OpenCV libraries for Benzene Image Processing Applications using Python Programming

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***Abstract:** Adulteration of Fuel is common feature among the trading community to get easy profits. Low cost similar boiling point range hydrocarbons, having alike composition are added as additives leading to modification and creates low quality when compared. to the base fuels. The existing methods of the addition of colours to the base fuels are a primitive method as the decolourant can be added to neutralize the colour of the end product. This paper will give the method of detecting the blending of fuel through image processing a better method. to the base fuels. The existing methods of the addition of colours to the base fuels are a primitive method as the decolourant can be added to neutralize the colour of the end product. This paper will give the method of detecting the blending of fuel through image processing a better method.*

***Keywords** : OpenCV, Benzene, Gasoline, Image processing, Python programming*

I. INTRODUCTION

In this Paper image data is used for different image processing application by utilizing various tools and methods that technology supporting the python programming is explored, image is represented 2D (2-dimensional Data) to transform the data into system readable form as matrix, by capturing each pixel information with the help of image processing techniques provide in the required information to the system. OpenCV is another open source computer vision tool that helps to extract the required information from the image data, as video is also a stream of images hence recognition of images in the video and little focused on real-time applications of fuel adulterants detection by using the color and shape identification are discussed.

1.1 Image Processing

This is a technique to convert the image to that of Digital form, to carry out operations on it so as to get a better image or to mine helpful information out of it. It can be processed through importing the image, Data compression and Analyzing the image. The other similar pattern recognition include "facial recognition, Application based on Biometric Artificial Intelligence (facial textures and shape) [1].

The accuracy of the facial recognition system as biometric technology is lower than iris recognition and fingerprint recognition; other applications consist of advanced human-computer interaction, video surveillance, automatic indexing of images, and video database, among others. Emotion recognition is the process of identifying human emotion, most typically from facial expressions as well as from verbal expressions, a development of computational methodologies [2]. The person walking and his face can be detected. Object detection has applications in many areas of computer vision, including image retrieval and video surveillance [3].

The "notebook" term can colloquially refer to many different thing, mainly the Jupyter web application, Jupyter Python web server, or Jupyter document format based on the context[6]. A Jupyter Notebook document is a JSON document, following a versioned schema, and containing an ordered list of input/output cells that can contain code, text (using Markdown), mathematics, plots, and rich media, usually ending with the ".ipynb" extension. There is no proper system to detect the face recognition, emotions detection Object identification and Fuel adulteration [7] [8].

Advantages of the Proposed System: Increased Security: **Fast and Accurate**: **No Contact**:

System Architecture, System Requirements, data flow diagrams and UML diagrams, the image processing applications and various algorithms used in image processing like Hough circle transform, Canny edge detection algorithm are given under.

Table 2.1: Review on OpenCV methods for image processing by various authors in chronological order from 2010 to 2016

S.No	Concept of the research article	Authors	Year of publication
1	3D Facial Landmark Detection & Face Registration	Panagiotis Perakis ,Georgios Passalis, TheoharisTheoharis, and Ioannis A. Kakadiaris	Jan - 2010
2	Learning to Detect a Salient Object	Tie Liu, Zejian Yuan, Jingdong Wang, Nanning Zheng, Xiaoou Tang & Heung - Yeung Shum	Mar – 2010

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3	Vehicle Detection Using Partial Least Squares	Aniruddha Kembhavi , David Harwood & Larry S. Davis	Oct - 2010
4	Face Detection and Tracking using OpenCV	S.V. Viraktamath, Mukund Katti & Aditya Khatawkar	Aug – 2013
5	Fuel Adulteration Detection System	V. Jersha Felix, Purohitam Adithya Udaykiran and K.Ganesan	Jan -2015
6	PCA Based Face Recognition and Facial Expression Identification System	B. Nagarjuna Singh, P. Pradeep	July-2015
7	Facial expression recognition	Jyoti Kumari, R.Rajesha & KM.Pooja	Aug -2015
8	Human Emotion classification based on Eyes and Mouth using Susan Edges	Dileep M R, AjitDanti	July - 2016

II. PARTIAL LEAST SQUARES APPLICATION IN DETECTION OF VEHICLE:

An object detection method using colour probability maps to capture the colour statistics of vehicles and their environs. Partial Least Squares (PLS) to project the data onto a much lower dimensional subspace was the method highlighted and used. The MLP based object tracking system is made robust by an optimum selection of unique features and by implementing the AdaBoost strong classification method [9].

