Monitoring System for Industrial Applications

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Abstract : With the increase in the technology there are numerous industries that are being operated for various purposes and production of various appliances. Gas is one of the vital aspects whose requirement is very much essential in numerous industries. Gas is a very critical aspect that needs to be monitored frequently in order to be safe from numerous accidents that could affect the industry. Leakage of gas is a very serious issue and each and every minute that is wasted during the leakage could cause a serious accident inside the industry. In order to make us and the industry safe from these kinds of accidents, it is of paramount importance to detect the emission of the gas in a brief time. As a solution to this problem, we have proposed a model to monitor the emission of gas in an industry by making use of Thermal Image Acquisition technique. MatLab is used as a GUI which is used for performing various monitoring functions autonomously. The model is also automated in such a way that if the corrective measures are not taken immediately within the stipulated time, then the gas supply would be disconnected and the system automatically shutdowns in order to keep the environment risk free. The performance of the system is evaluated using various parameters and serves to be better when compared to the existing models.

Index terms: Gas Leakage, Monitoring System, MatLab, Thermal Imaging, Filters, Pixel Classification

I. INTRODUCTION

Environment plays a vital role in all the living beings on this planet. There are so many environmental conditions that are safe for the human body and also there are several other resources whose consumption is not safe for the human body. With the increase in the technology, there are diverse industries that are being built and countless resources are used for production purposes. One of the pivotal resources used for the production and manufacturing of various products in the use of gas. There are many gases which are used in the industry and some of the most dangerous gas used are CH_4, CO, N_2, polyamide and hydrogen sulphide that are very much toxic for the humans when inhaled. Though these gases are toxic they are used by various industries for their product production. These gases need to be used in a very safe manner as its leakage leads to severe health issues to the person in contact with these gases.

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There are several surveillance methods in the industries to monitor if there are any leakages in the pipeline. Many of the monitoring systems use various imaging techniques such as Infrared imaging or Optical Imaging for detecting the leaks. All these methods have proved to consume a lot of time. In order to overcome this challenge, in this paper, we have used a Thermal Imaging Acquisition technique which makes use of low pass and high pass filters. Pixel classification is done using MatLab and is used for monitoring the leakages. In section 2, a summary of related works is given. Section 3 briefs about the proposed model and shows the detailed design of the proposed model. Section 4 presents the experimental results whereas the paper is concluded and future works are pointed out in Section 6.

II. RELATED WORK

There are various issues when a gas pipeline is used in industry. Innumerable health issues and accidents occur due to the use of harmful gases in the industry. In order to overcome these challenges and to propose a perfect gas leakage monitoring system, several researchers have been working upon. In some of the gas detection techniques, the authors have proposed a gas detection framework that makes use of imaging by making use of infrared thermal [1]. In [2], a gas detection technique has been proposed by making use of a monitoring system in the industry. With the enhancement of the technical era, all the communications are becoming wireless. This wireless application has also been successfully used in [3], for monitoring the leakage of gas emission from a pipeline. In this the author has made use of various gas sensors, that could easily detect if there is any leakage in the gas pipeline. In the traditional model, the gas leakage was detected by monitoring it through the use of the communication cabling system. The use of cables for the detection was seen to be more costly when compared to the use of wireless monitoring and communication system as the cabling system needs numerous cables to be installed within the industry. J.Ding has also stated the use of these cabling has proved to be more costly as it takes a lot of expensive to maintain and install the wires and they also tend to

wear out very easily [4]. As cabling has many disadvantages now the research work is being proposed in numerous monitoring systems that are connected and communicated in a wireless medium. Many research
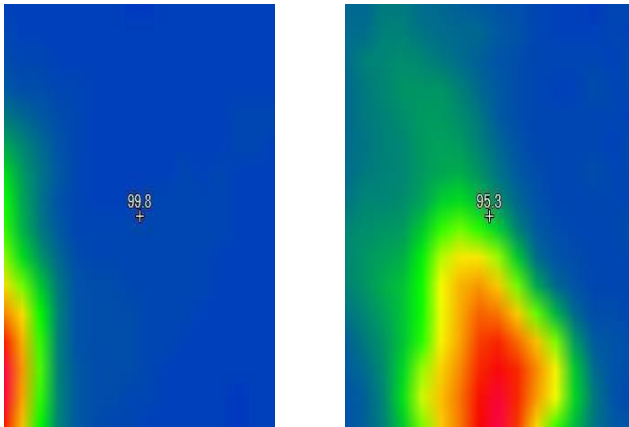
numerous wireless technologies. Some of them have made use of RF transceiver, while some others have made use of coordinator and routers for transmission. Several other new transmission techniques are also used as in [2][4][7][8]. GPRS techniques are also used vitally for transmission and monitoring purposes of the gas leakage in the industry. Though several research works have been proposed none of them seem to be autonomous. This paper is intended to overcome this challenge.

III. SYSTEM DESIGN OF PROPOSED MODEL

The proposed model designed in this current research paper is shown in Fig. 1. The system makes use of Thermal Imaging Acquisition technique that makes use of Thermal Camera. The filters that are used in the methodology are low pass filters and high pass filters which is used for various filtering techniques in which the gas leakage is identified or filtered.

