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Modeling with Multilayer Perceptron for Detection of Fuel Adulteration using Python Programming

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Abstract
Adulteration of fuel is introduction of an unknown substance into motor spirit unlawfully or not permitted resulting the product does not conform to the needs and specifications. Normally cheaper boiling point range hydrocarbons having more or less similar composition are added as additives leading to alter and degrade the quality of the base fuels. This method is adopted by the trading community for their quick illegal profits. This is coming as tail pipe exhaust in automobile lead to environmental pollution as well as human hazard. Ethanol and methanol added illegally to increase octane levels caused fuel pipes to leak exhaust. In order to detect the pollutants there shall be proper way both at laboratory level as well as statute. Artificial Neural Networks technique to analyze the fuel adulteration is a precise technique than any other existing methods.

The gasoline, hydrocarbon fractions are detected at the in-situ with the help of Internet of Things and can be controlling through the remote and that data can be collected through the smattering. This data will help in the finding the impurities in the gasoline, diesel pollutants released into the air from tailpipe exhaust. So in this paper we are using some advance computational technique called Multilayer perceptron (MPL) to identify the impurities in the fuels. This will reduce the global warming and toxic diseases. Multilayer perceptron (MLP) is one of the most efficient techniques for Detection of fuel adulterants; MLP is class of feed forward in the artificial neural network. It consists of Three layers i.e., input layer, hidden layer and output layer. For the recognition and 3D objects estimation from a 2D single perspective view Multilayer perceptron is used.

Keywords: Gasoline; Adultération; Hydro carbons, Computation Techniques; MLP; MVA.

Introduction
Multi-layer perceptron (MLP) is an architecture form the neural network and that has a feed-forward structure characteristics. MLP uses Back propagation technique for training the data. Back propagation is one of the techniques from the supervised learning. Sometimes MLP is also referred as vanilla neural networks. In machine learning the artificial neural networks has an important role in deep learning.

In day to day life the petroleum products are playing crucial role. The entire economy is dependent on the sale of petroleum products. The common man is solely depending on the Petroleum products right from the Cooking Gas, Transport, Energy, use of Plastics and its compounds. This has paved the way for some unscrupulous traders to make money with the illegal methods of selling the petroleum products with the adulteration of similar hydrocarbon solvents having more or less same characteristics. Normally this adultered fuel is not detected with the physical observation. The chemical analysis is required to detect the extent of adulteration. The adulteration of the fuel is causing release of toxins into air, decrease in life of the engine and its parts, causing health hazards. There is substantial change in the atmospheric temperature and pollution so the green house effect

The motor spirit (Gasoline) will consist of Methonol, Ethanol, Isopropanol, ETBF, Benzene, Tolune, Xylene, Ethylbenzene, Propylbenzene, Ethyltoluene, Mesitylene, Pseudocumene, Isodurene, Napthalene, Oxygen, aromatics, Olefins, Saturates, and Mahalanobis D. The quality of the fuel and its ignition properties are depend on the Motor Octane number (MON), Refinery Octane Number (RON), Anti Knock Index (AKI), Initial Boiling Point (IBP), T10, T50, T90, Final Boiling Point (FBP), Vapour Pressure (VP), E070, E100. (lesser MON) has improved anti-knock quality. The oil varies from the place to place where it is tapped with respect to the physical appearance, coloretc., but the fuel basically contain alkanes (higher boiling fraction, straight and branched chain, C1 to C40), cyclo alkanes or napthenes, and aromatic hydrocarbons, oxygen, nitrogen, sulphur and metallic constituents.

Toluene (inhalant drug for its intoxicating properties) will not soluble in water and is a clear having the smell of paint thinners and is used as octane booster. This toluene does not vaporize unless it attains temperature of 70C. Benzene, a hydrocarbon is having an aroma of sweet smell solvent. The other compounds xylenes and ethylbenzene are almost similar to toluene.