2.1 Fuel adulteration

As on now, various statutory agencies are concerned with the early, quick and reliable methods in the detection of fuel adulteration. The oil companies are also adopting physical methods of adding colour to the solvent such as kerosene with furfural (blue), adding aroma to the LPG for finding the detection of Gas, etc. Added to these methods we found that the application of Image processing is more reliable than existing methods adopted by various agencies.

Therefore, an attempt is made to detect the physical difference in adulteration made in the transport fuel gasoline. There are many blends available in the market which are the similar composition of hydrocarbons such as Naphtha, kerosene, Benzene, Hexane, Mineral turpentine oil, etc. which can easily miscible to the base fuel gasoline. Now on an experimental basis, the benzene sample is taken as a blend to the base fuel of gasoline and analysed, compared with the existing statistical methods [13].

As a result of adulteration, these fuels become impure and not suitable for usage in Internal Combustion Engines. Adulteration of transport fuel, which is currently a very flourishing business in our country, can lead to economic losses, increased emissions and deteriorated performance so also the parts of engines. Adulteration of fuel can cause health problems directly if inhaled by human beings through tailpipe emissions such as carcinogenic diseases. Fuel adulteration cause a marked consequence on the tailpipe release of vehicles, as adulterants change the chemistry of the base fuel exposé its quality substandard to the required fuel quality for the vehicles. This, sequentially, affects the combustion dynamics inside the combustion chamber of vehicles escalating the emissions of injurious pollutants significantly [13].

OpenCV-Python is a Python wrapper for the OpenCV C++ execution. All the OpenCV array structures are transformed to and from numpy arrays. This also makes it easier to join together with other libraries that use Numpy such as SciPy and Matplotlib. OpenCV now supports a multitude of algorithms connected to Computer Vision and Machine Learning [5] and is growing day by day. OpenCV supports a broad range of programming languages such as C++, Python, Java, etc., and is accessible on diverse platforms as well as Windows, Linux, OS X, Android, and iOS.

The image processing technique using OpenCV python is found to be one of the best techniques to detect fuel adulteration on experimental bases, such as benzene sample is taken as blend to the base fuel of gasoline and analyzed and compared with the existing statistical methods in which all experimental images with concatenation of Gasoline with Benzene up to 100 trails. Entire experiment 1200 images we have taken and that 1200 images separated into the 100 folders to process. By using Python Program from each folder, we take an average image in one folder like all the folders 100 images will be stored in the one Folder names Average. In python code for the Average of the image and it will cut the pic to circle using the Hough circle Transformation algorithm**.** After collected the all 100 average images then apply the detection process using the OpenCV Python code

The hydrocarbon fractions of the gasoline or Diesel can be detected at the in-situ with the application of the Internet of Things and can be accessed through the remote and data can be perceived through the smart phone. This will help in finding the tailpipe exhaust, pollutants released into the air. The use of cheaper fuels in the transport field is causing more concern with respect to the health hazard. If the exhaust gas elements/composition is detected in advance, environmental pollution can be contained to the limiting factors. This will help is limit global warming so also the carcinogenic diseases, the health hazard in a long way [7]. So, to identify the fuel adulteration in the fuels we are using Python OpenCV Libraries for image processing in this project. Disadvantages of the existing system are soaring execution Costs: Data Storage: vary in Appearance and Camera Angle:

III. FUEL ADULTERATION DETECTION SYSTEM:

Fuel adulteration detection can be made with the level detection technique system using image processing. [10].

3.1 Levels of Abstractions

Architecture is a coherent set of concepts for a structure, Conceptual Level, Logical Level, Physical Level, Implementation Level.

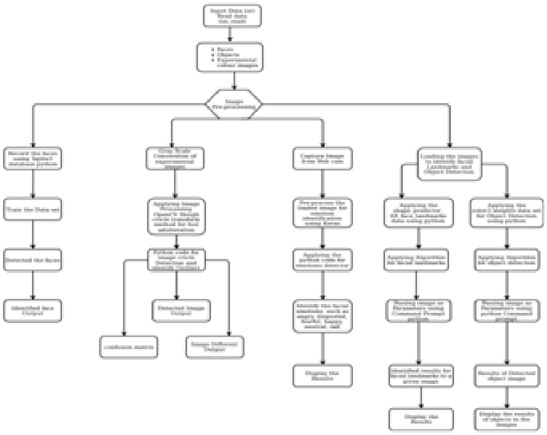


Figure 3.1: Architecture diagram for exploring OpenCV libraries for image processing application using python programming

1. The DFD, a graphical technique that represent information flow and the change that are applied as data moves from input to output.