Fig. 1 Block Diagram of Proposed model

The pixel classification technique is done using MatLab where each and every pixel in the image is monitored and analyzed and the final detection of heterogeneous gases are identified. Several parameters are used for analyzing the output using statistical analysis and all the operations are analyzed and performed in the MatLab. A prototype is built that makes use of the microcontroller and consists of various alarm system that is able to alert the entire industry. In case of any leakage, the framework is able to detect it and is responsible to send the message to the alarm system that is connected via the internet. The users are able to view the alert system while making use of the MatLab GUI. A controller is also attached to the autonomous monitoring system that is able to work without any manual intervention which is displayed in the LCD display. The entire system is fixed in an industry where there is a gas valve and also the entire system needs a power supply.
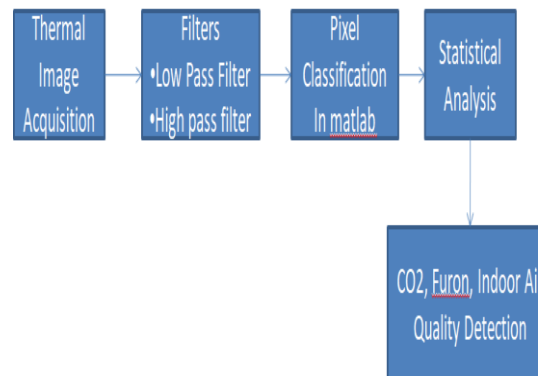
works have been developed using

Fig. 2 Thermal Imaging Camera

Fig. 3 Gas leakage detection

In Fig. 2, a thermal imaging camera is shown that is used for getting the inputs from the gas pipeline in the industry. The camera is used for recording the images of the gas pipeline if there is any leakage which is very much beneficial for the monitoring purposes in the industry where it is deployed.

IV. EXPERIMENTAL RESULTS

The proposed detection model was examined using various parameters. Fig. 3 shows the detection of gas leakage using Thermal camera. The image is taken using the camera and the filtering techniques are used to filter out the various gases in the specific location.

Fig. 4 Gas leakage detection

An image is taken and its mean SSIM index vale is calculated to detect the exact ratio of gas that has been leaked. In Fig. 4, the SSIM index value is calculated for one of the thermal images that has been captured by the thermal camera.
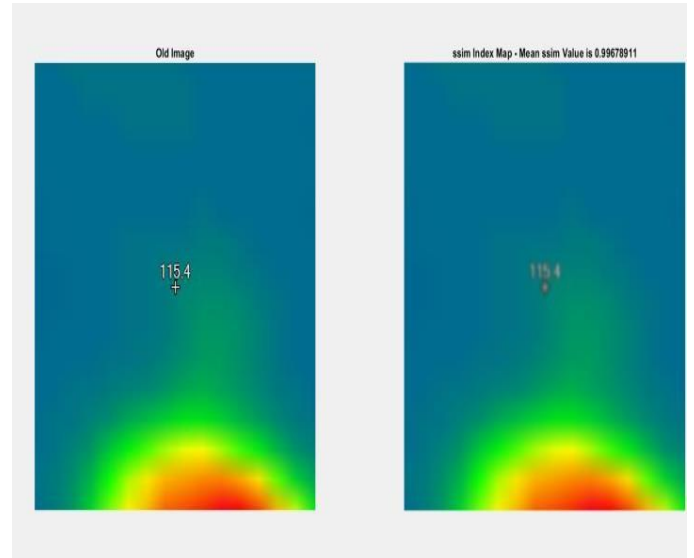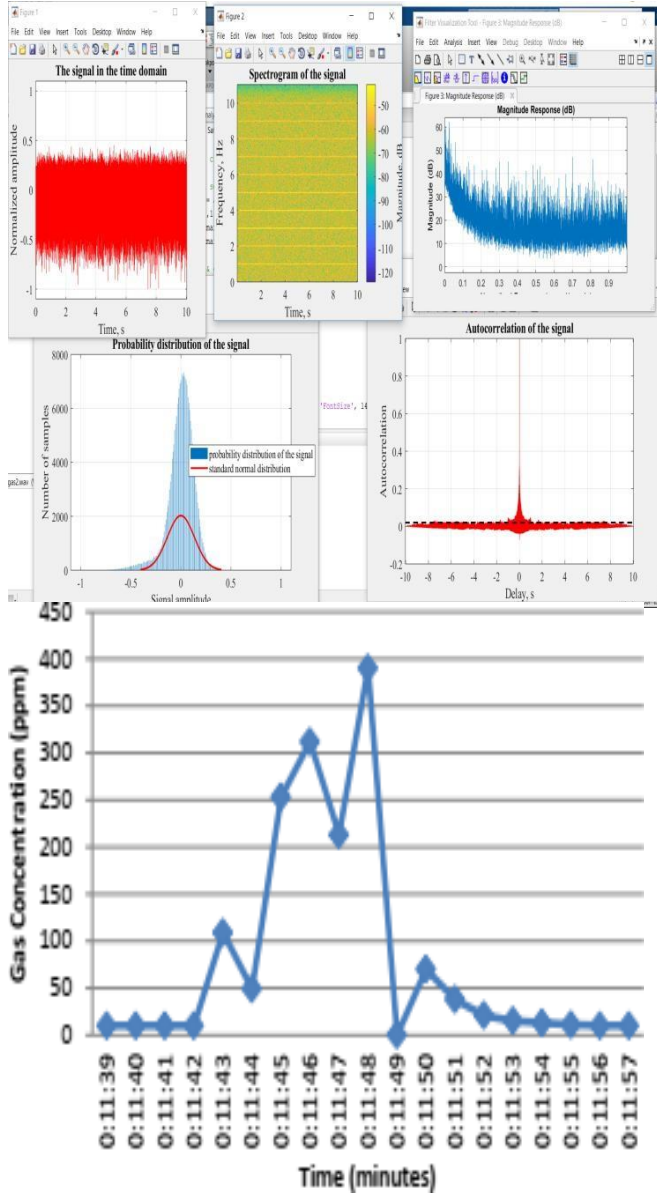