In the present study transport, fuel of gasoline is taken as a base fuel. To be more practical to have a clear picture of the extent of adulteration and its consequences on human health fuel samples are taken from the retail outlets, instead of drawing the samples from the Oil refinery. This fuel is blended with the available potential adulterants Naptha, Pentane, Kerosene, Mineral Turpentine Oil, Food Grade Hexane, Benzene, Toluene and analyzed in the portable FTIR machine, IROX Machine, Grabner Instruments, and Austria.

The changes in the observed values to that of the standard are compared. The Bureau of Indian standards vide IS 2796: 2008 for Gasoline specifications are compared with the observed values. The data is also compared with the European standards EN ISO 4529-2006.

Experimental: In India, following tests are performed to detect the fuel adulteration

Materials, samples : Commercially available Gasoline at retail outlets, Hexane, Mineral Turpentine Oil, Superior Kerosene, Fourier Transformation Infra Red machine. These samples are tested in the Legal Metrology State Government laboratories at Hyderabad, Telangana State, India.

Use of marker: blue dye and furfural. These markers shall have the properties of, miscible with fuels, Detectable by simple test procedures, Difficult to remove from marked fuels, Non-reactive with other fuel additives, No interaction with material of construction and fuel impurities, and should be cost effective. If any blend is used the color of the product will change.

Checking the density: The retail dealer of the petroleum products check the density of the fuel to be sold on day today basis. This is recorded in the register maintained at the retail outlet. The density of the fuel is converted to the standard 15C with the help of the ASTM chart. At time of the inspection, again the sample is drawn from the outlet. The value is converted to standard 15C. The difference of these if it is exceeding the permissible limit of +0.0030, it is considered as adultered.

Stock Verification: The amount fuel stored in the underground tank is considered for calculation. If the variation in underground tank is beyond normal operation level of 4%, it is not permitted. Evaporation/Handling Loses for Gasoline - 0.75% on annual average sales of 0-600 Kiloliters.

The Gas Chromatographer is normally used as a best tool for detecting hydrocarbon-based adulteration. The original Gas Chromatographer Finger prints (chromatogram) of the pure fuel are taken as standard and are compared with the adultered samples. The deviation from the original fuel is considered as an extent of adulteration.

Spectroscopic analysis utilizes light of changing wavelengths to distinguish and measure the individual chemicals in fuel sample, which have distinctive structures that absorb specific wavelengths of light in the mid infrared and near Infrared spectral regions. (Eg: IR pf Aromatics 600 – 900 wavenumbers and cetane improver at 1635 wavenumber). Spectroscopic partitions permit the characterization and quantification of the chemicals. Respective aromatic compound can be predicted and quantified, even when very small concentration changes exist.

In all the data collected is trained in the computational techniques and it is found that the values are more consistent with the base values. This is an effective tool for finding the adulteration for any volume of blend used. Normally the Octane number gives the value of fuel rating (Anti Knock quality). The octane number is equal to the percentage, by volume, of iso-octane in a mixture of iso-octane(C_8H_{18}) [100-Octane number] and normal heptane (C_7H_{18}) [0-Octane number]. With the addition of the anti knock additives like MMT- Methylcyclopentadienyl manganese tricarbonyl (MMT- levels up to 18 mg Mn/l), MMT is normally used in place of tetraethyl lead which is safer for health. Other are Methy Terrabutyle ethers MTBE, Ethyl Terrabutyle ethers ETBE in substitute for TEL. Pentacarbonyl- anti-knock agent in petrol in place of tetraethyllead, ferrocene and methyl cyclopentadienyl manganese tricarbonyl. Iron pentacarbonyl is a sturdy flame speed inhibitior in oxygen based flames. Tri methyl pentane (isooctane) is an octane isomer which defines the 100 point on the octane rating scale (0 is n-Heptane), which is an important component of gasoline. The deposits in the engine cylinder or other parts of the engine lead scavengers like Tricresyl phosphate, 1,2-Dibromoethane, 1,2-Dichloroethane are added to the gasoline. Present automobile vehicles are run on 87 octane.

Octane index: This gives the octane quality. The higher the octane index, the better is the anti-knock quality of the fuel. (RON+MON)/2. SAE Paper 2001-01-3584 [11].