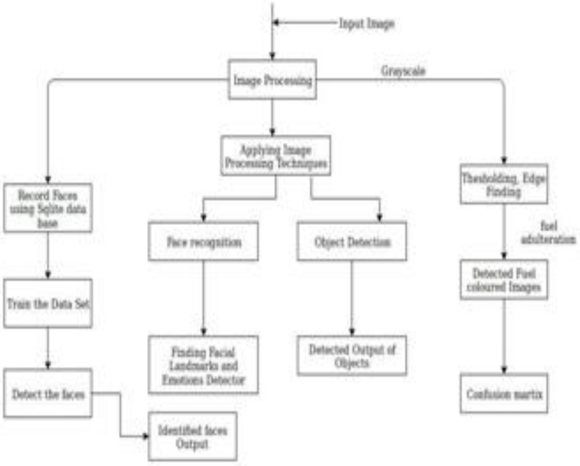

Input Image
Image Processing
Grayscale
Applying Image Processing Techniques
Thesholding, Edge Finding
Record Faces using Sqlite data base
Face recognition
Object Detection
fuel adulteration
Detected Fuel coloured Images
Train the Data Set
Finding Facial Landmarks and Emotions Detector
Detected Output of Objects
Confusion martix
Detect the faces
Identified faces Output

Figure.3.2: DFD diagram for exploring OpenCV libraries for image processing application using python programming

Unified Modeling Language a standardized general-purpose modeling language in the field of object-oriented software engineering to become a common language for creating models of object-oriented computer software, Meta-model and a notation.

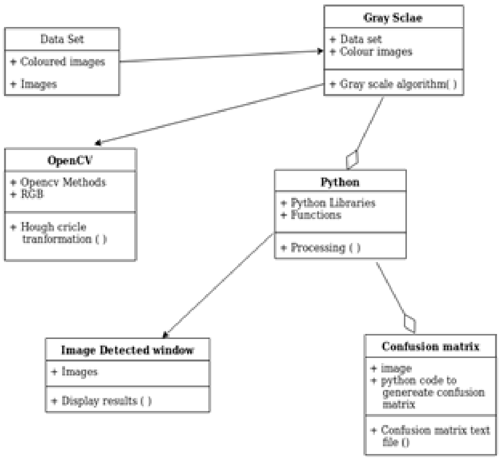
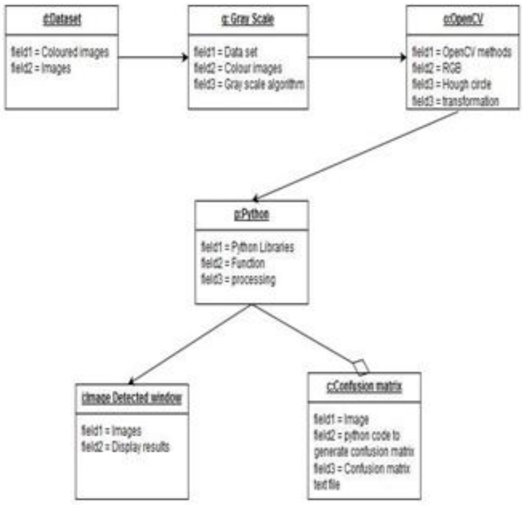


Figure.3.3: Class diagram for fuel adulteration detection using image processing



3.4: Figure.3.4:: Object diagram for fuel adulteration detection using image processing

3.3.3. Use Case Diagram

A use case diagram at its simplest is a depiction of a user's dealings with the system that shows the relationship between the user and the different use cases in which the user is involved [11]. A use case diagram can identify the different types of users of a system and the different use cases and will often be

accompanied by other types of diagrams as well. The use Cases are represented either circle or ellipse

