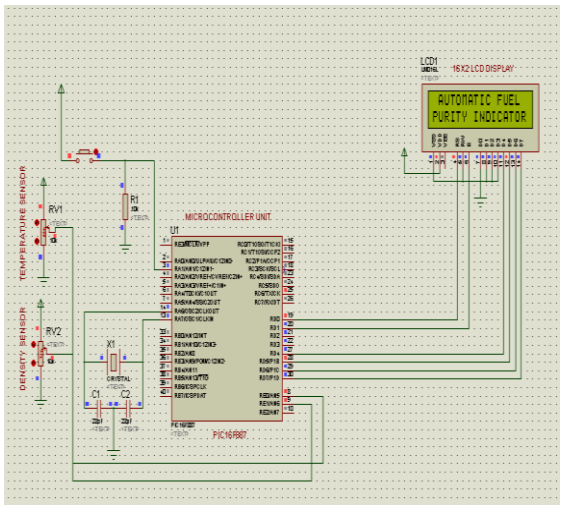
7.3(a) Simulation for pure diesel



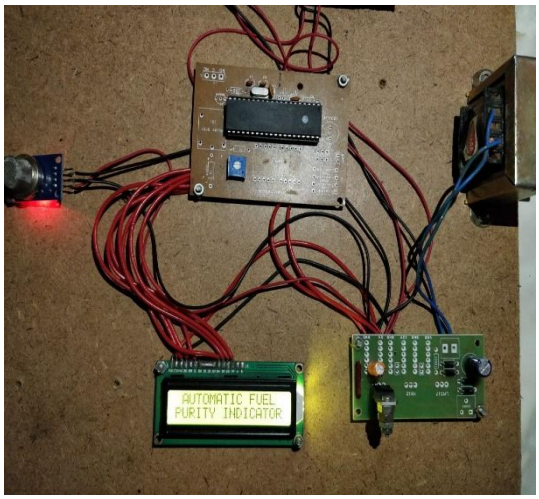
7.3(b) Hardware for pure diesel



7.4(a) Output in simulation



7.4(b) Output in hardware



VI. CONCLUSION

The impure petrol and diesel will affect the life span of internal combustion engine. A meter is designedto reduce the effect. The meter name is Gasoline purity meter by using pic microcontroller. This meter can be used in all automobile applications and thus all the engine can be saved. The above comparison of petrol, diesel and crude oil shows the density of liquids at various temperatures. Basically the density will increase when temperature is low and density decrease when temperature is in high condition.

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