The PLS-1 multivariate method can be could be utilized for detecting the adulteration in Gasoline. Though the volume of adulteration is enhanced up to 50% by volume there is no appreciable change in the values of adulteration even the distillation curves did not make out the characterize adulteration [13].

The original Gasoline if adultered with the Kerosene the levels of the carbon monoxide (CO) increased ranging 21.7 - 53%, un burnt hydrocarbon (HC) ranging 23.4 - 57.1% and particulate matter (PM) 2.4 -8.2% . it is also noticed the enhanced specific fuel consumption (SFC) due to fuel adulteration.

The effect of kerosene adultered with the Diesel fuel in the intervals of 5% increment is carried out per the test procedure ISO 8178-D2. The mixture has shown appreciable decrease in the viscosity, density and lubricity also the wear problems in sensitive fuel-injection pumps and fuel-injector designs. The 5% blend performed better emission characteristics than the other blends [6].

Distillation curves (ASTM D86) RMSEC (Root Mean Square Error of Calibration) and RMSEP (Root Mean Square Error of Prediction).

RMSEC values obtained were 0.051 and 0.078, and RMSEP values were 0.063 and 0.085 for MON and RON, respectively. This is an efficient tool to predict MON and RON values.

Aromatic hydrocarbons like benzene, toluene, xylenes, isoparaffins, olefins and additives such as ethanol and esters affect the Octane number by way of anti ignition, and conversely the long chains paraffins, and olefins (having more than 4-C atoms are prone to ignition. The Self ignition can lead to more consumption of fuel and increase in air pollution. The mean average of RON and MON give the antiknock index (AKI), ASTM D4814 and the preferred minimum value is 87.0.

Multivariate calibration related with infrared analysis, Gas chromatography may be used to find out physical or chemical features of fuel used. The results of the spectra achieved are compared with the standard reference samples are correlated for multivariate calibration model. The result of this model is used to analyze spectra of unknown samples in order to provide an estimate of the component concentration or value of the characteristic in the unknown sample [14].

Marcio Pozzobon Pedroso, Luiz Antonio Fonseca de Godoy, Ernesto Correa Ferreira, Ronei Jesus Poppi, Fabio, Journal of Chromatography A, 1201 (2008) 176–182 Identification of gasoline adulteration using comprehensive two-dimensional gas chromatography combined to multivariate data processing tectors combined to multi-way calibration methods are dominant tool to explain similar analytical trouble shooting where complex mixtures should be treated as a single analyte. This method is also utilized for fuel associated problems [12].

To improve the Antiknock Index or Pump Octane, the demand for increased octane number in gasoline production to meet the new generation automobile vehicles by making the light straight run (LSR) Isomerisation units reshuffle the molecules from straight chain, low-octane hydrocarbons to branched-chain, highoctane hydrocarbons known as isomers.

The obtained qualitative information of octane numbers which represent the fuel sample can be used in mathematical models by comparing with the standard values [8].

Light aliphatic (Strait or branched) hydrocarbons which are flammable when added to gasoline, tend to increase the life of engine on other hand Heavy aliphatic hydrocarbons increase knock, engine wear. The adulteration with light aliphatic hydrocarbons is difficult and the heavy aliphatic hydrocarbons is simple as these are not present in the basic fuel sample unlike detection of aromatic which is common compounds in gasoline. The hierarchical cluster analysis (data mining and statistics) is established instrument for evaluation and depiction of adulterated gasoline by unlawful mixing of organic solvent.

Adenilton Camilo Silva, José Eduardo Matos Paz, Liliana F.B. Lira Pontes,Sherlan Guimarães Lemos, Márcio José Coelho Pontes, Electrochimica Acta 111 (2013) 160– 164, An electroanalytical method to detect adulteration of ethanol fuel by using multivariate analysis.

The detection of adulteration in hydrated ethyl alcohol fuel samples with ethanol base on easy voltammetric measurements with the help of pattern recognition techniques (with and without variable selection procedures). The LDA/SPA and PLS-DA models gave classification rate of 93% for the prediction set.