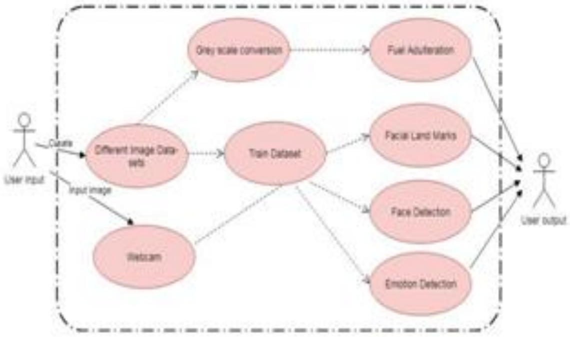


Figure 3.5: use case diagram for image processing

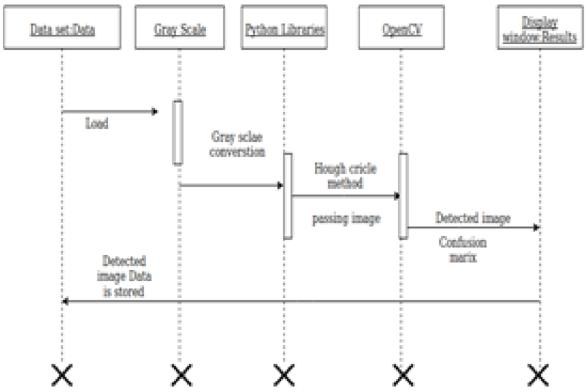


Figure 3.6: Sequence diagram for fuel adulteration detection using image processing technique

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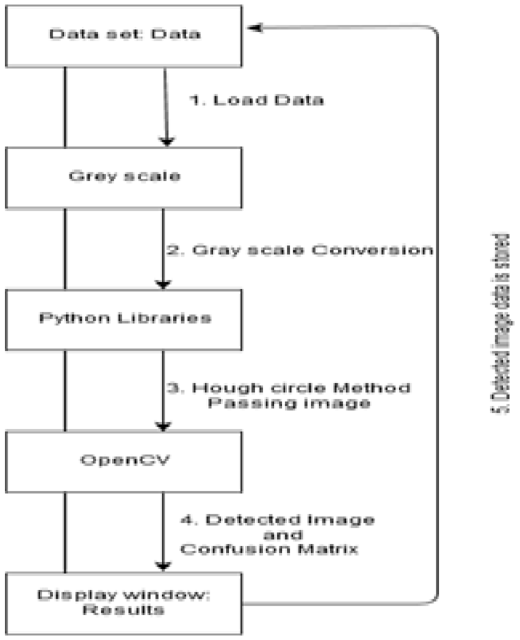

Data set: Data
1. Load Data
Grey scale
2. Gray scale Conversion
Python Libraries
3. Hough circle Method Passing image
OpenCV
4. Detected image and Confusion Matrix
Display window: Results
5. Detected image data is stored

Figure 3.7: Collaboration diagram for fuel adulteration detection using image processing

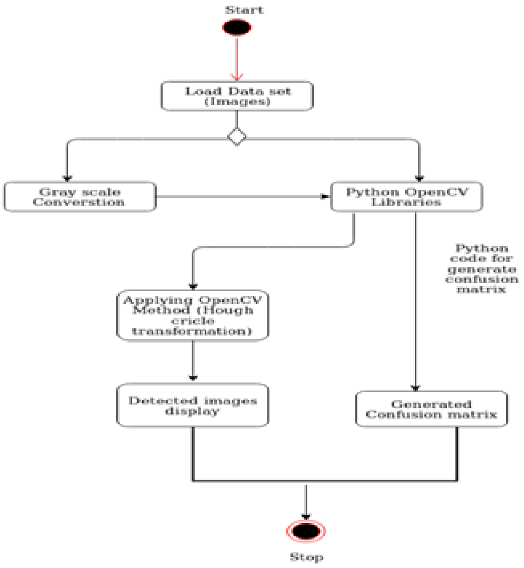

Start
Load Data set (Images)
Gray scale Converstion
Python OpenCV Libraries
Python code for generate confusion matrix
Applying OpenCV Method (Hough cricle transformation)
Detected images display
Generated Confusion matrix
Stop

Figure 3.8 :Activity diagram for fuel adulteration detection using image processing

The purpose of image processing is divided into, Visualization, Image sharpening and restoration, Image retrieval, Measurement of pattern, Image Recognition.