Fig. 5 Efficiency of proposed method

Various parameters have been used for detecting the efficiency of the proposed mode. Some of the parameters that have been used are the total time consumption, spectrogram of the current signal, what is the magnitude of the current signal and the probability distribution is also calculated. All the experimental analysis have been depicted in Fig. 5.

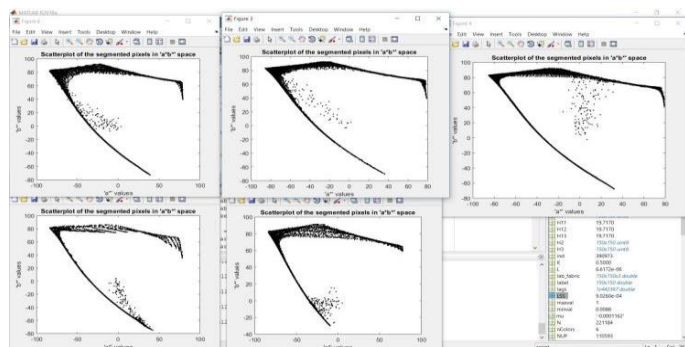**Fig. 6 Gas Leakage Monitoring System**

Fig. 7 Gas leakage detection in serious condition

The gas is detected using various pixel analysis. In Fig. 6, various scatterplots of the pixels obtained in various thermal images have been deployed. These plots are very much useful in detecting the leakage of the gas and in which direction it is being segmented. In Fig.7 the gas leakage detection is shown. It is measured in means of time and how much the gas has been leaked in the industry.

V. CONCLUSION

There are several industries that have been using gas for their manufacturing and production purposes. There are many gases that are very harmful when it is in human contact and causes a serious problem when inhaled by any living being. Though there are numerous research works that have been worked on detecting the leakages of the gas they fail to do the monitoring autonomously. In this paper, we have proposed a model that is able to monitor the gas leakage in an industry by making use of Thermal Camera. The framework uses MatLab interface for processing and analyzing various parameters of the gas leakage and is also used

for monitoring the entire system by the user. There are several parameters that were used to evaluate the performance of the proposed model. The experimental results proved that the proposed method has performed efficiently by monitoring the gas leakage in the industry.

VI. AUTHOR DETAILS

I Dr. D. Sivakumar**,** Currently working as a Professor, Department of Electronics and Communication Engineering, SRM Easwari Engineering college, Chennai. I have a vast experience of over 23 years in the field of engineering, academics, administration and active research. I am an alumnus of Madras University, Annamalai University and Anna University, Chennai. I have technical expertise spans in the area of MANET, wireless sensor networks, Wireless Mesh Networks, Mobile computing, Mobile Network Architecture Network Security and Intelligent Networks.

I have about 66 research publications to his credit in reputed international journals and about 75 conference proceedings. I have authored book pertaining to Information Technology. I have served as a doctoral level research supervisor in Anna University and Sathyabama University, Chennai. I have produced three Ph.D. holders so far. I am also a doctoral committee member in these universities.

I serve as a reviewer for the reputed Elsevier International Journal of Mobile communication and china communication journal. I have filed two patents in the area of Antenna design and analysis. I have conducted many workshops, seminar and both international and national conference in his tenure. I have got best paper presenter award **at international conference** received from Computer society of India during CSI convention " Digital connectivity-social impact, **Outstanding faculty award** in the field of wireless mobile Adhoc Networks for my constant research contribution since 2004.Award has been given by Venus International Research Foundation during contemporary academic meet VICAM 2016 and Got award for getting maximum project funding from Central Government of India at Adhiparasakthi Engineering College during 2010-2011. I am a recipient of the AICTE's research funding of INR 18 lakhs to do the active research in the area of wireless networks.

We Deepak.R, Dhanush.S and Dhivyalakshmi.G are currently pursuing Bachelors of Engineering, Department of Electronics and Communication Engineering, Easwari Engineering College, Chennai.

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