Spectroscopic analysis utilizes light of changing wavelengths to distinguish and measure the individual chemicals in fuel sample which have distinctive structures that absorb specific wavelengths of light in the mid infrared and near Infra Red spectral regions. (Eg: IR pf Aromatics 600 – 900 wave numbers and cetane improver at 1635 wave number). Spectroscopic partition permit the characterization and quantification of the chemicals. Respective aromatic compound can be predicted and quantified, even when very small concentration changes exist [5].

In the value of the hydrocarbons present in the fuel sample the colour of the sample change over the period if it is exposed to the atmospheric air. As the gasoline is a volatile product lower petroleum hydrocarbons get evaporated leaving the gums and solids accumulated in the fuel. This may change original properties such as colour, density, distillation range. Indian standard specification for motor gasoline/petrol IS 2796/2000. Normally Orange dyes (Phenyl azo2-naphthol) are added for regular petrol, red dyes are added for premium petrol and green dyes are added for aviation gasoline to distinguish and specify the quality of petrol or type of fuel.

Thus the good quality gasoline must be stable indefinitely if precautions are taken for storing the product such as storing in an airtight container, to prevent oxidation or water vapours mixing, constant temperature also to decrease the container leaking.

Health effects

The Natural initiative for occupational safety and health (NIOSH) specifies that the Ozone (O_3) Guideline value - 100 μg/m^3, 8-hour mean. This was subsequently reduced from 120 μg/m^3 . ("WHO Air Quality Guidelines").

The chemical reaction of the exhaust from automobile may also cause release of ozone. The released Nitric Oxide from the tail pipe of automobile reacts with the sunlight produce ozone.

NO_2+ Sunlight → NO + O.

Ozone is useful at upper strata, which prevent Ultraviolet rays, where as this can cause health problems at ground level.

The highest levels of ozone pollution occur during periods of sunny weather. Some of other tail pipe release gases and their ill effects are as under.

- Hydro Carbon – Dizziness, Headache
- Benzene- Carcinogen, Leukemia Occupational improne limit in air – 0.1ppm
- NOx – Pneumonia, influenza, asthma, chest pain. Exposure to 5 ppm NO_2 after immunization lead to significantly higher levels of serum IgE, BAC, IgG, IgE antibodies. Increased number of inflammatory cells in the lungs and elevated lymphocytes responsive to nitrogen compound to air exposed control rats. [A model of immune – mediated lung disease immunity following exposure. [Source Mathew I Gilman, Mary Joe, Selgrade]

- CO - One gallon MS can cause release of 18 pounds
- Lead - can reduce mental ability, damage blood, nerves, and organs, and raise blood pressure.
- Toxic air pollutants (benzene and formaldehyde) - suspected of causing cancer, genetic mutation, birth defects, or other serious illnesses in people even at relatively low levels. The chemicals can be inhaled directly or carried by small particles (dust or lint) into the lungs.
- Particulate Matter – less rain, cardiovascular
- SO_2 – from power plants, Vehicles
- PAHs Poly aromatic hydro carbons – Incomplete burning of fuel. These are not easily dissolve in water, evaporate in air. The range of PAHs are 0.02-1.2 mg/m3 (Rural) 0.15-19.3 mg/m3 (Urban)
- Catalytic converter – Platinum, palladium, Phoedium, --- Converts hydrocarbons, CO, NOx into less harmful gas.
- Nanoparticle Ds < 50mm ----More dangerous than micro size particles (David B Kittelston, DOI 10.1016/s0021-8502(92)10037-4
- Ultra fine particular as a potential environmental health hazard. [studies on model particles-Gunter, Ling yi Cheng, Robert Gelein, Carl John & James D 150microgram/m3, >45 microgram/m3 lead to pulmonary inflammation response. <50nm acute effects]
- Environmental Effects – Particulate form, Brake, Tyres, Road Wear, Traffic noise, Psychological Stress.

Naturally occurring gases trap some of the sun's heat near the Earth's surface - "greenhouse effect"- help in keep the Earth's temperature stable. European studies have reported that the daily mortality rises by 0.3% and that for heart diseases by 0.4%, per 10 µg/m3 increase in ozone exposure. Exceeded limit of Nitric and sulfuric acids may cause acid rains.