Raw data from imaging sensors contains deficiencies. It must undergo Pre- processing, enhancement and display, information extraction of processing.

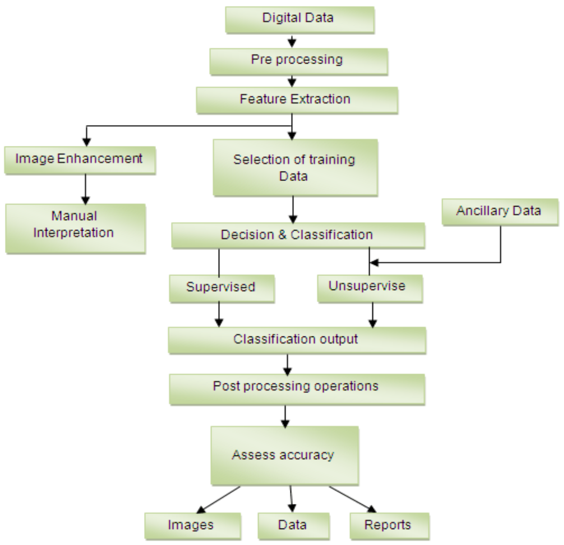


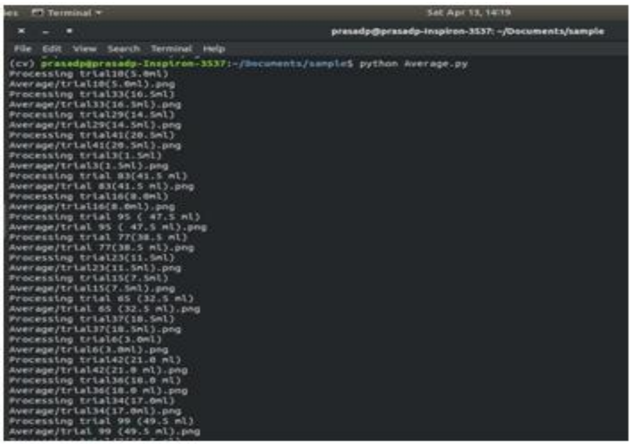
Figure 3.9: flow chart showing different phases in digital image processing [12]

IV. IMPLEATION

4.1 Detection of fuel adulteration though Image Processing OpenCV Python

Images are taken in burst mode of a camera. The photographs are of different concentrations of Benzene in Petrol. The task is to find out whether we can get any change with respect to the images pertaining to the concentrations of the Motor Spirit (Gasoline) with the image processing. The Photographs were made into folders according to the concentration of the fluids. The concentration varies from 0ml to 50ml with increments of 0.5 ml in the original sample of Gasoline which is maintained at 50ml. The samples to the tune of 100 iterations are collected and their images are taken. Total of 1200 images are collected @ 12 in each concentration. The concentration has reached till the attainment of 1:1 ratio i.e., Petrol and Benzene.

All the Photographs taken from a folder and to each image, the Hough Circle trans-formation method is applied using OpenCV Python to detect the Petri dish and to reduce the boundaries of the image to only the Petri dish. Then the image was resized to a standard format of 300x300 pixel. The average of these images is calculated, which was stored in a folder called Average. Each 'n' ml Photograph in that folder corresponds to average of the Photographs in the 'n' ml folder. Using Average.py python file average Photographs will be stored in that folder. To run the Average.py though the command prompt use python Average.py execution we be show in the figure. 4.1


Terminal
Sat Apr 13, 14:19
prasadp@prasadp-Inspiron-3537: ~/Documents/sample
File Edit View Search Terminal Help

```
(cv) prasadp@prasadp-Inspiron-3537:~/Documents/sample$ python Average.py
Processing trial10(5.0ml)
Average/trial10(5.0ml).png
Processing trial33(16.5ml)
Average/trial33(16.5ml).png
Processing trial29(14.5ml)
Average/trial29(14.5ml).png
Processing trial41(20.5ml)
Average/trial41(20.5ml).png
Processing trial3(1.5ml)
Average/trial3(1.5ml).png
Processing trial 83(41.5 ml)
Average/trial 83(41.5 ml).png
Processing trial16(8.0ml)
Average/trial16(8.0ml).png
Processing trial 95 ( 47.5 ml)
Average/trial 95 ( 47.5 ml).png
Processing trial 77(38.5 ml)
Average/trial 77(38.5 ml).png
Processing trial23(11.5ml)
Average/trial23(11.5ml).png
Processing trial15(7.5ml)
Average/trial15(7.5ml).png
Processing trial 65 (32.5 ml)
Average/trial 65 (32.5 ml).png
Processing trial37(18.5ml)
Average/trial37(18.5ml).png
Processing trial6(3.0ml)
Average/trial6(3.0ml).png
Processing trial42(21.0 ml)
Average/trial42(21.0 ml).png
Processing trial36(18.0 ml)
Average/trial36(18.0 ml).png
Processing trial34(17.0ml)
Average/trial34(17.0ml).png
Processing trial 99 (49.5 ml)
Average/trial 99 (49.5 ml).png
```

