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Air Pollution Monitoring Through Image Processing

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Abstract: Air pollution has become a major issue in the modern world, the reason is industrial emissions and increasing urbanization along with traffic jams and heating/cooling of buildings. Monitoring urban air quality is therefore required by municipalities and by the civil society. Current monitoring systems rely on smoke and exhaust detection system that has been developed for monitoring exhaust gases using far infrared camera which is costly. In this paper, we focus on an alternative or complementary approach, with image processing aiming at obtaining the images from environment and monitoring the pollutants present in the environment using image processing method. In image processing the input may be image or video frames. The outputs are also images. Various tasks like classification, feature extraction, recognizing different patterns can be done using image processing method.
Key Terms: Monitoring, feature extraction,

I. INTRODUCTION

Air pollution has become a major issue of modern metropolis because of industrial emissions and increasing urbanization along with traffic jams and heating/cooling of buildings. Monitoring urban air quality is therefore required by municipalities and by the civil society. Air pollution affects human health dramatically. According to World Health Organization (WHO), exposure to air pollution is accountable to seven million causalities in 2012.In 2013; the International Agency for Research on Cancer (IARC) classified particulate matter, the main component of outdoor pollution, as carcinogenic for humans. Air pollution has become a major issue of modern metropolis, where the majority of world population lives, and adding industrial emissions to the consequences of an ever denser urbanization. As a consequence, the reduction of pollutant emissions is the main aim of many sustainable development efforts, in particular those of smart cities. The main reason for air quality damage is due to the smoke exhaust from industries, pollution generated by power plants and the smoke exhaust from various vehicles. Industrial revolution made humans to advance further into twenty first century. Due to rapid increase in the industries pollution increased. The other reason for the air pollution is vehicles which emits smokes. These smokes accumulate in the environment and cause a serious effect to human beings, damages the ozone layer. This project focuses on air pollution monitoring through image processing. Polluted images are obtained from the environment. These images are compared with the other image which is pollution free. From those images diffusion process is done and ratio factor is obtained from the images. Proposed system works well for higher noise level, which is one of the advantages of the project. Another advantage is Fair noise illumination analysis.

II. RELATED WORK

A. PasiPyykönen, PerttiPeussa, MattiKutila

Kok-Wei Fong [1] addressed about the smoke and exhaust detection system that has been developed for monitoring exhaust gases to enforce environmental laws and regulations. The idea behind this paper is a camera-based smoke and exhaust detection system that came from the need to detect and identify vehicles with clearly visible exhaust fumes (smoke) in traffic flows. Traditional systems measuring the HSU grade are implemented with mobile units.The major advantage of this paper is detecting the smoke exhaust in any environment.The limitation is the cost of camera. Xiaoguangchen, Yaru li, Dongyue li [2]An efficient algorithm has been proposed in this paper to evaluate the Air Quality Index(AQI) based on image recognition technology. Experimental results show that the proposed algorithm can produce the AQI evaluation with a considerable accuracy 93.78% which is the major advantage.The limitation again is the cost of the camera being used.

Le Quy Don , Hanoi [3]this article presents study on application of remote sensing technique to evaluate air pollution on the mining area of QuangNinh province, the northeastern coast of Vietnam, using multispectral image LANDSAT 5 TM. The advantage of this

article is that the obtained results showed that the API index is an effective tool for air quality assessment and management.The limitation is the remote sensing method which is a complex method to obtain the results early.

S. N. Palve, P.D. Nemade and S.D. Ghude[4]

this paper aims to investigate possible impact of air pollutants over the climate change on Indian subcontinent using remote sensing method. Satellite derived column aerosol optical depth (AOD) is a cost effective way to monitor and study aerosols distribution and effects over a long time period is the major advantage of the paper.Whereas,the major limitation is the topography.

III. EXISTING SYSTEM

Existing system [1] studies the smoke and exhaustdetection system that has been developed for monitoring exhaust gases to enforce environmental laws and regulations. In many highly populated countries the Hart ridge Smoke Unit(HSU) grade is used to impose penalties. In many cases, HSU values above 50 are leading to legal actions.

Existing system [1] proposes a method that adopts two cameras, a far infrared camera and a high-resolution visible wavelength camera, as a detection system for smoky vehicle detection. The far infrared camera is used for detecting the vehicle exhaust fumes. This information is fused with visible spectrum information from the high-resolution camera. An algorithm evaluates if the identified vehicles are causing visible exhaust smoke. If smoke is detected, the system stores evidence for further actions. The first prototype version of the system needed an automatic adaptation procedure in order to calibrate far infrared and high-resolution images together. Mechanically, the system can be set up quickly in the chosen roadside location.

A developed prototype system is one step towards future tools for authorities to automatically detect and classify vehicles emitting smoke. If a permanent set-up isdesired, the system can be installed on a lamp post, beneath an overhead bridge or on other similar structures.

Figure 1.User interface for smoke detection and analysis system.