Table1: Few samples of the tail pipe exhaust deposits per annum in the United States and its Ill effects are listed as under:

S.No	Parameter	Emission	Annual Pollution	Remarks
1	Hydro Carbons	1.75g/km	35kg	Dizziness, Headache
2	CO	13.06	261	One gallon MS can cause release of 18 pounds, chronic heart
3	NOx	0.85	17.3	Pneumonia, influenza. asthma, chest pain
4	Particulate Matter, PM 10	48.6%	5.19kg	rain, cardiovascular.
5	Particulate Matter, PM 2.5	36.7%		pulmonary inflammation response
6	CO2	258g/km	5.19kg	greenhouse gas in the atmosphere, causes plants to provide less evaporative cooling

Results and Discussion

There is no such fuel sample which is said to be pure. This fact is universally conceded even at the refineries. As most of the commuters take the automobile fuel at retail outlets, the experiments are based on the real environment. Hence the commercially available Gasoline sample is doped with the similar hydrocarbon solvents of Superior Kerosene, Mineral Turpentine oil, Hexane. The original sample is gradually added dopants to the extent of 50 %. At every stage of doping the original gasoline sample with the above adulterants the samples are subjected to the FTIR spectroscopy. The observations and values are noted. These values are compared with the Indian Standards specified. In some cases the value differed due to the exposure of original gasoline to the environmental conditions. 4.2 The Gasoline is a volatile fuel. The exposure to the environment may result in the evaporation of lower hydrocarbons leaving sediments. We can also see the perceptible change in colour of the Gasoline. The no doping stage values can also be analyzed with the specifications. This is due to the addition of aromatic compounds to the Gasoline in order to boost the Octane number. The Government of India has adopted specifications in consonance with the modified specifications which are adopted internationally. The specifications are from Bharat stage-III to Bharat stage-IV. This has prompted to increase the octane number.

The binary code ie, 0, 1 is taken to evaluate the result. "0" stands for the sample that is within the specifications prescribed by the Bureau of Indian Standards. The "1" is for the sample which is beyond the specifications of Bureau of Indian Standards for Gasoline fuel.

The steady addition of adulterant Hexane into the base fuel did not give perceptible variation in the parameters of Olifins, MON, RON by volume but has increased values of Density, Benzene, Oxygen, Aromatics, Final Boiling Point, Vapour Pressure.

The periodical addition of adulterant Kerosene into the base fuel did not give perceptible variation in the parameters of MON, RON, Oxygen, Aromatics, Final Boiling Point, Vapour Pressure, by volume but has increased values of Density, olifins and that for mass the parameters MON, RON has beyond specifications.

In the case of Mineral turpentine oil the parameters of MON, RON did not effect at increased doping. Whe compared by volume except Oxygen, MON, RON values other parameters Density, Benzene, Oxygen, Aromatics, Final Boiling Point, and Vapour Pressure are beyond the specifications.

Alternatively every sample is subjected to the boiling. This causes the fuel to evaporate. The Initial Boiling, Final Boiling point and the extent of recovery, of the sample is noted. In all cases the recovery for the adultered samples is taken as one of the crucial parameter for determining the adulteration by the Bureau of Indian Standards. If 80% of the recovery of the sample exceeds the final boiling point the sample is said to be adultered. The increase in the Final Boiling point from the specified ranges show the sample is adultered.