Figure 4.1: Execution of average python file in each flooder from the command prompt

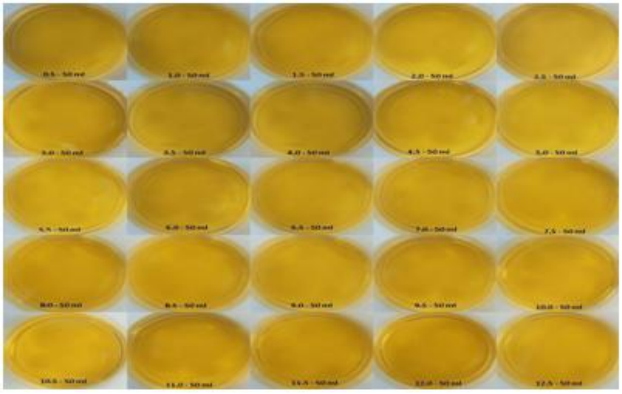


Figure 5.2: Photographs of Concentration of Gasoline (Motor sprit) with Benzene trails 1-25 i.e.., 0.5 ml each trail

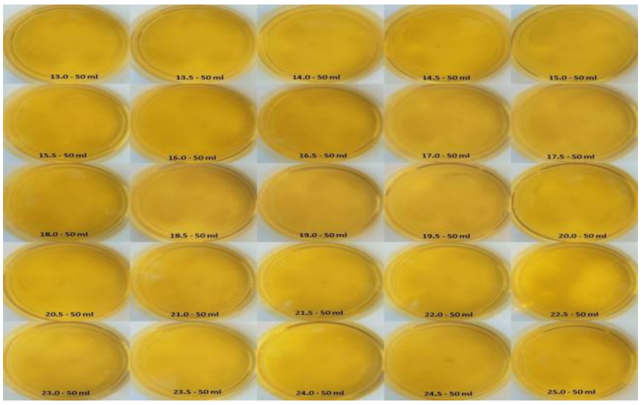


Figure 4.3: Photographs of Concentration of Gasoline(Motor sprit) with Benzene trails 26-50 i.e.., 0.5 ml each trail.

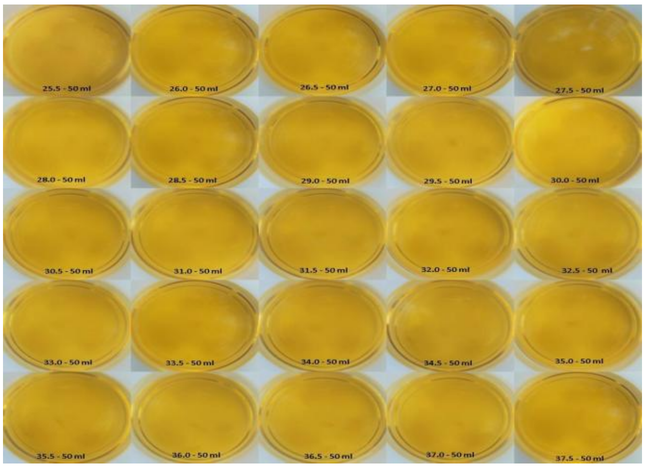


Figure 4.4: Photographs of Concentration of Gasoline(Motor sprit) with Benzene trails 50-75 i.e.., 0.5 ml each trail