A. Devices and Software

The idea of the smoke detection system is to look at vehicles from two possible angles: above or the roadside to see the rear of the vehicle and along the ground to detect possible smoke coming from underneath the vehicle. The installation makes it possible to monitor two lanes simultaneously. Naturally, the camera locations have to be chosen so that a large vehicle cannot completely obscure a smaller vehicle or its exhaust gases.

Each camera pair consists of a camera for visible wavelengths and a thermal camera. The camera views are calibrated so that when the thermal camera detects a hot spot, its location in the visible wavelength camera view can be calculated. The thermal camera is used to detect potential exhaust pipe locations, after which a developed smoke detection algorithm can be applied to the visible wavelength camera image to analyse the area around the potential pipe location.

B. SDAS Algorithm

The key idea of the study was to investigate a means to detect and identify smoke-exhausting vehicles from the traffic flow. For this purpose, we need to implement smoke detection analysis software (SDAS) that includes an algorithm for image processing. The algorithm is based on image analysis from thermal and visible wavelength cameras.

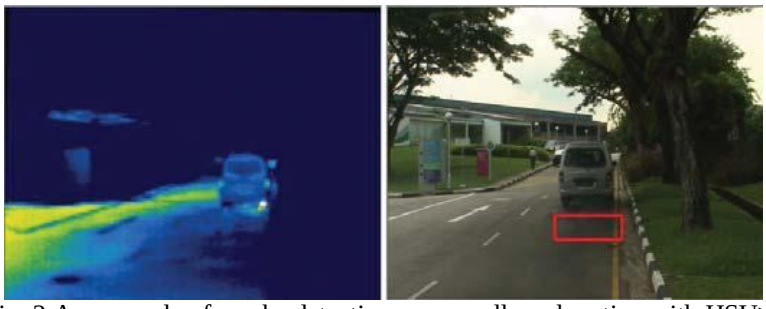

Fig. 2.An example of smoke detection on a small road section with HSU>90

For practical implementation reasons, the smoke detection problem was solved in two parts. The first was the collection of image material using a thermal camera and a visible wavelength camera, which had the same field of view. All the images was stored in digital form. The second and more important part was to analyse the collected image material and detect smoky vehicles from it.
The main disadvantage of the existing system is that Thermal camera and the far infra red camera used are very costly.Hence,it is difficult to implement using these cameras.
In the proposed system the camera system is been eliminated and the reference images are taken for monitoring the pollution level.

IV. PROPOSED SYSTEM

The main objective is to monitor the air pollution present in the environment. Image processing is used to detect the pollution in the atmosphere. Binary segmentation algorithm is used to segment the input image. With the help of the input images the pollution is monitored and the ratio factor and the diffusion process are obtained.
In existing system, various images of the environment at different levels of smoke emission from vehicles using far infrared camera and a high resolution visible wavelength camera are obtained.
These input images are preprocessed.Various Grey level images are obtained for different ranges of HSU.Density analysis of pixel is done using brightness ratio test.Finally the noise is estimated.
The key idea of the existing system was to investigate a means to identify smoke-exhausting vehicles from the traffic flow. For this purpose, we need to implement smoke detection analysis software (SDAS) that includes an algorithm for image processing. The algorithm is based on image analysis from thermal and visible wavelength cameras.
Thus, the proposed system obtains the images from the environment and monitors the pollution through image processing. The amount of pollution in the environment is obtained from the dialog box which displays the pollution level in the environment.
Various steps have been followed to obtain the pollution level in the environment. The various steps involved are obtaining the input image,pre-processing of the input image and edge detection using canny operator.Finally, a dialog box is been displayed to show the level of pollution.

A. Input Image

Input image is the image which is which is taken from the environment. The image obtained is used to monitor the pollution in the environment. The input image is obtained from the traffic or the road. It is not possible to obtain a satellite image.

Fig. 3. Input image

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B. Pre-Processing

Image pre-processing is the next step after obtaining the input image.The important aim of pre processing is to improve the standard of the image which will be processed for recognition.

Fig. 4.Pre processing

C. Edge Detection

Edges are boundaries between different textures or the change of intensity. Edge also can be defined as discontinuities in image intensity from one pixel to another. Edge detection uses canny edge detector which is an edge detection operator that uses a multi-stage algorithm to detect wide range of edges in images.

The canny algorithm is adaptable to various environments. Its parameters allow the recognition of edges of differing characteristics depending on the particular requirements of a given implementation.

