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Study on Automation in Gas Leakage Detection

Dr. Sujith kumar K
Assistant Professor, Department of EEE, Faculty of Engineering and Technology
Jain (Deemed-to-be University), Ramnagar District, Karnataka – 562112
Email Id- k.sujith@jainuniversity.ac.in

Abstract

If left undetected, because of any leakage from gases or smoke, a lot of harm can be done to humans as well as non-living objects. This can trigger explosions in factories, manufacturing and areas in the vicinity. In remote areas, such as vents, pipelines, caves, where it is difficult for humans to patrol and track any gas leakage during the day and night, there may even be instances of gas leakage. Human beings detect leakage by two ways, one is the sound caused by leakage and the other is the odor created by gas. But these two methods, all the time and for a long time, are not successful and realistic. In this paper, an automated robot was built to detect any leakage of gas or smoke in the field. It has two operating modes. One is the way to avoid any obstacles and the other is the way to follow a predefined path. It will then detect any leakage and send the data to the personnel concerned for further action.

Keywords: *Gas Sensors, Robot, Gas Leakage, Obstacle Avoidance, Line Follower, Autonomous.*

I. INTRODUCTION

Because of their widespread use with examples such as cooking and industrial usage, the use of flammable gases such as liquefied petroleum gases, methane, propane, i-Butane is growing with each passing day. But because of the leakage, this causes many incidents to increase. Such situations can often occur in which the gases or smoke from the pipelines or other connecting points can leak. Only by their smelling ability can humans detect leakage of gases, but this is possible only after the gas particles have blended with air and their concentration is high. If the workers walks along the pipeline route and notices any leakage, it is possible to monitor leakage from gas pipelines manually. However, any leakage will not be observed during the day and night as the assigned staff can only examine for any leakage throughout the determined schedule and record the patrolling outcome. If the workers senses leakage of any gas and detects the point of leakage, they will raise a question and notify the staff, but the individual has several dangerous aspects of this technique. This whole procedure should be carried out by a robot that will replace

humans in order to allow the whole process of flammable gas detection, monitoring the point of leakage and preventing people from coming into the vicinity. Thus, a robot that serves the following purposes is the key part of the paper:

1. Patrolling automatically along the gas pipeline according to the defined schedule.

2. Tracking any gas leakage and finding its leakage stage, as well.

3. Send warning to people nearby and to those concerned as well.

4. Record the gas ratio and store the data in a micro SDD based memory card. [1].

Fig 1: Automatic Gas Leakage Detector[2].

The suggested robot can work in line follower and avoid obstacle mode, making it distinctive from other general robots[3]. This dual operating mode and mini size has contributed to the uniqueness of the robot to be used in remote areas to detect gas or smoke. It has the ability to prevent any form of obstacle in its path in the mode of obstacle avoidance and is thus able to move freely throughout. Then the data is sent to the server wirelessly. This mode is used when it is important to verify any leakage within pipelines, gas or vents. It is thus capable of finding its route as well as wirelessly transmitting the signal. Alternatively, it follows the identified black line in the line tracking mode and also detects leakage of any gas and sends the necessary signal to the receiving mode. This mode is then used when the robot needs to follow some predefined track and then search for any gas leakage in that direction along with that test. [4]. Process of designing: The process involving the development has been categorized into three steps which are:

1. Robot component parts design
2. Designing robot hardware modules
3. Computer design

In order to perform the following functions, the robot was created. It will do routine patrolling alongside the gas pipeline as per the pre-determined schedule and will follow the line alongside the gas pipeline in doing so. The monitoring of the gas pipeline would then be achieved by keeping a record of the gas concentration [4]. A ringing alert would sound up and a light emitting diode would be illuminated if the gas concentration was measured higher than the usual value. For further study, the data recorded will be retained. Robot design: It would be possible to step forward, turn left and turn right, move forward and avoid the robot line that follows. Constructing the body b b. b. For going forward, a wheel pair is placed on the rear side and one wheel on the front as the driver's balancer. Components were placed inside it, such as a microcontroller, while other components such as LED gas sensors were placed on the body[5]. Since the robot has to move along the line, a line sensor is put at the lower part. Rechargeable battery is put at the rear part for supplying power. Hardware circuit designing: The various components used are driver for motor L298N for controlling the DC motor, Arduino Nana, and TCRT5000 line sensor, MQ-2 gas sensor that has the property of sensing flammable gases, RTC DS3231 timer, liquid crystal display, and Micro SD Modulus[6]. All these components are connected to the main signal and data processor. A gas sensor detects the presence of any flammable gas and then converts it to an equivalent form of voltage, which is then fed to the Arduino Nano. The line sensor reads the black line and provides resistance that is altered to voltage and the microcontroller gives command to the DC motor [6]. The gas data concentration is shown on the LCD panel of the LCD, then the memory card stores the data followed by a robot stop or LED turn-on and buzzing warning. For recording the data and scheduling the patrol, the RTC module is used. Gas detectors can be used to detect combustible, flammable and toxic gases, and oxygen depletion. This type of device is used widely in industry and can be found in locations, such as on oil rigs, to monitor manufacture processes and emerging technologies such as photovoltaic. They may be used in firefighting[7].