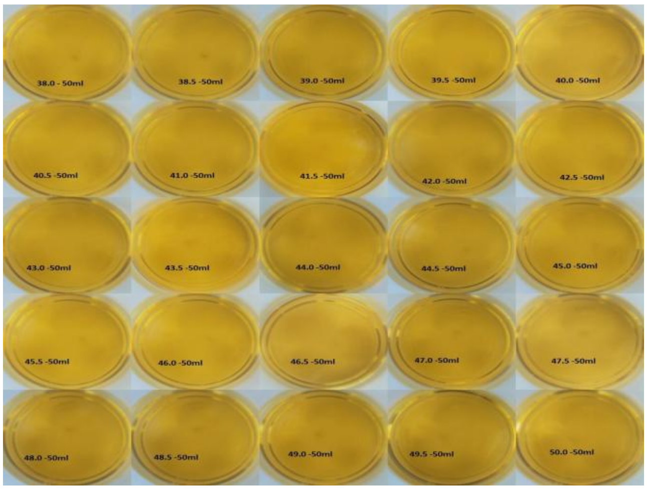


Figure .5.5: Photographs of Concentration of Gasoline (Motor sprit) with Benzene trails 76-100 i.e., 0.5 ml each trail

In the last step, we took the images from the Average folder as input. Each one was converted to grayscale and a sharpening mask was applied to increase the variation in detail so that the changes in the liquid are visible more clearly. Then the pixel intensity range of 185-255 was isolated. This creates a confusion matrix of the same size. The image is having 0's and 1's only, where pixels are in the range. The bitwise-and operation is applied between the mask and the grayscale image to be able to clearly visualize the changes between images. The output was written into a folder called Difference. Each image contains two parts; i.e., the left original image with the concentration of 'n' ml is on left side and the detected particles image is on the right side. The pixel value for each processed image was also written into a text file for each concentration using Difference.py python file.

V. RESULTS

5.1 Module 1 (Detection of fuel adulteration)

As we discussed in the chapter 4 detection of fuel adulteration using OpenCV Python, in which all experimental images with a concatenation of Gasoline with Benzene up to 100 trails. Entire experiment 1200 images we taken and that 1200 images separated into the 100 folders to process. By using Python Program from each folder, we tack average image in one folder like all the folders 100 images will be stored in the one Folder names Average. In python code for Average of the image and it will cut the picture to circle using the Hough circle Transformation algorithm. After collecting all 100 average images then apply the detection process using the OpenCV Python code. The experimental results are shown in Fig. No. 5.1.

Case 1:- Trail 30th with 15.0 : 50 ml of concatenation Gasoline with Benzene

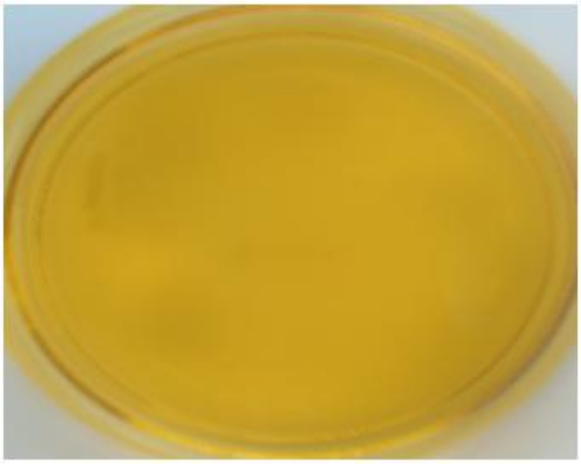


Figure 5.1: Experimental coloured image of trail 30th i.e.., concatenation of Benzene in Gasoline.

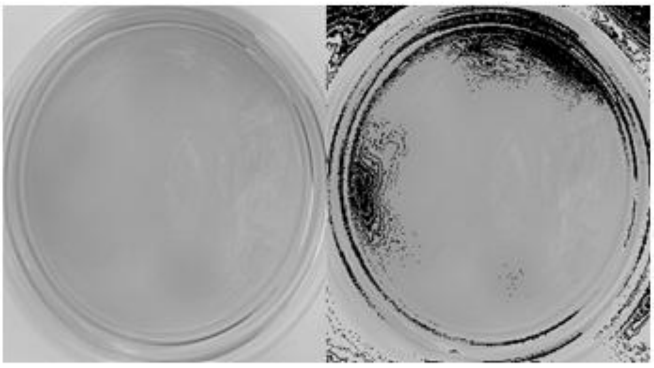


Figure 5.2: Output of trail 30th with comparison of original coloured image on left side i.e.., grey scale image, detection image will on the right side, some adulteration is observed.