Table 2: Gasoline doped wit Hexane
Result analysis of Gasoline doped with the Hexene Up to 1:1.9% Volume

		% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol
	Concentration	20 ml:0ml	20ml:01ml	20ml:02ml	20ml:03ml	20ml:04ml	20ml:05ml	20ml:06ml	20ml:07ml	20ml:08ml	20ml:09ml	20ml:10ml	20ml:11ml	20ml:12ml	20ml:12ml	20ml:13ml	20ml:14ml	20ml:15ml	20ml:16ml	20ml:17ml	20ml:18ml	20ml:19ml	20ml:20ml	20ml:21m
S.No	Parameter	b	b.1	b.2	b.3	b.4	b.5	b.6	b.7	b.8	b.9	b.10	b.11	b.12	b.13	b.14	b.15	b.16	b.17	b.18	b.19	b.20	b.21	b.22
1	Density	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	Benzene	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
3	Oxygen	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	Aromatics	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
5	Olefins	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	MON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	RON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	FBP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	VP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

		% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	%mass
	Concentration	20 ml:0ml	20ml:01ml	20ml:02ml	20ml:03ml	20ml:04ml	20ml:05ml	20ml:06ml	20ml:07ml	20ml:08ml	20ml:09ml	20ml:10ml	20ml:11ml	20ml:12ml	20ml:12ml	20ml:13ml	20ml:14ml	20ml:15ml	20ml:16ml	20ml:17ml	20ml:18ml	20ml:19ml	20ml:20ml	20ml:21m
S.NO	Parameter	a	a.1	a.2	a.3	a.4	a.5	a.6	a.7	a.8	a.9	a.10	a.11	a.12	a.13	a.14	a.15	a.16	a.17	a.18	a.19	a.20	a.21	a.22
1	Density	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	Benzene	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Oxygen	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	Aromatics	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Olefins	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	MON	0	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	RON	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	FBP	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
9	VP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3: Gasoline doped with Kerosene
Result analysis of Gasoline doped with the Superior Kerosene Oil upto 50% Volume

		% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass
Concentration		20 ml:0ml	20ml:01ml	20ml:02ml	20ml:03ml	20ml:04ml	20ml:05ml	20ml:06ml	20ml:07ml	20ml:08ml	20ml:09ml	20ml:10ml	20ml:11ml	20ml:12ml	20ml:13ml
S.no		b	b.1	b.2	b.3	b.4	b.5	b.6	b.7	b.8	b.9	b.10	b.11	b.12	b.13
1	Density	0	1	1	0	0	1	0	0	0	1	1	1	1	1
2	Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Oxygen	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Aromatics	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Olefins	1	1	0	1	1	1	1	1	1	1	1	1	1	1
6	MON	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	RON	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	FBP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	VP	0	0	0	0	0	0	0	0	0	0	0	0	0	0

		% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol
Concentration		20 ml:0ml	20ml:01ml	20ml:02ml	20ml:03ml	20ml:04ml	20ml:05ml	20ml:06ml	20ml:07ml	20ml:08ml	20ml:09ml	20ml:10ml	20ml:11ml	20ml:12ml	20ml:13ml
S.No	Volume	a	a.1	a.2	a.3	a.4	a.5	a.6	a.7	a.8	a.9	a.10	a.11	a.12	a.13
1	Density	0	1	1	0	0	1	0	0	0	1	1	1	1	1
2	Benzene	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	Oxygen	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Aromatics	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	Olefins	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	MON	1	1	1	1	1	1	1	1	1	1	1	1	1	1
7	RON	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	FBP	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	VP	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 4: Gasolene doped with Turpentine

Result analysis of Gasoline doped with the Mineral Turpentine Oil Upto 40% Volume

		% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass	% mass
	Concentra	20 ml:0ml	20ml:01ml	20ml:02ml	20ml:03ml	20ml:03ml	20ml:04ml	20ml:05ml	20ml:06ml	20ml:08ml	20ml:09ml	20ml:10ml	20ml:10ml	20ml:11ml	20ml:12ml	20ml:13ml
S.no	paramete	b	b.1	b.2	b.3	b.4	b.5	b.6	b.7	b.8	b.9	b.10	b.11	b.12	b.13	b.14
1	Density	0	1	1	0	0	1	1	0	0	0	1	1	1	1	1
2	Benzene	0	1	0	0	0	1	0	1	0	1	1	1	1	1	1
3	Oxygen	1	1	1	0	0	1	1	1	0	1	1	1	1	1	1
4	Aromatics	0	1	1	0	0	1	1	1	0	1	1	1	1	1	1
5	Olefins	0	1	1	0	0	1	1	1	0	1	1	1	1	1	1
6	MON	1	1	0	1	1	0	0	0	1	0	0	0	0	0	0
7	RON	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0
8	FBP	0	0	0	0	0	1	1	1	0	1	1	1	1	1	1
9	VP	0	0	0	0	0	1	1	1	0	1	1	1	1	1	1
		% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol	% Vol
	Concentra	20 ml:0ml	20ml:01ml	20ml:02ml	20ml:03ml	20ml:03ml	20ml:04ml	20ml:05ml	20ml:06ml	20ml:08ml	20ml:09ml	20ml:10ml	20ml:10ml	20ml:11ml	20ml:12ml	20ml:13ml
s.No	paramete	a	a.1	a.2	a.3	a.4	a.5	a.6	a.7	a.8	a.9	a.10	a.11	a.12	a.13	a.14
1	Density	0	1	1	0	0	1	1	0	0	0	1	1	1	1	1
2	Benzene	0	1	0	0	0	1	0	1	1	1	1	1	1	1	1
3	Oxygen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	Aromatics	0	1	1	0	0	1	1	1	0	1	1	1	1	1	1
5	Olefins	0	1	1	0	0	1	1	1	1	1	1	1	1	1	1
6	MON	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	RON	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0
8	FBP	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1
9	VP	0	1	1	0	0	1	1	0	1	1	1	1	1	1	1

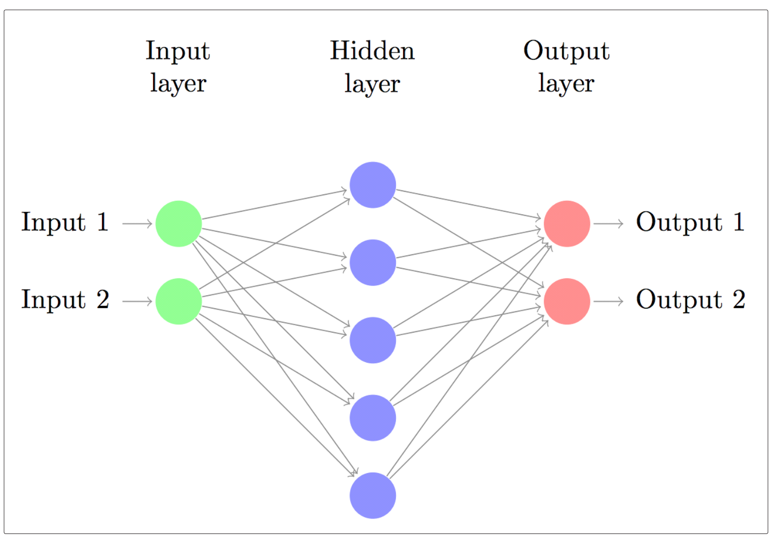

Figure 1: In machine learning the artificial neural networks algorithms we can detect the impurities in the fuels. An example MLP

A Multi-Layer Perceptron Network

The input to a neuron n_{ij}, also known as the "net" denoted ν_{ij}, is the weighted sum of all incoming edges plus an optional bias. Its output $f_i(\nu_{ij}) = o_{ij}$ is computed by applying the i-th layer's activation function f_i to ν_{ij}. By arranging the weights of each layer into a matrices , the output of the i-th layer of a MLP can be computed as:

$$\mathbf{o}_i = f_i(\boldsymbol{\nu}_i) = f_i(\mathbf{W}_i^T \mathbf{o}_{i-1} + \mathbf{b}_i) \,.$$

where $\boldsymbol{\nu}_i$ is vector of nets of the i-th layer, $\mathbf{W}_i$ is the weight matrix of the i-th layer, $\mathbf{b}_i$ is the bias vector of the i-th layer , and $f_i(\mathbf{x})$ is the activation function for the i-th layer. The activation function is applied component-wise to the resulting vector; $tanh$ and the sigmoid function are commonly used. In a network with $n+1$ layers, the final output $\hat{\mathbf{y}}$ given an input $\mathbf{x}$ can be defined as:

$$\hat{\mathbf{y}} = \mathbf{o}_n$$

$$\mathbf{o}_i = f_i(\mathbf{W}_i^T \mathbf{o}_{i-1} + \mathbf{b}_i)$$

$$\mathbf{o}_0 = \mathbf{x} \,.$$

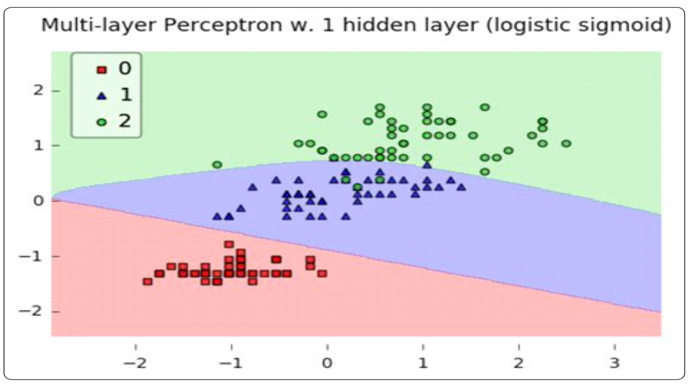

Figure 2: In the above figure Multi-layer Perceptron with hidden ayer shows the data in different phases with predicted points.

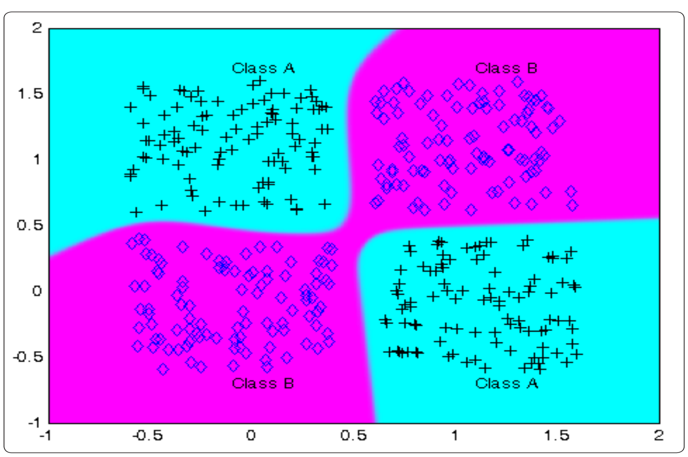

Figure 3: The above figure shows that data in different classes variations with the predicted values

Conclusion

By training the machine the Gasoline adulteration at any stage can be analyses more accurately with the help of Artificial Neural Networks which is a perfect mechanism both at laboratory level as well as at statutory level than any other existing methods. The important parameters of Density, RON, MON, Final Boiling Point change be perceived at every stages of samples. Due to specifying more tolerance limits the statute has given long rope to the persons who are involved in the illegal practice of blending the similar composition hydro carbons to the base fuel. Initially the addition of olifins, aromatic compounds may boost octane number but an increased value is more prone for air pollution. Another reason for tail pipe exhaust pollution is the addition of scavenging agents like lubricants to the base fuel.

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The topic have mainly focused on the environmental pollution and emission of toxic gases in the atmosphere with the increased utilization of the petroleum based fuels beside other, which has been the topic in the twenty-first session of the conference of the parties (COP) and the eleventh session of the conference of the parties serving as the meeting of the parties to the Kyoto Protocol (CMP) will take place from 30 November to 11 December, 2015, in Paris, France. Climate change conference, Paris, Nov'2015.

Author's contributions

Conceived the plan by taking the spirit of the economic survey in India causing air pollution due to adulteration of transport fuels. The material and equipment is taken from the Laboratories situated in the State Government statutory enforcing Legal Metrology laboratory, VFSTR, Vignan University under the constant guidance of the Dr.M.Ramakrishna. The experiments are performed with the help of Statutory Enforcing department Officials of Legal Metrology, of Telangana State, Public sector Oil Companies like

Bharat Petroleum Corporation, Indian Oil Corporation, Hindustan Petroleum Corporation, India. The Data is analysed by the authors. Authors have no competing financial interests.

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