II. LITERATURE REVIEW

The necessity of a wheeled robot to detect leakage of any gas or smoke in the vicinity of the robot was addressed by writers Heru Supriyono and Ahmad Nur Hadi. Some other functions, such as line tracking and sending and saving data to a micro SD card 1], have also been introduced. The determination of air quality resulting from rising human-induced activities was discussed by writers Souvik Manna, Suman Sankar Bhunia and Nandini Mukherjee. Air pollution caused by road vehicles was tracked in the paper and IoT was therefore proposed along with the combination of electrochemical toxic gas sensors and wireless sensor networks [2]. Authors Meer Shadman Saeed and Nusrat Alim have suggested a different way for an autonomous robot to detect gas leakage that can work in obstacle avoidance mode by the use of ultrasonic sensors as well as in line mode following the use of an IR sensor. Then a wireless signal will be sent [3]. The authors Hiroshi Ishida, Keita Yoshikawa and Toyosaka Moriizumi discussed an ultrasonic wave-based anemometer capable of measuring the direction of air flow in a three-dimensional sense and six semiconductor-based 3-D sensors were mounted around it [8]. The different elements used to make

the robot are: L298N engine driver, Arduino engine driver, Arduino engine driver[8] Nano, Direct current motor, TCRT5000 line sensor, MQ-2 gas sensor, clock generator and RTC DS3231 timer, module of micro SD, liquid crystal display, alarm for buzzing, light emitting diode and a battery as a source of power.

III. CONCLUSION

The main objective was to create a robot that can work in two modes, one is to avoid any obstacle in its way and the other is to follow the line mode where the leakage of any gas would be detected. Therefore, a robot model was built for wheels that would detect any gas leakage. Within the wheel, an element for sensing gas was mounted as well. In a flowchart for both modes of operation, the programmers for carrying out all the operations were shown and the related data was sent to the micro SD via the module if the ratio value was lower than six. It has been shown in Table 1 that there is an abrupt stop at a minimum of 5.92 cm. The effective, due to the dual modes of operation of the robot has increased and it will be able in a number of distant places for the collection and sending of information about leakage of any gas or smoke. For future modification, an embedded system can be installed inside the robot that will also detect and keep a record of parts per million concentrations of the gas leakage detected. Also other enhancements such as temperature sensors or data communication wirelessly can be done for increasing the features of the wheeled robot.

IV. REFERENCES

[1] P. Lopes dos Santos, T. P. Azevedo-Perdicoúlis, G. Jank, J. A. Ramos, and J. L. Martins de Carvalho, “Leakage detection and location in gas pipelines through an LPV identification approach,” Commun. Nonlinear Sci. Numer. Simul., 2011, doi: 10.1016/j.cnsns.2011.03.029.

[2] K. Keshamoni and S. Hemanth, “Smart gas level monitoring, booking & gas leakage detector over iot,” 2017, doi: 10.1109/IACC.2017.0078.

[3] M. F. Laresgoiti, I. De Marco, A. Torres, B. Caballero, M. A. Cabrero, and M. J. Chomón, “Chromatographic analysis of the gases obtained in tyre pyrolysis,” J. Anal. Appl. Pyrolysis, 2000, doi: 10.1016/S0165-2370(99)00073-X.

[4] Y. Zhang and G. Yan, “Detection of gas pipe wall thickness based on electromagnetic flux leakage,” Russ. J. Nondestruct. Test., 2007, doi: 10.1134/S1061830907020088.

[5] G. Börjesson, J. Samuelsson, J. Chanton, R. Adolfsson, B. Galle, and B. H. Svensson, “A national landfill methane budget for Sweden based on field measurements, and an evaluation of IPCC models,” Tellus, Ser. B Chem. Phys. Meteorol., 2009, doi: 10.1111/j.1600-0889.2008.00409.x.

[6] P. L. Dos Santos, T. P. Azevedo-Perdicoúlis, J. A. Ramos, J. L. M. De Carvalho, G. Jank, and J. Milhinhos, “An LPV modeling and identification approach to leakage detection in high pressure natural gas transportation networks,” IEEE Trans. Control Syst. Technol., 2011, doi: 10.1109/TCST.2010.2077293.

[7] A. Banik, B. Aich, and S. Ghosh, "Microcontroller based low cost gas leakage detector with SMS alert," 2018, doi: 10.1109/EDCT.2018.8405094.