Case 2:- Trail 70th with 35.0 : 50 ml of concatenation Gasoline with Benzene

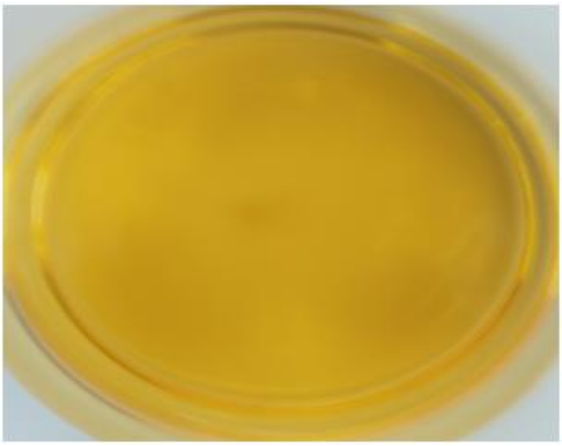


Figure 5.3 : Experimental coloured image of trail 70th i.e.., concatenation of Benzene in Gasoline

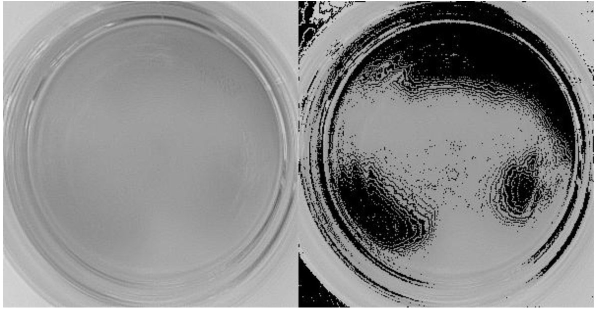


Figure 5.4 : Output of trail 70th with comparison of original coloured image on left side i.e., grey scale image, detection image will on the right side, some adulteration is observed

Case 3:- Trail 100th with 50 : 50 ml of concatenation Gasoline with Benzene

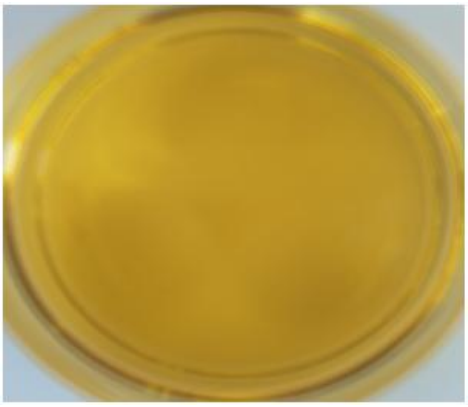


Figure 5.5: Experimental coloured image of trail 100th i.e., concatenation of Benzene in Gasoline

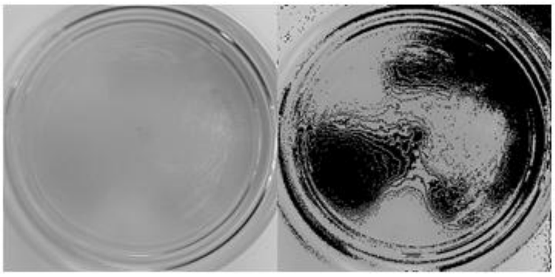


Figure 5.6 :Output of trail 100th with comparison of original coloured image on left side i.e., grey scale image, detection image will on the right side, adulteration is observed

VI. RESULTS AND DISCUSSION

There is no substantial change in the image obtained initially. The change can be observed with the gradual increase of concentration. At the concentration of visibility at the ratio of 3:5 there is appreciable change in the image. The dissolved particles can be seen thereafter in the images processed with the increase in concentration of Benzene in the original sample of Gasoline.

The experiments found the Accuracy percentage of object detection is very high in pixel images.

VII. CONCLUSION

The Open CV libraries for pre-processing the input image data and develop model by learning the extracted features from the pre-processing methods to detect the faces from captured images, by different algorithms. The new application of fuel adulterant detection in image taken from blended samples of benzene with base original gasoline can be better detected with image processing and compared with existing methods like adding colour agent (furfurol).

FUTURE SCOPE

The future of image processing will involve automatic driving all forms of transport, can also be used for detecting fuel adulteration to other blends with different image shapes are also identified

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