Fig. 5. Edge Detection

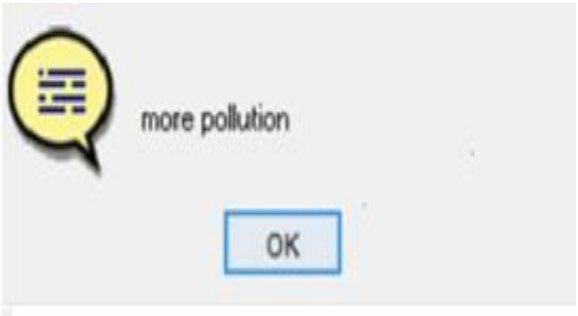

Fig.6. Dialog box to represent pollution level

V. METHODOLOGY

The input images are the sample images which are used as a reference image and to be compared with that of the polluted image**.** Image pre-processing is a vital step in any image analyzing system. Pre-processing of an image is used to improve the image quality of the input image. Partitioning the images into small frames in order to obtain a clarity regarding the frame which has the smoke content. Noise brightness ratio is used to find the ratio of the noisy image to that of the noiseless image. Diffusion process is used to remove unwanted noises (such as trees) and enhance the imagequality to show only the smoky or polluted area.

VI. CONCLUSION

Pollution is one of the major problem which causes severe problems to the human health. The objective of our project is to monitor the pollution using image processing technology. This objective is fulfilled by obtaining the noise brightness ratio by using the diffusion process. Image processing obtains the images of polluted and normal images which are compared and obtains the polluted parts using edge detection. Thus air pollution monitoring is done through the image processing.

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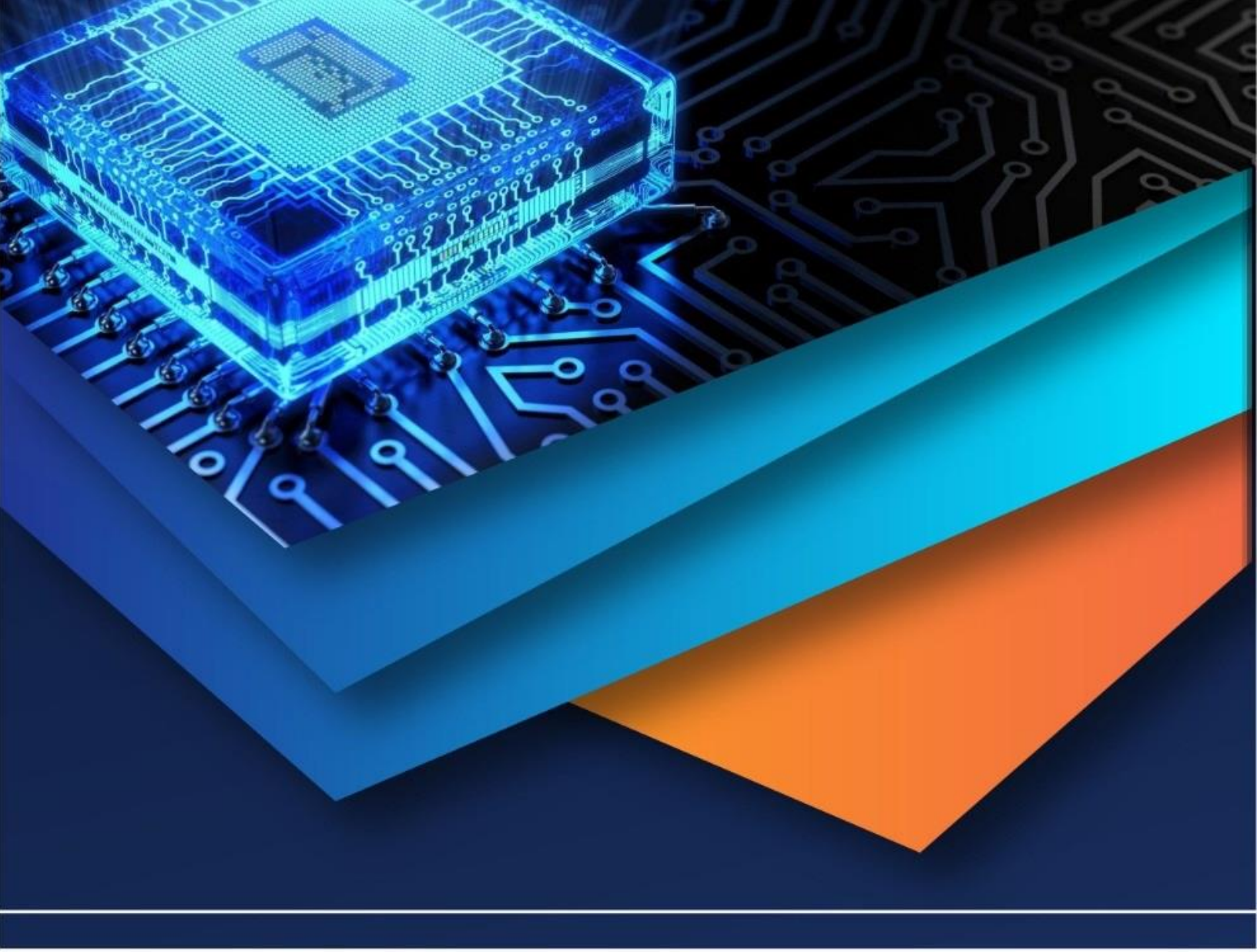

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